

Naval Air Engineering Station
Lakehurst, New Jersey

Five-Year Review Report



August 1, 2006

SDMS Document



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EXECUTIVE SUMMARY

This report is a comprehensive review of all Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) sites that require a five-year review at the Naval Air Engineering Station (NAES), Lakehurst, NJ. The sites requiring five-year reviews were identified by the United States Environmental Protection Agency (EPA) in the Preliminary Close Out Report for NAES dated September 2004. Soil at sites 13, 16, 17, 31 and 32, and groundwater at Areas A, B, C, D, H, I, J and K are addressed in this review. The first site-wide Five-Year Review Report for NEAS was approved by EPA on September 21, 2001.

On October 5, 2004, NAES received a Preliminary Close Out Report which designated the facility as construction complete. This designation indicates that all remedial work at the NAES has been completed or constructed and no further response is necessary except for operation, maintenance and monitoring. The Navy has initiated the activities necessary to achieve performance standards and site completion. As a result of the actions taken, there is no exposure of human or environmental receptors to site contaminants. In addition, contaminated groundwater at the site is under control.

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FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site name: Naval Air Engineering Station		
EPA ID: NJ7170023744		
Region: 2	State: NJ	City/County: Lakehurst/Ocean
SITE STATUS		
NPL status: Final		
Remediation status: Operating, Complete		
Multiple OUs?* YES	Construction completion date: October 5, 2004	
Has site been put into reuse? NO		
REVIEW STATUS		
Lead agency: EPA		
Author name: Michael Figura		
Author title: Environmental Engineer	Author affiliation: Naval Air Engineering Station	
Review period:** January 1, 2001 through December 31, 2005		
Date(s) of site inspection: November 16, 2005		
Type of review: NPL – Removal only		
Review number: 2 (second)		
Triggering action: Previous Five-Year Review Report		
Triggering action date: September 21, 2001		
Date due (five years after triggering action date): September 21, 2006		

* OU Refers to operable unit

** Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN

1.0 INTRODUCTION

1.1 AUTHORITY STATEMENT/PURPOSE

Section 121 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C. Section 9601 et seq., as amended ("CERCLA"), and 300.430(f)(4)(ii) of the National Contingency Plan (NCP) require that periodic reviews be conducted no less often than every five years for sites where hazardous substances, pollutants or contaminants will remain at the site above levels that allow for unlimited use and unrestricted exposure following the completion of all remedial actions for the site. The purpose of such a review is to assess whether the remedial actions being implemented continue to be protective of human health and the environment. This review was also conducted pursuant to Office of Solid Waste and Emergency Response (OSWER) directive 9355.7-03B-P.

This report is a comprehensive review of all CERCLA sites that require a five-year review at the Naval Air Engineering Station (NAES), Lakehurst, NJ. The sites requiring five-year reviews were identified by the United States Environmental Protection Agency (EPA) in the Preliminary Close Out Report for NAES dated September 2004. CERCLA and the NCP require that the five-year review period begin with the initiation of the selected remedial action. Currently, EPA defines the "initiation of remedial action," for purposes of Section 121(c) of CERCLA, as the remedial action contract award date. Initial five-year reviews were done in 1996 for Areas C and H and Site 28. A comprehensive review for all sites and areas was submitted on June 28, 2001.

On October 5, 2004, NAES received a Preliminary Close Out Report which designated the facility as construction complete. This designation indicates that all remedial work at the NAES has been completed or constructed and no further response is necessary except for operation, maintenance and monitoring. The Navy has initiated the activities necessary to achieve performance standards and site completion. As a result of the actions taken, there is no exposure of human or environmental receptors to site contaminants. In addition, contaminated groundwater at the site is under control.

This report is based on information contained in the Remedial Investigation (RI) Report (October 1992), the Endangerment Assessment (EA) Report (October 1992), and other site specific reports and information which are part of the Administrative Record file for NAES, which is available for public review at the Manchester Branch of the Ocean County Library in Manchester, New Jersey.

1.2 SITE HISTORY

NAES is located in Jackson and Manchester Townships, Ocean County, New Jersey, approximately 14 miles inland from the Atlantic Ocean. NAES is approximately 7,400 acres and is bordered by Route 547 to the east, the Fort Dix Military Reservation to the west, woodland to the north (portions of which are within Colliers Mill Wildlife Management Area), Lakehurst Borough and woodland, including the Manchester Wildlife Management Area, to the south. NAES and the surrounding area are located within the Pinelands National Reserve, the most extensive undeveloped land tract of the Middle Atlantic Seaboard. The groundwater at NAES is currently

classified by the New Jersey Department of Environmental Protection (NJDEP) as Class I-PL (Pinelands).

Currently, NAES's mission is to support programs of technology development, engineering, developmental evaluation and verification, systems integration, limited manufacturing, procurement, integrated logistic support management, and fleet engineering support for Aircraft-Platform Interface systems. The Station also provides facilities and support services for tenant activities (Department of Justice, N.J. Army National Guard, Army Communication and Electronics Command, etc.).

The NAES was listed as a Superfund site under CERCLA because it included a number of potentially contaminated areas. Contamination was the result of various operations and activities at the Station which required the use, handling, storage and occasionally the on-site disposal of hazardous substances. During the operational period of the facility, there have been documented, reported or suspected releases of these substances into the environment. Under CERCLA those potentially contaminated areas are designated as operable units or individual removal or remedial actions. For the remainder of this report the potentially contaminated source or soil areas will be referred to as "Sites". There were 45 sites investigated at NAES. Sites in close proximity have been grouped into geographical "Areas". There are 12 Areas at NAES (Areas A through L). Because groundwater within each area may have been contaminated by one or more of the sites within the area, groundwater is addressed as an operable unit by area. For the remainder of this report the term "Area" refers to potentially contaminated groundwater. Figure 1 provides the location of Sites and Areas at NAES.

There are no other contaminated locations other than those identified as "Sites" and "Areas" known to exist at the NAES under CERCLA oversight. The following sites have been cleaned or were found to be acceptable for unlimited use and unrestricted exposure: Sites 1-12, 14, 15, 18-30, 33-40, 42, 44, and 45; and, Areas E, F, G, and L. Sites deemed acceptable for unlimited use and unrestricted exposure are based on the NJDEP risk-based residential soil cleanup criteria. Areas deemed acceptable for unlimited use and unrestricted exposure are based on State and Federal maximum contaminant levels (MCLs) and State practical quantitation levels (PQLs) for groundwater. These sites and areas do not need to be addressed by this review. In addition, an ordnance site (Site 41) and an Advanced Underground Storage Facility (Site 43), were not addressed under CERCLA because the EPA determined that, due to the absence of any documented release of hazardous substances, addressing Site 41 under CERCLA was not required and Site 43 was cleaned up prior to NAES being listed on the NPL. These sites are, therefore, not covered by this report. Tables 1 and 2 provide a summary of each site and area at NAES.

An ecological risk assessment was conducted as part of the endangerment assessment for NAES. The results of this assessment can be found in the *Remedial Investigation, Phase III, Naval Air Warfare Center - Aircraft Division, Lakehurst, NJ, Volume V, Endangerment Assessment dated October 6, 1992*. A map of the surface water and wetlands at NAES is included as Figure 8.

NAES is currently a secured facility and is an active base used in a manner consistent with commercial and industrial exposure standards. There are no plans to change the current use of these sites. In addition, there is no current or planned use of these sites for residential housing,

child care centers, or gardening of edible crops.

1.3 SITE CHRONOLOGY

Event	Date
Initial Assessment Study Completed	March 1982
Listed on EPA National Priorities List	1987
Phase I Remedial Investigation Complete	April 1987
Phase II Remedial Investigation Complete	July 1990
Area C Groundwater Treatment System Startup	June 1991
Area H Groundwater Treatment System Startup	May 1992
Phase III Remedial Investigation Complete	October 1992
Site 32 Soil Excavation Completed	August 1993
Site 13 Record of Decision	September 14, 1993
Site 32 Record of Decision	September 14, 1993
Area D (Site 31) Record of Decision	September 14, 1993
Areas A&B Groundwater Treatment System Startup	October 1993
Sites 16 and 17 Vapor Extraction System Startup	August 1995
Area C (Sites 16 and 17) Soil and Groundwater Record of Decision	January 10, 1996
Area H Record of Decision	January 10, 1996
Site 13 Vapor Extraction System Startup	May 1996
Area K Record of Decision	May 7, 1997
Areas A&B Record of Decision	May 7, 1997
Areas I&J Record of Decision	August 30, 1999
Areas I and J Nanoscale Iron Treatment Started	November 2003
Site 13 Sparge System Startup	May 2004
Preliminary Close-out Report	September 2004

1.4 FIVE-YEAR REVIEW PROCESS

Members of the Technical Review Committee (TRC) including the EPA, NJDEP, Pinelands Commission, Ocean County Board of Health, and Pinelands Preservation Alliance were notified of the initiation of the five-year review at a TRC meeting held on October 5, 2005. Interested parties including all surrounding townships and interested public were also notified via the minutes of the meeting.

This five-year review consisted of a review of relevant documents including Records of Decision, O&M reports, monitoring data, and the current groundwater cleanup standards. The monitoring data for each area is summarized in tables 3 through 8.

A site inspection was conducted by the EPA (John Malleck, Bob Vaughn, Chloe Metz and Paul Ingrisano) on November 16, 2005.

Upon completion of the five-year review a copy of this report will be placed in the Station's Administrative Record for public review. Interested parties will be notified through the TRC minutes and the Restoration Advisory Board that the report is available.

2.0 AREAS A&B

2.1 Areas A & B Background

Areas A and B are adjacent to one another and located in the northeastern portion of the NAES (Figure 2). Due to its large size, Area A has been subdivided into two adjacent sections, Area A-East and Area A-West. Area A-East includes Sites 14 (old fire fighting school), 29 (original base landfill) and 37 (former fuel disposal and drum storage area). Area A-West includes Sites 12 (abandoned fuel storage facility 141), 18 (naval exchange gas station), 26 (contractor disposal area), 33 (refueler repair shop), 42 (former base landfill) and 44 (PCB storage and test areas). Area B is located in the northeastern portion of the NAES to the immediate south of Area A. Sites 9 (hangar 2 disposal area), 13 (former fuel farm no. 125), 15 (disposal area near building 562 parking lot), 36 (former hangar 1 liquid waste disposal area) and 39 (petroleum oils and lubricants disposal site) are located within Area B.

The Ridgeway Branch forms the northern boundary of Area A. Route 547 is coincident with the NAES property boundary and forms the eastern boundary of Area A-East. Along the northern edge of Area A, to the south of and adjacent to the Ridgeway Branch, is a wetland area. The remainder of Area A to the south and west of the wetlands is developed land consisting of various facility buildings and roads. Included in Area A-East is the Construction Battalion (CB) Compound. Area A-West encompasses the Hill water supply system which provides potable water to NAES facilities. Also included in Area A-West are the former Steam Plant No. 1 (Building 15) and wastewater treatment facility (no longer operating), and numerous buildings housing various NAES departments and operations.

Area B consists entirely of developed land, primarily various facility buildings, including Hangars 1, 2 (Bldg. 148) and 3 (Bldg. 149). A large percentage of Area B is paved; no stream or other surface water bodies are present in the area. The nearest facility boundary to Area B, Route 547, is approximately 2,000 feet to the east. The general direction of groundwater flow in Areas A and B is to the northeast, toward the wetlands and Ridgeway Branch.

The results of previous investigations and removal actions have documented the absence or removal of contamination posing a threat to human health or the environment at Sites 9, 12, 15, 18, 26, 33, 36, 37, 39, 42 and 44 in Areas A and B. Table 1 includes a summary of soil cleanup actions taken at these sites. The Navy and EPA, with NJDEP concurrence, issued Records of Decision (ROD), which determined that no further action was necessary at these Sites. The ROD for Sites 15, 18 and 26 was issued on September 16, 1991. The ROD for Site 44 was issued on December 31, 1991. The ROD for Sites 9, 12, 33, 36, 37, 39, and 42 was issued on September 14, 1993. These sites are considered suitable for unlimited use and unrestricted exposure.

More extensive remedial actions were implemented for Sites 13, 14 and 29. Based on the results of

removal actions conducted at Sites 14 and 29, these sites are considered suitable for unlimited use and unrestricted exposure. A five-year review is required for Site 13.

Table 3 provides a summary of the volatile organic contaminants detected in Areas A and B groundwater above EPA and/or NJDEP standards. A detailed description of the investigations and results for these areas is contained in the Focused Feasibility Study and Record of Decision (ROD) for Areas A and B Groundwater.

2.2 AREAS A & B REMEDIAL ACTIONS

Areas A and B Groundwater - Pump & Treat

In 1991, the Navy determined that it had sufficient data to perform an interim remedial action at Areas A and B. The interim remedial action implemented included groundwater pumping, treatment and recharge of treated water back to the aquifer. A recovery system which extracted groundwater via six recovery wells at a combined rate of 585 gallons per minute was installed. Four recovery wells were located at the downgradient edge of Area A-East to control the migration of contamination into the downgradient wetlands, Ridgeway Branch and toward off-base property. A recovery well was located within Area A-West to treat a smaller area of groundwater contamination. A recovery well was located downgradient of Site 13 to treat the higher levels of contamination migrating from this source area at Site 13. The ROD for the interim action was issued by the Navy and EPA, with NJDEP concurrence, on March 16, 1992.

The treatment system was designed by the Navy and awarded for construction in November 1991. Construction of the facility was completed and operation began in October 1993.

The final ROD for continued recovery and treatment of groundwater at Areas A and B was issued by the Navy and EPA, with NJDEP concurrence, on May 7, 1997.

The existing groundwater recovery system was modified to improve the capture of contaminated groundwater. Also, modifications were made to improve the effectiveness of remediation by adding a sparge wall along the downgradient edge of the plume, along the edge of the wetlands in Area A-east and a dual phase extraction system in Area A-west to enhance recovery of the product which continued to act as a source in this area.

Free-Product Recovery at Area A-West

Recovery of weathered fuel product at Area A-west was initiated in August 1995 using a SkimRite™ active free product skimming system. Over a three month period beginning in August 1995 approximately 30 gallons of free product were recovered from Area A-west and disposed of as hazardous waste. Due to problems with free product separation, the use of this system was discontinued after three months of operation.

In September 1997, a pilot study was conducted for the removal of free product that was observed in monitoring wells located in Area A-west. The product extraction system consisted of two fluid pumps which were installed in wells HC and ES. From 9 September to 22 October 1997 a total of eight tests were run to determine the optimal pumping rate for free product recovery. The study results indicated that the system was ineffective due to the small volume of

product available at the site. Only six gallons of product was recovered during the test period. Continued operation of the system until August 1998 recovered a total of approximately 15 gallons of product.

In May 1999, construction of a free-product recovery trench was instituted at Site 42 to recover free-product which has been observed in monitoring wells ES and HC. Due to the existence of a large storm water pipe that ran through the trench, excavation to the groundwater table was not possible and it was decided that a free-product recovery trench was not feasible. Excavation using conventional methods was conducted for removal of the remaining free product and contaminated soil in the smear zone. Approximately 30 cubic yards of contaminated soil was removed for proper off-site recycling.

From August 2001 to October 2001 two 150,000 gallon and one 250,000 gallon No. 6 fuel oil fuel tanks and associated secondary containment located within Area A-west were demolished. Excavation and removal of any contaminated soil located below the secondary containment was also included as part of this project. Approximately 94 cubic yards of soil was excavated and removed for off-base recycling.

Wetland Remediation in Area A-East

Sediment contaminated with petroleum hydrocarbons was removed from the wetlands downgradient from Area A-east in November 1996. Approximately 450 cubic yards of sediment were excavated. Since no chemical specific ARARs existed for sediment, the National Oceanic and Atmospheric Administration (NOAA) sediment quality criteria were used. All sediment above the NOAA effects range low (ER-L) level was removed. In a qualitative sense, the ER-L is the concentration above which adverse effects may begin or are predicted to begin among species. The excavated area was planted with native wetland species which have grown back to original site conditions and show no adverse ecological impacts. The sparge system described in the next section is preventing any further migration of contaminants into the downgradient wetlands.

Groundwater Sparging at Area A-East

A series of sixteen air sparging wells were installed along the perimeter of the wetlands in Area A-east to aid in the remediation of the higher levels of contamination detected in wells located adjacent to the wetlands. The system also prevents the migration of contaminated groundwater into the downgradient wetlands. A six-month pilot test for this treatment system was completed in September 1998. From system startup until April 1999, the maximum air injection rate of this system was 120 cubic feet per minute. In April of 1999, a second 200 cubic foot per minute blower was added to increase system effectiveness. The system has effectively reduced VOC levels in groundwater located adjacent to the wetlands from levels above 1,700 ug/l (detected in April 1996) to nondetectable levels.

Site 13 (Former Fuel Farm No. 125) Soil

The delineated contamination in the soil at Site 13 corresponds to an area directly under former Fuel Farm 125. This area is approximately sixty feet by sixty feet. Pursuant to a September 14, 1993 ROD, two vertical vapor extraction wells and two vertical vapor injection wells were installed at the site. The vapor extraction system began operation in May 1996. The system consists of air extraction with carbon adsorption for treatment as well as air injection to provide

oxygen in order to stimulate bio-remediation.

At Site 13, additional soil/groundwater contaminant delineation was conducted in October 2000. Based on the results of this sampling, in May 2001, the Navy expanded the venting/vapor extraction system to treat a larger area by adding an additional vapor extraction well. In May 2003, a sparge well was added to treat the high levels of contamination detected in groundwater at Site 13. The sparge system began operation on May 4, 2004, using a thermal oxidizer to treat the recovered soil vapor. The thermal oxidizer unit was operated from May 6, 2004 until September 8, 2004. A total of 1,100 pounds of VOCs were removed from the system during this time. After September 8th the sparge/vapor system continued operations with carbon adsorption for treatment of extracted vapor.

System performance is monitored through sampling of system influent and effluent and soil gas sampling at nine key locations. Based on the most recent data interpretation report for Sites 13 (dated April 6, 2005), the SVE system at Site 13 has removed approximately 5766 pounds of VOCs since startup. The performance and interpretation of data from this treatment system is presented in yearly reports entitled: Soil Vapor Extraction and Air Injection Systems, NPL Sites 13, 16 and 17, Data Interpretation Report.

2.3 AREAS A & B PROGRESS SINCE LAST FIVE YEAR REVIEW

The last five year review for Areas A and B was submitted in June 2001. The recommendations for Areas A and B were continued operation and maintenance of groundwater treatment and air sparging and vapor extraction systems with modifications to improve system performance. In May 2003, the vapor extraction system at Site 13 was modified by adding a sparge well to accelerate the remediation of the higher levels of groundwater contamination in Areas A and B.

Since the last five-year review additional monitoring wells NG and NH were installed at the area of highest groundwater contamination. Higher levels of some fuel related contaminants (benzene, toluene, ethylbenzene, and xylenes (BTEX)) were detected in these wells than previously detected in the area. The highest VOC level ever detected in Areas A and B groundwater was 3600 ug/l in 1988. During the last five years the highest VOC level detected was 2672 ug/l in 2004. The highest total VOC level detected in the October 2004 sampling round was 440 ug/l.

2.4 AREAS A & B TECHNICAL ASSESSMENT

Is the Remedy Functioning as Intended by the Decision Documents?

The review of documents, applicable or relevant and appropriate requirements (ARARs), risk assumptions, and results of the site inspection indicates that the remedy is functioning as intended by the ROD. Groundwater treatment continues to contain and treat the contaminated groundwater that migrates from this area as in-situ vapor treatment systems treat the higher "source areas" of contamination. The existing monitoring well network throughout this area provides sufficient data to monitor the extent of groundwater contamination and the effectiveness of the treatment systems.

Operation and maintenance of the system has been effective with no system effluent levels exceeding regulatory standards. O&M costs have remained consistent.

Treatment system optimizations to be implemented include the installation of an additional recovery well directly downgradient of the higher levels of groundwater contamination at Site 13 and the installation of additional sparge and vapor extraction points to treat the remaining higher levels of groundwater and soil contamination at Site 13.

Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standards and To Be Considereds

The ARARs listed in the ROD for this area include EPA MCLs and NJDEP PQLs. The ARARs for the contaminants of concern at this area were compared to the current standards to determine if any had changed. MCLs were added for carbon tetrachloride and 1,2-dichloroethane. PQLs have been revised for toluene, ethylbenzene, carbon tetrachloride, 1,1-dichloroethene, 1,2-dichloroethene and vinyl chloride. Table 3 has been updated to reflect the new values. Although the ARARs have changed, the remedy is still considered protective since ingestion of the groundwater pathway has been eliminated.

