RECORD OF DECISION

ST-14, Former East Side Gas Station
Andrews Air Force Base, Maryland

United States Army Corps of Engineers
Omaha District

United States Environmental Protection Agency
Region III

Maryland Department of the Environment

September 2007
2.12.2.1 Installation of Injection Points .......................................................... 2-22
2.12.2.2 Environmental Monitoring ................................................................. 2-22
2.12.2.3 Injection and Re-injection of Organic Carbon Substrate and
Oxygen-Releasing Compound ........................................................................ 2-23
2.12.2.4 Institutional Controls ......................................................................... 2-25
2.12.2.5 Summary of the Estimated Remedy Costs ........................................ 2-26
2.12.2.6 Estimated Outcomes of Selected Remedy .......................................... 2-26

2.13 STATUTORY DETERMINATIONS FOR GROUNDWATER REMEDY ............. 2-27
2.13.1 Protection of Human Health and the Environment .............................. 2-27
2.13.2 Compliance with Applicable or Relevant and Appropriate Requirements ........................................... 2-27
2.13.3 Cost Effectiveness .................................................................................. 2-27
2.13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource
Recovery) Technologies to the Maximum Extent Practicable ......................... 2-28
2.13.5 Preference for Treatment as a Principal Element .................................... 2-28
2.13.6 CERCLA 5-Year Review Requirements ............................................... 2-28

2.14 DOCUMENTATION OF SIGNIFICANT CHANGES ........................................ 2-28

3.0 RESPONSIVENESS SUMMARY ........................................................................ 3-1
3.1 OVERVIEW ..................................................................................................... 3-1
3.2 BACKGROUND AND COMMUNITY INVOLVEMENT .................................. 3-1
3.3 SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT
PERIOD ............................................................................................................... 3-2

4.0 REFERENCES ..................................................................................................... 4-1

Tables
Table 2-1 Comparative Analysis of Remedial Alternatives Summary

Figures
Figure 2-1 Andrews Air Force Base Location
Figure 2-2 ST-14 Site Location
Figure 2-3 ST-14 Site Features
Figure 2-4 ST-14 Pre-Design Study Test Areas
Figure 2-5 ST-14 Groundwater Elevation Map
Figure 2-6 ST-14 Conceptual Site Model – Potential Human Receptors
Figure 2-7 ST-14 Conceptual Site Model – Potential Ecological Receptors
Figure 2-8 Trichloroethene Concentrations in Groundwater at ST-14
Figure 2-9 Carbon Tetrachloride Concentrations in Groundwater at ST-14
Figure 2-10 Benzene Concentrations in Groundwater at ST-14
Figure 2-11 Conceptual Layout of Selected Remedy: Site-wide Enhanced Biodegradation
Figure 2-12 Approximate Extent of Intitutional Controls at ST-14

Appendices
A Maryland Department of Environment Concurrence Letter
B Applicable or Relevant and Appropriate Requirement Tables
C Public Comment Newspaper Notices
D Public Meeting Minutes: May 9, 2007
# LIST OF ACRONYMS AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFB</td>
<td>Air Force Base</td>
</tr>
<tr>
<td>AOC</td>
<td>Area of Concern</td>
</tr>
<tr>
<td>ARAR</td>
<td>Applicable or Relevant and Appropriate Requirement</td>
</tr>
<tr>
<td>BGP</td>
<td>Base General Plan</td>
</tr>
<tr>
<td>bgs</td>
<td>below ground surface</td>
</tr>
<tr>
<td>BTEX</td>
<td>Benzene, Toluene, Ethylbenzene, and Xylenes</td>
</tr>
<tr>
<td>BHHRA</td>
<td>Basewide Human Health Risk Assessment</td>
</tr>
<tr>
<td>CEI</td>
<td>Comprehensive Environmental Investigation</td>
</tr>
<tr>
<td>CERCLA</td>
<td>Comprehensive Environmental Response, Compensation and Liability Act</td>
</tr>
<tr>
<td>COC</td>
<td>Contaminant of Concern</td>
</tr>
<tr>
<td>COMAR</td>
<td>Code of Maryland Regulations</td>
</tr>
<tr>
<td>COPC</td>
<td>Contaminant of Potential Concern</td>
</tr>
<tr>
<td>CSM</td>
<td>Conceptual Site Model</td>
</tr>
<tr>
<td>CSF</td>
<td>Cancer Slope Factor</td>
</tr>
<tr>
<td>CT</td>
<td>Carbon Tetrachloride</td>
</tr>
<tr>
<td>CTE</td>
<td>Central Tendency Exposure</td>
</tr>
<tr>
<td>CVOC</td>
<td>Chlorinated Volatile Organic Compound</td>
</tr>
<tr>
<td>DCA</td>
<td>Dichloroethane</td>
</tr>
<tr>
<td>DCE</td>
<td>Dichloroethene</td>
</tr>
<tr>
<td>D&amp;M</td>
<td>Dames &amp; Moore, Inc.</td>
</tr>
<tr>
<td>DO</td>
<td>Dissolved Oxygen</td>
</tr>
<tr>
<td>EDB</td>
<td>Ethylene Dibromide</td>
</tr>
<tr>
<td>ERP</td>
<td>Environmental Restoration Program</td>
</tr>
<tr>
<td>FS</td>
<td>Feasibility Study</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographical Information System</td>
</tr>
<tr>
<td>HI</td>
<td>Hazard Index</td>
</tr>
<tr>
<td>HQ</td>
<td>Hazard Quotient</td>
</tr>
<tr>
<td>IC</td>
<td>Institutional Control</td>
</tr>
<tr>
<td>IEUBK</td>
<td>Integrated Exposure Uptake Biokinetic</td>
</tr>
<tr>
<td>ILCR</td>
<td>Incremental Lifetime Cancer Risk</td>
</tr>
<tr>
<td>ILHR</td>
<td>Incremental Lifetime Hazard Risk</td>
</tr>
<tr>
<td>IT</td>
<td>IT Corporation</td>
</tr>
<tr>
<td>kg</td>
<td>kilogram</td>
</tr>
<tr>
<td>LUC</td>
<td>Land Use Control</td>
</tr>
<tr>
<td>MDE</td>
<td>Maryland Department of the Environment</td>
</tr>
<tr>
<td>MNA</td>
<td>Monitored Natural Attenuation</td>
</tr>
<tr>
<td>NAPL</td>
<td>Non-aqueous Phase Liquid</td>
</tr>
<tr>
<td>NCP</td>
<td>National Oil and Hazardous Substances Pollution Contingency Plan</td>
</tr>
<tr>
<td>NPL</td>
<td>National Priorities List</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Operation and Maintenance</td>
</tr>
<tr>
<td>ORP</td>
<td>Oxidation-Reduction Potential</td>
</tr>
<tr>
<td>PAH</td>
<td>Polynuclear Aromatic Hydrocarbon</td>
</tr>
<tr>
<td>PCB</td>
<td>Polychlorinated Biphenyl</td>
</tr>
<tr>
<td>PCE</td>
<td>Tetrachloroethene</td>
</tr>
<tr>
<td>PID</td>
<td>Photoionization Detector</td>
</tr>
<tr>
<td>PLFA</td>
<td>Phospholipid Fatty Acid</td>
</tr>
<tr>
<td>PRG</td>
<td>Preliminary Remediation Goal</td>
</tr>
<tr>
<td>RAO</td>
<td>Remedial Action Objective</td>
</tr>
<tr>
<td>RBC</td>
<td>Risk-Based Concentration</td>
</tr>
<tr>
<td>RID</td>
<td>Reference Dose</td>
</tr>
<tr>
<td>RME</td>
<td>Reasonable Maximum Exposure</td>
</tr>
<tr>
<td>ROD</td>
<td>Record of Decision</td>
</tr>
<tr>
<td>SERA</td>
<td>Screening Ecological Risk Assessment</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>Shaw</td>
<td>Shaw Environmental, Inc.</td>
</tr>
<tr>
<td>SSL</td>
<td>Soil Screening Limit</td>
</tr>
<tr>
<td>SVOC</td>
<td>Semi-Volatile Organic Compound</td>
</tr>
<tr>
<td>TAL</td>
<td>Target Analyte List</td>
</tr>
<tr>
<td>TCE</td>
<td>Trichloroethene</td>
</tr>
<tr>
<td>TOC</td>
<td>Total Organic Carbon</td>
</tr>
<tr>
<td>µg/L</td>
<td>micrograms per liter</td>
</tr>
<tr>
<td>USAF</td>
<td>United States Air Force</td>
</tr>
<tr>
<td>USEPA</td>
<td>United States Environmental Protection Agency</td>
</tr>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
</tr>
<tr>
<td>UST</td>
<td>Underground Storage Tank</td>
</tr>
<tr>
<td>VC</td>
<td>Vinyl Chloride</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile Organic Compound</td>
</tr>
<tr>
<td>WSSC</td>
<td>Washington Suburban Sanitary Commission</td>
</tr>
</tbody>
</table>
RECORD OF DECISION

1.0 DECLARATION

1.1 SITE NAME AND LOCATION

Site ST-14, Former East Side Gas Station
Andrews Air Force Base (AFB), Maryland
EPA Superfund Site ID No. MD0570024000

1.2 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the selected remedy for groundwater at ST-14, located at Andrews AFB, in Prince George’s County, Maryland. The remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Andrews AFB was listed on the National Priorities List (NPL) by the United States Environmental Protection Agency (USEPA) on May 10, 1999 (FR vol. 64, no. 89, p. 24949-24956).

The remedy selection presented in this ROD is based on information contained in the Administrative Record file for ST-14. The United States Air Force (USAF) and USEPA have made the final remedy selection for the site addressed by this ROD. The Maryland Department of the Environment (MDE) concurs with the selected remedy.

1.3 ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public and the environment from actual or threatened releases of pollutants or contaminants from the site that may present an imminent and substantial endangerment to public health or welfare.

1.4 DESCRIPTION OF THE SELECTED REMEDY

The ST-14 site is an approximately 73-acre area located east of the flight line in the northeast portion of Andrews AFB. The area contains a number of low-rise office buildings, maintenance shops, and a soccer/softball field. A portion of the aircraft parking apron south of Building 3602 is included as part of ST-14. ST-14 was originally brought into the Environmental Restoration Program (ERP) because of gasoline leaks from underground storage tanks (USTs) and distribution lines at the Former East Side Gas Station, Building 3487. The gas station was built in 1945 as a full service station with two service bays, but was closed and converted to a convenience store in the early 1980s. The two 10,000-gallon USTs associated with the former gas station were removed in 1983.

Investigation of the gasoline contamination revealed the presence of trichloroethene (TCE) and carbon tetrachloride (CT) groundwater contamination that originated from sources upgradient (south and southwest) of Building 3487. Subsequent investigations identified a 54-acre groundwater TCE plume in the shallow aquifer. The approximate dimensions of the plume are 1,800-feet long, 1,700-feet wide, and 15 to 20 feet thick, from the water table (15 to 20 feet below the ground surface – bgs) to the underlying Calvert Formation (38 to 40 feet bgs). The TCE plume comprises four identified subplumes originating from several source areas. The maximum TCE concentration in groundwater samples collected in 2006...
was 2,610 µg/L. The main TCE plume encompasses two CT plumes from separate sources and a gasoline-related plume (consisting primarily of benzene, but also containing 1,2-dibromomethane (ethylene dibromide [EDB]), naphthalene, toluene, xylenes, and other gasoline-related compounds).

A baseline human health risk assessment (BHHRA) was performed as part of a Comprehensive Environmental Investigation (CEI) Addendum (Shaw, 2005), which evaluated potential human-health risks from exposure to soil, groundwater, indoor air via vapor intrusion, surface water, and sediment under current and future land use conditions. There is no current completed exposure pathway to groundwater at the ST-14 area and potential risks under current exposure scenarios were within or below risk-management guidelines for all evaluated media and receptors. Under hypothetical future land use conditions, child exposure to soil and use of groundwater for drinking water and other residential purposes results in potential risks exceeding the cancer risk-management range of $10^{-6}$ to $10^{-4}$ and a hazard index of 1, which are the benchmarks for response as indicated by the NCP at 40 CFR 300.430(e)(2)(i)(A). Evaluation of the vapor intrusion pathway also identified potential risks exceeding the risk-management range and threshold.

A Screening Ecological Risk Assessment (SERA) performed as part of the CEI Addendum identified potential risk to ecological receptors at ST-14 from direct exposure to surface soil, surface water, and sediment. However, the SERA documented that the tributary of Cabin Branch did not support aquatic communities due to the limited benthic habitat in the tributary. It was also noted that many of the potential risk drivers (i.e., aluminum, antimony, chromium, iron, silver, and vanadium) are not associated with known releases at ST-14 and may be the result of natural variation above background surface soil concentrations at Andrews AFB.

Food-chain modeling concluded that exposure of terrestrial and aquatic upper trophic-level receptors (mammals and birds) to bioaccumulative chemicals detected at ST-14 are acceptable. Potential risk to amphibians and reptiles could not be directly assessed because of the lack of toxicological data for these two groups. However, potential risk from bioaccumulative chemicals to amphibians and reptiles is probably also acceptable because there are few animals at ST-14 due to lack of habitat and acceptable risk was determined by the SERA for higher food-chain-level animals.

A Feasibility Study (FS) for ST-14 was conducted based on the results of the CEI (Earth Tech, 2006). The FS evaluated a variety of remedial alternatives for attainment of the following remedial action objectives (RAOs):

- Prevent the ingestion of shallow groundwater chemicals of concern (COCs) with concentrations exceeding listed preliminary remediation goals (PRGs, or cleanup criteria).
- Prevent, to the extent practicable, the off-site migration of groundwater with concentrations exceeding listed cleanup criteria.
- Restore shallow groundwater quality such that COC concentrations do not exceed listed cleanup criteria within a reasonable time frame.
- Prevent contaminated soil at the Former East Side Gas Station, from acting as a continuing source of benzene, EDB, and other gasoline-related contaminants exceeding groundwater cleanup criteria.
- Prevent contaminated soil at potential source areas from acting as a continuing source of CT and TCE contamination exceeding groundwater cleanup criteria.
- Prevent residential exposure to soil with contaminant concentrations exceeding cleanup criteria.
- Prevent residential exposure to shallow groundwater contaminants at levels of concern via vapor intrusion.

Groundwater cleanup criteria were developed for TCE and its breakdown product vinyl chloride (VC), CT, and benzene, toluene, ethylbenzene and xylenes (BTEX).

Based on the results of the FS, and after consideration of public comments, Alternative 4, Site-Wide Enhanced In-situ Biodegradation with Groundwater Monitoring and Institutional Controls (ICs), is selected as the remedy. Based on the CEI, the FS, and a follow up Source Area Investigation (Earth Tech, 2007), no continuing source areas were identified, and therefore source control was not included as part of the selected
remedy. The suspected source areas were examined during and after the CEI for detected contamination that could serve as a continuing source of re-contamination of shallow groundwater if not addressed by the remedy selected in this ROD. The RI concluded that, although some surface and subsurface soil samples exceeded the soil screening limits (SSLs), the exceedances were not statistically significant and do not indicate that soil contamination could recontaminate the groundwater after completion of the remedy. Additionally, the in-situ subsurface injections are anticipated to treat vadose zone subsurface soil contamination as well as the contaminated groundwater. Moreover, because the remedy consists of multiple injections into the subsurface coupled with performance monitoring, residual subsurface soil contamination which may leach to groundwater will be remedied over time. Additional treatment can be undertaken if groundwater contaminant concentrations stagnate or rise due to a rebound effect.

The major components of the selected remedy are as follows:

- Install injection well points to inject organic carbon substrate in the TCE and commingled TCE/CT plumes to create treatment barriers.
- Install injection well points to inject an oxygen-releasing compound in the benzene plume to create treatment barriers.
- Inject organic carbon substrate and oxygen-releasing compound into their respective well points.
- Perform groundwater monitoring, statistical evaluation of trends in concentrations of constituents requiring remediation, and 5-year reviews.
- Implement and maintain ICs in the form of groundwater use restrictions until the cleanup criteria are achieved. The USAF is responsible for implementing, monitoring, maintaining, and enforcing the identified ICs and will provide notification to USEPA and MDE as necessary.

The groundwater monitoring program for the selected remedy will (1) assess the effectiveness of organic carbon substrate and oxygen-releasing compound in accelerating biodegradation of TCE/CT and benzene, respectively; (2) collect additional data regarding COC concentrations to determine the frequency and location of re-injections of organic carbon substrate and oxygen-releasing compound, if necessary; and (3) evaluate the effectiveness of attaining groundwater cleanup criteria. Groundwater monitoring will consist of the collection of samples for laboratory analysis, as well as field measurements of geochemical parameters including oxidation-reduction potential (ORP), dissolved oxygen (DO), and pH.

The selected remedy will address groundwater contamination at ST-14 and fits into the overall strategy to investigate and address the 28 Environmental Restoration Program (ERP) sites and five Areas of Concern (AOCs) at Andrews AFB. The actions described in this ROD will be performed under the authority of USAF, USEPA, and in coordination with MDE.

The USAF and USEPA, in consultation with MDE, have determined that the cleanup of this site under the requirements of CERCLA is the appropriate course of action. This determination was reached after assessing historical data as well as data collected during the remedial investigation phase for ST-14.

1.5  STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with applicable or relevant and appropriate Federal and State requirements, is cost-effective, and utilizes permanent solutions and effective treatment technologies to the maximum extent practicable.

The remedy for groundwater at ST-14 satisfies the statutory preference for treatment as a principal element of the remedy. Treatment of groundwater has already been performed at three test areas at ST-14 as part of a Pre-Design Study, which demonstrated the success of the treatment technology (Earth Tech, 2007a). Site-wide groundwater treatment will be implemented to address the full extent of groundwater contamination at the site. The remedy is predicted to require 30 years to complete. Because the selected remedy will result in contaminated groundwater remaining on site above levels that allow for unlimited use and unrestricted exposure during the predicted 30-year period, a statutory review will be conducted within five years after
the site. The remedy is predicted to require 30 years to complete. Because the selected remedy will result in contaminated groundwater remaining on site above levels that allow for unlimited use and unrestricted exposure during the predicted 30-year period, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy continues to be protective of human health and the environment. In accordance with CERCLA Section 121(c) and 40 CFR 300.430(f)(4)(ii), five-year reviews will continue to be conducted until concentrations of contaminants requiring remediation (TCE, CT, and BTEX) are below cleanup criteria that allow for unlimited use and unrestricted exposure.

