Picatinny Arsenal Installation Restoration Program

Picatinny Arsenal is an Official Hawk Watch Site

PICATINNY ARSENAL
TASK ORDER 004
600 AREA DATA REPORT
AND
FEASIBILITY STUDY

600 Area Groundwater Plume (PICA 58)

VOLUME I
REPORT AND APPENDIX P

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/L .....micrograms per liter
µg/m^3 .....micrograms per cubic meter

AA.....Area of Attainment
ANL .....Argonne National Laboratory
AOC.....Area of Concern
ARAR .....Applicable or Relevant and Appropriate Requirement
atm-m^3/mole .....atmospheres-cubic meters per mole
ATSDR .....Agency for Toxic Substances and Disease Registry
AWDF.....Advanced Weapons Research Facility
AWQC .....Ambient Water Quality Criteria

bgs.....below ground surface
BHTV.....Borehole Acoustic Televiewer
BIP.....blow-in-place

CCOPC .....Criteria-based Contaminant of Potential Concern
CEA.....Classification Exception Area
CERCLA.....Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR.....Code of Federal Regulations
cis-1,2-DCE.....cis-1,2-Dichloroethene
COC .....Contaminant of Concern
COPC.....Contaminant of Potential Concern
COPEC.....Chemical of Potential Ecological Concern
CWA.....Clean Water Act
CY .....cubic yards

DAF .....Dilution Attenuation Factor
DDESB.....Department of Defense Explosives Safety Board
DENIX .....Defense Environmental Network and Information Exchange
DERA .....Defense Environmental Restoration Account
DERP .....Defense Environmental Restoration Program
DGM.....Digital Geophysical Mapping
DNX.....hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine
DO .....Dissolved Oxygen
DoD .....Department of Defense
DQO .....Data Quality Objective

EM .....Engineer Manual
EOD.....Explosives Ordnance Disposal
EP.....Engineer Pamphlet
EPIC.....Environmental Photographic Interpretation Center
ePTFE .....polytetrafluoroethylene
ERA.....Ecological Risk Assessment
ESS .....Explosives Safety Submission
EZ.....exclusion zone

Fe .....iron
FFA.....Federal Facilities Agreement
fpm .....feet per minute
FRTR.....Federal Remediation Technologies Round Table
FS.....Feasibility Study
FSP .....Field Sampling Plan

ft .....feet/foot
ft/day.....feet per day
ft/ft .....feet per foot
FW-NT.....Fresh Water – Non-Trout

g/cm^3 .....grams per cubic centimeter
GIS .....Geographic Information System
gpm .....gallons per minute
GPS.....Global Positioning System
GRA.....General Response Action
GWQS.....Groundwater Quality Standards

HA .....Health Advisories
HHCOPC.....Human Health Contaminant of Potential Concern
HHRA .....Human Health Risk Assessment
HMX 1,3,5,7-tetranitro-1,3,5,7-tetrazacyclooctane
HPFM .....Heat Pulse Flowmeter
HPLC.....High Purity Liquid Chromatographic
HRS.....Hazard Ranking Score
HTRW.....Hazardous, Toxic, and Radioactive Waste

IASL.....Indoor Air Screening Level
IC.....Institutional Control
ID.....Inner Diameter
IGWSRS.....Impact to Groundwater Soil Remediation Standard
IRP .....Installation Restoration Program
ISCO.....*In Situ* Chemical Oxidation
IT .....IT Corporation

J&E Model.....Johnson and Ettinger Vapor Intrusion Model

Kd .....distribution coefficient
kHz .....kilohertz
K_{oc}.....organic carbon/water partition coefficient
K_{ow} .....octanol/water partition coefficient

LAW.....Light Anti-Tank Weapon
LOC .....level of concern
log_{10} .....logarithm
LTM .....Long-Term Monitoring
LUC .....Land Use Control

MAG .....Mid-Atlantic Geosciences, LLC
MC.....munitions constituents
MCL.....Maximum Contaminant Limit
MCLG .....Maximum Contaminant Level Goal
MD.....munitions debris
MEC .....munitions and explosives of concern
mg/kg.....milligrams per kilogram
mg/L .....milligrams per liter
mL/min.....milliliters per minute
mm .....millimeters
mm Hg.....millimeters mercury
MMRP .....Military Munitions Response Program
Mn .....manganese
MNA .....Monitored Natural Attenuation

MNX hexahydro-1-nitroso-3,5–dinitro-1,3,5-triazine
MRS .....Munitions Response Site
msl.....mean sea level
MTBE .....Methyl Tertiary Butyl Ether
mV.....millivolts
MWL.....Meteoric Water Line

N_2 .....nitrogen gas
NCP.....National Oil and Hazardous Substances Pollution Contingency Plan
NFA .....No Further Action
NJAC.....New Jersey Administrative Code
NJDEP.....New Jersey Department of Environmental Protection
NJGWQS.....New Jersey Groundwater Quality Standards
NJMCL .....New Jersey Maximum Contaminant Limit
NJPQL.....New Jersey Practical Quantitation Limit
NO_3^{2-}.....nitrate
NPL .....National Priorities List
NTU .....nephelometric turbidity unit

O&M .....Operation and Maintenance
OPTV.....Optical Televiewer
ORP.....Oxidation-Reduction Potential
OSWER.....Office of Solid Waste and Emergency Response

PCB .....polychlorinated biphenyl
PCE .....Tetrachloroethene
PID .....photoionization detector
PP.....Proposed Plan
PPE .....Personal Protective Equipment
ppm .....parts per million
PRG.....preliminary remediation goals
PQL .....Practical Quantitation Limit
PTA .....Picatinny Arsenal

QA .....Quality Assurance
QAPP .....Quality Assurance Project Plan
QC.....Quality Control

RA .....Remedial Alternative
RAGS .....Risk Assessment Guidance for Superfund
RAO.....Remedial Action Objective
RBC.....risk-based concentration
RCRA .....Resource Conservation and Recovery Act
RDX.....Cyclonite
redox .....reduction/oxidation
REMTC.....Reactive and Explosive Materials Training Corporation
Rf.....retardation coefficient
RfC .....reference concentrations
RI.....Remedial Investigation
RME .....reasonable maximum exposure
ROD .....Record of Decision
RSL .....Regional Screening Level

SARA.....Superfund Amendments and Reauthorization Act of 1986
SCL .....Site Cleanup Level
SDWA.....Safe Drinking Water Act

SGSL.....Soil Gas Screening Level
Shaw .....Shaw Environmental, Inc., a CB&I Company
SO_4^{2-}.....sulfide
SOP.....Standard Operating Procedure
SOW.....Scope of Work
SQB.....sediment quality benchmark
SRWM.....Site Remediation Waste Management
SUXOS.....Senior Unexploded Ordnance Specialist
SVOC .....semivolatile organic compound
SWPPP .....Storm Water Pollution Prevention Plan
SWQS .....Surface Water Quality Standards

TAL.....target analyte list
TBC .....To-Be-Considered
TCE .....Trichloroethene
TCL.....Target Compound List
TIC.....Tentatively Identified Compound
TNX hexahydro-1,3,5-trinitroso-1,3,5-triazine

URF .....unit risk factors
USACE.....U.S. Army Corps of Engineers
USAEC.....U.S. Army Environmental Center
USATHAMA .....U.S. Army Toxic and Hazardous Materials Agency
USEPA .....U.S. Environmental Protection Agency
USGS .....U.S. Geological Survey
UXO.....Unexploded Ordnance
UXOQCS.....Unexploded Ordnance Quality Control Specialist

VC .....Vinyl Chloride
VI .....Vapor Intrusion
VLF.....Very Low Frequency
VOC.....Volatile Organic Compound

WES .....Water Experiment Station
Weston .....Weston Solutions, Inc.
WRA.....Well Restriction Area

ZVI.....Zero-Valent Iron

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (USACE) has tasked Shaw Environmental, Inc., a CB&I Company (Shaw), to conduct a focused Groundwater Investigation and Feasibility Study (FS) for the Picatinny Arsenal (PTA) 600 Area groundwater operable unit, also known as PICA 58. This data report/FS covers the affected groundwater in the area of the Advanced Weapons Research Facility (AWDF), surface water, soils, or waste material that may have contributed to the groundwater contamination. This document was submitted as final in January 2010. Subsequent to the submission, two changes took place necessitating update, modification, and resubmission of this document as Final, Revision #2. First, comments to the Proposed Plan (PP) for the site were received from the U.S. Environmental Protection Agency (USEPA). These comments requested additional data collection and requested the selection of a different remedial alternative (RA). This additional data collection has been completed and the results have been factored into the RA development and evaluation in this document. Second, the Remedial Investigation (RI) of the Inactive Munitions Waste Pit (PICA-013-R-01), Military Munitions Response Program (MMRP) site was completed. This new information was likewise incorporated into this document and the RAs were modified accordingly. The changes made for revision #2 of the document have been made in tracked changes to facilitate review of the new information. PTA is located in Rockaway Township, New Jersey (**Figure 1-1**). The 600 Area is located in the northwest corner of the PTA, and is shown on **Figure 1-2**.

Elevated concentrations of trichloroethene (TCE) were initially detected in groundwater at the newly installed well for the AWDF in 1994, and became the subject of a focused investigation. Subsequent testing of the AWDF and other 600 Area monitoring wells confirmed the presence of TCE, and detected elevated concentrations of cyclonite (RDX) and methyl tertiary butyl ether (MTBE) in groundwater. The Groundwater Investigation focused on determining the nature and extent of these contaminants, and to provide sufficient background data for preparation of a follow-on 600 Area FS. Remedial options are developed and evaluated in the FS, so that appropriate remedies may be selected for the site.

Three areas of concern (AOCs) were identified in the *600 Area Groundwater Remedial Investigation Work Plan* (Shaw, 2004). These AOCs were identified based upon review of existing reports and historical data, and personal interviews with individuals familiar with either former or current activities in the area. A fourth potential AOC (AOC 4) was identified after evaluation of sampling data from two newly installed wells. The four AOCs are shown on **Figure 2-1**, and are identified as follows:

- AOC 1 – Munitions Waste Pit, RI Site 12.
- AOC 2 – Metal Containers in eastern portion of RI Site 11.
- AOC 3 – Partially Buried Drums in western portion of RI Site 11.
- AOC 4 – Fill and soil mounds near Building 647.

The focused groundwater investigation began in the 600 Area in April 2004 with sampling of the AWDF well, which resulted in confirmation of TCE contamination. The investigation of 600 Area groundwater was performed in an iterative manner. The Army utilized on board reviews with the regulators and abbreviated work plans using a facility-wide FSP as a framework. The 600 Area RI scope of work (SOW) was subsequently presented to stakeholders in five sequential Work Plans, which reflects the iterative, step-wise approach needed in this case to delineate the TCE plume. In some cases interim data was presented to the regulators at a meeting or a site visit and the next round of investigation was carried out using meeting minutes or a letter format work plan. The SOW included the following elements/tasks:

- Passive soil gas survey in all AOCs.
- Very low frequency (VLF) surface geophysical survey of the 600 Area.
- Installation of eleven bedrock monitoring wells.
- Borehole geophysics and packer testing of the AWDF and installed monitoring wells.

- Aquifer Pumping Test.
- Groundwater and surface water oxygen isotope sampling.
- Groundwater, Surface Water, Sediment, and Soil Sampling.
- Human and Ecological Risk Assessment.

The 600 Area is underlain by the Green Pond Conglomerate, a Silurian age conglomerate that makes up most of Green Pond Mountain. Two mapped faults and a large fold axis trend northeast-southwest across the length of the 600 Area and are considered potential high permeability structures. The field evidence for these structures includes interpreted air photo fracture traces and a string of ponds, wetlands, and springs observed along the mapped trace of the faults/fold. The VLF study found conductive structures along the trace of each of these features. The aquifer test conducted at the AWDF well found an average bedrock permeability of 2.52 feet/day (ft/day), but was unable to determine the degree of aquifer anisotropy. Groundwater flow is generally toward the southeast, with an average measured gradient of 0.046 feet per foot (ft/ft). Measured vertical gradients at shallow/deep cluster wells are generally downward, with the exception of one weak upward measurement. This data indicates that shallow groundwater is recharging the deeper bedrock aquifer at these locations. The calculated groundwater seepage velocity is 2.32 ft/day.

Packer testing was conducted on the AWDF and selected monitoring wells to determine the distribution of water-bearing fractures and TCE contamination in the aquifer. Overall, fracture density and yield was found consistent with depth, and TCE groundwater contamination is well distributed over the tested borehole intervals at monitoring wells. TCE concentrations decreased with depth at the AWDF well and source area well (13MW-1). Surface water isotope data indicates that samples were derived from a groundwater source rather than precipitation. This data suggests that the wetlands are principally spring fed, and that detected TCE in surface water may be derived from groundwater.

A total of nine groundwater and surface water sampling rounds were conducted from November 2004 through June 2008, and included analysis for volatile organic compounds (VOCs) with Tentatively Identified Compounds (TICs) and Baseline explosives. The finalization of this document was delayed when additional investigation was requested by USEPA. During this delay the Army collected additional rounds of groundwater and surface water monitoring data. VOC level of concern (LOC) exceedances were detected in groundwater, and included TCE and MTBE. Surface water VOC exceedances included TCE, but were not observed in sediment and soil. Baseline explosive (RDX) exceedances were detected in groundwater and surface water, but not in sediment.

TCE was detected in 8 of 15 samples during the June 2008 sampling round, with 8 samples exceeding the LOC of 1.0 micrograms per liter (µg/L). A TCE plume was plotted from sampling data, and extends approximately 1,450 feet (ft) southwest from the source area well (13MW-1) to the 1.0 µg/L contour. The highest TCE concentration (130 µg/L) was detected at well 13MW-2, which is located in the downgradient plume area. Sampling conducted in April/May 2010 and January/February 2011 resulted in a similar pattern of TCE concentrations. The highest TCE concentrations were consistently observed at well 13MW-2 at 171 µg/L and 210 µg/L, respectively, for the 2010 and 2011 sampling rounds. TCE was not detected in two new monitoring wells (13MW-12 and 13MW-13) installed prior to the 2010 sampling round. The plotted TCE plume is unusually wide, and may have been laterally dispersed by a local bedrock high and/or permeable fault and fold structures in the study area. The overall width of the plume suggests some lateral TCE transport along the northern splay of the Picatinny fault. The southwestern and southeastern edges of the plume terminate in mapped wetland/stream areas, and likely discharge into these surface water bodies, where TCE is detected. Historical MTBE groundwater exceedances are detected at well 13MW-5, and are the subject of a separate 600 Area MTBE investigation. Similarly, RDX in groundwater was subject to a separate investigation and report. Although it was subject to a separate report and determined to require no further action, RDX groundwater concentrations within the 600 Area are discussed within this report.

Natural attenuation data was collected and assessed for TCE and RDX to determine the potential effectiveness of Monitored Natural Attenuation (MNA) as a remedial technology. Bioremediation sampling data was collected in support of MNA and bioremediation RAs. MNA data indicates aerobic to

mildly reducing conditions in most wells. Biological degradation is not considered a major attenuation mechanism due to current oxidation/reduction (redox) conditions and absence of significant degradation products. The principal projected TCE attenuation mechanism is advection and dispersion, which should be significant as shown with the wide mapped extent of the TCE plume. TCE data does not show a definitive concentration trend, and a reliable MNA cleanup time cannot be calculated.

TCE sampling data shows a steady state plume originating in AOC 1, which currently discharges to surface water at two locations, and impacted the (now off-line) AWDF non-potable well. The exact nature, volume, and size of the TCE source material was not known, but was presumed to be a thin layer of impacted soils buried under blasted rock debris from the Building 660 site. Further investigation of the potential source soils was considered impracticable due to the 10- to 30-ft-thick overlying rock debris, and potentially buried munitions and explosives of concern in the former munitions testing area. However, following comments received from the USEPA on the PP for 600 Area Groundwater and the removal of the majority of overlying rock debris (crushed and used as gravel for unrelated construction activities on PTA); the Army agreed to perform additional investigation of the 600 Area. This revised FS (Final, Revision #2) includes the results of this additional investigation. Additionally, the formulation and evaluation of RAs have been revised. The additional investigation included passive soil gas testing in the newly uncovered presumed source area, excavation and sampling of test pits and/or trenches based on the passive soil sampling results, and two additional rounds of groundwater and surface water sampling. A maximum TCE concentration of 23.9 milligrams per kilogram (mg/kg) was identified in the 24 to 24.5 ft interval below ground surface (bgs), approximately 120 ft north, northwest of 13MW-1. The results indicate that the active source of the 600 Area TCE groundwater plume is an approximately 5 ft thick layer of TCE impacted soil located just above bedrock centered between 13MW-1 and the burning cage located on-site.

Two conceptual source models were developed to predict plume characteristics and time to cleanup. The *Inactive Source Model* assumes an inactive or rapidly declining TCE source to the bedrock aquifer, and predicts time to cleanup based upon observed TCE concentration decreases at source area well 13MW-1 over all nine rounds of sampling for 13MW-1 conducted over six years. A cleanup time of 53 years was calculated from well 13MW-1 data using the USEPA time-dependent degradation rate method. The *Soil Leaching Model* assumes an ongoing, but declining source of TCE to the bedrock aquifer over time, and estimates time to cleanup using predicted soil leaching rates. The model VLEACH was used to simulate leaching of source area soils, and predicted that TCE impacted soils would decrease to New Jersey Department of Environmental Protection (NJDEP) Impact to Groundwater Standards for TCE in 35 years. A gross cleanup time of 50 years is assumed for costing purposes reflecting the more conservative model.

Through the RI, it has been determined that a response action is necessary for PICA 58. A subsequent evaluation of potential Applicable or Relevant and Appropriate Requirements (ARARs) identified the Safe Drinking Water Act (SDWA) Maximum Contaminant Limits (MCLs) and the New Jersey Groundwater Quality Standards (NJGWQS). As such, the response actions for groundwater will restore the groundwater to the more stringent of the two cleanup levels, MCLs or NJGWQS, thus restoring the groundwater to its beneficial use as a drinking water aquifer. The following remedial action objectives (RAOs) were developed for PICA 58:

- To prevent human exposure to contaminated groundwater that would cause unacceptable risk over the duration of the response action.
- To restore groundwater to the more stringent of the MCLs or NJGWQS for the identified contaminants of concern (COCs) in a reasonable timeframe, thereby restoring groundwater to its beneficial use as a drinking water source.

In this FS, COCs, site cleanup levels (SCLs), and areas of attainment (AAs) were developed for groundwater and surface water within the 600 Area. The list of COCs was developed in Section 8.0 (see **Tables 8-1** and **8-2**) by screening versus LOCs and evaluating constituents identified as potential risks in human health risk assessments (HHRAs). TCE was identified as the sole COC for groundwater.

An AA was selected to evaluate the most appropriate response action(s) for TCE contamination. The screening process generated the following remedial action alternatives to be considered in the detailed analysis:

TCE in Groundwater/Surface Water

- Alternative GW-1: No Action.
- Alternative GW-2: MNA with Institutional Controls (ICs).
- Alternative GW-3: *In Situ* Chemical Oxidation (ISCO) and MNA Polishing with ICs.
- Alternative GW-4: *In Situ* Enhanced Anaerobic Bioremediation and MNA Polishing with ICs.
- Alternative GW-5: TCE Source Material Excavation and MNA Polishing with ICs.
- Alternative GW-6: Total Landfill Removal and MNA Polishing with ICs

Table ES-1 Summary of Group 1 Alternatives Analysis

Alternative	Description	Capital Cost	Discounted O&M	Total Present Worth
Groundwater				
GW-1	NO ACTION	**$0.00**	**$0.00**	**$0.00**
GW-2	MONITORED NATURAL ATTENUATION (MNA) WITH INSTITUTIONAL CONTROLS	**$60,000.00**	**$620,235.73**	**$680,235.73**
GW-3	IN SITU CHEMICAL OXIDATION (ISCO) AND MNA WITH ICs	**$427,660.51**	**$653,834.50**	**$1,081,495.01**
GW-4	IN SITU ENHANCED ANAEROBIC BIOREMEDIATION AND MNA WITH Ics	**$469,863.67**	**$733,201.14**	**$1,203,064.81**
GW-5	TCE SOURCE MATERIAL EXCAVATION AND MNA WITH ICs	**$1,411,844.81**	**$249,834.17**	**$1,661,678.98**
GW-6	TOTAL LANDFILL REMOVAL AND MNA POLISHING WITH ICs	**$2,360,193.45**	**$249,834.17**	**$2,610,027.62**

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) has tasked Shaw Environmental, Inc. (Shaw) to conduct a focused Groundwater Investigation and Feasibility Study (FS) for the Picatinny Arsenal (PTA) 600 Area groundwater operable unit, also known as PICA 58. This work is being conducted under the Baltimore Hazardous, Toxic, and Radioactive Waste (HTRW) Contract, Number W912DR-05-D-0026, Task Order 4. This work is funded by the Department of Defense (DoD) under the Defense Environmental Restoration Program (DERP). Funding for the program is through the Defense Environmental Restoration Account (DERA). In March 1990, Picatinny was included on the National Priorities List (NPL) with a Hazard Ranking Score (HRS) of 42.92. The Picatinny Installation Restoration Program (IRP) is a federal-led Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) program. USEPA is the lead regulatory agency. Regulatory interaction is governed under a Federal Facilities Agreement (FFA).

This data report/FS (Final, Revision #2) covers the affected groundwater in the area of the Advanced Weapons Research Facility (AWDF), surface water, soils, or waste material that may have contributed to the groundwater contamination. This document was submitted as final in January 2010. Subsequent to the submission, two changes took place necessitating update, modification, and resubmission of this document as Final, Revision #2. First, comments to the Proposed Plan (PP) for the site were received from the U.S. Environmental Protection Agency (USEPA). These comments requested additional data collection and requested the selection of a different remedial alternative (RA). This additional data collection has been completed and the results have been factored into the RA development and evaluation in this document. Second, the Remedial Investigation (RI) of the Inactive Munitions Waste Pit (PICA-013-R-01), Military Munitions Response Program (MMRP) site was completed. This new information was likewise incorporated into this document and the RAs were modified accordingly. The changes made for revision #2 of the document have been made in tracked changes to facilitate review of the new information. PTA is located in Rockaway Township, New Jersey (**Figure 1-1**). The 600 Area is located in the northwest corner of the PTA, and is shown on **Figure 1-2**.

Elevated concentrations of trichloroethene (TCE) were initially detected in groundwater at the newly installed well for the AWDF in 1994, and became the subject of a focused investigation. A map showing the 600 Area is presented on **Figure 1-3**. Subsequent testing of the AWDF and other 600 Area monitoring wells confirmed the presence of TCE, and detected elevated concentrations of cyclonite (RDX) and methyl tertiary butyl ether (MTBE) in groundwater. The Groundwater Investigation focused on determining the nature and extent of these contaminants, and to provide sufficient background data for preparation of a follow-on 600 Area FS. The results of the Groundwater Investigation indicated the potential for a thin layer of TCE impacted soils, which could be a continuing source of groundwater contamination. This thin layer of soil was buried under rock debris blasted from the area of Building 660 during its construction. Following the removal of the majority of overlying rock debris, a source area investigation was performed in phases to determine the presence or absence of a continuing TCE source. The first phase of the source area investigation included passive soil gas testing across the newly uncovered area. The next phase involved intrusive investigation and sampling of test pits/trenches at the locations of elevated TCE in soil gas. Based on available evidence, the location of TCE source area coincided with the Munitions Waste Pit (PICA-013-R-01) munitions response site (MRS). In 2012, Weston Solutions, Inc. (Weston), completed the MMRP RI of the Munitions Waste Pit in order to determine the nature and extent of munitions and explosives of concern (MEC), munitions debris (MD), and munitions constituents (MC) at the MRS. RI activities included a geophysical survey of the site as well as MC sampling (split samples) of the 2012 excavation to investigate the TCE source area. Remedial options are developed and evaluated in the FS (Final, Revision #2), incorporating the results of the phased TCE source area investigation, two additional rounds of groundwater sampling, and the MMRP RI so that appropriate remedies may be selected for the site. The selected remedy will serve as the final remedy for TCE in groundwater, the continuing source of TCE in site soil, and the Munitions Waste Pit MRS (PICA-013-R-01).

1.1 DATA REPORT AND FEASIBILITY STUDY

The focused groundwater investigation began in the 600 Area in April 2004 with sampling of the AWDF well, which resulted in confirmation of TCE contamination. The investigation of 600 Area

groundwater was performed in an iterative manner. The Army utilized on board reviews with the regulators and abbreviated work plans using a facility-wide FSP as a framework. The 600 Area RI scope of work (SOW) was subsequently presented to stakeholders in five sequential Work Plans, which reflects the iterative, step-wise approach needed in this case to delineate the TCE plume. In some cases interim data was presented to the regulators at a meeting or a site visit and the next round of investigation was carried out using meeting minutes or a letter format work plan.

The Groundwater Data Report/FS documents the findings of work performed at the 600 Area. The US Army prepared the Data Report in pursuant to the scope of work (SOW) in the approved *600 Area Groundwater Remedial Investigation Work Plan* (Shaw, 2004), *600 Area Work Plan Addendum* (Shaw, 2005a), *600 Area Groundwater Investigation – Supplemental Investigation Work Plan* (Shaw, 2006a), *600 Area Groundwater Investigation – Pump Test Work Plan* (Shaw, 2007a), and the *600 Area Work Plan for Vapor Intrusion and Source Area Investigation* (Shaw, 2010); and information from the MMRP RI completed by Weston. Interim Data Investigation Reports were periodically sent to regulators for review, and include the *600 Area Groundwater Investigation Data Report* (Shaw, 2005b), *600 Area Groundwater Investigation – Update on Additional Work* (Shaw, 2006b), and *600 Area Groundwater Investigation – Well Log and Isotope Data* (Shaw, 2007b). Investigation results were also provided in a number of regularly scheduled partnering meetings, which were attended by the U.S. Army, regulators, and other stakeholders. The data provided in these reports and presentations are summarized in this report for completeness.

A formal RI report was not completed for the 600 Area groundwater operable unit. However, all of the data collected from the focused groundwater investigation and some of the other elements of an RI (i.e., risk assessments, fate and transport analysis) are presented in this Data Report and FS. The U.S. Army believes the presentation of data is this report sufficiently addresses the RI while expediting the completion of the FS for the site.

The purpose of the FS is to develop and evaluate remedial options such that appropriate remedies may be selected for the site. To ensure selection of appropriate remedies, this FS has been conducted in accordance with the CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and implemented by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] 300); USEPA guidance documents (USEPA, 1985; 1988a, b) and New Jersey Department of Environmental Protection (NJDEP) guidance documents (NJDEP, 1992, 2005b, and 2012).

This FS report addresses remediation of MEC/MC from the Munitions Waste Pit as well as remediation of groundwater within the 600 Area of the PTA through the completion of the following tasks:

- Remedial action objectives (RAOs) have been developed for the specific contaminants, affected media, and exposure pathways.
- Remedial technologies that, alone or in combination, can treat media have been identified.
- The remedial technologies have been screened to eliminate those that are not able to be technically implemented, either based on attainment of chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) or the volume of media that must be treated.
- As required by CERCLA/SARA, the remedial technologies have been assembled into RAs which, to the maximum extent practicable, utilize permanent solutions and alternative technologies.
- A detailed analysis of the RAs using the nine evaluation criteria listed in the NCP has been performed.

1.2 REPORT ORGANIZATION

The 600 Area Groundwater Data Report/FS is divided into two volumes.

- VOLUME I – Contains the Data Report and FS Report text, tables and figures, and is divided into eleven sections as follows:

Section 1.0 – Introduction – The purpose of the 600 Area Data Report/FS and organization of the report are presented. A background of PTA and the 600 Area is presented as well as a history of investigations completed in this region prior to the start of the Groundwater Investigation in 2004.

600 AREA GROUNDWATER DATA REPORT

Section 2.0 – Investigation Scope of Work and Methodology – This section summarizes the approved Work Plans and SOW for the 600 Area Data Investigation. Areas of concern (AOCs) are identified, and methodology for completion of the following tasks is discussed: hydrogeologic data review, unexploded ordnance (UXO) survey, passive soil gas survey, very low frequency (VLF) geophysical study, monitoring well installation, borehole geophysics, packer testing, aquifer pumping test, sampling, and quality assurance (QA)/quality control (QC).

Section 3.0 – Results of the 600 Area Investigation – This section presents a summary of all work completed, including soil gas and packer test sampling, for the various 600 Area Investigations since 2004.

Section 4.0 – Nature and Extent of Contamination – This section contains summary information regarding the contamination of groundwater, surface water, sediment, and soil. Results of all (non-screening) 600 Area sampling are summarized in this section. This section also addresses the following: the nature and extent of the contaminants in each media; an evaluation of possible sources of the groundwater plume, an assessment of the bioremediation sampling results within groundwater, a summary of all level of concern (LOC) exceedances, and an evaluation of the human health and ecological risks resulting from exposure to the contaminants.

Section 5.0 - Fate and Transport of Contaminants – This section describes the processes by which contaminants are transported and/or transformed in groundwater within the 600 Area.

600 AREA FEASIBILITY STUDY

Section 6.0 – Natural Attenuation of TCE and RDX in Groundwater – The section defines natural attenuation (NA) and provides an overview of the monitored natural attenuation (MNA) evaluation process. The adequacy of the 600 Area data to support MNA is addressed in detail, and provides an estimated time to cleanup for contaminants.

Section 7.0 – Remedial Action Objectives and Identification of ARARs – ARARs are identified for 600 Area groundwater and surface water. RAOs are then developed for groundwater and surface water constituents that exceed ARARs.

Section 8.0 – Identification of Contaminants of Concern, Site Cleanup Levels, and Areas of Attainment – Contaminants of concern (COCs), site cleanup levels (SCLs), and areas of attainment (AAs) by media are developed.

Section 9.0 – Identification and Screening of Remedial Technologies – General response actions (GRAs) applicable to 600 Area contamination are identified. These GRAs are broken down into technologies and process options, which are then screened based on ability to be implemented, effectiveness, and order-of-magnitude cost. RAs are developed by combining the remedial technologies that remain after screening. Vendor information is used to identify necessary pre- and post-treatment technologies.

Section 10.0 – Detailed Analysis of Remedial Alternatives – Using the nine criteria identified in the NCP (40 CFR 300.430(e)), a detailed evaluation of RAs is performed.

Section 11.0 – References

Appendix P – Remedial Alternatives Cost Estimates – **Appendix P**, which accompanies

Section 9.0, is included in the back of VOLUME I for convenience. All other Appendices (A though O) can be found in VOLUME II.

Each section is followed by the Tables and Figures that were referenced in that section, if any.

- VOLUME II – Appendices

Appendices A through **O**, as outlined in the List of Appendices on Page vi.

In this (Final, Revision #2) document, **Sections 1.0** through **4.0** have been updated with the results of two additional rounds of groundwater sampling, the TCE source area investigation, and the vapor intrusion (VI) investigation of Building 660. **Section 1.0** includes a summary of the MMRP RI of the Inactive Munitions Waste Pit (PICA-013-R-01). Available results from the MMRP RI are provided in **Appendix B**, including mapped results of the geophysical investigation, and tabulated results of soil sampling. **Sections 6.0, 9,0**, and **10.0** have been revised to incorporate the new information. All RAs have been revised to also address the Inactive Munitions Waste Pit.

1.3 INSTALLATION HISTORY

PTA is owned and operated by the U.S. Army. The facility was a major source of munitions for World War I, World War II, the Korean War, and the Vietnam Conflict. During those periods, PTA was involved in the production of explosives, rocket and munition propellants, pyrotechnic signals and flares, fuses, and metal components. Currently, the primary mission of PTA is research, development, and engineering of munitions and weapons.

Over the years, environmental investigations into the operations and waste management procedures for PTA have indicated the potential for contamination. The facility was included on the NPL in March of 1990.

1.4 600 AREA BACKGROUND

The 600 Area is located on the northwest boundary of PTA, and comprises an area of approximately 450 acres. The location of the 600 Area is shown on **Figure 1-2**. The 600 Area lies entirely within the Robinson Enclosure, which has restricted access. As shown on **Figure 1-3**, the Building 600 Area contains about 100 small structures associated with testing activities that take place in this portion of PTA. Many of these structures are less than 100 square feet in size and are used as shelters during testing operations. The structures typically have a sight glass or just a portion of the metal structure cut out to view testing. Other structures in the area include slightly larger buildings, which are currently locked. It is believed that these buildings are used for storing equipment and supplies involved with the testing in this area. At the western end of the 600 Area, an active testing area (SCAT Gun) utilizes Building 640. Buildings 640 and 660 are the only buildings used on a daily basis within the 600 Study Area.

The 600 Area lies on the southwestern upper slopes of Green Pond Mountain, and is bisected by Bear Swamp Road along its length. The topography in the Building 600 Area is characterized by long northeast trending bedrock escarpments and intervening lowland areas. Bedrock outcrops consist of a massive bedded conglomerate, which is mapped by the U.S. Geological Survey (USGS) as the Lower to Middle Silurian Age Green Pond Conglomerate. A thin layer of soil and glacial till overlies bedrock in low lying areas.

The lowland areas are located to the northeast of Bear Swamp Road and contain most active range areas. These areas also feature two small wetlands and ponds in the 600 Study Area. Ground elevation ranges from 775 to 1,250 feet (ft) mean sea level (msl) within the study area, with a total relief of 475 ft. Overland drainage is toward the southwest, where surface runoff is captured by a string of northeast trending wetlands, ponds, and drainages. These drainages ultimately discharge down a steep escarpment and into Picatinny Lake. Bedrock outcrops consist of a massive bedded conglomerate, which is mapped by the USGS as the Lower to Middle Silurian Age Green Pond Conglomerate. A thin layer of soil and glacial till overlies bedrock in low lying areas.

The 600 Area boundary was established during the collection of the RI data. It was drawn around operational areas within Sites 11, 12, and 13 as they contained potential sources of groundwater contamination. The sites within the 600 Area include:

- Site 11 – Buildings 647, 649, and 650, Munitions Test Range. This area was used for large caliber weapon and small arms firing. The area consisted of three sub-areas (647, 649, and 650). The westernmost area near Building 647 is the largest. It consisted of a short firing range (plate range) where inert projectiles were fired into a large armor-plated box filled with sand (ANL, 1991). The Building 647 area was also used for placement of fill earth. In 2011 a MEC removal was performed in preparation for construction of a new facility. Currently, the new facility has been completed and the area is an active munitions testing area. The Building 649 area historically had a building that was used to store fuzes (Argonne National Laboratory [ANL], 1991). The Building 650 area was historically used for static testing of munitions including a "rapid cook-off" operation where military items were exposed to open flame to test the reaction. The area was also subject to placement of fill earth and burial of small cylindrical canisters, which appeared to be MD.
- Site 12 (PICA-013-R-01) – Building 656, Munitions Waste Pit. This area has a designation (Site 12) originally applied for the IRP and a designation applied as part of the MMPR (PICA-013-R-01). This area historically contained buildings used to store explosives and black powder (ANL, 1991). Subsequent to the buildings being removed, the area was used as a munitions test range. Reports of land filling of items related to munitions testing, static testing of munitions items, testing of munitions items on test stands and within a fragmentation cage were also reported. Reports of a covered-unlined waste pit were also made (ANL, 1991).
- Site 13 – Building 640 – Munitions/Pyrotechnics Test Area. Past testing activities were confined to the northwestern portion of the site. Reportedly, inert materials such as inert projectiles, inert shells, and other metal were disposed of in the swamp present at the site (ANL, 1991). Large armor target plates were previously stored at the site. The western portion of the site has been redeveloped and currently contains the SCAT Gun test area where artillery pieces are fired and the rounds caught within large air-filled tubes.

Previous investigations at Sites 11, 12 and 13 are discussed below in **Sections 1.5.2.1, 1.5.2.2,** and **1.5.2.3**.

1.4.1 Advanced Warhead Development Facility

The currently active AWDF (Building 660) is located near the top of Green Pond Mountain at an approximate elevation of 1,115 ft msl and is approximately 1,000 ft from the Arsenal's western property boundary (**Figure 1-3**). As with all of the Building 600 Area, the AWDF is located in a remote portion of PTA amidst several test ranges that are currently used by the military for research and development.

The AWDF was constructed in 1999 and became operational in 2000. The facility is utilized to test shape charges, Explosively Formed Penetrators, and other experimental warheads in support of Armament Research and Development and Engineering Center's research and development mission. This facility provides a safe, secure, cost-effective, and environmentally acceptable means of conducting tests for terminal ballistic evaluation of armor defeating warheads. Indoor testing that takes place at the AWDF allows for testing to be conducted during all types of weather conditions throughout the year.

The AWDF includes a brick building containing a firing chamber shaped as a sphere having a 40-ft diameter, and a blast range tunnel with the dimensions of 16 ft high by 20 ft wide by 335 ft long. In addition to the sphere, the primary building contains an instrumentation room, control room, dark room, large target preparation room, restrooms, and small offices. Some of the instrumentation used for testing at the AWDF includes devices for flash radiography, digital x-rays, Cordin framing (high speed imaging using a Cordin camera), streaking camera photography, high-speed video-taping, and collecting radar data.

Prior to the construction of the AWDF, testing activities in the area were short-term and necessary supplies were brought in on a temporary basis to support the particular testing operation taking place. Other buildings in the area are small structures that were typically used for storage, shelters during testing, collecting data, and for videotaping testing operations.

1.4.2 AWDF Potable Well

A potable well was drilled in 1994 for the purpose of servicing the future AWDF (**Figure 1-3**). The well was drilled to a depth of 430 ft bgs and remained as a 6-inch diameter open hole until April 1999 when a well pump capable of discharging 5 gallons per minute (gpm) was installed in the well at 410 ft bgs along with the associated electrical wiring and plumbing. Northeastern Analytical Corporation first sampled the well in August 1994 for metals, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), anions, and other water quality parameters. The sample results found TCE concentrations (1.3 micrograms per liter [µg/L]) in exceedance of the New Jersey Groundwater Quality Standard (1.0 µg/L). Exceedances were also detected for iron, manganese, radon, color, hardness, pH, and corrosivity. As a result, a water treatment system was installed as an interim action to remove the detected compounds from groundwater. The system consists of the following treatment processes: aeration system with reservoir, chemical feed, green sand filter, storage reservoir, a pneumatic tank, and a carbon filter. The treated well water was used for non-potable uses such as flushing toilets and fire suppression. Potable water was provided by bottled water. The AWDF has since been connected to the base water supply system so the treatment system is no longer used. The AWDF well will be retained for use as only as a monitoring well for future groundwater sampling. In addition, a second interim action was taken with the implementation of a Classification Exemption Area (CEA) in 2002.

Follow-on groundwater sampling by Shaw of the AWDF well found TCE exceedances in February 2001 (39 µg/L) and February 2003 (83 µg/L). Elevated concentrations of Freon113 and MTBE were also detected in the February 2001 and February 2003 sampling rounds.

1.5 SUMMARY OF PREVIOUS INVESTIGATIONS

1.5.1 RI Concept Plan for PTA (USATHAMA, 1991)

Between 1976 and 1989, PTA and the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) identified 156 RI sites at PTA. Three RI sites were identified in the 600 Area, and are shown on **Figure 1-3**. It should be noted that while these areas were originally given IRP site designations, these sites are not currently active sites within the IRP. These areas are active test ranges necessary to the Army's mission at PTA. As such, they are not eligible for funding under the IRP. The information in this section is presented to allow the reader to understand the environmental background of the 600 Area. The sites include the following:

- Site 11 – Buildings 647, 649, and 650, Munitions Test Range.
- Site 12 – Building 656, Munitions Waste Pit.
- Site 13 – Building 640, Munitions/Pyrotechnics Test Area.

1.5.2 Site Investigation of PTA (Dames and Moore, 1989)

Dames and Moore conducted a site investigation for selected sites on PTA in 1989 including 600 Area Sites 11, 12, and 13.

1.5.2.1 Site 11 – Munitions Test Range (Buildings 647, 649, and 650)

Surficial soils, surface water, and sediment samples were collected to assess contamination as a result of munitions testing. No pre-existing wells were found within the site, and no new wells were constructed during this investigation. A total of eight shallow soil samples were collected, and analyzed for selected anions, metals and explosives. Sample locations are shown on **Figure 1-4**. Nitroglycerine was detected at three soil sample locations, which indicated limited local explosives contamination. A surface water and sediment sample was collected in each of the Site 11 ponds, and was analyzed for selected anions, metals and explosives. Surface water sampling results found exceedances of Ambient

Water Quality Criteria (AWQC) at SW-11-1 for cadmium, copper, and iron and SW11-2 for lead and sulfate. Sediment sample SD11-1 detected a low-level copper exceedance. The report determined that the source was probably natural, rather than from site testing activities. Explosives were not detected in surface water and sediment samples. A summary of sample data results are provided in **Appendix A**.

1.5.2.2 Site 12, Munitions Waste Pit, PICA-013-R-01 (Building 656)

Site 12 was investigated to determine if explosive residue had accumulated in soils at the site. No pre-existing wells were found within the site area, and no new wells were installed. A total of four soil samples and two sediment samples were collected from the site, and were analyzed for anions, metals and explosives. The sample locations are shown along with site features on **Figure 1-5**. The four soil samples were collected just to the north of the disposal area identified by the USEPA's Environmental Photographic Interpretation Center (EPIC) Installation Assessment of PTA (USEPA, 1989) (see **Section 4.4**). However, the two sediment samples were collected adjacent to and immediately downhill from the disposal area. The sample results indicated that localized contamination of surficial soils had occurred but that none of the soil contaminants have been transported to the swampy area adjacent to the site. 1,3-dinitrobenzene, 2,4-dinitrotoluene, nitroglycerine, RDX, and 2,4,6-trinitrotoluene were detected in at least one of the four surface soil samples. The concentration of 2,4-dinitrotoluene (11.7 milligrams per kilogram [mg/kg]) in sample SS12-2, which was collected near the metal cage, exceeded the LOC (4.2 mg/kg) for this explosive. No explosives were detected in the sediment samples. Several metals were detected in both surface soil samples and sediment samples. Copper in surface soil sample SS12-4 (1,400 mg/kg) exceeded the LOC of 600 mg/kg. Arsenic, copper, and lead in surface soil sample SS12-1 were reported greater than their respective detection limits, which are all well below the LOCs for these metals. Concentrations of cadmium (12.0 mg/kg), lead (120 mg/kg), and mercury (0.266 mg/kg) exceeded LOCs in sediment sample SD12-1 collected from the north side of the swampy area. The LOCs for these metals are 1.70 mg/kg, 38.8 mg/kg and 0.249 mg/kg, respectively. This site was the subject of the TCE source area investigation and MMRP RI. These investigation results are presented in **Section 4.5** and **Appendix B**, respectively. The MMRP RI activities at the site are summarized in **Section 1.5.5**. A summary of sample data results is provided in **Appendix A**.

1.5.2.3 Site 13 – Munitions/Pyrotechnics Test Area (Building 640)

Site 13 was investigated to determine if contamination was present from past testing or possible disposal of materials. Three shallow bedrock monitoring wells, DM13-1, DM13-2 and DM13-3, were drilled at the site and sampled for metals and explosives. Sampling results indicated no contamination of shallow groundwater from these sources, although secondary water standards were exceeded for iron and manganese.

Two surface water and sediment samples were collected from the wetland in Site 13, and sampled for selected anions, metals, and explosives. Surface water and sediment sampling locations are shown on **Figure 1-6**. Surface water sample SW13-2 exceeded the chronic AWQC for beryllium, which may be attributed to a natural or anthropogenic source. Elevated sulfate concentrations were detected in both surface water samples, and may be attributed to natural sources. Sediment sampling found an elevated sulfate concentration in one sample, which is attributed to natural sources. Explosives were not detected in either surface water or sediment samples. A summary of sample data results are provided in **Appendix A**.

1.5.3 Phase I and II Environmental Human Health and Ecological Risk Assessment – Munitions Testing Ranges, Picatinny Arsenal, Dover, New Jersey (USACHPPM, 1999)

The phase I field study was initiated in 1998 as a proactive environmental evaluation of currently active testing ranges. Phase I field sampling was conducted in March 1998. The study focused on residual metals and explosive compounds in surface soils, surface water and sediment. In the Phase I Report, Site 11 Buildings 647 and 650 were identified as requiring additional investigation to more realistically evaluate the potential health risk posed by chemical concentrations detected at the site. In the Phase II investigation, soil, water and sediment analytes were limited to those detected at each site in the first round of sampling. Phase II sampling was conducted in June 1999.

1.5.3.1 Site 11 – Building 647 Area

The Building 647 area was used for large caliber weapon and small arms firing. A new test building was constructed at the site and outdoor testing no longer takes place. The range area is approximately 100 by 400 ft in size and partially paved. The active test area was comprised of bulldozed material partially covered with grass. A small spring at the northwest corner of the site drains across the test area to a larger wetland area on the southeastern edge. Phase II sampling included the collection of two surface water and sediment samples from the downstream wetland stream drainage from the site. A sample location map is shown on **Figure 1-7**. Surface water metals results all fell below applicable benchmarks. Low concentrations of RDX (0.37 µg/L) were detected in surface water. Sediment sampling results indicate most metals exceeded benchmark values, with cadmium clearly above reference values. It was determined in the Report that the metal contaminants of potential concern (COPCs) do not have a direct link to range activities since these are not a component of energetics/explosives. There were no explosive compounds detected in sediment. A summary of sample data results are provided in **Appendix A**.

1.5.3.2 Site 11 – Building 650 Area

The Building 650 Area was heavily used for static detonation of munitions. The active test area consists of bulldozed and graded fill material with scattered vegetation and a forested perimeter. A bedrock outcrop borders the northern end of the site and a pond with a small wetland fringe borders the northeastern edge. Seven soil samples and four subsurface samples were collected in the Phase I sampling. Surface water and sediment samples were also taken downstream of the outflow pipe exiting from underneath the site. In Phase II, an additional 20 soil samples were collected along a grid pattern to better characterize the average site concentrations. Additional Phase II surface water and sediment samples were collected at upstream (pond outfall) and downstream (outfall pipe) site locations. All samples were analyzed for metals and explosives. A sample location map is shown on **Figure 1-8**.

Surface water samples from the upstream pond found slightly elevated levels of iron (2 milligrams per liter [mg/L]), which exceeded the New Jersey water quality standard of 1.0 mg/L. Explosive compounds were not detected in surface water and sediment. Sediment data indicates that most metals concentrations exceeded benchmark values, with copper concentrations clearly above reference values in the upstream pond. It was determined in the Report that the metal COPCs do not have a direct link to range activities since these are not a component of energetics/explosives. A summary of sample data results are provided in **Appendix A**.

1.5.4 Remedial Investigation of the Inactive Munitions Waste Pit (Site 12)

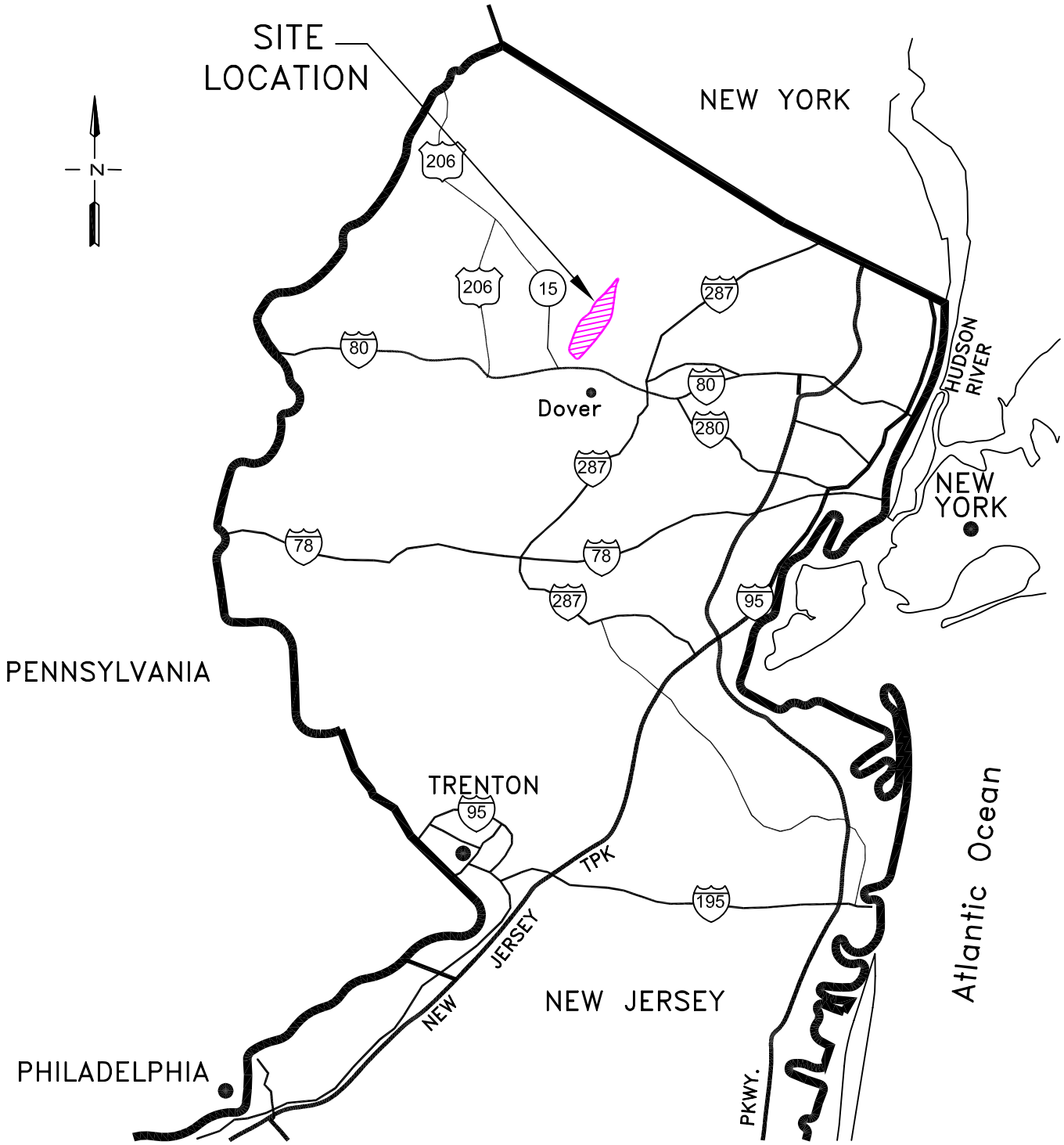
On January 30, 2012, Weston performed a digital geophysical mapping (DGM) transect survey using a Geonics EM31-MK2 Ground Conductivity Meter as part of the MMRP RI of the PICA-013-R-01 MRS (Site 12). The EM31-MK2 records ground conductivity (quad-phase) and magnetic susceptibility (in-phase) measurements. The in-phase component is particularly useful for the detection of buried metal structure and waste material. Effective depth of exploration is approximately 18 ft.

Based on available evidence, MEC and MD could have been released in the Inactive Munitions Waste Pit MRS from former testing activities and munitions disposal. The MMRP RI field objective was to perform EM31-MK2 transect surveys to detect burial features in the MRS where potential testing and burial activities would have occurred. If MEC burial sites were detected by DGM transect surveys, the extent of the burial feature would then be delineated. Both the ground conductivity and magnetic susceptibility measurements were to be processed and evaluated to identify high density areas indicative of burial sites. The point between the elevated responses associated with the burial site and the background response associated with an area free from conductive material would be defined as the burial site boundary.

The EM-31 MK2 transect survey was performed over the MRS to detect subsurface anomalies and determine if a munitions waste pit(s) was indicated in the subsurface. Due to large equipment present at the site on the east side of the site at the time, several DGM transects planned were not completed until August 20, 2012 following the May 2012 TCE source area test pit/trenching investigation discussed in **Section 4.5**. Weston completed the remaining DGM transects to the east of the confirmed buried waste to support determining the lateral extent of the waste pit.

The total length of geophysical transects completed across the site is 6,163 ft. Based on the DGM and intrusive investigation results, the lateral and vertical extent of a large waste pit has been determined. The waste pit area is estimated at 0.24 acres (10,498 square ft) and the depth to bedrock is 24.5 ft below ground surface (bgs). Assuming an even distribution of buried material, the approximate maximum volume of the waste pit is 257,201 cubic ft.

Mapped results of the DGM survey are provided in **Appendix B**, along with tabulated analytical results of soil sampling conducted concurrent with the May 2012 test pit/trenching investigation discussed in **Section 4.5**. Sample locations were co-located (i.e. split samples) with samples collected by Shaw.



DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	09/20/07	B. Demott	09/20/07	--	--	SITEMAP-2.dwg

SCALE
0 20 Miles

Picatinny Installation Restoration Program

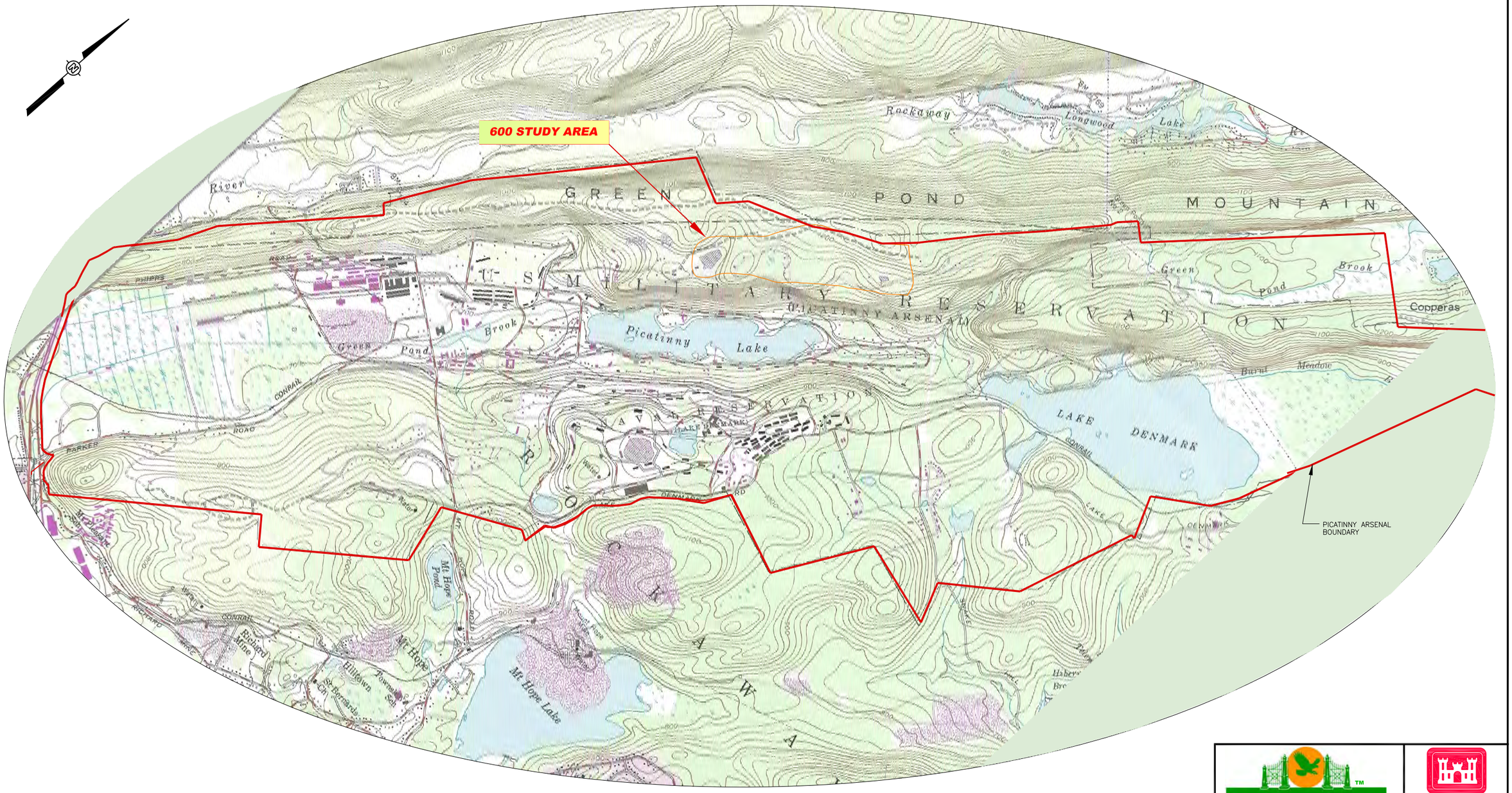
U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 1-1

PICATINNY
SITE LOCATION MAP
600 AREA REMEDIAL GW INVESTIGATION
PICATINNY, DOVER, NJ

File: N:\cad\CAD drawings\Picatinny\Basewide\SITEMAP-2.dwg
Plot Date/Time: Jan 14, 2009 - 3:13pm
Plotted By: stephen.Wiafe



LEGEND

- PICATINNY ARSENAL INSTALLATION BOUNDARY
- 600 STUDY AREA BOUNDARY

SCALE

0 2500 5000 FEET

SOURCE: US GEOLOGICAL SURVEY, RESTON, VIRGINIA 22092 (REVISED IN 1954)

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 1-2

600 STUDY AREA LOCATION MAP

600 AREA SOURCE INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	09/19/07	B. Demott	09/19/07	--	--	DoverTopo.dwg

File: N:\cad\CAD drawings\Picatinny\RCRA PART-B SUB-X\DoverTopo.dwg
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Plotted By: andrius.yanavicius

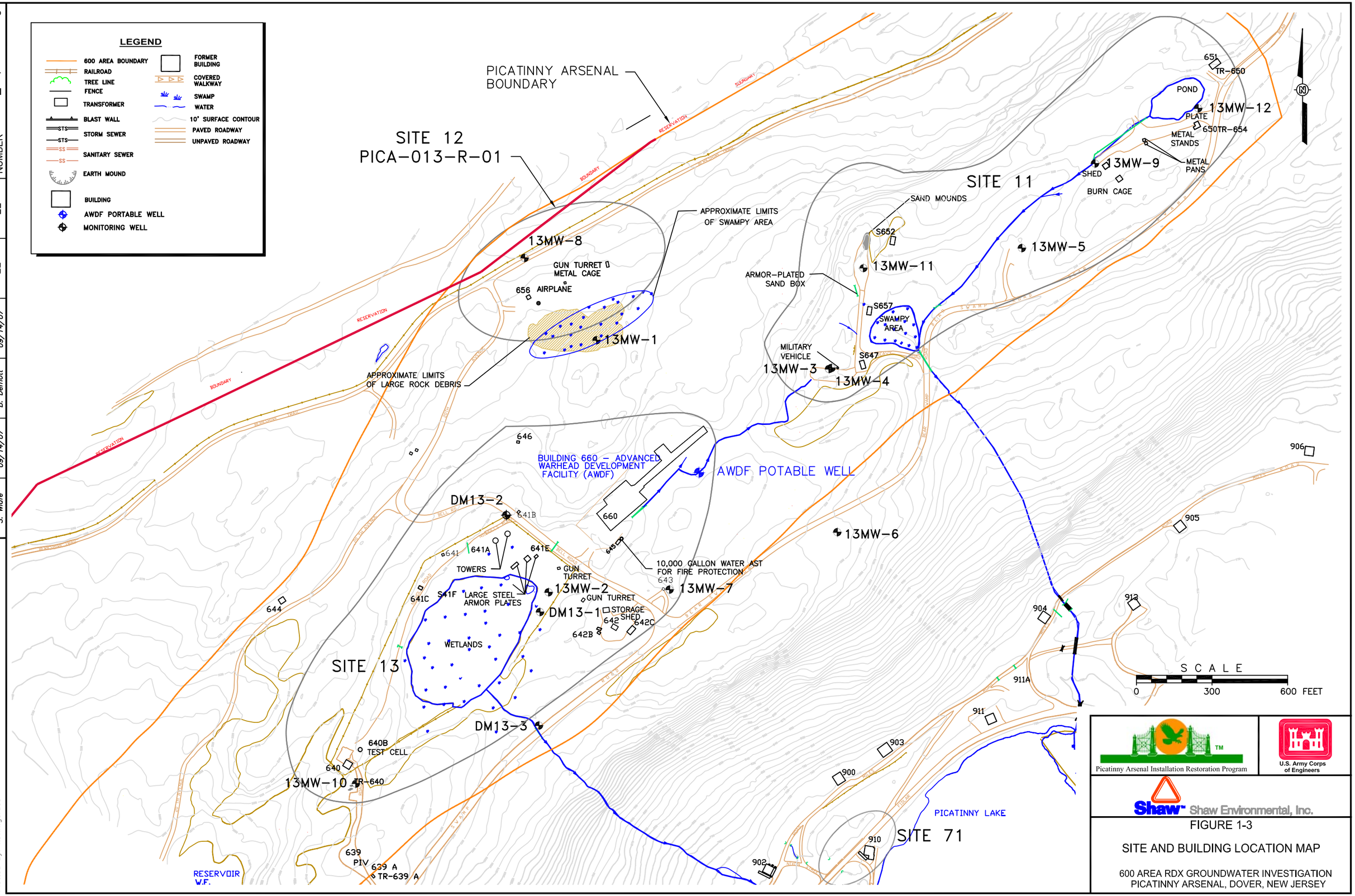


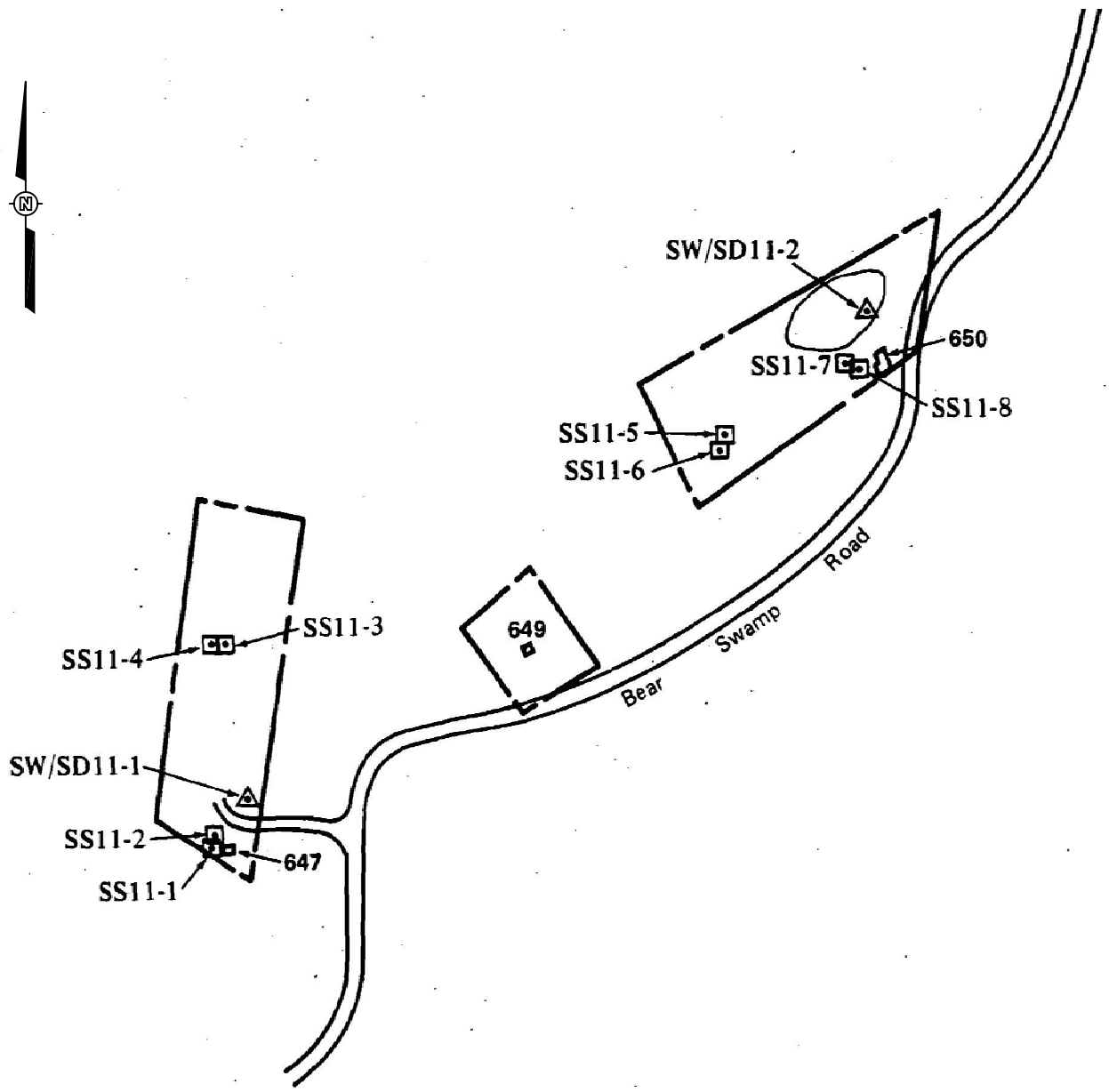
FIGURE 1-3

SITE AND BUILDING LOCATION MAP

600 AREA RDX GROUNDWATER INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

DRAWING NUMBER	APPROVED BY	CHECKED BY	DRAWN BY
AWDF_smp091008.dwg	-- --	B. Demott 09/14/07	S. Wiafe 09/14/07

File: N:\cad\CAD drawings\Picatinny\Area-N\AWDF_smp061008.dwg
Plot Date/Time: Apr 24, 2013 - 2:03pm
Plotted By: kevin.gerdes



LEGEND:

- SURFACE WATER/SEDIMENT SAMPLING LOCATION
- SHALLOW SOIL SAMPLING LOCATION

SCALE

0 300 600 FEET

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 1-4

SITE 11 - SITE INVESTIGATION SAMPLE LOCATION MAP

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

MAP COPIED FROM THE SITE INVESTIGATION OF PICATINNY ARSENAL, DOVER, NEW JERSEY (1989)–DAMES & MOORE.

U.S ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY CONTRACT No. DAAA15–85–D–0016.

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
S. Wiafe 09/19/07	B. Demott 09/19/07	-- --	Munition_091907.dwg

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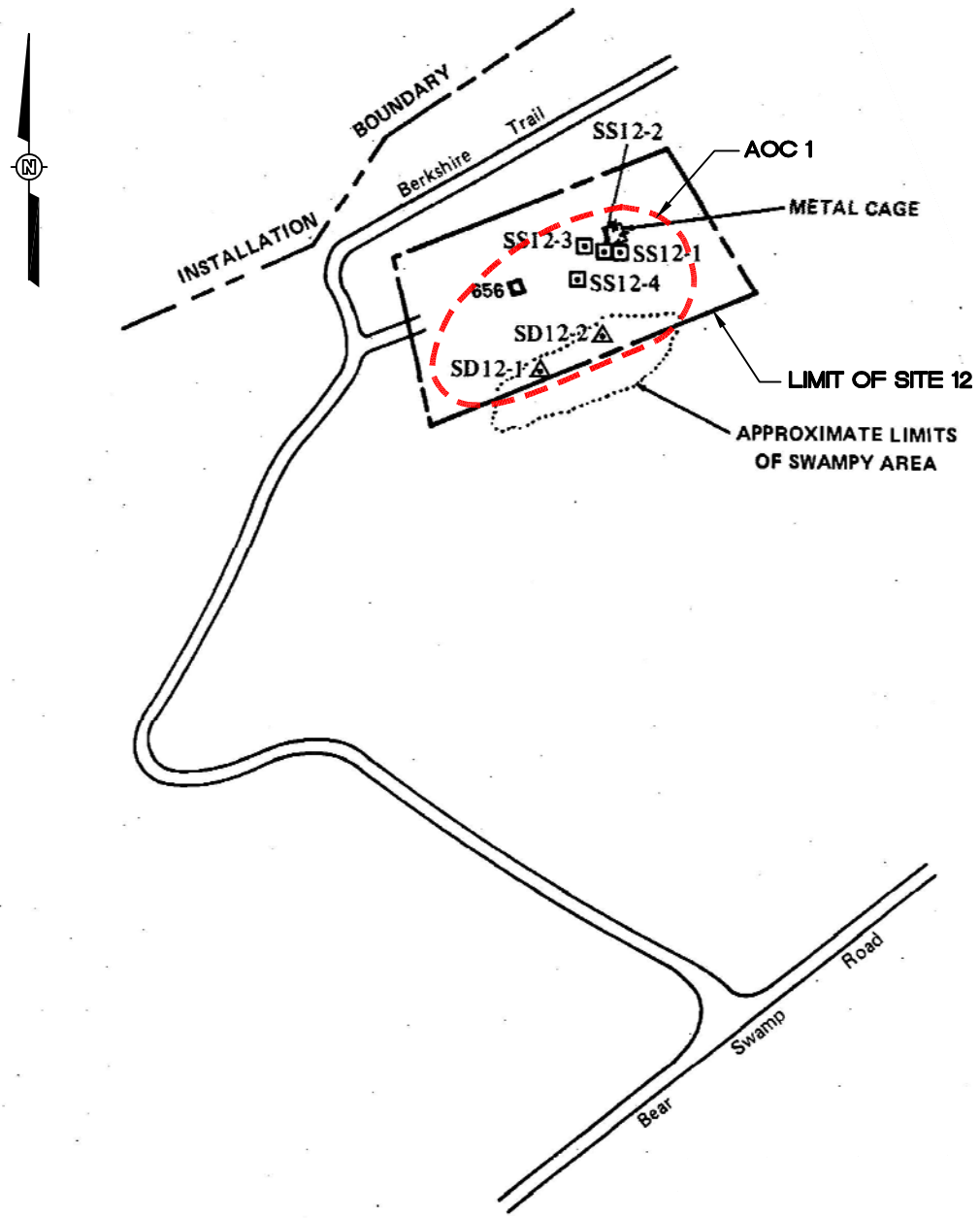
Plotted By: stephen.Wiafe



LEGEND:

- SURFACE WATER/SEDIMENT SAMPLING LOCATION
- SHALLOW SOIL SAMPLING LOCATION

SCALE

0 300 600 FEET

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 1-5

SITE 12 - SITE INVESTIGATION
SAMPLE LOCATION MAP

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

MAP COPIED FROM THE SITE INVESTIGATION OF PICATINNY ARSENAL, DOVER, NEW JERSEY (1989)–DAMES & MOORE.

U.S ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY CONTRACT No. DAAA15–85–D–0016.

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	01/04/10	B. Demott	01/04/10	--	--	Munition_091907.dwg

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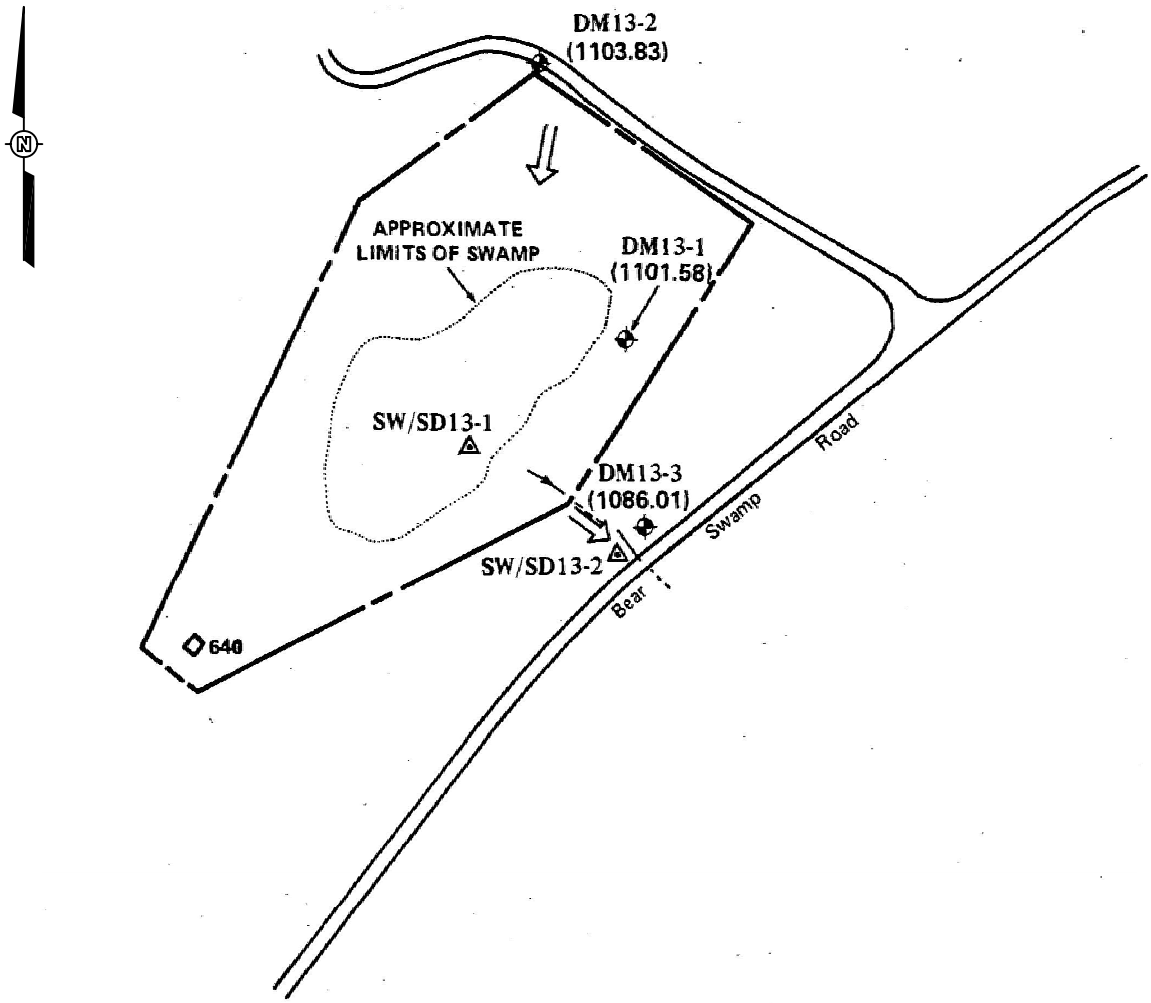

LEGEND:

- MONITORING WELL/GROUNDWATER SAMPLING LOCATION
- SURFACE WATER/SEDIMENT SAMPLING LOCATION
- 1103.83} WATER SURFACE ELEVATION AT TIME OF SAMPLING, APRIL - MAY 1988
- GROUNDWATER FLOW DIRECTION BASED ON WATER LEVELS AND TOPOGRAPHY

SCALE

0 300 600 FEET

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 1-6

SITE 13 - SITE INVESTIGATION SAMPLE LOCATION MAP

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

MAP COPIED FROM THE SITE INVESTIGATION OF PICATINNY ARSENAL, DOVER, NEW JERSEY (1989)–DAMES & MOORE.

U.S ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY CONTRACT No. DAAA15–85–D–0016.

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
S. Wiafe 09/19/07	B. Demott 09/19/07	-- --	Munition_091907.dwg

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Plotted By: stephen.Wiafe

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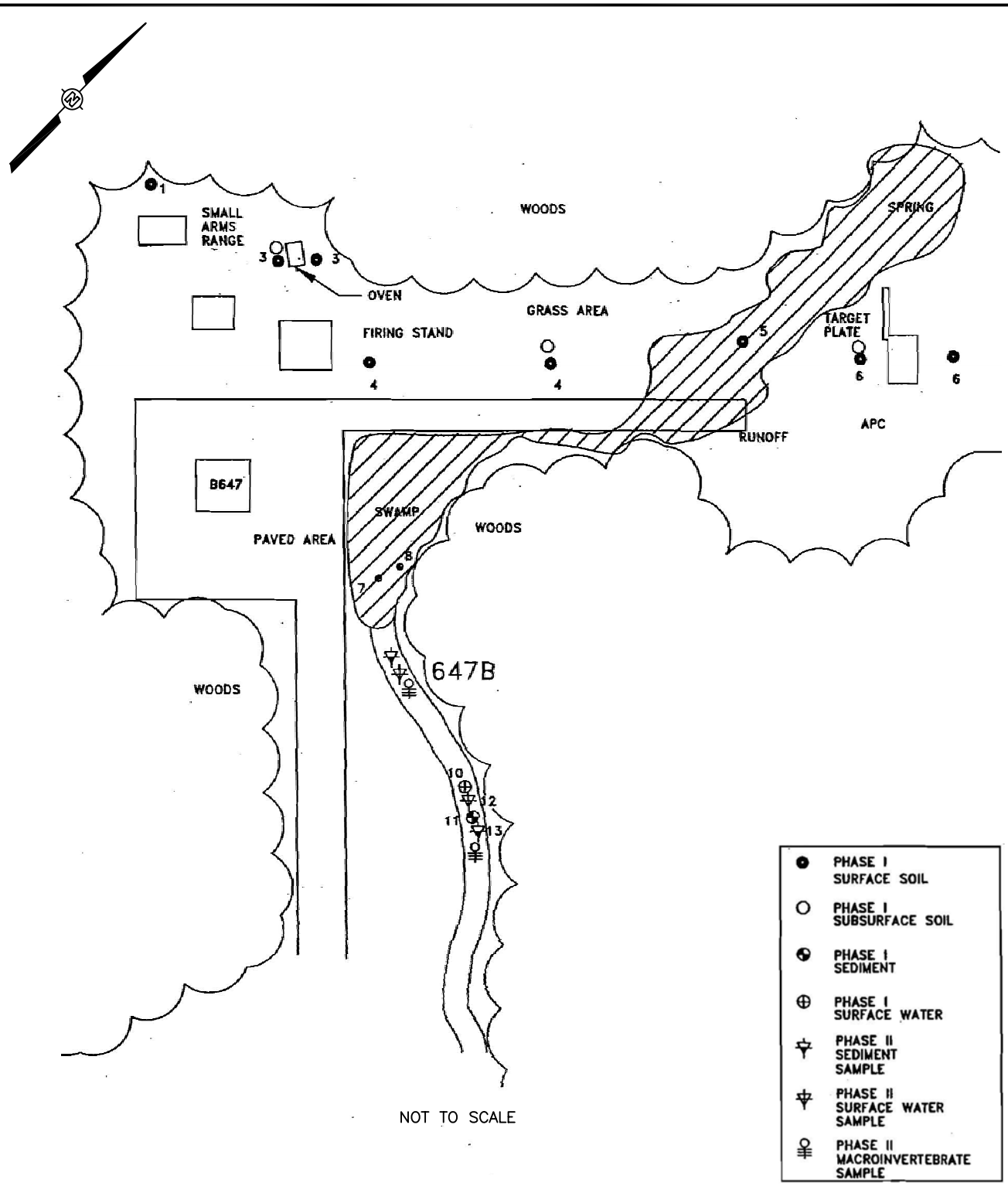

NOT TO SCALE

MAP COPIED FROM THE PHASE II ENVIRONMENTAL HUMAN HEALTH AND ECOLOGIC RISK ASSESSMENT (USACHPPM 1999).

USACHPPM PROJECT No. 39-EJ-7384-99.

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 1-7

SITE 11 - BUILDING 647 AREA
SAMPLE LOCATION MAP

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\Munition_091907.dwg
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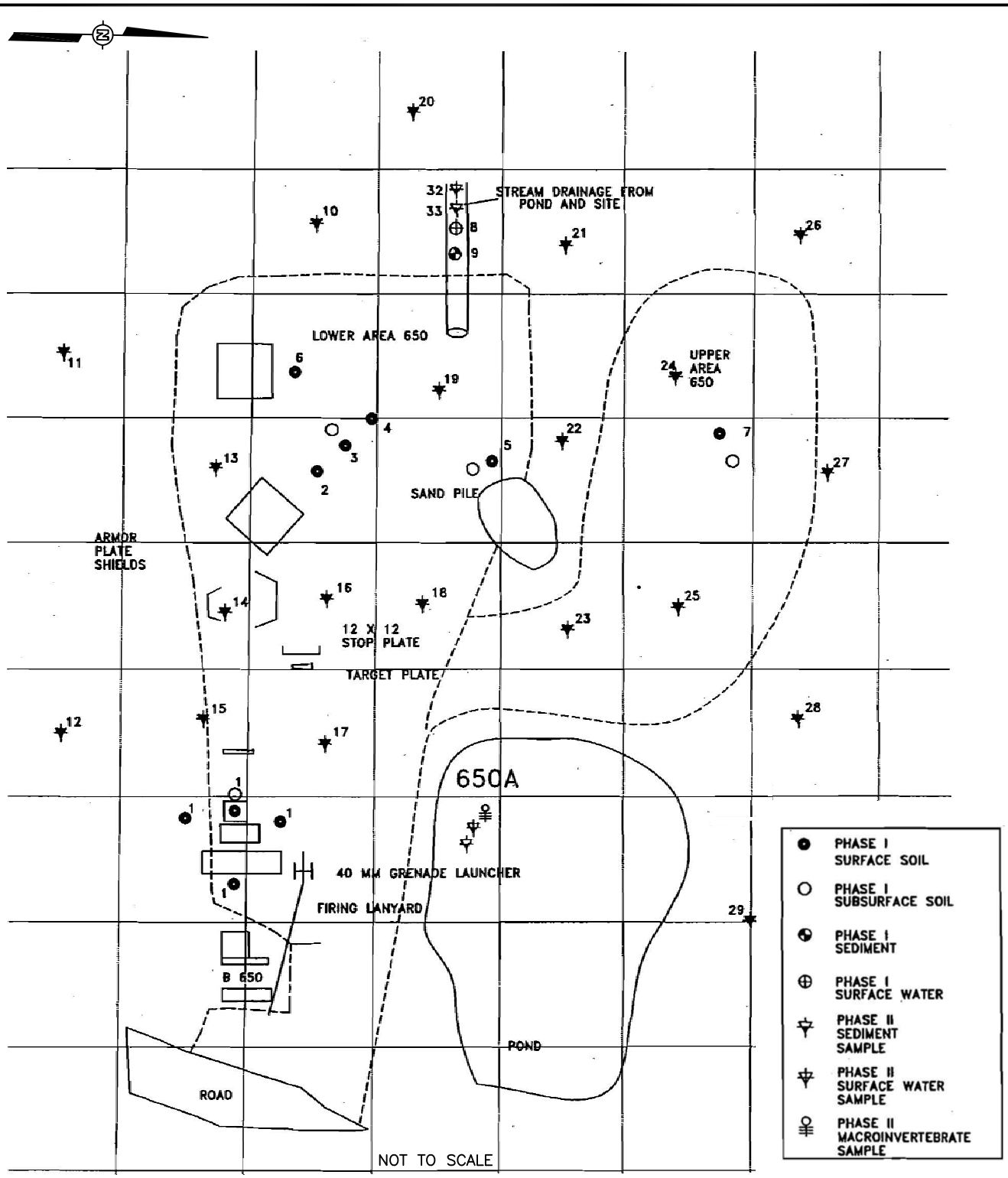

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
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MAP COPIED FROM THE PHASE II ENVIRONMENTAL HUMAN HEALTH AND ECOLOGIC RISK ASSESSMENT (USACHPPM 1999).

USACHPPM PROJECT No. 39-EJ-7384-99.

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 1-8

SITE 11 - BUILDING 650 AREA SAMPLE LOCATION MAP

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\Munition_091907.dwg
Plot Date/Time: Jan 14, 2009 - 3:59pm
Plotted By: stephen.Wiafe

2.0 INVESTIGATION SCOPE OF WORK AND METHODOLOGY

2.1 OVERVIEW

The focused groundwater investigation began in the 600 Area in April 2004 with sampling of the AWDF well, which resulted in confirmation of TCE contamination. The 600 Area RI SOW was subsequently presented to stakeholders in five sequential Work Plans, which reflects the iterative, step-wise approach needed in this case to delineate the TCE plume. The SOW for each RI Work Plan is summarized in the following Sections. All of the investigation activities were performed under the PTA Facility-Wide Field Sampling Plan (IT, 1999).

2.1.1 600 Area Groundwater RI Work Plan (2004)

The work plan was prepared to assess TCE contamination of the AWDF well. The Work Plan was submitted to the USEPA and NJDEP (regulators) on April 28, 2004, and was presented to stakeholders at a Partnering Meeting on October 20, 2004. The Work Plan SOW was accepted by regulators at that meeting. The Work Plan includes the following elements:

- Bedrock investigation including field reconnaissance and fracture trace analysis.
- Borehole geophysics and packer testing of AWDF well and newly installed wells.
- Passive soil gas survey.
- Monitoring well installation (Wells 13MW-1 through 4).
- Groundwater sampling for VOCs at existing and newly installed wells.
- Synoptic water level monitoring.

2.1.2 600 Area Work Plan Addendum (2005)

The Work Plan Addendum was prepared in order to further investigate the extent of TCE contamination found in newly installed wells. The Work Plan Addendum was presented and approved by stakeholders at the partnering meeting and site walk on November 30, 2005. The Work Plan Addendum was formally issued to regulators in December 2005. The Work Plan Addendum includes the following elements:

- Monitoring Well Installation (Wells 13MW-5 through 9).
- Borehole geophysics and packer testing/sampling at newly installed wells.
- Surface water/sediment sampling at locations SW/SD-1 through 9 for VOCs.
- Groundwater Sampling for VOCs at existing and newly installed wells.
- Passive soil gas survey in fill area north of wells 13MW-3/4.

2.1.3 600 Area Groundwater Investigation – Supplemental Work Plan (2006-2007)

The work plan supplement was prepared to further investigate the sidegradient extent of TCE contamination, and collect additional sampling and aquifer data for preparation of an RI/FS. The proposed Supplemental Work Plan SOW was presented to stakeholders during a partnering meeting on September 20, 2006, with submittal of the Work Plan to regulators in October 2006. The Supplemental Work Plan was conditionally approved by regulators at that meeting, subject to the addition of soil sampling and further review of the human health risk assessment (HHRA) SOW. The revised Work Plan (soil sampling) was approved by regulators in the February 7, 2007, partnering meeting, and scope of the HHRA was approved by USEPA on February 5, 2007. The Supplemental RI Work Plan includes the following elements:

- Installation of bedrock monitoring wells 13MW-10 and 11.
- Borehole geophysics and packer testing of the new wells.
- Aquifer pumping test.

- Quarterly groundwater sampling for VOCs and baseline explosives at existing and newly installed wells (except wells 13MW-8 & 9).
- Additional sampling of groundwater bioremediation parameters during second quarterly event.
- Quarterly surface water and sediment sampling at SW/SD-1 through 5 for VOCs and baseline explosives.
- Collection of ten soil samples at five locations, to be analyzed for VOCs.
- Preparation of the HHRA.

2.1.4 600 Area Groundwater Investigation – Pump Test Work Plan (2007)

The Pump Test Work Plan was submitted to regulators on March 29, 2007, and was approved by the NJDEP in the April 19, 2007, site walk-over. The Pump Test Work Plan Work Plan includes the following elements:

- Test and monitoring well selection.
- Antecedent water level monitoring.
- Step Test.
- 48- to 72-hour constant rate test and recovery test.
- Groundwater Treatment.
- Data Analysis.

2.1.5 600 Area RDX Work Plan (2008)

The 600 Area RDX Work Plan was presented to the Stakeholders during a partnering meeting on May 29, 2008, with submittal of the Work Plan to regulators on June 18, 2008. A supplemental round of VOC groundwater and surface water sampling was proposed (and approved) in concert with the RDX sampling event. The RDX Work Plan was approved by the NJDEP on June 19, 2008. The RDX Work Plan and Supplemental VOC sampling tasks include the following elements:

- Installation of well 13MW-12 near the Building 650 Pond.
- Baseline explosives sampling at wells 13MW-3, 4, 6, 9, 11, 12 (proposed), DM10-1, DM10-2 and MW-2_N. Surface water sampling at locations 11SW-1, 2, 3 and 13SW-6.
- VOC sampling at wells 13MW-1 through 13MW-8, 13MW-10 and 13MW-11, DM10-1 through DM10-3, and the AWDF well. Surface water sampling at locations 11SW-3, 13SW-3 through 13SW-6.
- Sediment sampling for baseline explosives at locations 11SD-1, 2, 3, and 13SD-6.
- Collection of 12 soil samples around the periphery of the Building 650 Pond.

Results of the RDX Work Plan have not been reported in the subject Report, rather were included in a 600 Area RDX Data Report. This report was submitted to the regulators on April 13, 2009 with a recommendation for no further action (NFA). The NFA recommendation was approved by the NJDEP on May 6, 2009 with concurrence from the USEPA. These included installation and sampling of well 13MW-12 and soil sampling around the Building 650 Pond. The excluded well and soil sample sites are located outside the 600 TCE plume study area.

2.1.6 600 Area Work Plan for Vapor Intrusion and Source Area Investigation (2010)

The VI and source area investigation work plan was submitted in December 2010, and was approved by the NJDEP in emails on December 14, 2010, and January 7, 2011. The USEPA concurred with the work plan approval. Elements of the VI and source area investigation plan included:

- Passive soil gas survey at Site 12 in areas previously covered by rock fill placed in the late 1990s.
- Soil sampling for VOCs from test pits and trenches based on the results of the passive soil gas survey.
- Additional analyses of semivolatile organic compounds (SVOCs), explosives, and metals from a subset of the test pit and trench sampling locations.
- Indoor air and soil gas sampling at Building 660 to investigate the potential for VI from the TCE groundwater plume.

2.2 WORK PLAN AREAS OF CONCERN

Three AOCs were identified in the RI Work Plan (2004). These AOCs were identified based upon review of existing reports and historical data, and personal interviews with individuals familiar with either former or current activities in the area. A fourth potential AOC (AOC 4) was identified after evaluation of sampling data from two newly installed wells. A soil gas study and follow-on soil sampling was proposed in the Work Plan Addendum (2005a) and Supplemental Work Plan (2006b), respectively. These AOCs are discussed individually in the following subsections and are shown on **Figure 2-1**.

2.2.1 AOC 1: Former Munitions Waste Pit, RI/FS Site 12

Site 12, identified as AOC 1, is approximately 3 acres and is located approximately 700 ft north of the AWDF (**Figure 1-2**). This site is located adjacent to 20th Avenue on Green Pond Mountain at an elevation of 1,175 ft msl, which is slightly above the elevation of the AWDF. Dames and Moore (1989) reported that steel armor plate and metal parts were disposed at this site. ANL noted that physical evidence of partially buried metallic objects indicated this site to be the location of a former dump (1991). In interviews conducted by ANL for the 1991 report, PTA personnel reported that munitions testing had taken place for several years previously. Dames and Moore (1989) noted that static testing of explosives and propellants occurred at this location. The site sits on a topographic high, immediately upgradient of a swampy area.

In 1996, an informal site visit was performed by ICF Kaiser which revealed that the eastern portion of the site had been filled. Along the leading edge of the push out, buried items could be seen including building debris, crushed drums, and a truck.

A site inspection in the early 2000s by Shaw personnel indicated that large rock debris had been placed over the fill at Site 12. According to PTA personnel, bedrock that had been blasted to level the ground surface to construct the AWDF was moved to the site. As of the writing of this report, minor amounts of partially buried metal and drums are still present on the periphery of the rubble, showing the extent of the former fill area.

2.2.2 AOC 2: Metal Containers in East Portion of RI/FS Site 11

AOC 2 is located near the extreme eastern portion of Site 11. During a field visit conducted in 2004, Shaw geologists observed a large number of disposed small cylindrical metal containers, which were painted dark green. The cylinders range in size from approximately 2 ft long and diameter of 4 inches, to 18 inches long and a diameter of 12 inches. It is unknown what the containers would have been used for or why they were disposed at this location. A soil gas survey was conducted at the AOC in 2005.

2.2.3 AOC 3: Partially Buried Drums in West Portion of RI/FS Site 11

AOC 3 is located northeast of a swampy area near the western end of Site 11 and consists of 55-gallon metals drums that have been partially buried at this location. The Shaw personnel who noticed the drums at the site noted that they were rusted and were partially collapsed by the weight of the overlying soil. There was no indication what the drums contained. A soil gas survey was conducted at the AOC in 2005. The drums were removed by PTA in 2012.

2.2.4 AOC 4: Soil Mounds Near Building 647

AOC 4 is located 150 ft north of Building 647, and consists of a series of sand and gravel fill mounds overlying a former testing site. The location was subject to filling two times. A wet area was filled to make it more useable as a range site. After use as a range, sand and gravel was placed there for an unknown purpose. The site location is shown on **Figure 2-1**. The sand and gravel fill was removed or regraded during a MEC removal action and subsequent construction projects at the site. The former ground surface material, sand and gravel fill, contains partially buried inert munitions, spent Light Anti-tank Weapon (LAW) launching tubes, and metal containers/drums. AOC 4 site soils, sediment, and surface water were previously investigated by the U.S. Army in 1989 and 2005, which is discussed in **Sections 1.5.2** and **1.5.4**. TCE was detected in groundwater at newly installed wells 13MW-3 and 4 in 2005, prompting further investigation of potential local TCE source areas. A soil gas study and follow-on soil sampling was proposed for AOC 4 in the Work Plan Addendum (2005a) and Supplemental Work Plan (2006b), respectively. The soil gas study was completed in August 2006, and the results are presented in **Section 3.5**. Results of the follow-on soil sampling, completed in March 2007, are presented in **Section 4.3.3**.

2.3 HYDROGEOLOGIC DATA REVIEW AND SITE RECONNAISANCE

In preparation of the RI Work Plan, existing reports and regional resource publications were researched. PTA aerial photography was evaluated from different years to identify potential landfill and other potential sources, and to develop a timeframe for their use. Stereo photo pairs were also evaluated to further delineate vertical relief in features such as soil berms and push outs, pits and depressions, and hydrologic features such as drainages and wetlands. Stereo air photos were also used to map bedrock fracture traces and photo-lineaments as part of the geological investigation.

A thorough field reconnaissance was subsequently conducted in 2004 at the 600 Area Sites 11, 12, and 13. The field reconnaissance included a walkover and inspection of all site areas and buildings, with particular attention to former land filled areas and potential source materials such as stained soils, drums or other containers. Hydrologic features were also noted including surface water drainage and impoundments, wetlands, and groundwater discharge/springs.

Bedrock features and outcrops were examined at all 600 Area sites, including measurement of bedrock bedding plane and joint orientation with a Brunton compass at Sites 11, 12, and 13. Bedrock structures such as faults and folds were logged where detected, and compared to mapped fracture traces and published bedrock maps and other data.

2.4 MEC AVOIDANCE SURVEY

Intrusive field activities such as soil gas monitoring, soil and sediment sampling, and well installation were conducted in areas that are known to potentially contain hazardous explosive ordnance items. These areas have been determined through a combination of inspections and knowledge of past ordnance disposal methods in these areas. For these reasons, an Explosives Ordnance Disposal (EOD) technician was utilized on-site during all initial intrusive field activities at a given sample location. This includes the use of an EOD technician for GORE-SORBER® installation since a slam bar or hammer drill is used to penetrate the ground surface for their installation. A UXO technician was also utilized during soil and sediment sampling, since intrusive sampling was conducted by bucket auger or trowel. MEC avoidance was also required in advance of drilling, where a 5-ft hole was hand dug by the driller. If the UXO technician could not provide clearance for a location, another location was chosen in the immediate vicinity where clearance could be granted.

The UXO technician utilized a Schonstedt or an equivalent instrument for the UXO avoidance surveys. The locator is a hand-held unit that uses two fluxgate magnetometers, aligned and mounted a fixed distance apart, to detect changes in the Earth's magnetic field caused by ferrous metal or disturbances caused by soil conditions. An audio and a metered signal are provided to the operator. The metered signal indicates whether the disturbance is geodetic or metal-related. The detection capability of the Schonstedt depends on the size and depth of the metal object and on the experience of the operator.

2.5 PASSIVE SOIL GAS SURVEY

Initial passive soil gas surveys were performed at AOCs 1 through 4 as identified in the RI Work Plan (2004) and the Work Plan Addendum (2005a). These work plans presented tentative soil gas module locations and a proposed number of modules. However, the work plans acknowledged that "The actual number of soil gas samples collected could be less if an insufficient amount of suitable sample locations can be located in the field". **Figures 2-2** (AOC 1), **2-3** (AOC 2), and **2-4** (AOCs 3 and 4) show the approximate location of collected soil gas samples. Available sample locations were limited at some AOCs by insufficient overburden thickness (<3 ft) to install the module. The number of proposed and collected GORE-SORBER® sampling modules for each AOC is presented on **Table 2-1**.

Passive soil gas screening was conducted using GORE-SORBER® sampling modules. Each module includes sensing elements that are constructed of GORE-TEX® expanded polytetrafluoroethylene (ePTFE) tubing that are packed with granular adsorbent material and resins, depending on the COCs. If VOCs are present, the surface area facilitates soil vapor transfer of VOCs on to the adsorbent material. A typical module is 3 ft long, with a 3 millimeter (mm) inner diameter (ID). A slam bar or electric hammer drill was used to drill 1-inch diameter holes to a depth of 3 ft for installing the GORE-SORBER® modules. The modules were installed into the holes using a stainless-steel insertion rod. The top of each module was connected to a retrieval cord. The entire apparatus and the boring annulus was sealed flush with the ground surface using a cork.

The soil gas sampling points are typically located on grid nodes that are spaced 50 ft apart on center. Attempts were made to install all of the GORE-SORBERS® 50 ft apart or less, however in some cases the location of the modules was changed in the field due to shallow overburden, refusal, or off-set due to MEC avoidance procedures. The location of each of the GORE-SORBER® modules is provided on the figures in this section. Variations in module placement are discussed on **Table 2-1**. The GORE-SORBER® was installed as close as possible to the originally proposed sample location. The grid end points were located in the field by Global Positioning System (GPS), and marked by wooden stakes. All grid sample points are marked with orange pin flags during sampling, and are left in place after the GORE-SORBERS® are removed. The approximate coordinate position of each sample location was recorded for future reference. A summary of GORE-SORBERS® location and module ID is presented in **Table 2-1**.

The GORE-SORBER® modules remained in the ground for approximately 2 weeks. After this time, the modules were collected and sent to the laboratory for analysis. Module recovery required that field personnel locate the module, remove the cork, grasp the cord, and manually pull the module from each location. Corks were separated from each module and discarded. The exposed modules were then sealed in their respective designated shipping vials and placed immediately on ice. At the laboratory, gas chromatography and mass selective detection was used to analyze the modules using modified EPA method 8260/8270 (**Appendix G)** for the compounds listed in **Table 2-2.** The GORE-SORBER® modules were supplied and analyzed by W.L. Gore & Associates, Inc., of Elkton, Maryland. QC samples for the GORE-SORBER® survey included trip blanks.

Additional passive soil gas sampling was conducted at AOC 1, as identified in the 600 Area Work Plan for Vapor Intrusion and Source Area Investigation (Shaw, 2010). The complete passive soil gas sampling results are presented in **Section 3.5**.

2.6 VLF GEOPHYSICAL STUDY

A VLF geophysical study was conducted in September 2004 to investigate mapped bedrock faults and folds, and detect water-bearing and conductive subsurface structures in the study area. VLF has been used extensively in the northeast for identification/delineation of water-bearing fractures in non-conductive gneiss/granite bedrock, and was expected to be effective in the Green Pond Conglomerate. This method is fast and easy to use, and is commonly used as a reconnaissance geophysical method for geologic mapping and hydrogeologic investigations. This data was used to develop the conceptual hydrogeologic model and optimize the location of bedrock monitoring wells.

VLF refers to the very low frequency band (15 to 25 kilohertz [kHz]), which is utilized by the military for communication with submerged submarines. There are 15 primary transmitters worldwide, which generate strong horizontal electromagnetic fields that are detected by field instruments. When the

horizontal VLF field strikes a suitable conductive structure, a secondary vertical field is generated that can be measured by instruments in the field. In order to generate a secondary field, the conductive structure must be elongated and tabular in shape, align or point towards the transmitter, and generally dip greater than 45 degrees. The mapped faults and fold axis in the study area align well with the Cutler Maine VLF transmitter, and meet the other requisite criteria for the use of this method.

VLF survey lines were oriented normal to target structures (mapped faults and fold), and avoided power lines that interfered with the signal. Survey lines were extended past target structures to fully develop potential data anomalies. The orientation of survey lines were checked in the field with a Brunton compass and GPS, and were subsequently cleared of brush for personnel/equipment access. VLF Survey lines are shown on **Figure 2-5**. The results of the VLF survey are presented in **Section 3.3**.

2.7 MONITORING WELL INSTALLATION

The focused groundwater investigation began in the 600 Area in April 2004 with sampling of the AWDF well, which resulted in confirmation of TCE contamination. The investigation of 600 Area groundwater was performed in an iterative manner. The Army utilized on board reviews with the regulators and abbreviated work plans using a facility-wide FSP as a framework. Installation of groundwater monitoring wells was discussed in three work plans (Shaw, 2004, Shaw, 2005a, and Shaw, 2006a). All groundwater monitoring wells were installed in accordance with the work plans without deviation.

A total of 11 wells were installed in three phases of activity. Wells 13MW-1 through 13MW-4 were installed in April 2004, 13MW-5 through 13MW-9 in February 2006, and 13MW-10 and 13MW-11 in December 2006. Well locations are shown on **Figure 2-6**. The rationale for installation of these wells is summarized in **Table 2-3**.

All wells were drilled by SGS Drilling, Inc., using the dual air rotary method. The dual rotary method was selected for its ability to drill through shallow glacial boulders which are encountered at the PTA. All well locations were evaluated in advance for overhead power lines and proximity to utilities, and staked in the field. Locations were subsequently evaluated and cleared for underground utilities by Chugach Inc. Well drilling permits were obtained from the NJDEP for each well by the driller, and each location was hand dug and cleared for UXO to 5 ft or top of rock before drilling. Where hand digging was not possible, the drill rig was used to advance the hole in 2-ft intervals after UXO clearance.

Well installation was supervised by a Shaw geologist, who recorded sediment type, depth to rock, lithology, fracture depth(s), well yield, total depth and well construction detail. Wells were initially drilled by either 10- or 12-inch diameter bit to 10 ft below the top of competent rock. A 6- or 8-inch-diameter steel casing was then installed in the hole and tremie grouted to the surface by a bentonite-cement grout. Drilling was usually completed the next day after the grout cured, and was completed as a 6- or 8-inch open borehole. Target well depth was between 150 to 250 ft bgs, which was determined in the field by the number and depth of water-bearing fractures. This target depth was determined after evaluation of the AWDF packer test sampling results and vertical distribution of TCE. Well 13MW-3 was drilled to 77 ft bgs as a shallow bedrock cluster well. All wells were air developed a minimum of 1 hour by the drill rig to clear sediment from the well and to estimate well yield.

Wells 13MW-1, 13MW-2, 13MW-4, 13MW-5, 13MW-7, 13MW-8, 13MW-10, and 13MW-11 were designated for subsequent borehole geophysics and packer testing/sampling, and were left as an open borehole until completion of activities. Wells 13MW-3, 13MW-6, and 13MW-9 were not packer tested and were completed upon drilling and air development. All wells were completed with either 2- or 4-inch PVC 20 slot screen and riser, and morie #1 filter sand. The tested well screen intervals were determined by evaluation of packer testing and sampling results. Well open borehole completion depths and the geophysical and packer testing schedule is summarized in **Table 2-4**. Monitoring well permits and Monitoring Well Records were prepared by SGS Drilling, Inc., and are provided in **Appendix C**. Well boring and construction logs were prepared by a Shaw geologist and are also presented in **Appendix C**. Final well construction detail is provided in **Table 2-5**.

Wells were subsequently developed by pumping a minimum 3 volumes of water to remove fine sediment from the well. Development water temperature, dissolved oxygen (DO), conductivity, pH, oxidation–reduction (redox) potential (ORP), and turbidity was monitored by a Shaw geologist using a

calibrated YSI 6280 multimeter with flow through cell. Development continued until a minimum three well volumes and 10 nephelometric turbidity unit (NTU) standard was achieved.

All completed wells were surveyed by Volosin Associates, a New Jersey licensed surveyor. Wells were located by both geographic coordinate (to 1/10 of a second) and New Jersey State plan coordinate (to nearest 10 ft). The surveyor also determined the elevation of top of inner casing and grade to within one hundredth of a foot. The top of inner casing measurement point was marked with a permanent marker by the surveyor for use as a water level measuring point. Well survey data is summarized in **Table 2-6**.

Based on preliminary results of the TCE plume source area investigation, presented in **Section 4.5**, the NJDEP requested the installation of an additional monitoring well to the northwest of the identified TCE contaminated soil. The purpose of this additional upgradient well was to demonstrate that TCE had not migrated upgradient along the groundwater bedding plane. The USEPA verbally concurred with this request from the NJDEP. Additional details for this additional monitoring well are presented in **Section 4.2.2**.

2.8 BOREHOLE GEOPHYSICS

Borehole geophysics were conducted in the open borehole of the AWDF well and bedrock monitoring wells 13MW-1, 13MW-2, 13MW-4, 13MW-7, 13MW-8, 13MW-10, and 13MW-11 to identify water conducting fractures and geologic contacts. This is important because almost all bedrock groundwater yield is obtained from open fractures and bedding planes or partings. Potential water-bearing fractures can be identified by downhole video, and inflections in borehole resistivity, conductivity, temperature, and caliper data. Heat pulse geophysical logging more directly measures groundwater inflow, and was utilized in selected wells. A borehole geophysics well testing summary is shown in **Table 2-4**. Borehole geophysics provided the precise depth of water-bearing fracture for follow-on packer testing and to determine the borehole fracture distribution. Fracture orientation (strike and dip) was measured by the optical and acoustic televiewer.

The surveys that were performed include a temperature and conductivity survey, a borehole television survey, an optical televiewer (OPTV) survey, an acoustical televiewer survey, 3-arm caliper survey and heat pulse flow meter. Details of these surveys are discussed in **Sections 2.8.1** through **2.8.6** below. All surveys were performed by Mid-Atlantic Geosciences, LLC (MAG) of Centreville, Maryland. MAG Standard Operating Procedures (SOPs) for the various surveys are included in **Appendix D**.

After completion of the downhole surveys, data was evaluated by MAG and Shaw personnel. Potential water-bearing fractures were identified in all wells for follow-up packer testing. Packer testing and sampling was used to confirm the presence and yield of individual water-bearing fractures and to discretely sample those zones. SGS Drilling, Inc., will perform the packer testing for this investigation. Details of the packer testing are provided in **Section 3.1.6**.

2.8.1 Fluid Temperature and Conductivity Survey

A fluid temperature and conductivity survey was the first survey performed in the well following removal of the pump and associated wiring. This survey was performed prior to other surveys to avoid mixing of the well water that could occur if other survey instruments are lowered into the well immediately prior to this survey. This survey consisted of continuously logging water temperatures and conductivities by lowering a probe into the well at a rate of 8 to 12 ft per minute (fpm). It is important to maintain the appropriate downward logging speed to allow adequate time for the instrument sensors to respond to minor changes. The data were continuously recorded using WinLogger data acquisition software. A printed log of the data was available immediately after the survey is complete. Printed logs indicate where water is entering or leaving the well. Abrupt changes in the slope of the logged temperature and conductivity data will be used to locate zones of interest. The fluid conductivity log provided borehole fluid electrolytic measurements. Water with lower dissolved solid concentrations will yield much lower fluid conductivity values than liquid containing a relatively high amount of dissolved solids. Fluid conductivity curves often deflect where water producing apertures or formations are transmitting water into or out of the well with a contrasting composition relative to the borehole fluid.