While recovery and treatment is capable of remediating groundwater to meet ARARs it may not be economically feasible to continue to operate this system once the higher areas of groundwater contamination are removed. Once groundwater contaminant levels have been reduced to an asymptotic level on the order of <50 ug/l the remaining contamination can more adequately be addressed via insitu treatment and long-term monitoring.

Changes in Exposure Pathways

A potential exposure pathway that has been introduced since the last five-year review is vapor intrusion. The EPA guidance for evaluating the vapor intrusion into indoor air was used to determine if the vapor intrusion exposure pathway poses a potential risk to human health at this area (See Appendix A). Based on the groundwater screening approach in the guidance, the levels of benzene, tetrachloroethene, trichloroethene and vinyl chloride in groundwater indicate the potential for vapor intrusion (See Table 9) In Areas A and B, there is groundwater contamination at the surface of the water table and there are buildings located within the area of the contaminated groundwater. There is also a potential source of vapor intrusion in the unsaturated zone at Site 13. Therefore, additional investigation of soil vapors in this area is warranted to ensure that vapor intrusion is not a problem.

Because the groundwater contamination in Areas A and B covers such a wide area, most of the area groundwater does not exceed the vapor intrusion criteria. It is proposed that the initial sampling to confirm or deny a potential vapor intrusion problem be conducted near the highest levels of contamination in the vicinity of Site 13. Hangar 1 and Buildings 60 and 123 are located within 100 ft. of the elevated levels of groundwater contamination. Hangar 1 is the largest building at the Station (700 ft. x 300 ft.) and presumably has a high air exchange rate. However this structure has smaller offices located within that may be vulnerable to vapor intrusion. The north side of Hangar 1 is home to the Center for Naval Aviation Technical Training with

approximately 75 personnel (including students). These personnel occupy the location for 8 to 10 hours per day. Additional classrooms for various training are also located along the north side of the hangar. The Ocean County Technical and Vocational School is located along the southern side of Hangar 1. The school has approximately 5 staff and 425 students that occupy the location from 1 to 8 hours per day. Building 60 is the Station's Credit Union. This is a 30 ft. by 60 ft. two story brick building. There are 7 people located in this building for 8 to 10 hours per day. Building 123 is the Station's gym and recreation center. This building also houses a lab and shipment receiving area. This building is 475 by 300 ft. with a 50 ft. ceiling which allows for a high air exchange rate. Less than 30 people work in this building for 8 to 10 hours per day. Several hundred people attend the gym for up to several hours per day. Groundwater in the vicinity of these buildings is approximately 30 feet below the ground surface.

Changes in Toxicity

The EPA Integrated Risk Information System (IRIS) was reviewed to determine if revisions had been made to the factors used to calculate risk from ingestion of contaminated groundwater. The original risk calculations were conducted in 1992 as part of the RI EA. A comparison of the original reference dose values and the revised values are provided in Table 12.

The toxicity value for trichloroethene is currently being updated by the EPA. The oral and inhalation cancer slope factor for TCE proposed by EPA Region 2 is $4 \times 10^{-1} \text{ (mg/kg-day)}^{-1}$. This proposed risk number yields an allowable groundwater concentration of 0.715 ug/l and a vapor intrusion target groundwater concentration of 0.086 ug/l (See Appendix B for calculations). These values are much lower than the current PQL of 1 ug/l and cannot be reliably measured by standard laboratory testing methods.

The protectiveness of the remedy does not change because of the new slope factor for TCE since the drinking water pathway is incomplete. The vapor intrusion pathway is being investigated to see if TCE and other site-related contaminants present risk and hazard from inhalation of vapors by building occupants. The new slope factor for TCE could play a role in determining risk and hazard from vapor intrusion.

A revised risk assessment is not required at this time since the use of groundwater at Areas A and B is restricted by an institutional control in the form of a classification exception area (CEA). The potential risk pathway of ingestion is not complete and, therefore, remediation to the PQL will be protective of human health.

Changes in Contaminant Characteristics

1,4-dioxane is a common stabilizer used with chlorinated solvents, most notably 1,1,1-trichloroethane (1,1,1-TCA). The 1,4-dioxane may be present at between 2 and 8% of the original 1,1,1-TCA solvent solution. 1,4-dioxane is miscible with water and is not retarded much in groundwater. It is normally at the front of any groundwater plume. Due to the historic nature of most spills at the base and the infrequent occurrence of 1,1,1-TCA, it is not expected that significant amounts are present. EPA and NJDEP do not currently have cleanup standards established for this compound.

Since the site conditions (contaminant release timeframe and hydrogeologic conditions) are very

similar for all areas across the base and Areas A and B have the highest level of 1,1,1-TCA (both historically and over the past five years) it is proposed that monitoring wells in this area be analyzed for 1,4-dioxane. The number and location of wells to be sampled for 1,4-dioxane will be determined at a later date in agreement with EPA. If elevated levels are discovered, a workplan to expand sampling for this compound throughout Areas A and B as well as other areas on base would be prepared.

Has any other information come to light that could call into question the protectiveness of the remedy?

There is no other information that calls into question the protectiveness of the remedy.

Summary of Technical Assessment

Additional sampling of this area for 1,4-dioxane and potential vapor intrusion will be required before the full protectiveness of this remedy can be verified.

2.5 AREAS A & B ISSUES

At this time the only issues identified that may impact the protectiveness of the remedy in place are:

- The potential for vapor intrusion caused by groundwater and soil contamination in the vicinity of Site 13.
- The potential for 1,4-dioxane to be present in groundwater.

2.6 AREAS A & B RECOMMENDATIONS

The sparge system installed in Area A-east appears to be working effectively. Upon start-up of this system, VOC levels in groundwater located adjacent to the wetlands reduced significantly and continue to remain reduced. Remediation systems in Area A appear to be working effectively as contaminant levels throughout the Area have been reduced to less than 40 ug/l and continue to decline.

The vapor extraction system installed at Site 13 will be capable of reducing soil contamination to acceptable levels and thus remove a source of groundwater contamination in Area B. To date more than 5766 pounds of VOCs have been removed. The sparge system at Site 13 has significantly reduced groundwater contamination from levels of 2672 ug/l to less than 10 ug/l during the October 2004 sampling round. At Site 13, additional sparge and vapor extraction points should be installed to treat the remaining elevated levels of contamination in soil and groundwater.

In 2006, an additional recovery well will be installed in Area B to treat the remaining higher levels of groundwater contamination.

The Navy believes that no further risk reduction is necessary (beyond the continued operation and maintenance of groundwater treatment and air sparging and vapor extraction systems with modifications to improve system performance). Groundwater monitoring will be conducted to monitor treatment system performance and location, concentration and migration of groundwater contamination. Data Interpretation Reports will continue to be prepared for the groundwater treatment system and the soil vapor treatment systems in Areas A and B.

Based on semi-annual groundwater monitoring results, it appears that the existing groundwater treatment system is capable of remediating the groundwater contamination in Areas A and B. A total VOC concentration of 3600 ug/l was detected in Areas A&B groundwater in 1988. During the October 2004 sampling round the highest total VOC level detected in Areas A&B groundwater was 440 ug/l.

A CEA has been established for groundwater at Areas A&B. A CEA is required pursuant to the State's Ground Water Quality Standards, New Jersey Administrative Code (NJAC) 7:9-6 whenever an approved remedy will not meet constituent standards for the term of the remediation. The establishment of a CEA is the State's method institutional control to protect human health until standards are achieved.

As a military facility, NAES can control the land use at the facility. Impacted sites are used for industrial purposes.

As determined appropriate by the TRC, other technologies may be used to expedite the residual fuel contamination in groundwater and soil. It is currently planned to add an additional recovery well to accelerate the recovery and treatment of groundwater in Area B. Expansion of the sparge system at Area B is also planned to accelerate the remediation of the residual sources.

Sampling of monitoring well HE, which contained the highest level of 1,1,1-TCA in the most recent sampling round, and recovery well RWAB-2, which had the highest levels in a downgradient well, shall be conducted to determine if 1,4-dioxane is present in Areas A and B. If elevated levels are discovered a workplan to expand sampling for this compound in area A&B and other areas shall be prepared.

A workplan shall be prepared to propose additional sampling required by EPA guidance to confirm or deny a vapor intrusion problem at Areas A and B. The initial investigation will be restricted to the area within 100 feet of Site 13 where groundwater contaminant levels exceed the EPA groundwater screening criteria.

Modification to current sampling frequency and analytical parameters may be made pending consultation with the TRC.

2.7 AREAS A & B PROTECTIVENESS STATEMENT

The implemented remedies for Areas A & B are protective of human health and the environment.

3.0 AREA C

3.1 AREA C BACKGROUND

Area C is located along the southern boundary of the NAES in the eastern portion of the Base (Figure 3). Area C includes Sites 10 (MOGAS station), 11 (hangar 5 storage area), 16 (Naval Air Technical Training Center (NATTC) fire fighting training area) and 17 (fuel farm 196). Area C is partially developed and includes various facility buildings, including Hangars 5 and 6, the base

MOGAS station and fuel farm 196. The Paint Branch traverses the northern portion of Area C and the Manapaqua Brook flows past Area C to the south, outside the NAES property line. There is no indication that groundwater contaminants are impacting these surface water bodies. Groundwater flow in Area C is in a generally east to northeast direction toward the downgradient Paint Branch.

A RI in Area C had revealed the existence of soil and groundwater contamination. The potential sources of soil and groundwater contamination were:

SITES 10 & 11: Site 10 consists of: (a) an area located about 40 feet to the west and behind building 306 which was used as a barrel storage area from about 1960 to 1970, (b) Rockwell Road, a wide sand and gravel area between McCord Road and Taxiway No. 5, which acted as a parking lot for fuel trucks and provided access to the 424 gas station and the back side of Fuel Farm 196; and (c) the 424 MOGAS Station. Potential sources of contamination at Site 10 include: 1) spilled fluids from the barrel storage area, 2) spraying of waste oils on Rockwell Road for dust control purposes, and 3) surficial releases from tank overfilling and poor maintenance practices at the MOGAS station. Due to low levels of contamination identified during the RI at Site 10, confirmation sampling was conducted in July 1995 which refuted the one RI sample which showed levels of contamination (Total Petroleum Hydrocarbons) above the NJ Soil Cleanup Criteria (found in the Area C Focused Feasibility Study Addendum dated July 31, 1995).

Site 11 consisted of a former drum storage area approximately 200 feet by 100 feet located about 50 yards north of Hangar 5. The drum storage area may have been a source of contamination although no information is available regarding its history or past usage. Adjacent to the site was an area about 1,000 by 300 feet from which approximately 350 cubic yards of surficial petroleum hydrocarbon contaminated soil was removed between 1981 and 1984. The visual discoloration was found to a depth of five inches. The site was subsequently expanded to include this area. Further delineation sampling of soil at Site 11 was undertaken in the Spring of 1992 based on high level petroleum hydrocarbons found during the RI Phase II. Approximately 76 cubic yards of contaminated soil was delineated and excavated in the summer of 1992. Post-excavation confirmation samples met NJDEP soil cleanup and EPA risk range criteria and this site is considered suitable for unlimited use and unrestricted exposure. A ROD for no further action for Site 11 was issued by the Navy and EPA, with NJDEP concurrence, on March 17, 1993.

Sites 10 and 11 are considered suitable for unlimited use and unrestricted exposure. A five-year review is required at Sites 16 and 17.

SITE 16: The former NATTC fire fighting training area was located east of Hangar 6 (Building 195), adjacent to the NAES civilian fire fighting training area. The two fire fighting pits in the area were supplied from nearby fuel tanks. The fuel burned during training was collected from defueling aircraft. The potential sources of contamination at the site include: 1) leaching of unburned fuel into soils and groundwater from the bottoms of the fire training pits during, and following fire training activities, 2) the operation of the cinder block oil/water separator and an unlined lagoon that received discharges from the NATTC fire fighting area, 3) the operation of an oil/water separator and the unlined lagoon that received discharge from the former civilian fire fighting area, and 4) various documented and unreported spills, including one that occurred on

March 15, 1986, when approximately 250 gallons of JP-5 were spilled as a result of a frozen tank valve.

SITE 17: Fuel Farm No. 196 is located to the south of Hangar 6. There were four 50,000-gallon underground tanks at this location. The tank farm was constructed in the mid-1940s. The tanks originally contained AVGAS until about 1974. From 1974 to 1995, they were used to hold JP-5. Each tank had a pumping station and a dry well. The dry wells were removed in 1982. The four 50,000 gallon underground JP-5 tanks were abandoned in 1997 and replaced by two above ground storage tanks. The potential sources of contamination at this site include: 1) minor fuel spills associated with filling fuel trucks, 2) draining of the condensate from the fuel tanks into a dry well, a common practice until about 1980, 3) a fuel spill of about 2,000 gallons in 1974, a spill of about 3,000 gallons in 1978, and a third spill in 1981 of 3,000 gallons. During a subsequent fuel recovery operation, a drawdown pump was installed in a recovery well to create a cone of depression on the groundwater table to facilitate the fuel recovery. Fuel spills associated with past practices were also recovered during the cleanup operation. A total of 11,000 gallons of fuel were recovered during this cleanup.

Table 4 provides a summary of the volatile organic contaminants detected in groundwater above EPA and/or NJDEP standards. A detailed description of the investigations and results for this area is contained in the Focused Feasibility Study and ROD for Area C Groundwater.

3.2 AREA C REMEDIAL ACTIONS

Area C Groundwater - Pump & Treat (June 1991)

The Navy determined in the spring of 1990, that it had sufficient data to perform an interim remedial action at Area C. The interim alternative implemented included groundwater pumping, treatment and recharge of treated water back to the aquifer. Groundwater was extracted via three wells at a combined rate of 200 gallons per minute. Recovery wells were located at Site 10 (the MOGAS station), Site 17 (fuel farm 196), and downgradient of Site 16 (NATTC fire fighting training area). The ROD for the interim action was issued by the Navy and EPA, with NJDEP concurrence, on December 14, 1990.

The treatment system was designed by the Navy and awarded for construction in September 1990. Construction of the facility was completed and began operation in June 1991.

A final ROD for continued recovery and treatment of groundwater was issued by the Navy and EPA, with NJDEP concurrence, on January 10, 1996.

The existing groundwater recovery system was modified to improve the capture of contaminated groundwater. Modifications to recovery well locations and pumping rates were implemented as part of the final action. Also, modifications to improve the effectiveness of the system by adding additional recovery wells to capture the most highly contaminated groundwater and adding free product recovery to enhance recovery of the minor amounts of product which continue to act as a source were implemented.

Sites 16 and 17 Soil

Excavation of the civilian fire fighting pits and lagoon and the NATTC lagoon (all located within

Site 16) was conducted between August 19, 1993 and September 2, 1993. Approximately 2000 cubic yards of contaminated soil was removed from Site 16 and was later processed and recycled on-site to become road-base for Station roads. These soil removals are not subject to this five-year review.

A contract to upgrade fuel farm 196 (Site 17) was awarded in the last quarter of Fiscal Year (July - September) 94. This upgrade included the abandonment of the underground storage tanks. This abandonment included removal of the tank appurtenances, the tank tops, and the tank fill stand. The tanks themselves were cleaned, then the bottoms broken, and the tanks were filled with clean sand. To replace the storage that was lost two new 25,000 gallon above ground tanks were constructed. These new tanks have all the required overfill protection devices, and a secondary containment. A new fill stand was also constructed as part of the upgrade.

Between January 1994 to July 1994, treatment systems for vapor extraction/bioventing at Site 17 and sparging/bioventing at Site 16 were designed. To determine design parameters, a bioventing study was performed at Sites 16 and 17 in May 1994. Start-up of these systems began on August 5, 1995. System performance is monitored through biweekly soil gas sampling for oxygen and carbon dioxide and by monthly grid soil sampling.

A final ROD for continued operations of the soil remediation systems with modifications implemented as needed was issued by the Navy and EPA, with NJDEP concurrence, on January 10, 1996. Through operation of the existing treatment facilities for soil vapor extraction at Site 17 and bioventing at Site 16, the Navy could determine the effectiveness of the systems and gather data which could be used to optimize the systems as necessary to accelerate soil remediation.

Based on the most recent data interpretation report for Sites 16 and 17 (dated April 6, 2005), the SVE system at Site 17 has removed approximately 5275 pounds of VOCs since startup. Due to fuel product in the groundwater at Sites 16 and 17, levels of Total Volatile Petroleum Hydrocarbons (TVPH) in soil gas have fluctuated over the past two years with a significant decrease observed in December 2004. The performance and interpretation of data for Sites 16 and 17 is presented in a separate report entitled: Soil Vapor Extraction and Air Injection Systems, NPL Sites 13, 16 and 17, Data Interpretation Report.

3.3 AREA C PROGRESS SINCE LAST FIVE YEAR REVIEW

The last five year review for Area C was submitted in June 2001. The recommendations for Area C were continued operation and maintenance of groundwater treatment and air sparging and vapor extraction systems with modifications to improve system performance.

Since the last five-year review levels of most contaminants have decreased in this area. The highest level of VOCs ever detected in Area C was 10,699.5 ug/l in 1998. The highest total VOC level detected over the past five years was 5950 ug/l in 2002. The highest total VOC level detected in the October 2004 sampling round was 1344 ug/l.

The highest levels of chlorinated VOCs were detected in well MV. There is a "hot spot" of chlorinated VOCs located in the vicinity of this well. A soil investigation to identify the source

was conducted in August 2005. While no source was identified it was determined that the elevated levels were localized within several feet of well MV. This well will continue to be monitored regularly. If chlorinated VOC levels exceed 100 ug/l additional investigation and/or treatment will be considered. The highest levels of BTEX were detected in monitoring well BA.

3.4 AREA C TECHNICAL ASSESSMENT

Is the Remedy Functioning as Intended by the Decision Documents?

The review of documents, ARARs, risk assumptions, and results of the site inspection indicates that the remedy is functioning as intended by the ROD. Groundwater treatment continues to contain and treat the contaminated groundwater that migrates from this area as in-situ vapor treatment systems treat the higher "source areas" of contamination. The existing monitoring well network throughout this area provides sufficient data to monitor the extent of groundwater contamination and the effectiveness of the treatment systems.

Operation and maintenance of the system has been effective with no system effluent levels exceeding regulatory standards. O&M costs have remained consistent.

Treatment system optimizations to be implemented include the installation of a sparge vapor extraction system to treat the elevated levels of groundwater/soil contamination remaining at Site 10 in the vicinity of well BA and sparge points to accelerated the remediation of the higher levels of groundwater contamination remaining at Site 17.

Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standards and To Be Considereds

The ARARs listed in the ROD for this area include EPA MCLs and NJDEP PQLs. The ARARs for the contaminants of concern at this area were compared to the current standards to determine if any had changed. PQLs have been revised for toluene, ethylbenzene, 1,1-dichloroethene, 1,2-dichloroethene and vinyl chloride. Table 4 has been updated to reflect the new values. Although the ARARs have changed, the remedy is still considered protective since ingestion of the groundwater pathway has been eliminated.

While recovery and treatment is capable of remediating groundwater to meet ARARs it may not be economically feasible to continue to operate this system once the higher areas of groundwater contamination are removed. Once groundwater contaminant levels have been reduced to an asymptotic level on the order of <50 ug/l the remaining contamination can more adequately be addressed via insitu treatment and long-term monitoring.

Changes in Exposure Pathways

A potential exposure pathway that has been introduced since the last five-year review is vapor intrusion. The EPA guidance for evaluating the vapor intrusion into indoor air was used to determine if the vapor intrusion exposure pathway poses a potential risk to human health at this area (See Appendix A). Based on the groundwater screening approach in the guidance, there

were no currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near the subsurface contaminants of concern. Only Hangar 6 is located near the area C groundwater contamination. This structure is used for storage. Due to the enormous size of this structure and the high air exchange rate, vapor intrusion is not expected to pose a risk to human health in the Area.

At Area C there is no potential for the vapor intrusion pathway to impact currently inhabited buildings or areas of concern under future development scenarios.

Changes in Toxicity

The EPA Integrated Risk Information System (IRIS) was reviewed to determine if revisions had been made to the factors used to calculate risk from ingestion of contaminated groundwater. The original risk calculations were conducted in 1992 as part of the RI EA. A comparison of the original reference dose values and the revised values are provided in Table 12.

The toxicity value for trichloroethene is currently being updated by the EPA. The oral and inhalation cancer slope factor for TCE proposed by EPA Region 2 is $4 \times 10^{-1} \text{ (mg/kg-day)}^{-1}$. This proposed risk number yields an allowable groundwater concentration of 0.715 ug/l and a vapor intrusion target groundwater concentration of 0.086 ug/l (See Appendix B for calculations). These values are much lower than the current PQL of 1 ug/l and cannot be reliably measured by standard laboratory testing methods.

