Table 3: Overview of VOC Groundwater Contamination at NAES Lakehurst				
Area	**Sources of Contamination (See Appendix C)**	**Contaminants Detected and Concentrations Recently Measured (see footnotes at end of table)**	**Reported Spatial Extent of Contamination**	**Regulatory and Remedial History (see footnotes at end of table)**
C	Contaminants originated from past spills, releases from an oil/water separator, leaking fuel storage equipment, and a waste lagoon where fire fighting training was conducted.	Contaminants of concern are petroleum hydrocarbons; chlorinated solvents have also been detected, but generally in lower amounts and in localized areas. The five organic contaminants detected at the highest levels were: Naphthalene—200 ppb Total Xylenes—142 ppb 2-Methylnaphthalene—130 ppb 1,3,5-Trimethylbenzene—66 ppb Tetrachloroethylene—63 ppb	Elevated contamination levels occur within the base boundaries, with no detections occurring at the perimeter monitoring well. Contamination is limited to the first 30 feet below the groundwater table.	In 1990, a Record of Decision was signed to implement an interim action of pumping and treating contaminated groundwater. This system first operated in June 1991, and has been supplemented with vapor extraction and bioventing systems. A subsequent Record of Decision in 1996 required that the groundwater treatment operations continue. Recent data suggest that the base is treating approximately 70 million gallons of contaminated groundwater from this area per year. NAES Lakehurst has occasionally modified the groundwater treatment system to optimize the system performance.
D	Contaminants originated from leaks and leachate from the base's former sanitary landfill, which spans 34 acres. Most of the landfill contains household wastes, but some industrial wastes were disposed of at this site.	Paint thinner, waste solvents, and other chemical wastes have contaminated the groundwater with various compounds, mainly aromatic hydrocarbons and chlorinated hydrocarbons. Between 1997 and 2000, elevated concentrations were noted for the following VOCs: 1,4-Dichlorobenzene—35.5 ppb *cis*-1,2-Dichloroethylene—25 ppb Chlorobenzene—24.9 ppb Vinyl chloride—17.84 ppb 1,2,4-Trichlorobenzene—14.3 ppb	Groundwater contamination (total VOC levels greater than 10 ppb) has extended roughly 1,000 feet northeast of the former landfill, but not to locations outside base property. Contamination is limited to the first 30 feet below the groundwater table.	In 1993, a Record of Decision was signed for this groundwater area. The selected remedy was no clean-up action, with continued groundwater monitoring. The monitoring locations included four pairs of perimeter monitoring wells, with each pair consisting of a shallow and deep monitoring well.

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E	The main source of contamination is IRP Site 28, which is contaminated soils caused by a leaking fuel line.	Groundwater was primarily contaminated with petroleum hydrocarbons. VOC contamination in recent years was limited to the following chemicals: 2-Methylnaphthalene—2.4 ppb Naphthalene—1.2 ppb Toluene—0.4 ppb	As of 2001, all groundwater contaminant levels in this area met applicable or relevant and appropriate requirements.	From 1993 to 1998, NAES Lakehurst pumped and treated contaminated groundwater from Area E. Because the groundwater contained relatively low concentrations of chemicals, EPA and NJDEP allowed NAES Lakehurst to shut down its groundwater pump-and-treat system for Area E in October 1998.
F	Contamination occurred when Navy contractors pumped liquid wastes into an open pit between 1966 and 1974. As much as 40,000 gallons of wastes were discharged.	Contaminants were suspected to be those found in oily wastes, lubricants, and anti-freeze, such as hydrocarbons and chlorinated solvents. Groundwater sampling during all three phases of the RI found no VOC contamination at levels greater than applicable or relevant and appropriate requirements. Groundwater is no longer monitored in this area.	NAES Lakehurst collected groundwater samples from Area F during three field investigations. No significant groundwater contamination has been detected.	Without evidence of significant groundwater contamination, a Record of Decision signed in 1993 by NAES Lakehurst and environmental regulators proposed no further action for Area F.