2.8.2 Borehole Television Survey

Following the fluid temperature and conductivity survey, a visual image of the entire length of the well borehole was made by performing a borehole television survey. A down-hole video camera was lowered into the well at a rate no greater than 1 ft per 6 seconds (not to exceed 10 fpm). The down-hole camera was connected to a video monitor to allow the operator and Shaw personnel to observe the well conditions as the camera is lowered into the well. The camera was stopped at selected depths to more fully observe specific conditions within the well. The video was recorded onto a video cassette tape for future review. The video included a digital presentation of the camera depth. The camera was oriented due north to qualitatively assess the orientation (i.e., strike and dip) of the observed intersecting joints and fractures. The down-hole video was used to identify the depths and orientation of intersecting joints and fractures, and to note any features that may impact the movement of groundwater into the well.

2.8.3 Optical Televiewer Survey

An OPTV survey using a borehole OPTV was performed on wells immediately after the wells were videotaped. The OPTV is a logging sonde that can provide high-resolution imagery information on the location and character of features such as fractures and solution openings. It can also provide the strike and dip of planer features, such as fractures and bedding planes. The OPTV functions by using a downhole camera that views a reflection of the borehole walls in a hyperbolic mirror. At successive depth increments (normally 0.5 mm), rings of pixels corresponding to scans of the borehole wall, are acquired from the probe and built up into an image. This is oriented to the north, displayed in real time and recorded for subsequent analysis. Limitations of the tool do exist. All OPTV sondes have a maximum diameter of investigation. The tool that was used for this investigation can properly function in boreholes up to 8 inches in diameter with clear borehole fluid. The orientation of the sonde is controlled by a series of magnetometers that can be affected by steel casing in the borehole. Operating near steel casing will alter the field of view received by the OPTV and distort the picture, making it impossible to accurately define features within 2 to 3 ft from the bottom of casing. For this investigation the sonde were lowered into the well at a rate of 3 to 5 fpm. The data was continuously recorded using WinLogger data acquisition software. Unlike the borehole television survey, it was not possible to stop at selected depths to more fully observe specific conditions within the well. It was also not be possible to generate a printed log of the data without downloading and interpreting the data, which was not practical during field data collection. It was possible to make detailed notes about fractures by watching a monitor at the surface as the instrument passed each interval. It was also possible to replay the recorded televiewer information in the field when necessary to more closely inspect an interval.

2.8.4 Acoustic Televiewer Survey

An acoustic televiewer survey using a borehole acoustic televiewer (BHTV) was performed following completion of the OPTV survey. The BHTV is a logging sonde that can provide high resolution imagery information on the location and character of features such as fractures and solution openings. It can also provide the strike and dip of planer features, such as fractures and bedding planes. The BHTV functions by using a high frequency transducer that is placed near the bottom of the tool. As the transducer spins it acts as both a transmitter and receiver that emits high frequency acoustic energy. The acoustic signal is reflected back to the receiver and a trigger pulse is transmitted to the up hole electronics from a flux-gate magnetometer each time the transducer passes magnetic north. The pulse is transformed into an oriented graphic representation of the well borehole wall. The orientation of the sonde is controlled by a series of magnetometers that can be affected by steel casing in the borehole and other aberration in the magnetic field. Limitations of the tool do exist. All BHTV sondes have a maximum diameter of investigation. The tool that was used for this investigation can optimally function in wells up to 6 inches in diameter, although wells up to 8 inches in diameter have been successfully logged. The major advantage of the acoustical televiewer survey is that the survey is not affected by turbid waters in the well. For this investigation the acoustical televiewer was lowered into the well at a rate of 6 to 8 fpm. Similar to the OPTV survey, it was not possible (or even necessary) to stop at selected depths to more fully observe specific conditions within the well. It was also not possible to generate a printed log of the data without downloading and interpreting the data, which was not practical during field data collection. It was possible to make detailed notes about fractures by watching a monitor at the surface as the

instrument passed each fracture interval. It was also possible to replay the recorded televiewer information in the field when necessary to more closely inspect an interval.

2.8.5 3-Arm Caliper Survey

This survey involved measuring and logging the average diameter of the entire well borehole. The caliper tool collects and transmits data as the tool is lifted upwards in the well. Three spring-loaded arms, acting in conjunction with each other, measured the average diameter of the well. The caliper tool was used to locate features, determine casing intervals, and measure the overall diameter of the well borehole. Caliper logs are collected by calibrating the downhole tool with a measuring template, lowering the tool to the desired depth, remotely opening the feeler arms, and then logging the open borehole and casing diameter in an upward direction. For this investigation, the caliper tool was raised from the bottom of the well at a rate of 15 to 18 fpm. The data was continuously recorded using WinLogger data acquisition software. The major advantage of this technique is that the survey is not impacted by turbid water in the well. Another advantage is that a printed log of the data can be provided immediately after the survey is complete.

2.8.6 Heat Pulse Flowmeter

The Heat Pulse Flowmeter (HPFM) was used in wells 13MW-1 through 13MW-4 and wells 13MW-10 and 11. Unlike all other logs that are continuous records of some parameter versus depth, HPFM logs are made with the sonde stationary in the borehole at discrete depth intervals or at stations selected to suit a particular study. In the sonde, large capacitors are charged from the surface power supply and can be discharged rapidly on command through a high resistance wire grid (like the heating elements of an electric stove). The discharge causes a sharp spike in the temperature of the disk of water occupying the heating grid. By conduction alone, the heat in this disk disperses slowly due to the poor heat conduction of water. In addition, the slight change of density of the heated water will cause it to rise very slowly by convection. However, in the presence of vertical flow, the heated disk of water will move up or down more rapidly with the flow velocity. In the sonde, thermistors are set at fixed equal distances above and below the heating grid, and sense the passage of the heated disc. Prior to the firing, the two thermistor outputs are equalized so it is possible to interpret any subsequent differential output as a relative change in temperatures between thermistors. The temperature differential data is sent to the surface where the flow rate (in fpm) can be calculated based upon known positions of the thermistors. If the borehole diameter is known, the flow in fpm can be converted to gallons per minute. Note that by convention, negative flow values represent downward flow.

The main limitation of the HPFM is that it can only accurately measure the vertical component of flow in the borehole. Any horizontal flow cannot be quantified due to the location of the thermistors relative to the heat grid. This factor must be taken into consideration when interpreting HPFM data.

2.8.7 Data Evaluation

After completion of the geophysical surveys, data was evaluated by MAG and Shaw personnel. MAG submitted a Borehole Geophysics Report after each mobilization summarizing the logging tool data, summary borehole plots and identification of potential water-bearing fracture zones. Results of the borehole geophysical survey are discussed in **Section 3.6**.

2.9 PACKER TESTING

Once potential water-bearing zones were identified in borehole geophysical surveys, packer testing and sampling were used to confirm the presence and yield of individual water-bearing fractures and to discretely sample those zones. SGS Drilling, Inc., conducted the packer testing for this investigation. **Table 2-4** identifies those wells that were packer tested in the RI investigation.

Nitrogen inflatable packers were used in the open boreholes to isolate selected zones of intersecting joints and fractures. Each isolated zone was purged at a maximum rate of 0.25 liters per minute with either a bladder pump or Grundfos Rediflo® pump to evacuate a minimum of one volume of groundwater equivalent to the interval isolated by the packer. The purge water was monitored for standard field parameters (i.e., pH, temperature, conductivity). Once a minimum of one volume of groundwater was purged, and the field parameters had stabilized in accordance with low-flow groundwater sampling procedures, a groundwater sample was collected for analysis of Target

Compound List (TCL) VOCs. After a groundwater sample had been collected, the zone was purged at the maximum sustainable pumping rate to determine the yield.

The length of the isolated zones was determined by the site geologist based on the number of zones identified by the surveys, and the intensity of intersecting joints and fractures within the zones. A summary of AWDF and monitoring well packer tested intervals is shown in **Table 2-7**. Packer testing was not conducted at shallow bedrock wells 13MW-3 and 13MW-9. Well 13MW-3 was not tested due to its shallow depth and proximity to deep cluster well 13MW-4, which was packer tested. Well 13MW-9 was also not tested due to its shallow depth and distance from the plotted TCE plume. Packer testing of 13MW-6 was initially proposed; however, it was not feasible due to the wells proximity to overhead power lines. Results of the packer testing are presented in **Section 3.7**.

2.10 AQUIFER PUMPING TEST

A bedrock aquifer pumping test was conducted, in 2007, in the 600 Area to determine the aquifer permeability at the AWDF well and adjacent monitoring wells. This data is necessary to calculate groundwater velocity and contaminant transport rates and provide background information to determine viable remedial technologies. The aquifer pumping test includes the following sequential work elements.

2.10.1 Test Well Selection

The water supply well at the AWDF well was selected as the pumping well due to its location near or at the center of the 600 Investigation Area, relative location in relation to bedrock monitoring wells, yield, and open borehole depth and length. As shown on **Figure 2-9**, the AWDF well is located along the plotted axis of the 600 Area TCE plume and between mapped faults. The AWDF well is surrounded by a number of bedrock monitoring wells, located both within the fault block and across mapped faults. Bedrock test wells utilized during the aquifer pumping test included 13MW-1, 13MW-2, DM13-2, 13MW-7, 13MW-6, and 13MW-4.

The AWDF well was drilled in 1994 to a depth of 450 ft. The well was completed into the Green Pond Conglomerate (bedrock), and was constructed with a 6-inch ID open borehole from 55 to 450 ft bgs. The AWDF well was pumped during development at 4 gpm over a period of 4 hours, drawing down approximately 158 ft. Based upon the provided Well Record pumping information, the AWDF well was step tested at 2.0, 3.0, 3.5, and 4 gpm.

In 2005, the AWDF well was packer tested including flow measurement and VOC sampling of 18 packer zones. The packer testing found that water-bearing fractures and TCE contamination were distributed across the length of the borehole. The length of the open borehole, distribution of fractures and relatively high yield (4 gpm) makes the AWDF well suited for aquifer testing, and is considered a fully penetrating test well.

One issue of concern during testing was the potential accelerated downgradient transport of TCE toward the AWDF well. Sampling of the AWDF well in November 2006 detected 81 µg/L TCE, which is treated by air stripping for non-potable use in the 660 Building. The highest concentration of TCE in October 2007 (120 g/L) was detected in well 13MW-1, which is located approximately 600 ft north-northwest (upgradient) of the proposed test well. Induced contaminant migration resulting from testing was minimal due to the low projected bedrock permeability and relatively low upgradient TCE source area concentration.

2.10.2 Test Monitoring Well Selection

Test wells utilized in the aquifer pumping test are depicted on **Figure 2-9**. The selected monitoring wells are arrayed in three directions; along bedrock strike/structure and strike, perpendicular to strike, and oblique to strike. Wells 13MW-2, 13MW-4, 13MW-5, and 13MW-10 are located along bedrock strike and structure (faults and fold axis) with the test well. Wells 13MW-1 and 13MW-8 are located perpendicular to bedrock strike along the TCE plume axis. Proposed monitoring wells 13MW-6 and 7 are located across the southern mapped fault, and oblique to the well relative to bedrock strike. The closest monitoring wells are located 400 ft (13MW-7) and 575 ft (13MW-2 and 13MW-4) from the test well.

Surveyed tide staffs were installed in standing water within two study area wetlands prior to testing (**Figure 2-9**), and were monitored during the constant drawdown test. There were no changes to wetland water levels during the test period.

2.10.3 Test Mobilization and Antecedent Water Level Monitoring

In Situ Trolls were programmed and installed into selected monitoring wells to provide electronic water level monitoring. Trolls continuously monitor antecedent, constant discharge test and recovery test water levels at the designated wells. These and other designated wells were also periodically monitored by hand to monitor aquifer drawdown and recovery. The existing electric pump is installed at 430 ft bgs, and was used in the aquifer pumping test. The pump specifications were evaluated by SGS Drilling, Inc. and are considered ideal for the proposed pumping rate of 2 to 4 gpm. A flow gauge manifold consisting of two sequential flow meters (0 to 10 gpm range) and flow control valve was installed at the test well head. Water was conveyed from the manifold to a 21,000-gallon frac tank by 1-inch ID HDPE hose.

Water level measurement started (at Troll monitored wells) one week in advance of testing to monitor overall groundwater elevation trends. Wells DM10-1 and DM10-2 were manually monitored as background wells, and are located approximately 2,800 ft from the test well. The background well was not impacted by the aquifer pumping test, and provided background water elevation data through the constant rate and recovery test period. Significant changes in background water levels can impact the interpretation of pumping and recovery data, and can be corrected using background or antecedent data.

2.10.4 Step Test and 48-Hour Constant Rate Pumping/Recovery Test

A step test was conducted to determine the pumping test rate and field proof the well pump, flow rate manifold and other discharge hose connections. The AWDF well was pumped at 2.0, 3.0, 3.5, and 4.0 gpm for a 1-hour period (each) to determine the total drawdown and specific capacity of the well at each pumping rate. A pumping rate was selected to stress the aquifer, but limit drawdown to one-third of the water column. The selected pumping rate also accounted for potential aquifer barrier boundaries, which would increase drawdown during the test.

The constant rate test was conducted a minimum 48 hours after the step test to allow for aquifer recovery. The test well was pumped at a constant rate over a maximum 72-hour period, requiring periodic adjustment of the flow valve to account for the falling head. Manual water level measurements will also be conducted at the test and four nearby monitoring wells (13MW-1, 13MW-2, 13MW-4, and 13MW-7). Manual measurements provide backup to the Trolls and allows real time assessment of test well/monitoring well drawdown. Other more distal monitoring wells were periodically monitored for drawdown. The duration of the test was determined by the drawdown response of nearby and more distal monitoring wells. At a minimum, drawdown is required at nearby monitoring wells to determine time-drawdown based aquifer parameters. Drawdown at more distal wells (i.e., 13MW-5, 13MW-8, and 13MW-10) was used in the calculation of aquifer parameters using time-drawdown and distance-drawdown methods.

Upon conclusion of the constant discharge test, the well pump was turned off, and aquifer water levels recovered to near pre-test levels. Recovery Test water level measurements were conducted for 6 hours and at Troll monitored wells for a 48-hour period.

Test water was stored in a 21,000-gallon frac tank located within 200 ft of the well. Upon conclusion of the recovery test, test water was treated by activated carbon at a maximum flow rate of 3 gpm. Activated carbon is an accepted treatment for TCE in groundwater, and would effectively remove site TCE at the low detected concentrations (85 µg/L). Treated water was discharged to an adjacent storm drain and swale.

2.10.5 Data Analysis and Reporting

Water elevation data was downloaded to semi-log plots for analysis using the Cooper Jacob method. Time-drawdown data was evaluated at the test and selected monitoring wells, in addition to distance-drawdown data from monitoring wells. Aquifer transmissivity and storage coefficient was calculated from the constant rate test data, with calculation of transmissivity from recovery test data. Results of the aquifer pumping test are provided in **Section 3.9**.

2.11 SAMPLING OF GROUNDWATER, SURFACE WATER, SEDIMENT AND SOIL MEDIA

2.11.1 Groundwater Sampling Program

Groundwater sampling was conducted in ten rounds starting in April 2004. The first sampling round was conducted in April 2004 with 4 existing wells, and expanded to as many as 16 wells with installation of new monitoring wells. Monitoring well 13MW-3 was inaccessible (covered with construction debris) during the 2010 and 2011 sampling rounds; and monitoring well 13MW-4 was inaccessible during the 2011 sampling round due to a MEC removal action and ongoing construction activities for Building 647. Groundwater sampling dates, wells and parameters are summarized in **Table 2-8**. All rounds involved the sampling of wells for TCL VOCs, which included analysis for library search TICs and MTBE. MTBE analysis was not conducted in nine of sixteen monitoring wells in April/May 2010 because analysis was limited to those wells with prior MTBE detections. Starting with the November 2006 sampling round, all wells were additionally sampled for Baseline explosives (1,3-Dinitrobenzene, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, 2-amino-4,6-Dinitrotoluene, 4-amino-2,6-Dinitrotoluene, HMX, Nitrobenzene, 2-Nitrotoluene, 3-Nitrotoluene, 4-Nitrotoluene, RDX, Tetryl, 1,3,5-Trinitrobenzene, 2,4,6-Trinitrotoluene). Baseline explosives sampling was discontinued after the June 2008 sampling round due to declining concentration trends and extremely low concentrations of explosives in surface water. A rinse blank, trip blank, and a field duplicate were collected according to the methodology described in **Section 2.11** of this Report. Groundwater sampling procedures are addressed in the following section.

2.11.2 Sampling Procedure

The low-flow sampling method (USEPA, 1998) was used to collect the groundwater samples at bedrock monitoring wells in the 600 Area. Sampling for all rounds of monitoring was conducted via low-flow methods in accordance with the facility-wide Field Sampling Plan (FSP). Noting that these wells were each screened across a water-bearing fracture, the pump was placed in the center of the screen interval. The AWDF well is plumbed to the treatment system and could not be sampled using a sampling pump or bailer. Instead, the system pump was run for 30 minutes to purge the lines, and a sample was drawn at a low-flow rate from a tap prior to the treatment system.

For low-flow sampling, the water level was measured in each well and recorded every 5 minutes during purging to monitor drawdown. Each well was purged at a pumping rate of approximately 100 to 300 millimeters per minute (mL/min), depending on the well drawdown. Samples were collected at a maximum flow of 200 mL/min to minimize sample disturbance and volatilization. A decontaminated, 2-inch diameter Grunfos stainless steel pump was used was used for purging and sample collection. Teflon lined polyethylene tubing was used in the wells and connected the sampling pump to a low-flow cell during purging. A YSI Model 6840 multimeter was used to measure parameters and determine when stability criteria were met. USEPA low-flow parameters and stabilization criteria include dissolved oxygen (DO – 10%), turbidity (NTU – 10%), redox potential (ORP – 3%), pH (0.1%), and conductivity (10 millivolts [mV]). DO readings were periodically checked with a LaMotte sampling kit, which used the modified Winkler titration method. Temperature was also recorded and stabilized within 0.1 degree Celsius. The YSI multimeter was calibrated each day prior to use for well purging/sampling. A backup Horiba 22 multimeter was maintained and calibrated on-site and was used to verify field parameter readings. Field parameters and sampling well water levels were taken every 5 minutes during purging, and continued until stabilization criteria were met. A minimum well purging period of 40 minutes was implemented to ensure representative samples from fracture zones in the bedrock well. Well purge data sheets are provided in **Appendix G**.

2.11.3 Bioremediation Sampling

Bioremediation sampling was conducted in March 2007 at ten monitoring wells to determine if microbial degradation of chlorinated solvent is occurring in the 600 Area. Sampled wells are listed in **Table 2-8**. Bioremediation sampling was conducted to determine the following:

- Presence/absence of daughter products (i.e., cis-1,2-dichloroethene [DCE], vinyl chloride [VC], ethane, ethane).
- Concentration of electron donors (i.e., ammonia, Mn (II), Fe (II), sulfide, methane).

- Concentration of terminal electron acceptors (i.e., DO, nitrate, Mn (IV), Fe (III), Sulfate).
- Groundwater quality parameters (i.e., DO, ORP, pH).

Sampling wells included 13MW-1 through 13MW-7, 13MW-10 and 13MW-11, and DM13-1 through DM13-3. Sampling included nitrate/ammonia, total/dissolved manganese, total/dissolved iron, iron (II), sulfate/sulfide, methane, ethene, and ethane. Groundwater quality parameters include pH, DO (meter and Winkler method), and ORP.

Explosives daughter products (i.e., hexahydro-1-nitroso-3,5–dinitro-1,3,5-triazine [MNX], etc.) were to be added if baseline explosives were detected in November 2006. However, only RDX was detected above LOCs in the first round of baseline explosives sampling. Since RDX only slightly exceed its LOC (0.5 µg/L) at a concentration of 0.66 µg/L in a single monitoring well (13MW-1), explosive daughter products were not added to the sampling program. However, baseline explosives sampling was continued through June 2008. Baseline explosives sampling was discontinued following approval of the NFA recommendation for RDX in May 2009, as discussed in **Section 2.1.5**.

2.11.4 Surface Water and Sediment Sampling

Surface water sampling was performed over ten rounds starting in November 2004. A summary of the surface water and sediment sampling program is shown in **Table 2-9**. Surface water/sediment sampling locations are shown on **Figure 2-7**. Sampling was expanded to nine locations, numbered SW-1 through SW-9, in January 2006. Surface water sampling was expanded from five to nine locations to evaluate the extent of surface water contamination downgradient of locations 13SW-5 and 13SW-3. After determining that contamination had not spread, surface water sampling was reduced back to five locations (SW-1 through SW-5) in September 2007. In the June 2008 sampling round, sampling location 13SW-6 was added back to the program to monitor a downgradient point of non-detection. In April/May 2010 and January 2011, sample location 11SW-10 was added as an additional monitoring point between 11SW-2 and 11SW-3, which was reduced to five locations (SW-1 through SW-5) in September 2007. One additional sampling location was added in each of the June 2008 and April/May 2010 sampling rounds. For the first two rounds, surface water samples were analyzed for TCL VOCs plus TICs and MTBE. Baseline explosives were added to the sampling program starting with the fourth round in November 2006, and were discontinued following the June 2008 sampling round due to declining concentration trends and extremely low concentrations of explosives in surface water.

Surface water samples were collected in ponded areas or open reaches of stream channels to minimize entrainment of sediment and other particulate matter. Prior to sampling, surface water parameters were monitored using an YSI model 6280 multimeter. Monitored parameters include temperature, DO, pH, conductivity, ORP, and turbidity. Samples were collected using a dedicated disposable plastic or glass container that was transferred into an appropriate VOC or Baseline explosive sample bottle.

Sediment sampling for VOCs was conducted in November 2004 at five locations, and was expanded to eight locations (SD-1 through 9, except SD-8) in January 2006. Sediment sampling was reduced to one sample at SD-1 starting in November 2006. Sediment samples were analyzed for TCL VOCs plus TICs and MTBE, except at 11SD-1 in 2006 and 2007, which was limited to baseline explosives.

Sediment samples were collected after surface water samples to minimize disturbance of the water column, and in quiescent stream/pond areas to ensure the collection of fine particulates/sediment. Samples were collected using a decontaminated stainless steel trowel and transferred into an appropriate VOC or baseline explosives sample container. A trip blank and field duplicate QA/QC sample(s) were collected for both surface water and sediment as part of the sampling program collected in accordance to the methodology described in Section 3.24 of the PTA FSP (IT, 1999). Results of the surface water/sediment sampling are presented in **Sections 4.3** and **4.4**.

2.11.5 Soil Sampling

Soil sampling was conducted in AOC 4 adjacent to soil gas sample locations in the fill mounds. The location of the fill mounds, areas regraded with a bulldozer, and soil sample locations are shown on

Figure 2-8. The fill mounds cover an area of approximately 135 by 15 ft (2,025 square ft), and range in height from 3 to 4 ft. Soil sample locations were set off approximately 2 ft from the marked GORE-SORBER® sample locations to ensure an undisturbed soil profile. Samples were collected at the 0.5 ft interval above and below the fill contact with native soils. All sample locations were cleared for UXO to 3.0 ft bgs. Soil samples were collected on March 23, 2007 from AOC 4, as part of the second 600 Area quarterly sampling event. There were no deviations in the number or location of soil samples collected from AOC 4.

Soil screening and sampling were conducted pursuant to the methods described in Section 6.27 of the *Field Sampling Manual* (NJDEP, 2005b). Undisturbed samples were initially removed from the soil interval by a large diameter core, and then immediately sub-sampled by an En Core® sampler. Three individual 5-gram Encore samples were collected from the large diameter core for each interval, and wrapped in a foil pouch. All samples were iced and maintained at 4 degrees Celsius and shipped to the lab within 48 hours of collection. Soil samples were analyzed for VOCs and MTBE.

Additional soil sampling was conducted as part of the source area investigation (trenching investigation) at AOC 1 in June 2011 and May 2012 (**Figure 2-2**). Trenching and test pit investigation was proposed in the *600 Area Work Plan for Vapor Intrusion and Source Area Investigation, Picatinny Arsenal, New Jersey* (Shaw, 2010). The work plan proposed to excavate test pits or trenches based upon soil gas results. A total of 30 soil samples were proposed if the results indicated the need for that many samples. A total of 13 soil samples were collected during the 2011 and 2012 rounds of investigation. The 2011 sampling round was stopped early due to the discovery of MEC. The 2012 trenching investigation was stopped early because of the discovery of VOC contaminated soil. The 2012 trenching investigation was not restarted because the primary objective, determining the presence or absence of a TCE source area, had been reached. For the 2011 and 2012 samples, the Encore® samplers were used to collect samples either directly from the soil or from the bucket of the excavator (for samples collected from greater than 2 ft bgs). Additional samples were collected from a subset of the VOC sample locations for analysis of SVOCs, baseline explosives, and target analyte list (TAL) Metals. Following the completion of VOC sample collection, a sufficient amount of soil from the specified sampling interval was placed on a decontaminated stainless-steel tray. Rocks and organic matter were removed and the soil was thoroughly homogenized using the coning and quartering method (ASTM C702-98) prior to sample collection. Sample results are presented in **Section 4.3**.

2.12 VAPOR INTRUSION INVESTIGATION SAMPLING

Building 660 is a two-story building constructed on a concrete slab. The footprint of Building 660 covers approximately 23,000 square ft. The VI investigation was performed according to the DoD Vapor Intrusion Policy and Guidance Handbook, NJDEP guidance, and USEPA policy (DoD, 2009, NJDEP 2005a, and USEPA, 2002b). Per NJDEP guidance and consistent with USEPA policy, the NJDEP recommends investigation of VI where structures are within 100 ft horizontally or vertically of shallow groundwater contamination in excess of groundwater screening levels. Therefore, VI at Building 660 was evaluated through the collection of near-slab soil gas samples, and indoor air samples. Near-slab soil gas samples were collected in lieu of sub-slab soil gas samples proposed in the *600 Area Work Plan for VI and Source Area Investigation* (Shaw, 2010) based on the review of as-built drawings, which showed a minimum concrete foundation thickness of 20 inches, with many areas significantly in excess of that value, and the presence of a vapor barrier. In addition, the building foundation was constructed directly on top of bedrock, minimizing the possibility of the presence of a vapor collection area facilitating sub-slab soil gas sampling.

Near-slab soil gas samples were collected concurrently with indoor air and ambient samples to assess VI and potential background contaminant sources.

A building walkthrough was conducted prior to indoor air and near-slab soil gas sampling to address:

- Detection of potential background sources of VOCs.
- Determination of the building construction.
- Recognition of points of VI in a structure.

- Identification of possible sample locations.
- Education of the occupants on VI and sampling procedures.

The building walkthrough was conducted approximately three weeks prior to the actual indoor air and near-slab soil gas sampling event. A photoionization detector (PID) was utilized during the building walkthrough to determine items such as individual cans of solvents that can be identified as vapor sources and removed from the building in advance of the sampling event. No readings were registered on the PID during the building walkthrough.

2.12.1 Soil Gas Sampling

Near-slab specifically refers to the collection of soil gas samples within 10 ft horizontally of a building's foundation (**Figure 4-12**). Analytical results from near-slab soil gas sampling may be utilized to determine whether the VI pathway is currently complete for a particular building. Per NJDEP VI guidance (NJDEP, 2005a), the following requirements were followed during near-slab sampling:

- The soil gas samples were collected in the vadose zone, at least 1 ft above the capillary fringe.
- A lab certified for an appropriate air method analyzed the samples (NJDEP – Site Remediation Waste Management [SRWM] Low Level USEPA TO-15 Method using 1-Liter or 6-Liter stainless steel canisters).

NJDEP guidance also states that near-slab soil gas samples should be collected at the depth corresponding to the range between 2 ft and 5 ft below the depth of the slab (and a minimum of 5 ft bgs). However, due to shallow bedrock at the site, the depth of near-slab sample probes located on the northwest side of the building was limited to a depth of approximately 2.5 to 3 ft bgs. These sample locations are within a topographic low adjacent to the asphalt pavement along the side of the building. The ground surface elevation within the topographic low is approximately 2 to 3 ft below the surface of the pavement. In addition, due to the presence of the asphalt pavement, these soil gas samples located west of Building 660 were technically located outside of the 10-ft perimeter for near-slab soil gas sampling. However, as the pavement abuts the building foundation, it is not believed to have negatively impacted the validity of the sample results. The remaining near-slab soil gas sample, east of Building 660, was collected in accordance with NJDEP guidance.

An active soil gas collection method (i.e., the "pulling" of a vapor sample through a temporary probe to a collection device) was employed. Manually driven soil vapor probes constructed of steel and equipped with a hardened drop-off steel tip were used. A 3/16-inch diameter Teflon tube was inserted through the center of the rod and connected to the drive point. Soil gas sampling events were not conducted after sizeable rainfall.

An annular seal was maintained in the soil against the probe rods. To verify the integrity of the seal, a tracer compound, helium, was used. Helium was employed under a shroud (5-gallon plastic bucket) placed around the sampling apparatus. Helium concentrations collected through the sample probe (after purging) were measured using a field-screening instrument and compared to the helium concentration under the shroud. According to NJDEP Guidance (NJDEP, 2005a), the presence of helium in soil gas collected through the sample probe, at a concentration greater than 5 percent of the concentration within the shroud, is indicative of a leak. Helium was detected during leak testing in two of the three soil gas probes at concentrations of 0.6 percent and 4.4 percent, below the level indicative of a leak. In addition, helium was not detected in laboratory analysis of any of the near-slab soil gas samples.

Stainless steel canister sample containers (6-Liter) were utilized for the collection of near-slab samples. Prior to attaching the sample container, the vapor probes were purged by drawing 3.0 volumes of air through the probe and connecting tubing. The volume is calculated as follows:

$$\text{Purge Volume} = 3.0\pi r2h$$

where r is the inner radius of the probe and connecting tubing, and h is the length of the probe and connecting tubing. A low purge rate at a maximum of 200 mL/min was utilized.

Soil gas samples were collected over a 24-hour period, utilizing pre-set regulators prepared by the certified laboratory. The corresponding sample flow rate was approximately 4.2 mL/min. Near-slab soil gas results were compared to the NJDEP Nonresidential Soil Gas Screening Levels (SGSL).

2.12.2 Indoor Air Sampling

Indoor air samples were collected concurrently with ambient air and near-slab soil gas samples (**Figure 4-12**). Stainless steel 6-Liter SUMMA canisters were employed for sample collection. SUMMA canisters employed for sample collection were certified clean per NJDEP Clean Canister Certification Requirements (NJDEP, 2009). Soil gas samples were collected over a 24-hour period.

A laboratory holding a current certification/accreditation from NJDEP Office of Quality Assurance and SRWM Low Level USEPA TO-15 Method was utilized to provide the canisters and to perform the analyses. The certified laboratory provides the 6-Liter stainless steel canisters under vacuum, with pre-set regulators (based on the sample time prescribed by the investigator).

Breathing zone height (3 to 5 ft) was targeted for sample collection. No potential intrusion area(s) (e.g., sumps, cracks in foundation) were identified in Building 660. One ambient (outdoor) sample was collected concurrently with the indoor samples to assist in evaluating background contaminant levels. This ambient air sample was collected at breathing zone height and located adjacent to the building air intake utilized to evacuate the firing chamber following testing. In addition, the ambient sample location was not located immediately next to auto traffic or other potential sources. Air samples were collected over a 24-hour period and the SUMMA canisters employed air filters to prevent clogging.

NJDEP guidance (NJDEP, 2005a) recommends collecting indoor air samples from more than one floor within a structure to address varying risk exposures and as part of the process to distinguish contaminants related to VI from background sources. This is important when background sources located within the structure generate the same VOCs identified as contaminants of concern associated with the site investigation, as is the case at Building 660. A treatment system is located on the second floor, which covers a small portion of the overall building footprint, for the purpose of treating TCE contaminated groundwater from the AWDF well for non-potable use in the building. One of the four indoor air samples collected at Building 660 was located on the second floor.

2.13 QUALITY ASSURANCE/QUALITY CONTROL

QA is defined as the overall system for assuring the reliability of data generated in support of project activities. The QA system provides an independent verification that QC measures, established during planning and assessed during operations, were implemented by project participants in a manner to ensure the integrity of environmental sampling and analysis activities. The QA program was implemented for the sampling and analysis of samples collected for the 600 Study.

The QA program was designed to achieve the Data Quality Objectives (DQOs) and associated QC criteria for the 600 Area Groundwater Investigation and was developed in accordance with specifications as referenced in the PTA Facility-Wide Quality Assurance Project Plan (QAPP) (IT, 1999). The referenced QC criteria established for sampling and analysis activities were developed in accordance with *U.S. Army Environmental Center (USAEC) Guidelines for Implementation of ER 1110-1-263 for USAEC Projects* (1993), *Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3* (USACE, 2001), Guidance for *Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988a), and the *Field Sampling Procedures Manual* (NJDEP, 1992). In cases where the above listed guidance documents were in conflict, the more stringent requirement was selected.

QC samples were collected before and during field activities to monitor the potential for the introduction of contaminants from outside sources, including sample shipment, decontamination of sampling equipment, and sample collection. The field QC samples for assessment of contamination contribution included rinse blanks, trip blanks, and source water samples as well as duplicate samples for the assessment of sampling and analytical precision. Analytical results for the field QC samples were reviewed by the Shaw QA Manager to determine whether the project-specific DQOs, as defined in the PTA Facility-Wide QAPP (IT, 1999), were met; and when applicable, limitations to the database were documented accordingly. An overview of the QA program and associated QC samples is presented in **Appendix E** of this report. Results of the QA/QC sampling are presented in **Section 4.8**.

2.14 HUMAN HEALTH RISK ASSESSMENT

An HHRA was prepared for 600 Area groundwater and surface water in accordance with the approved SOW in the Supplemental Work Plan. Details of the risk calculations (Risk Assessment Guidance for Superfund [RAGS] Tables) were provided to the USEPA on January 18, 2007, for review, and the HHRA approach was approved by the USEPA on February 5, 2007. A Revised HHRA Approach Memorandum was submitted to the USEPA on June 23, 2008, which proposed the use of updated Oak Ridge National Laboratory website screening and toxicity values in the HHRA (Shaw, 2008). The following HHRA assumptions were provided in the Supplemental Work Plan and Revised HHRA Approach Memorandum:

- Data used in the risk assessment will be for all "600 Area" monitoring well sampling locations within the delineated bedrock plume vicinities in Area N including wells at Site 13.
- Data from any wells that show contaminants at levels that exceed established Picatinny LOCs outside of the plume wells were included in risk assessment calculations.
- Data collected from monitoring wells outside of the plume footprint will not be evaluated.
- Data for all dates subsequent to the initiation of Low-Flow Groundwater Sampling Protocol (i.e., post-1999) will be included in the risk assessment. Data collected prior to 1999 will be excluded.
- The HHRA addressed all detected analytical constituents above LOCs (excluding TICs).
- A focused FS for 600 Area groundwater was prepared after the completion of the quarterly groundwater sampling. HHRA calculations were run for the TCE plume wells. This approach avoids underestimating TCE risks and hazards by including only monitoring wells with detected concentrations of this constituent, located within an identifiable plume.
- The HHRA generally followed the Picatinny HHRA Approach prepared and approved for the Phase III-1A Sites (IT, 2001) (i.e., RAGS-D format). Future groundwater receptor populations included (1) construction and maintenance workers and (2) industrial/research workers. It is assumed these receptors will be exposed to untreated groundwater that is used as a drinking water supply.
- Routes of exposure will include ingestion, dermal contact, and inhalation for future groundwater use.
- Routes of exposure will also include inhalation for vapor intrusion to indoor air from *in situ* groundwater VOCs by current and future receptors.
- No additional data validation was performed, the data was used “as is.”
- No radiological HHRA was performed.
- No ecological risk assessment was performed.
- No screening level groundwater data (such as open borehole and packer test samples) will be included in the data base, as it would be inappropriate to use these data in the HHRA.
- Exposure to surface water will be quantified in the HHRA. The HHRA will evaluate dermal contact and incidental ingestion for future military resident and on-site youth visitor scenarios.

Results of the Human and Ecological Risk Assessment are presented in **Sections 4.10** and **4.11**, respectively.

Table 2-1
Gore-Sorber Soil Gas Sample ID

Location	Sample Date	Module Number	Sample ID	Depth	Analysis
AOC 1	7/1/2004	451577	656GRJ6	0.0 - 36.0"	See Table 2-2
		451578	656GR-J2		
		451579	656GR-J4		
		451580	656GR-I3		
		451581	656GR-K3		
		451582	656GR-I5		
		451583	656GR-K5		
		451584	656GR-K6		
		451585	656GR-K7		
		451586	656GR-H6		
		451587	656GR-F7		
		451588	656GR-F8		
		451589	656GR-D8		
		451590	656GR-D7		
		451591	656GR-C7		
		451592	656GR-B7		
		451593	656GR-B8		
		451594	656GR-B9		
		451595	656GR-A6		
		8 additional soil gas module locations were attempted within AOC 1 but were found to be unsuitable due to shallow bedrock.			
AOC 2	6/29/2004	451561	650GR-F7	0.0 - 36.0"	
		451562	650GR-BC1		
		451563	650GR-BC2		
		451564	650GR-E7		
		451565	650GR-D7		
		451566	650GR-C7/D7		
		451567	650GR-C8		
		451568	650Gr-C6		
		451569	650GR-BP3		
		451570	650GR-BP2		
		All 10 soil gas modules were collected at this location, however modules 451562, 451564, 451565, and 451567 were moved approximately 150 feet to the southeast because the original locations were unsuitable due to boulders and shallow bedrock.			
AOC3	6/29/2004	451571	660GR-C4	0.0 - 36.0'''	
		451572	660GR-D3		
		451572	660GR-C3		
		451573	660GR-B4		
		451574	660GR-A5		
		451575	660GR-B1		
		Four soil gas modules were originally proposed for this AOC. A field adjustment was made to collect two additional moduals from within this AOC in order to provide better coverage.			

Table 2-1
Gore-Sorber Soil Gas Sample ID

AOC4	8/6/2006	502672	647GR-01	0.0 - 30.0"	
		502673	647GR-02	0.0 - 36.0"	
		502674	647GR-03	0.0 - 33.0"	
		502675	647GR-04	0.0 - 33.0"	
		502676	647GR-05	0.0 - 36.0"	
		502677	647GR-06	0.0 - 32.0"	
		502678	647GR-07	0.0 - 33.0"	
		502679	647GR-08	0.0 - 30.0"	
		502680	647GR-09	0.0 - 24.0"	
		502681	647GR-10	0.0 - 22.0"	
		Ten soil gas modules were proposed and collected for this AOC. As noted above some of the modules were installed shallower than 36 inches due to refusal.			
QA/QC	7/1/2004	451596	TRIP		
		451597	TRIP		
		451598	TRIP		
		451599	TRIP		
	8/6/2006	502682	TRIP		
		All QC samples were collected in accordince with planning documents.			

Table 2-2
GORE-SORBER Passive Soil Gas Survey Analyte List

Methyl tert-butyl ether	Trichloroethene	1,2,4-Trimethylbenzene	BTEX (gasoline range organics)
Trans-1,2-Dichloroethene	Toluene	1,4-Dichlorobenzene	Octane
1,1-Dichloroethane	1,2-Dichloroethane	Undecane	1,1,2-trichloro –
Cis-1,2-Dichloroethene	Tetrachloroethene	Pentadecane	1,2,2-trifluoreethane
Chloroform	Chlorobenzene	Tridecane	(freon113)
1,1,1-Trichloroethane	Ethylbenzene	2-Methyl naphthalene	
Benzene	m-,p-Xylene	Naphthalene	
Carbon Tetrachloride	o-Xylene	Vinyl Chloride	

Table 2-3
PTA 600 AREA
Rationale for Monitoring Well Location

Well ID	Installation Date	Rationale for Well Installation/Location	Work Plan and Approval
13MW-1	4/13/2005	Install bedrock well to assess potential GW contamination in AOC 1, and GW elevation control point.	GWRI WP - April 2004. Well location approved in Oct 20, 2004 Partnering Meeting.
13MW-2	4/13/2005	Install deep bedrock well to determine TCE concentrations and vertical hydraulic gradient. Install adjacent to existing well DM13-1, forming cluster.	
13MW-3	4/13/2005	Install shallow bedrock well to approximately 50 feet bgs. to assess potential contamination adjacent the wetland and stream.	
13MW-4	4/13/2005	Install deep bedrock well adjacent to 13MW-3 to measure deep contaminant concentrations and provide vertical hydraulic gradient data (in conjunction with cluster well 13MW-3).	
13MW-5	7/5/2006	Install bedrock well to monitor the NE (sidegradient) extent of TCE in the bedrock aquifer and provide water level control.	GWRI WP-Addendum (Dec. 21, 2005). Well locations presented/ approved during site walk on November 30, 2005.
13MW-6	7/18/2006	Install bedrock well to monitor the downgradient extent of the TCE plume	
13MW-7	7/18/2006	Install bedrock well to monitor the downgradient extent of the TCE plume	
13MW-8	7/18/2006	Install bedrock well to assess TCE/RDX concentration upgradient of AOC1 and well 13MW-1.	
13MW-9	7/10/2006	Install shallow bedrock well to assess potential RDX and MTBE GW contamination at Site 11.	
13MW-10	2/26/2007	Install bedrock monitoring well to determine if TCE plume extends further SW from the area of well 13MW-2.	GWRI Supplemental Work Plan. Well location approved in Partnering meeting on February 7, 2007.
13MW-11	2/26/2007	Install bedrock monitoring well to determine if AOC 4 is local source of TCE in GW and SW.	

Table 2-4
Borehole Geophysics and Packer Testing Summary

Well ID	Borehole Diameter (inches)	Total Depth Ft., bgs.	Borehole Television Survey	Fluid Temperature and Conductivity	Natural Gamma	3-Arm Caliper Survey	Optical Televiewer Survey	Acoustic Televiewer Survey	Heat Pulse Flow Meter (Passive)	Heat Pulse Flow Meter (Active - Pumped)	Borehole Survey Completion Date	Packer Testing and Sampling	Packer Testing Completion Date	Comments
AWDF	8	445	X	X			X	X			05/21/04	X	07/29/04	
13MW-1	8	253	X	X		X	X	X	X		01/12/06	X	02/22/05	
13MW-2	8	198	X	X		X	X	X	X		01/12/06	X	03/03/05	
13MW-3	6	77												Testing not conducted due to shallow depth and proximity to tested cluster well 13MW-4.
13MW-4	8	193	X	X		X	X	X	X		01/12/05	X	02/28/05	
13MW-5	8	150	X	X	X	X			X		02/28/06	X	06/21/06	
13MW-6	8	147	X	X	X	X					02/28/06			Packer testing not conducted due to low adjacent overhead powerlines.
13MW-7	8	200	X	X	X	X					02/28/06	X	06/20/06	
13MW-8	8	200	X	X	X	X					02/28/06	X	06/26/06	
13MW-9	6	45												Testing not conducted due to shallow depth.
13MW-10	6	200	X	X	X	X		X		X	01/03/07	X	01/31/07	
13MW-11	6	200	X	X	X	X		X		X	01/03/07	X	02/02/07	

Note: Well Construction Detail is Provided in **Table 2-5**

Table 2-5
New and Existing Well Construction Summary

Well ID	Well Completion Date	Well Design	Media	Steel Outer Casing, Diameter in inches.	Casing Depth, in Feet, bgs.	Total Depth	PVC Screen Size, inches	Screen length	Screen diameter	Filter Sand	Screened Interval, Ft. bgs
New Install Wells											
13MW-1	4/13/2005	Stick-up	Bedrock	8	26	253	0.020	25	4	Morie #1	228-253
13MW-2	4/13/2005	Stick-up	Bedrock	8	36	190	0.020	25	4	Morie #1	168-193
13MW-3	4/13/2005	Flush	Bedrock	6	19	75	0.020	25	2	Morie #1	47-72
13MW-4	4/13/2005	Flush	Bedrock	8	19	193	0.020	25	4	Morie #1	168-193
13MW-5	7/5/2006	Stick-up	Bedrock	8	20	150	0.010	25	4	Morie #1	125-150
13MW-6	7/18/2006	Stick-up	Bedrock	8	16.5	147	0.010	25	4	Morie #1	122-147
13MW-7	7/18/2006	Stick-up	Bedrock	8	17	105	0.010	25	4	Morie #1	80-105
13MW-8	7/18/2006	Stick-up	Bedrock	8	17	103	0.010	25	4	Morie #1	78-103
13MW-9	7/10/2006	Flush	Bedrock	6	20	45	0.010	25	2	Morie #1	25-45
13MW-10	2/26/2007	Flush	Bedrock	6	17	112.5	0.010	20	2	Morie #1	90-110
13MW-11	2/26/2007	Stick-up	Bedrock	6	14	30	0.010	10	2	Morie #1	17.3-27.3
Existing Site Wells											
AWDF	6/3/1994	Stick-up	Bedrock	6	40	430	open borehole	NA	NA	NA	
DM13-1	3/7/1988	Stick-up	Bedrock	6	2.5	22	0.020	10	4	unknown	12-22
DM13-2	2/25/1988	Stick-up	Bedrock	6	2.5	18	0.020	10	4	unknown	8-18
DM13-3	2/26/1988	Stick-up	Bedrock	6	2.5	27	0.020	10	4	unknown	17-27
DM10-1	3/1/1988	Stick-up	Bedrock	8	2.5	45	0.020	10	4	unknown	35-45
DM10-2	2/26/1988	Stick-up	Bedrock	8	2.5	33	0.020	10	4	unknown	25-35

Table 2-6
New and Existing Well Survey Data

Well ID	Well Permit Number	Well Longitude (West)	Well Latitude (North)	TIC Elev., Ft. MSL	GRND. Elev., Ft. MSL	Screened Interval, Ft. bgs	Elev. Top of Screen, Ft. MSL	Elev. Bottom of screen
New Install Wells								
13MW-1	25-00064449	74 32' 52.9"	40 57' 49.0"	1191.36	1189.49	228-253	961.49	936.49
13MW-2	25-00064446	74 32' 55.1"	40 57' 40.3"	1106.43	1104.06	168-193	936.06	911.06
13MW-3	25-00064447	74 32' 42.2"	40 57' 48.0"	1079.91	1080.22	47-72	1033.22	1008.22
13MW-4	25-00064448	74 32' 42.3"	40 57' 48.0"	1080.61	1080.95	168-193	912.95	887.95
13MW-5	25-00066439	74 32' 32.36"	40 57' 52.29"	1105.47	1102.92	125-150	977.92	952.92
13MW-6	25-00066440	74 32' 39.14"	40 57' 43.46"	1093.7	1090.27	122-147	968.27	943.27
13MW-7	25-00066441	74 32' 48.29"	40 57' 40.93"	1132.4	1128.83	80-105	1048.83	1023.83
13MW-8	25-00066443	74 32' 53.42"	40 57' 52.83"	1211.94	1209.39	78-103	1131.39	1106.39
13MW-9	25-00066442	74 32' 28.33"	40 57' 55.83"	1127.02	1127.3	25-45	1102.3	1082.3
13MW-10	25-00067937	74 33' 02.48"	40 57' 33.99"	1135.89	1133.62	90-110	1043.62	1023.62
13MW-11	25-00067938	74 32' 39.32"	40 57' 51.85"	1089.96	1087.65	17.3-27.3	1070.35	1060.35
Existing Site Wells								
AWDF	22-33701	74 32' 48.3"	40 57' 44.4"	1124.66	1122.11	40-450	1082.11	672.11
DM13-1	22-27058			1105.36	1103.3	12-22	1091.3	1081.3
DM13-2	22-27054			1111.45	1109.7	8-18	1101.7	1091.7
DM13-3	22-27055			1093.11	1090.8	17-27	1073.8	1063.8
DM10-1	22-27056			1223.14	1221.9	36-46	1185.9	1175.9
DM10-2	22-27057			1226.13	1223.2	25-35	1198.2	1188.2

Table 2-7
Well packer Test Intervals
(ft. bgs)

AWDF	13MW-1	13MW-2	13MW-3	13MW-4	13MW-5	13MW-6	13MW-7	13MW-8	13MW-9	13MW-10	13MW-11
55-65	48-73	35-60	None	45-70	125-150	None	80-105	80-105	None	89-109	0-25
65-75	87-112	70-95		90-115				145-170		120-140	113-133
75-85	125-150	165-190		138-163				170-200			136-156
99-109	225-250			163-196							
109-129											
130-140											
140-160											
178-188											
188-198											
214-224											
220-240											
241-251											
318-328											
338-348											
360-370											
376-369											
396-416											
416-436											

Table 2-8
Summary of Groundwater Sampling Program

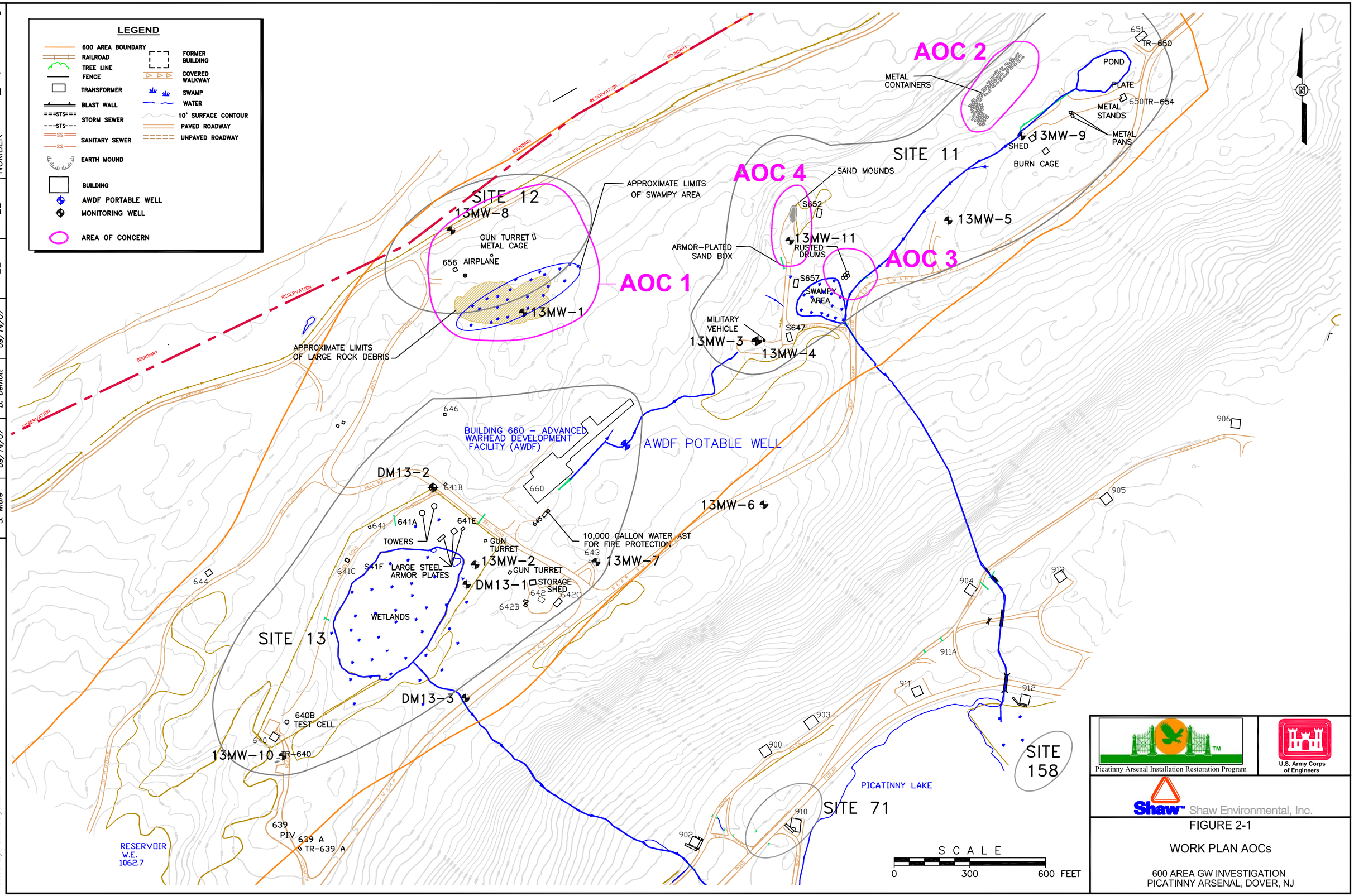
Well ID	TCL VOCs w/TICs & MTBE	Baseline Explosives	Bioremediation Parameters	Comments
Apr-04				
DM13-1	**X**			
DM13-2	**X**			
DM13-3	**X**			
AWDF	**X**	**X**		
May-05				
13MW-1	**X**			
13MW-2	**X**			
13MW-3	**X**			
13MW-4	**X**			
DM13-1	**X**			
DM13-2	**X**			
DM13-3	**X**			
July-06				
13MW-1	**X**			
13MW-2	**X**			
13MW-3	**X**			
13MW-4	**X**			
13MW-5	**X**	**X**		Explosives included as part of Site 11 Study
13MW-6	**X**			
13MW-7	**X**			
13MW-8	**X**			
13MW-9	**X**			
DM13-1	**X**			
DM13-2	**X**			
DM13-3	**X**			
DM10-1	**X**			
AWDF	**X**			
November-06				
13MW-1	**X**	**X**		
13MW-2	**X**	**X**		
13MW-3	**X**	**X**		
13MW-4	**X**	**X**		
13MW-5	**X**	**X**		
13MW-6	**X**	**X**		
13MW-7	**X**	**X**		
13MW-8				Well not included in 600 Area Supplemental Work Plan
13MW-9		**X**		Explosives included as part of Site 11 Study
DM13-1	**X**	**X**		
DM13-2	**X**	**X**		
DM13-3	**X**	**X**		
AWDF	**X**	**X**		
March-07				
13MW-1	**X**	**X**	**X**	
13MW-2	**X**	**X**	**X**	
13MW-3	**X**	**X**	**X**	
13MW-4	**X**	**X**	**X**	
13MW-5	**X**	**X**	**X**	
13MW-6	**X**	**X**	**X**	
13MW-7	**X**	**X**	**X**	
13MW-8	**X**	**X**		Wells 13MW-8 and 9 were added to quarterly sampling program
13MW-9	**X**	**X**		
13MW-10	**X**	**X**	**X**	
13MW-11	**X**	**X**	**X**	
DM13-1	**X**	**X**	**X**	
DM13-2	**X**	**X**	**X**	
DM13-3	**X**	**X**	**X**	
AWDF	**X**	**X**		
June-07				
13MW-1	**X**	**X**		
13MW-2	**X**	**X**		
13MW-3	**X**	**X**		
13MW-4	**X**	**X**		
13MW-5	**X**	**X**		
13MW-6	**X**	**X**		
13MW-7	**X**	**X**		
13MW-8	**X**	**X**		
13MW-9	**X**	**X**		
13MW-10	**X**	**X**		
13MW-11	**X**	**X**		
DM13-1	**X**	**X**		
DM13-2	**X**	**X**		
DM13-3	**X**	**X**		
AWDF	**X**	**X**		