A revised risk assessment is not required at this time since the use of groundwater at Area C is restricted by an institutional control in the form of a CEA. The potential risk pathway of ingestion is not complete and, therefore, remediation to the PQL will be protective of human health.

Changes in Contaminant Characteristics

1,4-dioxane is a common stabilizer used with chlorinated solvents, most notably 1,1,1-trichloroethane (1,1,1-TCA). The 1,4-dioxane may be present at between 2 and 8% of the original 1,1,1-TCA solvent solution. 1,4-dioxane is miscible with water and is not retarded much in groundwater. It is normally at the front of any groundwater plume. Due to the historic nature of most spills at the base and the infrequent occurrence of 1,1,1-TCA, it is not expected that significant amounts are present. EPA and NJDEP do not currently have cleanup standards established for this compound.

The highest level of 1,1,1-TCA detected in Area C over the past five years was 8.4 ug/l. Based on this level, it is not believed that 1,4-dioxane would be present at a level of concern in Area C groundwater. Monitoring wells in Areas A and B, where 1,1,1-TCA is detected at the highest concentrations, will be sampled initially to determine if this compound is present. If elevated levels are discovered, a workplan to expand sampling for this compound throughout Areas A and B as well as other areas on base would be prepared.

Has any other information come to light that could call into question the protectiveness of the remedy?

There is no other information that calls into question the protectiveness of the remedy.

Summary of Technical Assessment

Based on the technical assessment for Area C, the remedy in place is protective of human health. Additional sparge/vapor extraction systems will be added to accelerate the remediation of contaminants present in this Area.

3.5 AREA C ISSUES

At this time there are no issues identified that may impact the protectiveness of the remedy in place.

3.6 AREA C RECOMMENDATIONS

The vapor extraction/bioventing at Site 17 and the sparging/bioventing system at Site 16 will be capable of reducing soil contamination to acceptable levels and thus remove the sources of groundwater contamination in Area C. Additional sparge points should be installed to accelerate residual groundwater contamination.

Based on semi-annual groundwater monitoring results, it appears that the existing groundwater treatment system is capable of remediating the groundwater contamination in Area C. Total VOC concentrations in excess of 7000 ug/l were detected in Area C groundwater samples collected in 1988. During the October 2004 sampling round the highest levels detected in Area C groundwater were 1344 ug/l.

A CEA has been established for groundwater at Area C. A CEA is required pursuant to the State's Ground Water Quality Standards, NJAC 7:9-6 whenever an approved remedy will not meet constituent standards for the term of the remediation. The establishment of a CEA is the State's method institutional control to protect human health until standards are achieved.

As a military facility, NAES can control the land use at the facility. Impacted sites are used for industrial purposes.

The Navy believes that no further risk reduction is necessary (beyond the continued operation and maintenance of groundwater treatment and venting/vapor extraction systems with modifications to improve system performance). Groundwater monitoring will be conducted to monitor treatment system performance and location, concentration and migration of groundwater contamination. Data Interpretation Reports will continue to be prepared for the groundwater treatment system and annually for the soil vapor treatment systems in Area C.

As determined appropriate by the TRC, other technologies may be used to expedite the residual fuel contamination in groundwater and soil. It is currently planned to expand the sparge/vapor extraction system at Area C to accelerate the remediation of the residual sources.

Modification to current sampling frequency and analytical parameters may be made pending consultation with the TRC.

3.7 AREA C PROTECTIVENESS STATEMENT

The implemented remedies for Area C are protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

4.0 AREA D (SITE 31)

4.1 AREA D (SITE 31) BACKGROUND

The former NAES sanitary landfill (Site 31) is located along the northern boundary in the central portion of the Base (Figure 4). Site 31 and the surrounding downgradient area is referred to as Area D. The landfill became operational in 1960 or 1961. The landfill received trash and garbage from the facility for a period of approximately 20 years. The area of the landfill is estimated at 34 acres. In 1980, it was capped with approximately 6" of topsoil. The NJDEP approved the closure of the landfill in 1980. The landfill is now a large grassy field surrounded with trees and contains no landmarks. Depth to groundwater in the vicinity of the landfill is approximately 20 ft. A five-year review is required at Site 31.

A list of potentially hazardous materials that were reportedly disposed of at the landfill is provided in the following table.

AREA D
POTENTIALLY HAZARDOUS MATERIALS DISCARDED AT
INACTIVE SANITARY LANDFILL (SITE 31)

Material	Estimated Time Frame	Estimated Quantity
Trash	1960-1980	Unknown
Cutting oil	1964-1976	5,000 gallons
Solvents, paint, paint thinner, paint cans	1960-1976	160 gal/yr
Hydraulic fluid	1960-1976	Unknown
Asbestos	1960-1976	5 tons
Oil for dust control (over 1,000 yards)	1967-1968	200 gallons
Blacktop, concrete, wood, nylon webbing	1960-1976	Unknown
Sand containing lead slugs from rifle range	1980	200 cu.yds
Bowzers full of waste solvent and oil	1960	Unknown
Sludge from AVGAS tanks	1968-1969	Unknown
Triple rinsed pesticide cans	1961-1976	Unknown
Scrap metals	Unknown	Unknown
Freon Cylinders (50 lb.Bt)	1972-1976	400
Transformer filters with PCBs	Unknown	Unknown
Elemental mercury (buried after closure)	1980	400 grams
Fluorescent tubes in bags	1960-1976	1,000 tubes/year
Hydraulic fluid saturated aircraft filters	Unknown	250 per month

It is estimated, however, that these potentially hazardous wastes compose a very small percentage of total landfill waste, in comparison to the volume of normal household wastes. A compilation and analysis of landfill records on file at the NJDEP show only two instances of hazardous materials having been placed in the landfill. One entry is hazardous waste containers (which does not denote if empty or full) and one entry of dry hazardous waste. These wastes are not described any further. The percentage of hazardous waste disposed of between 1973-1976, according to these records, is calculated as less than 0.005 percent. There is no indication that any contaminants from the landfill are impacting ecological receptors located above the filled area.

The primary (most commonly detected) contaminants in groundwater at Area D are chlorinated solvents. The monitoring of landfill indicator parameters since 1982 at Area D has not revealed any significant upward or downward trend and levels are generally low. It appears, however, that the landfill is a source of low levels of volatile organic contamination, probably resulting from waste solvents, paint thinner, hydraulic fluid and other unidentified chemical wastes which reportedly were deposited in the landfill.

Rainbow pond is located downgradient of Site 31 adjacent to the northeast corner of the golf course. Sampling of the surface water and sediment in this pond and the downgradient Ridgeway Branch indicate no VOC contamination. Therefore, no adverse ecological effects were determined to be present in Area D resulting from the landfill wastes.

Table 5 provides a summary of the volatile organic contaminants detected in Area D groundwater above EPA and/or NJDEP standards.

4.2 Area D Remedial Actions

Final Remedial Action for Area D (Site 31) (September 1993)

The final ROD for long-term groundwater monitoring at Area D was issued by the Navy and EPA, with NJDEP concurrence, on September 14, 1993.

The results of the environmental investigations conducted show no evidence of significant contamination at Site 31. The levels of chlorinated solvents have been determined to not pose a risk to human health or the environment. However, groundwater monitoring was implemented to track any significant changes in contaminant concentrations or movement to ensure continued compliance with groundwater standards and monitor the risk to human health and the environment.

Area D groundwater is sampled semi-annually and the results are presented to the regulatory agencies at TRC meetings. The contaminant levels in the area have generally decreased since 1997 (see Table 5). Wells HP and DU historically have had the highest total VOC levels. The VOC levels in these two wells have reduced from a range of 50 to 65 ug/l total VOCs in 1999 and 2000 to a range of 9 to 21 ug/l for HP and 36 to 44 ug/l for DU in 2004 and 2005. Sampling results of well IF, 1700 feet downgradient from the landfill, shows a decrease from a high of 48 ug/l in 1998 to a range of 16 to 20 ug/l in 2004 and 2005.

To accelerate the time for groundwater to meet ARARs, two solar powered spray aeration systems

were installed on August 14, 1998 in Area D monitoring wells (HP and IF) with higher levels of volatile organic compounds (VOCs). These systems pump approximately 5 gpm during periods of sunshine between May and October. These systems have only a small, localized effect on reducing groundwater contamination in the area but will be continued since they are inexpensive to operate.

4.3 AREA D PROGRESS SINCE LAST FIVE YEAR REVIEW

The last five year review for Area D was submitted in June 2001. The recommendations for Area D was continued groundwater monitoring.

Since the last five-year review levels of most contaminants have decreased in this area. Total VOC concentrations in excess of 120 ug/l were detected in Area groundwater samples collected in 1994 - 1996. During the most recent sampling rounds conducted in February 2005 the highest total VOC level detected in Area groundwater was 44 ug/l.

4.4 AREA D TECHNICAL ASSESSMENT

Is the Remedy Functioning as Intended by the Decision Documents?

The review of documents, ARARs, risk assumptions, and results of the site inspection indicates that the remedy is functioning as intended by the ROD. Groundwater monitoring continues to show that the extent of groundwater contamination is limited and that the levels are reducing over time.

Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standards and To Be Considereds

The ARARs listed in the ROD for this area include EPA MCLs and NJDEP PQLs. The ARARs for the contaminants of concern at this area were compared to the current standards to determine if any had changed. The MCL was added for 1,2-dichloroethane. The MCLs for chloroform and cis-1,2-dichloroethene were revised. PQLs have been revised for chlorobenzene, cis-1,2-dichloroethene and vinyl chloride. Table 5 has been updated to reflect the new values. Although the ARARs have changed, the remedy is still considered protective since ingestion of the groundwater pathway has been eliminated.

Changes in Exposure Pathways

A potential exposure pathway that has been introduced since the last five-year review is vapor intrusion. The EPA guidance for evaluating the vapor intrusion into indoor air was used to determine if the vapor intrusion exposure pathway poses a potential risk to human health at this area (See Appendix A). Based on the groundwater screening approach in the guidance, there are no currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near the subsurface contaminants of concern. Only storage buildings are located within the area of the subsurface contamination.

At Area D there is no potential for the vapor intrusion pathway to impact currently inhabited buildings or areas of concern under future development scenarios.

Changes in Toxicity

The EPA Integrated Risk Information System (IRIS) was reviewed to determine if revisions had been made to the factors used to calculate risk from ingestion of contaminated groundwater. The original risk calculations were conducted in 1992 as part of the RI EA. A comparison of the original reference dose values and the revised values are provided in Table 12.

The toxicity value for trichloroethene is currently being updated by the EPA. The oral and inhalation cancer slope factor for TCE proposed by EPA Region 2 is $4 \times 10^{-1} \text{ (mg/kg-day)}^{-1}$. This proposed risk number yields an allowable groundwater concentration of 0.715 ug/l and a vapor intrusion target groundwater concentration of 0.086 ug/l (See Appendix B for calculations). These values are much lower than the current PQL of 1 ug/l and cannot be reliably measured by standard laboratory testing methods.

A revised risk assessment is not required at this time since the use of groundwater at Area D is restricted by an institutional control in the form of a CEA. The potential risk pathway of ingestion is not complete and, therefore, remediation to the PQL will be protective of human health.

Changes in Contaminant Characteristics

1,4-dioxane is a common stabilizer used with chlorinated solvents, most notably 1,1,1-trichloroethane (1,1,1-TCA). The 1,4-dioxane may be present at between 2 and 8% of the original 1,1,1-TCA solvent solution. 1,4-dioxane is miscible with water and is not retarded much in groundwater. It is normally at the front of any groundwater plume. Due to the historic nature of most spills at the base and the infrequent occurrence of 1,1,1-TCA, it is not expected that significant amounts are present. EPA and NJDEP do not currently have cleanup standards established for this compound.

1,1,1-TCA was not detected above the MCL or PQL in Area D. It is not believed that 1,4-dioxane would be present at a level of concern, if at all, in Area D groundwater.

Has any other information come to light that could call into question the protectiveness of the remedy?

Based on the technical assessment for Area D, the remedy in place is protective of human health.

4.5 AREA D ISSUES

At this time there are no issues identified that may impact the protectiveness of the remedy in place.

4.6 AREA D RECOMMENDATIONS

Based on the semi-annual groundwater monitoring results, it appears that groundwater contaminant levels are reducing naturally over time. Total VOC concentrations in excess of 120 ug/l were detected in Area groundwater samples collected in 1994 - 1996. During the most recent sampling rounds conducted in February 2005 the highest VOC level detected in Area groundwater was 44 ug/l.

The Navy believes that continued monitoring will be capable of protecting human health and the environment. Groundwater monitoring will continue to monitor the concentration and migration of groundwater contamination.

Due to the relatively low rates of pumping (5 gpm), the spray irrigation systems in Area D has a limited impact on contaminant reduction. It is recommended that these systems continue to operate to treat the higher levels of groundwater contamination in Area D.

A CEA has been established for groundwater at Area D. A CEA is required pursuant to the State's Ground Water Quality Standards, NJAC 7:9-6 whenever an approved remedy will not meet constituent standards for the term of the remediation. The establishment of a CEA is the State's method institutional control to protect human health until standards are achieved.

As a military facility, NAES can control the land use at the facility. Impacted sites are used for industrial purposes.

Modification to current sampling frequency and analytical parameters may be made pending consultation with the TRC.

4.7 AREAS D PROTECTIVENESS STATEMENT

The remedy for Area D is protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

5.0 AREA H

5.1 AREA H BACKGROUND

Area H is located in the central portion of the NAES (Figure 5). Area H consists of Sites 2 (experimental site at RSTS track 2), 21 (jet car maintenance shop) and 32 (launch end of the test tracks). The predominant physical feature in Area H is the Recovery System Track Sites (RSTS), Site 32, which consists of the launch end of five system test tracks and ancillary facilities. The test tracks are used to launch sled-mounted aircraft or jet engines that simulate aircraft landings on aircraft carriers. The sleds are arrested at the other end of the tracks to test arresting cables and nets. The tracks, which resemble railroad tracks, are one to one and one-quarter miles long. Ancillary facilities consist of several buildings used for storage and maintenance of equipment and supplies. Site 32 is believed to be responsible for the groundwater contamination present at Area H.

The results of previous investigations and removal actions conducted at former Sites 2 and 21 in Area H have documented the absence of any significant contamination posing a threat to human health or the environment. Site 2, located between tracks 1 and 2, had 200 cubic yards of visually oil-stained soil, removed in 1981. The ROD for no further action at Site 2 was issued by Navy and EPA, with NJDEP concurrence, on March 17, 1993. At Site 21, 22 cubic yards of petroleum hydrocarbon contaminated soil were removed in March 1991. The ROD for no further action at Site 21 was issued by Navy and EPA, with NJDEP concurrence, on January 2, 1992. These sites are considered suitable for unlimited use and unrestricted exposure and are not subject to this review..

A five-year review is required at Site 32.

Potential sources of contamination at Site 32 included: 1) a drainage system located at the end of each of the five test tracks designed to receive oil and fuel runoff, 2) fuel releases from a 1,500-gallon underground fuel storage steel tank located near Building 408, at the south launching end of Test Track No. 1, 3) a 15,000-gallon underground JP-5 fuel storage tank and a 400-gallon underground alcohol tank located adjacent to Building 393 which were taken out of service in 1986, and excavated and removed in April 1989, 4) a 5,400-gallon above ground JP-5 fuel storage tanker located adjacent to Building 393 where it was reported that on May 12, 1989, approximately 1,200 gallons of JP-5 were spilled as a result of a ruptured hose, 5) a 500 to 1,000-gallon underground steel tank, located near Building 397, used to store No. 2 heating fuel which was removed around 1982, 6) potential spills in the area of Buildings 388 and 397 which were used as a storage area for drums containing fuel, solvents and oils and for maintenance on jet sleds and other equipment, and 7) numerous documented, and potentially undocumented, small volume spills resulting from operations at the site.

Based on the results of the ecological risk assessment, contaminants at Area H have limited potential to adversely effect ecological receptors. The maximum soil contaminant concentrations are well below the 95th percent upper confidence level of New Jersey background concentrations. The only contaminants of concern found in soil were xylenes and TPHC, which appear at low levels.

Contaminated soil/sediment was excavated at Area H in August 1993. Post-excavation sampling was performed in March 1994. Samples were collected from each of the former dry wells which had been removed, the drainage swale, and the former underground storage tank area near track 1. The results met State light industrial land use cleanup criteria. This area is used for military testing activities and there currently there are no plans to change the land use. If in the future the land use changes additional investigation and remediation of soil may be required to meet other standards.

Table 6 provides a summary of the volatile organic contaminants detected in groundwater above EPA and/or NJDEP standards. A detailed description of the investigations and results for this area is contained in the Focused Feasibility Study and ROD for Area H Groundwater.

5.2 AREA H REMEDIAL ACTIONS

Area H Groundwater - Pump & Treat

The Navy determined in the spring of 1990, that it had sufficient data to perform an interim remedial action at Area H. The interim alternative implemented includes groundwater pumping, treatment and recharge of treated water back to the aquifer. Groundwater was extracted via two wells at a combined rate of 120 gallons per minute. Recovery wells were installed at the launch end of the test tracks and downgradient of the plume. A ROD for the interim action was issued by the Navy and EPA, with NJDEP concurrence, on December 14, 1990.

The treatment system was designed by the Navy and awarded for construction in April 1991. Construction of the facility was completed and began operation in May 1992.

The final ROD for continued recovery and treatment of groundwater with recovery system

modifications was issued by the Navy and EPA, with NJDEP concurrence, on January 10, 1996.

The existing groundwater treatment system was modified to improve the capture of contaminated groundwater. Modifications to recovery well locations and pumping rates were implemented as part of the final action. Also, modifications to improve the effectiveness of the system by adding an additional recovery well to capture the most highly contaminated groundwater and adding free product recovery to enhance recovery of product which continues to act as a source were implemented.

Free-product Removal at Area H (December 1997)

Since December 1997, free-product has been recovered from recovery wells RWH-1 and RWH-3 in Area H. The product was pumped from the surface of groundwater into drums for proper disposal. As of March 2005, 1041.6 gallons of product have been recovered from RWH-3 and 112.5 gallons of product have been recovered from RWH-1.

In May 1998, a sample of this product was sent to the National Research Laboratory for identification. The product was identified as JP-5. This type of fuel was used in the RSTS fuel system until 1996, at which time the fuel used was switched to JP-8. The original RSTS fuel system was shut down on December 7, 1998, at which time a new system with above ground piping replaced the original system.

The product recovered from well RWH-3 fluctuates but shows a decreasing trend over time. No product has been detected in RWH-1 since March 2002.

Remedial Action for Site 32 Soil (August 1993)

A ROD for Site 32 soil was issued by the Navy and EPA, with NJDEP concurrence, on September 14, 1993. The selected action was excavation and on-base recycling.

The contaminated soil was excavated during August 1993. The excavated soil was covered to await implementation of asphalt batching for treatment. The contaminated soil was treated during July 1994 and used as sub-base for road paving at NAES.

5.3 AREA H PROGRESS SINCE LAST FIVE YEAR REVIEW

The last five year review for Area H was submitted in June 2001. The recommendations for Area H were continued operation and maintenance of groundwater treatment with modifications to improve system performance.

Since the last five-year review levels of most contaminants have decreased in this area. The highest level of VOCs ever detected in Area H was 10,564 ug/l in 1997. The highest VOC level detected over the past five years was 1242 ug/l in 2004.

5.4 AREA H TECHNICAL ASSESSMENT

Is the Remedy Functioning as Intended by the Decision Documents?

The review of documents, ARARs, risk assumptions, and results of the site inspection indicates that the remedy is functioning as intended by the ROD. Groundwater treatment continues to contain and treat the contaminated groundwater that migrates from this area. The existing

monitoring well network throughout this area provides sufficient data to monitor the extent of groundwater contamination and the effectiveness of the treatment systems.

Operation and maintenance of the system has been effective with no system effluent levels exceeding regulatory standards. O&M costs have remained consistent.

Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standards and To Be Considereds

The ARARs listed in the ROD for this area include EPA MCLs and NJDEP PQLs. The ARARs for the contaminants of concern at this area were compared to the current standards to determine if any had changed. The MCL was added for styrene. PQLs have been revised for toluene, ethylbenzene, 2-butanone, 1,2-dichloroethene and styrene. Table 6 has been updated to reflect the new values. Although the ARARs have changed, the remedy is still considered protective since ingestion of the groundwater pathway has been eliminated.