1.6 ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for ST-14:

- Contaminants requiring remediation and their respective concentrations (Section 2.5.3.1).
- Baseline risk represented by all COCs (Sections 2.7.2 and 2.7.3).
- Cleanup criteria established for constituents requiring remediation and the basis for these levels (Section 2.8).
- Assumptions regarding current and reasonably anticipated future land use and current and future beneficial uses of groundwater relied upon in the baseline risk assessment and this ROD (Section 2.6).
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (Section 2.12.2.4).
- Estimated capital, annual O&M, and total present worth costs, discount rate, and number of years over which the remedy cost estimates are projected (Section 2.10).
- Key factors that led to selecting the remedy (Section 2.12.1).
- How source materials constituting principal threats have been addressed (Section 2.11).

1.7 AUTHORIZING SIGNATURES

The USAF and the USEPA select this remedy with the concurrence of MDE.

[Signatures]
P A U L  R. A C K E R L E Y, Colonel, USAF
Commander, 316th Wing

J A M E S J. B U R K E, Director
Hazardous Site Cleanup Division
U.S. EPA, Region III
2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

Andrews AFB is located in Prince George’s County, Maryland, near the community of Camp Springs, Maryland (Figure 2-1). Washington, D.C. is located approximately 5 miles northwest of the Base. The principal features of the Base occupy approximately 4,300 acres and consist of runways, airfield operations, industrial areas, and housing and recreational facilities.

Andrews AFB was originally established as the Camp Springs Army Air Field on August 25, 1942. The name was changed to Andrews AFB in 1947 when the USAF was established as a separate military service. The Base has served as the headquarters at various times for the Continental Air Command, the Strategic Air Command, the Military Air Transport Service, and the Air Force Systems Command. The major tenant command at Andrews AFB is the Naval Air Facility. The missions of the Naval Air Facility are flight operations and photographic reconnaissance. In June 2006, Andrews AFB became an Air Force District of Washington (AFDW) Base.

In May 1999, Andrews AFB was added to the NPL. The National Superfund electronic database identification number for Andrews AFB is MD0570024000.

The USAF is the lead agency and provides funding from the defense environmental restoration account for the remedial action discussed in this ROD. This document is issued by the USAF (the site owner) and the USEPA (the federal regulatory agency for overseeing compliance with CERCLA), and in coordination with the MDE.

The ST-14 site is an approximately 73-acre area located east of the flight line in the northeast portion of Andrews AFB (Figure 2-2). The area contains a number of low-rise office buildings, maintenance shops, and a soccer/softball field. A portion of the aircraft parking apron south of Building 3602 is included as part of ST-14.

2.2 SITE HISTORY, INVESTIGATIONS, AND ENFORCEMENT ACTIONS

2.2.1 Site History

ST-14 was brought into the Environmental Restoration Program (ERP) because of gasoline leaks from underground storage tanks (USTs) and distribution lines at the Former East Side Gas Station, Building 3487. The gas station was built in 1945 as a full service station with two service bays, but was closed and converted to a convenience store in the early 1980s. The two 10,000-gallon USTs associated with the former gas station were removed in 1983 after Maryland Department of the Environment (MDE) issued a Consent Order to conduct sampling due to the presence of product in the vicinity of the USTs. Portions of ST-14 have been used in the past for vehicle maintenance, and vehicle maintenance racks were located on the site.

The boundary of ST-14 was expanded as a result of a Dames & Moore (D&M) investigation in 1992 that revealed, in addition to the gasoline, the presence of TCE and CT apparently originating from sources upgradient of Building 3487 (D&M, 1992).

2.2.2 Previous Investigations and Actions

Environmental investigations have been conducted at the Base since 1985 and are being pursued under the USAF’s ERP. The ERP was developed by the Department of Defense in 1981 to identify, investigate, and clean up former industrial disposal sites on military bases. ST-14 was identified as an environmental site through the ERP. A summary of the results from studies and investigations at ST-14 is outlined below.
Two 10,000-gallon gasoline USTs were removed from the Former East Side Gas Station in 1983 (D&M, 1994). One 250-gallon motor oil UST was also removed from the site between 1983 and 1986. In addition, visually contaminated soil was removed during the UST removal; however, the exact quantity is unknown and no cleanup criteria were documented.

In 1984, the USAF installed ten shallow monitoring wells at ST-14. The wells were installed after gasoline vapors were detected during steam line replacement at the Former East Side Gas Station in 1984 (D&M, 1994). Only five of the wells, MW05-ST14 through MW09-ST14, could be located during later investigations (Shaw, 2005).

A Phase I Records Search report, prepared by Engineering Science (ES) in 1985, indicated that 20,000-gallons of gasoline were recovered during the 1983 UST removal; however, the report did not specify whether gasoline was recovered from the USTs and piping as free product or as gasoline-saturated soil (ES, 1985).

Based on recommendations in the Phase I Records Search report, and at the request of Andrews AFB, the U.S. Geological Survey (USGS) conducted additional investigations at ST-14 between 1988 and 1989 (USGS, 1990). The USGS investigation included installation of four new monitoring wells (MW01-ST14 through MW04-ST14), soil sampling for lead, and groundwater sampling of the nine wells. The sample results confirmed the presence of BTEX components within the groundwater in the vicinity of the Former East Side Gas Station.

As a follow-up to the USGS investigation, D&M conducted a groundwater contamination survey between 1991 and 1992 (D&M, 1992). The D&M investigation included sampling of the nine monitoring wells and the installation of five new monitoring wells (MW10-ST14 through MW14-ST14), advancement of six soil borings, advancement of 23 direct-push groundwater sample points, and collection of two surface water/sediment samples. Contaminants of concern (COCs) were not detected in surface water samples. Analytical results from groundwater sampling identified a BTEX plume originating at the Former East Side Gas Station and extending to the northeast. TCE and CT plumes were also identified and were determined to originate upgradient of Building 3487 (D&M, 1994).

On October 7, 1993, a 1,000-gallon steel UST containing No. 2 fuel oil was removed at Building 3471 (IT, 1995). The tank and excavation were inspected by MDE on October 8, 1993. Organic vapor analyzer readings of 350-ppm were recorded below the tank during excavation activities, and free product was observed in the surrounding soil. MDE requested the installation of three groundwater monitoring wells. One well (MW01-3471) was installed where the tank had been located, and two wells (MW02-3471 and MW03-3471) were installed downgradient.

A Remedial Investigation was undertaken for ST-14 through a series of investigations: The Final CEI (IT, 2000b), the CEI Addendum (Shaw, 2005) and the Pre-Design Study (Earth Tech, 2007a).


Between April 1999 and November 2000, IT Corporation (IT) conducted field activities at ST-14 to determine the nature and extent of groundwater contamination, investigate the potential source areas for groundwater contamination, and collect samples in support of the BHHRA and the SERA, which were ultimately completed later (IT, 2000b). The groundwater investigation included installation of 21 new monitoring wells and sampling from existing wells and 61 direct-push locations. The contamination-source investigation included a record review and completion of borings and other soil sampling. Sampling to support the risk assessments included samples from soil, sediment, surface water and groundwater seeps.

Groundwater sampling verified that CERCLA-regulated groundwater contaminants at ST-14 include TCE, vinyl chloride and CT. The CEI concluded that the Calvert Formation, a clay aquitard, serves as the lower boundary of the contamination, preventing further downward migration (IT, 2000b). Shallow groundwater...
contamination is located from the water table (approximately 15 to 20 feet bgs) down to the Calvert Formation (approximately 38 to 40 feet bgs).

Based on the geometry of the plume and a review of historical activities at ST-14, three potential source areas, the Former East Side Gas Station, Former Aircraft Wash Rack, and Southern Fire Department Wash Site (Figure 2-3), were identified and investigated during the Final CEI. Soil contaminant concentrations determined during the investigation were not sufficient to indicate a continuing source of groundwater contamination existing in these three areas. The investigation results were presented in the Final CEI report (IT, 2000b).

**CEI Addendum (2003)**

To fill groundwater investigation data gaps identified in the Final CEI, four additional shallow monitoring wells (MW35-ST14 through MW38-ST14) and one deep monitoring well were installed. Three additional potential source areas were also investigated, which included the Former Vehicle Wash Rack near the civil engineering yard, the area near the Naval Air Facility, and the Northern Fire Department Wash Site (Figure 2-3). Soil contaminant concentrations were found to be insufficient to be a continuing source for groundwater contamination in these three areas.

The results of the supplemental investigations, the BHHRA, and the SERA were presented in the Final CEI Addendum (Shaw, 2005). The calculated incremental lifetime hazard risk (ILHR) and hazard index (HI) indicated that adverse health effects were unlikely for current exposure scenarios, but that some human health risk associated with on-site contaminants in groundwater could exist in future exposure scenarios if shallow groundwater was used as drinking water.

The SERA identified potential risk to ecological receptors at ST-14 from direct exposure to surface soil, surface water, and sediment. However, the conclusions in the SERA were that the evaluated segment of Cabin Branch was not conducive to supporting aquatic communities and that there is limited benthic habitat in the sampled tributary of Cabin Branch. It was also noted that many of the potential risk drivers (i.e., aluminum, antimony, chromium, iron, silver, and vanadium) are not associated with known releases at ST-14 and may be the result of natural variation above Base background groundwater concentrations. Results of food-chain modeling indicated that exposure of terrestrial and aquatic upper trophic-level receptors (mammals and birds) to bioaccumulative chemicals detected at ST-14 are within an acceptable range. Potential risk to amphibians and reptiles could not be directly assessed because of the lack of toxicological data for these two groups. However, since no adverse effects were measured for mammals and birds, the potential risk from bioaccumulative chemicals to amphibians should also be acceptable as amphibians and reptiles are lower on the food chain and, consequently, concentrations of bioaccumulated chemicals in their systems would be less than in higher-level animals.

**Pre-Design Study (2007)**

A Pre-Design Study (PDS) was conducted between February and October 2006 to assess the effectiveness of enhanced in-situ bioremediation technology to degrade TCE and CT at ST-14 through reductive dechlorination. The PDS tested, and ultimately demonstrated, the effectiveness of the proposed approach and technology at ST-14 (Earth Tech, 2007).

The scope of the PDS involved the following components: (1) installation of injection and monitoring wells at three test areas (Figure 2-4); (2) baseline groundwater sampling and analyses; (3) injection of sodium lactate; (4) regular monitoring and analysis of geochemical parameters; (5) quarterly groundwater sampling and analysis to assess trends in the reduction and degradation of contaminant concentrations, microbial populations and available electron acceptors; and (6) re-injections of sodium lactate. Geochemical parameter monitoring and groundwater sampling were performed at a total of twelve locations (one injection point and three monitoring points at each of three test areas).
The results of the PDS were used to demonstrate how enhanced in-situ bioremediation could cleanup the groundwater contamination at ST-14. It was determined that the radius of influence for sodium lactate injections was 20 to 25 feet. In the PDS, approximately six months were required after the initial injection to establish a stable anaerobic reduction zone; however, it is anticipated that the six month lag time will be reduced when the full-scale remedy is implemented because of increased groundwater residence time in the thicker treatment zones created. A re-injection frequency of eight weeks supplied sufficient organic carbon to maintain reducing conditions at all test areas.

2.2.3 Enforcement Activities

Environmental investigations have been conducted at the Base since 1985 under the USAF’s ERP and through which ST-14 was identified as an environmental site. In 1983, MDE issued a Consent Order requiring soil sampling near an UST removal, which was completed in accordance with the Order.

2.3 COMMUNITY PARTICIPATION

The FS report and Proposed Plan for ST-14 at Andrews AFB, Maryland were made available to the public in April 2007. The AF has established an Information Repository, where key documents relied upon to make remedial decisions are placed. To review the documents in the Information Repository, visit:

Prince George’s County Memorial Library-Surratts-Clinton Branch
9400 Piscataway Road
Clinton, MD 20735
Phone (301) 868-9200
Hours: Monday–Wednesday 10am–9pm
Thursday–Friday 10am–6pm
Saturday 10am–5pm
Sunday 1pm–5pm (Sept. to mid-June)

The notice of availability of the Proposed Plan, along with a brief description of the plan, was published in the Prince George’s County Gazette and the Washington Post-Prince George’s “Extra” weekly edition on April 26, 2007. In addition, a public meeting was held on May 9, 2007, to present the Proposed Plan to community members (See Appendix D). The USAF and regulatory representatives were present to answer questions regarding the site conditions and evaluated alternatives. One community member was present at the meeting. No comments were received during the public comment period, which ran from April 26 to May 25, 2007.

2.4 SCOPE AND ROLE OF RESPONSE ACTION

This ROD summarizes several remedial alternatives evaluated for ST-14 and selects a remedy for the site. The actions described in this ROD will be performed under the authority of the USAF, USEPA, and in coordination with the MDE and the Prince George’s County Health Department. The selected remedy will address groundwater contamination at ST-14 and fits into the overall strategy to investigate and appropriately address the 28 ERP sites and 5 AOCs at Andrews AFB.

Since being listed on the NPL, four CERCLA RODs have been signed for sites at Andrews AFB and Brandywine DRMO, a nearby off-base site managed by Andrews AFB for purposes of CERCLA. As of the date of this ROD, remedy decisions and associated remedies have been implemented at three of the sites. The designation, media, and remedial action identified in the ROD for each of the sites are listed below:

- Site ST-10, PD-680 Spill Site, Groundwater Monitoring and ORC Injection (ROD September 2005)
- Site FT-04, Fire Training Area 3, Monitoring of HRC Treatment and Institutional Controls (ROD November 2005)
• Site SS-01, Brandywine DRMO, Bioaugmentation and Carbon Substrate Addition with Gradient Control (Interim ROD September 2006)
• Site SD-23, Sludge Disposal Area, No Action (ROD May 2007)

2.5 SITE CHARACTERISTICS

2.5.1 Physical Setting

ST-14 is defined as an approximately 73-acre rectangular area in the northeastern portion of the Base where there is a TCE groundwater plume (Figure 2-2). The area is comprised of low-rise office buildings, hangars, roads, parking lots, and grassed areas. The site is bordered by a creek to the northeast. The shallow soils underlying the site generally comprise three stratigraphic lithologies: clayey, gravelly silt; an intermediate sand and gravel stratum; and an underlying silty fine sand (IT, 2000). The Calvert Formation, a regional aquitard beneath Andrews AFB, is generally encountered at 38 to 40 feet bgs in the upgradient areas of the ST-14 area, although it outcrops a few feet below the top of the bank along the tributary of Cabin Branch on the northeast side of the site (Shaw, 2005).

Shallow groundwater at ST-14 is approximately 15 to 20 feet bgs within the majority of the site, but gradually decreases to the northeast in rough proportion to the lowering land surface elevation towards the Cabin Branch tributaries. The downward migration of shallow groundwater is limited by the Calvert Formation at a depth of approximately 38 to 40 feet bgs.

Groundwater in the area of ST-14 flows to the northeast and southeast due to a groundwater divide, which is illustrated in Figure 2-4. The hydraulic conductivity was estimated to be between $1.2 \times 10^{-3}$ and $8.6 \times 10^{-5}$ centimeters per second (cm/sec) (IT, 1997). Previous studies estimated corresponding groundwater velocities of 5.8 to 85 feet per year (ft/yr) based on a porosity of 0.3 and a hydraulic gradient of 0.02 feet per feet (ft/ft) from the flight line to the Cabin Branch tributary (see Figure 2-5) (IT, 1997).

Receptors come into contact with groundwater at ST-14 only in the areas where groundwater seeps to the tributaries of Cabin Branch in the northeastern portion of the Site. There are no human receptors because shallow groundwater at ST-14 is not used as a potable water supply. Deeper regional aquifers are used as sources for potable water, as discussed in Section 2.6.

No areas of archaeological or historical importance are present at ST-14.

2.5.2 Conceptual Site Model

The conceptual site model (CSM) for a site outlines contaminant sources, release mechanisms, exposure pathways, migration routes, and potential receptors based on current and future land use. The CSM provides a basis for risk assessments and responses. A CSM illustrating potential human and ecological exposure pathways at ST-14 is presented in Figures 2-6 and 2-7, respectively.

Human receptors evaluated for exposure to ST-14 groundwater include current and future groundskeepers, construction workers, school-age visitors, and future residents. Risk scenarios were developed for a variety of exposure pathways. Potential risks to human health are identified in Sections 2.7.1 through 2.7.2. A summary of the potential receptors and corresponding potential exposure pathways are presented in the following table.
Ecological receptors were evaluated for exposure to contaminants from ST-14 in the SERA. Risks were identified for the following receptors and pathways:

- Direct exposure of invertebrate, plant, and terrestrial reptile communities to aluminum, antimony, chromium, iron, vanadium, and polynuclear aromatic hydrocarbons (PAHs) in soil.
- Direct exposure of fish, aquatic plants, amphibians, and aquatic reptiles to iron and silver in surface water.
- Direct exposure of benthic (stream sediment) invertebrates, aquatic plants, amphibians, and aquatic reptiles to PAH in sediment.

The SERA concluded that the segment of Cabin Branch affected by ST-14 is not conducive to support aquatic communities and that limited benthic habitat in the tributary of Cabin Branch is natural since the interface between the Brandywine and the Calvert Formation (clay) forms the stream substrate. Therefore, the natural geologic conditions limit the habitat and, consequently, benthic organisms are limited as well. It was also noted that many of the potential risk drivers (i.e. aluminum, antimony, chromium, iron, silver, and vanadium) are not associated with known releases at ST-14 and may be the result of natural variation of soil metals above Andrews AFB background surface soil concentrations.

### 2.5.3 Nature and Extent of Contamination

This subsection summarizes the nature and distribution of contaminants in environmental media at ST-14. Evaluated media include the following:

- Groundwater
- Surface soil
- Soil at potential groundwater contaminant source areas
- Surface water and sediment

Data supporting this summary are presented in the Final CEI report (IT, 2000b) and the Final CEI Addendum (Shaw, 2005), which together comprise the remedial investigation (RI) for ST-14. The following discussion is based primarily on Section 4.0 of the Final CEI Addendum.