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G	Three IRP sites are located within Area G. Contamination resulted from a blimp crash, buried solid wastes, and discharge of used fuel onto soil surfaces.	During initial investigations, petroleum hydrocarbons and metals were detected in the groundwater at two of the IRP sites, but the measurements were of questionable quality. Follow-up investigations revealed no evidence of groundwater contamination at these sites. At the third site (the blimp crash site), trace levels of petroleum hydrocarbons and chlorinated solvents were detected in samples collected through 1992.	NAES Lakehurst collected groundwater samples during several field studies near the three IRP sites in Area G. No significant groundwater contamination was found in the most recent sampling events.	Records of Decision signed in 1991 and 1993 required no further action to address soil contamination at the three sites within Area G. The 1993 Record of Decision required continued groundwater monitoring, which has not revealed evidence of contamination levels above applicable or relevant and appropriate requirements.
H	Waste fuels and oils were discharged to unlined dry wells. Some chemicals seeped from these wells into the groundwater. Leaks from fuel storage and transfers also released chemicals to the soils.	Contaminants of concern are primarily petroleum hydrocarbons associated with waste fuels, though chemicals found in chlorinated solvents have also been detected. The five organic contaminants detected at the highest levels were: Total xylenes—560 ppb Naphthalene—270 ppb 2-Methylnaphthalene—250 ppb Ethylbenzene—190 ppb 1,3,5-Trimethylbenzene—180 ppb	Groundwater contamination has been found to extend at least 800 feet downgradient from the source. Contamination is limited to the first 30 feet below the groundwater table.	In 1991 a Record of Decision called for construction of a pump-and-treat system to reduce groundwater contamination levels. The treatment operation commenced in May 1992. A final Record of Decision issued in 1996 required continued operation of the treatment system and ongoing groundwater monitoring. NAES Lakehurst has modified the groundwater treatment system occasionally since 1996 to optimize the system performance.

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I/J	Contamination was caused by chemicals released in the area where NAES Lakehurst tests catapult launching equipment. The waste streams included process wastewater and industrial solvents.	The contaminants found at highest levels in Area I/J between 1996 and 2000 are chlorinated hydrocarbons. The highest levels of detection (shown below) occurred at on-base locations, with far lower levels detected outside the base boundary. *cis*-1,2-Dichloroethylene—579 ppb Trichloroethylene—291 ppb Methylene chloride—278.4 ppb Tetrachloroethylene—233 ppb 1,1,1-Trichloroethane—139 ppb	As Figure 5 shows, groundwater contamination is believed to extend up to 1 mile south of the property boundary at Area I/J. Contamination in this area extends up to 90 feet below the groundwater table.	In the early 1990s the Navy studied groundwater contamination at Area I/J extensively and investigated the effectiveness of several treatment technologies. A 1999 Record of Decision indicated that groundwater contamination in Area I/J will be addressed by natural restoration and ongoing groundwater monitoring. Bioremediation techniques and other novel treatment technologies also are being investigated for their ability to reduce levels of groundwater contamination.
K	All sources of contamination at Area K have been cleaned up. These included solvent storage facilities and wastes from equipment maintenance activities.	Groundwater contamination in Area K has been monitored for at least 18 years. The primary contaminants of concern are chlorinated hydrocarbons typically found in industrial solvents. The highest levels of groundwater contamination found in recent years are: Trichloroethylene—23.89 ppb Tetrachloroethylene—19.8 ppb *cis*-1,2-Dichloroethylene—11.1 ppb Vinyl chloride—4.37 ppb 1,1,1-Trichloroethane—0.934 ppb	Contamination in shallow groundwater has been detected up to 900 feet away from the suspected release sources. Contamination is limited to the first 30 feet below the groundwater table.	In 1997 a Record of Decision called for "limited pumping of groundwater with sprinkler irrigation" to remove VOCs, and called for ongoing groundwater monitoring. NAES Lakehurst periodically presents findings from this monitoring to regulatory agencies at technical review meetings.

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L	This area is the extreme northwestern corner of NAES Lakehurst. The IAS noted that contamination could exist in this area from the fire and explosion that occurred at the BOMARC site..	Groundwater samples were collected from Area L during three different phases of the RI. The RI documents conclude that "no significant levels of radiological contamination in groundwater" were observed in Area L.	NAES Lakehurst collected groundwater samples from Area L during three field investigations. No significant groundwater contamination has been detected.	In 1991, a Record of Decision for Site L reported that "no contamination was detected that would require remedial action to protect human health and the environment." Accordingly, no further action was required to address contamination in this area.