While recovery and treatment is capable of remediating groundwater to meet ARARs it may not be economically feasible to continue to operate this system once the higher areas of groundwater contamination are removed. Once groundwater contaminant levels have been reduced to an asymptotic level on the order of <50 ug/l the remaining contamination can more adequately be addressed via insitu treatment and long-term monitoring.

Changes in Exposure Pathways

A potential exposure pathway that has been introduced since the last five-year review is vapor intrusion. The EPA guidance for evaluating the vapor intrusion into indoor air was used to determine if the vapor intrusion exposure pathway poses a potential risk to human health at this area (See Appendix A). Based on the groundwater screening approach in the guidance, building 351, with a total of less than 5 employees, is inhabited and located within 100 feet of the groundwater contamination, and groundwater concentrations exceed the generic target media-specific concentration for benzene (see Table 10). Therefore, additional investigation of soil vapors in this area is warranted to ensure that vapor intrusion is not a problem.

Building 351 is a 50 ft. by 25 ft. pre-engineered metal building that is used as a workshop for test track operations. Workers sometimes occupy this building from 8 to 10 hours per day. Depth to groundwater is approximately 8 ft. near this building.

Changes in Toxicity

The EPA Integrated Risk Information System (IRIS) was reviewed to determine if revisions had been made to the factors used to calculate risk from ingestion of contaminated groundwater. The original risk calculations were conducted in 1992 as part of the RI EA. A comparison of the original reference dose values and the revised values are provided in Table 12.

The toxicity value for trichloroethene is currently being updated by the EPA. The oral and

inhalation cancer slope factor for TCE proposed by EPA Region 2 is 4×10^{-1} (mg/kg-day)⁻¹. This proposed risk number yields an allowable groundwater concentration of 0.715 ug/l and a vapor intrusion target groundwater concentration of 0.086 ug/l (See Appendix B for calculations). These values are much lower than the current PQL of 1 ug/l and cannot be reliably measured by standard laboratory testing methods.

A revised risk assessment is not required at this time since the use of groundwater at Area H is restricted by an institutional control in the form of a CEA. The potential risk pathway of ingestion is not complete and, therefore, remediation to the PQL will be protective of human health.

Changes in Contaminant Characteristics

1,4-dioxane is a common stabilizer used with chlorinated solvents, most notably 1,1,1-trichloroethane (1,1,1-TCA). The 1,4-dioxane may be present at between 2 and 8% of the original 1,1,1-TCA solvent solution. 1,4-dioxane is miscible with water and is not retarded much in groundwater. It is normally at the front of any groundwater plume. Due to the historic nature of most spills at the base and the infrequent occurrence of 1,1,1-TCA, it is not expected that significant amounts are present. EPA and NJDEP do not currently have cleanup standards established for this compound.

The highest level of 1,1,1-TCA detected in Area H over the past five years was 6.8 ug/l. Based on this level, it is not believed that 1,4-dioxane would be present at a level of concern in Area H groundwater. Monitoring wells in Areas A and B, where 1,1,1-TCA is detected at the highest concentration, will be sampled initially to determine if this compound is present. If elevated levels are discovered, a workplan to expand sampling for this compound throughout Areas A and B as well as other areas on base would be prepared.

Has any other information come to light that could call into question the protectiveness of the remedy?

There is no other information that calls into question the protectiveness of the remedy.

Summary of Technical Assessment

Based on the technical assessment for Area H, the remedy in place is protective of human health. Additional sparge/vapor extraction systems will be added to accelerate the remediation of contaminants present in this Area.

5.5 AREA H ISSUES

Collection of additional data is required at Area H to evaluate the completeness of the vapor intrusion pathway. At this time there are no other issues identified that may impact the protectiveness of the remedy in place.

5.6 AREAS H RECOMMENDATIONS

At Area H the groundwater pumping and treatment system is effectively containing and remediating the higher levels of groundwater contamination. The addition of groundwater sparging is recommended to accelerate the time to meet cleanup standards.

The Navy believes that no further risk reduction is necessary (beyond the continued operation and maintenance of groundwater treatment system with modifications to improve system performance). Groundwater monitoring will be conducted to monitor treatment system performance and location, concentration and migration of groundwater contamination. Data Interpretation Reports will continue to be prepared for the groundwater treatment system at Area H.

Based on semi-annual groundwater monitoring results, it appears that the existing groundwater treatment system is capable of remediating the groundwater contamination in Area H. A total VOC concentration of 8300 ug/l was detected in Area H groundwater in 1988. During the October 2004 sampling round the highest total VOC level detected in Area H groundwater was 1242 ug/l.

A CEA has been established for groundwater at Area H. A CEA is required pursuant to the State's Ground Water Quality Standards, NJAC 7:9-6 whenever an approved remedy will not meet constituent standards for the term of the remediation. The establishment of a CEA is the State's method institutional control to protect human health until standards are achieved.

A workplan shall be prepared to propose additional sampling required by EPA guidance to confirm or deny a vapor intrusion problem at Area H.

As a military facility, NAES can control the land use at the facility. Impacted sites are used for industrial purposes. As determined appropriate by the TRC, other technologies may be used to expedite the residual fuel contamination in groundwater and soil.

Modification to current sampling frequency and analytical parameters may be made pending consultation with the TRC.

5.7 AREA H PROTECTIVENESS STATEMENT

The implemented remedy for Areas H is protective of human health and the environment.

6.0 AREAS I&J

6.1 AREAS I & J BACKGROUND

Areas I and J are located along the southern boundary of NAES in the west central portion of the Station (Figure 6). Area I includes Sites 6 (catapult test facility), 7 (catapult test facility storage area), 23 (inactive disposal area at building 524), 24 (catapult test site 7419), and 25 (test department disposal area). Area J includes Sites 3 (drainage ditch at runway arrested landing site), 19 (7401 Test Site), 22 (jet blast deflector), and 40 (soil stabilization field test site). The NAES property boundary forms the southern border of Area I. Areas I and J are largely developed and include various Navy testing facilities, including a steam plant, catapult launching facilities and a Runway Arrested Landing Site (RALS) facility. The catapult runway traverses Areas I and J and Taxiway No. 4 parallels the southern NAES property line in the eastern portion of the Area. Groundwater flow in Areas I and J is in a generally east to southeast direction toward the facility boundary.

Since the facilities in Areas I and J were constructed in 1958, they have been used for the testing of aircraft launching and recovery activities. Past releases of liquid wastes associated with these testing activities resulted in the contamination of groundwater at these Areas. Potential sources of groundwater contamination east of the catapult and taxiway include past releases of wastewater from the catapult test facility, past releases of liquid wastes at the catapult test facility storage area, past releases associated with testing of catapult equipment, and former launching/recovery activities on Taxiway No. 4. This contamination occurred during the 1960's and early 1970's. Potential sources of the contaminant plume south of the runway include past releases of wastewater from the RALS facility, former activities at the jet blast deflector site, and former runway launching/recovery activities.

Remedial investigations revealed the existence of an extensive groundwater contaminant plume in Areas I and J and downgradient off-base locations. The main contaminants of the plume are chlorinated VOCs. The chlorinated VOC groundwater contaminant plume in Areas I and J encompasses portions of Sites 3, 6, 7, 22, 24, 25, areas along Taxiway No. 4, the catapult and runway area, and the uninhabited off-base area to the east. The nearest residence is located more than 4000 feet past the downgradient edge of the plume.

Sediment and surface water samples were collected as part of the baseline sampling for this area once the extent of groundwater contamination had been delineated. Samples were taken at locations of potential discharge of contaminated groundwater near the periphery and downgradient extent of the chlorinated VOC plume. The results of VOC analysis of stream surface water samples revealed no significant impacts from Areas I and J. The only VOCs detected were acetone (a suspected laboratory contaminant) and toluene (1 ug/l). The source of toluene is not known, but this compound is not a component of the groundwater plume in Areas I and J and its presence is not believed to be attributable to NAES activities. The results of VOC analysis of sediment samples revealed minimal and localized impact from Areas I and J. VOC concentrations were detected in the North Ruckles Branch samples. The compounds detected were also present in monitoring wells located adjacent to the sediment sampling location. VOCs in other sediment samples were limited to suspected laboratory contaminants. The data from this sampling round indicated that the quality of stream surface water and sediment has not been significantly impacted by activities in Areas I and J. For additional details on this sampling refer to *Groundwater, Sediment, and Surface Water Sampling and Analyses – Areas I and J, Naval Air Warfare Center – Aircraft Division, Lakehurst, NJ, June 28, 1993 (Dames and Moore)*. Continued groundwater sampling indicates that elevated VOCs are not reaching downgradient surface water or wetlands in this Area.

Areas I and J contain a wide range of potential contaminant sources generally related to past facility activities and possible associated releases. The sources of groundwater contamination are believed to be the result of releases that occurred in the past and no longer exist. Other actions have addressed these potential sources, so that no further impact to groundwater is expected from them.

At Sites 3 and 6, located within Areas I and J, contaminated sediment was removed in June of 1993 for treatment via on site recycling. Post removal sampling indicated no evidence of any significant soil or sediment contamination remaining at Sites 3 and 6. No unacceptable risks to human health or the environment exist at these Sites. Therefore, no further action is necessary for Sites 3 and 6.

The ROD for contaminated sediment removal at Sites 3 and 6 is dated September 14, 1993. At Site 19, 35 cubic yards of contaminated soil was removed in March 1991. A no further action ROD for this site was issued in November 1991. No additional soil or sediment contamination has been identified which could have been a source of the groundwater contamination in Areas I and J. These sites are considered suitable for unlimited use and unrestricted exposure.

The results of environmental investigations conducted at Sites 7, 22, 23, 24, 25, and 40 located in Areas I and J, showed no evidence of any significant contamination. No unacceptable risks to human health or the environment exist at these Sites. No potential impact to groundwater exists at these Sites. A ROD for no further action at Sites 23 and 40 was issued by the Navy and EPA, with NJDEP concurrence, on September 16, 1991. A ROD for no further action at Sites 7, 22, 24, and 25 was issued by the Navy and EPA, with NJDEP concurrence, on September 14, 1993. These sites are considered suitable for unlimited use and unrestricted exposure.

Table 7 provides a summary of the volatile organic contaminants detected in Areas I and J groundwater above EPA and/or NJDEP standards.

6.2 AREAS I & J REMEDIAL ACTIONS

Areas I and J Groundwater

Based on the results of the RI, the Navy originally proposed a groundwater recovery, treatment and recharge system as the preferred remedial alternative. However, in 1993 and 1994, a Groundwater Modeling Study, Wetland Impact Study and Recharge Basin Study were conducted to select and design the optimum groundwater extraction scheme capable of remediating the aquifer, while minimizing the adverse impact on wetlands. The results of these studies indicated that the effects of pumping would be insignificant compared to the reduction of contaminants resulting from natural attenuation and that groundwater recovery could result in the loss of 87 acres of wetlands.

As a result of those studies, an interim ROD for Areas I and J groundwater designated natural attenuation as the preferred remedial alternative. This ROD was issued by the Navy and EPA, with NJDEP concurrence, on November 30, 1994. As part of the interim decision for Areas I and J groundwater, it was determined that NAES would evaluate the effects of natural restoration for a period of three years. If this study determined that natural restoration would be effective, this alternative would then become the final alternative for Areas I and J groundwater.

A three year study was conducted between 1996 and 1999 to verify the existence and evaluate the effectiveness of the natural attenuation process in degrading the VOC plume in Areas I and J and downgradient, off-base locations. The Natural Attenuation Study demonstrated that natural restoration processes, primarily in the form of intrinsic biodegradation, are active within the contaminant plume. Groundwater flow and contaminant transport modeling, conducted as part of the study, predicted that natural restoration would reduce all contaminant concentrations to meet ARARs in 44 years (2042). The study recommended that natural restoration be selected as the final alternative for the remediation of groundwater contamination in Areas I and J, and downgradient off-base locations. The 3 Year Groundwater Natural Restoration Study report for Areas I and J Groundwater, dated May 1999, is available in the Administrative Record for NAES.

The final ROD for Areas I and J groundwater was issued by the Navy and EPA, with NJDEP

concurrency, on August 30, 1999. The final alternative selected was natural restoration with long-term groundwater monitoring to address the groundwater contamination in and downgradient of Areas I and J and co-metabolism treatment to further reduce the higher area of groundwater contamination. Air sparging was included in the ROD as a contingency remedy. Co-metabolism is a process in which microorganisms growing on one compound produce an enzyme that chemically transforms another compound on which they cannot grow. The implementation of this alternative included monitoring of the aquifer for both contaminant levels and parameters indicative of natural restoration to check the progress of the contaminant reduction. Modeling was conducted to provide updated predictions of the time required to meet ARARs. If co-metabolism was not proven effective, an alternate technology would be chosen by the TRC to be demonstrated and, if proven effective, implemented to treat the higher area of groundwater contamination in Areas I and J.

The three-year natural restoration study conducted for Areas I and J groundwater established and documented the presence of natural attenuation processes. Based on these results, natural restoration was selected as the final alternative to address groundwater in these areas. The groundwater in Areas I and J and downgradient, off-base locations is monitored on a semi-annual basis. A five year progress report, including revised groundwater contaminant fate and transport modeling, was prepared in June 2004. This report supported the finding of the previous study and recommended that natural restoration should continue to reduce the concentrations and limit the migration of contaminants. The revised model predicted that groundwater would meet cleanup standards in 48 years (2052).

Co-metabolic Treatment Pilot Test – Areas I and J (July 1999)

A pilot test was conducted to demonstrate the effectiveness of co-metabolism for treating groundwater contamination in Areas I and J. The system installed at Areas I and J injected oxygen and co-substrates into the zone of groundwater contamination. The distribution and dilution of injected co-substrates was monitored through bi-weekly sampling of treatment area monitoring wells. The specifics of the co-metabolic biostimulation demonstration and associated monitoring can be found in the Technology Demonstration Work Plan dated May 25, 1999 which is available for review in the Administrative Record for NAES. The pilot demonstration began operation in July 1999. The expected duration of the pilot demonstration was fourteen months. This technology was determined to be ineffective at treating the groundwater in Areas I and J and the pilot testing was discontinued in July 2000.

Bimetallic Nanoscale Particle Treatment – Areas I and J (November 2003)

An Explanation of Significant Differences (ESD) dated September 8, 2003 was submitted to use bimetallic nanoscale particle (BNP) technology instead of air sparging because it was believed that the BNP technology was better suited for treatment of groundwater in this area. This innovative technology involves the injection of submicron particles of zero valent iron. Nanoscale particles rapidly and completely degrade chlorinated organic compounds. When applied to water and soil contaminated with chlorine based organic solvents the nanoscale particles remove the organic chlorine and convert the solvent to benign hydrocarbons and chloride anions.

Laboratory bench-scale testing of the nanoscale particle technology on groundwater obtained

from NAES was conducted in April 2001. The results of this testing indicated that the chlorinated compounds in groundwater at NAES, Areas I and J can be completely dechlorinated with the nanoscale iron particles. The results of the bench-scale testing can be found in the *Treatability Study of the Use of Bimetallic Nanoscale Particles for the Treatment of Contaminated Groundwater, Naval Air Engineering Station Site, Lakehurst, New Jersey*, dated June 2001.

Field testing of the nanoscale particle technology was conducted in February 2002 to demonstrate the effectiveness of nanoscale particles at treating the chlorinated organic compounds in groundwater at NAES, Areas I and J. The results of the field testing indicated that the nanoscale particles were effective at decreasing oxidation reduction potential (ORP) in area groundwater thus creating conditions favorable for the dechlorination of chlorinated hydrocarbons. Treatment of groundwater with nanoscale particles resulted in a reduction in chlorinated volatile or VOCs of 74% in the months following injection at the field test site. Two months after the completion of the pilot test, reducing conditions were still observed within the field test area indicating continued VOC reduction. Based upon the results of the Areas I and J Natural Restoration Study it has also been demonstrated that the half-life of the cVOCs are much shorter, and therefore, the biodegradation rates quicker, where anaerobic groundwater conditions are present. The reduction in the ORP observed in the field test would further reduce the cVOC half-life and enhance the natural restoration process. However, the extent of nanoscale particle migration within the aquifer was limited and, therefore, the applicability of this technology appears to be limited to source area treatment or a passive barrier type of treatment. The results of the field testing can be found in the *Pilot Test Report - Bimetallic Nanoscale Particles Treatment of Groundwater at Area I, Naval Air Engineering Station Site, Lakehurst, New Jersey*, dated June 2002.

Treatment of the higher areas of contamination in Areas I and J using the nanoscale particle technology was implemented in November 2003. The treatment consisted of the injection of nanoscale particles at ten locations upgradient of monitoring well LK in the northern plume and five locations in the vicinity of monitoring well LC. A geoprobe was used to pressure inject the nanoscale particles from approximately 50 to 70 feet below grade using a bottom-up injection procedure as was performed during the pilot test. Approximately 1200 gallons of 2.0 gram/L nanoscale particle slurry was injected at each location. The total mass of nanoscale particle to be injected (approximately 20 lbs. per location) was estimated based upon the results of the bench scale test. Sampling of selected area wells was conducted prior to the injection of the nanoscale particles and 1 week, 2 weeks, 4 weeks, 8 weeks, 12 weeks, and 6 months after injection. The results of the sampling indicated that the nanoscale particles were effective at decreasing VOC levels in groundwater. Treatment of groundwater with nanoscale particles resulted in an average reduction of 79% for TCE and 83% for DCE with an average decrease for total VOCs of 74%. The results of the November 2003 treatment can be found in the *Nanoscale Particle Treatment of Groundwater Report at Areas I and J, Naval Air Engineering Station Site, Lakehurst, New Jersey*, dated August 2004.

6.3 AREAS I & J PROGRESS SINCE LAST FIVE YEAR REVIEW

The last five year review for Areas I and J was submitted in June 2001. The recommendations for Areas I and J were continued monitoring of the natural restoration process and

implementation of groundwater treatment using bimetallic nanoscale particles.

Since the last five-year review treatment of groundwater has been conducted using bimetallic nanoscale particles. Levels of all contaminants, except for the breakdown product vinyl chloride, have decreased in this area. The highest level of VOCs ever detected in Areas I and J was 1740 ug/l in 1988. The highest VOC level detected over the past five years was 552 ug/l in 2005. A second round of treatment using bimetallic nanoscale particles was implemented in November 2005 to expand the area of treatment and more completely reduce the higher levels of groundwater contamination. The results of this treatment will be available in the spring of 2006.

6.4 AREAS I & J TECHNICAL ASSESSMENT

Is the Remedy Functioning as Intended by the Decision Documents?

The review of documents, ARARs, risk assumptions, and results of the site inspection indicates that the remedy is functioning as intended by the ROD. Bimetallic nanoscale particle treatment has reduced the higher levels of VOC contamination by an average of 79%. Natural restoration continues to reduce the remaining lower levels of contamination.

Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standards and To Be Considereds

The ARARs listed in the ROD for this area include EPA MCLs and NJDEP PQLs. The ARARs for the contaminants of concern at this area were compared to the current standards to determine if any had changed. The MCL was added for 1,2-dichloroethane. PQLs have been revised for 1,1-dichloroethene, 1,2-dichloroethene, methylene chloride and vinyl chloride. The MCL was revised for trans-1,2-dichloroethene. Table 7 has been updated to reflect the new values. Although the ARARs have changed, the remedy is still considered protective since ingestion of the groundwater pathway has been eliminated.

Changes in Exposure Pathways

A potential exposure pathway that has been introduced since the last five-year review is vapor intrusion. The EPA guidance for evaluating the vapor intrusion into indoor air was used to determine if the vapor intrusion exposure pathway poses a potential risk to human health at this area (See Appendix A). Based on the groundwater screening approach in the guidance, there are no currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near subsurface contaminants of concern. The contaminant plume is located downgradient of site buildings and is migrating toward uninhabited off-base property. Contaminants in Areas I and J groundwater exist from 40 to 70 feet below the groundwater table which would preclude the generation of vapors. The contaminated groundwater is covered by up to 40 feet of clean groundwater and it is this clean portion of the aquifer that prevents vapors from migrating upward and becoming a vapor intrusion problem.

At Areas I and J there is no potential for the vapor intrusion pathway to impact currently inhabited buildings or areas of concern under future development scenarios.

Changes in Toxicity

The EPA Integrated Risk Information System (IRIS) was reviewed to determine if revisions had been made to the factors used to calculate risk from ingestion of contaminated groundwater. The original risk calculations were conducted in 1992 as part of the RI EA. A comparison of the original reference dose values and the revised values are provided in Table 12.