#### 2.5.3.1 Groundwater

Based on analysis of samples collected from direct-push points and 38 monitoring wells, the groundwater contamination at ST-14 primarily consists of: TCE (and its breakdown products cis-1,2-DCE and VC); CT; petroleum-related contaminants including benzene, toluene, 1,2-DCA, EDB, trimethylbenzenes, and xylenes; pesticides including lindane and heptachlor epoxide; and inorganics (metals).
**VOCs and SVOCs.** TCE was detected in groundwater across the majority of the ST-14 area. As illustrated in Figure 2-8 (adapted from the Final CEI Report [Shaw, 2005]), a groundwater plume approximately 1,800 feet long and 1,700 feet wide contains TCE at concentrations that exceed the maximum contaminant level (MCL) of 5 micrograms per liter (µg/L). Isoconcentration contours of TCE indicate four distinct areas of relatively high concentration and suggest potential upgradient sources in the vicinity of monitoring wells MW17-ST14 (TCE = 1,600 µg/L), MW11-ST14 (TCE = 1,400 µg/L), MW12-ST14 (TCE = 450 µg/L), and MW23-ST14 (TCE = 71 µg/L). Analysis of samples collected from soil borings completed in the vicinity of these wells during the CEI did not identify a continuing source for the contamination.

As a result of the lack of tetrachloroethene (PCE) detections at ST-14, it is believed that TCE is the parent compound released to the environment and not a PCE daughter product. TCE was commonly used as a degreaser by the USAF from the 1940s through the 1960s. Evidence of reductive dechlorination (natural breakdown) exists at the site as detections of cis-1,2-DCE (maximum detection of 220 µg/L in MW17-ST14) and VC (maximum detection of 5 µg/L in MW37-ST14). However, the persistence of TCE in downgradient locations indicates that the rate of degradation is low or possibly stalled. Available data for soil and groundwater do not suggest the presence of chlorinated VOCs as non-aqueous phase liquid (NAPL).

Trends in concentrations of TCE could not be determined by analysis of data collected over a span of up to 10 years. Variability in TCE concentrations of 1 to 2 orders of magnitude has been observed in some monitoring wells. The reason is for the variation in concentrations is not known; the reason could be variations in sampling protocol, plume migration, fluctuation in groundwater flow/level, or another mechanism (Shaw, 2005).

TCE has migrated significantly downgradient from its suspected source area(s). TCE has been detected in samples collected from seeps on the banks of two tributaries of Cabin Branch (IT, 2000b). The seeps are located above the contact between the shallow groundwater zone and the Calvert Formation. TCE has not been detected in MW36-ST14, which is screened in the Calvert Formation, indicating that TCE is not migrating vertically downward.

CT was detected in several monitoring wells in the northern portion of ST-14. The MCL of 5 µg/L was exceeded in five monitoring wells. Isoconcentration contours for CT indicate a potential source area near monitoring well MW23-ST14 (CT = 75 µg/L). The isoconcentration contours can be seen in Figure 2-9. The Final CEI Addendum identifies the Northern Fire Department Wash Site as the source for CT in groundwater at ST-14. The plume initially migrates eastward before assuming a northeasterly flow as it approaches the Cabin Branch tributary. CT has not been detected in groundwater seep, surface water, or sediment samples.

A second CT plume was identified southeast of the Former East Side Gas Station in the vicinity of MW31-ST14 (39 µg/L) and MW32-ST14 (22 µg/L). The source of this plume may be CT that was discarded after being used to clean auto parts at the gas station (Shaw, 2005). CT was not detected in soil samples collected in the area. Groundwater flows to the southeast. CT has not been detected in the nearby tributary of Cabin Branch.

Gasoline-related VOCs including benzene, toluene, ethylbenzene, tert-butyl benzene, chloromethane, EDB, 1,2-DCA, and trimethylbenzene isomers have been detected in the vicinity of the Former East Side Gas Station. The SVOCs naphthalene and 2-methylnaphthalene have also been detected in this area. Benzene is the predominant contaminant, with detections of up to 20,000 µg/L (Figure 2-10). The benzene plume migrates eastward and northeastward towards the tributaries of Cabin Branch. Benzene has been detected in seep locations along the banks of both tributaries. Direct-push sampling conducted in June 2006 did not identify residual source area soils with benzene contamination.

**Pesticides.** Pesticides were detected in samples from 18 monitoring wells. The detections were not distributed in any discernible pattern. All of the detections were at concentrations below 1 µg/L. The pesticides identified in groundwater were: aldrin; lindane; alpha-, beta-, and delta-benzenehexachloride (BHC); alpha- and gamma-chlordane; 4,4’-DDD; 4,4’-DDE; 4,4’-DDT; dieldrin; endosulfan I and II; endrin; heptachlor; and heptachlor epoxide. With the exception of lindane (one sample) and heptachlor epoxide
(two samples), the detections were below their applicable MCLs. The minor pesticide detections were factored into the BHHRA, but were insignificant to the overall results of the risk analysis.

**Inorganics (Metals).** Cadmium, chromium, lead, and thallium were detected in at least one groundwater sample at levels exceeding their respective MCLs or action levels. Lead is the only inorganic chemical detected above a regulatory standard that can be attributed to releases at the site. Lead was detected at a concentration of 94.6 µg/L in a filtered sample collected from MW10-ST14. The lead in the groundwater sample likely originated from releases of leaded gasoline. Lead was detected at other monitoring wells in the benzene plume at concentrations below the federal action level of 15 µg/L.

Cadmium was detected in three samples at concentrations exceeding the MCL of 5 µg/L. Thallium detections exceeded the MCL of 2 µg/L in samples from 16 monitoring wells. Chromium exceeded the MCL in one sample at a concentration of 158 µg/L in MW10-ST14. The maximum detection of iron was 108,000 µg/L in an unfiltered sample collected from MW04-ST14. Arsenic, antimony and manganese were all detected at concentrations below MCLs or action levels.

### 2.5.3.2 Soil at Potential Groundwater Contaminant Source Areas

Three soil borings were completed at six separate potential source areas as part of the CEI and Supplemental CEI. Based on the analysis of the samples collected from the six locations, soil containing VOCs, SVOCs, pesticides, and metals were reported. Only borings from the Former Aircraft Wash Rack and the Northern Fire Department Wash Site had contaminant concentrations that were consistent with past releases. However, the contaminant concentrations in these two areas appear too low to act as a continuing source for downgradient groundwater contamination.

Boring locations, numbers and target analytes are presented in the following table.

<table>
<thead>
<tr>
<th>Program and Area</th>
<th>Soil Borings</th>
<th>Target Analytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEI Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Former East Side Gas Station</td>
<td>SB07, SB08, SB09</td>
<td>VOCs</td>
</tr>
<tr>
<td>Former Aircraft Wash Rack</td>
<td>SB16, SB17, SB18</td>
<td>VOCs</td>
</tr>
<tr>
<td>Southern Fire Dept. Wash Site</td>
<td>SB19, SB20, SB21</td>
<td>VOCs</td>
</tr>
<tr>
<td>Supplemental CEI Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Former Vehicle Wash Rack</td>
<td>SB22, SB23, SB24</td>
<td>VOCs, SVOCs, pesticides/PCBs metals, TOC</td>
</tr>
<tr>
<td>Area Near Naval Air Facility</td>
<td>SB25, SB26, SB27</td>
<td>VOCs, SVOCs, pesticides/PCBs metals, TOC</td>
</tr>
<tr>
<td>Northern Fire Dept. Wash Site</td>
<td>SB28, SB29, SB30</td>
<td>VOCs, SVOCs, pesticides/PCBs metals, TOC</td>
</tr>
</tbody>
</table>

Detected VOC soil concentrations were compared to USEPA Region III SSLS and are discussed in the following paragraphs. The comparison aided in assessing the potential for soil to be a source for groundwater contamination. A dilution attenuation factor of 20 was used due to the anticipated size of individual sources (less than 0.5 acres), as recommended by the USEPA Soil Screening Guidance (USEPA, 1996).

**Former East Side Gas Station.** Petroleum-related VOCs were detected in SB07-ST14, located in the vicinity of the former USTs, and PID screening results indicated that most of the contaminated soil was located greater than 5 feet bg. Benzene, m,p-xylene, and trimethylbenzenes exceed their SSLS in samples collected from approximately 4.5 to 6.0 feet bg. However, the benzene concentrations are not consistent
with the concentrations necessary to provide a source for the high levels of benzene detected in groundwater samples from MW10-ST14.

**Former Aircraft Wash Rack.** TCE, 1,2-DCE, and several petroleum-related VOCs were detected in soil borings SB17-ST14 and SB18-ST14 at the Former Aircraft Wash Rack. Benzene and TCE exceeded their SSLs in samples taken from approximately 6.0 to 7.5 feet bgs (within a thin clay layer). The concentrations of TCE (17 µg/kg max) and benzene (4.5 µg/kg max) are consistent with a release of TCE and fuel but are not high enough to supply a continuing source for downgradient groundwater contamination. The SSL exceedances were not statistically significant (2 exceedances in 6 samples collected) and do not indicate that soil contamination could recontaminate the groundwater after completion of the remedy.

**Southern Fire Department Wash Rack.** Acetone and chloroform were the only VOCs detected above the laboratory reporting limits in samples collected from soil borings at the Southern Fire Department Wash Rack. Acetone was detected above the SSL in 2 of 4 samples from borings SB19-ST14 and SB20-ST14. Chloroform was detected in one of six samples above the SSL in a sample collected approximately 1 foot bgs at SB21-ST14. TCE and its daughter products were not detected in samples collected from the borings. The soil data collected does not indicate a source area for downgradient groundwater contamination. The SSL exceedances were not statistically significant and do not indicate that soil contamination could recontaminate the groundwater after completion of the remedy.

**Former Vehicle Wash Rack.** Several VOCs, SVOCs, pesticides, and metals were detected in samples collected from at least one of the soil borings completed in the vicinity of the Former Vehicle Wash Rack. Trimethylbenzene isomers, benzene, ethylbenzene, isopropyl benzene, toluene, n-propylbenzene, and xylenes were detected at concentrations of at least 12 µg/kg in samples from SB23-ST14 and SB24-ST14 collected directly below the asphalt. These detections may be associated with the overlying asphalt rather than with a release of gasoline (Shaw, 2005). Benzene was detected in SB23-ST14 above its SSL at a depth of 0.5 to 1.0 feet bgs. TCE and its daughter products were not detected in the borings.

Twenty SVOCs were reported in the deeper samples of SB23-ST14 and the shallow sample of SB24-ST14. The 9- to 10-foot bgs sample from SB23-ST14 contained benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene at concentrations of up to 17,000 µg/kg. The source of the PAHs is most likely from the fuels used in the area. The limited mobility of these PAHs, and isolated nature of their detections, suggest that little risk of contact or future uptake by potential receptors exists.

Aluminum, arsenic, chromium, iron, and vanadium were identified as chemicals of potential concern (COPCs) in the risk assessment and were detected in several samples. None were detected in more than one sample at a concentration that exceeded the upper tolerance limits (UTLs), indicating that concentrations may not be elevated in comparison to background levels (Shaw, 2005). The data collected at the Former Vehicle Wash Rack indicate that it is unlikely to be a source of groundwater contamination.

**Area Near Naval Air Facility.** Soil borings SB25-ST14, SB26-ST14, and SB27-ST14 were completed in the vicinity of monitoring wells MW13-ST14 and MW15-ST14 where elevated levels of TCE (890 µg/L) have been observed. Three samples were collected from each boring. VOCs, SVOCs, pesticides, and metals were detected in samples collected from the soil borings.

TCE was detected in three surface samples (0.5 to 1.0 feet bgs) at concentrations below the residential RBC and above the SSL, but was not detected in the deeper samples; 1,4-dichlorobenzene was also detected in one of the surface samples at a concentration slightly exceeding the SSL. The low TCE concentrations are not believed to signify a local soil release. The SSL exceedances were not statistically significant and do not indicate that soil contamination could recontaminate the groundwater after completion of the remedy.

Fourteen SVOCs were detected in the surface soil sample from SB25-ST14. SVOCs were not detected in the deeper samples. Six pesticides were detected in surface soil samples. No detections occurred in deeper samples indicating that their presence in surface soil was the result of normal application and not a release. Arsenic, chromium, and manganese were detected in several samples. No more than two detections
exceeded background UTLs for any of the metals, indicating that the concentrations present do not deviate significantly from background levels.

**Northern Fire Department Wash Site.** Soil borings SB28-ST14, SB29-ST14, and SB30-ST14 were completed at the Northern Fire Department Wash Site. Three samples were collected from each boring. VOCs, SVOCs, pesticides, and metals were detected in samples collected from the borings.

Twenty-seven VOCs were detected in at least one of the subsurface soil samples collected from SB30-ST14. The compounds with the highest detected concentrations were bromochloromethane (7,600 µg/kg); p-isopropyltoluene (3,500 µg/kg); methylene chloride (280 µg/kg); and dibromomethane (190 µg/kg). Bromochloromethane and dibromomethane are compounds used in fire extinguishers. Methylene chloride and p-isopropyltoluene are solvents. The presence of these compounds in subsurface soil indicates that the area was used for cleaning fire trucks and discharging fire extinguishers.

TCE was detected in the 9- to 10-foot bgs interval of SB30-ST14 at a concentration of 3.2 µg/kg, exceeding the SSL of 0.26 µg/kg. Methylene chloride and 1,4-dichlorobenzene also exceeded their SSLs in this sample. While uncertain, the source of these contaminants is most likely the historic activities at this location. The SSL exceedances were not statistically significant and do not indicate that soil contamination could recontaminate the groundwater after completion of the remedy.

A total of 11 SVOCs were detected in the shallow and deep samples from SB28-ST14. SVOCs were not detected in samples from SB29-ST14. Benzoic acid was detected in the 9- to 10-foot bgs interval of SB30-ST14. Twelve pesticides were detected in one surface soil sample and four subsurface soil samples.

Above-background levels of barium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, potassium, sodium, vanadium, and zinc were observed in samples from the soil borings at the Northern Fire Department Wash Site. There is no apparent correlation between the elevated levels of metals and organic contamination, and the metals may be from non-native fill added during construction activities.

The analytical results of soil borings at the Northern Fire Department Wash Site are consistent with a release of solvents. However, the detected concentrations are not considered significant enough to indicate existence of a continuing source for downgradient groundwater contamination.

The low SSL exceedances were less than their applicable EPA Region III Residential RBCs for soils. Two of nine samples contained exceedances of the TCE SSL, while one of nine samples contained exceedances of the methylene chloride and 1,4-dichlorobenzene SSLs. The exceedances were not statistically significant and do not indicate that soil contamination could recontaminate the groundwater after completion of the remedy. Because the remedy consists of multiple injections into the subsurface coupled with performance monitoring, residual subsurface soil contamination which may leach to groundwater will be remedied over time. Additional treatment can be undertaken if groundwater contaminant concentrations stagnate or rise due to a rebound effect.

### 2.5.3.3 Surface Soil

Near-surface soil sampling conducted during the remedial investigation activities found several samples with low VOC, PAH, and pesticide concentrations. The concentrations encountered did not readily appear to be indicative of significant release or continuing source areas, but rather routine and non-localized ongoing base operations and pesticide application.

During the CEI, surface soil was collected from eight locations and analyzed for VOCs, SVOCs, metals, and TOC. The locations were sampled again as part of the supplemental CEI activities and analyzed for pesticides. Low concentrations of up to five VOCs were present in all eight of the initial samples. TCE and 1,1,1-trichloroethane were identified in one sample at concentrations of 3.6 and 0.87 µg/kg, respectively. One sample contained 11 PAHs and a second sample contained seven. The other six samples did not contain any SVOCs. A total of 20 TAL inorganics were reported in the samples.
Ten pesticides were detected in the surface soil samples. Only one compound, dieldrin, exceeded its preliminary risk screening value. Dieldrin was detected at 190 µg/kg in SS01-ST14. SS01-ST14, located on the northwest side of the Former East Side Gas Station, had the highest occurrence of pesticide detections.

### 2.5.3.4 Surface Water and Sediment

Surface water and sediment samples collected from the Cabin Branch tributaries downstream of ST-14 contained TCE and DCE, indicating the edge of the groundwater plume has reached this boundary.

Five surface water and sediment sample pairs (SW/SE05-ST14 through SW/SE09-ST14) were collected from the main tributary of Cabin Branch at the northern boundary of ST-14. Two sample pairs (SW/SE03-ST14 and SW/SE04-ST14) were collected from the minor (southern) tributary of Cabin Branch that begins at Fetchet Avenue. The samples were analyzed for VOCs, SVOCs, and metals. Surface water samples were also analyzed for total dissolved solids and pH.

TCE was detected in surface water and sediment in two locations along the major tributary. TCE was detected at 1 µg/L at SW07-ST14, where the TCE and benzene plumes discharge to the creek. Cis-1,2-DCE and benzene were also detected in this sample at concentrations of 0.94 µg/L and 2.5 µg/L, respectively. TCE was also detected in surface water sample SW06-ST14 at a concentration of 0.56 µg/L. The sediment sample containing the highest level of TCE (56 µg/kg), SE06-ST14, is located approximately 170 feet downstream from SW06-ST14. VOCs were not detected in the surface water and sediment samples collected from the minor (southern) tributary. Samples collected downstream from the point where the tributaries merge did not contain VOCs. One of the seven sediment samples contained SVOCs at concentrations that exceeded risk criteria. The presence of SVOCs in sediment was attributed to runoff from roads and parking lots.

### 2.6 CURRENT AND FUTURE LAND AND RESOURCE USES

ST-14 is located in a developed part of Andrews AFB with industrial and administrative usage. There are numerous buildings on site that are used by workers, but no residential buildings are present. Land use at this site will continue to be industrial/administrative for the foreseeable future, with the addition of some retail food establishments expected in the coming years. Although unlikely, residential usage is possible should the base mission change significantly. In this instance, even if changed to residential, groundwater usage by residents is extremely unlikely. Despite this extremely unlikely possibility, to be conservative, the site risk was evaluated with respect to residential usage, assuming that residents would be using groundwater for potable purposes.

There are no potable water supply wells located on Andrews AFB, including ST-14. Groundwater at ST-14, and throughout the Base, is not used as a potable water source at this time and is not expected to be used for such purposes in the future. Andrews AFB is currently served by public water supplied by the Washington Suburban Sanitary Commission (WSSC), which obtains its water from surface waters of the Potomac and Patuxent Rivers. Typical water supply wells in Prince George’s County draw water from confined deep aquifers located between 200 and 600 feet below grade, which is significantly deeper than the surficial aquifer impacted by ST-14. The silt and clay of the Calvert Formation, which underlies the shallow groundwater at ST-14, act as a semi-confining layer, limiting the vertical migration of contaminated groundwater from ST-14. Horizontal migration off-site is possible as groundwater from ST-14 discharges to the tributaries of Cabin Branch.