Notes: Various base documents were considered to identify the highest levels of contamination that have been detected. Data from both monitoring wells and recovery wells were considered when generating this table. Groundwater monitoring data were also available for metals, but these data are not summarized in this table because the focus on site cleanup efforts has been almost entirely on VOCs. The data sources for each area are listed below:

Area A/B:	Two most recent semi-annual data reports available during the site visit (NAES 2001a, 2002a).
Area C:	Two most recent semi-annual data reports available during the site visit (NAES 2001b, 2002c).
Area D:	Data compiled in the most recent five-year review (NAES 2001c).
Area E:	Two most recent semi-annual data reports available during the site visit (NAES 2001d, 2002d).
Area F:	The Record of Decision for Site 38 (NAES 1993a).
Area G:	The Record of Decision for the IRP site within Area G (Site 1) identified as being a source of contamination (NAES 1993b).
Area H:	Two most recent semi-annual data reports available during the site visit (NAES 2001e, 2002e).
Area I/J:	Data compiled in the most recent five-year review (NAES 2001c).
Area K:	Data compiled in the most recent 5-year review (NAES 2001c).
Area L:	The Record of Decision for Area L (NAES 1991).

Appendices

Appendix A: ATSDR Plain Language 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).

General Terms

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

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

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

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

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

Aerobic
Requiring oxygen [compare with anaerobic].

Ambient
Surrounding (for example, ambient air).

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

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

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

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

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

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

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

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

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

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

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

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

CAP [see Community Assistance Panel.]

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

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

Carcinogen
A substance that causes cancer.

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

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

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

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

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

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

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

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

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

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

Completed exposure pathway [see exposure pathway].

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

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

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

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

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

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

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

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

DOD
United States Department of Defense.

DOE
United States Department of Energy.

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

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

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

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

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

EPA
United States Environmental Protection Agency.

Epidemiologic surveillance [see Public health surveillance].

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

In vivo
Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with in vitro].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

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

Metabolite
Any product of metabolism.

mg/kg
Milligram per kilogram.

mg/cm2
Milligram per square centimeter (of a surface).

mg/m3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality
Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

Mutagen
A substance that causes mutations (genetic damage).

Mutation
A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP)
Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

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

Prevalence survey
The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement
The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

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

Radioisotope
An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide
Any radioactive isotope (form) of any element.

RCRA [see Resource Conservation and Recovery Act (1976, 1984)]

Receptor population
People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA
RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD [see reference dose]

Risk
The probability that something will cause injury or harm.

Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor [see uncertainty factor]

SARA [see Superfund Amendments and Reauthorization Act]

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or an environment.

Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance
A chemical.

Substance-specific applied research
A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's toxicological profiles. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Surveillance [see public health surveillance]

Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Synergistic effect
A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:
Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)

National Center for Environmental Health (CDC)
(http://www.cdc.gov/nceh/dls/report/glossary.htm)

National Library of Medicine (NIH) (http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

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Appendix B: Air Modeling Assumptions and Results

In Section III.D of this PHA, we concluded that NAES Lakehurst's air emissions of four contaminants (carbon monoxide, nitrogen oxides, PM10, and sulfur dioxide[8]) pose no apparent public health hazard. This conclusion was based largely on two observations: (1) NAES Lakehurst is primarily a research and development facility, which tends to have relatively low emission rates when compared to large-scale manufacturing installations and many industrial facilities, and (2) air emissions data reported for the installation are considerably lower than those from manufacturing and production facilities located throughout New Jersey. Another observation that factored into this conclusion was the findings of an air dispersion modeling analysis that ATSDR conducted, which the rest of this appendix describes.

In cases where no air sampling data are available, ATSDR will often use air dispersion models to assess potential inhalation exposures to air contaminants. Air modeling analyses can be classified into two very general categories: screening evaluations and refined evaluations. A screening modeling evaluation is typically used to gain initial insights on potential levels of air contamination resulting from a single source or from multiple sources. Refined evaluations are often conducted when screening applications suggest that a more detailed review of air dispersion is necessary.