The toxicity value for trichloroethene is currently being updated by the EPA. The oral and inhalation cancer slope factor for TCE proposed by EPA Region 2 is $4 \times 10^{-1} \text{ (mg/kg-day)}^{-1}$. This proposed risk number yields an allowable groundwater concentration of 0.715 ug/l and a vapor intrusion target groundwater concentration of 0.086 ug/l (See Appendix B for calculations). These values are much lower than the current PQL of 1 ug/l and cannot be reliably measured by standard laboratory testing methods.

A revised risk assessment is not required at this time since the use of groundwater at Areas I and J is restricted by an institutional control in the form of a CEA. The potential risk pathway of ingestion is not complete and, therefore, remediation to the PQL will be protective of human health.

Changes in Contaminant Characteristics

1,4-dioxane is a common stabilizer used with chlorinated solvents, most notably 1,1,1-trichloroethane (1,1,1-TCA). The 1,4-dioxane may be present at between 2 and 8% of the original 1,1,1-TCA solvent solution. 1,4-dioxane is miscible with water and is not retarded much in groundwater. It is normally at the front of any groundwater plume. Due to the historic nature of most spills at the base and the infrequent occurrence of 1,1,1-TCA, it is not expected that significant amounts are present. EPA and NJDEP do not currently have cleanup standards established for this compound.

The highest level of 1,1,1-TCA detected in Areas I and J over the past five years was 5.74 ug/l. Based on this level, it is not believed that 1,4-dioxane would be present at a level of concern in Areas I and J. Monitoring wells in Areas A and B, where 1,1,1-TCA is detected at the highest concentration, will be sampled initially to determine if this compound is present. If elevated levels are discovered, a workplan to expand sampling for this compound throughout Areas A and B as well as other areas on base would be prepared.

Has any other information come to light that could call into question the protectiveness of the remedy?

There is no other information that calls into question the protectiveness of the remedy.

Summary of Technical Assessment

Based on the technical assessment for Areas I and J, the remedy in place is protective of human health.

6.5 AREAS I & J ISSUES

At this time there are no issues identified that may impact the protectiveness of the remedy in place.

6.6 AREAS I&J RECOMMENDATIONS

Based on the results of the natural restoration study, natural restoration will be able to effectively reduce the groundwater contamination to meet applicable regulatory standards. Groundwater quality at 55 selected wells is monitored to determine the progress of natural restoration, verify the vertical and horizontal extent of the plume, monitor the migration of the plume, if any, and monitor the line of compliance. The frequency of natural restoration monitoring will initially be semi-annually (twice each year) and will be modified as deemed necessary by the Navy in consultation with the TRC to meet the objectives. The results of continued natural restoration and groundwater quality monitoring will be provided at regularly scheduled TRC meetings and in reports that are issued every year.

The line of compliance is a series of wells used to define the downgradient extent of the plume. It is required that ARARs be met at the downgradient line of compliance. If a sampling result from a line of compliance well exceeds ARARs, the well will be resampled. If the well continues to show levels above ARARs, a decision will be made by the Navy in consultation with the TRC to install additional wells or conduct other actions as deemed necessary to protect human health and the environment.

Pilot testing of co-metabolism for the treatment of chlorinated VOCs in Areas I and J groundwater was conducted from July 1999 to July 2000. It was determined that this technology was not capable of effectively reducing the contaminants present in Areas I and J groundwater.

Air sparging was not implemented as the contingency remedy because a new technology (bimetallic nanoscale particle (BNP) technology) emerged which is better suited for treatment of groundwater in Areas I and J.

Treatment of the higher VOC levels (> 50 ug/l) of groundwater contamination was conducted in November 2003 with positive results. An additional treatment using a higher amount of nanoscale particles to more completely treat the contaminants was implemented in November 2005.

The natural restoration remedy selected for this area remains protective of human health and the environment. The CEA established for Areas I and J groundwater will limit the use of impacted groundwater until standards are achieved. The nanoscale particle treatment discussed are being implemented to accelerate the remediation of the higher areas of contamination and thus reduce the time for the entire Area to meet ARARs.

The existing groundwater flow and contaminant transport model will be updated every 5 years, prior to the completion of the five-year reviews, to include additional groundwater quality data and updated natural restoration rates to provide a more accurate prediction of the contaminant reduction and time required to meet ARARs. The modeling results will be provided to the regulatory agencies and placed in the Administrative Record for NAES.

A CEA has been established for groundwater at Areas I&J. A CEA is required pursuant to the State's Ground Water Quality Standards, NJAC 7:9-6 whenever an approved remedy will not meet constituent standards for the term of the remediation. The establishment of a CEA is the

State's method institutional control to protect human health until standards are achieved.

As a military facility, NAES can control the land use at the facility. Impacted sites are used for industrial purposes.

Modification to current sampling frequency and analytical parameters may be made pending consultation with the TRC.

6.7 AREAS I&J PROTECTIVENESS STATEMENT

The implemented remedies for Areas I and J are protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

7.0 AREA K

7.1 AREA K BACKGROUND

Area K is located in the northwestern portion of NAES (Figure 7) and includes Sites 4 (deadload maintenance shop), 5 (arresting engine RSTS track 2), 8 (building 529, arresting end of track 1), 27 (RSTS scrap dump), and 30 (RSTS track 4). Area K encompasses the receiving end of the five Recovery Systems Test Sites (RSTS) test tracks. The tracks are generally surrounded by grass-covered and wooded areas. A wetland area is present in the north/northeast portion of Area K and the NAES property line forms the northern boundary of Area K.

The results of remedial investigations conducted at Area K have verified the presence of VOCs in groundwater. Reported or potential contaminant sources that may have contributed to the elevated levels of VOCs in Area K groundwater are summarized below:

Site 4 (Deadload Maintenance Shop) A solvent storage rack was located at this site, directly behind Building 372, the deadload maintenance shop, between the arresting ends of test tracks Nos. 2 and 3. Between 1958 and 1980, 55 gallon drums containing dry cleaning solvent and lubricating oil were stored at this site. Barrels reportedly leaked while in storage, creating a 10 foot by 20 foot black discoloration of the soil immediately below the rack. The total amount of leakage is unknown. In the early 1980s, a secondary containment was constructed for storage of hazardous material/waste. All stained soil was removed and replaced with clean fill.

Site 8 (Arresting End of RSTS Track No. 1) This site is located five feet northeast of Building 529 at the end of Track No. 1 and comprises a 5 foot by 5 foot area. Maintenance activities produced unknown wastes which were reportedly disposed of by pouring onto the ground next to Building 529. A small solvent storage facility was also located next to Building 529 which operated continuously between 1957 and 1981. Some leakage of containers reportedly occurred at this site. However, no visible signs of soil contamination were present during the 1981 site investigation. In 1981, a secondary containment facility was constructed for hazardous material/waste storage at this site.

Results of the ecological risk assessment indicated that chemical contaminant levels in Area K do not represent a health risk to any specified ecological receptor. Downgradient monitoring wells

in Area K located within the wetlands indicate that elevated levels of VOCs are not reaching downgradient surface water or wetland areas.

The results of previous investigations and removal actions at former Sites 4, 5, 8, 27 and 30 in Area K have documented the absence of any significant soil contamination posing a threat to human health or the environment. These sites are considered suitable for unlimited use and unrestricted exposure. A ROD for no further action was issued by the Navy and EPA, with NJDEP concurrence, on September 16, 1991.

Table 8 provides a summary of the volatile organic contaminants detected in Area K groundwater above EPA and/or NJDEP standards.

7.2 AREA K REMEDIAL ACTIONS

Final Remedial Action for Area K (September 1993)

The final ROD for Area K is dated May 7, 1997. To address low levels of VOCs in groundwater in Area K, the selected alternative was long-term monitoring with limited spray aeration treatment.

Sampling for VOCs is conducted semi-annually using the existing network of 24 monitoring wells in the area. A spray aeration system was installed at the end of Track 1 (well KI) and between Test Tracks 2 and 3 (well KE) to pump and aerate the groundwater containing the highest levels of contaminants. Spraying only occurs in temperate months of the year to prevent freezing and aid in the volatilization of contaminants.

The results of the environmental investigations conducted show no evidence of significant contamination at Area K. However, groundwater monitoring has been implemented to ensure continued compliance with groundwater standards and monitor the risk to human health and the environment.

Area K groundwater is sampled semi-annually and the results are presented to the regulatory agencies at TRC meetings.

7.3 AREA K PROGRESS SINCE LAST FIVE YEAR REVIEW

The last five year review for Area K was submitted in June 2001. The recommendation for Area K was continued groundwater monitoring.

Since the last five-year review levels of most contaminants have decreased in this area. Wells GY, KE and KH historically have had the highest total VOC levels. The VOC levels in these wells have reduced significantly from a high of 110 ug/l in 1998 to a range of 2 to 14 ug/l in 2004 and 2005.

7.4 AREA K TECHNICAL ASSESSMENT

Is the Remedy Functioning as Intended by the Decision Documents?

The review of documents, ARARs, risk assumptions, and results of the site inspection indicates that the remedy is functioning as intended by the ROD. Groundwater monitoring continues to

show that the extent of groundwater contamination is limited and that the levels are reducing over time.

Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Changes in Standards and To Be Considereds

The ARARs listed in the ROD for this area include EPA MCLs and NJDEP PQLs. The ARARs for the contaminants of concern at this area were compared to the current standards to determine if any had changed. The MCL was added for 1,2-dichloroethane. The MCL was revised for chloroform. PQLs have been revised for toluene, cis-1,2-dichloroethene, 1,3-dichloropropane and vinyl chloride. Table 8 has been updated to reflect the new values. Although the ARARs have changed, the remedy is still considered protective since ingestion of the groundwater pathway has been eliminated.

Changes in Exposure Pathways

A potential exposure pathway that has been introduced since the last five-year review is vapor intrusion. The EPA guidance for evaluating the vapor intrusion into indoor air was used to determine if the vapor intrusion exposure pathway poses a potential risk to human health at this area (See Appendix A). Based on the groundwater screening approach in the guidance, building 372 is inhabited, with a total of less than 10 employees, and located in the vicinity of the subsurface contamination and the levels of tetrachloroethene, trichloroethene, and vinyl chloride exceeded the target media-specific concentrations (see Table 11). Therefore, collection of additional data is required at Area K to evaluate the completeness of the vapor intrusion pathway.

Building 372 is a 80 ft. by 40 ft. pre-engineered metal building that is used as a workshop for test track operations. Workers occupy this building from 8 to 10 hours per day. Depth to groundwater is approximately 4 ft. near this building.

Changes in Toxicity

The EPA Integrated Risk Information System (IRIS) was reviewed to determine if revisions had been made to the factors used to calculate risk from ingestion of contaminated groundwater. The original risk calculations were conducted in 1992 as part of the RI EA. A comparison of the original reference dose values and the revised values are provided in Table 12.

The toxicity value for trichloroethene is currently being updated by the EPA. The oral and inhalation cancer slope factor for TCE proposed by EPA Region 2 is $4 \times 10^{-1} \text{ (mg/kg-day)}^{-1}$. This proposed risk number yields an allowable groundwater concentration of 0.715 ug/l and a vapor intrusion target groundwater concentration of 0.086 ug/l (See Appendix B for calculations).

These values are much lower than the current PQL of 1 ug/l and cannot be reliably measured by standard laboratory testing methods.

A revised risk assessment is not required at this time since the use of groundwater at Area K is restricted by an institutional control in the form of a CEA. The potential risk pathway of ingestion is not complete and, therefore, remediation to the PQL will be protective of human

health.

Changes in Contaminant Characteristics

1,4-dioxane is a common stabilizer used with chlorinated solvents, most notably 1,1,1-trichloroethane (1,1,1-TCA). The 1,4-dioxane may be present at between 2 and 8% of the original 1,1,1-TCA solvent solution. 1,4-dioxane is miscible with water and is not retarded much in groundwater. It is normally at the front of any groundwater plume. Due to the historic nature of most spills at the base and the infrequent occurrence of 1,1,1-TCA, it is not expected that significant amounts are present. EPA and NJDEP do not currently have cleanup standards established for this compound.

The highest level of 1,1,1-TCA detected in Area K over the past five years was 1.05 ug/l. Based on this level, it is not believed that 1,4-dioxane would be present at a level of concern in Area K. Monitoring wells in Areas A and B, where 1,1,1-TCA is detected at the highest concentration, will be sampled initially to determine if this compound is present. If elevated levels are discovered, a workplan to expand sampling for this compound throughout Areas A and B as well as other areas on base would be prepared.

Has any other information come to light that could call into question the protectiveness of the remedy?

Based on the technical assessment for Area K, the remedy in place is protective of human health.

7.5 AREA K ISSUES

Collection of additional data is required at Area K to evaluate the completeness of the vapor intrusion pathway. At this time there are no other issues identified that may impact the protectiveness of the remedy in place.

7.6 AREA K RECOMMENDATIONS

Based on the semi-annual groundwater monitoring results, it appears that groundwater contaminant levels are reducing naturally over time. Total VOC concentrations in excess of 110 ug/l were detected in Area K groundwater samples collected in 1988. During the most recent sampling conducted in February 2005 the highest total VOC levels detected in Area groundwater were 13.7 ug/l.

The Navy believes that continued monitoring will be capable of protecting human health and the environment. Groundwater monitoring will be conducted to monitor the concentration and migration of groundwater contamination.

Due to the relatively low rates of pumping (5 gpm), the spray irrigation systems in Area K has a limited impact on contaminant reduction. It is recommended that these systems continue to operate to treat the higher levels of groundwater contamination in Area K.

A workplan shall be prepared to propose additional sampling required by EPA guidance to confirm or deny a vapor intrusion problem at Area K.



A CEA has been established for groundwater at Area K. A CEA is required pursuant to the State's Ground Water Quality Standards, NJAC 7:9-6 whenever an approved remedy will not meet constituent standards for the term of the remediation. The establishment of a CEA is the State's method institutional control to protect human health until standards are achieved.

As a military facility, NAES can control the land use at the facility. Impacted sites are used for industrial purposes.

Modification to current sampling frequency and analytical parameters may be made pending consultation with the TRC.

7.7 AREAS K PROTECTIVENESS STATEMENT

The remedy for Area K is protective of human health and the environment.

8.0 STATEMENT OF PROTECTIVENESS

I certify that the implemented remedial actions at Areas A&B, C, D, H, I&J, and K are protective of human health and the environment. There are no exposure pathways that could result in unacceptable risks and none are expected as long as the site use remains unchanged and the engineered, access and institutional controls, currently in place, continue to be properly operated, monitored and maintained.



L. B. Gordon

Commanding Officer
Naval Air Engineering Station
Lakehurst, NJ

9.0 NEXT FIVE-YEAR REVIEW

The next five-year review will be conducted by September 21, 2011.



List of Acronyms

ARARs - Applicable or Relevant and Appropriate Requirements
BTEX – benzene, toluene, ethylbenzene, and xylenes
CEA – Classification Exception Area
CERCLA – Comprehensive Environmental Response, Compensation and Liability Act
EA – Endangerment Assessment
EPA - Environmental Protection Agency
ESD - Explanation of Significant Differences
MCL – Maximum Contaminant Level
NAES – Naval Air Engineering Station
NATTC – Naval Air Technical Training Center
NCP – National Contingency Plan
NJAC – New Jersey Administrative Code
NOAA – National Oceanic and Atmospheric Administration
PQL – Practical Quantitation Level
RALS – Runway Arrested Landing Site
RI – Remedial Investigation
ROD – Record of Decision
TPHC – Total Petroleum Hydrocarbons
TRC – Technical Review Committee
VOC – Volatile Organic Compound

Table 1
NAES Lakehurst
Soil and Sediment Cleanup Status

Site #	Area	OU	Site Name	ROD Date RA Report Date (where appropriate) ESD Date (where appropriate)	NJDEP Residential Soil Cleanup Criteria Met?	Operation & Maintenance (O&M) Monitoring (T) Institutional Controls (ICs)	Subject to Five Year Review	Soil and Sediment Cleanup Status
1	G	8	Blimp Crash Site	ROD: No Further Action, June 21, 1993.	Yes	NA	No	Prior to August 1992, 337 cubic yards of contaminated soil was removed.
2	H	9	Experimental Site at RSTS Track 2	ROD: No Further Action, June 21, 1993.	Yes	NA	No	In 1981, 200 cubic yards of oil-stained soil was removed.
3	J	13	Drainage Ditch at Runway Arrested Landing Site	ROD: Excavation with on-site recycling, September 27, 1993 RA Report: June 22, 1995	NA	NA	No	Contaminated sediment was removed from the drainage swale in 1993. The swale continues to receive permitted industrial discharge. If land use changes, additional sampling of swales would be required.
4	K	24	Deadload Maintenance Shop, Arresting End of Track 2	ROD: Spray aeration and long-term groundwater monitoring, July 7, 1997. (covered under Area K)	Yes	NA	No	Stained soil was removed in the early 1980's and replaced with clean fill.
5	K	7	Arresting Engine RSTS Track 2 Building 371	ROD: No Further Action, January 3, 1992.	Yes	NA	No	In March 1991, 19 cubic yards of contaminated soil were removed.
6	I	13	Catapult Test Facility	ROD: Excavation with on-site recycling, September 27, 1993 RA Report: June 22, 1995	NA	NA	No	Contaminated sediment was removed from the drainage swale in 1993. The swale continues to receive permitted industrial discharge. If land use changes, additional sampling of swales would be required.
7	I	12	Catapult Test Facility Storage Area	ROD: No Further Action, September 27, 1993.	Yes	NA	No	No significant soil contamination found.

Site #	Area	OU	Site Name	ROD Date RA Report Date (where appropriate) ESD Date (where appropriate)	NJDEP Residential Soil Cleanup Criteria Met?	Operation & Maintenance (O&M) Monitoring (T) Institutional Controls (ICs)	Subject to Five Year Review	Soil and Sediment Cleanup Status
8	K	24	Building 529, Arresting End of Track 1	ROD: Spray aeration and long-term groundwater monitoring, July 7, 1997. (covered under Area K)-	Yes	NA	No	No significant soil contamination found
9	B	10	Hangar 2 Disposal Area	ROD: No Further Action, September 27, 1993.	Yes	NA	No	No significant soil contamination found
10	C	18	MOGAS Station	ROD: No Further Action, February 20, 1996. ESD: May 24, 2002	Yes	NA	No	No significant soil contamination found
11	C	8	Hangar 5 Storage Area	ROD: No Further Action, June 21, 1993.	Yes	NA	No	Prior to 1992, 431 cubic yards of contaminated soil were removed.
12	A west	10	Abandoned Fuel Storage Facility 141	ROD: No Further Action, September 27, 1993.	Yes	NA	No	
13	B	23	Former Fuel Farm No. 125	ROD: Vapor Extraction, September 27, 1993 RA Report: November 22, 1996	No	O&M T	Yes	Ongoing sparge/soil vapor extraction system
14	A	11	Old Fire Fighting School	ROD: Excavation and On-Site Recycling, September 27, 1993. RA Report: June 22, 1995	Yes	NA	No	Sediment contamination was studied and found to not have an adverse ecological impact. Soil from burn pads removed in 1993.
15	B	3	Disposal Area Near Building 562 Parking Lot	ROD: No Further Action, September 30, 1991	Yes	NA	No	No soil or groundwater contamination found at the site.
16	C	18	NATTC Fire Fighting Training Area	ROD: Continued operation of the bioventing system with modifications to enhance system performance. (covered under Area C), February 20, 1996 ESD: May 24, 2002	No	O&M T	Yes	In August 1994, soil removed from fire fighting lagoons and burn pads.

Site #	Area	OU	Site Name	ROD Date RA Report Date (where appropriate) ESD Date (where appropriate)	NJDEP Residenti al Soil Cleanup Criteria Met?	Operation & Maintenance (O&M) Monitoring (T) Institutional Controls (ICs)	Subject to Five Year Review	Soil and Sediment Cleanup Status
17	C	18	Fuel Farm 196	ROD: Continued operation of the soil vapor extraction and bioventing systems with modifications to enhance system performance. (covered under Area C), February 20, 1996. ESD: May 24, 2002	No	O&M T	Yes	Underground storage tanks abandoned in accordance with regulations.
18	A west	3	Naval Exchange Gas Station	ROD: No Further Action, September 30, 1991.	Yes	NA	No	Dry well removed in 1985.
19	J	7	Sats Catapult (7401 Test Site)	ROD: No Further Action, January 3, 1992.	Yes	NA	No	In March 1991, 35 cubic yards of soil were removed.
20	G	22	Tetraethyl Lead Disposal Site	ROD: No Further Action, September 27, 1993.	Yes	NA	No	May 14, 1992 soil excavation revealed no significant contamination.
21	H	7	Jet Car Maintenance Shop	ROD: No Further Action, January 3, 1992.	Yes	NA	No	In March 1991, 22 cubic yards of contaminated soil were removed.
22	J	12	Jet Blast Deflector	ROD: No Further Action, September 27, 1993.	Yes	NA	No	No significant soil contamination detected.
23	I	3	Inactive Disposal Area at Building 524	ROD: No Further Action, September 30, 1991.	Yes	NA	No	In 1981, an unknown quantity of soil was removed. No contamination was detected in soil or groundwater samples collected from the site.
24	I	12	Catapult Test Site 7419	ROD: No Further Action, September 27, 1993.	Yes	NA	No	No significant soil contamination detected.
25	I	12	Test Department Disposal Area	ROD: No Further Action, September 27, 1993.	Yes	NA	No	No significant soil contamination detected.
26	A	3	Contractor Disposal Area North of Building 337	ROD: No Further Action, September 30, 1991.	Yes	NA	No	No significant soil contamination detected.