Maryland’s Anti-Degradation Policy (Code of Maryland Regulations [COMAR] 26.08.02.04) requires protection of the quality of the waters of the state, including groundwater, restricts water quality degradation, and requires improvement of water quality that does not meet applicable standards. As a result, groundwater clean-up criteria are based on the possible future use of groundwater for potable purposes, regardless of the unlikelihood of such use.
2.7 SUMMARY OF SITE RISKS

The Final CEI Addendum contains a BHHRA to document potential human health risks associated with exposure to site media at ST-14. A site-specific SERA was prepared to assess whether chemicals released from the East Side Gas Station and other source areas at the site pose unacceptable risks to ecological receptors. The following subsections summarize the results of the BHHRA and SERA as presented in the Final CEI Addendum (Shaw, 2005). Details of the risk assessments are contained in Sections 6.0 and 7.0 of the Final CEI Addendum.

2.7.1 Human Health Risk Assessment Summary

The primary objective of the BHHRA was to provide risk-based information for site management decisions involving the environmental media at the site. Specifically, this included the following:

- Identify and evaluate baseline risks to human health (i.e., risks that may exist in the absence of remediation or institutional controls) associated with environmental media.
- Identify and evaluate uncertainties and potential data gaps associated with potential risks.

The conclusions of the BHHRA provide a basis for (1) determining whether future study and/or site remediation is appropriate and (2) comparing potential health and environmental impacts associated with various remedial alternatives evaluated in the FS. The BHHRA was prepared following the Risk Assessment Guidance for Superfund (RAGS) Human Health Evaluation Manual, Part D, Standardized Planning, Reporting and Review of Superfund Risk Assessment (USEPA, 2001b).

The BHHRA was conducted for surface soil, subsurface soil, groundwater, surface water, and sediment associated with ST-14. These media, as well as air concentrations modeled from soil and groundwater, were screened against the respective USEPA Region III Risk-Based Concentrations (RBCs) to identify COPCs for the various media. A comparison of background data was used to determine whether each COPC was site-related or existed naturally at the site.

2.7.1.1 Identification of Contaminants of Potential Concern

The selection of COPCs is a conservative screening process that identifies those chemicals that may be present at the site at concentrations that could result in risks to exposed receptors. The COPC selection process is conservative to ensure that potential risks are not overlooked at the early stages of the BHHRA. The maximum detected concentration of each compound in each medium (surface soil, subsurface soil, groundwater, and sediment) was compared to a screening value to select the COPCs. If the maximum detected concentration of a compound exceeded the screening value, the compound was selected as a COPC and retained for further evaluation. USEPA Region III RBCs were used as the screening levels to identify COPCs. These RBCs are conservatively set to represent an excess lifetime cancer risk of $1 \times 10^{-6}$ or a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. Chemicals eliminated from further evaluation at this step do not present unacceptable risks to exposed human receptors.

2.7.1.2 Exposure Assessment

The exposure assessment defines and evaluates the type and magnitude of human exposure to the chemicals present at a site or migrating from a site. The exposure assessment depicts the physical setting of the site, identifies potentially exposed populations, and estimates chemical intakes under the identified exposure scenarios. A complete exposure pathway consists of all five of the following elements: source (e.g., chemical), environmental transport medium (e.g., subsurface soil), mechanism for release and migration of chemical (e.g., leaching from subsurface soil), point or site of human contact (exposure point, e.g., groundwater accumulating in an excavation), and route of intake (e.g., accidental ingestion of groundwater by a site worker). The compilation of contaminant sources, potentially complete exposure pathways, and potential receptors is depicted in the BHHRA CSM in Figure 2-6.
The potential human receptors evaluated for exposure to the selected site media at ST-14 are identified in Section 2.5.2. The reasonable maximum exposure (RME) scenario was evaluated for each receptor. The RME scenario represents the highest level of human exposure that could be reasonably expected to occur. For scenarios where the RME hazard of risk was greater than the USEPA target level, the central tendency exposure (CTE) scenario was evaluated to provide additional information. The CTE scenario portrays the median exposure estimate and corresponding risk rather than upper limit or maximum exposure estimate.

Pathway-specific information for these receptors, such as the values of exposure parameters used to quantify exposure, is presented in the Final CEI Addendum (Shaw, 2005). Exposure parameters used in the BHHRA were compiled from USEPA sources and professional judgment.

2.7.1.3 Toxicity Assessment

This section provides the methodologies for the characterization of the potential human health risks associated with exposure to site media. The toxicity assessment identifies the potential adverse health effects in exposed populations from exposure to site contaminants. Toxicity values used in the BHHRA were obtained from sources in accordance with the USEPA policy on human health toxicity values in Superfund risk assessments (USEPA, 2003).

The toxicity value used to evaluate carcinogenic effects is the cancer slope factor (CSF). The CSF is an upper-bound estimate of the probability that a person will develop cancer over a lifetime based on a given dosage. The toxicity value used to evaluate non-carcinogenic effects is the reference dose (RfD). The RfD is an estimate of the daily exposure level for the human population that is likely to be without appreciable risk during an established period of time, ranging from several weeks to a lifetime, depending on the exposure scenario being evaluated.

2.7.1.4 Risk Characterization

The results of the exposure assessment and toxicity assessment were used to develop numerical estimates of the potential health risks associated with site-related contamination.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. The incremental probability is generally expressed in scientific notation (e.g., $1 \times 10^{-6}$). An incremental lifetime cancer risk (ILCR) of $1 \times 10^{-6}$ indicates a 1 in 1,000,000 chance of developing cancer as a result of exposure to site media. This risk is in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. The NCP at 40 CFR Section 300.430(e)(2)(i)(A)(2) indicates that a generally acceptable risk range for site-related exposures is $1 \times 10^{-4}$ to $1 \times 10^{-6}$.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified period (e.g., lifetime) with an RfD derived for a similar exposure period. An RfD represents a level to which an individual may be exposed that is not expected to result in any adverse health effects. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ of less than 1 indicates that a receptor’s dose of a single contaminant is less than the RfD and that toxic non-carcinogenic effects from that chemical are unlikely. The hazard index (HI) is the sum of the HQs for all chemicals of concern (COCs) to which a receptor is exposed. An HI of less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. An HI of greater than 1 indicates that site-related exposure may present a risk to human health.

2.7.2 Baseline Human Health Risk Assessment Results

There are currently no complete pathways to contaminated groundwater at ST-14. The groundwater at ST-14 is not used currently for drinking, washing, or industrial uses because the base is served by public...
water supplied by WSSC. As a conservative measure, however, the BHHRA evaluated potential risks from exposure to groundwater for future residents (adult and child).

Based on hypothetical future land use scenarios, the BHHRA identified potential human health risks from vapor intrusion, child exposure to soil (includes subsurface), accidental ingestion of groundwater by construction workers and groundskeepers, and residential use of groundwater as exceeding the USEPA risk-management guidelines or a target HI of 1.

The calculated RME ILCR for the future construction worker ($4 \times 10^{-5}$) does not exceed the USEPA’s risk-management range, while the calculated ILCRs for the future groundskeeper ($9 \times 10^{-6}$) and future resident ($5 \times 10^{-3}$) scenarios do exceed the risk-management range. The calculated CTE ILCR for the future construction worker ($9 \times 10^{-5}$) and groundskeeper ($6 \times 10^{-5}$) do not exceed the risk-management range, but the calculated CTE ILCR for the future resident ($3 \times 10^{-4}$) does. The calculated RME and CTE HI values for the future construction worker (16 and 5), future child resident (107 and 26), and future adult (68 and 16) exceed the HI criterion of 1. The only future receptor scenario with both an RME and a CTE ILCR that do not exceed the risk-management range is the future school-age visitor ($5 \times 10^{-6}$ and $5 \times 10^{-7}$, respectively); similarly, the calculated RME (0.1) and CTE (0.01) HI values for this receptor are less than the HI criterion of 1.

Risks associated with the use of groundwater as tap water (for all exposures) accounted for the greatest portion of risks for the future construction worker, future groundskeeper, and future resident. The BHHRA points out that the installation of a shallow well for use of untreated tap water is highly unlikely on Andrews AFB. For comparison purposes only, assuming that groundwater will not be used as tap water, the RME ILCR for the future groundskeeper would drop to $6 \times 10^{-5}$ and would be within the risk-management range. Similarly, the RME total HI values for the construction worker and groundskeeper would both be 1, and the CTE total HI values for the future construction worker and groundskeeper would both be 0.4.

Assuming future resident exposure to soil and vapor intrusion into a hypothetical residence, but not groundwater use, the calculated RME ILCR value of $1.96 \times 10^{-5}$ ($4.82 \times 10^{-5}$ associated with soil and $1.48 \times 10^{-4}$ associated with vapor intrusion exposure), still exceeds the risk-management range. The calculated CTE ILCR value of $2.3 \times 10^{-5}$ ($1.8 \times 10^{-5}$ associated with soil and $4.98 \times 10^{-6}$ associated with vapor intrusion) does not. The total calculated RME and CTE HI values for the child resident who does not use site groundwater (10 and 2, respectively) exceed the HI criterion of 1, indicating that adverse non-cancer effects could be likely. The calculated RME HI for the adult who does not use groundwater is 3, which exceeds the criterion of 1; the CTE HI (0.4) is less than 1 for this receptor. The RME ILCR and HI results were based on the assumption that the resident will live at the house for 30 years.

The vapor intrusion pathway accounts for 75 percent of the cancer risk and 56 percent of the non-cancer risk for the future resident in the RME scenario. The Final CEI Addendum points out that the model used to evaluate vapor intrusion is regarded only as a screening tool and that the vapor intrusion ILCR and HI values should be regarded as tentative (Shaw, 2005).

Exposure to lead was evaluated with the Integrated Exposure Uptake Biokinetic (IEUBK) Model using the model’s default setting and ST-14 mean soil and groundwater concentrations. Model outputs indicated a geometric mean lead blood level of 1.6 µg/L for an exposed child. Only 0.476 percent (USEPA protection goal is 5 percent) of children would be expected to have blood-lead concentrations of 10 micrograms per deciliter. A child blood-lead level of 10 micrograms per deciliter is considered elevated by the USEPA. It is expected that modeled blood-lead levels for adults would be lower. Therefore, unacceptable human health risks from lead exposure at ST-14 are not expected.

### 2.7.3 Screening Ecological Risk Assessment

Results of food-chain modeling indicated that exposure of terrestrial and aquatic upper trophic-level receptors (mammals and birds) to bioaccumulative chemicals detected at ST-14 is acceptable. Potential risk to amphibians and reptiles could not be directly assessed because of the lack of toxicological data for these two
groups. However, based on the fact that no adverse effects were measured for mammals and birds, the SERA concluded that the level of potential risk from bioaccumulative chemicals to amphibians and reptiles is also acceptable because those animals are lower on the food chain (Shaw, 2005). In addition, the SERA concluded that the segment of Cabin Branch affected by ST-14 is not conducive to support aquatic communities and that limited benthic habitat in the tributary of Cabin Branch is natural since the interface between the Brandywine and the Calvert Formation (clay) forms the stream substrate. Therefore, the natural geologic conditions limit the habitat and, consequently, benthic organisms (benthic receptors) are limited as well.

2.7.4 Conclusions of Risk Assessments and Basis for Action

The risk assessments determined that there are risks or hazards that exceed USEPA target levels for a future construction worker, future groundskeeper, future adult resident, and future child resident. Exposure to shallow groundwater (especially TCE in groundwater) accounts for the majority of the risk or hazard posed to hypothetical receptors. As a result, this ROD selects a response action to mitigate the risks potentially posed by TCE and other VOCs in groundwater. The response action selected in this ROD is necessary to protect public health or welfare from actual or threatened releases of pollutants or contaminants from the site which may present an imminent and substantial endangerment to public health and welfare. The risk associated with the low SSL exceedances in surface and subsurface soils will be eliminated through institutional controls. The SSL exceedances were not statistically significant and do not indicate that soil contamination could recontaminate the groundwater after completion of the remedy. Additionally, the selected groundwater remedy is expected to address residual soil contamination which may leach to groundwater over time because the remedy employs multiple injections into the subsurface coupled with performance monitoring. Additional treatment can be undertaken if groundwater contaminant concentrations stagnate or rise due to a rebound effect.

2.8 REMEDIAL ACTION OBJECTIVES

Based on an evaluation of site conditions, an understanding of the contaminants, the physical properties in groundwater, the results of the risk assessments, and an analysis of applicable or relevant and appropriate requirements (ARARs), the following remedial action objectives (RAOs) were developed for ST-14:

- Prevent the ingestion of shallow groundwater containing contaminants that exceed federal MCLs, non-zero maximum contaminant level goals (MCLGs), or in their absence, an excess cancer risk of $1 \times 10^{-4}$ to $1 \times 10^{-6}$ or a hazard quotient (HQ) of 1.
- Prevent off-site migration of shallow groundwater with contamination above cleanup levels.
- Restore shallow groundwater to expected beneficial uses to the extent practicable within a reasonable time frame.
- Prevent residential exposure to soil.
- Prevent residential and/or commercial exposure to groundwater contaminants at levels of concern via dermal contact, ingestion, or vapor intrusion.

The remedial action selected for the site should attain these RAOs, which address the unacceptable risks from VOCs in site soils and groundwater. The RAOs are intended to clean up the groundwater and, during the remediation, ensure potential future human receptors do not come into contact with the groundwater at the site (i.e., through drinking or contact during construction activities) so that no unacceptable exposure to the hazardous constituents will occur.

Achievement of the RAOs will be quantitatively measured by the achievement of cleanup criteria during the implementation of the remedy. Cleanup criteria for ST-14 were set to federal Safe Drinking Water Act MCLs.
### 2.9 DESCRIPTION OF ALTERNATIVES FOR GROUNDWATER

Six remedial alternatives were developed in the FS for ST-14 to address the constituents requiring remediation in site groundwater.

- Alternative 1: No Action
- Alternative 2: Limited Action
- Alternative 3: Source Control with Institutional Controls and Monitored Natural Attenuation
- Alternative 4: Site-wide Enhanced In-situ Biodegradation with Groundwater Monitoring and ICs
- Alternative 5: Source Control and Site-wide Enhanced In-Situ Biodegradation with Groundwater Monitoring and ICs
- Alternative 6: Groundwater Extraction and Treatment with Groundwater Monitoring and ICs

The following subsections describe the alternatives developed for groundwater at the ST-14 area.

#### 2.9.1 Alternative 1: No Action

CERCLA requires that the No Action alternative be evaluated to establish a baseline for comparison to other remedial alternatives. Alternative 1 will not be evaluated according to screening criteria, and will pass through screening to be evaluated during detailed analysis (USEPA, 1988b).

Review of available monitoring data suggests that conditions are not conducive to natural biological degradation of the plume, so reductions in concentration are expected to occur primarily as a result of flushing and the natural attenuation processes of dilution and dispersion. Based on the groundwater modeling conducted as part of the FS, the estimated time period to achieve cleanup goals for groundwater by no action is 200 years.

#### 2.9.2 Alternative 2: Limited Action

This alternative consists of groundwater monitoring and evaluation to assess changes in contaminant concentrations over time, implementation of institutional controls in the form of deed covenants or other legal instruments to prohibit potable use of groundwater for any ST-14 property transferred before attainment of cleanup goals, and 5-year reviews to assess whether original assumptions about exposure and potential risk remain true and whether the remedy remains protective of human health and the environment. ICs will be implemented through Andrews AFB restrictions on water use. In addition, Maryland’s Individual Water Supply and Individual Sewerage Systems regulations at COMAR 26.03.01.05 prohibit installation of individual water supplies where an adequate community water supply is available. Andrews AFB is served by the WSSC public water supply, and the Maryland regulations would prohibit installation of new private potable water supply wells.
Review of available monitoring data suggests that conditions are not conducive to natural biological degradation of the TCE plume, so reductions in concentration are expected to occur primarily as a result of flushing and the natural attenuation processes of dilution and dispersion. The benzene plume would be allowed to attenuate through degradation, flushing, dilution, and dispersion. Based on the groundwater modeling conducted as part of the FS, the estimated time period to achieve cleanup goals is 200 years.

2.9.3 Alternative 3: Source Control with Institutional Controls and Monitored Natural Attenuation

This alternative adds source control components, including groundwater hot-spot treatment, to the components of Alternative 2: Limited Action. The rationale for adding source control components is to reduce the overall time required for the groundwater plume as a whole to attenuate to cleanup criteria and meet the remedial action objectives.

A major benefit of Alternative 3 is that, if significant sorbed/residual chlorinated solvents or fuel-related hazardous substances persist in the suspected source areas, the additional treatment or removal of these source areas and treatment of groundwater hot-spot areas exceeding 1,000 µg/L will reduce the period of time that monitored natural attenuation monitoring activities must be performed, thereby lowering long-term operation and maintenance costs. Gasoline-contaminated soils at the Former East Side Gas Station would be excavated and treated as part of this alternative, and in-situ chemical oxidation would be used to treat a likely TCE source area between the Former Aircraft Wash Rack and Naval Air Facility.

The time benefits of adding source control to monitored natural attenuation are moderate. Based on the groundwater modeling conducted as part of the FS (Earth Tech, 2006), the estimated time period to achieve cleanup goals would be reduced from 200 to 150 years when source controls are added. Alternative 3 does not include specific measures to reduce the concentration of CT. The groundwater modeling discussed in the FS shows that CT will meet cleanup criteria in approximately 75 years without specific treatment. Since this is less than the amount of time needed for TCE to meet cleanup goals under Alternative 3, there is no time-benefit to providing CT treatment.

Alternative 3 would include ICs as described in Alternative 2. This alternative would also include an environmental monitoring program to assess long-term progress toward attaining remediation goals and 5-year reviews to assess whether original assumptions about exposure and potential risk remain true and whether the remedy remains protective of human health and the environment.

2.9.4 Alternative 4: Site-wide Enhanced In-situ Biodegradation with Groundwater Monitoring and Institutional Controls

This alternative replaces the source control components of Alternative 3 with enhanced biodegradation treatment zones for the contaminated groundwater. Enhanced in-situ biodegradation would utilize substrate addition to create anoxic conditions suitable for anaerobic reductive dechlorination of TCE and CT plumes. The benzene plume would be treated through in-situ enhanced aerobic biodegradation utilizing rows of oxygen-releasing compound subsurface injections.