ATSDR conducted a screening analysis of air emissions from NAES Lakehurst to assess whether the air emissions sources have the potential for causing air pollution at off-site locations in excess of EPA's health-based air quality standards. To conduct such an analysis, assumptions must be made regarding the air emission sources and the model inputs. The following paragraphs describe the assumptions we made in completing this analysis:

- *Approach to characterizing emissions.* When evaluating this site, ATSDR obtained annual emissions data for NAES Lakehurst from the installation's 2001 "Emissions Statement" submitted to NJDEP. That statement reports the total air emissions of the four contaminants of interest for the entire installation. Source-specific emission rates were not included in the summary of the Emissions Statement that NAES Lakehurst provided to ATSDR. For an initial assessment of air quality impacts, ATSDR assumed that the installation's overall air emissions are released from a single source at a location central to the operations. This assumption essentially concentrates all of NAES Lakehurst's air emissions at a single point—an approach that likely overstates air quality impacts because emissions actually occur from locations across the entire installation. ATSDR believes this assumption is sufficient for an initial evaluation of the air exposure pathway, and we will update the modeling analysis if source-specific emissions data are provided. Emission rates ATSDR considered in this analysis are documented below, both in units of tons per year and grams per second. The latter units are commonly used for inputs into most air dispersion models.

[8] Emissions data are available for volatile organic compounds, but this pollutant was not modeled because it is a mixture of many individual contaminants, all with different toxicologic implications. Chemical-specific emissions data for these individual contaminants were not available in the data reviewed by ATSDR.

Pollutant	Emission Rate (tons/year)	Emission Rate (grams/second)
Carbon monoxide	14.8	0.427
Nitrogen oxides	44.39	1.28
PM10	7.24	0.209
Sulfur dioxide	31.69	0.914

- *Approach to evaluating dispersion.* Many different models have been developed to assess atmospheric dispersion of air emissions—ATSDR used SCREEN3 for this evaluation. The SCREEN3 model is a screening tool designed to assess worst-case air quality impacts from typical continuous emissions sources, like stacks (EPA 1995). All air emissions from NAES Lakehurst were evaluated using a single point source at a location central to the installation's operations. As stated previously, this assumption does not represent the actual configuration of air emissions sources, but most likely overstates air quality impacts by concentrating in a single location emissions that occur over a broad area. The central location was selected in the eastern half of the installation, at a point ¾ of a mile from the nearest residential receptor outside the base. It should be noted that air emissions sources on the western half of the installation (i.e., emissions associated with the jet test tracks and catapults) are more than 4 miles away from this location. Therefore, concentrating all air emissions at this single point clearly overstates the air quality impacts from these sources. Although a refined modeling evaluation would clearly account for source-specific data, ATSDR believes the approach taken for this screening analysis is useful for predicting the magnitude of air quality impacts from the installation's overall air releases.

  ATSDR used the following stack parameters to model dispersion from the hypothetical source placed at the center of the installation's operations: stack height and diameter of 15 meters and 1 meter, respectively, with releases occurring at 5.0 meters per second at ambient temperature. These parameters were selected to reflect common source parameters for boilers that ATSDR has evaluated at other sites. We note that the boilers at NAES Lakehurst accounted for the largest portion of the installation's air emissions. The SCREEN3 model was run assuming dispersion occurs in a rural setting (an assumption that leads to higher estimated concentrations than in urban settings) and in simple terrain.

  For all pollutants, SCREEN3 output is an estimate of the maximum 1-hour average ambient air concentration at the nearest off-site receptor, located ¾ of a mile from the emissions source considered in this evaluation. To estimate annual average air concentrations, ATSDR multiplied the estimated 1-hour average value by a factor of 0.1—consistent with procedures EPA published for screening analyses (EPA 1992).

- *Modeling results.* Table B-1 presents the estimated maximum 1-hour average and annual average air concentrations predicted for the four pollutants, along with EPA's corresponding air quality standards. All of the predicted short-term and long-term average air concentrations were considerably lower than air quality standards, which indicates that

NAES Lakehurst's contribution to air pollution in Ocean County is not of public health concern. ATSDR acknowledges that this finding is based on a screening evaluation of air emissions from NAES Lakehurst, which could understate or overstate actual air quality impacts. The fact, however, that predicted concentrations were all at least 5 times lower than health-based air quality standards (rather than marginally lower than the standards) provides some comfort that the modeling analysis is not failing to identify air quality impacts of public health concern.