Site #	Area	OU	Site Name	ROD Date RA Report Date (where appropriate) ESD Date (where appropriate)	NJDEP Residential Soil Cleanup Criteria Met?	Operation & Maintenance (O&M) Monitoring (T) Institutional Controls (ICs)	Subject to Five Year Review	Soil and Sediment Cleanup Status
27	K	3	Recovery Systems Test Sites (RSTS Scrap Dump)	ROD: No Further Action, September 30, 1991.	Yes	NA	No	No significant soil contamination detected.
28	E	4	Westfield Hangar Area	ROD: Vapor extraction/sparge added to accelerate existing groundwater treatment system, July 7, 1997. Interim RA Report: July 29, 1994. Final RA Report: September 15, 2005.	Yes*	NA	No	Between August 9-13, 1990, contaminated soil was removed.
29	A	17	Original Base Landfill	ROD: No Further Action, September 26, 1994.	Yes	NA	No	Drums and contaminated soil were removed in 1993. As a former landfill, the Navy may impose a deed restriction.
30	K	3	Recovery Systems Sites Track 4 Recovery End	ROD: No Further Action, September 30, 1991.	Yes	NA	No	Contaminated soil was removed prior to 1985.
31	D	15	Former Sanitary Landfill	ROD: No Further Action with groundwater monitoring, September 27, 1993. (covered under Area D)	?	O&M T ICs	Yes	No soil sampling has been conducted. The landfill was capped and closed in 1980. As a former landfill, a deed restriction for this area would be required. A classification exception area (CEA) has been established for this site.

Site #	Area	OU	Site Name	ROD Date RA Report Date (where appropriate) ESD Date (where appropriate)	NJDEP Residenti al Soil Cleanup Criteria Met?	Operation & Maintenance (O&M) Monitoring (T) Institutional Controls (ICs)	Subject to Five Year Review	Soil and Sediment Cleanup Status
32	H	14	Launch End of the Test Tracks	ROD: Asphalt Batch Recycling/Off-Site Disposal, September 27, 1993. RA Report: June 22, 1995.	No	NA	Yes	An UST, various dry-wells and contaminated soil were removed prior to 1994. The presence of fuel product in the vadose zone and the site's continued use as a test facility would require the site to undergo additional investigation if land use were to change.
33	A	10	Refueler Repair Shop, Building 345	ROD: No Further Action, September 27, 1993.	Yes	NA	No	A dry well was removed in 1989.
34	G	3	Parachute Jump Circle	ROD: No Further Action, September 30, 1991.	Yes	NA	No	No significant soil contamination was found.
35	E	8	Helicopter Defueling Area	ROD: No Further Action, June 21, 1993.	Yes	NA	No	Contaminated soil removed in 1992.
36	B	10	Former Hangar 1 Liquid Waste Disposal Area	ROD: No Further Action, September 27, 1993.	Yes	NA	No	No significant soil contamination found.
37	A	10	Former Fuel Disposal and Drum Storage Area	ROD: No Further Action, September 27, 1993.	Yes	NA	No	No significant soil contamination found.
38	F	9	Oil Skimming and Sewage Disposal Area	ROD: No Further Action, June 21, 1993.	Yes	NA	No	No significant soil contamination found.
39	B	10	Petroleum Oils and Lubricants Disposal Site	ROD: No Further Action, September 27, 1993.	Yes	NA	No	No significant soil contamination found.
40	J	3	Soil Stabilization Field Test Site	ROD: No Further Action, September 30, 1991.	Yes	NA	No	No significant soil contamination found.
41	NA	25	Ordnance Impact Area	Site was removed from CERCLA program by EPA on January 14, 1997. ROD: NA	Not applicable	NA	No	No chemical contamination found in soil. Presence of unexploded ordnance would require a deed restriction for the affected area.

Site #	Area	OU	Site Name	ROD Date RA Report Date (where appropriate) ESD Date (where appropriate)	NJDEP Residential Soil Cleanup Criteria Met?	Operation & Maintenance (O&M) Monitoring (T) Institutional Controls (ICs)	Subject to Five Year Review	Soil and Sediment Cleanup Status
42	A west	10	Former Base Landfill	ROD: No Further Action, September 27, 1993.	Yes	NA	No	No significant soil contamination found.
43	NA.	NA	Advanced Underwater Warfare Storage Building, 343	Building is suitable for unrestricted use. (See EPA letter of September 16, 1985) ROD: NA	Not applicable	NA	No	Building 343 was investigated and found to need no further action prior to the RI/FS. Building survey did not find a radiological hazard.
44	A	6	PCB Storage and Test Areas	ROD: No Further Action, December 31, 1991.	Yes	NA	No	In the spring of 1991, 13 cubic yards of PCB contaminated soil were removed and disposed. Area is suitable for unrestricted use.
45	L	3	Area adjacent to Air Force BOMARC Site	ROD: No Further Action, September 30, 1991.	Yes	NA	No	Sediment sampling revealed no significant contamination.

* Soil sampling conducted on November 20, 1995 indicated NJDEP residential soil cleanup criteria met.

Table 2
NAES Lakehurst
Groundwater Cleanup Status

Area	OU	ROD Date RA Report date (where appropriate) ESD Date (where appropriate)	Operation & Maintenance (O&M) Monitoring (T) Institutional Controls (ICs)	Subject to Five Year Review	Groundwater Cleanup Status
A&B	21	ROD: Continued operation of the existing groundwater treatment facility with modifications to enhance system performance, July 7, 1997. Interim RA Report: November 25, 1994 ESD: May 24, 2002 ESD: September 30, 2003	O&M T ICs	Yes	In September 1998, a sparge wall was installed at Site 29 and in May 2003, a sparge/vapor extraction system was installed at Site 13 to accelerate remediation of groundwater contamination.
C	18	ROD: Continued operation of the existing groundwater treatment facility with modifications to enhance system performance, February 20, 1996. Interim RA Report: April 15, 1992 ESD: May 24, 2002	O&M T ICs	Yes	In August 1995, a sparge system was installed at Site 16 to accelerate remediation of groundwater contamination.
D	15	ROD: Groundwater Monitoring, September 27, 1993	O&M T ICs	Yes	
E	20	ROD: Continued operation of the existing groundwater treatment facility with addition of vapor extraction/sparge, July 7, 1997. Final RA Report: September 15, 2005	NA	No	On October 18, 1998, the groundwater recovery and treatment system was shut down. The vapor extraction/sparge system was shut down on June 19, 2001
F	9	ROD: No Further Action, June 21, 1993.	NA	No	
G	8	ROD: A 5-year program to monitor the status of groundwater quality, June 21, 1993.	NA	No	All objectives of the final workplan for groundwater monitoring, dated January 5, 1994 have been achieved.
H	19	ROD: Continued operation of the existing groundwater treatment facility with modifications to enhance system performance, February 20, 1996. Interim RA Report: May 23, 1993 ESD: May 24, 2002	O&M T ICs	Yes	

Area		ROD Date RA Report date (where appropriate) ESD Date (where appropriate)	Operation & Maintenance (O&M) Monitoring (T) Institutional Controls (ICs)	Subject to Five Year Review	Groundwater Cleanup Status
I&J	26	ROD: Natural restoration, groundwater monitoring and co-metabolism, September 27, 1999. Interim RA Report: September 15, 2005 ESD: September 30, 2003	O&M T ICs	Yes	
K	24	ROD: Spray aeration and continued long-term groundwater monitoring, July 7, 1997.	O&M T ICs	Yes	
L	3	ROD: No Further Action, September 30, 1991.	NA	No	

Table 3
Areas A and B
Volatile Organic Compounds Which Exceeded EPA MCLs and/or NJDEP PQLs

Contaminant	Highest Levels Detected Prior to 2001 (ug/l)	Highest Levels Detected During Last 5 Years (2001 – 2005) (ug/l)	EPA MCL (ug/l)	NJDEP PQL (ug/l)
Benzene	380	240	5	1
Toluene	2000	1000	1000	1
Ethylbenzene	190	230	700	2
Xylene (total)	580	990	10,000	2
Carbon Tetrachloride	6.7	ND	5	1
Dibromochloromethane	8	0.44	-	1
1,2-Dichloroethane	180	3	5	2
1,1-Dichloroethene	23	2.9	7	1
1,2-Dichloroethene	2400	120	70	1
1,2-Dichloropropane	2	ND	-	1
Tetrachloroethene	720	250	5	1
1,1,1-Trichloroethane	170	9.7	200	1
Trichloroethene	253	96	5	1
Vinyl Chloride	2000	2.5	2	1

MCL - Maximum Contaminant Levels

PQL - Practical Quantitation Levels

ND - not detected

Table 4
Area C
Volatile Organic Compounds Which Exceeded EPA MCLs and/or NJDEP PQLs

Contaminant	Highest Levels Detected Prior to 2001 (ug/l)	Highest Levels Detected During Last 5 Years (2001 – 2005) (ug/l)	EPA MCL (ug/l)	NJDEP PQL (ug/l)
Benzene	410	66	5	1
Toluene	2200	130	1000	1
Ethylbenzene	1200	1200	700	2
Xylene (total)	5100	3370	10,000	2
Chlorobenzene	14	ND	100	1
1,1-Dichloroethene	21	ND	7	1
1,2-Dichloroethene	300	67	70	1
Tetrachloroethene	88	480	5	1
1,1,1-Trichloroethane	50	8.4	200	1
Trichloroethene	39	39	5	1
Vinyl Chloride	8.8	7.7	2	1

MCL - Maximum Contaminant Levels

PQL - Practical Quantitation Levels

ND - not detected

Table 5
Area D
Volatile Organic Compounds Which Exceeded EPA MCLs and/or NJDEP PQLs

Contaminant	Highest Levels Detected Prior to 2001 (ug/l)	Highest Levels Detected During Last 5 Years (2001 - 2005) (ug/l)	EPA MCL (ug/l)	NJDEP PQL (ug/l)
Benzene	1.87	1.07	5	1
o-Xylene	2.99	2.39	10,000	1
p,m-Xylene	5.98	ND	10,000	2
Chloroform	2.14	0.613	-	1
Chlorobenzene	53.6	24.4	100	1
1,2-Dichlorobenzene	15	12.2	600	5
1,3-Dichlorobenzene	11	3.12	600	5
1,4-Dichlorobenzene	59.3	24.3	75	5
1,2-Dichloroethane	2.18	ND	5	2
Cis-1,2- Dichloroethene	25	5.07	70	1
1,2,4-Trichlorobenzene	23.3	42	70	1
Trichloroethene	1.6	5.07	5	1
Vinyl Chloride	17.84	9.04	2	1

MCL - Maximum Contaminant Levels

PQL - Practical Quantitation Levels

ND - not detected

Table 6
Area H
Volatile Organic Compounds Which Exceeded EPA MCLs and/or NJDEP PQLs

Contaminant	Highest Levels Detected Prior to 2001 (ug/l)	Highest Levels Detected During Last 5 Years (2001 - 2005) (ug/l)	EPA MCL (ug/l)	NJDEP PQL (ug/l)
Benzene	150	7.7	5	1
Toluene	600	2.2	1000	1
Ethylbenzene	1200	130	700	2
Xylene (total)	6300	480	10,000	2.(m&p) 1.(o)
2-Butanone (MEK)	1100	ND	-	2
1,2-Dichloroethene	167	31	70	1
Styrene	57	ND	100	2
Tetrachloroethene	4.5	3	5	1
1,1,1-Trichloroethane	1.94	6.8	200	1
Trichloroethene	2.02	4	5	1

MCL - Maximum Contaminant Levels

PQL - Practical Quantitation Levels

ND - not detected

Table 7
Areas I and J
Volatile Organic Compounds Which Exceeded EPA MCLs and/or NJDEP PQLs

Contaminant	Highest Levels Detected Prior to 2001 (ug/l)	Highest Levels Detected During Last 5 Years (2001 – 2005) (ug/l)	EPA MCL (ug/l)	NJDEP PQL (ug/l)
Benzene	1.32	ND	5	1
Bromodichloromethane	1.32	ND	-	1
Bromoform	3.6	ND	-	0.8
Chlorodibromomethane	1.75	ND	-	1
Chloroform	2.9	0.7	100	1
1,2-dichloroethane	3.02	0.4	5	2
1,1-dichloroethene	12.3	2.1	7	1
cis-1,2-dichloroethene	579	351	70	1
trans-1,2-dichloroethene	8.57	2.4	100	1
methylene chloride	278.4	6.79	5	1
1,1,2,2-tetrachloroethane	2.01	ND	-	1
Tetrachloroethene	233	54	5	1
1,1,1-trichloroethane	139	5.74	200	1
Trichloroethene	291	93.5	5	1
Vinyl Chloride	30.98	38.4	2	1

MCL - Maximum Contaminant Levels

PQL - Practical Quantitation Levels

ND - not detected

Table 8
Area K
Volatile Organic Compounds Which Exceeded EPA MCLs and/or NJDEP PQLs

Contaminant Of Concern	Highest Levels Detected at Area K (ug/l)	Highest Levels Detected During Last 5 Years (2001 - 2005) (ug/l)	EPA MCL (ug/l)	NJDEP PQL (ug/l)
Benzene	1.65	ND	5	1
Toluene	6.34	ND	1000	1
o-Xylene	8.45	ND	10,000	1
p,m-Xylene	3.72	ND	10,000	2
Chloroform	3.15	1.05	-	1
Dibromochloroethane	2	ND	-	1
1,2-Dichloroethane	48	ND	5	2
Cis-1,2-Dichloroethene	13.05	13.4	70	1
1,3-Dichloropropane	12.9	ND	-	1
Tetrachloroethene	40.1	10.2	5	1
1,1,1-Trichloroethane	7	1.05	200	1
Trichloroethene	29.4	19.2	5	1
Vinyl Chloride	110	11.6	2	1

MCL - Maximum Contaminant Levels

PQL - Practical Quantitation Levels

ND - not detected

Primary Maximum Contaminant Levels (MCLs) are Federally enforceable contaminant levels allowable in public drinking water supplies. They have been established from health-based data by EPA's Office of Drinking Water Regulations (40 CFR 141) established under the authority of the Safe Drinking Water Act. MCLs are periodically revised as more information becomes available. When MCLs are not available, proposed MCLs were used as the comparison criteria for some analytes.

On January 13, 1993, the revised N.J.A.C. 7:9-6 which includes the Groundwater Quality Criteria was signed. The criteria establish the groundwater classifications for the Pinelands, including Class I-PL (Preservation Area) and Class I-PL (Protection Area). The actual groundwater criteria are the natural quality and background quality, respectively (N.J.A.C. 7:9-6.7). However, for some constituents natural quality is often much lower than can be measured in a laboratory, therefore, some measurable criteria are necessary to determine compliance. Practical Quantitation Levels (PQLs) are the lowest concentration of a constituent that can be reliably achieved among laboratories within specified limits of precision and accuracy during routine laboratory operating conditions. PQLs will be used to determine compliance with groundwater quality criteria for Class I-PL groundwater

Table 9
Areas A and B
Vapor Intrusion Groundwater Assessment

Contaminant	Highest Levels Detected During Last 5 Years (2001 – 2005) (ug/l)			Target Groundwater Concentration Risk = 10 ⁻⁶ (ug/l)	Target Groundwater Concentration Risk = 10 ⁻⁴ (ug/l)
	Area A-east	Area A-west	Area B		
Benzene	2.1	1.6	240	5	140
Toluene	0.73	3.5	1000	1500	1500
Ethylbenzene	1.4	0.22	230	700	700
Xylene (total)	4.2	2.3	990	22,000	22,000
1,2-Dichloroethane	0.28	-	3.0	5	230
1,1-Dichloroethene	-	-	2.9	190	190
1,2-Dichloroethene	120	13	4.8	210	210
Tetrachloroethene	0.5	250	2.3	5	110
1,1,1-Trichloroethane	6.2	0.38	9.7	3100	3100
Trichloroethene	81	9.4	96	5	5.3
Vinyl Chloride	2.5	1.4	0.44	2	2.5

Table 10
Area H
Vapor Intrusion Groundwater Assessment

Contaminant	Highest Levels Detected During Last 5 Years (2001 – 2005) (ug/l)	Target Groundwater Concentration Risk = 10 ⁻⁶ (ug/l)	Target Groundwater Concentration Risk = 10 ⁻⁴ (ug/l)
Benzene	7.7	5	140
Toluene	2.2	1500	1500
Ethylbenzene	130	700	700
Xylene (total)	480	22,000	22,000
1,2-Dichloroethene	31	210	210
Tetrachloroethene	3	5	110
1,1,1-Trichloroethane	6.8	3100	3100
Trichloroethene	4	5	5.3

Table 11
Area K
Vapor Intrusion Groundwater Assessment

Contaminant Of Concern	Highest Levels Detected During Last 5 Years (2001 - 2005) (ug/l)	Target Groundwater Concentration Risk = 10 ⁻⁶ (ug/l)	Target Groundwater Concentration Risk = 10 ⁻⁴ (ug/l)
Chloroform	1.05	80	80
Cis-1,2-Dichloroethene	13.4	210	210
Tetrachloroethene	10.2	5	110
1,1,1-Trichloroethane	1.05	3100	3100
Trichloroethene	19.2	5	5.3
Vinyl Chloride	11.6	2	25

Table 12
Updated Oral Exposure Reference Dose and Slope Factors for Contaminants of Concern

Contaminant Of Concern	Reference Dose used in Original 1992 Risk Calculations (mg/kg-day)	Revised Reference Dose From 2005 EPA IRIS Web Site (mg/kg-day)	Year of Revision	Oral Exposure Slope Factor used in Original 1992 Risk Calculations (mg/kg-day) ⁻¹	Revised Oral Exposure Slope Factor From 2005 EPA IRIS Web Site (mg/kg-day) ⁻¹
Benzene	NA	4x10 ⁻³	2003	2.9x10 ⁻²	1.5x10 ⁻²
Toluene	2x10 ⁻¹	8x10 ⁻²	2005	NA	NE
Ethylbenzene	1x10 ⁻¹	1x10 ⁻¹	1991	NA	NE
Xylene (total)	2	2x10 ⁻¹	2003	NA	NE
2-Butanone (MEK)	5x10 ⁻²	6x10 ⁻¹	2003	NA	NE
Chlorobenzene	NE	2x10 ⁻²	1993	NE	NE
Chloroform	NE	1x10 ⁻²	2001	NE	NA
Dibromochloromethane	NE	2x10 ⁻²	1991	NE	6.2x10 ⁻²
1,2-Dichlorobenzene	NE	9x10 ⁻²	1991	NE	NE
1,3-Dichlorobenzene	NE	NA	-	NE	NE
1,4-Dichlorobenzene	NE	NA	-	NE	NE
Methylene Chloride	NE	9x10 ⁻²	2001	NE	NA
1,2-Dichloroethane	NA	9x10 ⁻²	1991	9.1x10 ⁻²	9.1x10 ⁻²
1,1-Dichloroethene	9x10 ⁻³	5x10 ⁻²	2002	6x10 ⁻¹	NA
1,2-Dichloroethene	1x10 ⁻²	NA	-	NA	NE
1,2-Dichloropropane	NE	NA	1991	NE	NE
Tetrachloroethene	1x10 ⁻²	1x10 ⁻²	1988	5.2x10 ⁻²	NE
1,1,1-Trichloroethane	9x10 ⁻²	NA	-	NA	NE
Trichloroethene	NA	NA	-	1.1x10 ⁻²	NE
Vinyl Chloride	NA	3x10 ⁻³	2000	1.9	1.5

NA – Not Available

NE – Not Evaluated

Table 13

Recommendations and Follow-up Actions

Recommendation	Action	Milestone dates	Responsible party
1. Sample area groundwater for 1,4-dioxane	Determine number and location of wells to sample and level of laboratory deliverable required.	January 07	TRC
	Obtain funding and task contractor to samples wells for 1,4-dioxane.	April 07	NAES
2. Install additional sparge and vapor extract points at Site 13	Obtain funding, prepare and award specification.	August 06	NAES
	Install new sparge and vapor extract points and connect to existing treatment system.	November 06	Puente Construction
3. Install additional recovery well in Area B	Obtain funding, prepare and award specification.	August 06	NAES
	Install new recovery well and connect to existing groundwater treatment system.	November 06	Puente Construction
4. Install additional sparge points at Site 17.	Obtain funding, prepare and award specification.	August 06	NAES
	Install new sparge points and associated piping and blower.	November 06	Puente Construction

Table 14

Comments and Suggestions

1. The potential for vapor intrusion at Areas A & B, H, and K requires further investigation.
2. Sample groundwater for the presence of 1,4-dioxane.
3. The Base Master Plan should indicate that soil in areas previously remediated may need to be readdressed prior to a change in land use to ensure that soil levels remain protective based on the new land use.
4. The Base Master Plan should indicate that no excavation should be conducted in the former sanitary landfill (Site 31)
5. The Base Master Plan should address new buildings and/or the use of unoccupied buildings that are above areas of groundwater concentrations exceeding the vapor intrusion screening values to ensure that vapors are not entering the building or impacting human health.