A major benefit of Alternative 4 is that in-situ biodegradation should clean up the groundwater faster than source control with natural attenuation and significantly reduce the period of time that long-term monitoring activities must be performed, thereby lowering long-term operation and maintenance costs. The time benefits of adding enhanced in-situ biodegradation to natural attenuation are not quantifiable; however, the time benefits are greater for this alternative than for Alternative 3 because this alternative addresses both hot spot and site-wide contamination. Although no groundwater modeling was conducted to assess Alternative 4, it is estimated that approximately 20 to 30 years would be required to achieve cleanup objectives.

Alternative 4 would include ICs and an environmental monitoring program as described in Alternative 3.
2.9.5 Alternative 5: Source Control and Site-wide Enhanced In-situ Biodegradation with Groundwater Monitoring and Institutional Controls

This alternative adds an enhanced biodegradation treatment component for the chlorinated solvent groundwater plumes to the components of Alternative 3 to further reduce the overall time required for the groundwater plumes as a whole to reach cleanup criteria and meet the remedial action objectives. Similar to Alternative 3, this alternative is intended to encompass all of the source area technologies as a potential component of this alternative; however, this alternative will not evaluate each of these technologies independently. The enhanced biodegradation component of this alternative would target the remediation of the TCE and CT plumes through enhanced biological reductive dechlorination. The benzene plume would be allowed to attenuate through degradation, flushing, dilution, and dispersion.

A benefit of Alternative 5 is that the additional treatment of a portion of the site-wide chlorinated solvent plumes (TCE and CT plumes) by enhanced biodegradation could significantly reduce the period of time that monitored natural attenuation activities (only required for the plume) must be operated, thereby lowering long-term operation and maintenance costs.

The time benefits of adding source control and groundwater treatment are substantial. Based on the groundwater modeling completed in the FS, the estimated time period for this alternative to achieve cleanup goals is 20 years.

As in Alternatives 3 and 4, Alternative 5 would include ICs and an environmental monitoring program.

2.9.6 Alternative 6: Groundwater Extraction and Treatment with Groundwater Monitoring and Institutional Controls

Alternative 6 includes extraction of contaminated groundwater from overburden to hydraulically contain the groundwater plume at ST-14 on site and to remove contaminant mass from the most concentrated areas of the plume. Alternative 6 would include ICs in the form of deed covenants or other legal instruments to prohibit potable use of groundwater for any ST-14 property transferred before attainment of cleanup goals. Maryland’s Individual Water Supply and Individual Sewerage Systems regulations at COMAR 26.03.01.05 prohibit installation of individual water supplies where an adequate community water supply is available. Andrews AFB is served by the WSSC public water supply, and the Maryland regulations prohibit installation of new water supply wells. This alternative also includes: (1) an environmental monitoring program to assess long-term progress toward attaining cleanup criteria and (2) five-year reviews to assess whether original assumptions about exposure and potential risk remain true and whether the remedy remains protective of human health and the environment. Alternative 6 does not include remedial components to reduce the mass of sorbed contaminants in subsurface soil (except by dissolution and flushing).

The FS assumed that groundwater extraction would be implemented through installation of 14 groundwater extraction wells corresponding to a combined hot spot and containment pumping scenario. Two of the wells would be located in the vicinity of the highest TCE concentrations, and 12 would be installed as a well fence near the downgradient extent of the plumes. Extracted groundwater would be pumped from the extraction wells via pipelines to a new on-site treatment facility where it would be treated prior to discharge to either the Andrews AFB sanitary sewer system or to the storm sewer system for ultimate discharge.

Based on the groundwater modeling conducted in the FS, the estimated time period for this alternative to achieve cleanup goals is 75 years.

Environmental monitoring would be implemented in the overburden (shallow) aquifer. Monitoring locations would include plume boundaries to verify the area of effective groundwater capture and hydraulic containment. Monitoring would include water level measurements and water sample collection and analysis within the plume to assess long-term progress toward attaining cleanup goals. The monitoring network would also be used to verify that off-site migration is not occurring. The monitoring well network would include both
existing and new monitoring wells as appropriate. The long-term monitoring program would include 5-year site reviews to assess whether the remedy remains protective of human health and the environment.

2.9.7 Common Elements and Distinguishing Features of Each Alternative

With the exception of the No Action alternative (Alternative 1), each alternative would include long-term monitoring programs, including 5-year site reviews, to assess whether the remedy remains protective of human health and the environment. In addition, for each alternative (except Alternative 1) it is expected that all activities can be designed and implemented to comply with location-, action-, and chemical-specific ARARs. Alternative 1 would not trigger any ARARs. With the exception of Alternatives 1 and 2, each alternative would include the implementation of ICs.

The alternatives can be distinguished by the technology being utilized (described in the previous section), and by the range in estimated costs and times to achieve the cleanup goals, which are provided in the table located in Section 2.10 below.

2.10 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP outlines the approach for comparing remedial alternatives. Evaluation of the alternatives is based on “threshold,” “primary balancing,” and “modifying” criteria. To be considered for remedy selection, an alternative must meet the two following threshold criteria:

1. Overall protection of human health and the environment.
2. Compliance with ARARs or ARAR waiver in accordance with CERCLA Section 121(d)(4).

The primary balancing criteria are then considered to determine which alternative provides the best combination of attributes. The primary balancing criteria are:

1. Long-term effectiveness and permanence.
2. Reduction of toxicity, mobility, or volume through treatment.
3. Implementability.
4. Short-term effectiveness.
5. Cost.

A comparative evaluation for these seven criteria was conducted in the FS for the six remedial alternatives developed to address ST-14 groundwater, and the No Action alternative required under CERCLA. A summary of the evaluation is provided in Table 2-1. The cost information is repeated in the following table for ease of comparison.
Comparison of Estimated Duration and Costs

<table>
<thead>
<tr>
<th>Comparison Feature</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
<th>Alternative 4</th>
<th>Alternative 5</th>
<th>Alternative 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation Period (years)</td>
<td>200</td>
<td>200</td>
<td>150</td>
<td>30</td>
<td>20</td>
<td>75</td>
</tr>
<tr>
<td>Capital Costs</td>
<td>$0</td>
<td>$339,000</td>
<td>$1,985,000</td>
<td>$2,475,000</td>
<td>$8,132,000</td>
<td>$8,005,000</td>
</tr>
<tr>
<td>Present Worth of Annual and Periodic Costs</td>
<td>$0</td>
<td>$3,691,000</td>
<td>$4,296,000</td>
<td>$848,000</td>
<td>$7,272,000</td>
<td>$8,005,000</td>
</tr>
<tr>
<td>Present Worth</td>
<td>$0</td>
<td>$4,030,000</td>
<td>$6,281,000</td>
<td>$3,323,000</td>
<td>$15,404,000</td>
<td>$10,322,000</td>
</tr>
<tr>
<td>Total (Long-term) Costs</td>
<td>$0</td>
<td>$18,052,000</td>
<td>$16,267,000</td>
<td>$3,500,000</td>
<td>$16,302,000</td>
<td>$21,945,000</td>
</tr>
</tbody>
</table>

Notes:
Alternative 1: No Action
Alternative 2: Limited Action
Alternative 3: Source Control with ICs and Monitored Natural Attenuation
Alternative 4: Site-wide Enhanced In-Situ Biodegradation w/GW Monitoring and ICs
Alternative 5: Source Control and Site-wide Enhanced In-situ Biodegradation w/GW Monitoring and ICs
Alternative 6: Groundwater Extraction and Treatment w/ GW Monitoring and ICs

Based on the criteria evaluation and ranking, Alternative 4 was identified as the selected remedy and was presented to MDE and the public as such in the Proposed Plan. Comments on the Proposed Plan are used as the basis for evaluating the selected remedy further against two modifying criteria:

1. State Acceptance
2. Community Acceptance

State Acceptance

The State of Maryland has provided a concurrence letter supporting Alternative 4 as the preferred remedy for ST-14 (see Appendix A).

Community Acceptance

The notice of a public comment period from April 26 to May 25, 2007, as well as availability of the Proposed Plan at the local Information Repository, was published in the Prince George’s County Gazette and the Washington Post-Prince George’s “Extra” weekly edition on April 26, 2007. In addition, a public meeting was held on May 9, 2007, to present the Proposed Plan to community members. The USAF and regulatory representatives were present to answer questions regarding the site conditions and evaluated alternatives. One community member was present at the meeting. No comments were received during the public comment period.

2.11 PRINCIPAL WASTE THREATS

The NCP, at 40 CFR Section 300.430(a)(1)(iii)(A), establishes an expectation that USEPA will use treatment to address “principal threats” posed by a site wherever practicable. The “principal threat” concept is applied to the characterization of “source materials” at NPL sites. A source material is a material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air or acts as a source for direct exposure. Contaminated
groundwater generally is not considered to be a source material. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.

Principal threats exist in groundwater at ST-14 in the form of dissolved-phase benzene, CT, and TCE. While several exceedances of SSLs exist in the subsurface soil, it is expected that the groundwater remedy will address residual contamination in the vadose zone because of fluctuating groundwater levels. In addition, the remedy consists of multiple injections into the subsurface coupled with performance monitoring, and therefore, residual subsurface soil contamination which may leach to groundwater will be remedied over time.

2.12 SELECTED REMEDY FOR GROUNDWATER

Based on the evaluation of the remedial alternatives, Alternative 4 is the selected remedy for the remediation of benzene, CT, and TCE contamination in groundwater at ST-14.

2.12.1 Summary of the Rationale for the Selected Remedy

Based on information currently available, the USAF believes the selected remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria, as required by the NCP at 40 CFR Section 300.430(f)(4)(i). The USAF expects the selected remedy to satisfy the following statutory requirements of CERCLA Section 121, 42 U.S.C. 9621: (1) be protective of human health and the environment, (2) comply with ARARs, (3) be cost-effective, (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and (5) satisfy the preference for treatment as a principle element, or explain why the preference for treatment will not be met.

Alternative 4 is the selected remedy for ST-14 for the following reasons: (1) Alternatives 1 through 3 would require longer than 30 years to achieve MCLs; (2) Alternatives 4 through 6 all achieve MCLs and other RAOs within the specified timeframe (20 to 30 years) and reflect CERCLA’s preference for active treatment; (3) Alternative 4 is the most cost-effective remedy.

This remedy affords adequate protection of human health and the environment, as well as compliance with ARARs. It will reduce the magnitude of risks to acceptable levels (i.e., cleanup criteria) through active treatment within a reasonable timeframe for ST-14 because potable water is currently provided by the WSSC and the current land use as a military base is expected to continue in the future. In accordance with Maryland’s Anti-Degradation Policy for waters of the state, the beneficial use of groundwater will be restored for potential future receptors. Additionally, ICs will be implemented under Alternative 4 to prevent the potable use of shallow groundwater and to limit contact with shallow groundwater as long as benzene, CT, and TCE concentrations are above levels that allow for unlimited use and unrestricted exposure.

2.12.2 Description of the Selected Remedy

The primary components of the selected remedy are:

- Install organic carbon substrate injection points in the form of a barrier formation or treatment zone perpendicular to groundwater flow in the TCE plume.
- Install oxygen-releasing compound injection points in the form of a barrier formation or treatment zone perpendicular to groundwater flow in the benzene plume.
- Inject organic carbon substrate and oxygen-releasing compound.
- Conduct groundwater monitoring to assess the effectiveness of the remedy, adjust re-injection frequency and location, and monitor plume movement.
- Re-inject organic carbon substrate and oxygen-releasing compound as needed.
• Implement and maintain ICs in the form of groundwater use restrictions until cleanup criteria are met, and implement LUCs to prevent incompatible land use (residential).

Details of the selected remedy are discussed below. A conceptual layout of the selected remedy is provided in Figure 2-11.

The selected remedy which principally addresses groundwater contamination is also expected to remediate residual contamination in subsurface vadose zone soils at the potential source areas discussed in Section 2.5.3.2. Although some soil surface and subsurface samples exceeded the SSLs, the exceedances were not statistically significant and do not indicate that soil contamination could recontaminate the groundwater after completion of the remedy. Because the remedy consists of multiple injections into the subsurface coupled with performance monitoring, residual subsurface soil contamination which may leach to groundwater will be remedied over time. Additional treatment can be undertaken if groundwater contaminant concentrations stagnate or rise due to a rebound effect.

2.12.2.1 Installation of Injection Points

Full scale implementation of the selected remedy will require the installation of approximately 201 injection points for the treatment of the TCE and commingled TCE/CT plumes using organic carbon substrate, and 40 for the treatment of the benzene plume. The injection points will be installed using direct-push technology. The points will be constructed using 1-inch diameter polyvinyl chloride casing with 10-foot, pre-packed wire screens. The injection points will be installed in staggered rows with approximately 25-foot spacing to form treatment barriers or zones situated perpendicular to groundwater flow.

2.12.2.2 Environmental Monitoring

The activities to be performed under Alternative 4 also include groundwater monitoring (i.e., post-injection groundwater sampling/analysis). In addition, CERCLA-mandated 5-year reviews of the effectiveness of on-going remedies will be conducted and will serve as an additional opportunity to evaluate the effectiveness of the remedy. The objectives of the groundwater monitoring program associated with this alternative are to ensure that:

• Significant and measurable reductions in contaminant concentrations have occurred throughout the footprint of the commingled contaminant plumes when compared to baseline conditions.
• The commingled contaminant plumes do not expand beyond the baseline footprint.
• Contamination or injected substrates do not migrate off-site and/or off-base.
• Treatment of all COCs occurs before the contaminated groundwater leaves the existing footprint of the commingled contaminant plumes.

A monitoring network will be utilized in the footprint of the contaminant plumes to ensure that favorable geochemical parameters for biodegradation of all COCs are maintained and to ensure that progress toward the cleanup criteria continues throughout the plume.

To determine that the treatment is operational and functional, trend analyses will be performed using statistical methods and tools, and/or regression analyses will be performed in addition to the plume footprint evaluation. The overall trend towards achievement of MCLs is expected to be asymptotic. It is anticipated that a significant decrease in COC concentrations will be achieved during the first five years of groundwater treatment. Thereafter, concentrations are expected to decrease although not as rapidly since concentrations will be much lower. If the data indicate that the contaminant plumes are expanding beyond the baseline footprint, that decreasing trends in contaminants cannot be confirmed, and/or that achievement of MCLs is no longer anticipated within a 20- to 30-year timeframe, then re-injection of any one or more of the following may be required: substrate, buffer for pH adjustment, microorganisms or any other additive approved by the
Andrews AFB partnership team, including USEPA, that will enhance the reduction of COCs at ST-14. Following completion of treatment, baseline (pre-treatment) geochemical parameters will be restored in the aquifer for precipitation of metals (iron, arsenic, and manganese) that are liberated above initial pre-treatment concentrations as a result of the treatment of COCs.

The groundwater monitoring program for this alternative is anticipated to include quarterly groundwater monitoring for the first 18 months of the remedy implementation, semi-annual monitoring for the second 18 months, and annual monitoring for years 4 through 30 or until the cleanup criteria are achieved. Samples will be analyzed for VOCs, metals, nitrate, sulfate, methane, ethane, ethene, alkalinity, and TOC. Samples will also be collected from select monitoring wells for microbial analysis to confirm the presence of reductive dechlorinating microorganisms. Additional monitoring locations may be installed if necessary. Field measurements will include temperature, conductivity, pH, ORP, and dissolved oxygen. Data collected will be used to demonstrate the actual trends in decreasing concentrations of COCs and to observe the generation of metabolites. The groundwater monitoring program will help determine if the treatment frequency is adequate and/or if additional treatment is warranted to attain the cleanup criteria in the 20- to 30-year timeframe.

Monitoring data will be used to perform a Mann-Kendall statistical trend analysis using the Monitoring and Remediation Optimization System (MAROS) (AFCEE, 2000). The Mann-Kendall analysis(es) will be used to evaluate whether contaminant concentrations at individual wells are stable, increasing, or decreasing and whether the cleanup criteria will be achieved in the estimated 20- to 30-year timeframe. The Mann-Kendall analysis requires a minimum of four data points. The initial analysis will be performed after 18 months of monitoring, using six data points generated by quarterly sampling.

The monitoring data and statistical trend analysis demonstrating the reduction of the COCs and their daughter compounds will also allow for targeting any potential additional treatments for specific areas where levels of contamination may rebound or biological degradation is not sufficient to achieve the cleanup criteria.

### 2.12.2.3 Injection and Re-injection of Organic Carbon Substrate and Oxygen-Releasing Compound

**Organic Carbon Substrate for TCE and Commingled Plumes**

Upon the completion of the installation of injection points, an initial injection of organic carbon substrate will be performed in the TCE and commingled TCE/CT plumes. An oxygen-releasing compound will be injected in the benzene plume.

Re-injection of organic carbon substrate will occur every eight weeks until anaerobic conditions are established. The re-injection frequency is subject to change based on the results of monitoring. Post-injection performance monitoring will be used to confirm that the anaerobic reaction zone is fully established and that supplemental injections are not necessary across the length of each bio-barrier. The collected post-injection data will also be utilized to assess whether the injection frequency is sufficient to maintain the desired anaerobic reducing conditions. The criteria that will be used to determine when subsequent re-injections are necessary include:

- A TOC concentration of less than 50 mg/L for each mg/L of total chlorinated VOCs at monitoring wells within the anaerobic bio-reactive zones.
- The ORP is greater than -50 millivolts (mV) (e.g., -37mV) at any monitoring point within the anaerobic bio-reactive zones.

The anaerobic bio-reactive zone is defined as the areas within the radius of influence of each injection barrier or treatment zone.
Following the initial injections, field parameters including ORP, dissolved oxygen (DO), pH, conductivity, and turbidity will be measured on a monthly basis to verify the changes in geochemical conditions and confirm that conditions are conducive to dechlorination.

The field parameters will be used as trigger indicators for establishing reducing conditions and determining the extent of the anaerobic bio-reactive zones. Based on the Pre-Design Study, it is estimated that it will take 6 months to establish reducing conditions in the injection areas. The presence of reducing conditions will be determined based on ORP, DO, and TOC. The optimal ORP is more negative than -50 mV (e.g., -105 mV). DO concentrations should be less than 0.5 mg/L in the anaerobic areas. In order to optimize the degradation of chlorinated VOCs, the TOC concentration should be maintained at a minimum of 50 times the maximum total chlorinated VOC concentration. For example, a total chlorinated VOC concentration of 300 µg/L would require a minimum of 15,000 µg/L of TOC.