Table 2-8
Summary of Groundwater Sampling Program

Well ID	TCL VOCs w/TICs & MTBE	Baseline Explosives	Bioremediation Parameters	Comments
September-07				
13MW-1	**X**	**X**		
13MW-2	**X**	**X**		
13MW-3	**X**	**X**		
13MW-4	**X**	**X**		
13MW-5	**X**	**X**		
13MW-6	**X**	**X**		
13MW-7	**X**	**X**		
13MW-8	**X**	**X**		
13MW-9	**X**	**X**		
13MW-10	**X**	**X**		
13MW-11	**X**	**X**		
DM13-1	**X**	**X**		
DM13-2	**X**	**X**		
DM13-3	**X**	**X**		
AWDF	**X**	**X**		
June-08				
13MW-1	**X**			
13MW-2	**X**			
13MW-3	**X**	**X**		
13MW-4	**X**	**X**		
13MW-5	**X**	**X**		
13MW-6	**X**	**X**		
13MW-7	**X**			
13MW-8	**X**			
13MW-9	**X**	**X**		
13MW-10	**X**			
13MW-11	**X**	**X**		
DM10-1		**X**		
DM10-2		**X**		
MW-2N		**X**		
DM13-1	**X**			
DM13-2	**X**			
DM13-3	**X**			
AWDF	**X**	**X**		
April/May-10				
13MW-1	**X**			MTBE not analyzed
13MW-2	**X**			MTBE not analyzed
13MW-3				
13MW-4	**X**			
13MW-5	**X**			
13MW-6	**X**			
13MW-7	**X**			MTBE not analyzed
13MW-8	**X**			MTBE not analyzed
13MW-9	**X**			
13MW-10	**X**			MTBE not analyzed
13MW-11	**X**			
13MW-12	**X**			
13MW-13	**X**			
DM10-1				
DM10-2				
MW-2N				
DM13-1	**X**			MTBE not analyzed
DM13-2	**X**			MTBE not analyzed
DM13-3	**X**			MTBE not analyzed
AWDF	**X**			MTBE not analyzed
January/February-11				
13MW-1	**X**			
13MW-2	**X**			
13MW-3				
13MW-4				
13MW-5	**X**			
13MW-6	**X**			
13MW-7	**X**			
13MW-8	**X**			
13MW-9				
13MW-10	**X**			
13MW-11	**X**			
13MW-12				
13MW-13				
DM10-1				
DM10-2				
MW-2N				
DM13-1	**X**			
DM13-2	**X**			
DM13-3	**X**			
AWDF	**X**			

Table 2-9
Summary of Surface Water/Sediment Sampling Program

Surface Water Sample Locations	*VOCS w/TICs and MTBE*	Baseline Explosives	Sediment Sample Locations	*VOCS w/TICs and MTBE*	Baseline Explosives
November-04					
11SW-1	*X*		**11SD-1**	X	
11SW-2	*X*		**11SD-2**	X	
11SW-3	*X*		**11SD-3**	X	
13MW-4	*X*		**13SD-4**	X	
13SW-5	*X*		**13SD-5**	X	
January-06					
11SW-1	*X*		**11SD-1**	*X*	
11SW-2	*X*		**11SD-2**	*X*	
11SW-3	*X*		**11SD-3**	*X*	
13SW-4	*X*		**13SD-4**	*X*	
13SW-5	*X*		**13SD-5**	*X*	
11SW-6	*X*		**11SD-6**	*X*	
11SW-7	*X*		**11SD-7**	*X*	
13SW-8			**13SD-8**		
13SW-9	*X*		**13SD-9**	*X*	
August-06					
11SW-1	*X*		**11SD-1**		
11SW-2	*X*		**11SD-2**		
11SW-3	*X*		**11SD-3**		
13SW-4	*X*		**13SD-4**		
13SW-5	*X*		**13SD-5**		
November-06					
11SW-1	*X*	X	**11SD-1**		X
11SW-2	*X*	X	**11SD-2**		
11SW-3	*X*	X	**11SD-3**		
13SW-4	*X*	X	**13SD-4**		
13SW-5	*X*	X	**13SD-5**		
March-07					
11SW-1	*X*	X	**11SD-1**		X
11SW-2	*X*	X	**11SD-2**		
11SW-3	*X*	X	**11SD-3**		
13SW-4	*X*	X	**13SD-4**		
13SW-5	*X*	X	**13SD-5**		
June-07					
11SW-1	*X*	X	**11SD-1**		X
11SW-2	*X*	X	**11SD-2**		
11SW-3	*X*	X	**11SD-3**		
13SW-4	*X*	X	**13SD-4**		
13SW-5	*X*	X	**13SD-5**		
September-07					
11SW-1	*X*	X	**11SD-1**		X
11SW-2	*X*	X	**11SD-2**		
11SW-3	*X*	X	**11SD-3**		
13SW-4	*X*	X	**13SD-4**		
13SW-5	*X*	X	**13SD-5**		
11SW-6	*X*		**11SD-6**		
June-08					
11SW-1	*X*	X	**11SD-1**		X
11SW-2	*X*	X	**11SD-2**		X
11SW-3	*X*	X	**11SD-3**		X
13SW-4	*X*		**13SD-4**		
13SW-5	*X*		**13SD-5**		
11SW-6	*X*	X	**11SD-6**		X
April/May-10					
11SW-1	*X*				
11SW-2	*X*				
11SW-3	*X*				
13SW-4	*X (no MTBE)*				
13SW-5	*X (no MTBE)*				
11SW-6	*X*				
11SW-10	*X*				
January-11					
11SW-1					
11SW-2					
11SW-3	*X*				
13SW-4	*X*				
13SW-5	*X*				
11SW-6	*X*				
11SW-10	*X*				


LEGEND
600 AREA BOUNDARY
RAILROAD
TREE LINE
FENCE
TRANSFORMER
BLAST WALL
STORM SEWER
SANITARY SEWER
EARTH MOUND
BUILDING
AWDF PORTABLE WELL
MONITORING WELL
AREA OF CONCERN
FORMER BUILDING
COVERED WALKWAY
SWAMP
WATER
10' SURFACE CONTOUR
PAVED ROADWAY
UNPAVED ROADWAY
AOC 1
AOC 2
AOC 3
AOC 4
SITE 11
SITE 12
SITE 13
SITE 158
SITE 71
METAL CONTAINERS
POND
PLATE
METAL STANDS
METAL PANS
SHED
BURN CAGE
13MW-9
13MW-5
SAND MOUNDS
S652
13MW-11
RUSTED DRUMS
ARMOR-PLATED SAND BOX
S657
SWAMPY AREA
MILITARY VEHICLE
S647
13MW-3
13MW-4
APPROXIMATE LIMITS OF SWAMPY AREA
13MW-8
GUN TURRET
METAL CAGE
656
AIRPLANE
13MW-1
APPROXIMATE LIMITS OF LARGE ROCK DEBRIS
BUILDING 660 - ADVANCED WARHEAD DEVELOPMENT FACILITY (AWDF)
AWDF POTABLE WELL
DM13-2
641B
641A
641E
TOWERS
GUN TURRET
13MW-2
GUN TURRET
DM13-1
STORAGE SHED
642
642C
642B
LARGE STEEL ARMOR PLATES
WETLANDS
10,000 GALLON WATER TANK FOR FIRE PROTECTION
13MW-6
13MW-7
DM13-3
640B
TEST CELL
13MW-10
TR-640
RESERVOIR W.E. 1062.7
PICATINNY LAKE
SCALE
0
300
600 FEET
Picatinny Arsenal Installation Restoration Program
U.S. Army Corps of Engineers
Shaw Environmental, Inc.
FIGURE 2-1
WORK PLAN AOCs
600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NJ
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APPROVED BY
CHECKED BY B. Demott 09/14/07
DRAWN BY S. Wiafe 09/14/07
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Plot Date/Time: Apr 18, 2013 - 1:00pm
Plotted By: andrius.yancvicius

LEGEND

- Montoring Well
- 2004 Soil-Gas Sample Location
- 2010/2011 Soil-Gas Sample Location
- Extent of Fill Material Deposited at Test Site in 1970s
- Burning Cage

N

Scale:

0 37.5 75 Feet

U.S. Army Corps of Engineers

Picatinny Arsenal Installation Restoration Program

Shaw® a world of Solutions™

FIGURE 2-2

AOC 1: PASSIVE SOIL-GAS SAMPLE LOCATIONS

PICATINNY ARSENAL, DOVER, NEW JERSEY

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Plot Date/Time: Apr 18, 2013 – 1:18pm
Plotted By: andrius.yanavicius

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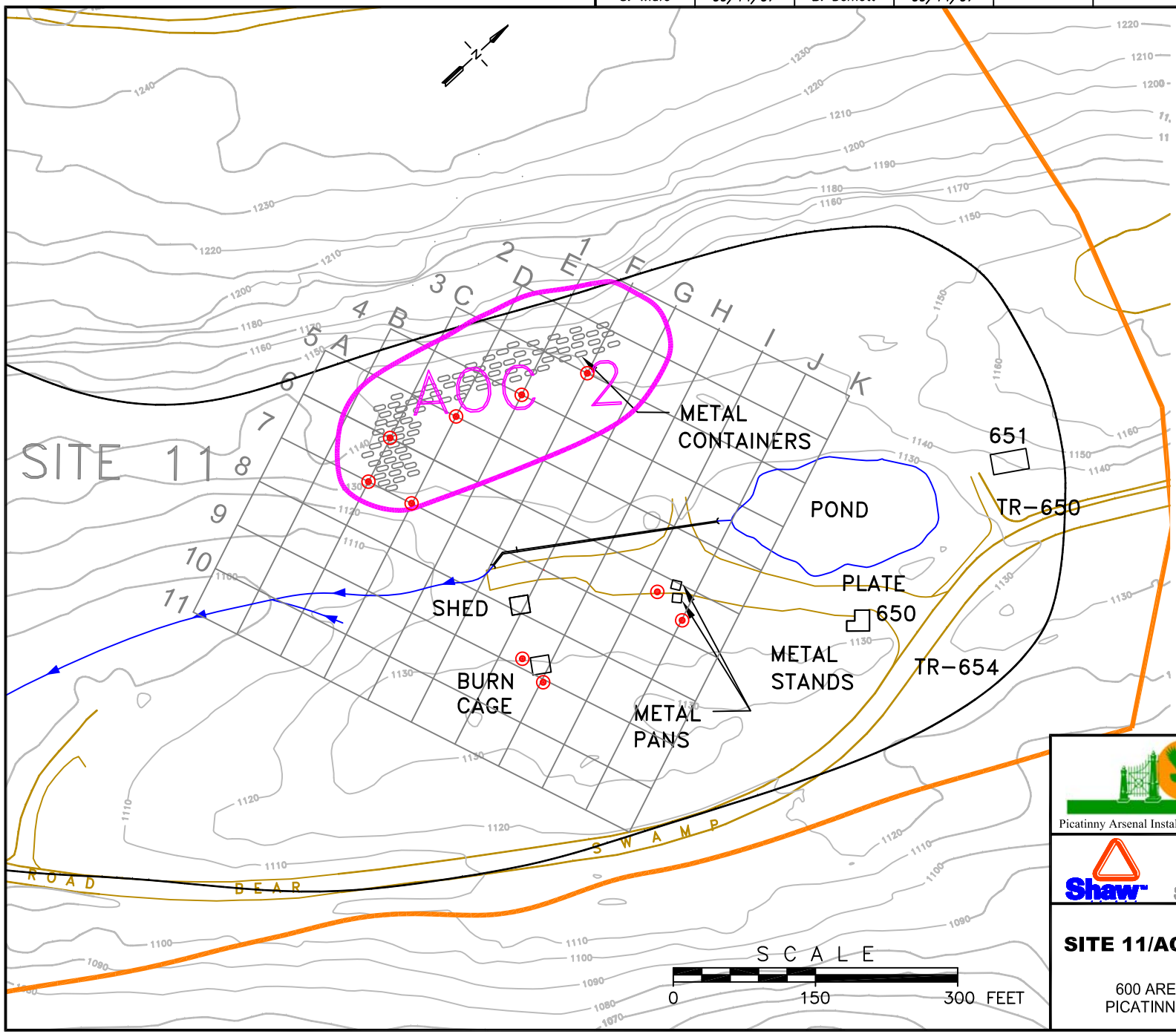


LEGEND

- AREA 600 BOUNDARY
- RAILROAD
- TREE LINE
- FENCE
- TR-732 TRANSFORMER
- BLAST WALL
- STS OR STS STORM SEWER
- SS OR SS SANITARY SEWER
- EARTH MOUND
- BLDG. NO. BUILDING
- BLDG. NO. FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER

600 AREA GW RI SAMPLING LOCATIONS

- SOIL GAS SURVEY POINT
- PASSIVE SOIL GAS SURVEY GRID

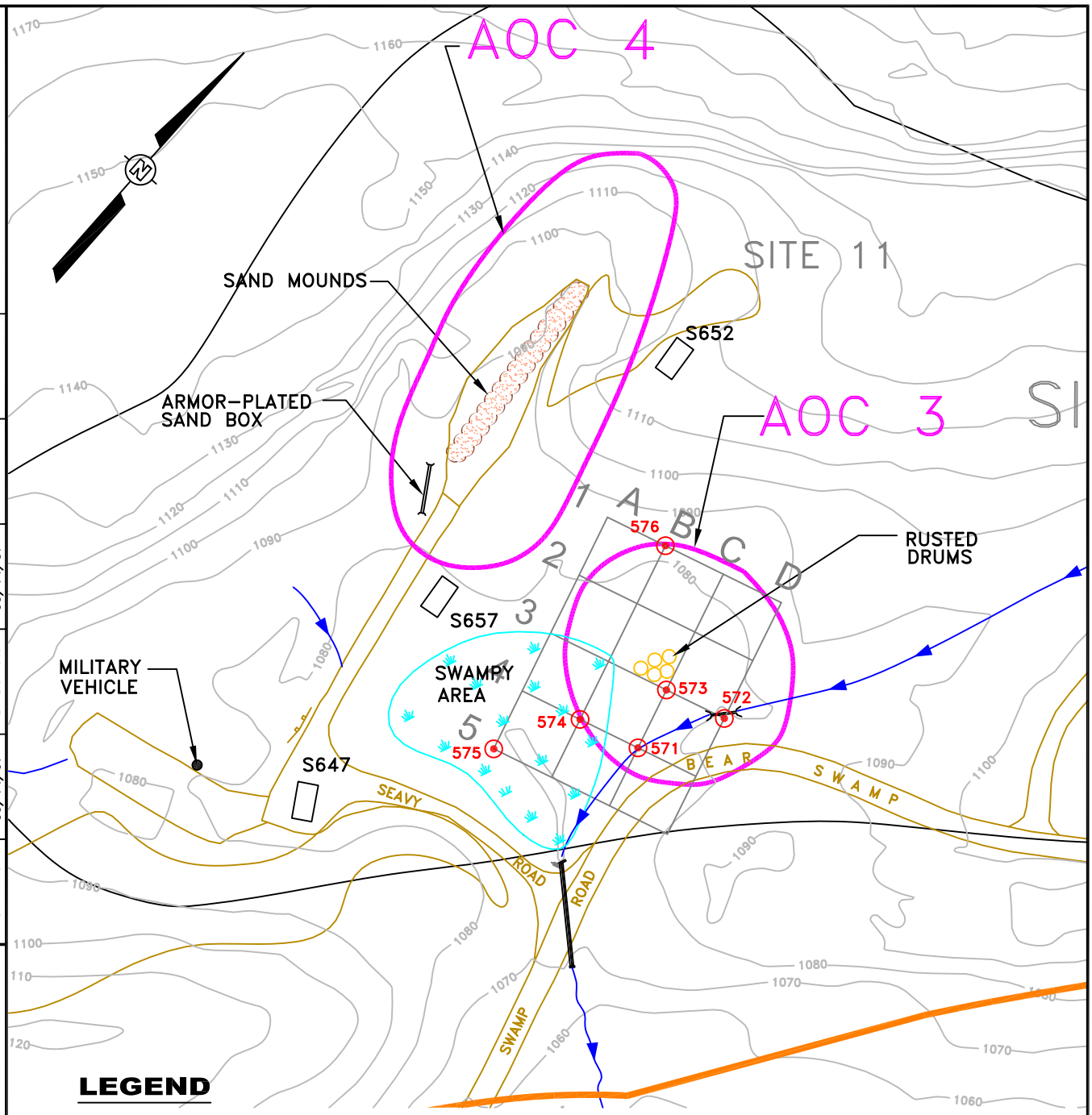
Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 2-3
SITE 11/AOC 2 : SOIL GAS SAMPLING LOCATIONS

600 AREA REMEDIAL GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY



LEGEND

- AREA 600 BOUNDARY
- RAILROAD
- TREE LINE
- FENCE
- TR-732 TRANSFORMER
- BLAST WALL
- ===STS=== OR ---STS--- STORM SEWER
- ===SS=== OR ---SS--- SANITARY SEWER
- EARTH MOUND
- BLDG. NO. BUILDING
- BLDG. NO. FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER

SCALE

0 120 240 FT.

600 AREA GW RI SAMPLE LOCATIONS

- SOIL GAS SURVEY POINT
- PASSIVE SOIL GAS SURVEY GRID

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE NO. 2-4

AOC 3: SOIL GAS SAMPLE LOCATIONS

600 AREA REMEDIAL GW INVESTIGATION
PICATINNY, DOVER, NEW JERSEY

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S. Wiafe 09/14/07	B. Demott 09/14/07	-- --	NAD032304.dwg

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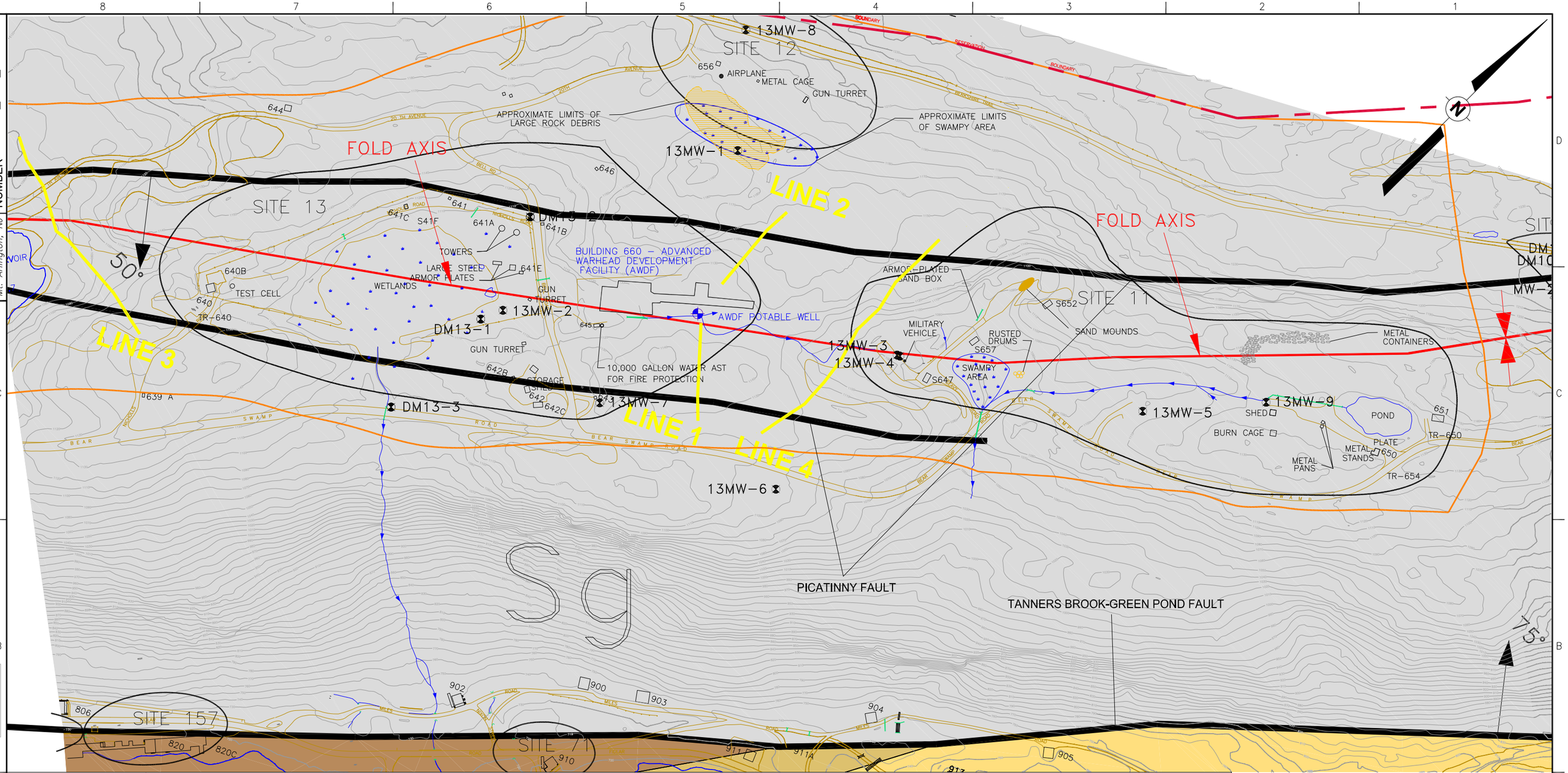
Plotted By: andrius.yanavicius



DESCRIPTION OF MAP UNITS

Green Pond Conglomerate

Sg (Middle and Lower Silurian) (Rogers,1836)–Medium to coarse grained quartz–pebble conglomerate, quartzitic arkose and orthoquartzite, and thin to thick bedded reddish–brown siltstone. Grades downward into less abundant gray, very dark red, or grayish–purple, medium to coarse–grained, thin to very thick bedded pebble to cobble–conglomerate containing clasts of red shale, siltstone, sandstone, and chert; yellowish–gray sandstone and chert; dark–gray shale and chert; and white–gray and pink milky quartz. Quartz cobbles as much as 4 in. long. Unconformably overlies Leithsville.

Leithsville Formation

Єl (Middle and Lower Cambrian) (Wherry,1909) Light to dark–gray and light–olive–gray, fine to medium grained, thin to medium–bedded dolomite. Grades downward through medium–gray, grayish–yellow, or pinkish–gray dolomite and dolomitic sandstone, siltstone, and shale to medium–gray, medium–grained, medium bedded dolomite containing quartz sand grains as stringers and lenses near the base. Lower contact gradational with Hardyston Quartzite. Unit ranges from 0 to 185 ft thick regionally.

Hardyston Quartzite

Єh (Lower Cambrian) (Wolf and Brooks, 1898)–Light–to medium–gray and bluish–gray conglomeratic sandstone. Varies from pebble conglomerate, to fine–grained, well cemented quartzite, to arkosic or dolomitic sandstone. Conglomerate contains subangular to subrounded white quartz pebbles as much as 1 in. long. Lower contact unconformable with Middle Proterozoic rocks. Unit ranges from 0–30 ft. thick regionally.

VERNON SUPERSUITE (Volkert and Drake, 1998)

Losee Metamorphic Suite (Drake, 1984; Volkert and Drake, 1999)

Quartz–Oligoclase gneiss

Ylo (Middle Proterozoic)–White–weathering, light–greenish–gray, medium to medium–coarse–grained, moderately layered to massive, foliated gneiss composed of oligoclase or andesine, quartz, and variable amounts of hornblende, augite, biotite and magnetite. Locally contains layers of amphibolite (Ya) too thin to be shown on map. Unit commonly has gradational contacts with biotite–quartz–oligoclase gneiss (Ylb) and hypersthene–quartz–plagioclase gneiss (Yh) and occurs as thin, conformable layers within bodies of diorite (Yd).

Sg — Silurian
unconformity
Єl, Єh — Cambrian
unconformity
Ylo — Middle Proterozoic
BEDROCK MONITORING WELL

FAULTS:
U / D — Normal Fault – U=upthrown side, d=downthrown side. Arrow shows attitude of fault plane, if known.
D / U — Reverse Fault – U=upthrown side, d=downthrown side. Arrow shows attitude of fault plane, if known.

FOLDS: showing trace of axial surface, dip direction of limbs, and plunge direction

Synform
WETLANDS
AREA 600 BOUNDARY
VLF SURVEY LINE

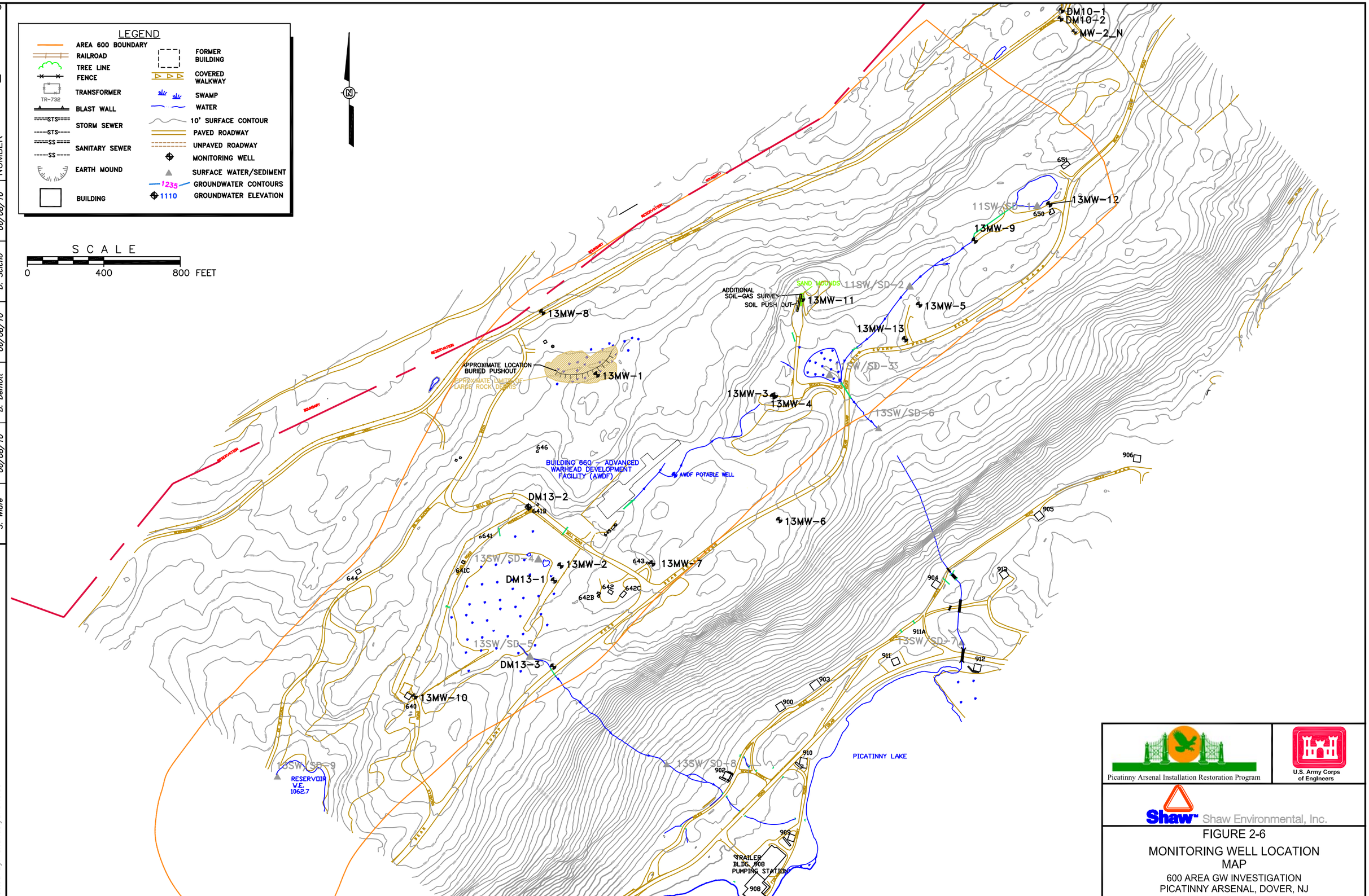
SCALE
0 250 500 750 FEET

Picatinny Installation Restoration Program
U.S. Army Corps of Engineers

DESIGNED BY: A. Smith	Shaw Environmental, Inc.
DRAWN BY: S. Wiafe	VLF SURVEY LINES
CHECKED BY: B. Demott	AWDF GW Investigation PICATINNY, DOVER, NEW JERSEY

APPROVED BY:	DATE:	SCALE:	DRAWING NO.	FIGURE NO.
D. Schicho	9/14/07	AS SHOWN	AWDF_Geo_NAD83	2-5

OFFICE: Mt. Arlington, NJ
DRAWING NUMBER: AWDF_Geo_NAD83



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

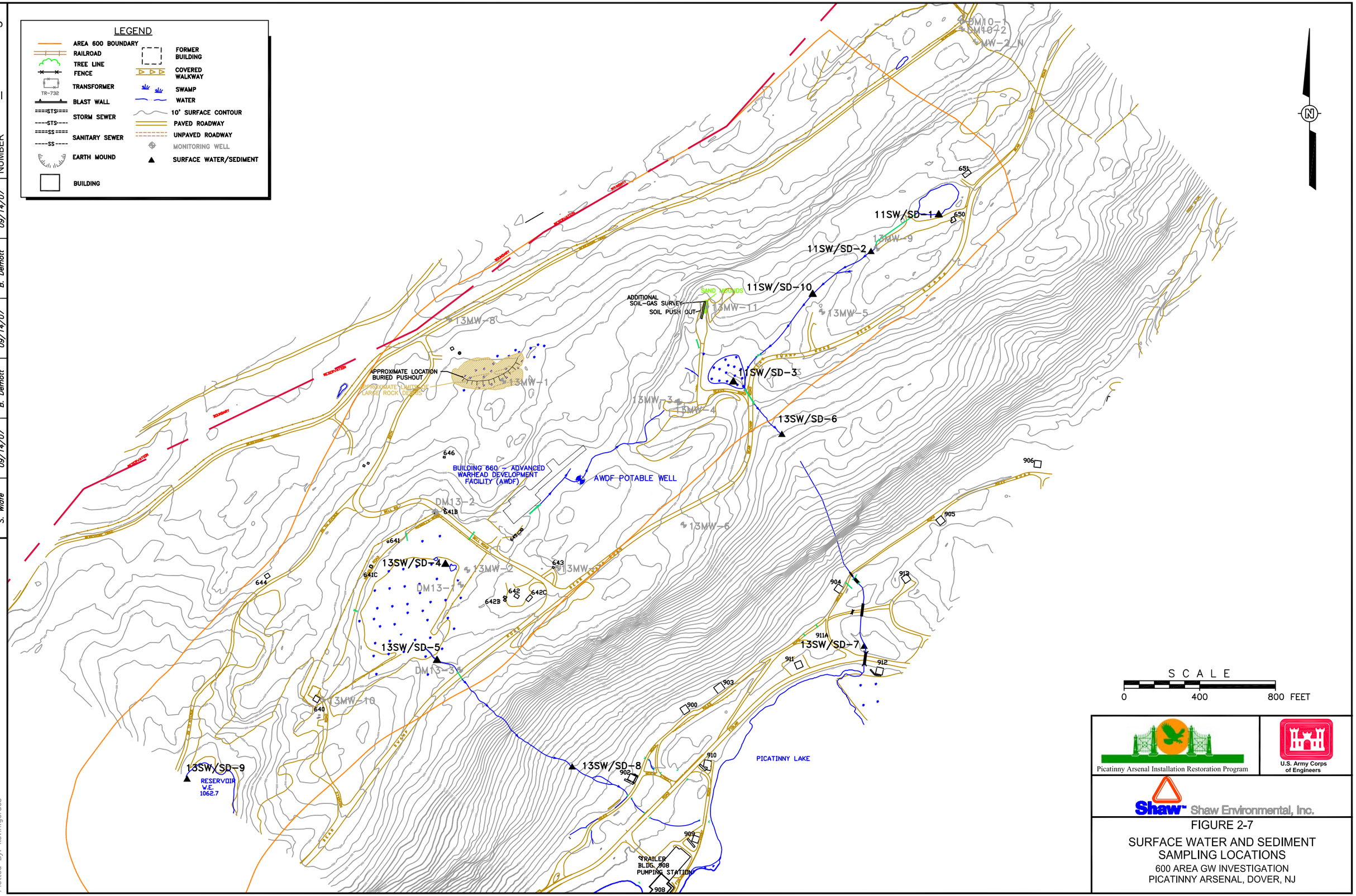
FIGURE 2-6

MONITORING WELL LOCATION MAP

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NJ

DRAWING NUMBER	APPROVED BY		CHECKED BY		DRAWN BY	
AWDF_091407.dwg	D. Scicho	06/08/10	B. Demott	06/08/10	S. Wiafe	06/08/10

File: \\seimtarfs01\common\cad\CAD drawings\Picatinny\Area-N\AWDF_091407.dwg
Plot Date/Time: Apr 18, 2013 - 3:17pm
Plotted By: andrius.yanavicius



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 2-7

SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

600 AREA GW INVESTIGATION

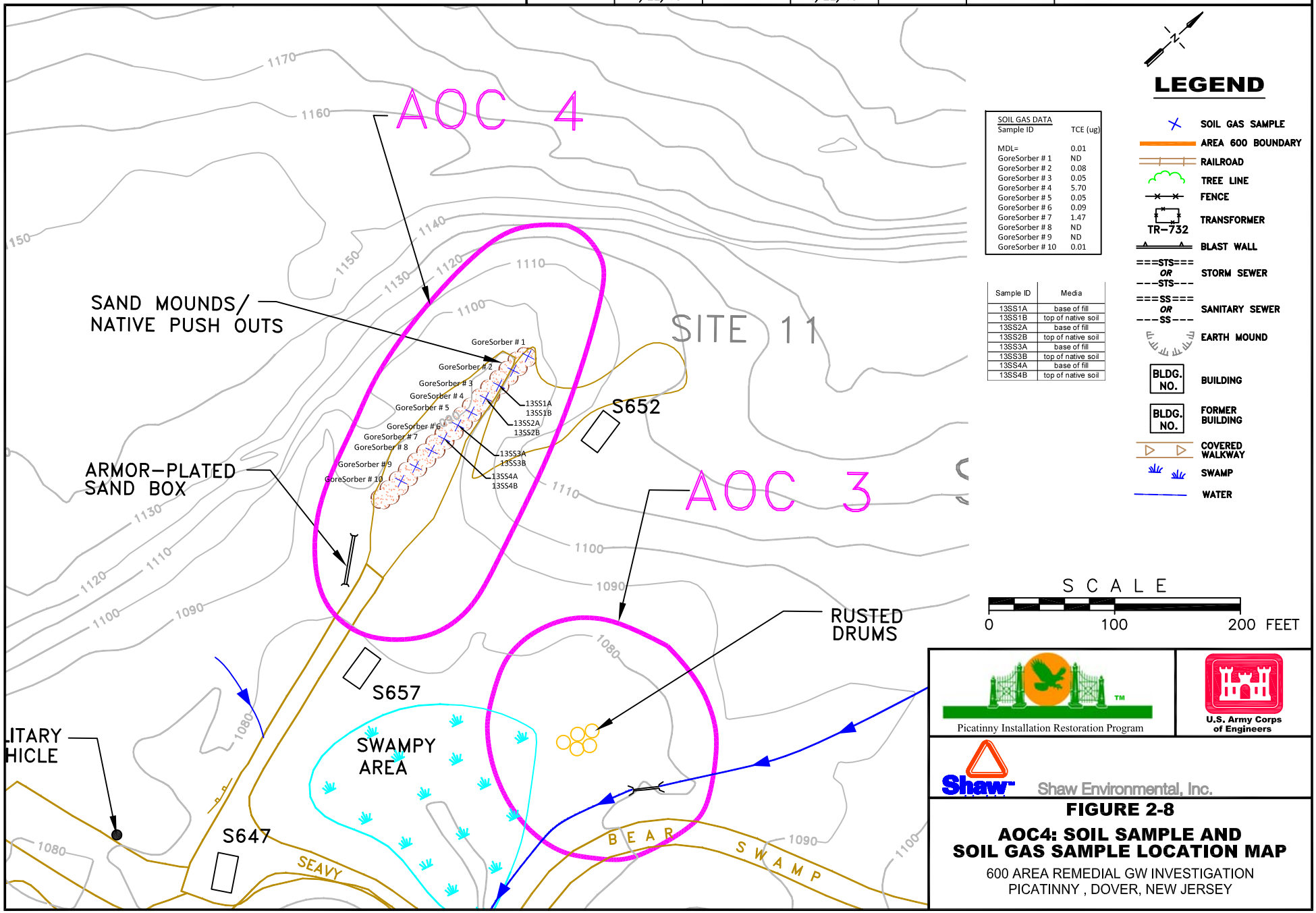
PICATINNY ARSENAL, DOVER, NJ

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	09/14/07	B. Demott	09/14/07	B. Demott	09/14/07	SW_090907.dwg

File: N:\cad\CAD drawings\Picatinny\Area-N\SW_090907.dwg
Plot Date/Time: Apr 24, 2013 - 2:01pm
Plotted By: kevin.gerdes

XREF Files: IMAGE Files: shaw-env-R2.JPG
File: J:\cad\CAD drawings\Picatinny\Area-N\NAD032304.dwg
Plot Date/Time: Apr 23, 2013 – 8:17am
Plotted By: andrius.yanavicius

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	NAD032304.dwg
A. Yanavicius	4/22/13	K. Gerdes	4/22/13	--	--		



SOIL GAS DATA

Sample ID	TCE (ug)
MDL=	0.01
GoreSorber # 1	ND
GoreSorber # 2	0.08
GoreSorber # 3	0.05
GoreSorber # 4	5.70
GoreSorber # 5	0.05
GoreSorber # 6	0.09
GoreSorber # 7	1.47
GoreSorber # 8	ND
GoreSorber # 9	ND
GoreSorber # 10	0.01

Sample ID	Media
13SS1A	base of fill
13SS1B	top of native soil
13SS2A	base of fill
13SS2B	top of native soil
13SS3A	base of fill
13SS3B	top of native soil
13SS4A	base of fill
13SS4B	top of native soil

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

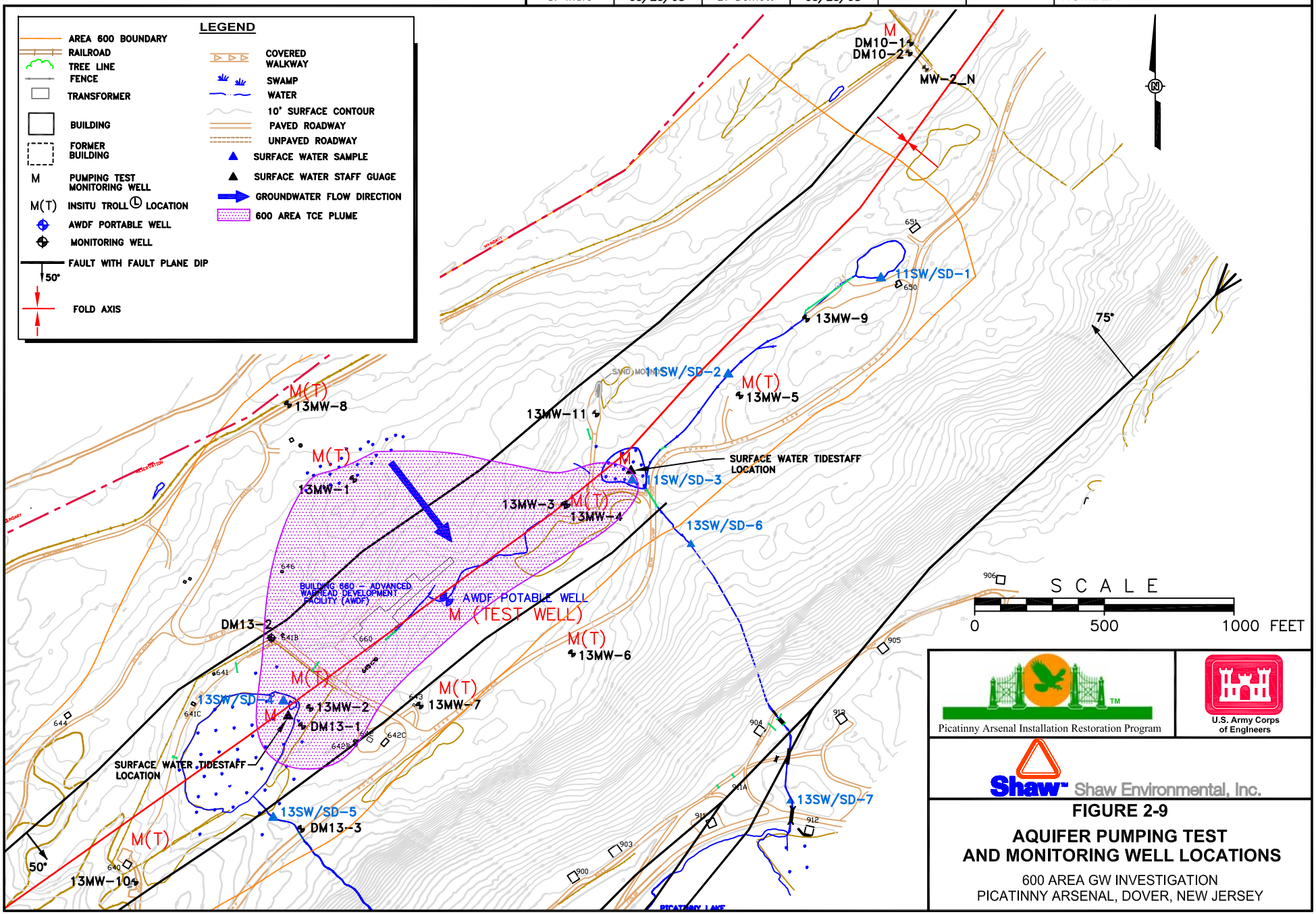
FIGURE 2-8

AOC4: SOIL SAMPLE AND SOIL GAS SAMPLE LOCATION MAP

600 AREA REMEDIAL GW INVESTIGATION
PICATINNY , DOVER, NEW JERSEY

File: \\seimtarfs01\common\cad\CAD drawings\Picatinny\Area-N\AWDF_091807.dwg
Plot Date/Time: Apr 18, 2013 – 4:28pm
Plotted By: andrius.yanavicius

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	AWDF_091807.dwg
S. Wiafe	03/25/08	B. Demott	03/25/08	--	--		



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 2-9

AQUIFER PUMPING TEST AND MONITORING WELL LOCATIONS

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

3.0 RESULTS OF THE 600 AREA REMEDIAL INVESTIGATION

3.1 TOPOGRAPHY AND HYDROLOGY

3.1.1 Physiography and Topography

The PTA is located within the New Jersey Highlands, a subdivision of the Appalachian Highland province. The highlands are characterized by a northeast-southwest trending system of folded and faulted PreCambrian to Devonian Age Rocks that form a sequence of ridges and valleys. Thick glacial deposits are commonly encountered in valley and other lowland settings. Further discussion of the geology is presented in **Section 3.2**. PTA has developed significant relief by differential erosion of geologic units. Green Pond Mountain and Copperas Mountain bound PTA to the northwest, and consist of erosion resistant conglomerate and sandstone.

The 600 Area lies on the southeastern upper slope of Green Pond Mountain at PTA, and trends southwest-northeast along the mountain. The 600 Area topography is shown on **Figures 1-3** and **3-1**. The northwest boundary of the 600 Area runs along the top of Green Pond Mountain, and reaches a maximum elevation of 1,260 ft msl. The 600 Area slopes to the southeast, and is characterized by long northeast trending bedrock escarpments and intervening terraces and lowland areas. Bedrock outcrops consist of a massive bedded conglomerate, which is mapped by the USGS as the Lower to Middle Silurian Age Green Pond Conglomerate. The lowland areas are located to the northeast of Bear Swamp Road and contain most of the active range areas. The 600 Area is bounded to the southeast by Bear Swamp Road at 1,100 ft msl, and a steep escarpment that drops approximately 400 ft to Picatinny Lake.

3.1.2 Meteorology and Hydrology

PTA lies within the Middle Atlantic Seaboard, which is characterized by four distinct seasons and moderate summers and winters. The regional climate is humid. In northern New Jersey, the average annual rainfall is 46.45 inches for the period 1895 to 2009 (Office of the New Jersey State Climatologist [ONJSC], 2009). Precipitation is distributed fairly uniformly throughout the year, with approximately 120 days of precipitation annually (NOAA, 1984).

PTA lies within the Green Pond Brook Subwatershed, which flows into the Rockaway River. PTA surface water bodies and drainages are shown on **Figure 1-3**. Green Pond Brook enters at the northeast corner of PTA, confluences with the Lake Denmark drainage (Burnt Meadow Brook), and flows into Picatinny Lake. Green Pond Brook exits the southwest site of Picatinny Lake and flows southwest to Route 15 and the PTA boundary. The State of New Jersey use designation for Green Pond Brook upstream of and including Picatinny Lake is *Fresh Water 2 – Trout Producing, Category 1 waters (FW-TP(C1))*, reflecting the classification of the Green Pond Brook segment upstream from Picatinny Lake. The Green Pond Brook and Picatinny Lake are designated category 1 (C1) because the "waterway or water body of interest flows through or is entirely located within State parks, forests or fish and game lands, Federal wildlife refuges, or other special holdings." Picatinny Lake is the receiving waters for the 600 Area.

600 Area drainage features and wetlands are shown on **Figure 3-2**. Upland 600 Area drainage is toward the southwest, where surface runoff is captured by a string of northeast-southwest trending wetlands, ponds and drainages. Site 11 drainage features include a small spring fed pond, which regularly discharges to a culvert under the test range and into an unnamed stream. The unnamed stream flows southwest past AOC 3, and into a 0.46-acre wetland. The wetland area was mapped by the USACE Water Experiment Station (WES) in 1994. This wetland also receives runoff from a portion of the AWDF (Building 660) and seasonal spring(s) located to the northwest of the wetland. The unnamed stream gains substantial flow volume from its origin at the pond to the discharge structure under Bear Swamp Road, and is likely spring fed along its length. This perennial stream discharges to Picatinny Lake. As a perennial tributary to Picatinny Lake (Green Pond Brook), it would be classified as *Fresh Water 2 – Trout Producing, Category 1 waters (FW-TP(C1))*, reflecting the classification of the Green Pond Brook segment upstream from Picatinny Lake.

A second wetland area is mapped in Site 13, and receives runoff via a culvert and drainage ditch from the western portion of the AWDF. This wetland is at least seasonally spring fed, since the discharge stream flows during dry weather. The Site 13 wetland area totals 2.84 acres (WES, 1994), and is

mapped as part man made (1.51 acres) and red maple (1.33 acres). Discharge from the wetland is seasonal, although water is retained year round in a small wetland pond. The wetland stream discharges to a culvert under Bear Swamp Road, and into Picatinny Lake.

3.2 GEOLOGY

PTA resides within the Green Pond Valley bounded to the northwest by Green Pond Mountain in the southern portion of the valley and Copperas Mountain in the northern part of the valley. The bedrock in the northwestern portion of the valley is composed of lower Paleozoic sedimentary rocks, which unconformably overlie the Middle Proterozoic basement rocks, and are faulted by a series of northeast trending faults (i.e., Tanners Brook-Green Pond Fault, Picatinny Fault, Berkshire Valley Fault, and the Gorge Fault, which splays off of the Tanners Brook-Green Pond Fault). The PTA Geology Map is shown on **Figure 3-3**.

The 600 Area Bedrock Geology Map (**Figure 3-4**) shows that the AWDF is underlain by the Green Pond Conglomerate, a Silurian age conglomerate that makes up most of Green Pond Mountain. It is composed of medium- to coarse-grained quartz-pebble conglomerate, quartzitic arkose and orthoquartzite, and thin- to thick-bedded reddish-brown siltstone. It grades downward into less abundant gray, very dark red, or grayish-purple, medium- to coarse-grained, thin- to very thick-bedded pebble to cobble-conglomerate containing clasts of red shale, siltstone, sandstone, and chert; yellowish-gray sandstone and chert; dark-gray shale and chert; and white-gray and pink milky quartz. At Picatinny, the lower contact of the Green Pond Conglomerate has been cut out by the Tanners Brook-Green Pond Fault, which places the Green Pond Conglomerate over the Leithsville.

Immediately south of the AWDF is the Picatinny Fault, which has a northeast trending strike and dips to the southeast at approximately 50 degrees. It has been characterized (Volkert, 2002) by a zone of brittle fabric a few hundred feet in width and terminates in a pair of splays in the western wall of the valley adjacent to the northern end of Picatinny Lake. The Building 600 Area lies between these two splays, immediately north of the southern splay. **Figure 3-4** also shows a mapped synform fold axis, which is located between the Picatinny Fault splays along the length of the 600 Study Area.

3.3 600 AREA AIR PHOTO AND FRACTURE TRACE ANALYSIS

As part of the RI, Shaw completed a fracture trace analysis to identify areas of major fractures in the vicinity of the Building 600 Area. These fracture zones are manifested as surface lineations and vegetation patterns and are indicative of water-bearing zones. This information was used to help evaluate the direction of groundwater movement and possible contaminant transport within the bedrock.

Fracture trace analyses are usually made using black and white aerial photographs (typically at a scale of 1:20,000) and a stereoscope that allows viewing the photographs three dimensionally. In addition to viewing the photograph itself, the topographic relief of the area is also viewed. The identification of the fracture alignments is very subjective and can be influenced by the type of light used to view the photographs and also the particular photographs used in the analysis. It should be understood that this process does not identify all fractures since certain fractures (e.g., those that are not vertical or near vertical) do not appear as observable surface expressions. The fracture trace analysis was conducted by reviewing stereoscopic aerial photographs of the PTA area taken on November 26, 1962, and March 14, 1974.

Shaw identified a total of seven lineations (fracture traces) within the Building 600 Area as shown on **Figure 3-5**, and two other lineations due north of the area. The elongated northeast trending lineation is located along the mapped trace of the southern splay of the Picatinny Fault. Two of the lineations, trending north-northeast, border the AWDF, and terminate in the vicinity of AOC 1.

3.3.1 Local Overburden and Bedrock Geology

The 600 Area occupies the southern slope of Green Pond Mountain, which largely consists of exposed bedrock outcrops (Green Pond Conglomerate) along its length. A thin veneer of overburden overlies bedrock along portions of the hillside, typically consisting of soil overlying dense sand, clay and pebble lodgement till and bedrock. The thickest deposits are found in isolated wetland and pond areas, where overburden measured 12 ft thick at well 13MW-2. The overburden is locally saturated in the wetland areas, but is not considered a viable overburden aquifer due to its limited thickness and extent.

Bedrock outcrops in the 600 Area were examined to determine the bedrock lithology, and measured with a Brunton Compass to determine the orientation of bedding planes, joints, and other fractures. Prominent outcrops in the 600 Area consist of a tan to grey, massive-bedded pebble conglomerate and sandstone, which are interbedded with a red, thinner-bedded siltstones and shales. These same lithologies were encountered during subsurface drilling and borehole geophysics in the study area. Bedding planes are massive and poorly defined, except in the thin siltstone and shale interbeds. Bedrock joints in the 600 Area are for the most part planar and well defined, unmineralized, and steeply dipping. The spacing between joints varies between inches and tens of feet, with greater joint density seen in siltstone and shale bedrock. The outcrops are dominated by northwest trending cross-joints that dip steeply to the northeast and southwest. A subordinate set of joints were observed trending northeast and dip moderately to the northwest and southeast.

Evidence of bedrock faulting was seen along the escarpment north of well 13MW-11, including bedrock slickensides and mineralized breccias. Bedrock folds and mineralized fractures were observed in outcrops located adjacent both sides of the AWDF. The geologic field investigation findings are in close agreement with the published 600 Area geologic data and mapping (Volkert, 2002).