Appendix A

Vapor Intrusion Screening

The following site assessments are based on the following EPA guidance: Evaluation the Vapor Intrusion into Indoor Air, November 2002, EPA530-F-02-052.

Area A-east

Tier 1 – Primary Screening

Q1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface?

A1: Yes, all contaminants of concern for Areas A and B listed in Table 3 of this report are considered to be sufficiently volatile and toxic in accordance with Table 1 of the EPA vapor intrusion screening guidance.

Q2: Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near subsurface contaminants of concern.

A2: No, The nearest inhabited buildings are located more than 200 feet east of the suspected area of groundwater contamination.

Conclusion: At Area A-east there is no potential for the vapor intrusion pathway to impact currently inhabited buildings or areas of concern under future development scenarios.

Area A-west

Tier 1 – Primary Screening

Q1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface?

A1: Yes, all contaminants of concern for Areas A and B listed in Table 3 of this report are considered to be sufficiently volatile and toxic in accordance with Table 1 of the EPA vapor intrusion screening guidance.

Q2: Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near subsurface contaminants of concern.

A2: No, The nearest inhabited buildings are located approximately 150 feet up-gradient of the suspected area of groundwater contamination. Buildings 15 and 266 are located above the contaminated groundwater in Area A-west, however, these buildings consist of an abandoned power plant and storage facilities which are not inhabited.

Conclusion: At Area A-west there is no potential for the vapor intrusion pathway to impact currently inhabited buildings or areas of concern under future development scenarios.

Area B

Tier 1 – Primary Screening

Q1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface?

A1: Yes, all contaminants of concern for Areas A and B listed in Table 3 of this report are considered to be sufficiently volatile and toxic in accordance with Table 1 of the EPA vapor intrusion screening guidance.

Q2: Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near subsurface contaminants of concern.

A2: Yes, Buildings 1, 123, 60, and 572 are inhabited and located above the contaminated groundwater.

Q3: Does evidence suggest immediate action may be warranted to mitigate current risks?

A3: No, no odors, physiological effects, wet basements, or short-term safety concerns are known, or are reasonably suspected to exist.

Tier 2 - Secondary Screening

Q4(a): Are indoor air quality data available?

A4(a): No.

Q4(c): Is there any potential contamination (source of vapors) in the unsaturated zone soil at any depth above the water table.

A4(c): Yes, unsaturated zone soil at Site 13 is being treated via vapor extraction.

Q4(g): Do measured or reasonably estimated soil gas concentrations exceed the generic target media-specific concentrations.

A4(g): Vapor points throughout the area of treatment are monitored using a photoionization detector (PID) on a weekly basis. The concentration may exceed the media-specific concentrations, however, sufficient data of acceptable quality is not available.

Conclusion: Collection of additional data is required at Area B to evaluate the completeness of the vapor intrusion pathway.

Area C

Tier 1 – Primary Screening

Q1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface?

A1: Yes, all contaminants of concern for Area C listed in Table 4 of this report are

considered to be sufficiently volatile and toxic in accordance with Table 1 of the EPA vapor intrusion screening guidance.

Q2: Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near subsurface contaminants of concern.

A2: No, Only Hangar 6 is located near the area C groundwater contamination. This structure is used for storage. Due to the enormous size of this structure and the high air exchange rate, vapor intrusion is not expected to pose a risk to human health in the Area.

Conclusion: At Area C there is no potential for the vapor intrusion pathway to impact currently inhabited buildings or areas of concern under future development scenarios.

Area D

Tier 1 – Primary Screening

Q1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface?

A1: Yes, all contaminants of concern for Area D listed in Table 5 of this report are considered to be sufficiently volatile and toxic in accordance with Table 1 of the EPA vapor intrusion screening guidance.

Q2: Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near subsurface contaminants of concern.

A2: No, only storage buildings are located within the area of the subsurface contamination.

Conclusion: At Area D there is no potential for the vapor intrusion pathway to impact currently inhabited buildings or areas of concern under future development scenarios.

Area H

Tier 1 – Primary Screening

Q1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface?

A1: Yes, all contaminants of concern for Area H listed in Table 6 of this report are considered to be sufficiently volatile and toxic in accordance with Table 1 of the EPA vapor intrusion screening guidance.

Q2: Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near subsurface contaminants of concern.

A2: Yes, Building 351 is inhabited. (by less than 5 employees) and located within 100 feet from the upgradient edge of the plume.

Q3: Does evidence suggest immediate action may be warranted to mitigate current risks?

A3: No, no odors, physiological effects, wet basements, or short-term safety concerns are

known, or are reasonably suspected to exist.

Tier 2 - Secondary Screening

Q4(a): Are indoor air quality data available?

A4(a): No.

Q4(c): Is there any potential contamination (source of vapors) in the unsaturated zone soil at any depth above the water table.

A4(c): No, contaminated soil at Site 32 was excavated and removed from the site.

Q4(d): Do measured or reasonably estimated groundwater concentrations exceed the generic target media-specific concentrations.

A4(d): Yes, benzene slightly exceeded the screening criteria during this five year review period (7.7 ug/l vs. a screening level of 5 ug/l, see Table 10).

Q4(g): Do measured or reasonably estimated soil gas concentrations exceed the generic target media-specific concentrations.

A4(g): Sufficient data of acceptable quality is not available.

Conclusion: Collection of additional data is required at Area H to evaluate the completeness of the vapor intrusion pathway.

Areas I and J

Tier 1 – Primary Screening

Q1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface?

A1: Yes, all contaminants of concern for Areas I and J listed in Table 7 of this report are considered to be sufficiently volatile and toxic in accordance with Table 1 of the EPA vapor intrusion screening guidance.

Q2: Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near subsurface contaminants of concern.

A2: No, the contaminant plume is located downgradient of site buildings and is migrating toward uninhabited off-base property. Contaminants in Areas I and J groundwater exist from 40 to 70 feet below the groundwater table which would preclude the generation of vapors.

Conclusion: At Areas I and J there is no potential for the vapor intrusion pathway to impact currently inhabited buildings or areas of concern under future development scenarios.

Area K

Tier 1 – Primary Screening

Q1: Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present in the subsurface?

A1: Yes, all contaminants of concern for Area K listed in Table 8 of this report are considered to be sufficiently volatile and toxic in accordance with Table 1 of the EPA vapor intrusion screening guidance.

Q2: Are currently (or potentially) inhabited buildings or areas of concern under future development scenarios located near subsurface contaminants of concern.

A2: Yes, Building 372 is inhabited. However, this building is located at the farthest upgradient part of the plume where contaminant levels are below the groundwater screening criteria and less than five employees work at this building.

Q3: Does evidence suggest immediate action may be warranted to mitigate current risks?

A3: No, no odors, physiological effects, wet basements, or short-term safety concerns are known, or are reasonably suspected to exist.

Tier 2 - Secondary Screening

Q4(a): Are indoor air quality data available?

A4(a): No.

Skip to question 4(c).

Q4(c): Is there any potential contamination (source of vapors) in the unsaturated zone soil at any depth above the water table.

A4(c): No, contaminated soil at Sites 4 and 8 was excavated and removed from the site.

Q4(d): Do measured or reasonably estimated groundwater concentrations exceed the generic target media-specific concentrations.

A4(d): Yes, the levels of tetrachloroethene, trichloroethene, and vinyl chloride exceeded the screening criteria. (See table 11)

Q5(a): Do groundwater concentrations of potential concern exceed target media-specific concentrations by a factor of greater than 50?

A5(a): No, see table 11.

Q5(b): Are there site conditions or data limitations under which we would not recommend the use of semi-site specific attenuation factors?

A5(b): No, the groundwater is relatively shallow (<15 ft below foundations) however, there are no buildings with significant openings to the subsurface or very low air exchange rates.

Q5(c): Are the depth to vapor source and the overlying unsaturated zone soil type adequately characterized?

A5(c): Yes, depth to groundwater and site geologic conditions are readily available.

Q5(d): Is there any potential contamination in the unsaturated zone soil at any depth above the water table?

A5(d): No, extensive soil investigation and remediation as required were performed in this area.

Q5(e): Do measured or reasonably estimated groundwater concentrations exceed the target media-specific concentrations?

A5(e): Yes, the levels of tetrachloroethene, trichloroethene, and vinyl chloride exceeded the target media-specific concentrations. (See table 11)

Conclusion: Collection of additional data is required at Area K to evaluate the completeness of the vapor intrusion pathway.

Appendix B
Calculation of Allowable Groundwater and Vapor Intrusion Target Concentrations for TCE Based on Revised Cancer Slope Factor

The following calculations are based on the following EPA guidance: Comprehensive Five-Year Review Guidance, Hypothetical Scenario for a Change in Toxicity, pg. G-8, June 2001, EPA 540-R-01-007 and Evaluation the Vapor Intrusion into Indoor Air, Appendix D, November 2002, EPA 530-F-02-052.

Calculation of Allowable Groundwater Concentration:

For Industrial Scenario:

$$IR = 1 \text{ L/day}$$

$$EF = 250 \text{ days/year}$$

$$ED = 25 \text{ years}$$

$$BW = 70 \text{ kg}$$

$$AT = 70 \text{ years} \times 365 \text{ days/year} = 25,550 \text{ days}$$

The allowable concentration of TCE in groundwater that corresponds to a risk level of 1×10^{-6} is determined by the following equation:

$$\begin{aligned} C(\text{mg/L}) &= (R \cdot BW \cdot AT) / (CSF \cdot IR \cdot EF \cdot ED) \\ &= (1 \times 10^{-6} \cdot 70 \cdot 25550) / (4 \times 10^{-1} \cdot 1 \cdot 250 \cdot 25) \\ &= 7.15 \times 10^{-4} \text{ mg/L} = 0.715 \text{ ug/L} \end{aligned}$$

Calculation of Vapor Intrusion Target Concentration:

For Industrial Scenario:

$$EF = 250 \text{ days/year}$$

$$ED = 25 \text{ years}$$

$$TCR = 1 \times 10^{-6}$$

$$AT = 70 \text{ years} \times 365 \text{ days/year} = 25,550 \text{ days}$$

$$URF = (4 \times 10^{-1} \cdot 0.001 \cdot 20) / (70) = 1.14 \times 10^{-4}$$

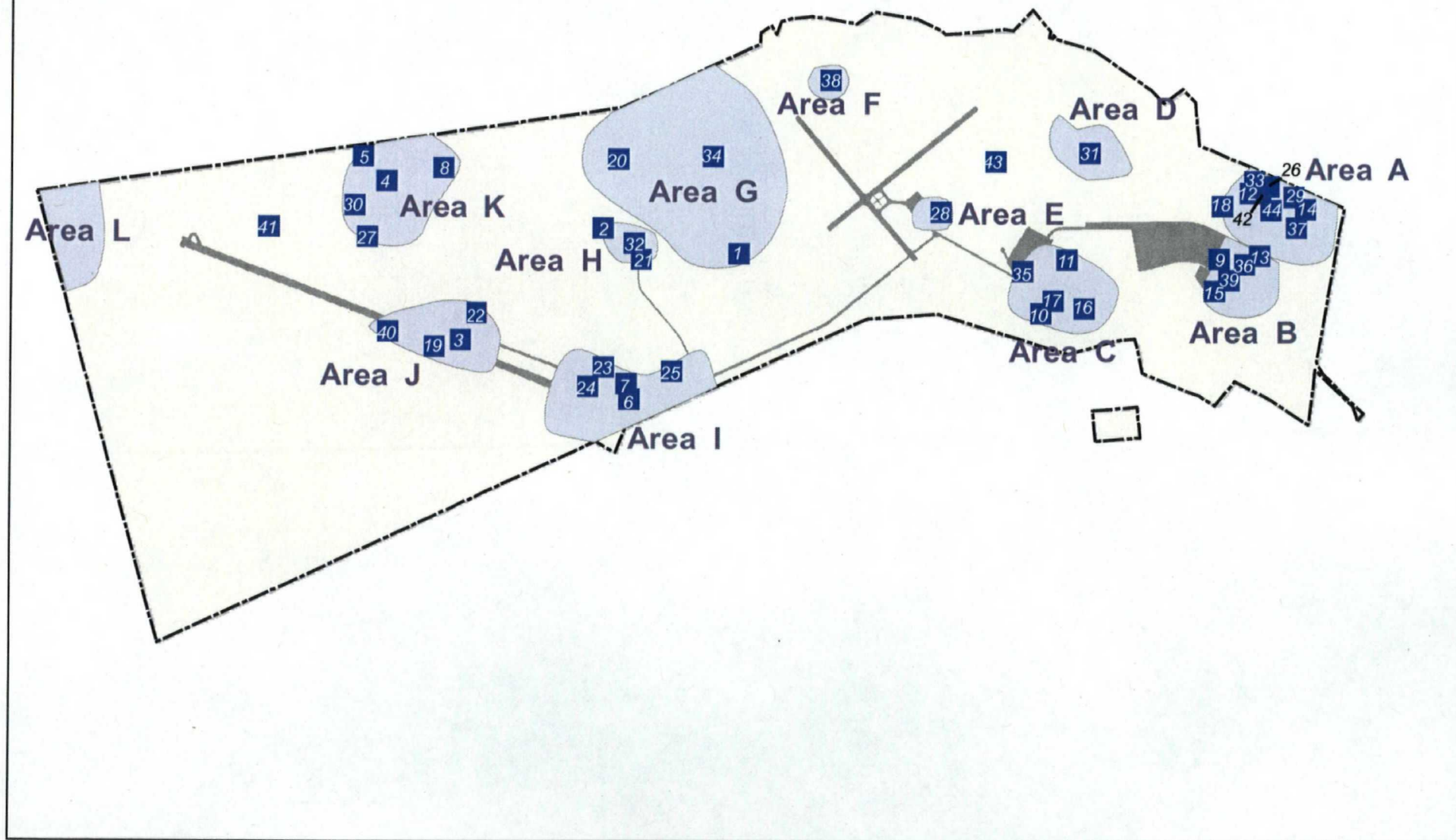
The vapor intrusion target concentration for TCE in groundwater that corresponds to a risk level of 1×10^{-6} is determined by the following equations:

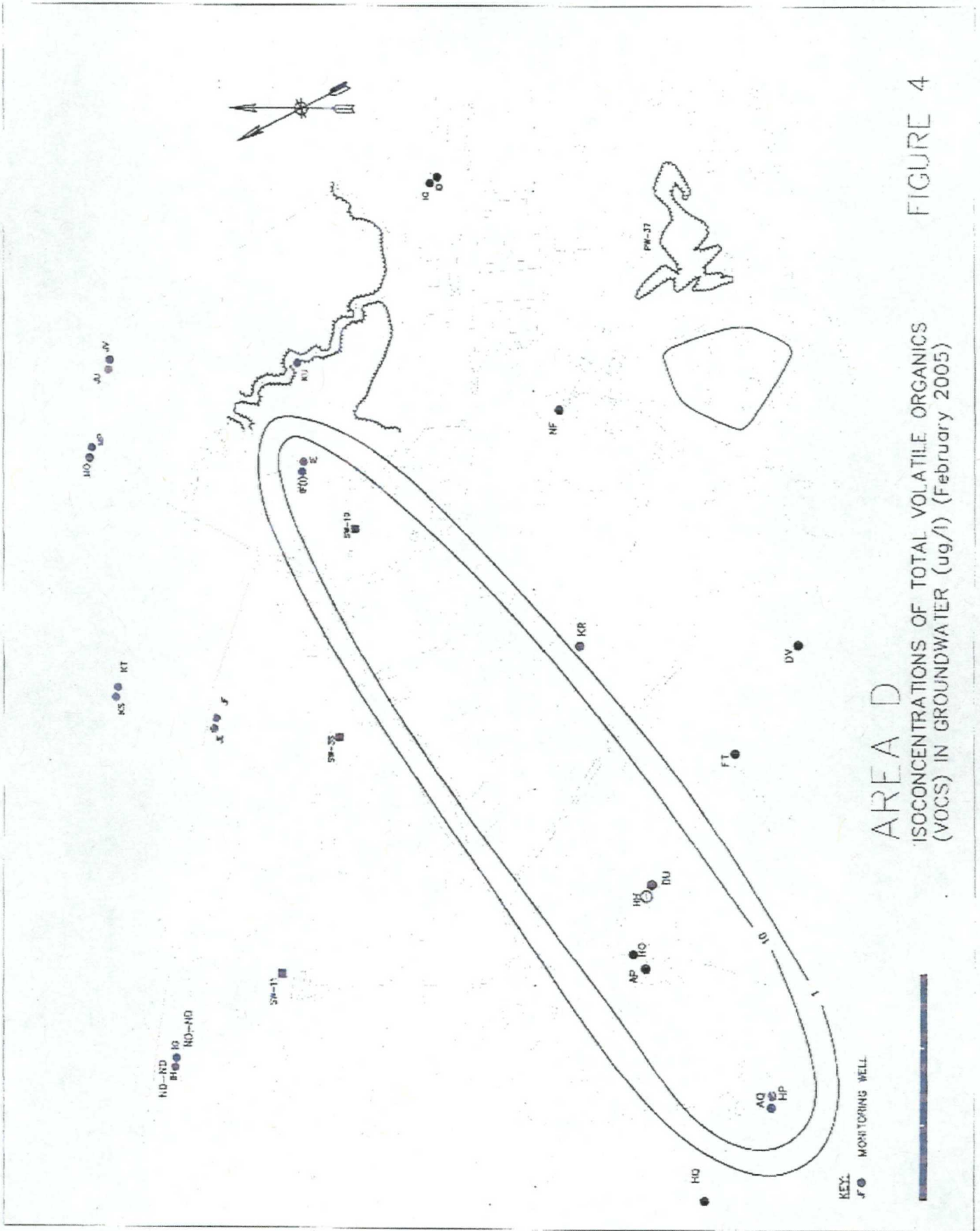
$$\begin{aligned} C_{\text{target}}(\text{g/m}^3) &= (TCR \cdot AT) / (EF \cdot ED \cdot URF) \\ &= (1 \times 10^{-6} \cdot 25550) / (250 \cdot 25 \cdot 1.14 \times 10^{-4}) \\ &= 0.036 \end{aligned}$$

$$\begin{aligned}C_{gw}(\text{ug/L}) &= C_{\text{target}} * 10^{-3} * 1/H * 1/@ \\ &= 0.036 * 10^{-3} * 1/4.21 \times 10^{-1} * 1/1 \times 10^{-3} \\ &= 0.086 \text{ (ug/L)}\end{aligned}$$