After fully establishing the anaerobic reactive zones, a more extensive monitoring program will be implemented involving existing and additional monitoring locations. If post-injection monitoring indicates that the anaerobic reactive barriers are not maintained, and TCE and its metabolites are not being reduced, additional or supplemental injections will be proposed and implemented. The potential additional injections may also target the locations with insufficient delivery of organic substrates, and the additional injections can be determined based on the location-specific conditions at that time.

If these evaluations result in the conclusion that TOC and ORP are not the limiting factors on reductive dechlorination of TCE (i.e., an adequate anaerobic reducing zone is established and sufficient carbon is present, but TCE remains statistically stable and no metabolites are generated), pH adjustment will be evaluated further and implemented, if necessary. If TCE and its metabolites (cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and vinyl chloride) stall within the anaerobic bio-reactive zones and the geochemical transition zone between barriers is not sufficient to aerobically attenuate DCEs and vinyl chloride, bioaugmentation, which involves the process of providing reductive-dechlorinating microbial species into the anaerobic bio-reactive zones, will be evaluated further and implemented. If CT and its metabolites (chloroform, dichloromethane, and chloromethane) stall without further degradation to MCLs or regulatory levels, the need for bioaugmentation will be evaluated and implemented as necessary.

The establishment of appropriate biochemical conditions for remediation will be demonstrated with the establishment and maintenance of anaerobic reaction zones near and immediately downgradient of the injection points and the CVOC reduced concentration trends throughout the plume due to the organic substrates.

Oxygen-Releasing Compound for Benzene Plume

Consistent with the proposed design of the aerobic and aerobic cometabolic bio-barriers for the BTEX and commingled BTEX/TCE plumes, respectively, oxygen-releasing product injections will be performed annually to enhance bioremediation of BTEX and TCE. Following each annual oxygen-releasing product injection and based on the post-injection monitoring results, if a statistically significant rebound in the BTEX (as detected by benzene as indicator parameter) or TCE concentrations is observed, an assessment will be performed to determine whether additional injections or other measures such as additional groundwater monitoring are warranted.

The other criterion utilized to determine when subsequent or supplemental injections are warranted is the dissolved oxygen (DO) concentration. DO concentrations are expected to be 3 to 5 mg/L at monitoring wells within the aerobic reactive zone or within 20 feet downgradient of injection locations during the monitoring event immediately following the injection. Note that subsequent utilization of DO and perhaps a return to sub-oxic or anaerobic conditions following the initial event is, to a certain degree, to be expected and DO concentrations alone would not trigger an evaluation for further injections. Because anaerobic biodegradation of these contaminants would continue and due to the relatively slow groundwater flow and low permeability of the formation, the dissolved contaminant plume is expected to continue to be slow moving and will continue to degrade.
2.12.2.4 Institutional Controls

The objectives of the ICs at ST-14 include the following:

- Ensure no use of groundwater, except for purposes of monitoring, until site conditions allow for unlimited use and unrestricted exposure.
- Ensure no residential land use until site conditions allow for unlimited use and unrestricted exposure.
- Ensure that construction activities on-base do not interfere with the remedy, including required monitoring, re-injection, treatments, or five-year reviews.
- Ensure protection from contaminated subsurface soil and groundwater for all persons who access the site, including future maintenance and construction workers.
- Ensure that any proposed changes in land use are consistent with protection goals.
- Ensure that any groundwater extracted for purposes of monitoring that exceeds relevant regulatory criteria is handled in accordance with ARARs.

Figure 2-12 depicts the approximate boundary of ST-14 wherein ICs will be enforced. The USAF is responsible for implementing ICs at ST-14. Under Alternative 4, the site will have a land use controls boundary identified in the Base geographical information system (GIS), as well as on hard copy maps of Restoration sites. This designation prohibits activities such as residential development or potable use of groundwater. Additionally, groundwater use is currently restricted, as documented in the Base General Plan (BGP), and procedures are in place to limit contact with and ensure protection from groundwater through the issuance of dig permits and other protective measures (Parsons, 2003). Records of the groundwater contamination will be kept in the Base GIS/environmental database. The restricted-use designation for groundwater will remain in place until groundwater monitoring indicates that the cleanup criteria have been met at ST-14.

The USAF will notify USEPA and MDE as soon as practicable but no longer than 10 days after discovery of any activity that is inconsistent with the IC objectives or use restrictions, or any other action that may interfere with the effectiveness of the ICs. The USAF will notify USEPA and MDE regarding how the USAF has addressed or will address the breach within 10 days of sending USEPA and MDE notification of the breach.

The USAF will provide notice to USEPA and MDE at least 6 months prior to any transfer or sale of ST-14 so that USEPA and MDE can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective ICs. If it is not possible for the facility to notify USEPA and MDE at least 6 months prior to any transfer or sale, then USAF will notify USEPA and MDE as soon as possible but no later than 60 days prior to the transfer or sale of any property subject to ICs. In addition to the land transfer notice and discussion provisions above, the USAF further agrees to provide USEPA and MDE with similar notice, within the same timeframes, as to federal-to-federal transfer of property. The USAF shall provide a copy of the executed deed or transfer assembly to USEPA and MDE. The USAF shall not modify or terminate ICs, implementation actions, or modify land use without approval by USEPA and MDE. The USAF shall seek prior concurrence before any anticipated action that may disrupt the effectiveness of the ICs or any action that may alter or negate the need for ICs.

Other ICs proposed for ST-14 include the following:

- Review and approval of any changes in land use, including construction of new facilities or additions to existing facilities at ST-14 by the Andrews AFB Facility Review Board, which interacts with the Community Planner using the BGP as a guide to land use issues.
- Inclusion of the restrictions at ST-14 on the BGP. All ERP sites and restrictions at Andrews AFB are identified in the BGP. Any proposed activity or construction on an ERP site requires an “ERP Waiver to Construct” memorandum, approved and signed by USAF Headquarters Air Mobility Command (AMC).
• Review of proposed construction activities at ST-14 by Andrews AFB Environmental Flight through the following processes: Environmental Impact Analysis Process (EIAP), National Environmental Policy Act (NEPA) Design Reviews of Proposed Construction, review of routine work orders that involve alterations to facilities, and review of dig permits.

• Posting signs at the site identifying ST-14 as a CERCLA site. The signs will summarize the nature of contamination at the site and will state that no construction or excavation activities and no groundwater use or withdrawal is permitted within the area without written authorization by the USAF. Contact information for the ERP project manager will also be included on the signs.

• Continued prohibition of potable use of groundwater. Potable use of groundwater is prohibited at ST-14 (and Andrews AFB, in general). Environmental personnel review of work orders and dig permits will also ensure that potable groundwater wells will not be installed at ST-14.

The ICs will remain in place until the concentration of hazardous substances at the site allows for unrestricted use and exposure. Monitoring of the environmental use restrictions and controls will be conducted annually by Andrews AFB. The monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and provided to USEPA and MDE for informational purposes. The annual monitoring reports will be used in preparation of the 5-year review to evaluate the effectiveness of the remedy. The ICs can be modified as new data are analyzed. Andrews AFB shall notify USEPA and MDE 45 days in advance of any proposed land use changes that are inconsistent with land use control objectives or the selected remedy.

In addition to these ICs, COMAR 26.03.01.05.A prohibits issuance of a permit to individual residents or businesses for private water supply wells when public water supplies are available; therefore, the installation of groundwater wells intended for potable use will not be approved.

2.12.2.5 Summary of the Estimated Remedy Costs

The estimated total cost of the selected remedy is $3,500,000, and the estimated present worth cost (based on a 5.5 percent discount rate over a duration of 25 years) is $3,323,000. This cost estimate is based on the best available information regarding the anticipated scope of the remedial alternative and is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost. The assumptions used to develop the cost estimate for the selected remedy are described in the final FS. Changes in the cost elements may occur as a result of new information and data collected during implementation of the remedial alternative. Changes beyond the range of +50 to -30 percent may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Differences, or a ROD amendment.

2.12.2.6 Estimated Outcomes of Selected Remedy

The anticipated future land use following full completion of the selected remedy is unrestricted, which could allow residential usage. The potential groundwater use that is anticipated to be available at the site upon completion of the remedy is also unlimited use and unrestricted exposure, once the concentrations of TCE, CT, and BTEX are below the cleanup criteria. The estimated timeframe required to achieve this groundwater use is 20 to 30 years.

The cleanup criteria for TCE, CT, and BTEX and their respective degradation products are presented in Section 2.8 and are the applicable MCLs, based on the beneficial use of groundwater at the site.

The anticipated community impact of the selected remedy is the availability of additional groundwater for potential drinking water in the future and the removal of potential risk associated with groundwater COCs. The anticipated environmental benefit of the selected remedy is restoration of the shallow aquifer to original conditions, prior to environmental releases from ST-14.
2.13 STATUTORY DETERMINATIONS FOR GROUNDWATER REMEDY

The selected remedy for contaminated groundwater at ST-14 satisfies the statutory requirements of Section 121 of CERCLA, 42 U.S.C. Section 9621. Under CERCLA, remedial actions at sites must achieve protection of human health and the environment, comply with federal and state ARARs, be cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element are preferred. The following discussion addresses how these statutory requirements and preferences are met by the selected remedy.

2.13.1 Protection of Human Health and the Environment

The selected remedy for groundwater will be protective of human health and the environment. ICs will minimize the risk of direct exposure to the contaminated groundwater until concentrations of TCE, CT and BTEX have been reduced to cleanup criteria. There are no short-term threats associated with the selected remedy for groundwater than cannot be readily controlled. In addition, no cross-media impacts are expected from the selected remedy. Monitoring and statistical evaluation of trends in concentrations of constituents requiring remediation will ensure that the selected groundwater remedy is effective and that the plumes are not expanding or unexpectedly increasing in concentration. If remediation cleanup criteria are not met, additional treatment will be proposed and implemented for the site.

2.13.2 Compliance with Applicable or Relevant and Appropriate Requirements

Field activities performed as part of this remedy will include plume-wide treatment and installation and sampling of groundwater monitoring wells. These field activities will require compliance with State of Maryland regulations regarding installation and construction of wells, as well as subsequent abandonment. Additionally, the remedy will require injection of substrate to affect the groundwater quality; therefore, Maryland groundwater quality standards must be considered. Finally, all investigative-derived waste generated from groundwater sampling and drilling activities must be handled in accordance with State of Maryland regulations. It is expected that field activities can be designed and implemented to comply with action-specific ARARs, as presented in Table B-1, Appendix B.

Chemical-specific ARARs triggered by the selected remedy are presented in Table B-2. The remedy includes specific actions to reduce contaminant concentrations in site groundwater where the groundwater COCs exceed chemical-specific ARARs (e.g., MCLs). It is anticipated that MCLs will be attained within 20 to 30 years. It is assumed that following treatment by the selected remedy, a period of long-term monitoring of natural attenuation will follow until chemical-specific ARARs are achieved.

2.13.3 Cost Effectiveness

According to the NCP at 40 CFR 300.430(f)(1)(ii)(D), a remedy is cost-effective if its costs are proportional to its overall effectiveness. The USAF and USEPA have determined that the selected remedy is cost-effective. Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment, and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost effectiveness. The selected remedy is the least costly alternative evaluated (with the exclusion of the No Action alternative). The estimated total present worth of the selected remedy is $3,323,000, which is 18 percent less than the present worth of the next least expensive alternative. Alternative 5 will achieve RAOs sooner than the selected remedy but is nearly five times as expensive. The selected remedy is therefore the most cost-effective alternative.
2.13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

The USAF and USEPA, with MDE concurrence, have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. The USAF and USEPA have determined that the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria. The selected remedy affords adequate protection of human health and the environment by initiating in-situ treatment of constituents requiring treatment in groundwater and monitoring contaminant concentrations and migration. ICs would be in place until concentrations of constituents requiring remediation are reduced to acceptable levels. The selected remedy achieves compliance with ARARs and satisfies the long-term effectiveness balancing criterion by reducing the magnitude of lingering risks to acceptable levels (i.e., cleanup criteria) within a timeframe reasonable for ST-14 because potable water is currently supplied by the WSSC and the beneficial use of the groundwater will be restored for potential future receptors. The selected remedy also satisfies the reduction of toxicity, mobility, or volume through treatment balancing criterion by stimulating the natural degradation of site contaminants through reductive dechlorination and aerobic degradation.

The selected remedy will satisfy the statutory preference for treatment as a principal element. Active treatment of groundwater using injections of organic carbon substrate and oxygen-releasing compounds is the primary component of the selected remedy.

The USAF and USEPA also considered the two modifying criteria (i.e., state and community acceptance) in selection of the remedy. No comments were received in opposition to the selected remedy.

The selected remedy satisfies all balancing criteria and modifying criteria.

2.13.5 Preference for Treatment as a Principal Element

The selected remedy for groundwater satisfies the statutory preference for treatment as a principal element. Treatment of the TCE plume and commingled TCE/CT plume was initiated at three areas of relatively high VOC concentrations during the ST-14 pre-design study via three separate injections of organic carbon substrate to enhance natural biodegradation processes. The effectiveness of the injections was realized six months following the initial injection.

Concentrations of TCE, CT, and BTEX will be monitored according to the frequency identified in Section 2.12.2.2. If an increasing concentration trend is observed and it is unlikely that the trend will go downward, then additional treatment (e.g., substrate injection) will be proposed and implemented. Similarly, if rebound in the TCE, CT or benzene concentrations is observed, an assessment will be performed to determine whether an additional injection or other measures as detailed in sections 2.12.2.2 and 2.12.2.3, such as additional groundwater monitoring, are warranted. Therefore, the selected remedy includes a provision for further treatment if cleanup criteria in Section 2.8 are not met.

2.13.6 CERCLA 5-Year Review Requirements

Because the selected remedy for groundwater at ST-14 will result in hazardous substances, pollutants, or contaminants remaining on site above the clean up criteria for 20 to 30 years, a remedy review will be conducted in accordance with CERCLA Section 121(c) within 5 years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment, and every 5 years thereafter, until the concentrations of TCE, CT, and benzene are below cleanup criteria.

2.14 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for ST-14 groundwater and soil at Andrews AFB, Prince George's County, Maryland, was released for public comment on April 26, 2007. The Proposed Plan identified that no further action was required for soil other than the enactment of LUCs. No comments were received during the public comment
period. It was determined that no significant changes to this determination, as originally identified in the Proposed Plan, were necessary or appropriate.

The Proposed Plan identified enhanced in-situ biodegradation as the preferred alternative for groundwater.
### TABLE 2-1
Comparative Analysis of Alternatives
ST-14 Record of Decision
Andrews Air Force Base, Maryland

<table>
<thead>
<tr>
<th>THRESHOLD CRITERIA</th>
<th>BALANCING CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT</td>
<td>IMPLEMENTABILITY</td>
</tr>
<tr>
<td>COMPLIANCE WITH ARARs</td>
<td>Long-term Effectiveness and Permanence</td>
</tr>
<tr>
<td></td>
<td>Reduction of Toxicity, Mobility, or Volume Through Treatment</td>
</tr>
<tr>
<td></td>
<td>Short-term Effectiveness</td>
</tr>
<tr>
<td>ALTERNATIVE</td>
<td>OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT</td>
</tr>
<tr>
<td><strong>Alternative 1:</strong> No Action</td>
<td>Alternative is protective of human health under current land use conditions, but not under possible future or unrestricted use scenarios.</td>
</tr>
<tr>
<td><strong>Alternative 2:</strong> Limited Action</td>
<td>Alternative is protective of human health under current and possible future or unrestricted use scenarios. However, there is greater uncertainty under future conditions than for alternatives which attain cleanup goals more quickly. No significant risks to ecological receptors.</td>
</tr>
</tbody>
</table>

2-30
### TABLE 2-1: Comparative Analysis of Alternatives

**ST-14 Record of Decision**  
**Andrews Air Force Base, Maryland**

<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT</th>
<th>COMPLIANCE WITH ARARs</th>
<th>LONG-TERM EFFECTIVENESS AND PERMANENCE</th>
<th>REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT</th>
<th>SHORT-TERM EFFECTIVENESS</th>
<th>IMPLEMENTABILITY</th>
<th>COST</th>
</tr>
</thead>
</table>
| Alternative 3: Source Control with Institutional Controls and Monitored Natural Attenuation | Alternative is protective of human health under current and possible future or unrestricted use scenarios. However, this alternative still requires 150 years to achieve cleanup. There is greater uncertainty under future conditions than for alternatives which attain cleanup goals more quickly. No significant risks to ecological receptors. | Chemical-specific ARARs would not be attained within a reasonable time-frame (less than 100 years). Expected to require obtaining of an ARAR waiver. It is expected that all activities can be designed and implemented to comply with action-specific ARARs. | This alternative has good long-term effectiveness and permanence once cleanup goals are attained. Would satisfy CERCLA’s preference for treatment as a principal component of remedial action although most of the contamination would not be treated. Would not generate residual wastes. | Because there is no current exposure to groundwater, there will be no short-term adverse effects to the community from exposure to groundwater during implementation. Construction activities to implement alternative would pose moderate risk to on-site workers. Reliance on institutional controls and administrative processes to protect human health under possible future land use conditions for 150-year period until attainment of cleanup goals provides little or no short-term effectiveness. | Technical feasibility is high. Proposes substrate injection, and in-situ chemical oxidation and reduction, and excavation and ex-situ treatment of soil. These technologies are readily implemented and licensed vendors and contractors are readily available. Administrative feasibility is low because of the estimated long period of time (150 years) required to attain cleanup goals, and therefore overall implementability is low. | Capital: $1,985,000  
Total PW: $6,281,000  
Total Nondiscounted Cost: $16,267,000 |
<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT</th>
<th>COMPLIANCE WITH ARARs</th>
<th>LONG-TERM EFFECTIVENESS AND PERMANENCE</th>
<th>REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT</th>
<th>SHORT-TERM EFFECTIVENESS</th>
<th>IMPLEMENTABILITY</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 4: Site-wide Enhanced In-Situ Biodegradation with Groundwater Monitoring and ICs</td>
<td>Alternative is protective of human health under current and possible future or unrestricted use scenarios. No significant risks to ecological receptors. The time period for attainment of cleanup goals is estimated to be between 20 and 30 years. Considered second best among alternatives for protecting human health.</td>
<td>Chemical-specific ARARs would be attained within an estimated 20 to 30 years. No ARAR waiver required. It is expected that all activities can be designed and implemented to comply with action-specific ARARs. Overall compliance with ARARs is best among alternatives.</td>
<td>This alternative has good long-term effectiveness and permanence once cleanup goals are attained. Would satisfy CERCLA’s preference for treatment as a principal component of remedial action. Would not generate residual wastes. Provides a high level of control over toxicity, mobility, and volume.</td>
<td>Because there is no current exposure to groundwater, there will be no short-term adverse effects to the community from exposure to groundwater during implementation. Poses less short-term risk to construction and on-site workers than Alternatives 3 or 5 because of shorter time period required for implementation. There is some risk, however, due to extensive use of drilling and injection equipment. Reliance on institutional controls and administrative processes to protect human health under possible future land use conditions for 30-year period or until attainment of cleanup goals. Provides the second best short-term effectiveness among alternatives.</td>
<td>Technical feasibility is high. Proposes substrate injection, and in-situ chemical oxidation and reduction. This technology is readily implemented and licensed vendors and contractors are readily available. Administrative feasibility is high because cleanup goals would be met in 20 to 30 years. Migration of contamination can be managed, and future human exposure can be controlled. Overall implementability is considered the best among the alternatives.</td>
<td>Capital: $2,475,000 Total PW: $848,000 Total Nondiscounted Cost: $3,500,000</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 2-1
Comparative Analysis of Alternatives
ST-14 Record of Decision
Andrews Air Force Base, Maryland