3.4 VLF GEOPHYSICAL SURVEY

The VLF field investigation was conducted on September 9 and 10, 2004. VLF data as collected using the ABEM WADI VLF instrument, which measures the electromagnetic components of the VLF field and presents the results on a display screen. The strongest signals were derived from the Cutler Maine directional transmitter at 24.0 kHz (NAA) and 25.3 kHz (NAA), and were used for this investigation. For all surveys, the VLF data was collected along four survey lines that were aligned normal to the mapped geologic structures. The VLF survey lines are shown on **Figure 2-5**. Lines 1 and 2 crossed a single splay of the mapped fault close to the AWDF. Lines 3 and 4 each crossed both fault splays as well as the mapped axis of the synform (between the splays). VLF readings were acquired at intervals of 20 ft along the lines, and were collected in a forward and then reverse direction to check data repeatability.

Data was processed using RAMAG VLF software. Data was plotted as filtered curves and a current density cross section. Current density cross sections are shown for lines 1 (2), 2, 3 & 4 on **Figures 3-6a** through **3-9**. The study was able to correlate the conductive and non conductive features with the mapped trace of the structures. **Figures 3-6a** and **3-6b** show apparently contradictory interpretations of the VLF data. However in both plots, a distinct linear conductive anomaly is shown dipping to the south. This anomaly may show the southern splay of the Picatinny fault. **Figure 3-7** shows line 2 data, which does not show a defined conductive or other feature. Line 3 is located west of the AWDF and crosses both mapped faults and the fold axis. **Figure 3-8** shows a large conductive feature along the trace of fold axis, but is inconclusive with respect to the other mapped structures. Line 4 was also placed across the mapped trace of the three structures, and is shown on **Figure 3-9**. **Figure 3-9** shows a conductive anomaly at the mapped fold location, and linear conductive anomalies along the north and south portion of the line. These anomalies may mark the northern and southern splays of the Picatinny fault.

In summary, the VLF data shows a southward dipping conductive zone in lines 1 and 4 along the mapped southern segment of the Picatinny fault. This feature however did not show up as a conductive feature in VLF line 3. Linear conductive anomalies along the northern end of VLF lines 3 and 4 may represent the northern splay. A broad conductive anomaly is located in the middle of VLF lines 3 and 4, and correlates well with the mapped location of the fold axis. Additional detail is presented in the VLF Geophysical Report, which is provided in **Appendix F**.

3.5 PASSIVE SOIL GAS TESTING

As part of the RI, GORE-SORBER® passive soil gas soil surveys were conducted in four AOCs to measure VOC soil gas levels and delineate zones of potential groundwater contamination. Soil gas samples in AOCs 1 through 3 were sampled (installed) in June 2004, and in August 2006 for AOC 4. The soil gas modules and follow-up analysis was performed by W.L. Gore & Associates. The four AOCs are shown on **Figure 2-1**, and are identified as follows:

- AOC 1 – Munitions Waste Pit, RI Site 12.

- AOC 2 – Metal Containers in eastern portion of RI Site 11.
- AOC 3 – Partially Buried Drums in western portion of RI Site 11.
- AOC 4 – Fill and soil mounds near Building 647.

Additional passive soil gas testing was performed at AOC 1 in January 2011 following the removal of the majority of rock debris overlying the site. GORE-SORBER® sample locations are shown on **Figures 2-2** through **2-4**. Samples were analyzed using a modified EPA method 8260/8270, and include analysis of QA/QC trip blank samples. A total of 50 samples were analyzed, including 5 trip blanks for the RI. An additional 29 samples were analyzed, including 2 trip blanks, for the 2011 TCE source investigation at AOC 1. Photographs from the additional passive soil gas testing at AOC 1 are included in the source area investigation photographic log (**Appendix L**). Color soil gas contour maps were generated for MTBE and TCE results in AOC 1, MTBE results in AOC 2, and TCE results in AOCs 3 and 4. The corresponding maps are shown on **Figures 3-10a/b**, **3-11**, and **3-12**. **Figure 3-10a** shows the results of the June 2004 soil gas survey. **Figure 3-10b** shows the combined TCE soil gas results from June 2004 and January 2011. The Soil Gas Reports are provided in **Appendix G**.

In AOC 1, MTBE and TCE were each detected in one module at very low levels during the RI. TCE was detected in a total of six modules from the 2011 investigation at AOC 1, including four adjacent samples. All of the locations where TCE was detected were targeted for additional investigation by excavation of test pits or trenching with corresponding soil sampling. This additional trenching investigation was performed in the Spring of 2011 and 2012. Relatively high levels of Freon113 and MTBE were identified at AOC 2 near the burn cage/burn pan area, with low levels of TCE detected in several modules. Relatively high levels of Freon113 were also detected at AOC 3, with MTBE being identified at very low levels. TCE was also identified at AOC 3 at low levels. Low levels of TCE were also detected in two modules in AOC 4, where follow-on soil sampling was conducted due to its proximity to TCE impacted wells.

3.6 STABLE ISOTOPE TESTING RESULTS

Radioisotope samples were collected in 2006 from wells 13MW-1, 13MW-3, 13MW-4, 13MW-5, 13MW-6, 13MW-8, 13MW-9 and surface water at sampling locations 11SW-1 (Pond), 11SW-3 (Wetland Stream), and 13MW-4 (wetland pond). Radioisotope sampling was conducted to determine if surface water at these locations is derived from precipitation or groundwater discharge.

The stable oxygen isotope study is based on the tendency of oxygen isotope pairs, $^{18}O/^{16}O$, to fractionate and separate into light and heavy fractions. The oxygen isotope ratio of seawater changes upon evaporation, becoming enriched in the lighter ^{16}O isotope. Continental precipitation data shows consistent results with respect to the isotope ratio, and plots along a line that is called the meteoric water line (MWL). Continental precipitation will tend to group close to this line. Groundwater samples tend to be enriched in ^{18}O due to interaction with the oxygen in the rocks (Mayo et al., 1985). Surface water samples derived from groundwater should therefore be enriched in ^{18}O and plotted out above the MWL.

Results of the radioisotope analysis are shown on **Figure 3-13**. Sample 11SW-1 plots in the upper right hand of the graph and is slightly below the MWL. This plot location is typical of precipitation that falls in areas of higher latitude with lower temperatures. Local groundwater samples group in the lower left of the graph above the mean sea level. Samples 11SW-3 and 13SW-4 plot above the mean sea level in the center of the graph, and suggests mixing of groundwater and surface water at these locations. The radioisotope data indicates that groundwater discharges to the wetlands at these sample locations, and may be mixed with runoff from precipitation. Isotope sample results are provided in **Appendix H**.

As described in **Section 3.1**, the isolated pond at the 11SW-1 sample location regularly discharges to the local stream, indicating a spring or groundwater source. This apparently contradicts the radioisotope data for this sample, which indicates a precipitation source. The radioisotope data may also reflect a local mixture of precipitation runoff and groundwater source.

3.7 BOREHOLE GEOPHYSICS

Borehole geophysics were conducted in the open borehole of the AWDF well and bedrock monitoring wells 13MW-1, 13MW-2, 13MW-4, 13MW-7, 13MW-8, 13MW-10, and 13MW-11 to identify water conducting fractures and geologic contacts. The conducted surveys included temperature and conductivity, borehole television, OPTV, acoustical televiewer, 3-arm caliper, and heat pulse flow meter. The borehole geophysics testing program is summarized in **Table 2-4**.

In order to identify zones within the open interval of the AWDF supply well for packer testing and sampling, a borehole geophysical investigation was performed in July-August of 2004. Based on a thorough review of these results, twelve 10-ft zones within the borehole were initially selected for further investigation. The zones that were selected were chosen on the basis of even distribution throughout the open water column and the likelihood of water production (amount and openness of fractures, temperature/conductivity inflections, etc).

Borehole geophysics were also conducted at 9 of 12 newly installed bedrock monitoring wells. Data evaluation focused on the identification of water-bearing zones for later packer testing. Wells 13MW-10 and 11 were also evaluated using the HPFM, which identified open fractures in those wells. Packer test intervals were ultimately selected after review of the well boring log and depths of water-bearing fractures, and borehole geophysical data.

Borehole geophysical reports were prepared for all phases of work by the contractor, Mid Atlantic Geophysics, and are provided in **Appendix D**. The borehole geophysics report provides all logging data for each geophysical test, and interpretation of the optical and acoustic televiewer data. Open fractures and potential water-bearing zones are identified in the geophysical reports.

3.8 PACKER TESTING

Packer testing was conducted on the AWDF well and eight newly installed bedrock monitoring wells to measure groundwater flow (yield) and sample each packer interval for VOCs. Packer testing was conducted by SGS Drilling, Inc. under the supervision of a Shaw geologist. Packer test dates, packer intervals, yield, and sampling results are summarized for each well in **Table 3-1**.

A detailed packer test study was conducted at the AWDF potable well in March 2004 to determine the vertical distribution of water-bearing fractures and TCE contamination within the borehole. This data was also used to determine target drilling depths for newly installed bedrock monitoring wells. Twelve 10-foot packer test intervals were initially selected from borehole geophysical data, including the 55-65, 65-75, 75-85, 99-109, 130-140, 178-188, 188-198, 214-224, 241-251, 318-328, 338-348, and 360-370 ft intervals. All but the two shallowest zones produced water with TCE concentrations in excess of the LOC.

Evaluation of sampling data found that the AWDF bulk well TCE sample (81 µg/L) concentration exceeded all of the packer tested zones, which suggested that an untested “hot” fracture or fractures may exist elsewhere in the AWDF borehole. An apparent geologic contact was also detected by borehole geophysics at 418 ft bgs, below the tested intervals. There was concern that this contact could be producing significant water and act as a contaminant conduit.

To address these concerns, six additional packer tests were conducted in July 2004 using 20-ft intervals and were analyzed for VOCs. One zone specifically included the geologic contact at 418 ft, and the entire portion below 418 ft was tested. The other zones tested were selected based upon fractures identified primarily by reviewing the borehole video and by vertical concentration trends identified as a result of the initial 12 packer tests. The six additional zones tested were as follows: 109-129, 140-160, 220-240, 376-396, 396-416 and 416-436 ft below casing. All of the zones produced water with TCE concentrations in excess of the LOC. The analytical and yield testing results for the AWDF well are presented in **Table 3-1**. **Figure 3-14** shows the vertical distribution of TCE and other detected VOCs in the AWDF well.

The AWDF packer test data shows peak TCE concentrations of 55 to 71 µg/L at a depth range of approximately 140 to 188 ft bgs. TCE concentrations decrease with depth to 9 and 11 µg/L at the lowermost two test intervals. Fracture yield and density are consistent to about 250 ft, at which point they decline with depth.

Packer testing was conducted at up to four intervals at bedrock monitoring wells 13MW-1, 13MW-2, 13MW-4, 13MW-5, 13MW-7, 13MW-8, 13MW-10, and 13MW-11. Packer testing of 13MW-1, 13MW-2, and 13MW-4 were conducted in February and March, 2005. Wells 13MW-5, 13MW-7, and 13MW-8 were packer tested in June 2006. Packer testing of 13MW-10 and 13MW-11 were conducted in January and February, 2007. **Figure 3-15** shows that all tested packer zones in wells 13MW-1, 13MW-2, and 13MW-4 produced water with TCE concentrations in excess of the LOC. Wells 13MW-1 shows peak TCE concentrations at the top packer intervals, whereas well 13MW-4 shows a gradual increase of TCE concentration with depth. The vertical distribution of TCE in the AWDF and wells 13MW-1, 13MW-2, and 13MW-4 is shown on **Figure 3-15**. Overall, fracture density and yield is consistent with depth, and TCE groundwater contamination is considered to be well distributed over the tested borehole intervals at monitoring wells. After evaluation of packer test results, screened intervals were selected based upon packer yields and sampling results. Where feasible, the most impacted TCE packer intervals were selected for screen placement. Final screened intervals for packer tested wells are shown in **Table 2-5**.

3.9 WATER LEVEL MEASUREMENT

A total of seven synoptic rounds were conducted at all available wells between November 2004 and October 2007. Groundwater elevations could not be taken at the AWDF well because it was in service and has a pitless adaptor. Two “background” monitoring wells (DM10-1 and DM10-2) were added in November 2006 to provide additional elevation control. Two surface water staff gauges were also added in June 2007 at sample locations 11SW-3 and 13SW-4 to provide elevations for comparison to groundwater data. Groundwater synoptic water level readings collected during these rounds are summarized in **Table 3-2**. Groundwater elevations fluctuated up to 23.72 ft during the monitoring period, with the greatest variance seen at upland wells DM10-1, DM10-2 (18.87 ft), and 13MW-8 (14.63 ft). The smallest variance is seen in shallow bedrock wells 13MW-9 (0.22 ft), DM13-1 (0.58 ft), and 13MW-3 (1.5 ft), which are located adjacent wetland areas. The highest overall groundwater elevations were observed in March 2007, with the lowest in June 2007. The March 14, 2007, and June 13, 2007, potentiometric maps are shown on **Figures 3-16** and **3-17**.

Groundwater flow is generally toward the southeast, with local flow varying from south to south-southeast. The average gradient is 0.090 feet per foot (ft/ft), as measured from well 13MW-8 to 13MW-6. On **Figure 3-17**, it is noted that the gradient steepens dramatically after the 1,070 ft contour, and may be influenced by the steep sloping hillside located southeast of well 13MW-6. Alternatively, well 13MW-6 may not be in direct communication with the aquifer, or artesian in nature. The groundwater gradient is 0.046 ft/ft as measured from well 13MW-8 to the nearest downgradient 1,070 ft contour on **Figure 3-17**. For this study, the 0.046 ft/ft gradient is used since it is the most representative of the immediate study area.

Groundwater elevation data for shallow and deep bedrock cluster wells DM13-1/13MW-2 and 13MW-3/13MW-4 were evaluated for each synoptic round to determine the vertical gradient, if any. The vertical gradients are measured by comparing the groundwater elevation of two cluster wells screened at different intervals. For example, a higher elevation in a shallow well would indicate a component of downward flow. The greater the head difference, the larger the vertical gradient. **Table 3-2** shows the calculated vertical gradients for cluster wells at each synoptic event. Vertical gradients at both clusters are generally downward, except one weak upward measurement taken on 12/12/06 at cluster 13MW-3/13MW-4. This data indicates that shallow groundwater is recharging the deeper bedrock aquifer at these locations. It is noted that these clusters are located adjacent the downgradient portion of the wetlands, and that groundwater discharge is probably occurring along the upgradient edge of the wetlands by way of seeps and springs.

3.10 AQUIFER PERMEABILITY TESTING

An aquifer pumping test was conducted in the 600 Area to determine the aquifer permeability and degree of anisotropy, if any. Pretest groundwater monitoring began on April 17, 2007, with the start of the pumping test on April 23, 2007. The constant discharge test was run 46 hours, at which time the recovery well test was run. Recovery water level monitoring was concluded on April 25 at the test well, and April 27, 2007, at electronically monitored wells. Details concerning the pretest monitoring, aquifer testing, and data analysis are disused in the following sections.

3.10.1 Pretest Monitoring

Pretest groundwater monitoring began on April 17, 2007, using *In Situ* trolls at monitoring wells 13MW-1, 13MW-2, 13MW-4, 13MW-5, 13MW-7, 13MW-8, and 13MW-10. Well locations are shown on **Figure 2-9**. Pretest groundwater elevation data is shown on **Figure 3-18** for wells 13MW-2 and 13MW-4. Pretest data for wells 13MW-5, 13MW-6, 13MW-7, and 13MW-10 are shown in **Appendix I**. The data shows a spike then steady decline in groundwater levels immediately after a major precipitation event (4.9 inches) on April 15 and 16, 2007. Trolls in monitoring wells 13MW-1 and 13MW-8 malfunctioned, and the data was lost.

A step test was conducted on the AWDF test well on April 20, 2007, to determine the appropriate pumping rate for the 48-hour test. A flow control manifold was used for the test, which included two inline flow gauges, flow control valve and sampling spigot. Pumped water was stored in a 20,000-gallon Modutank for the duration of the step, constant discharge, and recovery testing. Step test rates were determined after review of the test well drillers development log. The existing well pump was used for the test, and had a capacity of 5 gpm. The well was initially pumped one hour at 3.0 and 4.0 gpm, but was adjusted down to 3.5 gpm for the final 1 hour of the test. Drawdown began to stabilize after 1 hour of pumping (@ 3.5 gpm), with a final drawdown of 137 ft. This data was extrapolated for a 48-hour period, and projected a total test drawdown of 170 ft.

3.10.2 Aquifer Testing

The scheduled 48-hour aquifer pumping test started at 1251 on April 23, 2007. Water level measurements were electronically monitored in all wells except the test well and background wells DM10-2 and 2. Continuous manual monitoring was conducted at the AWDF well, with periodic manual monitoring of all other wells as back up to the trolls. Test well discharge was maintained at approximately 3.4 to 3.5 gpm over the duration of the test. Test data was plotted in the field to project total test well drawdown, identify aquifer boundaries, and determine the duration of the test. The constant discharge test was stopped after 46 hours to expedite recovery monitoring before the arrival of a storm. Total test well drawdown was 127.96 ft, with a maximum monitoring well drawdown of 3.15 ft at well 13MW-7. Recovery monitoring started at shutdown and was continued at the test well for 6 hours, and 48 hours at electronically monitored wells. Test and monitoring well pumping and recovery data are provided in **Appendix I**.

3.10.3 Data Analysis

All electronic well monitoring data for the constant discharge test and recovery test periods was downloaded from trolls, in addition to electronic entry of the manual test well and monitoring well data. The monitoring well drawdown data was corrected for background water level declines at wells 13MW-2, 13MW-4, 13MW-5, 13MW-7, and 13MW-10, as extrapolated from the 24-hour pretest period. Trolls malfunctioned at monitoring wells 13MW-1 and 13MW-8, and all electronic data was lost. Manually collected data from these wells could not be corrected for the background water level decline due to the loss of the electronic pretest data, and further analysis was not done. Well 13MW-6 data did not show any response to the test, and was not used for analysis. The overall quality and coverage of the collected test and monitoring well data is considered very good, and is minimally impacted by the loss of data at wells 13MW-1 and 13MW-8.

Time-drawdown data plots were generated for the test and all monitoring wells, and are shown in **Appendix I**. Time-drawdown plots for the AWDF and 13MW-2 wells, and 13MW-4 and 13MW-7 wells are shown on **Figures 3-19** and **3-20**, respectively. Aquifer transmissivity and storage coefficient parameters were calculated from the plots using the Cooper Jacob graphical method (Driscoll, 1986). A summary of calculated aquifer parameters is shown in **Table 3-3**. As shown, the calculated hydraulic conductivity values range from 0.0027 to 6.15 feet/day (ft/day) at the test well and monitoring well 13MW-5, with an average value of 2.52 ft/day. A minor aquifer recharge boundary is observed at 250 minutes on **Figure 3-19**, and indicates that a more conductive (permeable) aquifer zone was encountered during testing.

A distance-drawdown analysis was also conducted using corrected aquifer drawdown data from the end of the test, and is shown on **Figure 3-21**. As shown, data points are somewhat scattered, and a fitted line was used to calculate aquifer parameters. The calculated aquifer transmissivity of 2,545

gallons per day per ft is greater than the range of time-drawdown values, and may reflect enhanced northeast-southwest trending aquifer permeability. Drawdown data from other wells oriented oblique to this trend could not be analyzed due to data loss (13MW-1 & 8) and non-response of water levels in well 13MW-6.

Recovery data for the test well was evaluated using a residual-drawdown plot and is shown on **Figure 3-21**. The calculated transmissivity value is similar to those calculated for the constant rate test.

Permeability data from the aquifer pumping test indicates that the aquifer has an average permeability of 2.52 ft/day, and may have enhanced permeability along a northeast and southwest line from the test well. The range and mean value (time-drawdown) fall in the range for fractured igneous and metamorphic rock (Freeze and Cherry, 1979). This is the most appropriate lithologic category for the aquifer media due to its low intrinsic porosity and massive, poorly defined bedding. The calculated storage coefficient ranges from 7.4×10^{-3} to 3.9×10^{-5} (dimensionless) falls into the range for a confined aquifer. The data suggests the presence of an overlying impermeable (aquaclude) or less permeable (aquatard) rock or till, and/or limited connection of water-bearing fractures to the surface.

3.11 GROUNDWATER SEEPAGE VELOCITY

The bedrock groundwater seepage velocity is calculated based on average gradient, pumping test well permeability value, and aquifer effective porosity. The seepage velocity was calculated pursuant to the following formula (Reference):

$V_s = KI/n_e$

Where:

V_s= Seepage Velocity, L/T

K = Hydraulic Conductivity, L/T

I = Hydraulic Gradient, L/L

n_e = Effective Porosity, L^3/L^3

The applied hydraulic gradient is 0.046 ft/ft and effective porosity value of 0.05 for fractured bedrock. The applied effective porosity of 0.05 is the midpoint published value for the effective porosity of fractured crystalline rock (Driscoll, 1986). The applied aquifer test permeability is 2.52 ft/day. The calculated groundwater seepage velocity is 2.32 ft/day.

3.12 HYDROGEOLOGIC MODEL

The study area is underlain by the Green Pond Conglomerate, which has little primary porosity in its matrix, and transmits water via secondary interconnected fractures. The term fracture includes open bedrock bedding planes, parting lineations, joints, and faults. The Green Pond Conglomerate is tight and massively bedded, except where interbedded with siltstone and shale units. The outcrops are crosscut by two well defined joint sets, which probably form the principal conduits for groundwater flow in the aquifer matrix (unfaulted/folded rock).

In faulted rock, the fault plane and adjacent fracture zone are usually very permeable, and readily transmit groundwater along the fault plane. The mapped north and south splays of the Picatinny fault are considered potential high permeability structures. The field evidence for these structures includes interpreted air photo fracture traces and a string of ponds, wetlands and springs observed along the mapped trace of the faults. The mapped fold axis in the fault block is also a potential conductive structure, since tight folds typically fracture along the axis, forming a conductive zone along the trace of the fold. The VLF study found conductive structures along the trace of each of these features. The aquifer test conducted at the AWDF well found an average bedrock permeability of 2.52 ft/day, but was unable to determine the degree of aquifer anisotropy.

A conceptual hydrogeologic model was prepared from the above assumptions, and is shown on **Figure 3-22**. The model illustrates the predicted aquifer anisotropy and enhanced permeability along the faults and fold axis. The predicted aquifer anisotropy would have the probable effect of dispersing a plume (from AOC 1) along conductive structures during contaminant migration. Stable isotope data

indicate that mapped wetlands located to the northeast and southwest of the AWDF are groundwater discharge points, and would include groundwater originating in the AOC 1 area. Discharge from the northeastern wetland is perennial, with seasonal discharge from the southwestern wetland. The AWDF pumping well is also a local groundwater discharge point, and is pumped at an average 850 gallons/day.

Table 3-1
Packer Test Sampling Results

Well ID	Packer Interval, in Ft. BGS	**TCE**	**Freon113**	**MTBE**	**Toluene**	**Yield, in GPM**	Screened Interval, Ft. BGS
AWDF	*LOC*	*1.0*	*59,000*	*70*	*1,000*		Open Borehole
	55-65	0.00	0.00	0.00	110	0.02	
	65-75	0.92	0.00	1.10	84	0.16	
	75-85	**5.7**	1.7	1.50	40	0.3	
	99-109	**8.9**	4.4	2.20	84	0.01	
	109-129	**26.0**	6.9	3.10	40	0.04	
	130-140	**24**	4.3	1.70	72	0.01	
	140-160	**71**	20.0	1.30	18	0.12	
	178-188	**55**	9.7	0.80	74	0.15	
	188-198	**42**	9.1	0.87	55	0.07	
	214-224	**49**	9.4	0.67	61	0.13	
	220-240	**48**	9.4	1.40	28	0.13	
	241-251	**41**	8.6	1.10	37	0.06	
	318-328	**30**	5.5	0.00	240	0.02	
	338-348	**25**	5.0	0.97	84	0.03	
	360-370	**35**	6.6	0.95	12	0.07	
	376-369	**35**	5.9	0.00	100	0.01	
	396-416	**9**	1.4	1.80	2	<0.01	
	416-436	**11**	1.7	0.99	3	0.01	
13MW-1	48-73	**240**	2.9	0.00	18	>0.09	228-253
	87-112	**220**	4.7	0.00	29	>0.09	
	125-150	**180**	3.0	0.00	48	>0.09	
	225-250	**210**	13.0	0.00	18	>0.09	
13MW-2	35-60	**25**	1.9	0.00	12	>0.09	168-193
	70-95	**24**	1.4	0.00	31	>0.09	
	165-190	**24**	2.0	0.00	1.4	>0.09	
13MW-3	Not Packer Tested						
13MW-4	45-70	**17**	2.6	1.50	120	>0.09	168-193
	90-115	**21**	4.3	1.70	170	0.9	
	138-163	**22**	4.9	1.80	150	0.1	
	163-196	**23**	5.8	1.60	130	0.16	
13MW-5	125-150	**6.0 J**	220	65 J	ND	0.5	125-150
13MW-6	Not Packer Tested						
13MW-7	80-105	ND	110	ND	3.1	5	80-105
13MW-8	80-105	ND	1.1	ND	1.2	0.35	78-103
	145-170	ND	1.7	ND	5.5	0.5	
	170-200	ND	2.1	ND	7.8	0.4	
13MW-9	Not Packer Tested						
13MW-10	0-80	No Sample				0	90-110
	89-109	ND	ND	ND	48D	0.5	
	136-156	ND	ND	ND	290D	0.03	
13MW-11	0-25	38D	0.85JD	ND	3,3D	1.5	17.3-27.3
	113-133	No Sample				<0.1	
	136-156	No Sample				0	

Table 3-2
Groundwater Synoptic Data

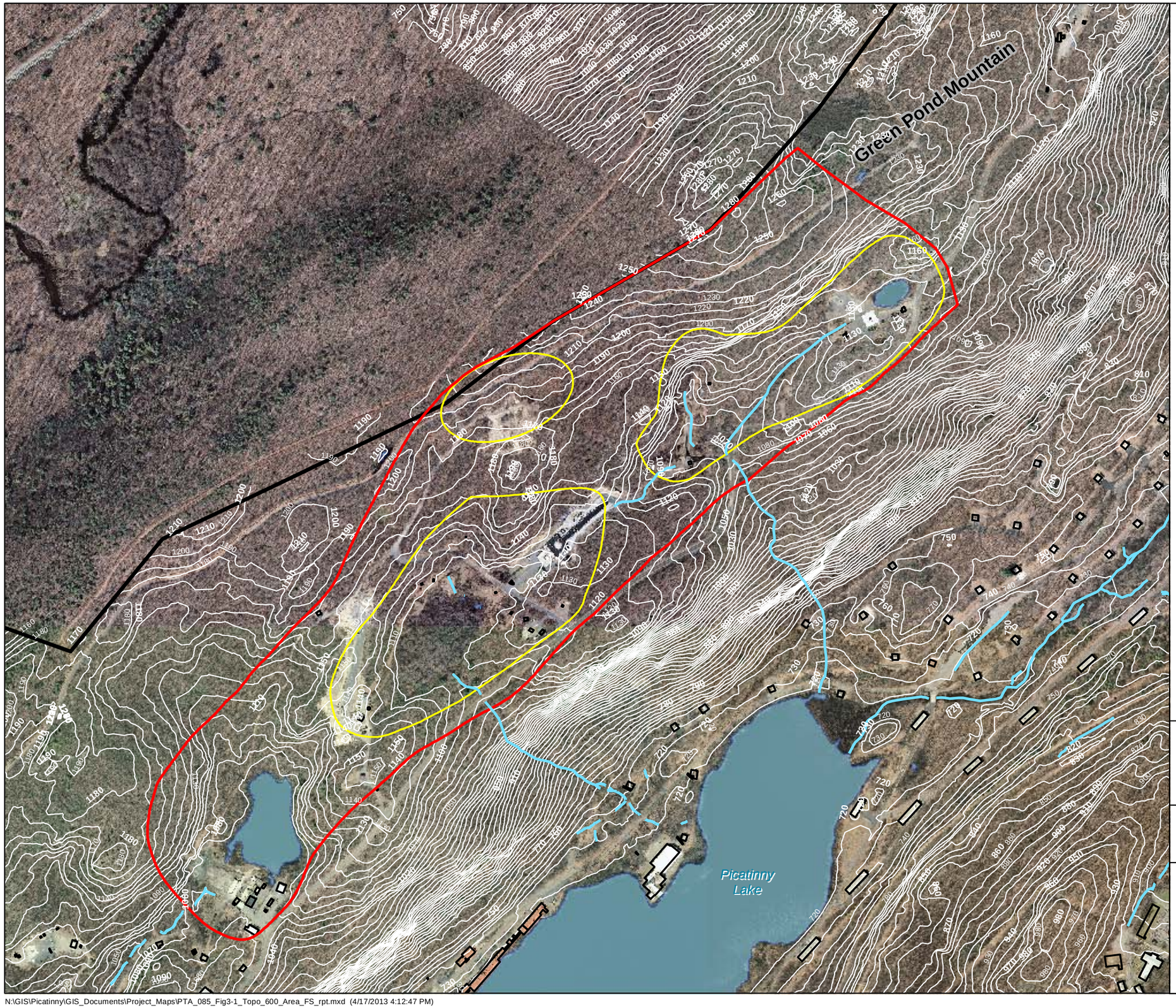
Well ID	TIC Elev. (Ft.)	Screened Interval, Ft. bgs	Screen Midpoint in Ft. MSL	GW Elev. 5/05	GW Elev. 7/27/06	GW Elev. 12/12/06	GW Elev. 3/14/07	GW Elev. 6/13/07	GW Elev. 9/07	GW Elev. 6/08
13MW-1	1191.36	228-253	950.86	1126.25	1130.74	1126.39	1132.33	1120.41	1115.94	1125.89
13MW-2	1106.43	168-193	926.35	1097.43	1096.04	1099.04	1099.71	1095.65	1094.93	1096.17
13MW-3	1079.91	47-72	1020.41	1076.51	1075.01	1075.7	1076.05	1075.04	1073.98	1075.11
13MW-4	1080.61	168-193	900.11	1075.91	1074.39	1074.51	1077.62	1073.79	1073.01	1073.89
13MW-5	1105.47	125-150	967.97		1067.45	1067.62	1070.25	1066.74	1066.06	1066.07
13MW-6	1093.7	122-147	958.89		957.54	958.72	953.87	954	952.24	951.01
13MW-7	1132.4	80-105	1039.37		1071.77	1072.86	1083.42	1071.44	1066.88	1071.46
13MW-8	1211.94	78-103	1094.44		1161.87	1160.65	1172.94	1158.31	1143.82	1164.73
13MW-9	1127.02	25-45	1092.02		1126.77	1126.77	artesian	1126.55	1126.06	1126.02
13MW-10	1135.89						1078.95	1074.07	1072.84	1072.21
13MW-11	1089.96						1082.25	1076.48	1061.49	1076.36
DM13-1	1105.36	12-22	1088.81	1101.13	1100.55	1100.57	1101.71	1100.53	1100.44	1100.51
DM13-2	1111.45	8-18	1098.15	1102.75	1101.73	1104.71	1103.83	1101.59	Dry	1102.42
DM13-3	1093.11	17-27	1071.21	1086.08	1085.23	1085.32	1086.68	1084.93	1083.05	1085.86
DM10-1	1223.14	36-46	1182.64		1192.79		1210.11	1186.39	Dry	1197.08
DM10-2	1226.13	25-35	1196.13		1193.22		1210.49	1191.62	Dry	1197.63
staff 13SW-3	1073.46					`		1070.46		
staff 13SW-4	1102.47							1100.47		1101.47

Vertical Gradient

DM13-1	Shallow Well			0.023	0.028	0.012	0.009	0.03	0.064	0.034
13MW-2	Deep Well			Down	Down	Down	Down	Down	Down	Down
13MW-3	Shallow Well			0.005	0.005	-0.01	0.013	0.01	0.03	0.017
13MW-4	Deep Well			Down	Down	Up	Down	Down	Down	Down

Table 3-3
Aquifer Pumping Test Results

Well ID	Time-Drawdown Method Transmissivity (T, in GPD/FT) and Hydraulic Conductivity (K, in FT/DAY), in parenthesis[1].	Time-drawdown Method Storage Coefficient[1] (S)	Recovery Test Residual drawdown vs. t/t[1] T in GPD/FT and (K) in FT/DAY	Distance-Drawdown Method[1.] T in GPD/FT and (K) in FT/DAY	Distance-Drawdown Method[1] (S)
AWDF (Test Well)	11(0.0118)		8.2(0.0027)		
13MW-2	611(2.7)	5.2×10^{-5}		2545(11.3)	7.4×10^{-3}
13MW-4	361(1.6)	1.4×10^{-4}			
13MW-5	1388(6.15)	1.4×10^{-4}			
13MW-7	407(1.87)	1.2×10^{-4}			
13MW-10	641(2.8)	3.9×10^{-5}			



LEGEND

- Water Feature
- Elevation Contour (10 ft Interval)
- Building
- Water Body
- Site Boundary
- Arsenal Boundary
- 600 Study Area Boundary

N

0 262.5 525 1,050 Feet

U.S. Army Corps of Engineers

Picatinny Arsenal Installation Restoration Program

Shaw Environmental, Inc

FIGURE 3-1

600 AREA TOPOGRAPHY

Picatinny Arsenal, Dover, New Jersey

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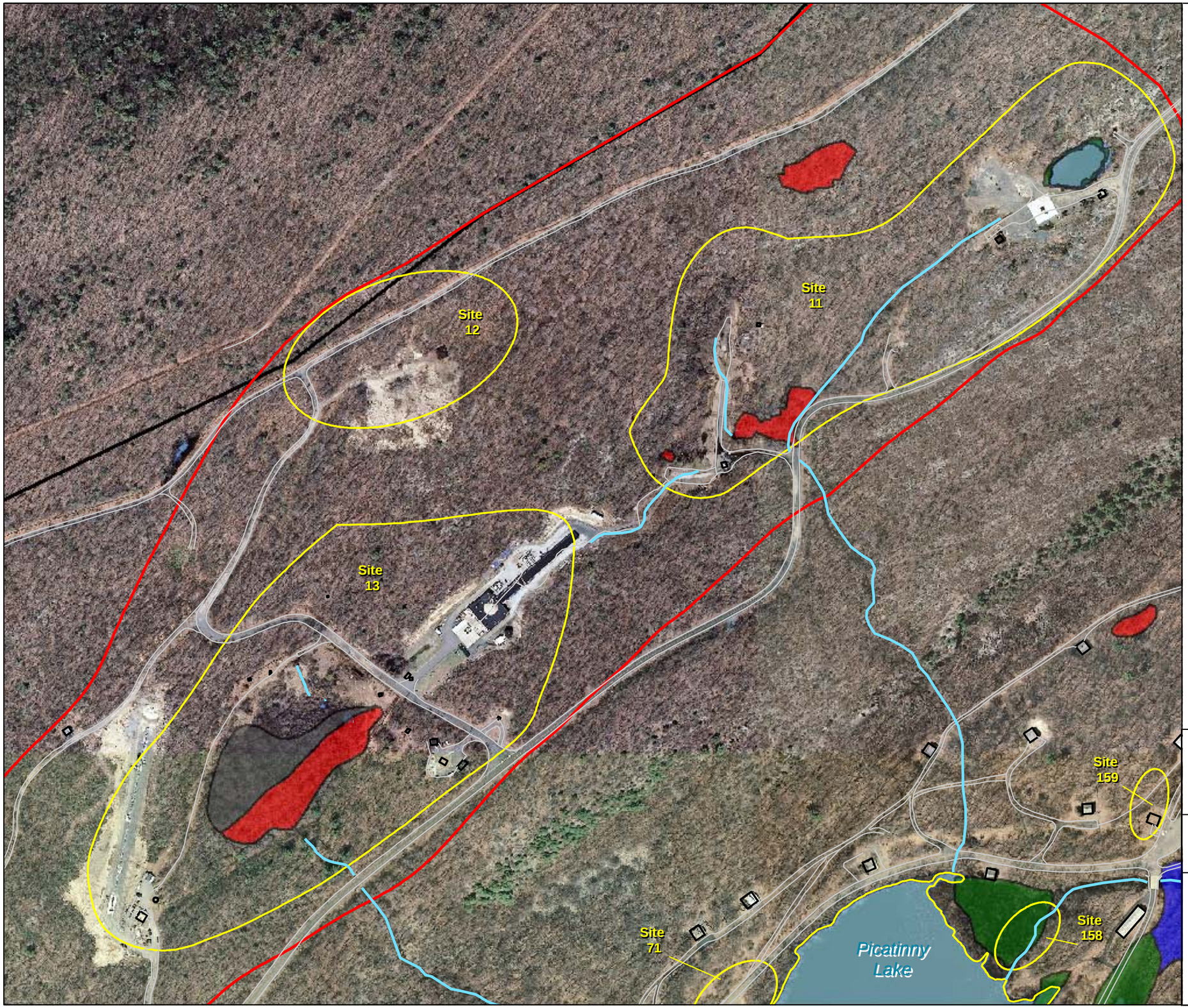

LEGEND

- Road
- Water Feature
- Building
- Water Body
- Site Boundary
- Arsenal Boundary
- 600 Study Area Boundary

Wetland (WES, 1994)

- RM (Red Maple)
- B/M (Birch/Maple)
- SS (Scrub Shrub)
- MM (Man Made)

N

0 150 300 600 Feet

U.S. Army Corps of Engineers

Picatinny Arsenal Installation Restoration Program

Shaw Environmental, Inc

FIGURE 3-2

600 AREA HYDROLOGY

Picatinny Arsenal, Dover, New Jersey

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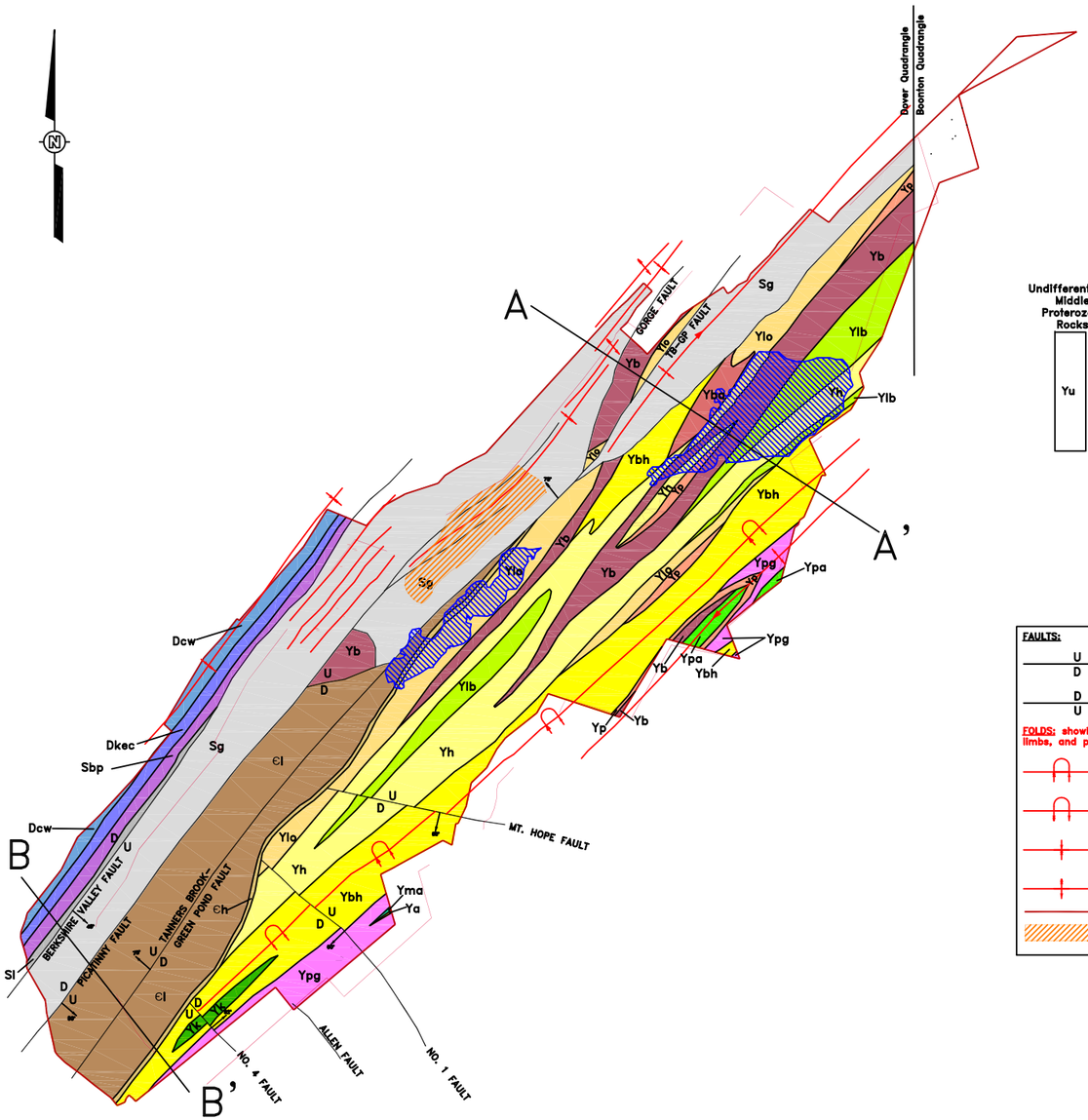


DESCRIPTION OF MAP UNITS
Green Pond Mountain Region

Cornwall Shale

Dcw (Middle Devonian) (Hartnagel, 1907)–Black to dark–gray, very thin to thick–bedded, fossiliferous, fissile shale, interbedded with medium–gray and light–olive gray to yellowish–gray, laminated to very thin bedded siltstone that increases in upper part. Lower contact with Kanouse Sandstone probably conformable. Unit is about 950 ft. thick.

Kanouse Sandstone, and Connelly Conglomerate, undivided

Dkec (Lower Devonian) Kanouse Sandstone (Kummel, 1908)–Medium–gray, light–brown, and grayish–red, fine– to coarse–grained, thin– to thick–bedded sandstone and pebble conglomerate. Basal conglomerate is interbedded with siltstone and contains well–sorted, subangular to subrounded, gray and white quartz pebbles less than 0.4 in. long. Lower contact with Esopus Formation gradational. Unit is about 46 ft. thick.

Esopus Formation (Vanuxem,1842; Boucot, 1959) Light– to dark–gray, laminated to thin–bedded siltstone interbedded with dark–gray to black mudstone, dusky–blue sandstone and siltstone, and yellowish–gray, fossiliferous siltstone and sandstone. Lower contact probaly conformable with Conelly Conglomerate. Unit is about 180 ft. thick near the map area.

Conelly Conglomerate (Chadwick, 1908) Grayish–orange weathering, very light gray to yellowish–gray, thin–bedded quartz–pebble conglomerate. Quartz pebbles are subrounded to well rounded, well sorted, and as much as 0.8 in. long. Unit is about 36 ft. thick.

Berkshire Valley and Poxino Island Formations, undivided

Sbp (Upper Silurian) (Barnett,1970)–Yellowish–gray–weathering, medium–gray to pinkish–gray, very thin to thin–bedded fossiliferous limestone interbedded with gray to greenish–gray calcareous siltstone and silty dolomite, medium–gray to light–gray dolomite conglomerate, and grayish–black thinly laminated shale.Lower contact conformable with Poxino Island Formation. Unit ranges in thickness from 90 to 125 ft.

Longwood Shale

Sl (Upper and Middle Silurian) (Darton,1894)–Dark reddish–brown, thin– to very thick–bedded shale interbedded with cross–bedded, very dark–red, very thin– to thin–bedded sandstone and siltstone. Lower contact conformable with Green Pond Conglomerate. Unit is about 330 ft. thick.

Green Pond Conglomerate

Sg (Middle and Lower Silurian) (Rogers,1836)–Medium to coarse grained quartz–pebble conglomerate, quartzitic arkose and orthoquartzite, and thin to thick bedded reddish–brown siltstone. Grades downward into less abundant gray, very dark red, or grayish–purple, medium to coarse–grained, thin to very thick bedded pebble to cobble–conglomerate containing clasts of red shale, siltstone, sandstone, and chert; yellowish–gray sandstone and chert; dark–gray shale and chert; and white–gray and pink milky quartz. Quartz cobbles as much as 4 in. long. Unconformably overlies Leithsville.

Leithsville Formation

Єl (Middle and Lower Cambrian) (Wherry,1909) Light to dark–gray and light–olive–gray, fine to medium grained, thin to medium–bedded dolomite. Grades downward through medium–gray, grayish–yellow, or pinkish–gray dolomite and dolomitic sandstone, siltstone, and shale to medium–gray, medium–grained, medium bedded dolomite containing quartz sand grains as stringers and lenses near the base. Lower contact gradational with Hardyston Quartzite. Unit ranges from 0 to 185 ft thick regionally.

Hardyston Quartzite

Єh (Lower Cambrian) (Wolf and Brooks, 1898)–Light–to medium–gray and bluish–gray conglomeratic sandstone. Varies from pebble conglomerate, to fine–grained, well cemented quartzite, to arkosic or dolomitic sandstone. Conglomerate contains subangular to subrounded white quartz pebbles as much as 1 in. long. Lower contact unconformable with Middle Proterozoic rocks. Unit ranges from 0–30 ft. thick regionally.

Hornblende granite

Ybh (Middle Proterozoic) (Drake,1984)–Pinkish–gray– to buff–weathering, pinkish–white or light–pinkish–gray, medium– to medium–coarse–grained, massive, moderately foliated granite and sparse granite gneiss composed of mesoperthite, microline microperthite, quartz, oligoclase, and hastingsite. Common accessory minerals include zircon, apatite and magnetite. Small bodies of pegmatite too small to be shown on map are common. Rb–Sr isochron age of about 1116 Ma (Volkert et al., 2000).

Microperthite alaskite

Yba (Middle Proterozoic)–Pale pinkish–white–to buff–weathering, pale pinkish–white, medium– to coarse–grained, massive, moderately foliated granite and sparse granite gneiss composed of microline, microperthite, quartz, oligoclase, and trace amounts of hastingsite biotite, zircon, apatite and magnetite.

Pyroxene granite

Ypg (Middle Proterozoic)–Gray– to buff–weathering, greenish–gray to greenish–buff, medium to medium–coarse–grained, massive, moderately foliated granite and sparse granite gneiss containing mesoperthite to microperthite, quartz, oligoclase, and hedenbergite to ferrohedenbergite. Common accessory minerals include titanite, zircon, apatite, magnetite, and pyrite. Locally includes small bodies of amphibolite too small to be shown. Rb–Sr isochron age about 1095 Ma (Volkert et al., 2000).

Pyroxene alaskite

Ypa (Middle Proterozoic)–Tan–to buff–weathering, greenish–buff, medium–grained, massive, moderately foliated alaskite composed of mesoperthite to microperthite, oligoclase, and quartz. Common accessory minerals are hedenbergite and magnetite. Zircon, apatite, and titanite occur less commonly.

Potassic feldspar gneiss

Yk (Middle Proterozoic)–Buff to pale pinkish–white–weathering, buff, pale pinkish–white or light–pinkish–gray, medium grained, massive, moderately foliated gneiss composed of quartz, microcline microperthite, oligoclase, biotite, and magnetite. Garnet and sillimanite occur less commonly.

Biotite–quartz–feldspar gneiss

Yb (Middle Proterozoic)–Pale pinkish–white– to pinkish–gray– or gray–weathering, locally rusty weathering, pinkish–gray, tan, or greenish–gray, fine to medium–coarse–grained, moderately layered and foliated gneiss containing microcline microperthite, oligoclase, quartz, biotite, garnet, and sillimanite. Graphite and pyrrhotite are confined to the variant that weathers rusty. The rusty type is commonly spatially associated with thin, moderately layerd metaquartzite containing accessory biotite, feldspar, graphite, and pyrrhotite, and also with layers of green, medium–grained diopsidite, both too thin to be shown.

Pyroxene gneiss

Yp (Middle Proterozoic)–Light–gray– to white–weathering, greenish–gray to light–greenish–gray, medium–grained, moderately layered and foliated, gneiss containing oligoclase, diopside or salite, variable amounts of quartz, and trace amounts of titanite, magnetite and epidote. Locally interlayered with light–gray to light–greenish–gray, well layered quartz–epidote gneiss west of Longwood Lake. Commonly spatially associated with pyroxene amphibolite (Ya) and rusty biotite–quartz–feldspar gneiss (Yb).

Quartz–Oligoclase gneiss

Ylo (Middle Proterozoic)–White–weathering, light–greenish–gray, medium to medium–coarse–grained, moderately layered to massive, foliated gneiss composed of oligoclase or andesine, quartz, and variable amounts of hornblende, augite, biotite and magnetite. Locally contains layers of amphibolite (Ya) too thin to be shown on map. Unit commonly has gradational contacts with biotite–quartz–oligoclase gneiss (Ylb) and hypersthene–quartz–plagioclase gneiss (Yh) and occurs as thin, conformable layers within bodies of diorite (Yd).

Albite–oligoclase alaskite

Yla (Middle Proterozoic)–Pale pink– to white–weathering, light–greenish–gray to light–pinkish–green, medium to medium–coarse–grained, alaskite and local granite composed of characteristic pink albite or oligoclase, quartz, and variable amounts of hornblende and (or) augite, magnetite, and locally abundant rutile, Unit appears to be spatially related to quartz–gneiss from which it may have formed. Commonly interlayered with thick conformable amphibolite.

Biotite–quartz–oligoclase gneiss

Ylb (Middle Proterozoic)–Light–gray weathering, light–greenish–gray, to light–greenish–gray, medium–to medium coarse grained, moderately layered and foliated, gneiss composed of oligoclase or andesine, quartz, biotite and local hornblende. Contains layers of amphibolite (Ya) too thin to be shown on the map.

Hyperstyne–quartz–plagioclase gneiss

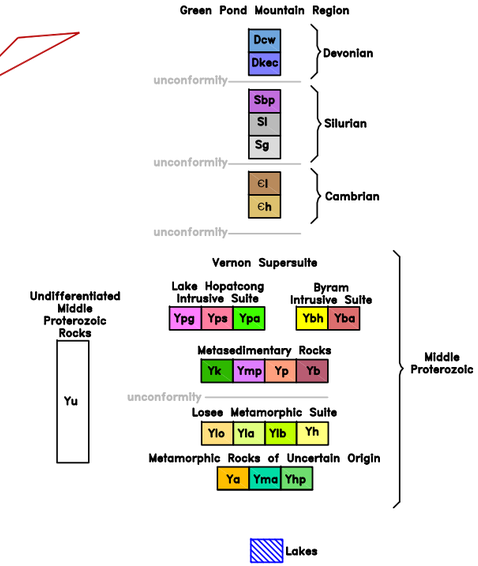
Yh (Middle Proterozoic)–Light–gray to tan–weathering, greenish or greenish–brown, medium–grained,moderately layered and foliated, greasy lustered gneiss composed of andesine or oligoclase, quartz, augite, hornblende, hypersthene, and magnetite. Commonly contains conformable layers of amphibolite (Ya) and quartz–oligoclase gneiss (Ylo) containing hornblende and augite too thin to be shown.

Amphibolite

Ya (Middle Proterozoic)–Grayish–black–weathering, black to grayish–black,medium–grained gneiss composed of hornblende (dominantly magnesiohastingsite), andesine, and magnetite. Some variants contain biotite and others contain augite and local hypersthene. All types are undifferentiated on the map.

Microantiperthite

Yma (Middle Proterozoic)–White– to gray–weathering, light–greenish–gray, medium– to medium–coarse–grained, moderately foliated alaskite and local granite containing microantiperthite, quartz, oligoclase, sparse amounts of hornblende and clinopyroxene and trace amounts of biotite.



FAULTS:

Normal Fault – U=upthrown side, d=downthrown side. Arrow shows attitude of fault plane, if known.

Reverse Fault – U=upthrown side, d=downthrown side. Arrow shows attitude of fault plane, if known.