FIGURE 1

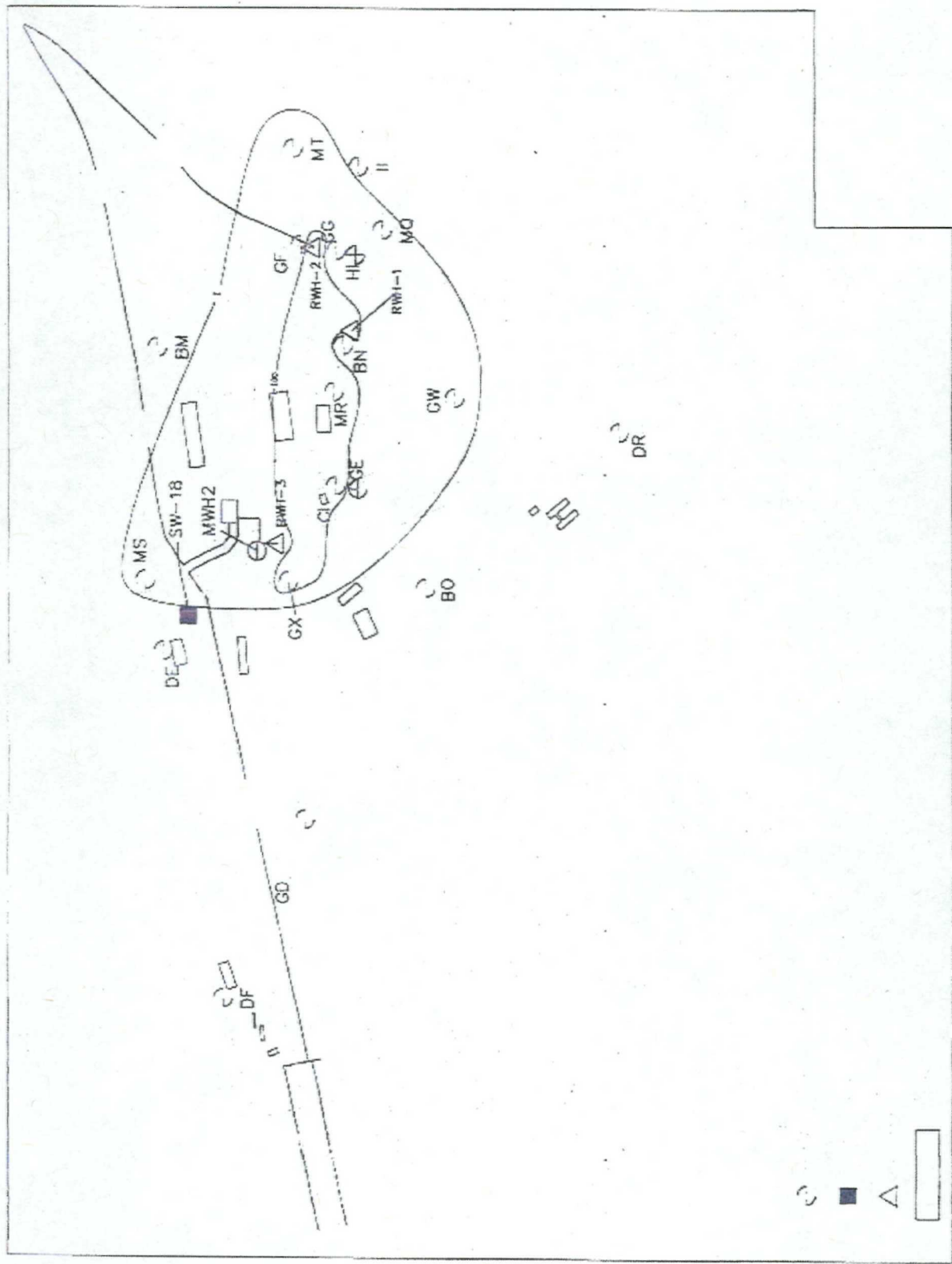
NAVAL AIR ENGINEERING STATION LAKEHURST SITE AND AREA LOCATIONS





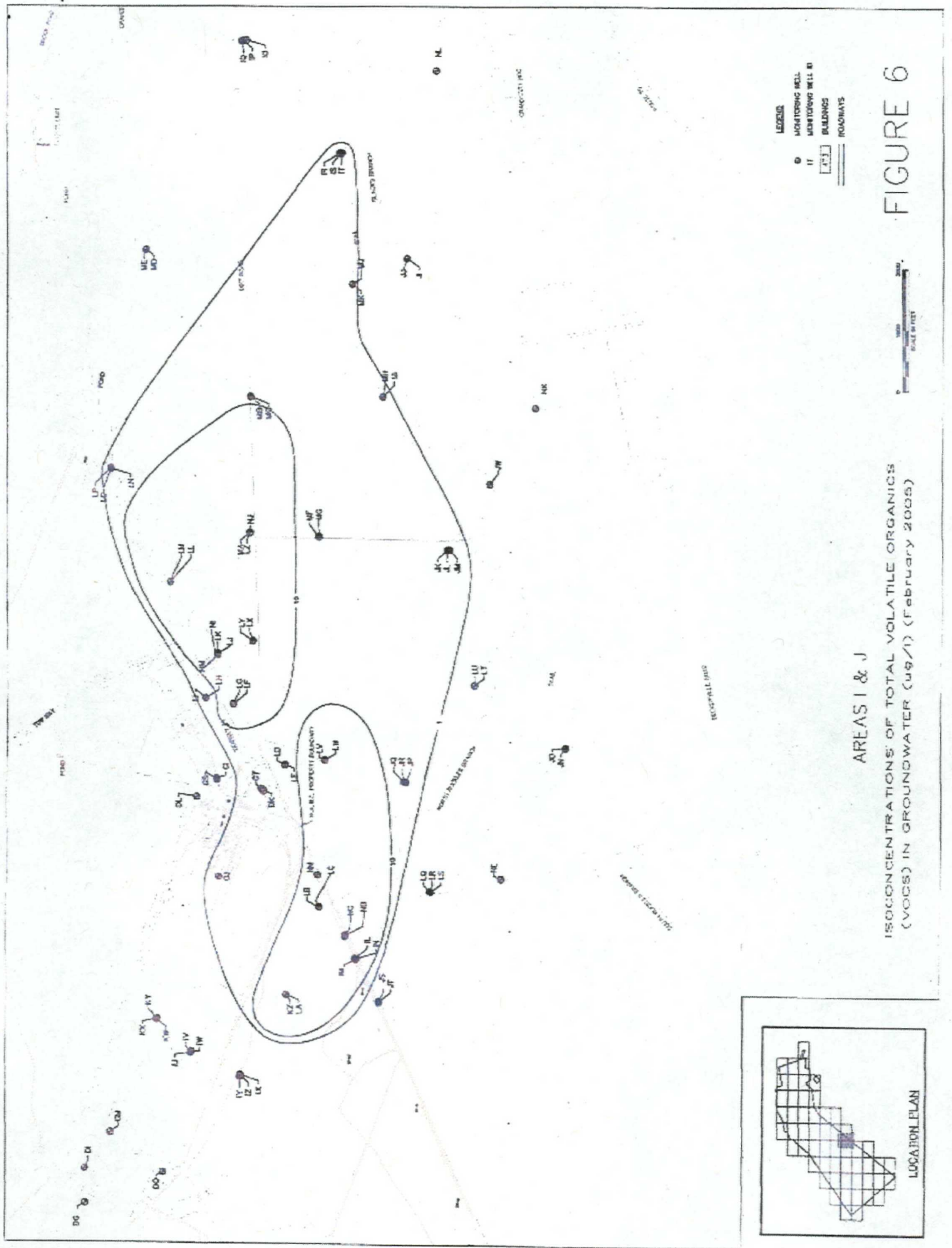
AREA D
 ISOCONCENTRATIONS OF TOTAL VOLATILE ORGANICS
 (VOCs) IN GROUNDWATER (ug/l) (February 2005)

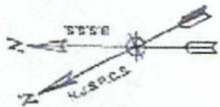
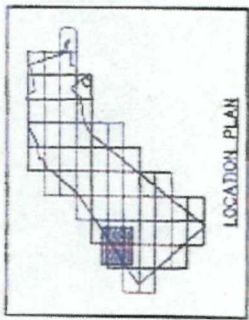
FIGURE 4



AREA H
 ISOCONCENTRATIONS OF VOCs IN GROUNDWATER ($\mu\text{g/l}$) (October 2004)
 NAVAL AIR ENGINEERING STATION (NAES) LAKEHURST, NJ

FIGURE 5





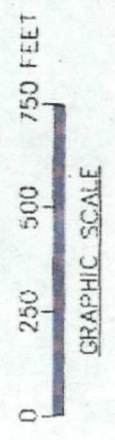
Wetlands

SITE 8

SITE 4

AREA K

ISOCONCENTRATIONS OF TOTAL VOLATILE ORGANICS (VOCs) IN GROUNDWATER (ug/l) (February 2005) **FIGURE 7**



KEY:
● MONITORING WELL

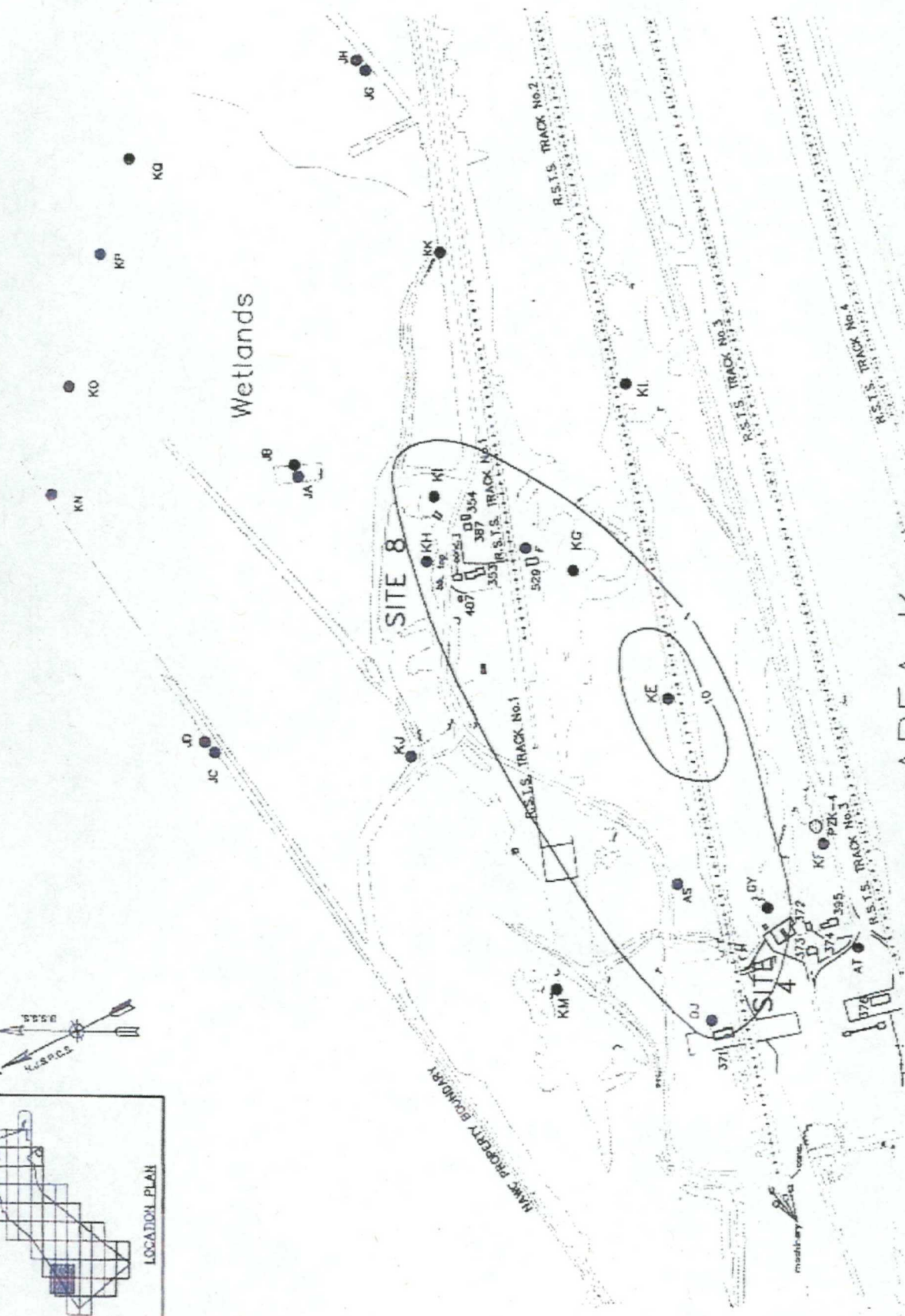
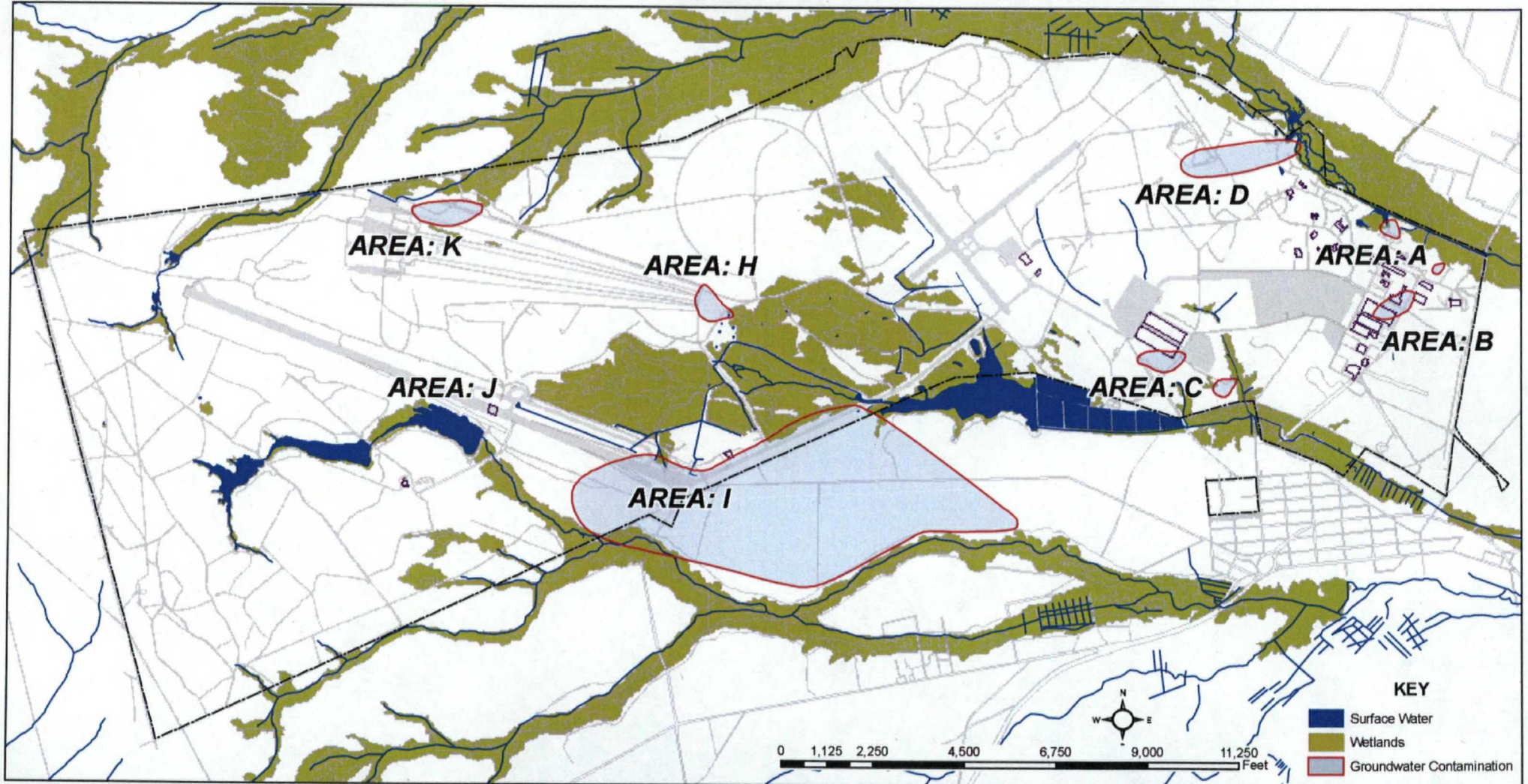
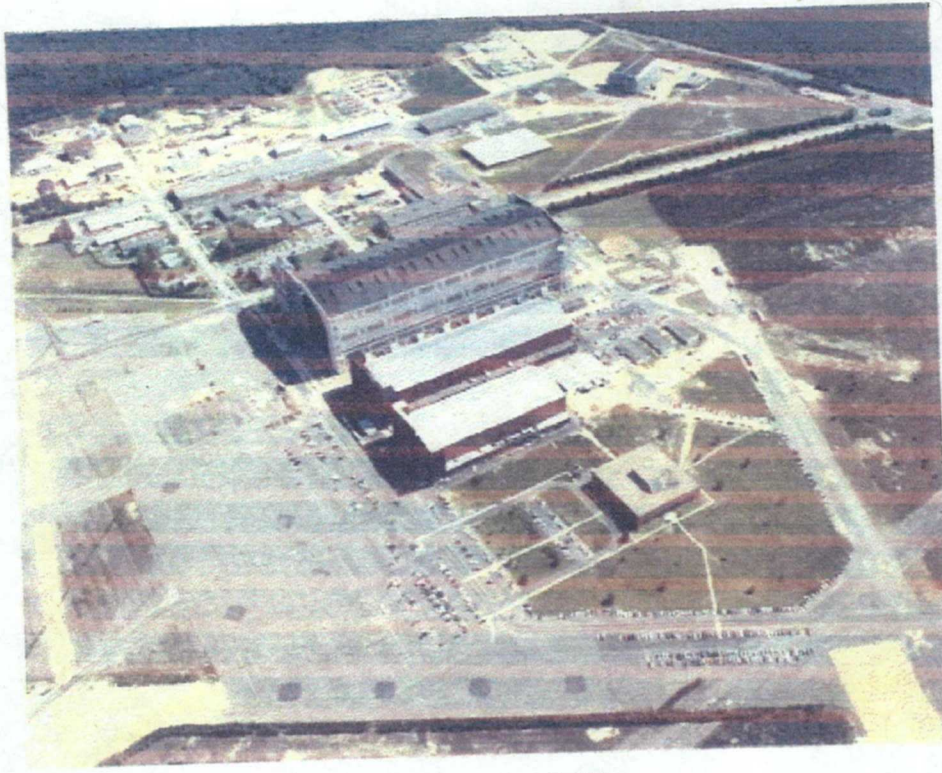


FIGURE 8
NAES Lakehurst Wetlands and Surface Water





Areas A & B



Area C



Area D



Area H



Areas I & J



Area K

NAES - LAKEHURST FIVE-YR REVIEW

5th round

R - Routine adj/mod
RW - add or modify wells
RM - modify monitoring

VI - contains not issue
VI* - bld own plane confirm no exposure

OU AREA	SITES	Media	Decision DATES	REMEDY	Subject TO REMEDY	ISSUES / Recommendations	Protection statement	COMMENT
1	C	GW-IRA	2/91	pH, recharge	N			replaced by final Remedy
2	H	GW-IRA	2/91	pH, recharge	N			" "
3	L	15, 18, 23, 26 27, 30, 34, 40, 45	9/91	Nothing	N			
4	E	GW-IRA	9/91		N			Replaced by final remedy
5	A/B	GW-IRA	3/92	pH, recharge	N			" "
6	44	soils	12/91	removal	N			
7	5, 19, 21		1/92	N	N			
8	G	1, 11, 35	6/93	N	N			
9	F	2, 38	9/93	N	N			
10	A/B	9, 12, 33, 36 37, 39, 42	9/93	N	N			
11	14	soils	9/93	N	N			sed. control. spot ero OK
12	J	7, 22, 24, 25	9/93	N	N			
13	3, 6	soils	9/93	removal	N			subject to permitted discharge
14	H (32)	soils	9/93	removal	Y		D	see 19 area H
15	(D) (31)	GW	9/93	M	Y - done		P	CEA in place, spray operation
16	J	GW IRA	1/95	MNA	N			replaced by final remedy
17	A 29	LF	9/94	removal	N			May have dms restriction
18	(C) 10, (6), 17	GW	2/96, 5/02	SUE, pH SUE excavating	Y - EXPAUD SUE, RM,		P	CEA in place,
19	(H)	GW	2/96, 5/02	pH, SUE exc product	Y - EXPAUD SUE, VI*, RM,		P	Removal spray CEA in place, fuel in vadose zone, continue area area cleanup met standards
20	E 28	GW, soil	7/97	SUE, pH	N			CEA in place, Bids use road to FU on Vapor intrusion
21	(A/B)	GW	7/97, 5/02, 9/03	SPRAYSUE PPT	Y - RW, RM, VI*, 1, 4 closure		P	
22	20		9/93	N	N			
23	B (13)	soil	9/93	SUE	Y			See 21 area A/B
24	(K) 4, 8	GW	9/97	Air spraying spray, M	Y - VI*, RM,		P	CEA in place
25	41	ordinance	9/97	not CERCLA	N			No ROD, not subject to CERCLA
26	(J)	GW	9/99, 9/03	MNA none	Y - update model, RM,		P	CEA in place, pH would have depleted wellhead,
	43	hdg	9/85	N	N			
Overall statement: Areas A & B, C, D, H, J, and K are protective no site-wide decontamination needed								

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