<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT</th>
<th>COMPLIANCE WITH ARARs</th>
<th>LONG-TERM EFFECTIVENESS AND PERMANENCE</th>
<th>REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT</th>
<th>SHORT-TERM EFFECTIVENESS</th>
<th>IMPLEMENTABILITY</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 5: Source Control and Site-wide Enhanced In-situ Biodegradation with Groundwater Monitoring and ICs</td>
<td>Alternative is protective of human health under current and possible future or unrestricted use scenarios. No significant risks to ecological receptors. The time period for attainment of cleanup goals is estimated to be 20 years. Considered best among alternatives at protecting human health.</td>
<td>Chemical-specific ARARs would be attained within an estimated 20 years. No ARAR waiver required. It is expected that all activities can be designed and implemented to comply with action-specific ARARs. Overall compliance with ARARs is best among alternatives.</td>
<td>This alternative has good long-term effectiveness and permanence once cleanup goals are attained.</td>
<td>Would satisfy CERCLA’s preference for treatment as a principal component of remedial action. Would not generate residual wastes. Provides a high level of control of toxicity, mobility, and volume.</td>
<td>Because there is no current exposure to groundwater, there will be no short-term adverse effects to the community from exposure to groundwater during implementation. Poses greater short-term risks to construction and on-site workers than Alternative 3 because of greater time period required for implementation and the extensive use of drilling and injection equipment. Reliance on institutional controls and administrative processes to protect human health under possible future land use conditions for 20-year period until attainment of cleanup goals. Provides best short-term effectiveness among alternatives.</td>
<td>Technical feasibility is high. Proposes substrate injection, in-situ chemical oxidation and reduction. This technology is readily implemented and licensed vendors and contractors are readily available. However, the proposed extent of substrate injections associated with Alternative 4 would present more technical difficulty than the substrate injection component of Alternative 3. Administrative feasibility is high because cleanup goals would be met in 20 years and alternative provides better management of the migration of contaminated groundwater. Overall implementability is second best among alternatives.</td>
<td>Capital: $8,132,000 Total PW: $15,404,000 Total Nondiscounted Cost: $16,302,000</td>
</tr>
</tbody>
</table>
### TABLE 2-1

**Comparative Analysis of Alternatives**  
**ST-14 Record of Decision**  
**Andrews Air Force Base, Maryland**

<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT</th>
<th>COMPLIANCE WITH ARARs</th>
<th>LONG-TERM EFFECTIVENESS AND PERMANENCE</th>
<th>REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT</th>
<th>BALANCING CRITERIA</th>
<th>SHORT-TERM EFFECTIVENESS</th>
<th>IMPLEMENTABILITY</th>
<th>COST</th>
</tr>
</thead>
</table>
| Alternative 6: Groundwater Extraction and Treatment with Groundwater Monitoring and ICs | Alternative is protective of human health under current and possible future or unrestricted use scenarios. However, this alternative requires 75 years to achieve cleanup. There is greater uncertainty under future conditions than for alternatives which attain cleanup goals more quickly. No significant risks to ecological receptors. Considered third best among alternatives at protecting human health. | Chemical-specific ARARs would be attained within an estimated 75 years. No ARAR waiver required. It is expected that all activities can be designed and implemented to comply with action-specific ARARs. Overall compliance with ARARs is second best among alternatives. | This alternative has good long-term effectiveness and permanence once cleanup goals are attained. Would satisfy CERCLA’s preference for treatment as a principal component of remedial action. This alternative’s combination of remedial components provides most extensive control of toxicity, mobility, and volume among alternatives. Would not generate residual wastes. | Because there is no current exposure to groundwater, there will be no short-term adverse effects to the community from exposure to groundwater during implementation. Poses greatest short-term risk to construction and on-site workers because of greatest level of construction activities and duration of remedy operation. Reliance on institutional controls and administrative processes to protect human health under possible future land use conditions for 75-year period until attainment of cleanup goals. Provides the third best short-term effectiveness among alternatives. | Technical feasibility is high, although alternative would be the most technically difficult to implement considering the long-term operation and maintenance of the groundwater extraction and treatment system, and the sampling and monitoring requirements associated with discharge to surface water. Administrative feasibility moderate because cleanup goals would be met in 75 years and alternative provides the best management of the migration of contaminated groundwater. Overall implementability is third best among alternatives. | Capital: $2,317,000  
Total PW: $10,322,000  
Total Nondiscounted Cost: $21,945,000 |

**Notes:**  
ARAR = Applicable or Relevant and Appropriate Requirement  
NPW = Net present worth
Base map source: 1997 DeLorme Street Atlas USA Version 5.0
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Exposure</th>
<th>Receptor</th>
<th>Exposure Type</th>
<th>Rationale for Selection or Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>Surface Soil</td>
<td>Construction Worker</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visitor</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td>Air</td>
<td>Suspended particulates from surface soil</td>
<td>Construction Worker</td>
<td>Inhalation</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Inhalation</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visitor</td>
<td>Inhalation</td>
<td>None</td>
</tr>
<tr>
<td>Subsurface Soil</td>
<td>Soil</td>
<td>Construction Worker</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visitor</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td>Air</td>
<td>Suspended particulates from subsurface soil</td>
<td>Construction Worker</td>
<td>Inhalation</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Inhalation</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visitor</td>
<td>Inhalation</td>
<td>None</td>
</tr>
<tr>
<td>Surface Water</td>
<td>Water Stream</td>
<td>Construction Worker</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visitor</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td>Air</td>
<td>Volatilization from water</td>
<td>Construction Worker</td>
<td>Inhalation</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Inhalation</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visitor</td>
<td>Inhalation</td>
<td>None</td>
</tr>
<tr>
<td>Animal Tissue</td>
<td>Ingestion of fish</td>
<td>Construction Worker</td>
<td>Ingestion</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Ingestion</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visitor</td>
<td>Ingestion</td>
<td>None</td>
</tr>
<tr>
<td>Sediment</td>
<td>Sediment Stream</td>
<td>Construction Worker</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visitor</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td>Spring Water</td>
<td>Water Seeps along stream bank</td>
<td>Construction Worker</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Dermal</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visitor</td>
<td>Dermal</td>
<td>None</td>
</tr>
</tbody>
</table>

Figure 2-6: Potential Human Receptors
Andrews Air Force Base Site ST-14
Prince George’s County, Maryland
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Medium</th>
<th>Exposure Point</th>
<th>Receptor Population</th>
<th>Exposure Age</th>
<th>Exposure Route</th>
<th>Type of Analysis</th>
<th>Rationale for Selection or Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Future</td>
<td>Groundwater</td>
<td>Groundwater Tap water</td>
<td>Resident Adult</td>
<td>Dermal</td>
<td>Quant</td>
<td>Groundwater may be used as tap water in the future</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Adult</td>
<td>Dermal</td>
<td>Quant</td>
<td>Groundwater may be used as tap water in the future</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Child</td>
<td>Ingestion</td>
<td>Quant</td>
<td>Groundwater may be used as tap water in the future</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker Adult</td>
<td>Dermal</td>
<td>Quant</td>
<td>Groundwater may be used for handwashing in the future</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper Adult</td>
<td>Dermal</td>
<td>Quant</td>
<td>Groundwater may be used for ingestion in the future</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visitor Adolescent</td>
<td>Dermal</td>
<td>None</td>
<td>Visitor use of groundwater expected to be minimal</td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>Bedrock aquifer--vapors at showerhead</td>
<td>Resident Adult</td>
<td>Inhalation</td>
<td>Quant</td>
<td>Groundwater may continue to be used</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indoor Air via vapor intrusion</td>
<td>Resident Adult</td>
<td>Inhalation</td>
<td>Quant</td>
<td>Vapors from groundwater may volatilize to soil gas and enter home</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Adult</td>
<td>Inhalation</td>
<td>None</td>
<td>Child is assumed not to shower</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Child</td>
<td>Ingestion</td>
<td>None</td>
<td>Child is assumed not to shower</td>
<td></td>
</tr>
<tr>
<td>Soil</td>
<td>subsurface soil</td>
<td>Resident Adult</td>
<td>Dermal</td>
<td>Quant</td>
<td>Future resident may contact current surface and subsurface (i.e., combined) soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>Quant</td>
<td>Future resident may contact current surface and subsurface soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Adult</td>
<td>Dermal</td>
<td>Quant</td>
<td>Future resident may contact current surface and subsurface soil</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>Quant</td>
<td>Future resident may contact current surface and subsurface soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker Adult</td>
<td>Dermal</td>
<td>Quant</td>
<td>Construction may occur under future conditions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>Quant</td>
<td>Construction may occur under future conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper Adult</td>
<td>Dermal</td>
<td>Quant</td>
<td>Workers may continue to be on site. A groundskeeper would likely have maximum exposure</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>Quant</td>
<td>Workers are may continue to be on site. A groundskeeper would likely have maximum exposure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visitor</td>
<td>Adolescent</td>
<td>Dermal</td>
<td>Quant</td>
<td>Adolescents may play on the site in the future</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>Quant</td>
<td>Adolescents may play on the site in the future</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker Adult</td>
<td>Ingestion</td>
<td>Quant</td>
<td>May inhale dust associated with construction activities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper Adult</td>
<td>Ingestion</td>
<td>Quant</td>
<td>Receptor may inhale windborne particles from combined soil</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visitor Adolescent</td>
<td>Ingestion</td>
<td>Quant</td>
<td>Adolescents may play on the site</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker Adult</td>
<td>Ingestion</td>
<td>Quant</td>
<td>Volatilization from combined soil may occur</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper Adult</td>
<td>Ingestion</td>
<td>Quant</td>
<td>Volatilization from combined soil may occur</td>
<td></td>
</tr>
<tr>
<td>Animal Tissue</td>
<td>Meat/milk from livestock fed groundwater</td>
<td>Meat/Milk Production Adult</td>
<td>Ingestion</td>
<td>None</td>
<td>Base property will not be used for agriculture</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Adult</td>
<td>Ingestion</td>
<td>None</td>
<td>Base property will not be used for agriculture</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Child</td>
<td>Ingestion</td>
<td>None</td>
<td>Base property will not be used for agriculture</td>
<td></td>
</tr>
<tr>
<td>Plant Tissue</td>
<td>groundwater</td>
<td>Home-grown produce Adult</td>
<td>Ingestion</td>
<td>None</td>
<td>Base property will not be used for agriculture</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Adult</td>
<td>Ingestion</td>
<td>None</td>
<td>Base property will not be used for agriculture</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Child</td>
<td>Ingestion</td>
<td>None</td>
<td>Base property will not be used for agriculture</td>
<td></td>
</tr>
<tr>
<td>Soil</td>
<td>subsurface soil</td>
<td>Resident Adult</td>
<td>Dermal</td>
<td>Quant</td>
<td>Future resident may contact current surface and subsurface (i.e., combined) soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>Quant</td>
<td>Future resident may contact current surface and subsurface soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Adult</td>
<td>Dermal</td>
<td>Quant</td>
<td>Future resident may contact current surface and subsurface soil</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>Quant</td>
<td>Future resident may contact current surface and subsurface soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker Adult</td>
<td>Dermal</td>
<td>Quant</td>
<td>Construction may occur under future conditions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>Quant</td>
<td>Construction may occur under future conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper Adult</td>
<td>Dermal</td>
<td>Quant</td>
<td>Workers are may continue to be on site. A groundskeeper would likely have maximum exposure</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>Quant</td>
<td>Workers are may continue to be on site. A groundskeeper would likely have maximum exposure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visitor</td>
<td>Adolescent</td>
<td>Dermal</td>
<td>Quant</td>
<td>Adolescents may play on the site in the future</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>Quant</td>
<td>Adolescents may play on the site in the future</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker Adult</td>
<td>Ingestion</td>
<td>Quant</td>
<td>May inhale dust associated with construction activities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper Adult</td>
<td>Ingestion</td>
<td>Quant</td>
<td>Receptor may inhale windborne particles from combined soil</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visitor Adolescent</td>
<td>Ingestion</td>
<td>Quant</td>
<td>Adolescents may play on the site</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker Adult</td>
<td>Ingestion</td>
<td>Quant</td>
<td>Volatilization from combined soil may occur</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper Adult</td>
<td>Ingestion</td>
<td>Quant</td>
<td>Volatilization from combined soil may occur</td>
<td></td>
</tr>
<tr>
<td>Animal Tissue</td>
<td>Meat/milk from on-site livestock/game</td>
<td>Meat/Milk Production Adult</td>
<td>Ingestion</td>
<td>None</td>
<td>Base property will not be used for agriculture</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Adult</td>
<td>Ingestion</td>
<td>None</td>
<td>Base property will not be used for agriculture</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Child</td>
<td>Ingestion</td>
<td>None</td>
<td>Base property will not be used for agriculture</td>
<td></td>
</tr>
<tr>
<td>Plant Tissue</td>
<td>Produce grown on soil</td>
<td>Home-grown produce Adult</td>
<td>Ingestion</td>
<td>None</td>
<td>Base property will not be used for agriculture</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Adult</td>
<td>Ingestion</td>
<td>None</td>
<td>Base property will not be used for agriculture</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child Child</td>
<td>Ingestion</td>
<td>None</td>
<td>Base property will not be used for agriculture</td>
<td></td>
</tr>
</tbody>
</table>
### Figure 2-6
Potential Human Receptors
Andrews Air Force Base Site ST-14
Prince George's County, Maryland

<table>
<thead>
<tr>
<th>Scenario Timeframe</th>
<th>Medium</th>
<th>Exposure Medium</th>
<th>Exposure Point</th>
<th>Receptor Population</th>
<th>Receptor Age</th>
<th>Route Analysis</th>
<th>Type of Exposure Pathway</th>
<th>Potential Human Receptor S</th>
<th>Rationale for Selection or Exclusion of Exposure Pathway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Water</td>
<td>Water</td>
<td>Stream water</td>
<td>Resident</td>
<td>Adult</td>
<td>Dermal</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child</td>
<td>Dermal</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker</td>
<td>Adult</td>
<td>Dermal</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Adult</td>
<td>Dermal</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visitor</td>
<td>Adolescent</td>
<td>Dermal</td>
<td>Quant</td>
<td>Visitor may play/wade in the stream</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Air</td>
<td>Resident</td>
<td>Adult</td>
<td>Inhalation</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child</td>
<td>Inhalation</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker</td>
<td>Adult</td>
<td>Inhalation</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Adult</td>
<td>Inhalation</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visitor</td>
<td>Adolescent</td>
<td>Inhalation</td>
<td>None</td>
<td>Exposure expected to be low due to dilution and not quantifiable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>Volatilization from stream water</td>
<td></td>
<td>Resident</td>
<td>Adult</td>
<td>Inhalation</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child</td>
<td>Inhalation</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker</td>
<td>Adult</td>
<td>Inhalation</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Adult</td>
<td>Inhalation</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visitor</td>
<td>Adolescent</td>
<td>Inhalation</td>
<td>None</td>
<td>Stream of insufficient size and carrying capacity for gamefish</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>None</td>
<td>Stream of insufficient size and carrying capacity for gamefish</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal tissue</td>
<td>Ingestion of fish</td>
<td></td>
<td>Resident</td>
<td>Adult</td>
<td>Ingestion</td>
<td>None</td>
<td>Stream of insufficient size and carrying capacity for gamefish</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child</td>
<td>Ingestion</td>
<td>None</td>
<td>Stream of insufficient size and carrying capacity for gamefish</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker</td>
<td>Adult</td>
<td>Ingestion</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Adult</td>
<td>Ingestion</td>
<td>None</td>
<td>Receptor not expected to contact surface water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visitor</td>
<td>Adolescent</td>
<td>Ingestion</td>
<td>None</td>
<td>Stream of insufficient size and carrying capacity for gamefish</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stream of insufficient size and carrying capacity for gamefish</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment</td>
<td>Sediment</td>
<td>Stream Sediment</td>
<td>Resident</td>
<td>Adult</td>
<td>Dermal</td>
<td>None</td>
<td>Receptor not expected to contact sediment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child</td>
<td>Dermal</td>
<td>None</td>
<td>Receptor not expected to contact sediment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>None</td>
<td>Receptor not expected to contact sediment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker</td>
<td>Adult</td>
<td>Dermal</td>
<td>None</td>
<td>Receptor not expected to contact sediment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Adult</td>
<td>Dermal</td>
<td>None</td>
<td>Receptor not expected to contact sediment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visitor</td>
<td>Adolescent</td>
<td>Dermal</td>
<td>Quant</td>
<td>Visitor may play/wade in the stream</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>None</td>
<td>Receptor not expected to contact sediment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Receptor not expected to contact sediment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Receptor not expected to contact sediment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring Water</td>
<td>Water</td>
<td>Seeps along stream bank</td>
<td>Resident</td>
<td>Adult</td>
<td>Dermal</td>
<td>None</td>
<td>Receptor not expected to contact seep water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child</td>
<td>Dermal</td>
<td>None</td>
<td>Receptor not expected to contact seep water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>None</td>
<td>Receptor not expected to contact seep water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Worker</td>
<td>Adult</td>
<td>Dermal</td>
<td>None</td>
<td>Receptor not expected to contact seep water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Groundskeeper</td>
<td>Adult</td>
<td>Dermal</td>
<td>None</td>
<td>Receptor not expected to contact seep water</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visitor</td>
<td>Adolescent</td>
<td>Dermal</td>
<td>Quant</td>
<td>Visitor may play/wade in the stream</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ingestion</td>
<td>None</td>
<td>Receptor not expected to contact seep water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Receptor not expected to contact seep water</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 2-7
Preliminary Ecological Conceptual Model
ST-14
Andrews Air Force Base, Maryland

Source
Leaks and Spills

Transport Pathways
- Storm Water System
- Surface Runoff
- Groundwater
- Leaching/Desorption
- Surface and Subsurface Soils

Exposure Media
- Surface Water (stream)
- Sediment (stream)
- Surface Soil
- Uptake/Accumulation

Biota

Exposure Route
Ingestion
Direct Contact
Root uptake

Receptors
Aquatic
- Invertebrates
- Fish
- Amphibians/Reptiles
- Birds
- Mammals

Terrestrial
- Invertebrates
- Plants
- Amphibians/Reptiles
- Birds
- Mammals

- Receptor evaluated quantitatively
- Receptor not evaluated quantitatively

Complete pathway
Incomplete pathway
LEGEND
GROUNDWATER
FLOW DIRECTION
TCE CONTOUR, MARCH 2006
TCE CONCENTRATION
MARCH 2006
MONITORING WELL
NOTES
1. TCE concentrations in ug/L.