ATSDR's conclusion regarding the air exposure pathway is that any exposures to site-related contaminants are likely not at levels that would be associated with adverse health effects. This conclusion is based on the results of this modeling analysis, the fact that NAES Lakehurst is primarily a research and development facility (rather than a chemical manufacturing or materials processing plant), and the fact that air emissions from NAES Lakehurst are considerably less than emissions reported for numerous other sites across the state of New Jersey.

Table B-1
Results of Screening Analysis of Air Contaminants Released from NAES Lakehurst

Pollutant	1-Hour Average Concentrations		Annual Average Concentrations	
	Estimated Concentration ($\mu g/m^3$)	EPA's National Ambient Air Quality Standard ($\mu g/m^3$)	Estimated Concentration ($\mu g/m^3$)	EPA's National Ambient Air Quality Standard ($\mu g/m^3$)
Carbon monoxide	59	40,000	5.9	None available
Nitrogen oxides	180	None available	18	100
PM10	29	150	2.9	50
Sulfur dioxide	130	1,300	13	80

Notes: The "estimated concentrations" are based on ATSDR's screening analysis of air emissions from NAES Lakehurst. These concentrations are estimates of the increase of air contamination that might result from the installation's emissions. Other emissions sources of these same pollutants are found throughout Ocean County and also contribute to actual levels of air pollution.

The National Ambient Air Quality Standards listed in this table are concentration limits EPA developed to protect human health and our environment from harmful levels of air pollution. Specific notes on the selected values follow: For carbon monoxide, EPA has published health-based air quality standards for 1-hour average and 8-hour average concentrations, but not for concentrations of longer averaging times. For nitrogen oxides, the estimated annual average concentration is compared to EPA's health-based standard for nitrogen dioxide, a toxic chemical that is part of "nitrogen oxides"—no short-term air quality standards are available for this pollutant. For PM10, the predicted 1-hour average concentration is compared to EPA's 24-hour average health-based standard; EPA has not published PM10 air quality standards for shorter averaging times. For sulfur dioxide, the predicted 1-hour average concentration is compared to EPA's 3-hour average air quality standard, which is not health-based, but rather was promulgated to protect things we value other than our health (e.g., vegetation, property, visibility).

Appendix C: ATSDR's Evaluation of Potential Contamination in Soil, Surface Water, Sediment, and Locally Caught Fish

This appendix presents ATSDR's review of data on potential contamination in soil, surface water, sediment, and locally caught fish at NAES Lakehurst. It focuses largely on the sites of environmental contamination identified through the base's Installation Restoration Program (IRP). However, the appendix also evaluates additional known or suspected waste sites not evaluated during the IRP. Table C-1 documents the information ATSDR obtained and interpreted for each of the sites of concern. Most of the information in this appendix draws from the Records of Decision entered between NAES Lakehurst, the U.S. Environmental Protection Agency, and the New Jersey Department of Environmental Protection. A list of these Records of Decision appears at the end of this appendix.

At most sites, contamination was known or expected to occur in multiple media. This appendix does not, however, address groundwater contamination because Section III.A of this PHA is devoted entirely to that issue. For the remaining media, Table C-1 documents conclusions stated in the RODs and in other site documents. ATSDR found no public health hazards associated with current conditions at the sites listed in the table. This finding was generally based on three factors:

- Environmental contamination levels at many sites were not at levels that would pose a health concern to individuals who access this site. This trend was observed at sites of suspected contamination, for which future sampling events revealed no evidence of actual contamination, and at sites where cleanup efforts had already addressed past environmental releases.

- For most sites, NAES Lakehurst and regulatory agencies have already entered into RODs that found no human health risks associated with various land use scenarios. The majority of sites had RODs requiring no further action to address contamination in media other than groundwater.

- Limited access to the sites prevented extensive exposures to any environmental contamination that remained at the sites. Most sites are located in or near industrial areas at the installation, and no sites are found in the immediate vicinity of housing, the day care center, and recreational facilities. Therefore, base residents and base personnel are expected to have extremely limited contact with areas where contamination remains.

The remainder of this section is Table C-1, which documents the information available for the waste sites that ATSDR evaluated.