FOLDS: showing trace of axial surface, dip direction of limbs, and plunge direction

Overturned Synform

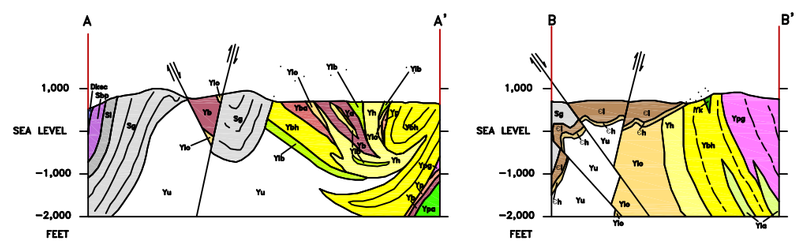
Overturned Antiform

Synform

Antiform

Picatinny Boundary

600 Area



SCALE

0 5000 10,000 FEET

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 3-3

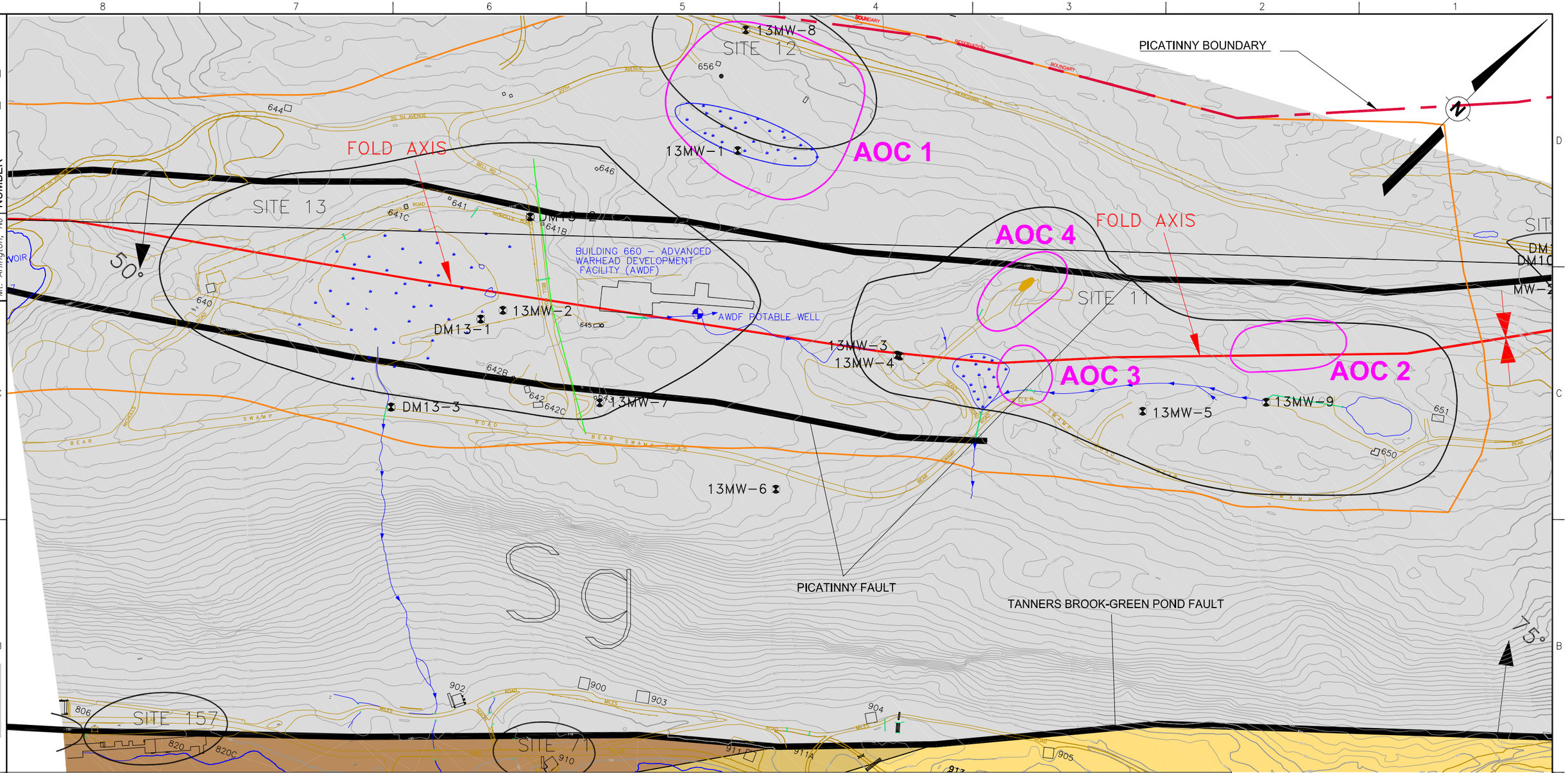
BEDROCK GEOLOGIC MAP OF PICATINNY ARSENAL

600 AREA GW INVESTIGATION

PICATINNY ARSENAL, DOVER, NEW JERSEY

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
S. Waite 09/17/07	B. Demott 09/19/07	-- --	PTA_GEO091707.dwg

File: N:\cad\CAD drawings\Picatinny\Geology Maps\OutdatedMaps\PTA_GEO091707.dwg
Plot Date/Time: Apr 22, 2013 – 7:58am
Plotted By: andrius.yanovicius



DRAWING NUMBER AWDF_Geo_NAD83

OFFICE Mt. Arlington, NJ

VERIFY SCALE 0 1"

XREF Files: IMAGE Files: ace2.TIF
File: J:\2\2\CAD drawings\Picatinny\Area-N\AWDF_Geo_NAD83.dwg
Plotted by: Time: Apr 22, 2013 – 5:12pm
Plotted by: S:\Kendrus\xanovicus
Plot Scale: 1:1

DESCRIPTION OF MAP UNITS

Green Pond Conglomerate

Sg (Middle and Lower Silurian) (Rogers,1836)–Medium to coarse grained quartz–pebble conglomerate, quartzitic arkose and orthoquartzite, and thin to thick bedded reddish–brown siltstone. Grades downward into less abundant gray, very dark red, or grayish–purple, medium to coarse–grained, thin to very thick bedded pebble to cobble–conglomerate containing clasts of red shale, siltstone, sandstone, and chert; yellowish–gray sandstone and chert; dark–gray shale and chert; and white–gray and pink milky quartz. Quartz cobbles as much as 4 in. long. Unconformably overlies Leithsville.

Leithsville Formation

Єl (Middle and Lower Cambrian) (Wherry,1909) Light to dark–gray and light–olive–gray, fine to medium grained, thin to medium–bedded dolomite. Grades downward through medium–gray, grayish–yellow, or pinkish–gray dolomite and dolomitic sandstone, siltstone, and shale to medium–gray, medium–grained, medium bedded dolomite containing quartz sand grains as stringers and lenses near the base. Lower contact gradational with Hardyston Quartzite. Unit ranges from 0 to 185 ft thick regionally.

Hardyston Quartzite

Єh (Lower Cambrian) (Wolf and Brooks, 1898)–Light–to medium–gray and bluish–gray conglomeratic sandstone. Varies from pebble conglomerate, to fine–grained, well cemented quartzite, to arkosic or dolomitic sandstone. Conglomerate contains subangular to subrounded white quartz pebbles as much as 1 in. long. Lower contact unconformable with Middle Proterozoic rocks. Unit ranges from 0–30 ft. thick regionally.

VERNON SUPERSUITE (Volkert and Drake, 1998)

Losee Metamorphic Suite (Drake, 1984; Volkert and Drake, 1999)

Quartz–Oligoclase gneiss

Ylo (Middle Proterozoic)–White–weathering, light–greenish–gray, medium to medium–coarse–grained, moderately layered to massive, foliated gneiss composed of oligoclase or andesine, quartz, and variable amounts of hornblende, augite, biotite and magnetite. Locally contains layers of amphibolite (Ya) too thin to be shown on map. Unit commonly has gradational contacts with biotite–quartz–oligoclase gneiss (Ylb) and hypersthene–quartz–plagioclase gneiss (Yh) and occurs as thin, conformable layers within bodies of diorite (Yd).

Sg — Silurian
unconformity
Єl, Єh — Cambrian
unconformity
Ylo — Middle Proterozoic
BEDROCK MONITORING WELL

FAULTS:

U / D — Normal Fault – U=upthrown side, d=downthrown side. Arrow shows attitude of fault plane, if known.

D / U — Reverse Fault – U=upthrown side, d=downthrown side. Arrow shows attitude of fault plane, if known.

FOLDS: showing trace of axial surface, dip direction of limbs, and plunge direction

Synform

WETLANDS

AREA 600 BOUNDARY

SCALE

0 250 500 750 FEET

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

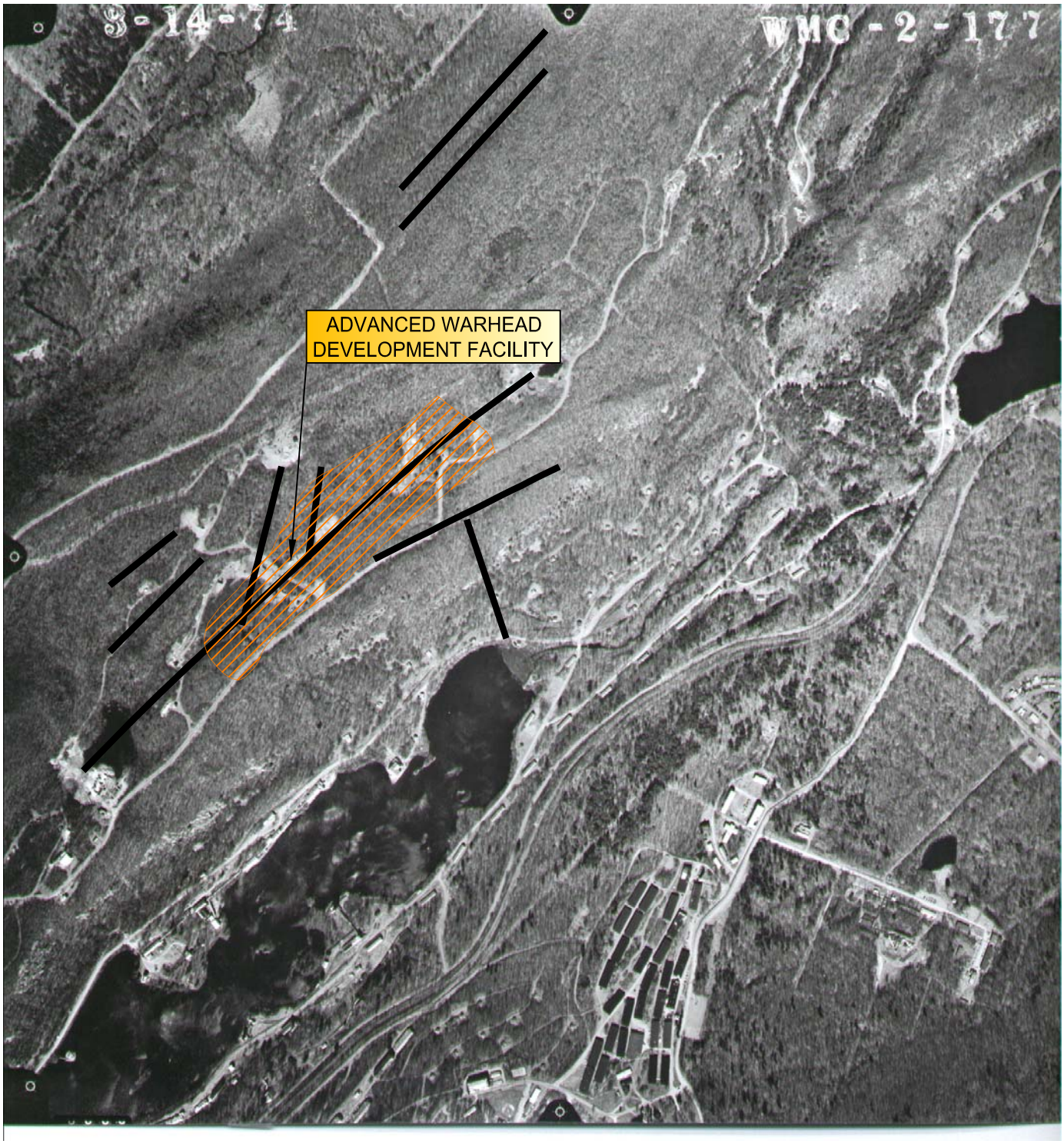
Shaw Environmental, Inc.

DESIGNED BY:	A. Smith
DRAWN BY:	S. Wiafe
CHECKED BY:	--
APPROVED BY:	--

GEOLOGIC MAP OF THE 600 AREA

600 AREA PROPOSED PLAN
PICATINNY ARSENAL, DOVER, NEW JERSEY

DATE:	SCALE:	DRAWING NO.	FIGURE NO.
02/12/10	AS SHOWN	AWDF_Geo_NAD83	3-4



LEGEND

OBSERVED LINEATIONS

AREA 600 (APPROXIMATE)

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 3-5

LINEATIONS OBSERVED FROM FRACTURE TRACE ANALYSIS

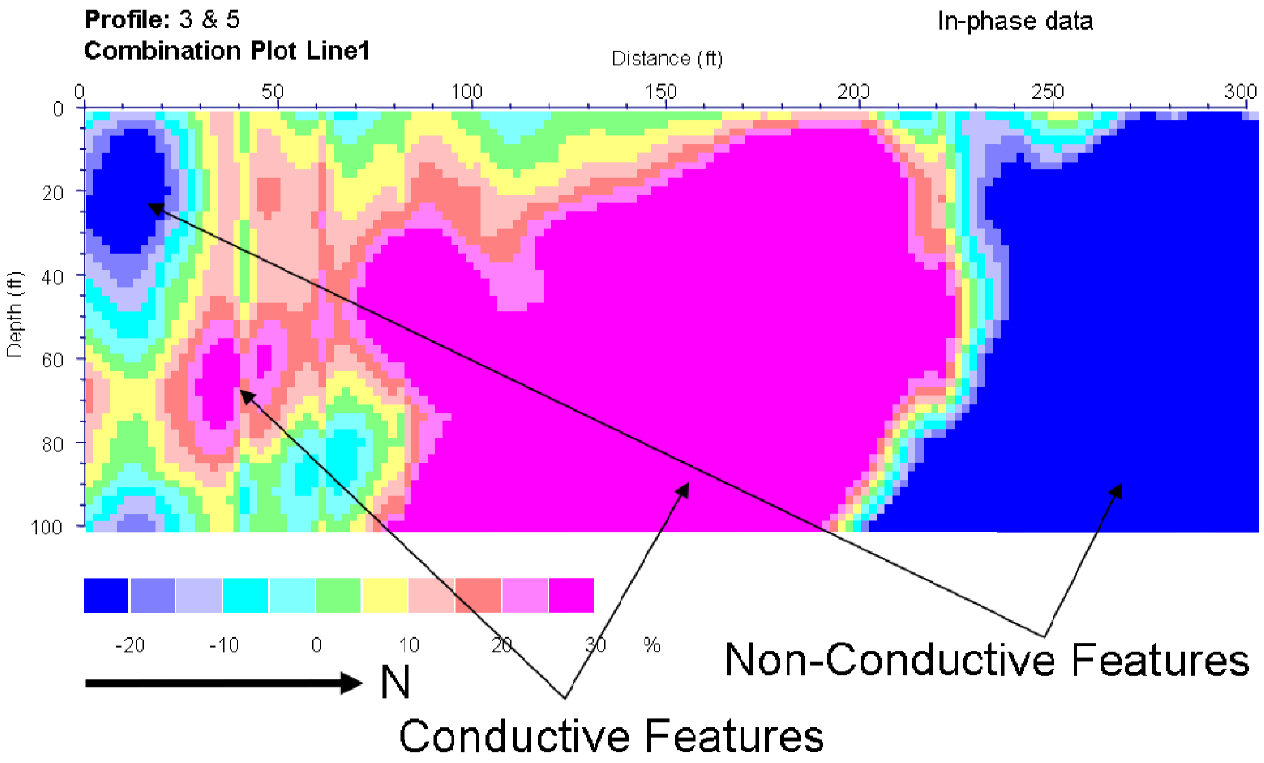
600 AREA GROUNDWATER RI
PICATINNY ARSENAL, DOVER, NJ

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S.Wiafe	09/17/07	B. Demott	09/17/07	--	--	AWDF_Frac.dwg

XREF Files: IMAGE Files: ace2.TIF
Plot Date/Time: Apr 22, 2013 - 9:14am
Plotted By: andrius.yanavicius

File: N:\cad\CAD drawings\Picatinny\Area-N\600Pre-report.dwg
Plot Date/Time: Jan 14, 2009 - 4:48pm
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	600Pre-report.dwg
S. Wiafe	09/17/07	B. Demott	09/17/07	--	--		



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

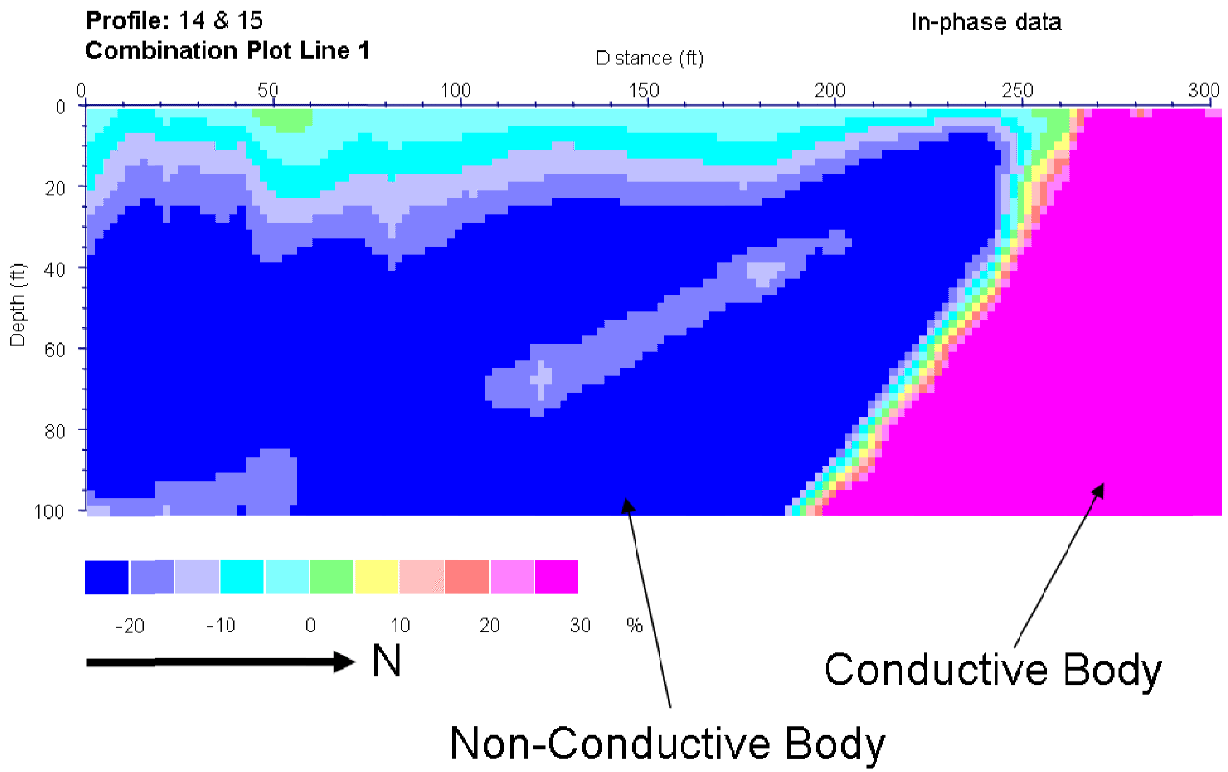
FIGURE 3-6

VLF SURVEY LINE 1

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\600Pre-report.dwg
Plot Date/Time: Jan 14, 2009 - 6:14pm
Plotted By: joy.pasquarelli

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	600Pre-report.dwg
S. Wiafe	09/17/07	B. Demott	09/17/07	--	--		



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

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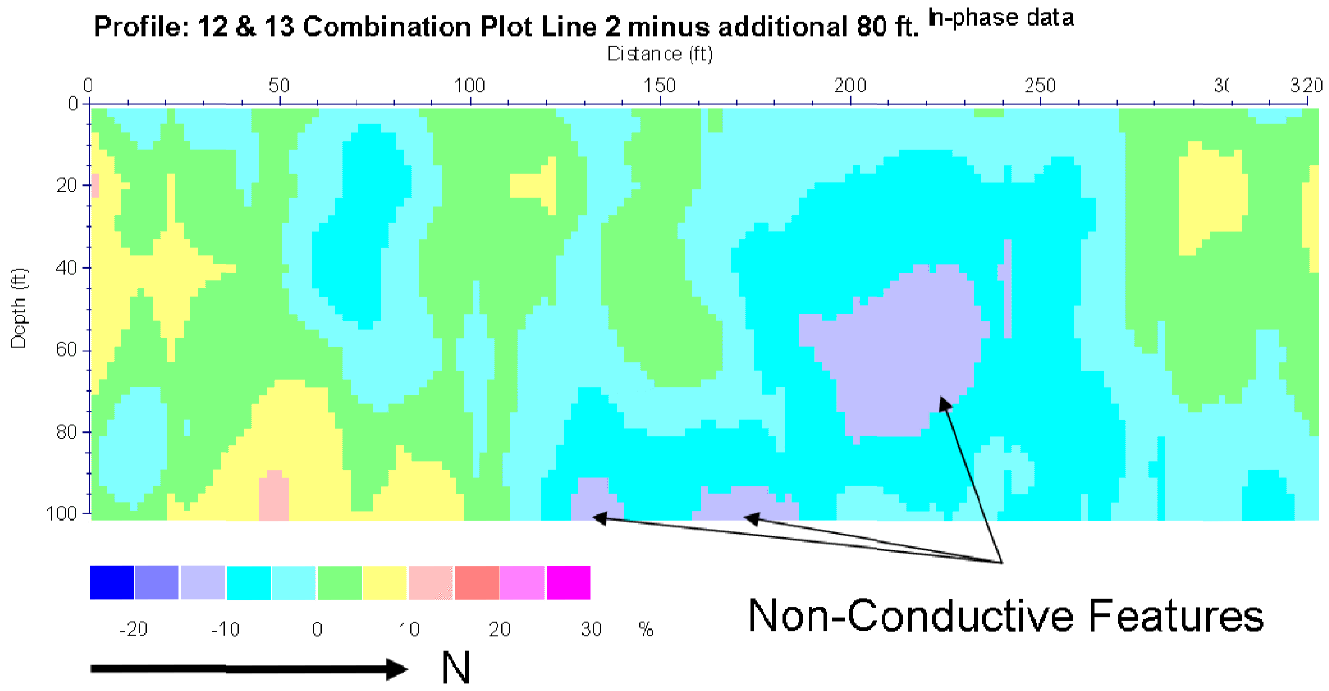
FIGURE 3-6b

VLF SURVEY LINE 1
(REVERSE)

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\600Pre-report.dwg
Plot Date/Time: Jan 14, 2009 - 4:49pm
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	600Pre-report.dwg
S. Wiafe	09/17/07	B. Demott	09/17/07	--	--		



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

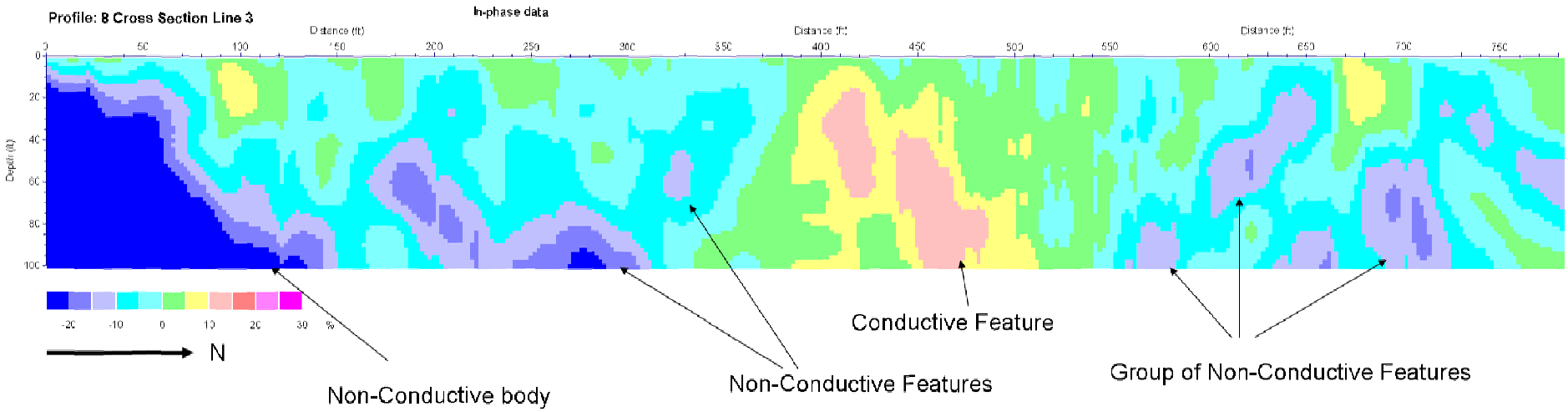
FIGURE 3-7

VLF SURVEY LINE 2

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\600Pre-report.dwg
Plot Date/Time: Jan 14, 2009 - 4:49pm
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	600Pre-report.dwg
S. Wiafe	09/17/07	B. Demott	09/17/07	--	--		



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

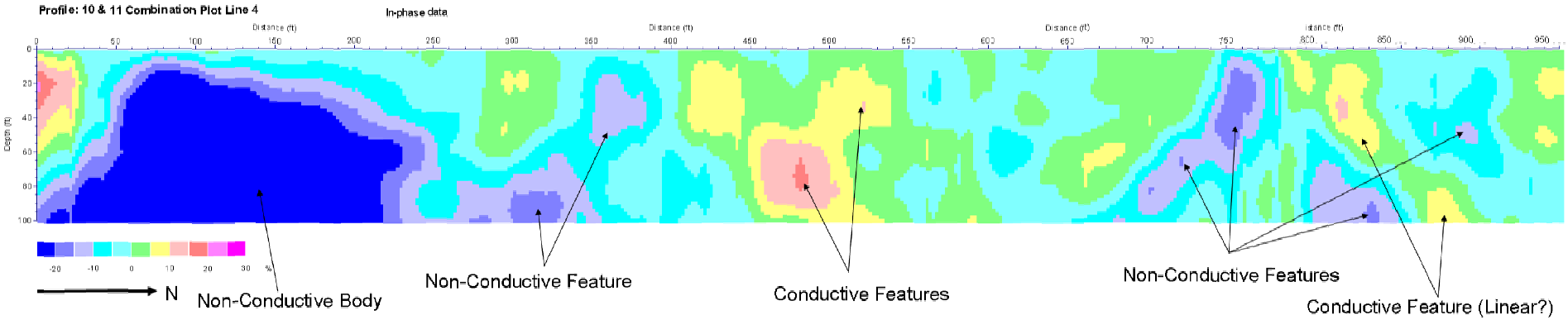
FIGURE 3-8

VLF SURVEY LINE 3

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\600Pre-report.dwg
Plot Date/Time: Jan 14, 2009 - 4:50pm
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	600Pre-report.dwg
S. Wiafe	09/17/07	B. Demott	09/17/07	--	--		



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

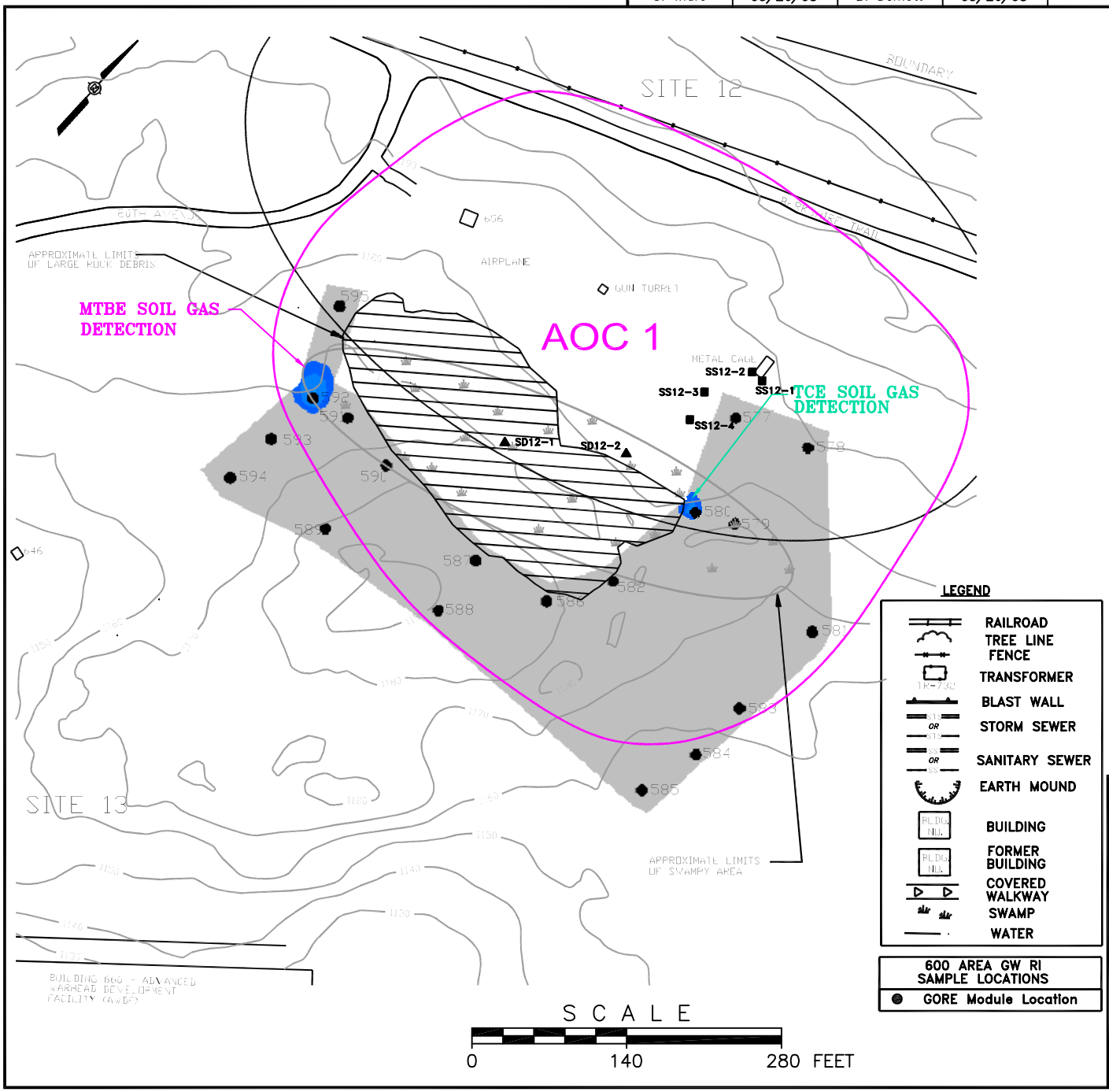
FIGURE 3-9

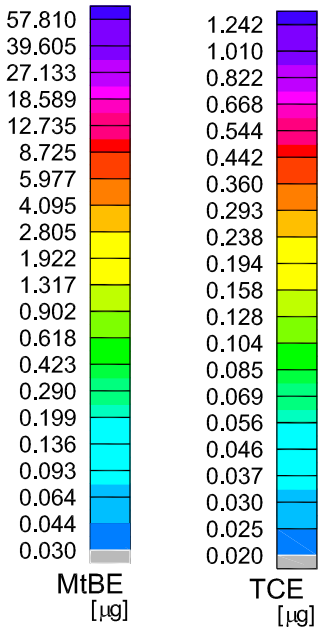
VLF SURVEY LINE 4

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\NAD83_3-2 MTBE.dwg
Plot Date/Time: Nov 11, 2008 – 11:08am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	03/26/08	B. Demott	03/26/08	--	--	NAD83_3-2 MTBE.dwg





LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TRANSFORMER
- BLAST WALL
- STORM SEWER
- SANITARY SEWER
- EARTH MOUND
- BUILDING
- FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER

600 AREA GW RI SAMPLE LOCATIONS

- GORE Module Location

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

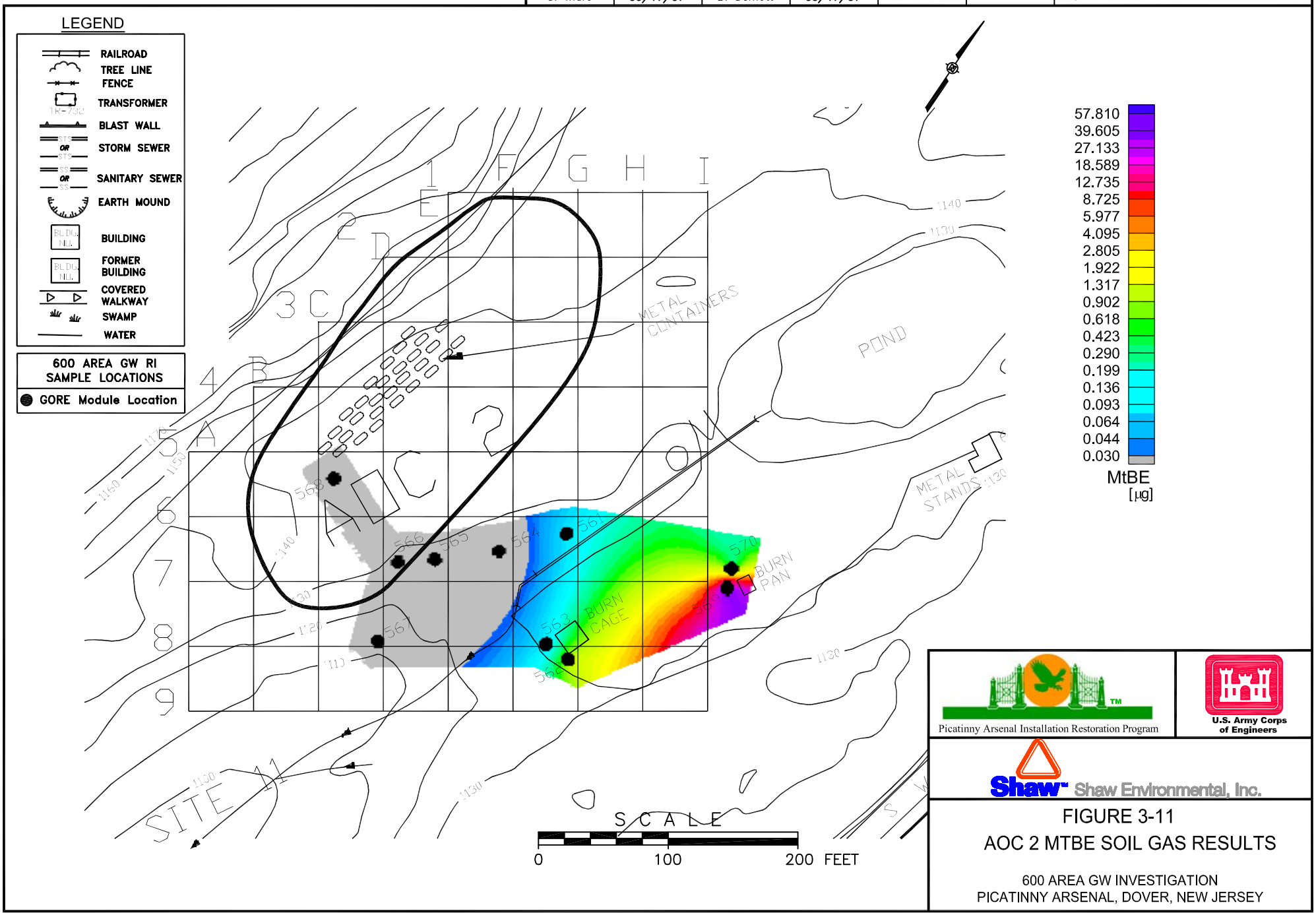
FIGURE 3-10

AOC 1 TCE & MTBE SOIL GAS RESULTS

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\AOC-2_MBTE.dwg
Plot Date/Time: Nov 11, 2008 – 11:00am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	AOC-2_MBTE.dwg
S. Wiafe	09/17/07	B. Demott	09/17/07	--	--		



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

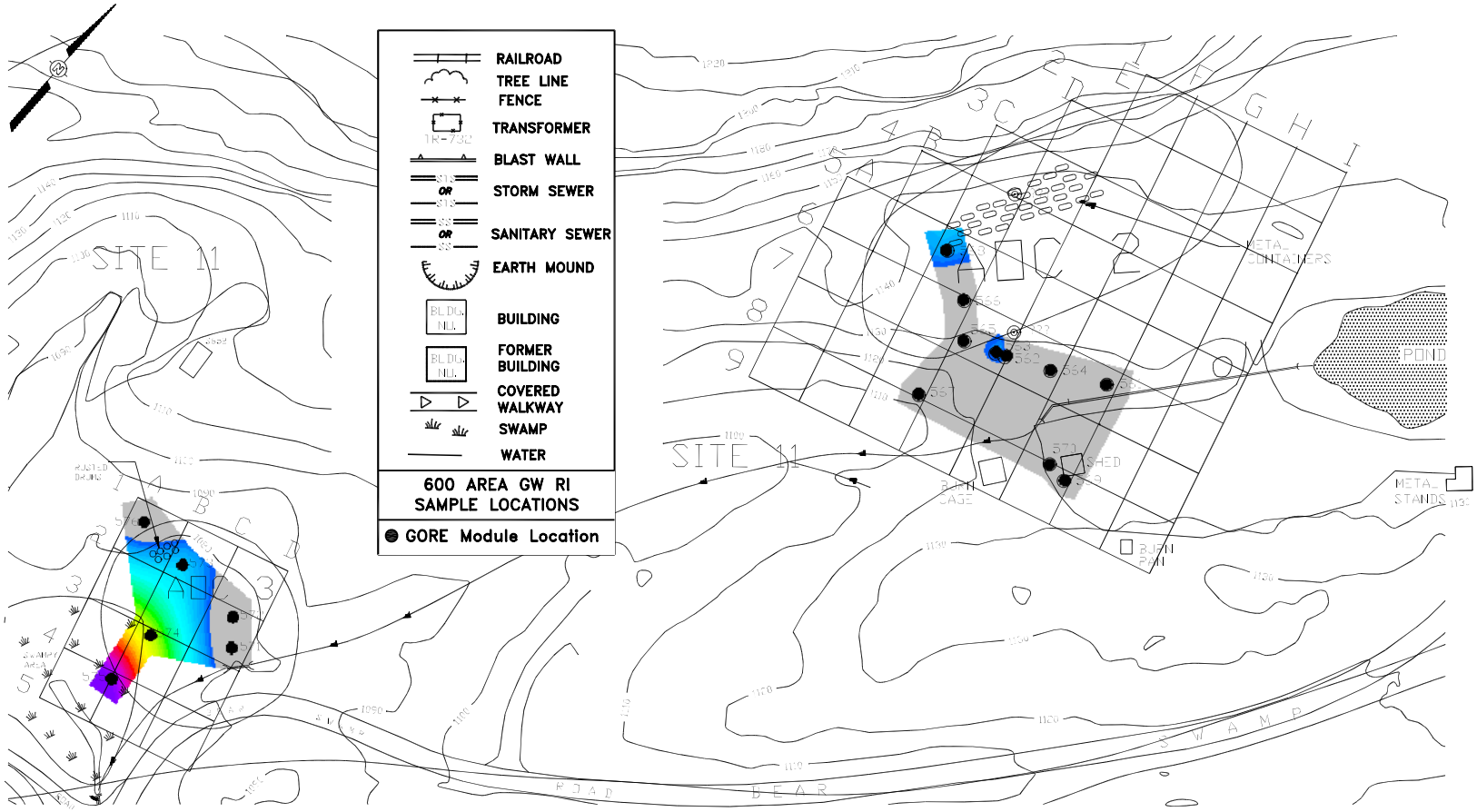
Shaw Environmental, Inc.

FIGURE 3-11
AOC 2 MTBE SOIL GAS RESULTS

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\AOC2&3 TCE BASE.dwg
Plot Date/Time: Nov 11, 2008 – 11:04am
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	AOC2&3 TCE BASE.dwg
S. Wiafe	03/26/08	B. Demott	09/26/08	--	--		



SCALE

0 160 320 FEET

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

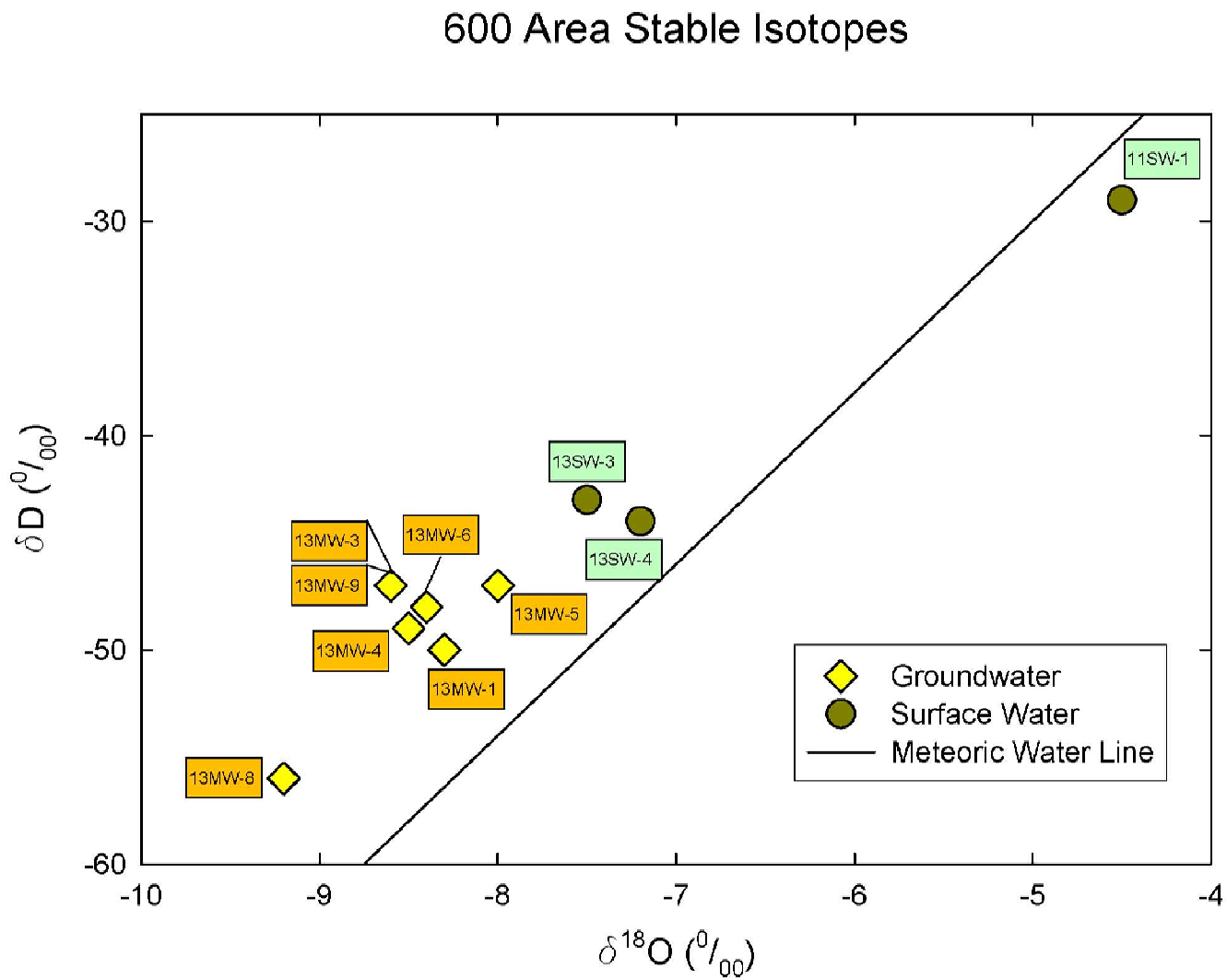
FIGURE 3-12

AOC 2 & 3 TCE SOIL GAS RESULTS

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\AOC2&3 TCE BASE.dwg
Plot Date/Time: Jan 14, 2009 – 4:57pm
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	AOC2&3 TCE BASE.dwg
S. Wiafe	09/17/07	B. Demott	09/17/07	--	--		



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

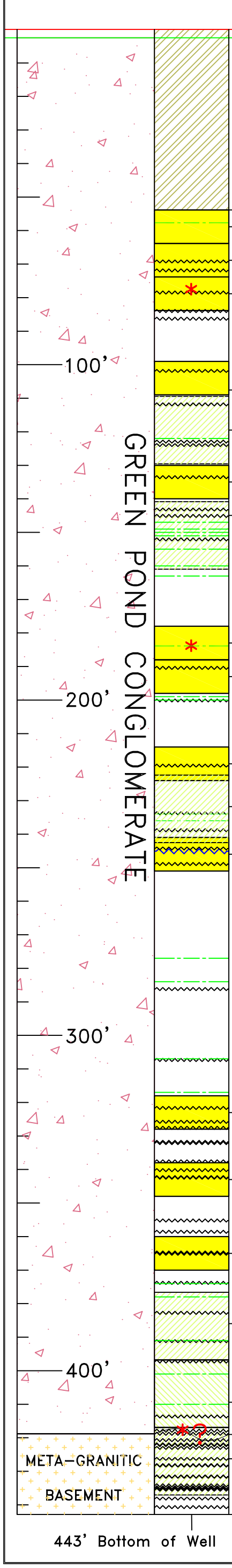
FIGURE 3-13

MWL PLOT FOR RADIOISOTOPE DATA

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

XREF Files: IMAGE Files: piclogo3.tif
File: N:\cad\CAD drawings\Picatinny\Area-N\Packer080104.dwg
Plot Date/Time: Jan 14, 2009 - 5:00pm
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
A. Smith	6/18/04	--	--	--	--	Packer080104.dwg



Interval 1: 55'-65'		
Interval Yield:	0.08 L/min	0.02 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	ND
Freon 113	59,000	ND
MTBE	70	ND
Toluene	1,000	110

Interval 2: 65'-75'		
Interval Yield:	0.16 L/min	0.04 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	0.92
Freon 113	59,000	ND
MTBE	70	1.10
Toluene	1,000	84

Interval 3: 75'-85'		
Interval Yield:	1.14 L/min	0.3 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	5.7
Freon 113	59,000	1.7
MTBE	70	1.50
Toluene	1,000	40

Interval 4: 99'-109'		
Interval Yield:	0.04 L/min	0.01 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	8.9
Freon 113	59,000	4.4
MTBE	70	2.20
Toluene	1,000	84

Interval 2-1: 109'-129'		
Interval Yield:	0.16 L/min	0.04 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	26
Freon 113	59,000	6.9
Toluene	70	40
MTBE	1,000	3.1

Interval 2-2: 140'-160'		
Interval Yield:	0.12 L/min	0.03 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	71
Freon 113	59,000	20
MTBE	70	1.3
Toluene	1,000	18

Interval 5: 130'-140'		
Interval Yield:	0.04 L/min	0.01 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	24
Freon 113	59,000	4.3
MTBE	70	1.70
Toluene	1,000	72

Interval 6: 178'-188'		
Interval Yield:	0.57 L/min	0.15 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	55
Freon 113	59,000	9.7
MTBE	70	0.80
Toluene	1,000	74

Interval 7: 188'-198'		
Interval Yield:	0.25 L/min	0.07 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	42
Freon 113	59,000	9.1
MTBE	70	0.87
Toluene	1,000	55

Interval 8: 214'-224'		
Interval Yield:	0.50 L/min	0.13 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	49
Freon 113	59,000	9.4
MTBE	70	0.67
Toluene	1,000	61

Interval 2-3: 220'-240'		
Interval Yield:	0.50 L/min	0.13 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	48
Freon 113	59,000	9.4
MTBE	70	1.4
Toluene	1,000	28

Interval 9: 241'-251'		
Interval Yield:	0.22 L/min	0.06 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	41
Freon 113	59,000	8.6
MTBE	70	1.10
Toluene	1,000	37

LEGEND

FRACTURES IDENTIFIED BY OPTICAL TELEVIEWER
- Continuous Open Fracture
- Partial Open Fracture

FRACTURES IDENTIFIED BY BOREHOLE VIDEO
- Probable Water Bearing Fracture
- Possible Water Bearing Fracture
- Packer Test Interval
- ADDITIONAL PACKER TEST ZONES
- Steel Casing
- * Conductivity Inflection

Interval 10: 318'-328'		
Interval Yield:	0.08 L/min	0.02 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	30
Freon 113	59,000	5.5
MTBE	70	ND
Toluene	1,000	240

Interval 11: 338'-348'		
Interval Yield:	0.12 L/min	0.03 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	25
Freon 113	59,000	5.0
MTBE	70	0.97
Toluene	1,000	84

Interval 12: 360'-370'		
Interval Yield:	0.25 L/min	0.07 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	35
Freon 113	59,000	6.6
MTBE	70	0.95
Toluene	1,000	12

Interval 2-4: 376'-396'		
Interval Yield:	0.03 L/min	0.01 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	35
Freon 113	59,000	5.9
MTBE	70	ND
Toluene	1,000	100

Interval 2-5: 396'-416'		
Interval Yield:	0.01 L/min	<0.01 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	9.0
Freon 113	59,000	1.4
MTBE	70	1.8
Toluene	1,000	2.0

Interval 2-6: 416'-436'		
Interval Yield:	0.04 L/min	0.01 gpm
Analytical Data	LOC (ppb)	Conc. (ppb)
TCE	1.0	11.0
Freon 113	59,000	1.7
MTBE	70	0.99
Toluene	1,000	3.0

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

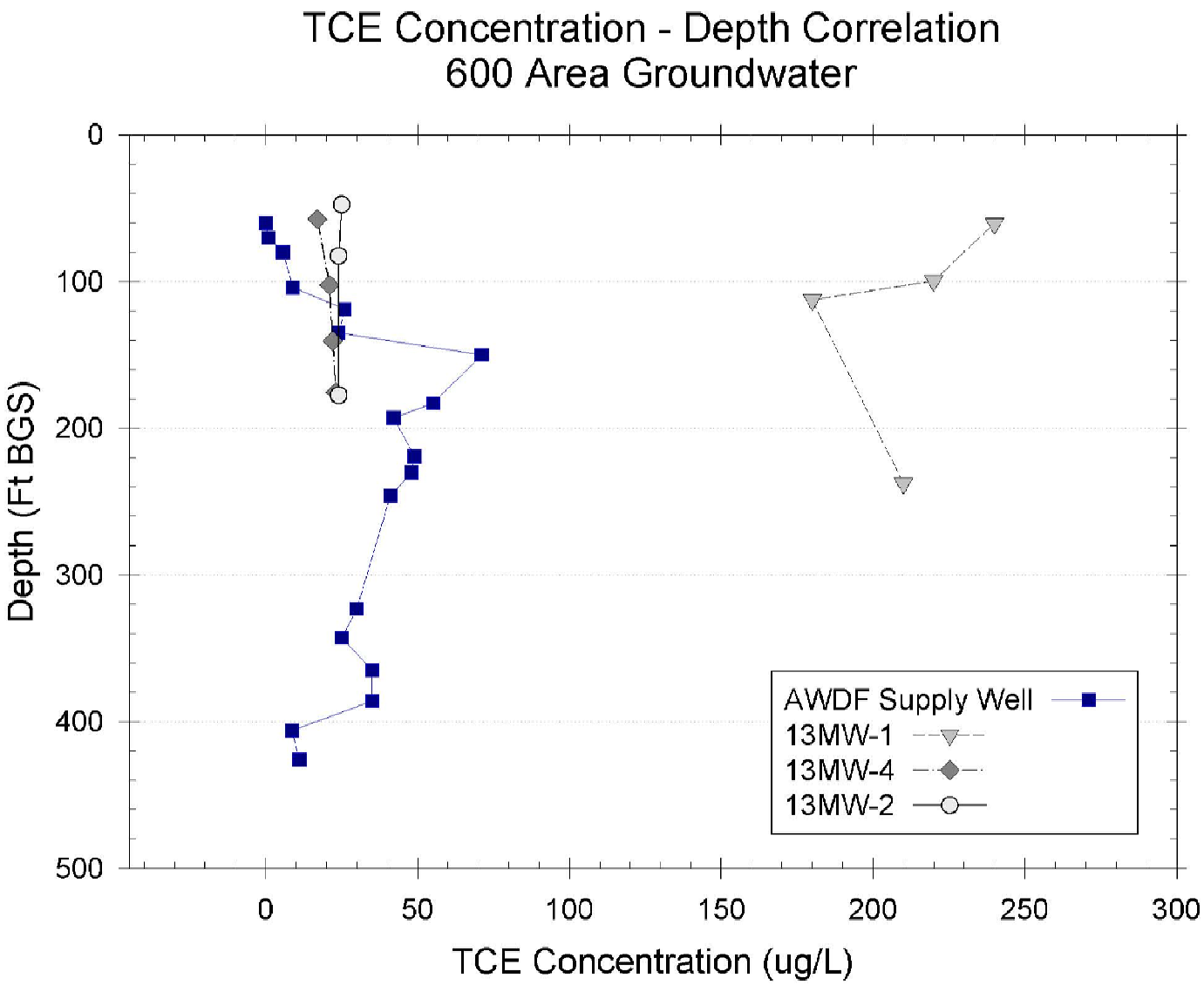
FIGURE 3-14

AWDF PRODUCTION WELL
SCHEMATIC PACKER TEST SUMMARY

600 Area GW Investigation
PICATINNY, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\AOC2&3 TCE BASE.dwg
Plot Date/Time: Jan 14, 2009 – 4:58pm
Plotted By: stephen.Wiafe

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	AOC2&3 TCE BASE.dwg
S. Wiafe	09/17/07	B. Demott	09/17/07	--	--		



Picatinny Arsenal Installation Restoration Program

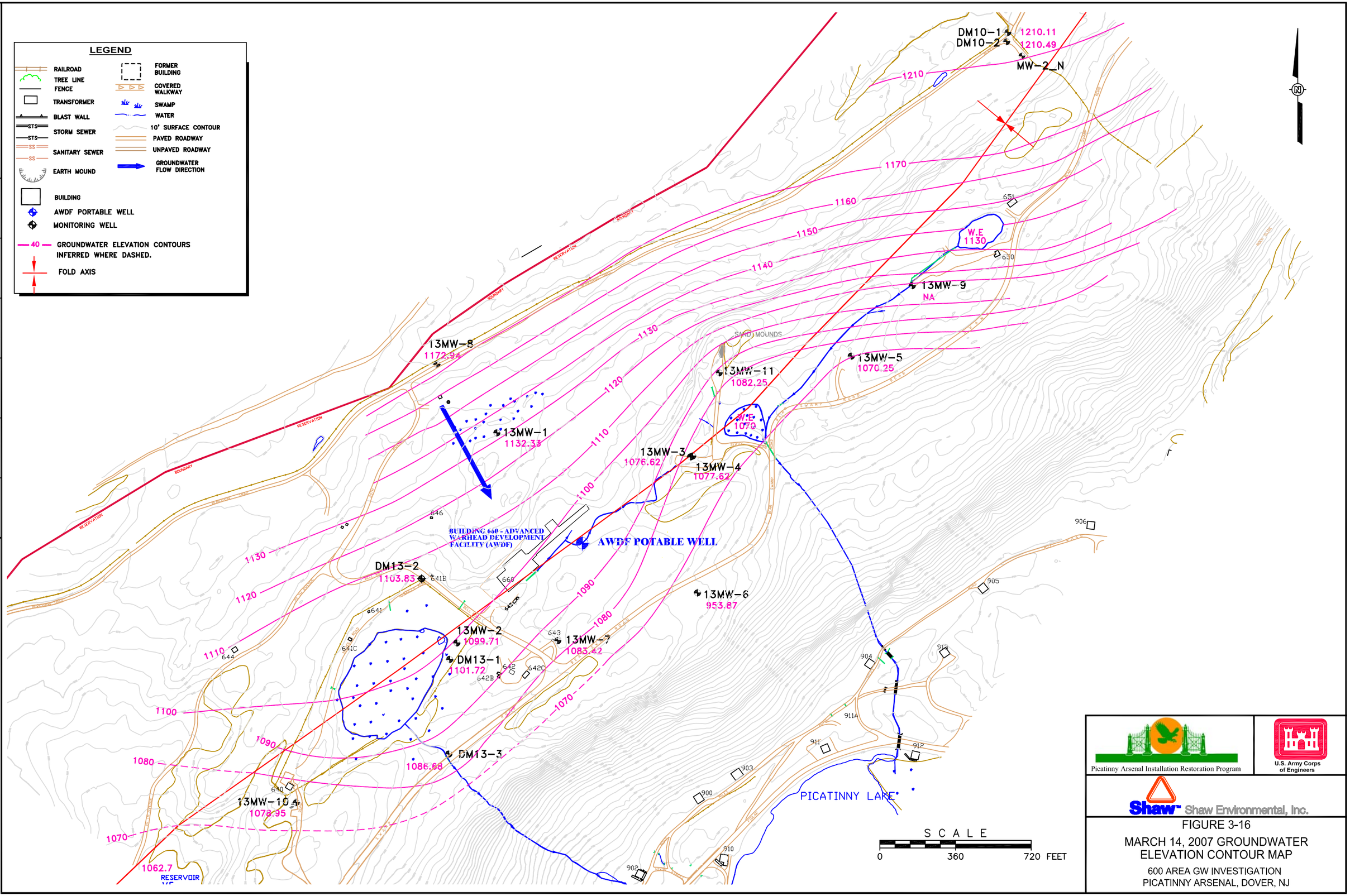
U.S. Army Corps of Engineers

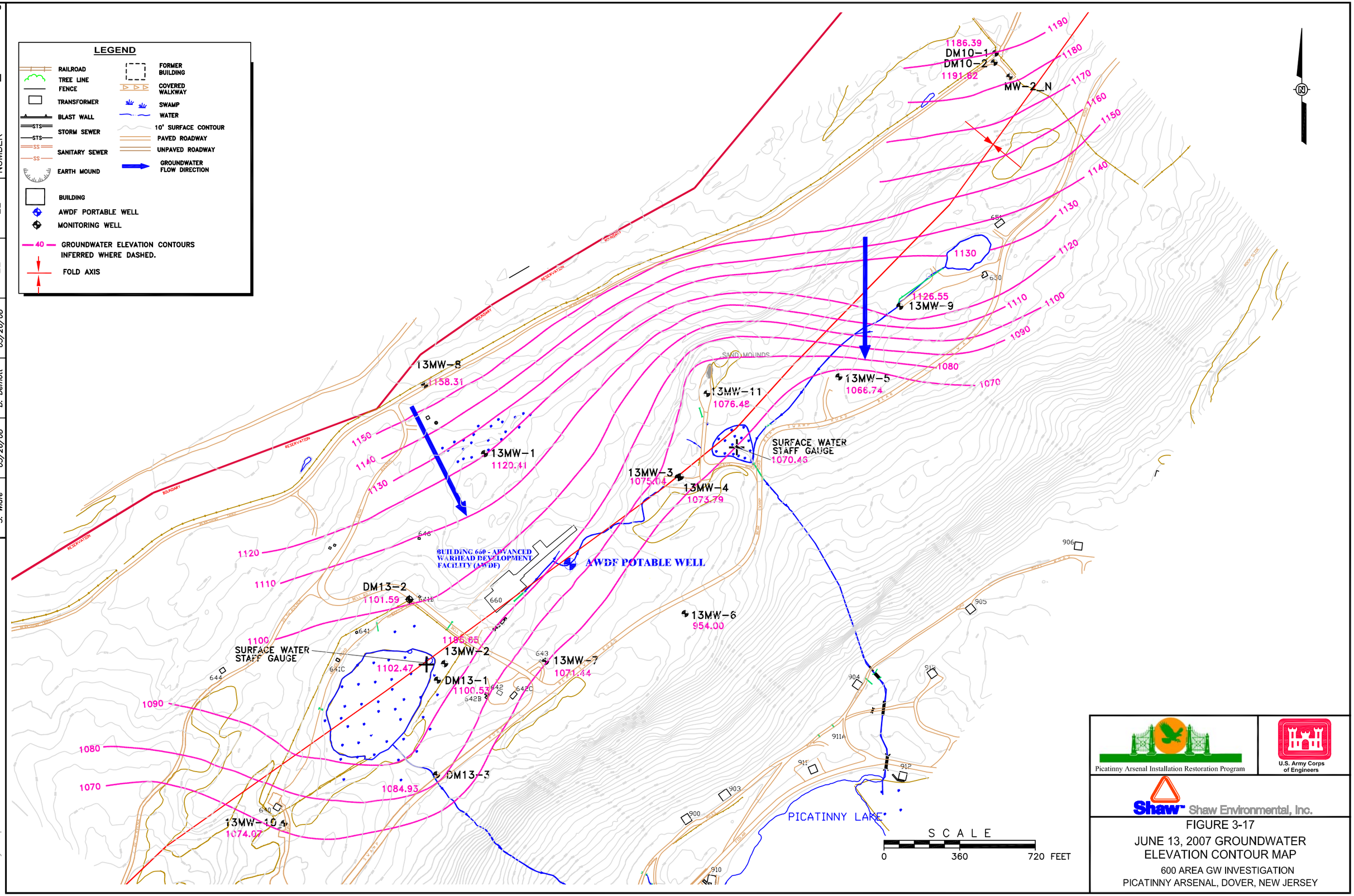
Shaw Environmental, Inc.