APPROXIMATE BOUNDARY
OF ST-14

Andrews Air Force Base - Camp Springs, MD
ST-14 Record of Decision
31 MAR 2004
Figure 2-B
Figure 2-B
Sheet 2 of 1

1" = 250'

Approximate Scale in Feet
250' 125' 0 250'

50' 25' 0 75'
LEGEND

CARBON TETRACHLORIDE CONTOUR, MARCH 2006

CARBON TETRACHLORIDE CONCENTRATION, MARCH 2006

MINING WELL

GROUNDWATER FLOW DIRECTION

NOTES:
1. CARBON TETRACHLORIDE CONCENTRATIONS IN µg/L.

APPROXIMATE BOUNDARY OF ST-14
LEGEND

BENZENE CONTOUR, MARCH 2006

22.3
BENZENE CONCENTRATION IN µg/L, MARCH 2006

MONITORING WELL

GROUNDWATER FLOW DIRECTION

PROPOSED BENZENE TREATMENT AREA
USING ENHANCED IN-SITU AEROBIC BIODEGRADATION SYSTEM

Figure 2–10
Benzene Concentrations in Groundwater at ST–14
3.0 RESPONSIVENESS SUMMARY

The responsiveness Summary provides a summary of the public’s comments, concerns, and questions about ST-14 remedial action and the USAF’s responses to these concerns.

The public comment period for the proposed remedy for ST-14 was from April 26 to May 25, 2007. A public meeting was held on May 9, 2007 to describe the proposed remedy and to solicit and accept either written comments or verbal comments. The Notice of the public meeting was published on April 26, 2007, in the Prince George’s County Gazette and the Washington Post-Prince George’s “Extra” weekly edition.

3.1 OVERVIEW

At the time of the public comment period, USAF had endorsed Alternative 4 as the preferred remedy. Alternative 4 consisted of site-wide enhanced in-situ biodegradation with institutional controls and long term monitoring to address the TCE, benzene, and CT in the site groundwater.

MDE concurs with the preferred remedy. No public comments were received during the public comment period that disagreed with the selected remedy.

3.2 BACKGROUND AND COMMUNITY INVOLVEMENT

The USAF has maintained a public involvement and information program for the ERP since 1990, and has established an Information Repository, where key documents relating to remedial decisions are placed, including the Administrative Record for ST-14.

To review the Information Repository, visit:

Prince George’s County Memorial Library-Surratts-Clinton Branch
9400 Piscataway Road
Clinton, MD 20735
Phone (301) 868-9200
Hours: Monday–Wednesday 10am–9pm
Thursday–Friday 10am–6pm
Saturday 10am–5pm
Sunday 1pm–5pm (Sept. to mid-June)

Andrews AFB community relations activities for the final selected remedy for ST-14 included the following:

- The documents relied upon to make the final remedial decision concerning the investigation and analysis of ST-14 (i.e., Comprehensive Environmental Investigation Addendum and Feasibility Study), as well as copies of the Proposed Plan, were placed in the Information Repository.
- Newspaper announcements on the availability of the documents and the public meeting and comment period were published in the Prince George’s County Gazette and the Washington Post-Prince George’s “Extra” weekly edition on April 26, 2007.
- A public meeting was held on May 9, 2007 to present the Proposed Plan, explain the remedy, and answer questions.
3.3 SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD

No comments were received during the public comment period. One community member was present at the public meeting, but offered no comments.
4.0 REFERENCES


September 5, 2007

Mr. Brian Dolan
316 CES/CEVR
3466 North Carolina Avenue
Andrews Air Force Base, Maryland 20762

RE: MDE Concurrence Letter for the Final Record of Decision for the ST-14 Site, Andrews Air Force Base, Maryland.

Dear Mr. Dolan:

The Record of Decision (ROD) for Site ST-14 documents the Air Force’s findings from the Remedial Investigation Report and the site-specific risk assessment; and affirms alternative #4 in the Feasibility Study Report as the preferred remedy for this site. The Federal Facilities Division (FFD) of the Maryland Department of Environment’s Waste Management Administration concurs with the Air Force’s remedy selection.

A public meeting was held on May 9, 2007 to present the Proposed Remedial Action Plan (PRAP) for the ST-14 site to the public. A public comment period extending from April 26 through May 25, 2007 provided another opportunity for public comment. No comments were received by the Air Force during the public comment period. One community member was present at the public meeting, but offered no comments or questions about the PRAP for ST-14. The FFD supports the Air Force’s selected remedy for the ST-14 site.

If you have any questions, please contact me at (410) 537-3398.

Sincerely,

[Signature]

Rick Grills
Section Head
Federal Facilities Division

RG: mh
cc: Mr. Andrew Sohanski
Ms. Manfred Reichwein
Mr. Horacio Tablada
Mr. Harold L. Dye, Jr.
Appendix B
Applicable or Relevant and Appropriate Requirement Tables
<table>
<thead>
<tr>
<th>REGULATORY AUTHORITY</th>
<th>CHEMICAL MEDIUM</th>
<th>REQUIREMENT</th>
<th>STATUS</th>
<th>REQUIREMENT SYNOPSIS</th>
<th>CONSIDERATION IN THE REMEDIAL RESPONSE PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Groundwater</td>
<td>Groundwater Quality Standards COMAR 26.08.02.04(A) thru (C) and 26.08.02.09(B) thru (D)</td>
<td>Applicable</td>
<td>Maryland Antidegradation Policy: actions cannot degrade state waters. Section 09(B) identifies Maryland groundwater classifications. Section 09(C) and (D) regulate discharges to the underground of the State.</td>
<td>Remedial action at ST-14 will require discharges to the groundwater, affecting the groundwater quality.</td>
</tr>
<tr>
<td>State</td>
<td>Groundwater</td>
<td>Well Construction and Abandonment COMAR 26.04.04.02, 26.04.04.07, 26.04.04.11</td>
<td>Applicable</td>
<td>To ensure a clean and adequate supply of underground drinking water, the State carries out programs to prevent contamination of aquifers from improper well construction and well abandonment.</td>
<td>The remedial action at ST-14 may include the installation of groundwater monitoring wells.</td>
</tr>
<tr>
<td>State</td>
<td>Groundwater</td>
<td>Drilling and installation of wells COMAR 26.05.01.01 thru .08</td>
<td>Applicable</td>
<td>Establishes licensing requirement for persons drilling and installing wells in the State, to ensure that monitoring wells are installed by qualified well drillers.</td>
<td>The remedial action at ST-14 may include the installation of groundwater monitoring wells.</td>
</tr>
<tr>
<td>State</td>
<td>Soil and Groundwater</td>
<td>Sampling and Analysis COMAR 26.13.03.02</td>
<td>Applicable</td>
<td>Establishes specific analytical requirements for testing and evaluating solid, hazardous, and water wastes.</td>
<td>The remedial action at ST-14 will generate soil and groundwater IDW from monitoring well installation and groundwater sampling.</td>
</tr>
</tbody>
</table>

Notes:
- CFR = Code of Federal Regulations
- COMAR = Code of Maryland Regulations
- IDW = Investigation-Derived Waste
### TABLE B-2
Synopsis of Federal and State **Chemical-Specific** Applicable or Relevant and Appropriate Requirements for the Selected Remedy
ST-14 Record of Decision
Andrews Air Force Base, Maryland

<table>
<thead>
<tr>
<th>REGULATORY AUTHORITY</th>
<th>CHEMICAL MEDIUM</th>
<th>REQUIREMENT</th>
<th>STATUS</th>
<th>REQUIREMENT SYNOPSIS</th>
<th>CONSIDERATION IN THE REMEDIAL RESPONSE PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal</td>
<td>Groundwater</td>
<td>Safe Drinking Water Act, National Primary Drinking Water Regulations, Maximum Contaminant Levels (MCLs) [40 CFR 141.61(a)(1) thru (3) and (5).]</td>
<td>Applicable</td>
<td>The National Primary Drinking Water Regulations establish MCLs for common organic and inorganic contaminants. MCLs specify the maximum permissible concentrations of contaminants in public drinking water supplies. MCLs are federally enforceable standards based in part on the availability and cost of treatment techniques.</td>
<td>Active treatment will be conducted to meet MCLs in groundwater. Monitoring will be performed to measure changes in contaminant concentrations or migration. MCLs will be achieved through active treatment and natural attenuation processes.</td>
</tr>
<tr>
<td>State</td>
<td>Drinking Water</td>
<td>Drinking Water Standards COMAR 26.04.01.07(D)(1) thru (3) and (5)</td>
<td>Applicable</td>
<td>MCLs for organic chemicals in drinking water</td>
<td>State MCLs are ARARs for remedial actions at ST-14.</td>
</tr>
</tbody>
</table>

**CFR** = Code of Federal Regulations  
**COMAR** = Code of Maryland Regulations  
**MCLs** = Maximum Contaminant Levels
Appendix C
Public Comment Newspaper Notice
County honors its heroes at Valor Awards charity lunch

BY DANIEL VALENTINE

STAFF WRITER

By the time Nicholas Fiore got to the scene on Oxon Hill, the driver was passed out behind the wheel and the Cadillac Escalade was on fire.

Brewing the heat and blinding smoke, Fiore smashed out the window with his baton, undid the seat belt and pulled the driver out from the fire that burned the vehicle into a black metal skeleton in the early hours of Jan. 1, 2006.

Exchanging his regular uniform for his dress clothes Wednesday, Fiore joined 29 other public safety officers who were honored for heroism and excellent service at the annual Valor Awards, an annual charity event where county police, fire, correctional and sheriff's offices recognized outstanding performance in 2006.

Many of the officers knew exactly what Fiore went through.

Several officers were given ribbons and plaques for pulling motorists from their burning cars, while others earned recognition for equally harrowing events performed on- and off-duty.

Officer Michael I. Ebaugh earned his award by facing down a hostile driver who had trapped him in a power window during a traffic stop on May 31, 2006, just after midnight.

As the driver started reaching into the passenger seat, Ebaugh smashed the window with his flashlight, pulled his gun and pulled the driver out of the car.

He later found a loaded .45 hand-

"It's only afterwards that you start shak-

"Prince George's police and firefigh-

"But something was different in this case. The man, after he was denied bail, was screaming "It ain't me", and insisted that police had confused him with his brother, a convicted felon who often used his name as an alias. His vehemence made Owens look further.

After checking his fingerprints again, Owens started calling the FBI, who had issued a warrant for the man. Federal investigators confirmed that his suspect had a scar on his forehead. The man Owens had not.

After confirming that the brother was already in jail at another location, Owens worked overtime to call up a judge to make sure the man was set free before the weekend.

"Just want to make sure things are done to the end," Owens said. "I wouldn't want to go home for a minute thinking we had the wrong guy.

Hundreds attended the luncheon ceremony in Upper Marlboro Wednesday for the off-

cers. Tickets from the luncheon help fund a public safety charity that assists families during the holidays.

E-mail Daniel Valentine at dvalentine@ gazette.net.

"These awards are all about the willingness of people in our society to step up and make a difference."

Melvin High, county police chief

Schedule your A/C or Heat Pump Tune-up Now!

Carrier Belair Engineering

Turn to the Experts

"For Your Best in Heating & Air Call Belair"

301-249-0300

www.belaireng.com

Firefighter/paramedic Jamie Leigh Joroff is congratulated after winning the Fire/EMS Department Bronze Medal of Valor during the 30th annual Prince George's County Public Safety Valor Awards luncheon Wednesday in Upper Marlboro. (MATTGALLAGHER/THEGAZETTE)

"The United States Air Force Requests Public Comment on the Proposed Plan for ST-14 at Andrews AFB"

The U.S. Air Force (USAF) and the U.S. Environmental Protection Agency (USEPA) have issued a Proposed Plan for addressing shallow groundwater contamination at a site called “ST-14” at Andrews Air Force Base. You are invited to review the Proposed Plan and its supporting documents and submit your comments on the plan during the 30-day public comment period, April 26 – May 25, 2007.

SITE DESCRIPTION: The ST-14 area is located east of the flight line in the northeast portion of the Base. ST-14 was brought into the ERP in 1985 because of gasoline leaks from underground storage tanks (USTs) and distribution lines at the Former East Side Gas Station, Building 3487. The gas station was built in 1945 as a full service station with two service bays but was closed and converted to a convenience store in the early 1960s. The two 10,000-gallon USTs associated with the former gas station were removed in 1963. Since then the USAF has carried out several investigative efforts to determine the nature and extent of groundwater contamination resulting from both the UST leakage as well as discharges from several waste tanks previously located in the vicinity of the gas station. The primary groundwater contaminants at ST-14 are trichloroethene; carbon tetrachloride; and petroleum-related compounds such as benzene, toluene, ethylbenzene and xylenes (BTEX).

PROPOSED PLAN: The USAF and USEPA propose active treatment of the groundwater contaminants via injection of organic carbon substrate to address the trichloroethene and carbon tetrachloride; and injection of an oxygen-releasing compound to enhance reduction of BTEX near the former gas station. Active treatment will be followed by a groundwater monitoring program and institutional controls to ensure no exposure prior to achievement of federal regulatory standards.

FOR REVIEW: The Proposed Plan and all supporting documents are available for review at Prince George’s County Library, Surratts-Clinton Branch, 9400 Piscataway Road, Clinton, Maryland (301-888-9205).

TO LEARN MORE: The USAF and USEPA invite you to attend an information session on the Proposed Plan. This will be held on Wednesday May 9, 6:30-7:30 p.m. at the Colony Hotel and Conference Center, 7491 Surratts Road, Clinton, Maryland.

The USAF will present and explain the proposed plan and will receive oral and written comments at the meeting.

TO SUBMIT COMMENTS: Written comments may be submitted by mail, email or fax to:

313th Wing Public Affairs Office (313 WG/PA)
1535 Command Drive
Andrews AFB, MD 20762-7001
Fax: 301-981-4583
Email: 313WPA coment@andrews.af.mil

1996932
The United States Air Force Requests Public Comment on the Proposed Plan for ST-14 at Andrews AFB

The U.S. Air Force (USAF) and the U.S. Environmental Protection Agency (USEPA) have issued a Proposed Plan for addressing chemical groundwater contamination at Andrews Air Force Base, Maryland (also known as Andrews AFB). You are invited to review the Proposed Plan and its supporting documents and submit your comments on the plan during the 30-day public comment period, April 26 - May 26, 2007.

SITE DESCRIPTION: The ST-14 area is located east of the flight line in the northeast portion of the base. ST-14 was brought into the EPA's 1986 list of groundwater sites for cleanup due to releases of trichloroethylene (TCE), tetrachloroethylene (PCE), and other volatile organic compounds (VOCs) from several drycleaning businesses located at the base. Andrews AFB has been added to the list of Superfund sites.

The primary groundwater contaminants at ST-14 are trichloroethylene (TCE), tetrachloroethylene (PCE), and other VOCs. These compounds were released from drycleaning businesses on the base and have migrated through the soil and entered the groundwater.

The Proposed Plan includes the following elements:

- Identification and characterization of the groundwater contamination area
- Environmental cleanup strategies
- Monitoring and long-term management of the site

For further information, visit the USAF website at https://www.raf.org or the USEPA website at https://www.epa.gov.

TO LEARN MORE: The USAF and the USEPA invite you to attend an informational session on the Proposed Plan. This will be held on Wednesday, May 9, 8:30-9:30 a.m., at the Colony South Hotel and Conference Center, 7401 Park Road, District of Columbia. The meeting will include a formal presentation and an opportunity for questions and answers. The Proposed Plan and supporting documents are available for review at Prince George's County Library, 19340 Piscataway Road, Clinton, Maryland (301-988-9200).

TO SUBMIT COMMENTS: Written comments may be submitted by mail, email, or in person to the following address:

13th Wing Public Affairs Office (316 WG/PA)
13th Command/AF
Andrews AFB, MD 20762-7001
Fax: 301-981-4588
Email: 316PA.comre@Andrews.af.mil
Appendix D
Public Meeting Minutes and Presentation
Meeting Minutes

Air Force and Regulatory Attendees (Alphabetically):
Brian Dolan, Andrews AFB
Judy Gallagher, Earth Tech
Rick Grills, MDE
Manfred Reichwein, Prince George's County Health Department

Meeting Summary:

A public meeting was held in order to make available Environmental Restoration Program (ERP) representatives to answer questions from the general public regarding the ST-14 Former East Side Gas Station Proposed Plan. The meeting commenced at 6:30 PM in the Lord Calvert Room. All attendees were requested to provide their names and contact information on the sign-in sheet.

The meeting was advertised in large circulation local newspapers 14 days prior to the meeting. Informational posters and copies of the Proposed Plan were prepared and available at the meeting. Copies of a recently mailed Andrews AFB Environmental Newsletter were also available.

The main poster displayed near the projection screen was a detailed diagram of the ST-14 site. One poster provided an explanation of the CERCLA process. Another poster depicted the anticipated effects of the proposed remedial alternative on contaminated groundwater. A final poster listed the Andrews AFB contact information for written comments from the community.

A slide presentation was performed that explained the history, risks, and remedial plans for the ST14 site. One member of the public (Mr. Tom DelZoppo) attended the meeting and was complimentary of the remedial approach.

No concerns or questions were asked regarding the recommendations in the Proposed Plan for ST-14. The meeting adjourned at 7:30 PM.