FIGURE 3-15

TCE PACKER TEST RESULTS FOR
AWDF, 13MW-1,13MW-2 AND 13MW-4 WELLS

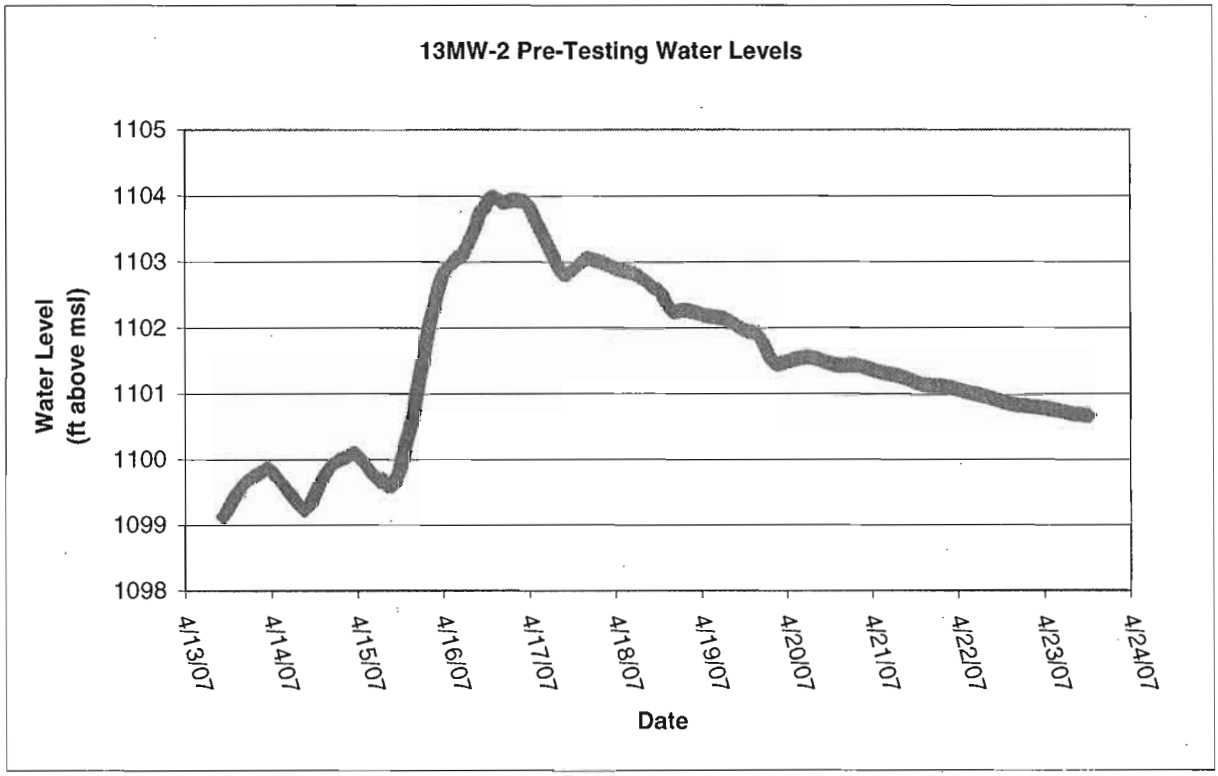
600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY


LEGEND
RAILROAD
TREE LINE
FENCE
TRANSFORMER
BLAST WALL
STORM SEWER
SANITARY SEWER
EARTH MOUND
BUILDING
AWDF PORTABLE WELL
MONITORING WELL
40 GROUNDWATER ELEVATION CONTOURS INFERRED WHERE DASHED.
FOLD AXIS
FORMER BUILDING
COVERED WALKWAY
SWAMP
WATER
10' SURFACE CONTOUR
PAVED ROADWAY
UNPAVED ROADWAY
GROUNDWATER FLOW DIRECTION
DM10-1 1210.11
DM10-2 1210.49
MW-2_N
13MW-8 1172.94
13MW-1 1132.33
13MW-3 1076.62
13MW-4 1077.62
13MW-11 1082.25
13MW-5 1070.25
13MW-9 NA
W.E 1130
W.E 1070
SAND MOUNDS
BUILDING 660 - ADVANCED WARHEAD DEVELOPMENT FACILITY (AWDF)
AWDF POTABLE WELL
DM13-2 1103.83
13MW-6 953.87
13MW-2 1099.71
13MW-7 1083.42
DM13-1 1101.72
DM13-3 1086.68
13MW-10 1078.95
1062.7
RESERVOIR
PICATINNY LAKE
RESERVATION BOUNDARY
SCALE
0 360 720 FEET
Picatinny Arsenal Installation Restoration Program
U.S. Army Corps of Engineers
Shaw Environmental, Inc.
FIGURE 3-16
MARCH 14, 2007 GROUNDWATER ELEVATION CONTOUR MAP
600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NJ
DRAWING NUMBER AWDF_072007.dwg
APPROVED BY
CHECKED BY B. Demott 03/26/08
DRAWN BY S. Wiafe 03/26/08
File: N:\cad\CAD drawings\Picatinny\Area-N\AWDF_072007.dwg
Plot Date/Time: Nov 11, 2008 - 10:49am
Plotted By: stephen.Wiafe



File: N:\cad\CAD drawings\Picatinny\Area-N\AWDF_072007.dwg
Plot Date/Time: Nov 11, 2008 - 10:38am
Plotted By: stephen.Wiafe

Figure 3-18
Pre Test Water Level Data
Wells 13MW-2 and 13MW-4



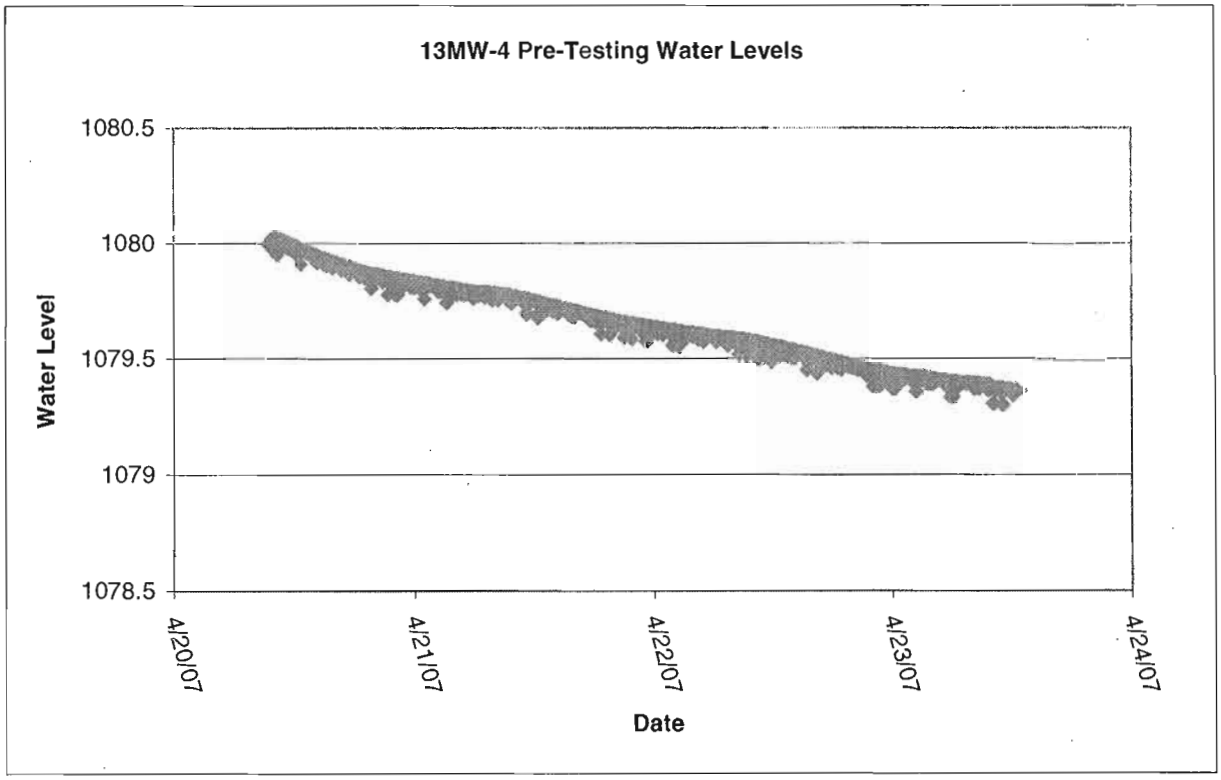
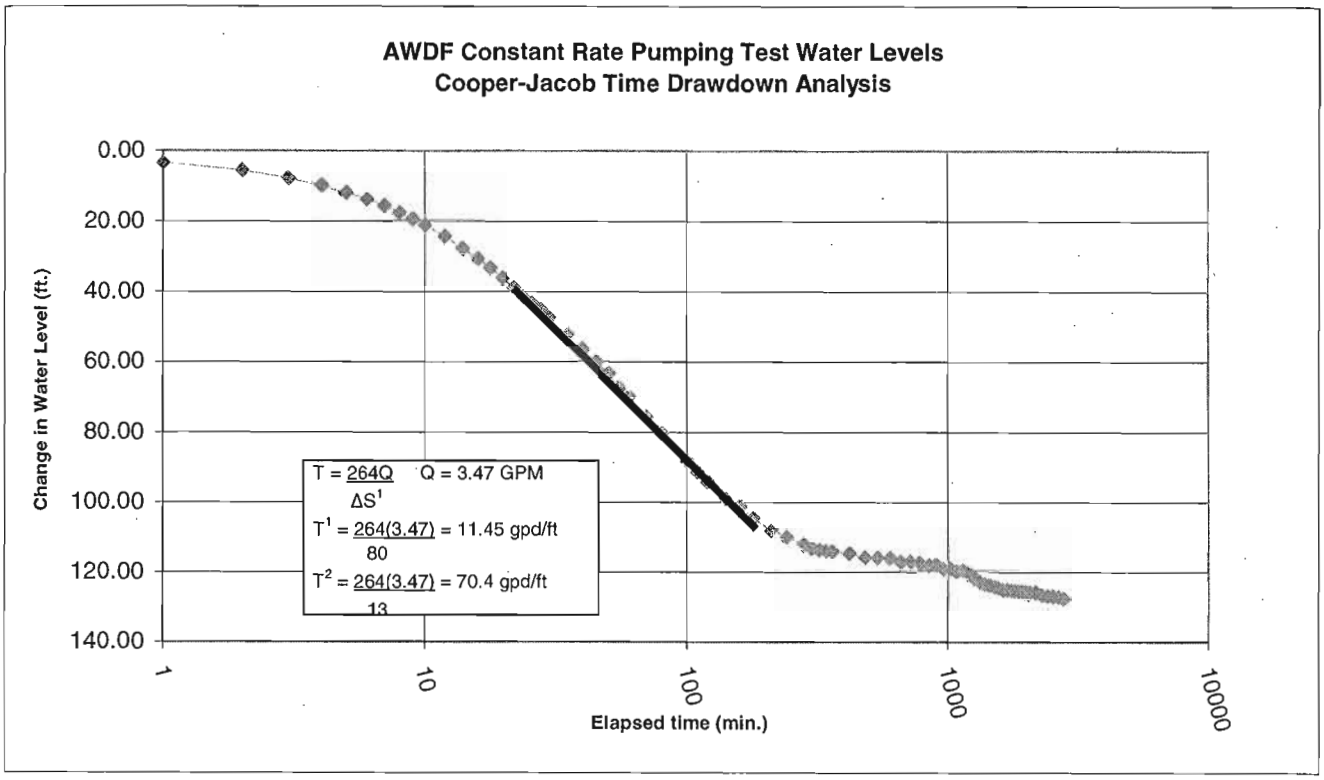


Figure 3-19
Time-Drawdown Plot
of AWDF and 13MW-2



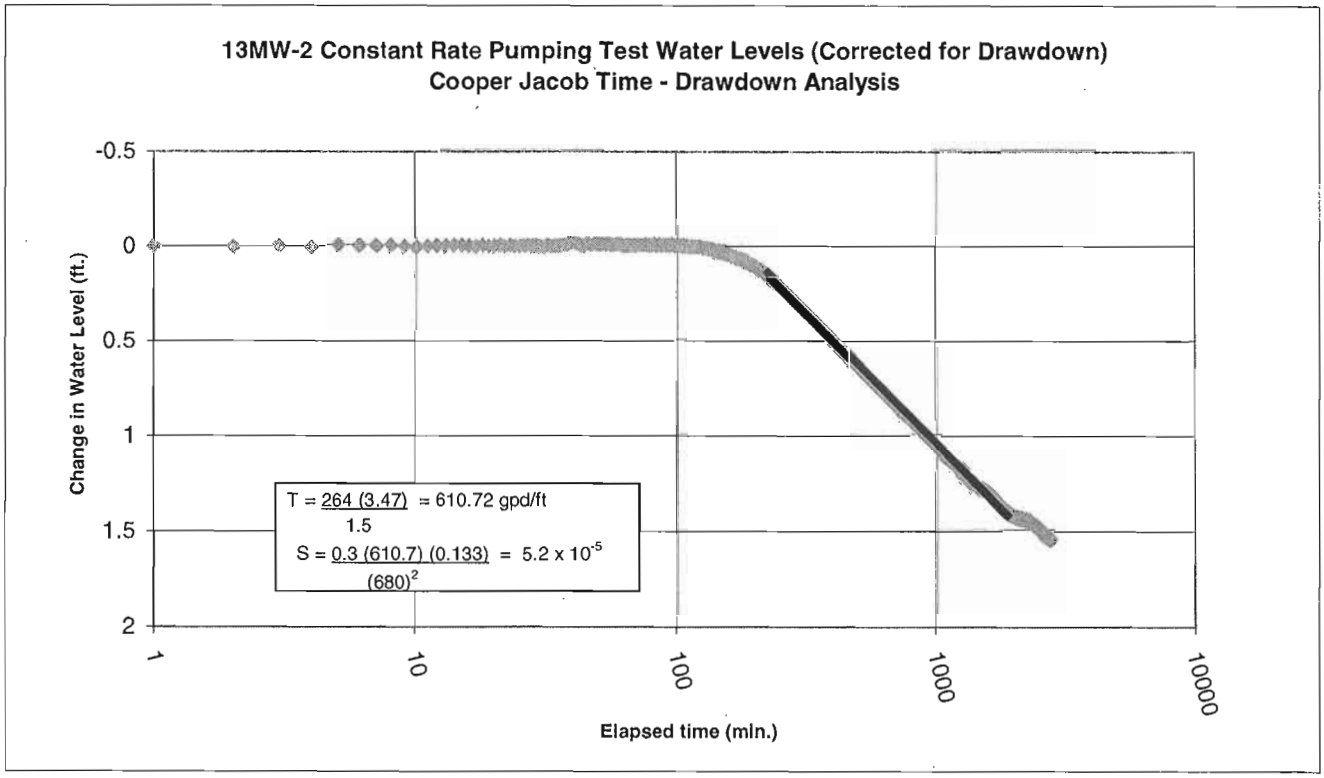
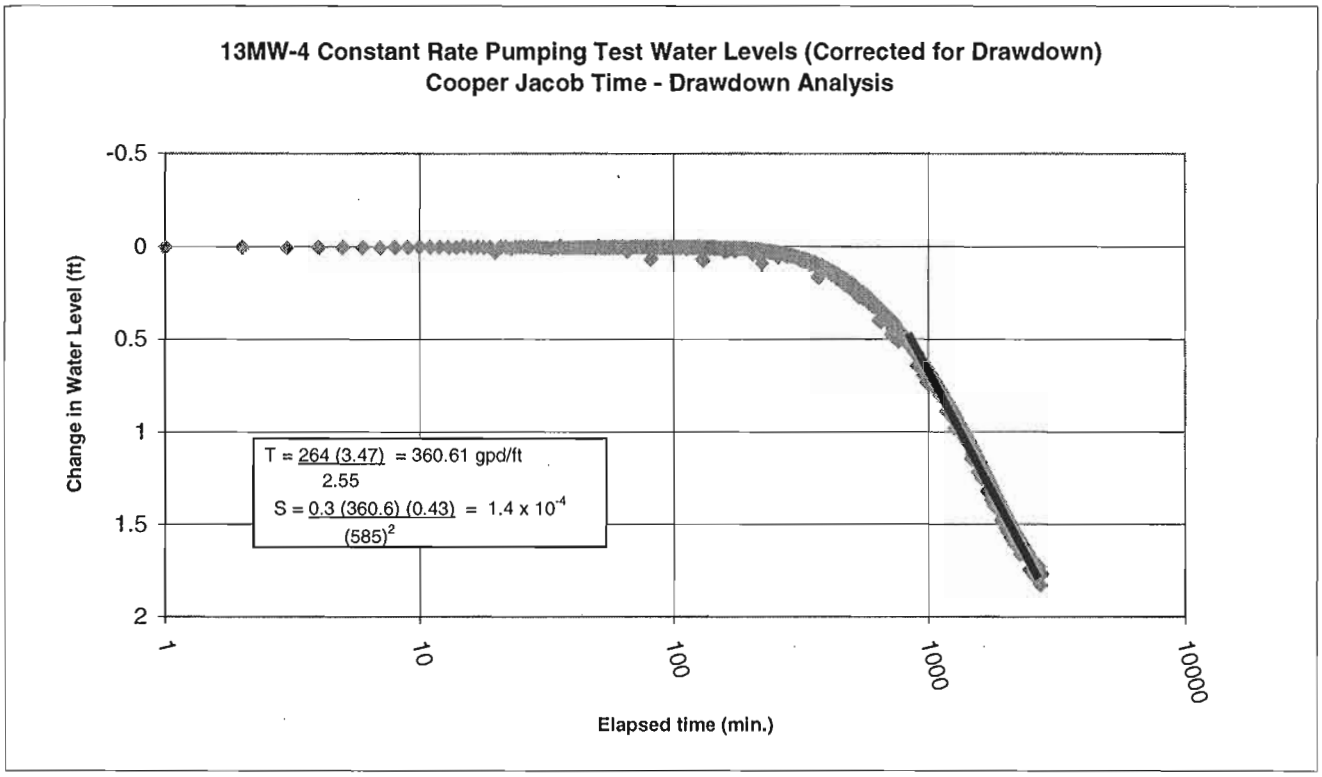


Figure 3-20
Time-Drawdown Plot
of 13MW-4 and 13MW-7



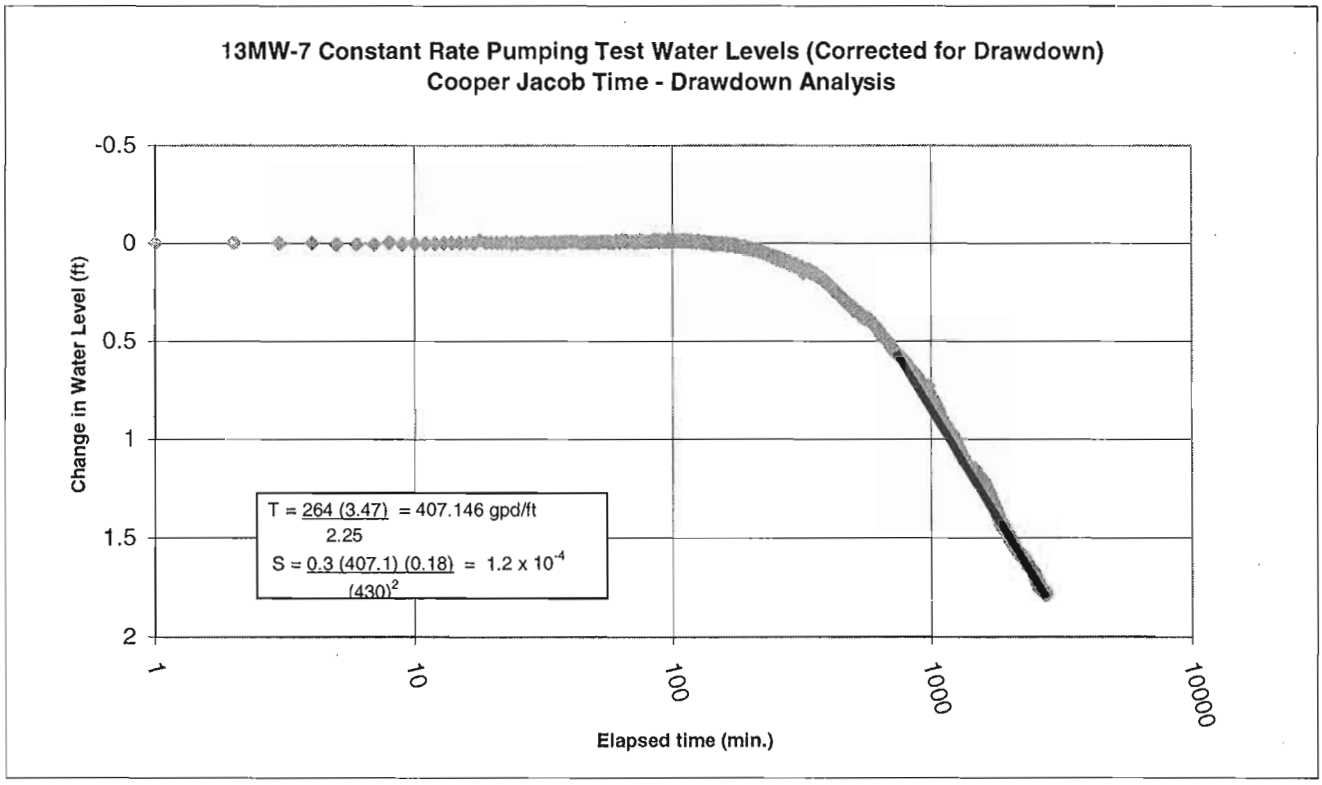
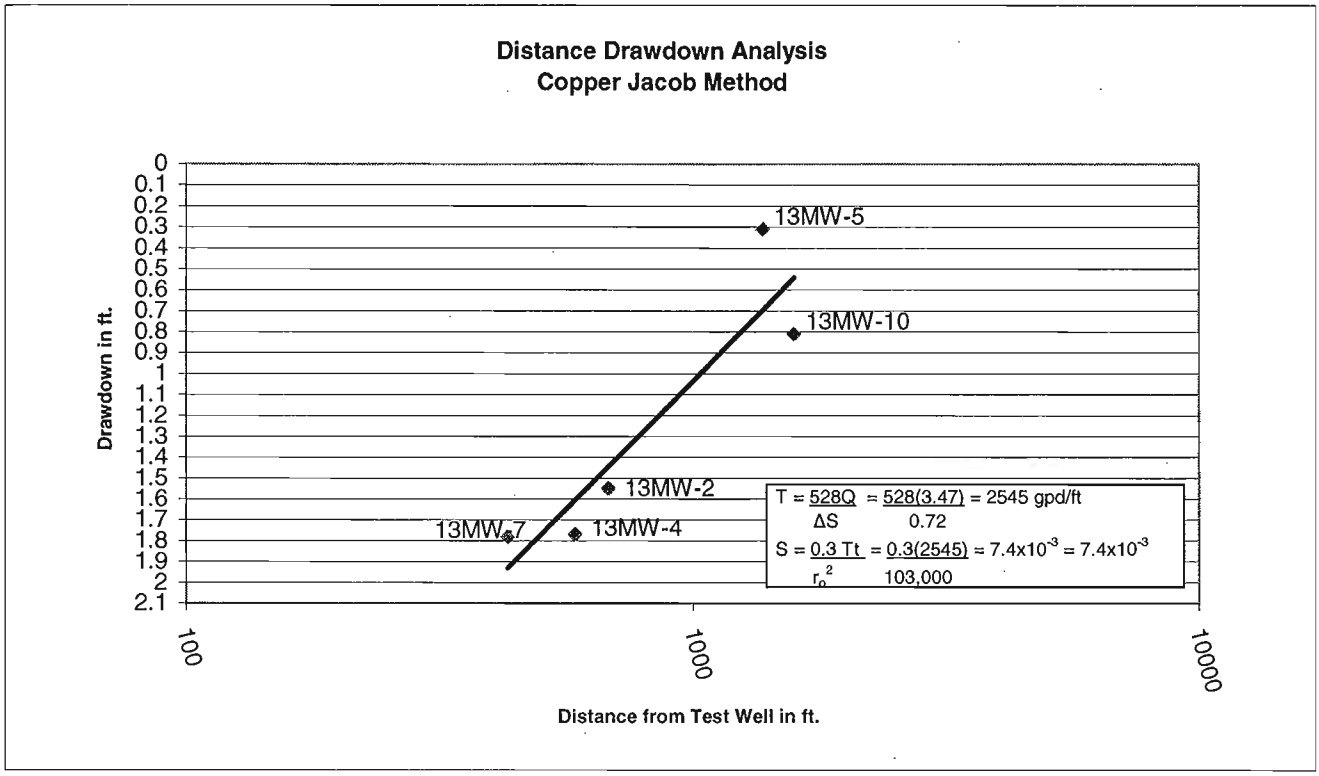
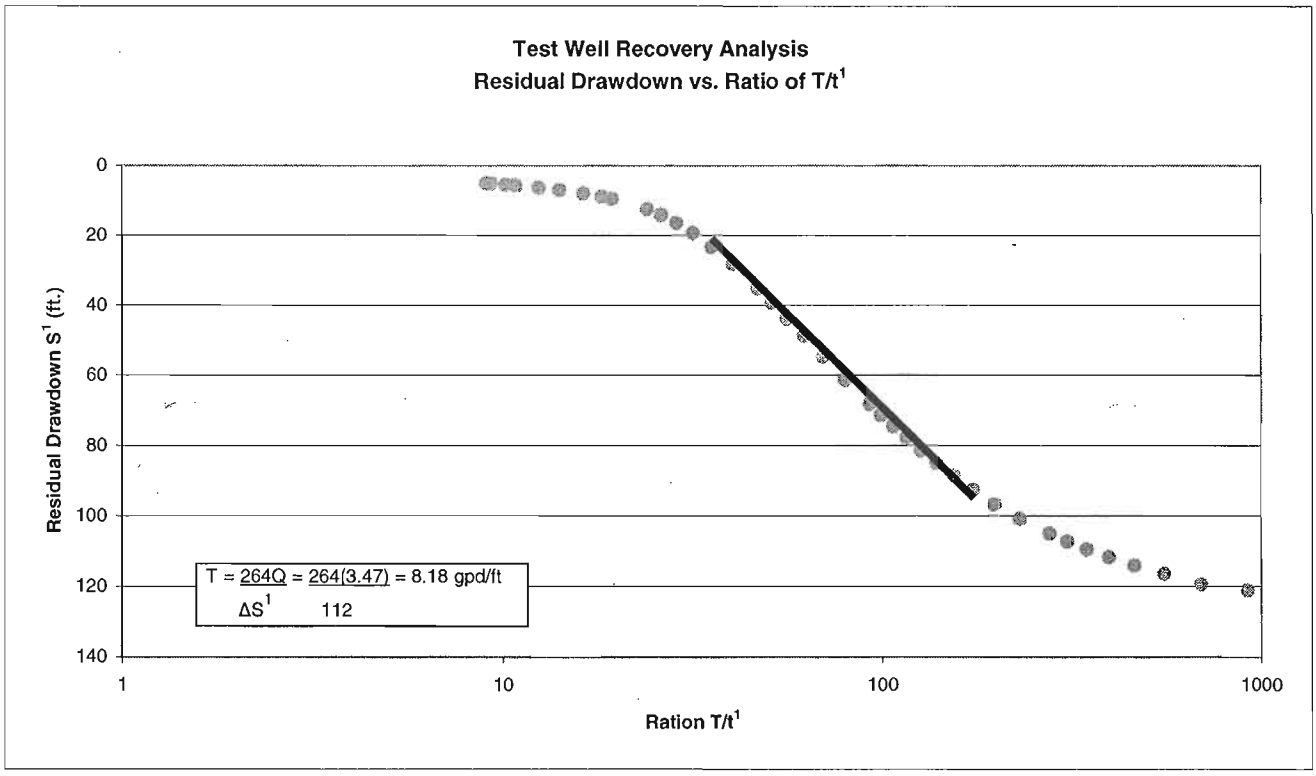
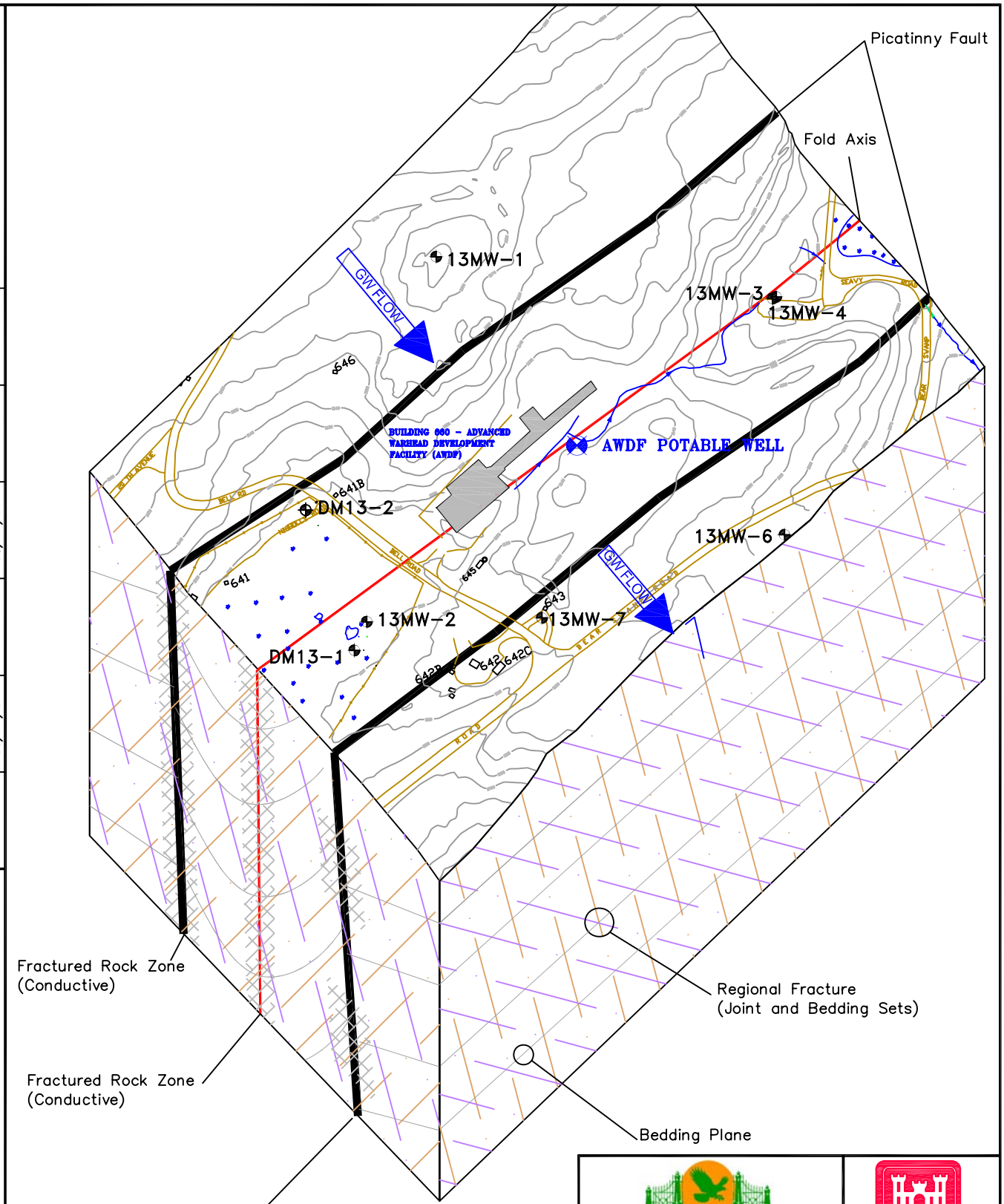


Figure 3-21
Distance-Drawdown and Residual Recovery Plot







DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S.Wiafe	09/17/07	B. Demott	09/17/07	--	--	AWDF_ConMod.dwg

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE No. 3-22

Conceptual Hydrogeologic Model

600 Area GW Investigation
PICATINNY, DOVER, NEW JERSEY

File: N:\cad\CAD drawings\Picatinny\Area-N\AWDF_ConMod.dwg
Plot Date/Time: Jan 14, 2009 - 5:04pm
Plotted By: stephen.Wiafe

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 OVERVIEW

A total of eight groundwater and seven surface water sampling rounds were conducted during the period November 2004 through June 2008. Two additional rounds of groundwater and surface water sampling were completed in May 2010 and February 2011. A summary of the sampling dates and analytes are shown for groundwater, surface water, and sediment media in **Tables 2-8** and **2-9**. As shown, the groundwater sampling rounds were expanded over time to include newly installed wells in 2005 (13MW-1, 2, 3 & 4), 2006 (13MW-5, 6, 7, 8 & 9), 2007 (13MW-10 and 11), and 2010 (13MW-12 and 13). Existing Site 10 wells DM10-1, DM10-2, and MW-2N were added to the June 2008 sampling round and were sampled for baseline explosives per the RDX Work Plan. The groundwater and surface water sampling rounds included analysis for VOCs w/TICs and Baseline explosives. VOC LOC exceedances were detected in groundwater, and included TCE and MTBE. Surface water VOC LOC exceedances included TCE, but were not observed in sediment and soil. Baseline explosive (RDX) exceedances were detected in groundwater and surface water, but not in sediment. The results of VOC and baseline explosives sampling in groundwater, surface water, sediment, and soil media are addressed in **Sections 4.2** through **4.6**. Sampling of groundwater for bioremediation parameters were conducted in March 2007 to characterize the groundwater redox environment and determine viable remedial technologies. The results of bioremediation and QA/QC sampling is presented in **Sections 4.7** and **4.8**, respectively. **Tables 4-1** through **4-9** present the analytical sampling results, including bioremediation parameters, and QA/QC analyses. Well purge Data Sheets are provided in **Appendix J**. An electronic data deliverable is included in **Appendix K**.

4.2 VOCS IN GROUNDWATER

VOC sampling has been conducted at the AWDF well since 1994, and in newly installed monitoring wells since 2005. Results of groundwater VOC sampling is shown in **Table 4-1**. June 2008 VOC data shows eight exceedances of TCE in groundwater. VOC results from 2010 and 2011 were consistent with the 2008 data, although monitoring well 13MW-4 was not sampled in 2011 and 13MW-3 was not sampled in either 2010 or 2011. Well 13MW-3 could not be located in 2010, and is likely to have been buried under construction materials and/or debris (13MW-4 was located under a pile of pipe). In 2011, neither 13MW-3 nor 4 were located and a temporary road had been constructed over the approximate location of the two monitoring wells. Following completion of construction activities at the site, wells 13MW-3 and 13MW-4 were located and modified to allow future sampling. Historical MTBE and tetrachloroethene (PCE) exceedances were each detected in one well. An additional nine VOCs are historically detected in groundwater, including the following: chloromethane, cis-DCE, carbon disulfide, toluene, VC, 2-butanone, acetonitrile, bromomethane, and 2-hexanone. A summary of 600 Area groundwater VOC detections, range of concentrations and exceedances is presented in **Table 4-2**. The results of TCE and MTBE groundwater sampling are discussed in the following sections.

4.2.1 TCE in Groundwater

TCE was detected in 8/15 samples during the June 2008 sampling round, with 8 samples exceeding the LOC of 1.0 µg/L. Results of TCE groundwater sampling is shown in **Table 4-1**, and is summarized on **Figure 4-1**. TCE groundwater isopleth maps were prepared from the June 2007 and June 2008 data, and are shown on **Figures 4-2a** and **4-2b**, respectively. While the source area investigation was being planned and completed in the 600 area, there was a delay between the initial drafting of the FS and its' finalization. In order to continue monitoring the plume while this FS was being completed, additional rounds have been completed since 2008. The more recent data is consistent with the plume depictions from 2007 and 2008. The 2007 and 2008 plume depictions are illustrative of the CSM and current conditions at the site. On **Figure 4-2b**, the highest TCE concentration (130 µg/L) is detected at well 13MW-2, which is located southwest and downgradient of the former explosives detonation area (AOC 1). The next highest TCE concentration of 110 µg/L was detected at well 13MW-1, which is located in AOC 1. The plotted June 2008 TCE plume extends approximately 1,450 ft southwest from 13MW-1 to the 1.0 µg/L contour. The axis of the plume apparently runs south from well 13MW-1, and then southwest to well 13MW-2 and DM13-1. The southwest portion of the plume is bounded by wells 13MW-10 (ND), DM13-3 (ND), and 13MW-7 (ND). The southeast edge of the plume extends an

approximate 1,260 ft from well 13MW-1, and is bounded by monitoring wells 13MW-5 (ND) and 13MW-6 (ND).

The plotted TCE plume is very wide, and may have been laterally dispersed by the bedrock high adjacent well 13MW-1 and/or permeable fault and fold structures in the study area. The overall width of the plume suggests lateral TCE transport along the northern splay of the Picatinny fault and/or fractures associated with the mapped fold axis (see **Figure 3-4**). The southwestern and southeastern edges of the plume terminate in mapped wetland/stream areas, and likely discharge into these surface water bodies, where TCE is detected. A comparison of the June 2007 and June 2008 isopleth maps (**Figures 4-2a** and **4-2b**) show very similar well TCE concentrations, plume shape and extent.

The AWDF well has a VOC sampling history back to 1994 (**Figure 4-3**), and shows increasing TCE concentrations from August 1994 (1.3 µg/L) to August 2004 (61 µg/L). The AWDF well began operation in 1999, and it is unclear whether the results show an incipient TCE plume, or capture of an existing plume via pumping. AWDF well data for the period August 2004 to June 2008 shows fluctuating TCE concentrations over time, and does not show a discernable trend. TCE time-concentration plots were also prepared for wells 13MW-1, 13MW-2, 13MW-4, and DM13-1 to evaluate historical TCE concentration trends, and are shown on **Figure 4-3**. Source area (AOC 1) well 13MW-1 shows fluctuating TCE concentrations during the sampling period April 2005 to January 2007 (170 µg/L), with progressively lower TCE concentrations observed in June 2007 (130 µg/L), October 2007 (120 µg/L), and August 2008 (110 µg/L). This decrease in source area groundwater TCE concentrations may reflect the reduction of TCE mass leaching into the bedrock aquifer in AOC 1.

TCE data for downgradient plume monitoring well 13MW-2 shows considerable fluctuation during the period July 2006 to June 2008, with no apparent concentration trend. Other plume monitoring wells 13MW-4, AWDF, and DM13-1 likewise show fluctuating TCE concentrations. A comparison of current and historical TCE well data and TCE isopleth maps (see **Figures 4-2a** and **4-2b**) shows little change in the plume shape and extent over time. This data suggests that the plume is stable at the downgradient edge of the plume, where TCE mass (input) is in equilibrium with the rate of groundwater TCE attenuation and discharge to surface water. This is expected to change as source area concentrations decline, and would likely result in lower groundwater plume and surface water TCE concentrations.

Plume monitoring wells (AWDF, DM13-1, 13MW-2, and 13MW-4) do not currently show decreased TCE concentrations resulting from declines in source area well 13MW-1. This is not unexpected due to the recent onset of lower TCE concentrations (18 months) at well 13MW-1, and the likely TCE transport timeframe to downgradient wells. Therefore, changes in downgradient well TCE concentrations would not be expected in the current dataset.

The vertical extent of TCE contamination was evaluated using packer test data at the AWDF well and monitoring wells 13MW-1, 13MW-2, 13MW-8, and DM13-1. The vertical distribution of TCE in the 600 Area is shown on **Figure 4-4**. Packer test data from the AWDF best illustrates the vertical distribution of TCE, and is shown on **Figures 3-14** and **4-4**. As shown, the maximum TCE concentration at the AWDF well is at 972 ft msl, and declines with depth to 11.0 µg/L at 696 ft msl.

4.2.2 Installation of Deep Upgradient Monitoring Well

Based on the results of the TCE source area investigation, which identified TCE contaminated soil at AOC 1, the NJDEP requested the installation of an additional monitoring well to address a concern that TCE could migrate off post (13MW-14). The direction of groundwater flow has been determined to be toward the south/southeast, and the aquifer behaves as an equivalent porous media (i.e., TCE will not migrate counter the direction of groundwater flow after it reaches the water table). However, the concern that has been raised addresses the possibility that TCE could travel from the source soils through discrete fractures dipping toward the northwest, potentially leading to off post migration of TCE above its LOC in groundwater. The location and construction of the monitoring well was determined based on review of the geophysical data discussed in **Section 2**, and was submitted to NJDEP for approval prior to well installation. The well was drilled on 11 January 2013. The first and only water detected during the drilling was at 128 ft, bgs. The driller rig-developed the well for about 2 hours, and estimated the yield at 0.5 GPM. We developed the well by over pumping (800+ gallons) on January 16, and estimated the well yield at 0.3 GPM. Drilling was completed to 398 ft bgs which was well below the zone requested by the

NJDEP. Groundwater from various depths within the open bore hole including the 330 ft bgs interval requested by the NJDEP were sampled using the USEPA low flow method. Samples were collected from 128 ft bgs, 270 ft bgs and 325 ft bgs and analyzed for VOCs. All of the samples were non-detect for TCE. The rationale for the selection of each sampled interval is as follows:

1. 128 feet, bgs., first, and possibly only groundwater inflow detected in well. Contact between red-brown arkosic quartzite and siltstone and harder gray brown /green quartzite. The estimated well yield (by rig air displacement) at this interval is 0.5 GPM. PID reading at well head and discharge (0.0 PPM)

2. 270 feet, bgs., contact between gray-green quartzite and tan-red arkosic quartzite/siltstone. The estimated well yield (by rig air displacement) is 0.5 GPM – no additional water. PID reading at well head and discharge (0.0 PPM).

3. 325 feet, bgs., contact between red-brown quartzite and gray-green quartzite. The estimated well yield (by rig air displacement) at this interval is 0.5 GPM – no additional water. PID reading at well head and discharge (0.0 PPM).

4.2.3 MTBE in Groundwater

Exceedances of the MTBE groundwater LOC (70 µg/L) were detected at well 13MW-5 during the June 2005 (130 µg/L) and November 2006 (140 µg/L) sampling round. Sample results are shown on **Figure 4-1**. MTBE concentrations have since decreased in March 2007 (51 µg/L), June 2007 (35 µg/L), October 2007 (21 µg/L), April 2010 (7.26 µg/L), and February 2011 (2.3 µg/L).

4.3 VOCS IN SURFACE WATER, SEDIMENT, AND SOIL

Surface water VOC sampling started in June 2005, and was expanded in October 2007 to include 11SW-6. Sampling location 11SW-10 was included in April 2010. Results of surface water VOC sampling is shown in **Table 4-3**. One TCE LOC exceedance was detected at sample location 11SW-3 in June 2008 and April 2011. TCE LOC exceedances were identified in three surface water samples in January 2011 (11SW-3, 13SW-4, and 13SW-6). A summary of 600 Area surface water VOC detections, range of concentrations and exceedances is presented in **Table 4-4**. The results of surface water TCE sampling are discussed in **Section 4.3.1**.

Sediment VOC sampling was conducted in November 2004 and January 2006, with the detection of a toluene LOC exceedance in both years at SD-1. Results of sediment VOC sampling is shown in **Table 4-5**. A summary of 600 Area sediment VOC detections, range of concentrations and exceedances is presented in **Table 4-6**. The results of Toluene sediment sampling is discussed in **Section 4.3.2**. Results of AOC 4 soil sampling is provided in **Section 4.3.3**.

4.3.1 VOC Surface Water Sampling Results

TCE surface water exceedences were detected at sample locations 11SW-3, 13SW-4, and 11SW-6 in January 2011. TCE surface water exceedances were only detected at sample location 11SW-3 in the June 2008 (6.4 µg/L) and May 2010 (4.3 µg/L) sampling rounds. TCE exceedances were also detected at this location in June 2005 (7.8 µg/L), November 2006 (2.8 µg/L), March 2007 (4.4 µg/L), June 2007 (12.0 µg/L), and October 2007 (14.0 µg/L) sampling rounds. A TCE exceedance was detected at downgradient sample location 13SW-6 (2.2 µg/L) in January 2006. Low concentrations of TCE were more recently detected at 13SW-6 in October 2007 (0.88J µg/L) and June 2008 (0.74J). Historical TCE surface water exceedances are observed at sample location 13SW-4 in the June 2005 (9.5 µg/L) and November 2006 (5.0 µg/L) rounds. TCE was detected at low concentrations in March 2006 (0.89 µg/L) and March 2007 (0.97 µg/L), and not detected at this surface water location in June 2007, October 2007, and June 2008. Results of TCE surface water sampling are shown in **Table 4-3**, and are summarized on **Figure 4-5**. The plotted TCE groundwater plume (see **Figure 4-2b**) extends into the wetland areas adjacent sample location 11SW-3, and is the probable source of TCE in surface water.

4.3.2 VOC Sediment Sampling Results

There are two historical toluene LOC exceedances at sample location SD-1 in November 2004 (0.12 mg/kg) and January 2006 (0.071 mg/kg). The toluene LOC (sediment quality benchmark [SQB]) is 0.05 mg/kg. Toluene was not detected in downstream sample location SD-2 in corresponding sampling rounds. Sediment sample results are shown in **Table 4-5** and **Figure 4-5**.

4.3.3 VOC Soil Sampling Results

A total of eight soil samples were collected in March 2007 at soil piles located in AOC 4 north of Building 647. These samples were collected in follow-up to soil gas testing at the same location(s). A soil sample location map is shown on **Figure 2-8**, and sampling results are shown in **Table 4-7a** and **Figure 4-6**. As shown, low concentrations of TCE are detected in all samples, with a maximum concentration of 0.0063 mg/kg. This concentrations falls well below the applicable TCE LOC (New Jersey Impact to Groundwater Standard) of 1.0 mg/kg, and indicates that the tested soils are not a potential groundwater source.

A total of 13 soil samples were collected in June 2011 and May 2012 as part of the source area investigation for the 600 Area TCE groundwater plume. The results of the source area investigation, including VOC sampling, are discussed in **Section 4.5**.

4.4 ORIGIN OF THE TCE PLUME

The source area of the TCE plume has been identified as AOC 1 (Site 12), the former test area located north of Building 660. Based on historical aerial photographic analysis (USEPA, 1989b), the site was constructed between 1957 and 1963 by clearing the native vegetation and leveling of the area. The USEPA's EPIC Installation Assessment of PTA (USEPA, 1989b) reported disposal of debris along a fill face at the site in 1970. Dump trucks were identified in the aerial photography near the fill face, and possible stain was noted near the center of the site. The stain was no longer present in photographs from 1974, although additional dumping was reported along the northeastern fill face. A circular bermed pit with a rectangular object was reported at the northern end of the site. A partially bermed area was identified at the same location in 1986/87 photography, located to the northwest of a burning cage initially identified in 1963 and still present at the site to date. During a site reconnaissance in 1996, the face of the fill was visually observed to contain construction debris, drum debris, and the remnants of a buried military vehicle (truck). However, no rock fill had been placed at the site at that time. During a site reconnaissance conducted in 2007, the remnant of a steel structure was discovered at the location. The rock fill was present at the time of the 2007 site reconnaissance. The steel object was likely filled with sand or similar media and used as a target into which test munitions were fired. The partially bermed area was also present and would have served as a safety barrier which also utilized a natural depression in the ground surface. The feature was likely misidentified as a pit from the 1974 aerial photography, and is therefore unrelated to the TCE plume. The 1986/87 photographic analysis concluded that the area had likely been covered since 1974; 1979 photography did not provide detailed features for adequate analysis.

Large amounts of blasted rock from the Building 660 site were deposited in the AOC 1 area beginning in the late 1990s. **Figure 4-7** shows the 2002 aerial extent of preexisting (1970) fill and later Building 660 fill (1990s), which was representative of site conditions prior to the removal of blasted rock in 2010/2011. The more recent fill material appears much lighter in contrast with the darker gray area immediately surrounding the burning cage and to the south and west where the drum and other debris are located. An inspection of the site in 2005 observed a partially buried drum and other canisters in the formerly (1970) filled areas, in addition to discarded LAW rocket tubes and 80-mm mortar shells. The maximum vertical extent of the blasted rock fill exceeded 20 ft when it was in place.

The probable source of TCE in groundwater is leaching of impacted soils/fill associated with the 1970s debris disposal activity in AOC 1. This hypothesis is supported by the presence of crushed drums seen in the fill material, soil gas results and the detection of TCE in monitoring well 13MW-1 immediately downgradient of the 1970s fill material. Initial sampling of the AWDF well, after its completion in 1994, resulted in the detection of TCE (1.3 µg/L). Subsequent concentration increases were detected in 2000 (39 µg/L), 2002 (82 µg/L), and 2003 (110 µg/L). As noted in **Section 4.2.1**, the AWDF well began operation in 1999, and it is unclear whether the increasing TCE concentrations detected after that time

reflect the migration of an incipient TCE plume or capture of existing sidegradient plumes(s) via pumping. The wide lateral extent and depth of the current plume indicates that TCE is thoroughly dispersed within the bedrock aquifer, and suggests that the plume would have migrated within a broad front toward the AWDF well. In the alternative scenario involving the AWDF well capture of an existing plume, the likely source would be the former Site 11 test areas and fill (within AOC 1) dating back to the 1970s. Because the 1970s fill material was covered by a thick layer of blasted rock from the late 1990s until 2010, no source area investigation was feasible during that timeframe. However, the majority of the rock was removed during a construction project in 2010/2011. The removal of the rock facilitated the investigation of the 1970s fill as a potential source as had been previously requested by the USEPA.

4.5 TCE PLUME SOURCE AREA TEST PITS AND TRENCHING

On June 20 through 24, 2011, Shaw completed two test pits and began one of two proposed trenches in order to investigate the source of TCE in the 600 Area groundwater. Four objectives were established for the source area investigation: determine if an active source of TCE is present (fill earth or containers), determine the thickness of the 1970s fill, determine the presence or absence of contamination other than VOCs, and determine the size of the TCE source area (if identified). A total of two test pits and two trench locations were planned based on the results of passive soil gas results from January 2011 (**Figure 4-8**). The two 10 ft by 10 ft test pits targeted isolated detections of TCE in site soil gas, while two crossing trenches were planned to investigate TCE detected in four adjacent sample locations. While excavating the eastern end of the planned 45 ft trench (TR2), Shaw UXO technicians identified MEC at a depth of approximately 4.5 ft bgs in the eastern end of trench TR2. Following discovery of MEC (identified as a CDU-10/B gravel mine canister), excavation was immediately halted and notification was made to Picatinny Police (automatic notification of installation EOD), Picatinny Range Control, Picatinny IRP Manager, Picatinny MMRP Manager, Picatinny Safety, and the USACE Project Manager. Discovery of a large amount of MD and one MEC item changed the site status from low probability of finding MEC to a high probability, therefore requiring the completion of an Explosives Safety Submission (ESS). This temporarily halted the TCE plume source area investigation. A summary of MD and MEC identified in the June 2011 Test Pit/Trenching Investigation is presented on **Table 4-10**. Photographs from the Test Pit/Trenching Investigation are included in the source area investigation photographic log (**Appendix L**). Additional details of the June 2011 source area investigation include:

- Shaw completed the two test pits (TP-1 and TP-2) to the planned depth of 12 ft bgs. Due to instability of a nearby gravel pile (which was partially removed to clear the location) the location of TP-2 was adjusted in the field. However, as a result, TP-2 was excavated approximately 20 ft west of the proposed location (**Figure 4-9**).
- Shaw began excavation of the eastern end of the 45 ft trench (TR2). Excavation of TR2 reached a maximum depth of 5 ft bgs prior to the discovery of MEC, at which point the planned excavation was terminated. The planned 60 ft trench (TR1) was not started due to the discovery of MEC in TR2.
- Nine samples were collected; three from each test pit and three from the start of trench TR2.
- Two samples were collected and named 13TR2-1(4.5-5). These two samples were collected at the same depth interval, within 2 to 3 ft, horizontally of each other, and were collected based on different sampling rationale. One sample, collected on June 22, 2011, was collected from beneath a crushed drum (potential TCE source) prior to the discovery of MEC. The rationale for the second sample, collected on June 23, was the discovery of the gravel mine canister, and the continual collapsing of the gravel/soil sidewalls of the trench.
- As shown on **Table 4-7b**, the results indicated that VOCs were below LOCs. TCE was detected in only one sample (0.0051 mg/kg), collected from sample location 13TR2-1(4.5-5) on June 23, 2012 (collected from soil directly beneath the gravel mine canister).
- A total of six samples were analyzed for additional parameters (baseline explosives, SVOCs, TAL metals). No explosive compounds were detected. With the exception of

arsenic (detected below background levels in all samples), only benzo(a)pyrene (0.601 mg/kg) was detected above its LOC (0.2 mg/kg),

After completion of an ESS, the trenching investigation was restarted in May 2012. The following activities were conducted under the ESS prepared by the USACE, Baltimore District. Excavation was conducted by Reactive and Explosive Materials Training Corporation (REMTC). Shaw personnel provided logistical support and performed soil sampling associated with the investigation. Only qualified UXO personnel were permitted on-site during intrusive activity.

On May 22 through 24, 2012, Shaw supported the continued trenching investigation in AOC 1, suspected to contain the source of TCE contamination in the 600 Area groundwater. Trenching began at the southern extent of the intended 60-ft trench trending north-south (TR-1) through the suspected source area (based on the results of passive soil gas sampling completed in January 2011). Intended to be a 60-ft trench with a depth extending into clean native soil or top of bedrock, the loose gravel nature of the fill material resulted in the final excavation of a test pit with an approximate 40-ft diameter opening at the surface and a final depth of 24.5 ft bgs terminating at the bedrock interface. Locating the top of bedrock achieved one of the objectives of the source area investigation. Additionally, high level PID readings obtained from soil excavated from the bottom of the excavation indicated the possible presence of a TCE source area. The excavation was terminated due to the volume of contaminated soil generated, determined based on the PID readings. Based on the local topography, the southern end of the 60-ft trench represents the deepest extent of fill for the proposed trench investigation.

A total of four soil samples were collected, at various depths, from the excavation. Continual sidewall collapse caused by the loose gravel encountered necessitated moving the excavator northward with increasing depth of the excavation to ensure a solid footing for the machine. The first sample (1 to 1.5 ft bgs) was collected at the southern extent of the intended trench, while the final sample (24 to 24.5 ft bgs) was collected from the center of the excavation, approximately 20 ft north of the initial location. Debris from the excavation was staged on plastic for subsequent disposal by appropriate means. MD and MEC were segregated from the remaining debris. Soil exhibiting any response on a PID was also staged on plastic, covered, and sampled for subsequent disposal at an appropriate facility. Additional details of the investigation findings are summarized below:

- Sample TR1-1(1-1.5) was collected from the former surface soil interval, indicated by the organic soil layer encountered, and analyzed for VOCs. Trace levels of acetone and 2-butanone (methyl ethyl ketone) were identified; however, concentrations of both compounds were significantly below LOCs.
- At approximately 10-ft bgs, the excavator began encountering debris including MD, 55-gallon drums and related debris, a smaller drum/canister, as well as wood scraps and wires. Liquid was observed dripping from one crushed and rusted drum containing a large quantity of MD. Soil from this interval exhibited no response on a PID. Sample TR1-1(10.5-11) was collected from the 10.5-11 ft bgs soil interval directly below the crushed, rusted drum containing MD and analyzed for VOCs. A trace concentration of acetone was identified at a concentration significantly below LOCs.
- Multiple drums and significant quantities of MD were excavated from the 10 to 20 ft bgs interval. All of the drums were crushed, exhibited no PID response, and contained no free phase liquid. A label on one of the excavated drums clearly identified its former contents as TCE. Soil in the 18 to 20 ft bgs interval exhibited apparent staining, in contrast to lighter colored soil both above and below. Sample TR1-1(19-20) was collected from the 19-20 ft bgs soil interval, which exhibited a PID response of 3.7 parts per million (ppm). TCE was detected at a concentration of 1.24 mg/kg, which is below the LOC, but above default screening levels established for the protection of groundwater. Additional VOCs detected at levels significantly below regulatory screening levels were cis-1,2-dichloroethane, naphthalene, and 1,2,4-trimethylbezene, as well as several TICs (for which there are no screening levels). Analysis for SVOCs identified only low levels of tentatively identified compounds for which there are no established screening levels. RDX (0.16 mg/kg) was the only explosive compound detected (below its LOC of 24 mg/kg). All metals results were below screening levels with the exception

of arsenic, which exceeded its USEPA Industrial Regional Screening Level (RSL), but was below the NJDEP Soil Remediation Standard based on statewide background. In addition, arsenic results were below background threshold values established for PTA.

- Soil in the 20-24.5 ft bgs interval exhibited PID responses from 700 to 1,000 ppm with the highest PID reading from soil collected directly on top of bedrock. Soil in this interval contained little to no gravel or debris (the little debris that was included with the excavated soil from this depth was likely due to the collapsing sidewalls). It is likely that soil at this depth interval is native soil. Expedited turn-around time was requested for VOCs analysis of sample TR1-1(24-24.5) collected from the 24-24.5 ft bgs soil interval in order to confirm that VOCs registering on the PID included TCE. TCE was identified at a concentration of 23.9 mg/kg. Trace levels of cis-1,2-DCE, p-isopropyltoluene, naphthalene, PCE, and 1,2,4-trimethylbenzene (significantly below LOCs) and several tentatively identified compounds (for which there are no screening levels) were also identified.
- A fibrous container containing an unknown white substance was excavated from approximately 20-ft bgs. Initial analyses performed on the unknown substance for reactivity and identification of perchlorate were negative. Additional analyses were performed for chloride, mercury, metals, pesticides, pH, redox potential. And SVOCs. The analyses identified trace metals concentrations, as well as several tentatively identified SVOCs; however none of the identified constituents exceeded LOCs.

Figures 4-10 and **4-11** depict cross sections of the test pit/trench excavations, including sample locations (with TCE results) and characterization of the materials encountered. Soil sampling results from both the 2011 and 2012 test pit/trench investigations are summarized on **Table 4-7b**.

4.6 VAPOR INTRUSION SAMPLING RESULTS

The potential for VI into buildings overlying the TCE plume was evaluated in accordance with DoD, NJDEP and USEPA protocols (DoD, 2009, NJDEP, 2005a, and USEPA, 2002b). Based on these protocols, it was determined that Building 660 was the only building with the potential for VI. Accordingly, a VI investigation was performed in the spring of 2011.

Three near-slab soil gas samples (13NSSG-1 through 13NSSG-3), four indoor air samples (13IA-1 through 13IA-4), and one ambient air sample (13IA-Amb) were collected at Building 660 to investigate the potential for VI of chlorinated solvents (TCE and its daughter products) previously identified in the 600 Area groundwater. Sample locations, chemical concentrations exceeding applicable screening levels, and all detected concentrations of TCE and its daughter products are presented on **Figure 4-12**. Neither TCE nor its daughter products were detected above applicable screening levels. TCE was detected in soil gas in near-slab soil gas sample 13NSSG-2 at a concentration of 17 micrograms per cubic meter (µg/m^3), below its NJDEP Nonresidential SGSL of 27 µg/m^3. In addition, the TCE daughter product trans-1,2-dichloroethene was detected in near-slab soil gas sample 13NSSG-3 at a concentration of 8 µg/m^3, below its NJDEP Nonresidential SGSL of 5,100 µg/m^3. Neither TCE nor its daughter products were detected in any of the indoor air samples, ambient sample or near-slab soil gas sample 13NSSG-1.

No compounds were detected above NJDEP Nonresidential SGSLs. Two compounds were detected above applicable screening levels for indoor air. Benzene was detected at a concentration of 3 µg/m^3, above its NJDEP Nonresidential Indoor Air Screening Level (IASL) of 2 µg/m^3 and its USEPA Industrial Air RSL of 1.6 µg/m^3 in sample 13IA-3. The compound 1,3-Butadiene was detected at a concentration of 0.5 µg/m^3 also in sample 13IA-3. The concentration of 1,3-butadiene exceeds its USEPA Industrial Air RSL (0.41 µg/m^3) but is below its NJDEP Nonresidential IASL (1 µg/m^3). There were no exceedences of applicable screening levels in the remaining indoor air samples. According to the Agency for Toxic Substances and Disease Registry (ATSDR) (ATSDR, 2011), benzene is widely used in the United States, ranking in the top 20 chemicals for production volume and is used in the production of some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Benzene is also a component of crude oil, gasoline, and cigarette smoke. Information available from ATSDR on 1,3-butadiene states that it is used to make synthetic rubber widely used for tires on cars and trucks, and that

exposure may occur due to contaminated air from car and truck exhaust, waste incineration or wood fires, and cigarette smoke. It is possible that both benzene and 1,3-butadiene detected in sample 13IA-3 result from the use of several products noted during the building survey (stored in a flammable cabinet in the target preparation/fabrication room) containing petroleum distillates (i.e. engine degreaser, corrosion inhibitor, insect spray). Neither benzene nor 1,3-butadiene were detected in any of the soil gas samples, and neither are contaminants of concern in the 600 Area groundwater.

Chloromethane (1 µg/m^3), toluene (1 µg/m^3), and trichlorofluoromethane (1 µg/m^3) were detected in the ambient air analysis. All three compounds were detected in each of the four indoor air samples, but (with the exception of toluene) were not detected in soil gas. The highest concentrations of these three compounds detected in the indoor air and soil gas samples were two orders of magnitude below corresponding IASLs, SGSLs, and RSLs.

The complete results of the VI investigation of Building 660 were presented in the *Building 660 Vapor Intrusion Investigation Report* (Shaw, 2011). The VI sampling results support the conclusion that there is currently no complete VI pathway for Building 660.

4.7 EXPLOSIVES IN GROUNDWATER

Baseline explosives sampling has been conducted at the AWDF well since 2004 and in all monitoring wells from November 2006 through October 2007 (four rounds). RDX groundwater sampling was reduced to eight wells in June 2008 per the RDX Work Plan, and included three additional wells from Site 10. Results of the RDX groundwater sampling are shown in **Table 4-1**. The October 2007 sampling data is used for discussion purposes, since it is the most recent, complete set of data. One RDX exceedance was detected at well 13MW-1 in the October 2007 sampling round. A summary of 600 Area groundwater explosives detections, range of concentrations and exceedances is presented in **Table 4-2**. The results of RDX sampling is discussed in the following section.

4.7.1 RDX in Groundwater

RDX was detected in six samples during the October 2007 sampling round, with one sample exceeding the LOC of 0.50 µg/L. For RDX, there is no established MCL or New Jersey Groundwater Quality Standards (NJGWQS). The LOC for RDX is based on the interim NJDEP practical quantitation limit (PQL). However, the more critical criterion for RDX is the Federal Health Advisory of 2.0 µg/L. Results of RDX groundwater sampling is shown in **Table 4-1**, and is summarized on **Figure 4-1**. As shown on **Figure 4-1**, an RDX exceedance was detected at well 13MW-1 (0.67 µg/L). RDX was also detected at wells 13MW-2 (0.18J), 13MW-3 (0.3J), 13MW-7 (0.485J), 13MW-8 (0.42 µg/L), and the AWDF well (0.2J). **Figure 4-1** shows that RDX has been historically detected at these wells (except 13MW-8) since sampling started in 2004 and 2005, and shows no apparent concentration trend. Based on the locations of the wells exhibiting low levels of RDX along with the historical use of the 600 Area, it is probable that the source of RDX contamination originated in AOC 1 and Site 11. In order to determine the potential for a source of RDX to 600 area all groundwater data was analyzed, additional soil sampling was performed within Site 11 along with surface water/sediment data. The results of this investigation along with a recommendation for no further action were presented in the *Picatinny Arsenal Task Order 17 600 Area RDX Investigation Data Report* (Shaw, 2009). The NJDEP and USEPA approved the data report and agreed with this recommendation.

4.8 EXPLOSIVES IN SURFACE WATER AND SEDIMENT

Baseline explosives were sampled in 600 Area surface water locations in November 2006, March 2007, June 2007, November 2007, and June 2008 (reduced scope). Results of surface water explosives sampling is shown in **Table 4-3**. The October 2007 sampling data is used for discussion purposes, since it is the most recent, complete set of data. There were no RDX surface water exceedances detected in the October 2007 (or June 2008) round; however, historical exceedances are recorded at sample locations 11SW-1, 11SW-2, and 13SW-5. HMX and Nitrobenzene are also detected in surface water. A summary of 600 Area surface water explosives detections, range of concentrations and exceedances is presented in **Table 4-4**.

Sediment baseline explosives sampling was initiated in January 2006 (at SD-1) after the detection of a surface water RDX exceedance at corresponding location SW-1 in November 2006.

Additional sediment samples were collected at this location in June 2006, March 2007, and June 2008. Additional sediment sample locations SD-2 and SD-3 were analyzed for baseline explosives in June 2008. Results of sediment explosives sampling are shown in **Table 4-5**. There were no LOC exceedances in sediment, and nitrobenzene was the only explosive compound detected. A summary of 600 Area sediment explosives detections is presented in **Table 4-6**. Surface water RDX and sediment sample results are addressed in the following sections.

4.8.1 Explosives in Surface Water

There are no RDX exceedances observed in the five samples collected in the October 2007 surface water sampling round. RDX was detected in pond sample (unnamed pond) 11SW-1 (0.39J) and stream samples (unnamed stream) 11SW-3 (0.08J µg/L) and 13SW-6 (0.049J). RDX was also detected in the June 2008 sampling at 11SW-3 (0.31 µg/L), but was not detected at locations 11SW-1 and 13SW-6. RDX surface water data is shown on **Figure 4-5**. The highest historical RDX concentration was detected at 11SW-1 in November 2006 (10.0 µg/L), which is located in a pond. As discussed in **Section 3.1.1**, the pond discharges to the sampled stream, and is probably spring fed. RDX exceedances were also detected at downstream location 11SW-2 in November 2006 (3.7 µg/L) and March 2007 (0.87 µg/L). Additional sampling at this location has been unsuccessful due to dry conditions. Low concentrations of RDX have been detected at downstream sampling location 13SW-3 in November 2006 (0.22J µg/L), March 2007 (0.26 µg/L), June 2007 (0.22J µg/L), October 2007 (0.08J µg/L), and June 2008 (0.32 µg/L). This data indicates a potential RDX surface water source in the pond. A separate 600 Area investigation is underway to identify the upstream source of RDX to the wetland and 13SW-3 sample location.

A single RDX LOC exceedance was detected at wetland sample location 13SW-5 (0.87J µg/L) in November 2006. RDX is not detected in subsequent February 2006 and October 2007 sampling rounds. RDX is not detected in four sampling rounds at upstream sample 13SW-4. RDX is detected in low concentrations at well 13MW-2 (0.18 to 0.23 µg/L), but is not detected in shallow bedrock wells DM13-1 through 3. The source of RDX at this location may be groundwater.

4.8.2 Explosives in Sediment

Sediment explosives sampling was initially conducted in January 2007 at 11SD-1 after detection of an RDX surface water exceedance at sample location 11SW-1. RDX was not detected at 11SD-1 at that time or during later sampling in March 2007 and June 2008. This data indicates that pond sediment at 11SD-1 is not the source of RDX in surface water.

4.9 BIOREMEDIATION PARAMETER SAMPLING RESULTS

A total of nine wells were sampled for redox parameters and TCE degradation products during the March 2007 sampling event. Bioremediation parameters, including redox analytes, groundwater quality parameters and potential complete dechlorination degradation product sampling results are summarized in **Table 4-9**. All groundwater samples were collected using low-flow purging and sampling techniques to minimize disturbance to the water column. Bioremediation sampling was conducted to determine groundwater redox conditions in the aquifer, and evaluate MNA as a potential remedy for TCE and RDX groundwater contamination in the FS.

During biodegradation, microorganisms utilize available nutrients and carbon sources for energy and cell reproduction by facilitating the transfer of electrons from donors to acceptors. This results in oxidation of the electron donor and reduction of the electron acceptor. Electron donors include natural organic carbon and petroleum hydrocarbons. Electron acceptors are compounds that occur in relatively oxidized states. The more important naturally-occurring electron acceptors in groundwater include DO, nitrate, iron (Fe^{+3}), sulfate, and carbon dioxide (CO_2) (USEPA 1998). In addition, manganese (IV) can act as an electron acceptor in some groundwater systems (ASTM 1998, USEPA 2000). Groundwater field parameters and electron acceptor data are evaluated in the following sections.

4.9.1 Groundwater Quality Parameters

Groundwater parameters such as ORP and pH can provide information regarding general aquifer redox conditions and the feasibility of biodegradation/MNA in the 600 Area (USEPA 1998). The ORP of groundwater is a measure of electron activity and is an indicator of the relative tendency of a solution to accept or transfer electrons. ORP was measured in the field using a calibrated YSI multiprobe with a

flow-through cell. The ORP data was measured after water quality parameters had stabilized and immediately prior to sample collection. Redox potentials recorded during the March 2007 sampling round ranged from -128.4 mV to +216.1 mV, with the lowest ORP value reported at well 13MW-4. As shown in **Table 4-9**, the majority of measured ORP values fall within the slightly reduced category (>-100 mV to +250 mV), with well 13MW-4 categorized as 'reduced'.

4.9.2 Concentration of Terminal Electron Acceptors

Microorganisms will couple terminal electron accepting redox reactions that yield the greatest free energy. Therefore, there is an order to the succession of redox reactions. For most groundwater systems, the order of redox reactions, from highest to lowest energy yielding, is aerobic respiration, denitrification, manganese reduction, iron (Fe^{+3}) reduction, sulfate reduction, and methanogenesis (USEPA 2000). Reduction of electron acceptors is sequential, and less thermodynamic reactions will not proceed until the more favorable acceptor is depleted. Most of the reactants and products of the redox reactions referred to above are water-soluble. The dominant terminal electron accepting process can be identified by analyzing groundwater for the associated products and reactants (USEPA 1998). Below is a brief discussion of the specific reactants and products that were measured in 600 Area groundwater samples.

4.9.2.1 Dissolved Oxygen

DO serves as the terminal electron acceptor for aerobic respiration. However, anaerobic processes such as reductive dehalogenation cannot occur in the presence of molecular oxygen (USGS 2006). The DO concentration of 600 Area groundwater samples were measured in the field using a calibrated YSI multiprobe meter and analyzed on-site using a DO kit (Winkler method). DO sampling results are shown in **Table 4-9**. As shown, meter and test kit DO values were fairly consistent, except at well 13MW-1, where there was a considerable discrepancy. The YSI meter data ranged from 0.21 to 10.59 ppm, with the lowest readings reported at wells 13MW-4 (0.21 ppm) and 13MW-8 (0.5 ppm). Field kit data ranged from 0.6 to 10.5 ppm, with the lowest readings reported at wells 13MW-4 (0.6 ppm) and DM13-3 (0.10 ppm). The combined data shows that two of nine wells (13MW-4 and 13MW-8) reports less than 1.0 ppm DO in groundwater.

Aerobic degradation of organic compounds typically occurs with DO concentrations greater than 1.0 ppm, but have been reported as low as 0.5 ppm (USGS, 2006). Seven wells show DO readings in excess of 1.0 µg/L, which is consistent with aerobic groundwater conditions.

4.9.2.2 Nitrogen Speciation Data

After DO has been depleted in groundwater, nitrate (NO_3^{-2}) can be used as the terminal electron acceptor for anaerobic biodegradation (USEPA 1998). In a process called denitrification, reduction of NO_3^{-2} yields nitrite, which in turn reduces to ammonia. The end reduced nitrogen species is nitrogen gas (N_2). As part of the bioremediation sampling, nine groundwater samples were analyzed for nitrate, and ammonia. Sampling results are presented in **Table 4-9**. No nitrogen species were detected in well DM13-2, and that well was not evaluated with respect to nitrate reduction. Nitrate was detected in five of eight samples, with concentrations ranging from 0.068J to 0.33J ppm. Ammonia was detected in all eight wells, with concentrations ranging from 0.077J to 0.19J ppm. The highest ammonia concentration was detected at well DM13-3. Evaluation of the nitrogen bioremediation data shows utilization/depletion of nitrate as an electron acceptor in seven of eight wells (less DM13-2), with the corresponding accumulation of reduced ammonia.

4.9.2.3 Manganese Speciation Data

Under slightly reducing conditions, bacteria can use manganese in the minerals rhodochrosite, manganite and pyrolusite as electron acceptors. Manganese (Mn^{+4}) is thus reduced to Mn^{+2}, which is typically found in the dissolved phase (ASTM 1998). Mn^{+2} sample concentrations are approximated using the field filtered (dissolved) manganese sampling results. It is noted, however, that some fine manganese particulate or colloidal material may pass the 0.45 micron field filter, and be analyzed as part of the dissolved fraction. This would result in the overestimation of the Mn^{+2} fraction in groundwater. Mn^{+4} fractions are likewise approximated by subtraction of the filtered iron concentrations from the unfiltered iron results.

Manganese sampling results shown in **Table 4-9** show utilization/depletion of Mn^{+4} in all wells, and accumulation of dissolved phase Mn^{+2}. This data is consistent with the nitrogen speciation data presented in the preceding section.

4.9.2.4 Iron Speciation Data

Ferric iron or particulate iron (Fe^{+3}) can be utilized as an electron acceptor upon depletion of oxygen, nitrate and Manganese (Mn^{+4}) in groundwater (ASTM 1998, USEPA 1998). Ferrous iron or dissolved iron (Fe^{+2}) is the reduced form and is typically found in the dissolved phase. Fe^{+2} sample concentrations are approximated using the field filtered (dissolved) iron sampling results. It is noted, however, that some fine iron particulate or colloidal material may pass the 0.45 micron field filter, and be analyzed as part of the dissolved fraction. This would result in the overestimation of the Fe^{+2} fraction in groundwater. Fe^{+3} fractions are likewise approximated by subtraction of the filtered iron concentrations from the unfiltered iron results.

Evaluation of the iron bioremediation data shows utilization/depletion of ferric iron as an electron acceptor in four of nine wells, with the corresponding accumulation of ferrous iron. Elevated ferrous iron concentrations were detected at wells 13MW-4, 13MW-7, 13MW-8 and 13MW-10, and may indicate iron reducing conditions at those wells.

4.9.2.5 Sulfur Speciation Data

Once all of the ferric iron has been reduced, sulfate (SO_4^{2-}) can serve as the terminal electron acceptor for anaerobic biodegradation (ASTM 1998). This process is termed sulfate reduction and results in the production of sulfide. Sulfide was detected in well 13MW-4 (2.1 µg/L), and may indicate the utilization/reduction of sulfate to sulfide at that location.

4.9.2.6 Methane

Once sulfate is depleted, CO_2 can act as an electron acceptor during anaerobic biodegradation, and is reduced to methane under strongly reducing (less than -240 mV) conditions (ASTM 1998, USEPA 1998). Methane groundwater concentrations in excess of 0.5 mg/L may be an indicator of methanogenesis (USEPA, 1998). Methane was detected in four of nine wells, with wells 13MW-4 (2.0 µg/L) and 13MW-8 (4.4 mg/L) having concentrations in excess of 0.5 µg/L. The detection of methane at well 13MW-4 is somewhat consistent with the low detected ORP readings (-128.4 mV) and indication of sulfate reduction in that sample. The detection of methane at well 13MW-8 is inconsistent with the measured ORP and other electron acceptor data.

4.10 RESULTS OF QA/QC SAMPLING

The focused data investigation sampling activities were conducted in compliance with the PTA QAPP (IT, 1999), *U.S. Army Environmental Center Guidelines for Implementation of ER 1110-1-263 for USAEC Projects* (1993), *Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3* (USACE, 2001), *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988a), and *Field Sampling Procedures Manual* (NJDEP, 1992). Field QC samples were collected during sampling and included trip blanks, equipment rinsate blank, and duplicate samples.

Trip blanks were provided by the laboratory and consisted of High Purity Liquid Chromatographic (HPLC) water. Trip blanks were shipped with each cooler containing samples for VOC analysis. A total of 27 trip blanks were submitted for TCL analysis. The results of the VOC analysis are presented in **Table 4-8a**. Trace concentrations of methylene chloride and/or acetone was detected in most samples, and is attributed to lab contamination during extraction. Trace concentrations of toluene (2 samples) and styrene (1) were also detected, and is attributed to laboratory blank water contamination. Additionally, 1,2 – dichlolorethane was detected in one trip blank (2/10/2011) at a concentration of 1.1 µg/L. This was the only detection of 1,2 dichloroethane during all of the monitoring events through the duration of the project. A low level of chloroform 0.687 µg/L was detected in one trip blank (4/19/2010).

Equipment rinsate blanks were collected to assess potential cross contamination from reusable equipment, which includes Grunfos submersible pumps and sediment trowels/mixing bowls. A rinsate blank was collected by pouring an aliquot of HPLC-grade water through each type of equipment after decontamination, and checks whether the decontamination procedure was successful in removing

contaminants from the equipment. A total of 32 rinsate blanks were collected during sampling rounds, and were analyzed for VOC and baseline explosives. The results of the rinsate blank analysis are shown in **Table 4-8b**. Trace concentrations of methylene chloride and/or acetone were detected in a number of samples, and is attributed to laboratory contamination during extraction. Low concentrations of nitrobenzene (2) and 2,4-dinitrotoluene (1) were detected in rinsate blanks collected in June 2007, and indicates probable residual contamination of these pumps resulting from inadequate decontamination. One low concentration hit of chloromethane was detected in one of the June 2008 rinsate blanks. Compounds detected in rinsate blanks were blank qualified and assigned to all samples in the decontamination lot. Sporadic low level detections of VOCs were found in rinse blanks throughout the project. These detections were consistent with laboratory contamination or source water contamination. Detections of compounds with the potential to be site related are discussed individually.

4.11 SUMMARY OF LOC EXCEEDANCES IN THE 600 AREA

The purpose of this sub-section is to provide the reader a summary of all compounds that have been found to exceed LOCs for groundwater, surface water, and sediment in the 600 Area. This list of compounds will be used to develop the COPCs that will be addressed by this FS.

4.11.1 Groundwater Exceedances

A total of seven VOC and explosive compounds have historically exceeded applicable LOCs. Summaries of compounds detected in groundwater are presented in **Table 4-2**. The seven LOC exceeding compounds (with number of exceedances/samples) are as follows:

1. 1,2-Dichloroethane (1/124)
2. MTBE (2/115)
3. Methylene chloride (1/124)
4. PCE (1/124)
5. RDX (5/68)
6. 1,1,2,2 Tetrachloroethane (1/124)
7. TCE (67/124)

4.11.2 Surface Water Exceedances

A total of three VOCs and explosive compounds historically exceeded applicable LOCs. Summaries of compounds detected in surface water are presented in **Table 4-4**. The three LOC exceeding compounds (with number of exceedances/samples) are as follows:

1. MTBE (1/49)
2. RDX (3/21)
3. TCE (15/51)

4.11.3 Sediment LOC Exceedances

Two toluene LOC exceedances were detected in sediment at sample location 11SD-1. A summary of compounds detected in sediment is presented in **Table 4-6**.

4.12 HUMAN HEALTH RISK ASSESSMENT

Estimated cancer risks and noncancer hazards were quantified for the 600 Area based on the USEPA-approved PTA Phase III-1A HHRA Approach (IT, 2001), site-specific risk approach detailed in the January 2007 Memorandum to USEPA (Shaw, 2007c), and the revised approach detailed in 2008 correspondence (Shaw, 2008). The risk assessment was performed in 2008 and 2009 after the approach was reviewed and agreed to by the USEPA. The risk assessment was presented in the draft FS in 2009. Subsequent to the initial regulatory review and approval of the FS, there was a request by the USEPA to complete a source investigation and vapor intrusion study. Planning and completion of the source investigation caused a delay in the finalization of this document. In order to continue monitoring the

groundwater plume the Army collected additional rounds of data after 2008. This data was consistent with earlier data and in general showed decreasing trends. Based on this information the risk assessment has not been updated with sampling data collected after 2008. Additionally, the vapor intrusion investigation was consistent with the results of the initial Johnson and Ettinger Vapor Intrusion Model (J&E Model). Neither the model nor the VI investigation indicated the potential for unacceptable risk. Therefore both the J&E model result and the VI investigation result are both presented without the addition of the 2010/2011 data. Risk assessment details, including procedures used for the selection of site groundwater and surface water COPCs, chemical-specific factors and vapor emission equations for COPCs, 600 Area risk tables, and the risk assessment uncertainty analysis, are presented in **Appendix M**. Results from the Johnson and Ettinger Vapor Intrusion Model are presented in **Appendix M**.

Current and projected land use in the 600 Area is controlled by the operation of active outdoor test ranges in Sites 11 (Building 650) and 13 (Building 640), the Building 647 Area, and the indoor range at the AWDF. The 600 Area is located in a secure part of PTA, and is restricted to on-site research workers and construction excavation workers. Future military housing is very unlikely in the 600 Area due to long-term projected range operation and potential for MEC. Accordingly, military residents were not evaluated in this HHRA.

Estimated cancer risks and noncancer hazards were quantified for exposure scenarios for on-site industrial research workers and on-site construction excavation workers. For these receptors, groundwater routes of exposure evaluated included: ingestion and dermal contact, inhalation of VOCs during washroom use, and volatilization of constituents from *in situ* groundwater to indoor air followed by inhalation. For surface water, routes of exposure were limited to dermal contact with water by industrial research workers. All of these exposure scenarios should be considered future scenarios, except for the inhalation of VOCs from *in situ* groundwater and the dermal contact with surface water by on-site workers, because no workers currently use 600 Area groundwater.

Human health contaminants of potential concern (HHCOPCs) selected for the Site include nine compounds in groundwater and three compounds in surface water are shown in **Table 4-11**. The COPCs were generally selected based on preliminary remediation goals (PRGs for target cancer risk of 1E-6 and target noncancer hazard of 0.1) and available Chemical-Specific Criteria (see **Appendix M,** Table 2.1 for groundwater COPC selection and **Appendix M,** Table 2.2 for surface water COPC selection).

A summary of estimated risks and hazards for the future exposure scenarios is shown in **Table 4-12** (see **Appendix M**, Risk Summary Tables 9.1 and 10.1 for Future Industrial/Research Workers, Tables 9.2 and 10.2 for Future Construction/Excavation Workers). The estimated total reasonable maximum exposure (RME) cancer risk of 1.1E-05 for the future industrial research worker scenario is based upon the following risks associated with the three exposure pathways evaluated and totaled: 9.8E-06 for ingestion, 5.8E-07 for inhalation, and 1.8E-07 for dermal contact. The estimated RME risk for the future industrial research worker falls within USEPA's cancer risk range of 1E-4 to 1E-6. The estimated total RME cancer risk is 2.2E-08 for the future construction excavation worker scenario, which is based entirely on the evaluated dermal exposure pathway.

The estimated total RME noncancer hazard of 0.005 for the future industrial research worker scenario is based upon the following hazards associated with the three exposure pathways evaluated and totaled: 0.0048 for ingestion, 0.00051 for inhalation, and 0.000045 for dermal contact. The estimated total RME noncancer hazard of 0.0001 for the future construction excavation worker scenario is based entirely on the dermal exposure pathway evaluated. The estimated RME hazards for the future industrial research worker receptor and construction excavation worker are both below USEPA's target noncancer hazard.

A summary of estimated risks and hazards for the current and future exposure scenarios involving surface water is shown in **Table 4-13** (see **Appendix M,** Risk Summary Tables 9.3 and 10.3 for Current and Future Industrial/Research Workers). The estimated total RME cancer risk of 1.1E-09 for the current/future industrial research worker scenario is based entirely on the dermal contact pathway. This estimated RME risk for the industrial research worker is below USEPA's target cancer risk range of 1E-4 to 1E-6.

The estimated total surface water RME noncancer hazard of 0.000009 for the current/future industrial research worker scenario is also based solely on the dermal contact pathway. This estimated RME hazard for the industrial research worker receptor is below USEPA's target noncancer hazard index of 1 (see **Appendix M**, Table 9.3 for Current and Future Industrial/Research Workers).

The risk assessment was performed prior to the VI investigation carried out at Building 660 in 2011. Therefore, the risk from VI to indoor air was modeled using the J&E Model. The J&E Model was used to evaluate risks and hazards from the inhalation of organics that may migrate from *in situ* groundwater to indoor air. These risks and hazards were estimated separately from the RAGS-D assessment presented in **Appendix M**. This is because the RAGS-D format is not amenable to the J&E Model risk and hazard output because the J&E Model uses unit risk factors (URFs) and reference concentrations (RfCs) to assess exposure to VOCs in air, not estimated doses, and the J&E Model calculates risks and hazards. The results of the Building 660 VI investigation (summarized in Section 4.6) support the output of the J&E Model, discussed below. Since the calculated risks and hazards from the J&E Model are not a driver for remedial action at the site, it is unnecessary to update the risk assessment based on the 2011 VI data.

A summary of estimated risks and hazards for the current and future inhalation of organics off-gassing from *in situ* groundwater to indoor air is shown in **Table 4-14** (see **Appendix M** - J&E Model input and output files). **Table 4-14** results show that the estimated cancer risk from the off-gassing of organics from *in situ* groundwater to indoor air for the current and future industrial research worker is acceptable, as the risk (6.3E-06) falls within the USEPA's target cancer risk range of 1E-4 to 1E-6. The estimated noncancer hazard of 0.002 is also acceptable, as it is below USEPA's target hazard index of 1.

These indoor risks and hazards may be added to the risks and hazards presented in **Tables 4-12** and **4-13**. The summation of risks and hazards from **Tables 4-12**, **4-13**, and **4-14** results in a total estimated industrial research worker cancer risk of 1.7E-5 and a total estimated hazard index of 0.007 (see **Table 4-15**). The summed risks are within the USEPA's target risk range and the summed hazards are below the target hazard index of 1. The risk and hazard driver in all cases is TCE.

4.13 ECOLOGICAL RISK ASSESSMENT

Aquatic receptors (e.g., fish and macro invertebrates) could be exposed to surface water chemicals of potential ecological concern (COPECs) from groundwater feeding into 600 Area flowages via seeps or springs. If concentrations are high enough, exposure to these high concentrations could lead to reduced survival and reproduction of aquatic organisms or alter the benthic macro invertebrate community.

Ecological concerns at 600 Area surface water can be assessed through an examination of ecological LOCs. Ecological LOCs were initially derived for use in the *Phase II Ecological Risk Assessment* (IT, 2000) and in the *Phase III Screening Level Ecological Risk Assessment* (Shaw, 2005c). These ecological screening values can be compared to concentrations of COPECs in surface water of the 600 Area to determine if there is any potential for an ecological impact from those COPECs. These screening levels are intended to be conservative estimates of potential effects; that is, although the presence of concentrations above screening values does not imply that effects are present, all concentrations being below the screening values does generally represent a great deal of confidence that effects due to the COPECs will not be present.

For the 11 chemicals detected in surface water (Table 1), screening values were available from the following sources for these chemicals:

- Suter and Tsao (1996). Suter and Tsao (1996) developed Tier II values for 2-butanone, acetone, toluene, and TCE. Tier II values are derived in the same manner as AWQC, but represent parameters that do not have sufficient data for development of an AWQC and are expected to be higher than AWQC in no more than 20 percent of cases.
- Talmage et al. (1999). Although the USEPA has not calculated AWQC for RDX or HMX, sufficient data are available to do so, and Talmage et al. (1999) developed Tier II chronic values for these two explosives.

- USEPA Region 6 (2005). The Texas Commission on Environmental Quality has published updated surface water benchmarks, and these benchmarks are used for chloromethane, cis-1,2-DCE, Freon113, MTBE, and nitrobenzene, as no values are available from the two previously listed sources (Suter and Tsao [1986] and Talmage et al., [1999]).

Concentrations of these chemicals in 600 Area surface water are all below screening values and are not expected to have any adverse effects on aquatic life at the 600 Area.

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-1				13MW-1				13MW-1				13MW-1				13MW-1				13MW-1			
		Date Sampled:	5/20/2005				7/31/2006				11/1/2006				3/5/2007				6/15/2007				10/24/2007			
		Depth Sampled (ft):	226-251				226-251				226-251				226-251				226-251				226-251			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	50	UD	50	3.7	50	UD	50	3.7	40	(U)D	40	3	50	UD	50	3.7	59	(U)D	59	6.5	50	(U)	50	5.5
Acetonitrile	120	TWRBC	100	R	100	7.5	100	UD	100	7.5	80	UD	80	6	100	UD	100	7.5	120	UD	120	21	100	U	100	18
Benzene	1	NJMCL, NJPQL	5	UD	5	1.1	5	UD	5	1.1	4	UD	4	0.88	5	UD	5	1.1	5.9	UD	5.9	0.76	5	U	5	0.65
Bromodichloromethane	1	NJPQL	5	UD	5	0.7	5	UD	5	0.7	4	UD	4	0.56	5	UD	5	0.7	5.9	UD	5.9	0.88	5	U	5	0.75
Bromoform	4	Quality Criteria	5	UD	5	0.85	5	UD	5	0.85	4	UD	4	0.68	5	UD	5	0.85	5.9	UD	5.9	3.8	5	U	5	3.2
Bromomethane	10	Quality Criteria	10	UD	10	1.8	10	UD	10	1.8	8	UD	8	1.4	10	UD	10	1.8	12	UD	12	2.4	10	U	10	2
2-Butanone	300	Quality Criteria	50	UD	50	2	50	UD	50	2	40	UD	40	1.6	50	UD	50	2	59	UD	59	3.4	50	U	50	2.8
Carbon disulfide	700	Quality Criteria	5	UD	5	1.4	5	UD	5	1.4	4	UD	4	1.1	5	UD	5	1.4	5.9	UD	5.9	0.76	5	U	5	0.65
Carbon tetrachloride	1	NJPQL	5	UD	5	0.95	5	UD	5	0.95	4	UD	4	0.76	5	UD	5	0.95	5.9	UD	5.9	0.76	5	U	5	0.65
Chlorobenzene	50	NJMCL, Quality Criteria	5	UD	5	1	5	UD	5	1	4	UD	4	0.8	5	UD	5	1	5.9	UD	5.9	0.88	5	U	5	0.75
Chloroethane	3.6	TWRBC	10	UD	10	1.2	10	UD	10	1.2	8	UD	8	0.96	10	UD	10	1.2	12	UD	12	1.7	10	U	10	1.4
Chloroform	70	Quality Criteria, MCLG	5	UD	5	0.8	5	(U)D	5	0.8	4	UD	4	0.64	5	UD	5	0.8	5.9	UD	5.9	0.94	**43**		5	0.8
Chloromethane	30	HA	10	UD	10	0.7	10	(U)D	10	0.7	8	UD	8	0.56	10	UD	10	0.7	12	UD	12	1.8	10	U	10	1.5
Dibromochloromethane	1	NJPQL	5	UD	5	0.95	5	UD	5	0.95	4	UD	4	0.76	5	UD	5	0.95	5.9	UD	5.9	1.1	5	U	5	0.9
Dichlorodifluoromethane	1000	Quality Criteria	10	UD	10	1.2	10	UD	10	1.2	8	UD	8	1	10	UD	10	1.2	12	UD	12	1.8	10	U	10	1.6
1,1-Dichloroethane	50	NJMCL, Quality Criteria	5	UD	5	1	5	UD	5	1	4	UD	4	0.84	5	UD	5	1	5.9	UD	5.9	0.88	5	U	5	0.75
1,2-Dichloroethane	2	NJMCL, NJPQL	5	UD	5	0.8	5	UD	5	0.8	4	UD	4	0.64	5	UD	5	0.8	5.9	UD	5.9	1.3	**20**		5	1.1
1,1-Dichloroethene	1	Quality Criteria, NJPQL	5	UD	5	0.9	5	UD	5	0.9	4	UD	4	0.72	5	UD	5	0.9	5.9	UD	5.9	1.1	5	U	5	0.95
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	2.5	UD	2.5	1	**1.3**	**JD**	2.5	1	2	UD	2	0.84	2.5	UD	2.5	1	2.9	UD	2.9	1	2.5	U	2.5	0.85
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	2.5	UD	2.5	0.8	2.5	UD	2.5	0.8	2	UD	2	0.64	2.5	UD	2.5	0.8	2.9	UD	2.9	1.1	2.5	U	2.5	0.95
1,2-Dichloropropane	1	NJPQL	5	UD	5	0.75	5	UD	5	0.75	4	UD	4	0.6	5	UD	5	0.75	5.9	UD	5.9	1.1	5	U	5	0.9
cis-1,3-Dichloropropene	1	NJPQL	5	UD	5	0.6	5	UD	5	0.6	4	UD	4	0.48	5	UD	5	0.6	5.9	UD	5.9	0.82	5	U	5	0.7
trans-1,3-Dichloropropene	1	NJPQL	5	UD	5	0.85	5	UD	5	0.85	4	UD	4	0.68	5	UD	5	0.85	5.9	UD	5.9	1.1	5	U	5	0.95
Ethyl benzene	700	MCL, Quality Criteria, MCLG	5	UD	5	0.95	5	UD	5	0.95	4	UD	4	0.76	5	UD	5	0.95	5.9	UD	5.9	1	5	U	5	0.85
2-Hexanone		NA	50	UD	50	1.8	50	UD	50	1.8	40	UD	40	1.4	50	UD	50	1.8	59	UD	59	2.4	50	U	50	2
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	5	UD	5	0.9	5	UD	5	0.9	4	UD	4	0.72	5	UD	5	0.9	29	UD	29	1	5	U	5	0.85
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	25	UD	25	1.6	25	UD	25	1.6	20	UD	20	1.3	25	UD	25	1.6	29	UD	29	1.9	25	U	25	1.6
Methylene chloride	3	NJMCL, Quality Criteria	5	UD	5	0.95	5	(U)D	5	0.95	4	UD	4	0.76	5	UD	5	0.95	5.9	UD	5.9	1.9	15	(U)	5	1.6
Styrene	100	MCL, Quality Criteria, MCLG	5	UD	5	0.65	5	UD	5	0.65	4	UD	4	0.52	5	UD	5	0.65	5.9	UD	5.9	0.65	5	U	5	0.55
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	5	UD	5	1.1	5	UD	5	1.1	4	UD	4	0.88	5	UD	5	1.1	5.9	UD	5.9	1.1	**5.1**		5	0.9
Tetrachloroethene	1	NJMCL, NJPQL	5	UD	5	0.95	**2.2**	**JD**	5	0.95	4	UD	4	0.76	5	UD	5	0.95	5.9	UD	5.9	1.7	5	U	5	1.4
Toluene	600	Quality Criteria	5	UD	5	0.85	5	UD	5	0.85	4	UD	4	0.68	5	UD	5	0.85	5.9	UD	5.9	0.76	5	U	5	0.65
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	5	UD	5	1	5	UD	5	1	4	UD	4	0.84	5	UD	5	1	5.9	UD	5.9	1.3	5	U	5	1.1
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	5	UD	5	1.1	5	UD	5	1.1	4	UD	4	0.88	5	UD	5	1.1	5.9	UD	5.9	1.6	5	U	5	1.4
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**140**	**D**	5	1.4	**140**	**D**	5	1.4	**120**	**D**	4	1.1	**170**	**D**	5	1.4	**130**	**D**	5.9	1	**120**		5	0.85
Trichlorofluoromethane	2000	Quality Criteria	10	UD	10	0.8	10	UD	10	0.8	8	UD	8	0.64	10	UD	10	0.8	12	UD	12	1.2	10	U	10	1
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**28**	**D**	5	1.3	**32**	**D**	5	1.3	**43**	**D**	4	1	**93**	**D**	5	1.3	**56**	**D**	5.9	1.6	**52**		5	1.4
Vinyl chloride	1	NJPQL	10	UD	10	1	10	UD	10	1	8	UD	8	0.84	10	UD	10	1	12	UD	12	1.3	10	U	10	1.1
Total Xylenes	1000	NJMCL, Quality Criteria	5	UD	5	2.2	5	UD	5	2.2	4	UD	4	1.8	5	UD	5	2.2	5.9	UD	5.9	1.6	5	U	5	1.4
Explosives																										
1,3-Dinitrobenzene	1	HA	NT				NT				**0.088**	**J COL**	0.2	0.06	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.036
2,4-Dinitrotoluene	10	NJPQL	NT				NT				0.2	U	0.2	0.066	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.062
2,6-Dinitrotoluene	10	NJPQL	NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.051
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				0.2	U	0.2	0.063	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.066
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				0.2	U	0.2	0.088	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.065
HMX	400	HA	NT				NT				**0.15**	**J**	0.5	0.061	**0.19**	**J**	0.5	0.07	**0.2**	**J COL**	0.5	0.07	**0.11**	**J COL**	0.5	0.037
Nitrobenzene	6	NJPQL	NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.063
2-Nitrotoluene	61	TWRBC	NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075
3-Nitrotoluene	61	TWRBC	NT				NT				0.2	U	0.2	0.16	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.042
4-Nitrotoluene	61	TWRBC	NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075
RDX	0.5	NJPQL	NT				NT				**0.55**		0.5	0.053	**0.62**		0.5	0.1	**0.62**		0.5	0.1	**0.67**		0.5	0.037
Tetryl	150	TWRBC	NT				NT				0.2	U	0.2	0.078	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.065
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				0.2	U	0.2	0.052	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.035
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				NT				**0.3**	**COL**	0.2	0.051	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.05

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-1				13MW-1				13MW-1				13MW-2				13MW-2				13MW-2			
		Date Sampled:	6/10/2008				5/10/2010				2/8/2011				5/9/2005				7/25/2006				10/31/2006			
		Depth Sampled (ft):	226-251				226-251				226-251				165-190				165-190				165-190			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	14	UD	14	0.77	10	U	10	1.8	5	U	5	0.5	17	UD	17	1.2	40	UD	40	3	25	(U)D	25	1.8
Acetonitrile	120	TWRBC	NT				5	U	5	1.67	NT				33	R	33	2.5	80	UD	80	6	50	UD	50	3.8
Benzene	1	NJMCL, NJPQL	2.8	UD	2.8	0.059	1	U	1	0.14	1	U	1	0.32	1.7	UD	1.7	0.37	4	UD	4	0.88	2.5	UD	2.5	0.55
Bromodichloromethane	1	NJPQL	2.8	UD	2.8	0.031	1	U	1	0.18	1	U	1	0.36	1.7	UD	1.7	0.23	4	UD	4	0.56	2.5	UD	2.5	0.35
Bromoform	4	Quality Criteria	2.8	UD	2.8	0.1	1.5	U	1.5	0.5	1	U	1	0.47	1.7	UD	1.7	0.28	4	UD	4	0.68	2.5	UD	2.5	0.42
Bromomethane	10	Quality Criteria	2.8	UD	2.8	0.29	2	U	2	0.32	1	U	1	0.2	3.3	UD	3.3	0.6	8	UD	8	1.4	5	UD	5	0.9
2-Butanone	300	Quality Criteria	14	UD	14	0.78	5	U	5	1.6	5	U	5	1.3	17	UD	17	0.65	40	(U)D	40	1.6	25	UD	25	0.98
Carbon disulfide	700	Quality Criteria	2.8	UD	2.8	0.045	1	U	1	0.26	1	U	1	0.2	1.7	UD	1.7	0.47	4	UD	4	1.1	2.5	UD	2.5	0.7
Carbon tetrachloride	1	NJPQL	2.8	UD	2.8	0.031	1	U	1	0.24	1	U	1	0.2	1.7	UD	1.7	0.32	4	UD	4	0.76	2.5	UD	2.5	0.48
Chlorobenzene	50	NJMCL, Quality Criteria	2.8	UD	2.8	0.047	1	U	1	0.21	1	U	1	0.49	1.7	UD	1.7	0.33	4	UD	4	0.8	2.5	UD	2.5	0.5
Chloroethane	3.6	TWRBC	2.8	UD	2.8	0.15	1	U	1	0.27	1	U	1	0.2	3.3	UD	3.3	0.4	8	UD	8	0.96	5	UD	5	0.6
Chloroform	70	Quality Criteria, MCLG	2.8	UD	2.8	0.041	1	U	1	0.23	1	U	1	0.34	1.7	UD	1.7	0.27	4	UD	4	0.64	2.5	UD	2.5	0.4
Chloromethane	30	HA	2.8	UD	2.8	0.11	**0.499**	**J**	1	0.36	1	U	1	0.2	3.3	UD	3.3	0.23	8	(U)D	8	0.56	**0.46**	**JD**	5	0.35
Dibromochloromethane	1	NJPQL	2.8	UD	2.8	0.035	1	U	1	0.18	1	U	1	0.2	1.7	UD	1.7	0.32	4	UD	4	0.76	2.5	UD	2.5	0.48
Dichlorodifluoromethane	1000	Quality Criteria	2.8	UD	2.8	0.058	2	U	2	0.26	1	U	1	0.2	3.3	UD	3.3	0.42	8	UD	8	1	5	UD	5	0.62
1,1-Dichloroethane	50	NJMCL, Quality Criteria	2.8	UD	2.8	0.041	1	U	1	0.24	1	U	1	0.36	1.7	UD	1.7	0.35	4	UD	4	0.84	2.5	UD	2.5	0.52
1,2-Dichloroethane	2	NJMCL, NJPQL	2.8	UD	2.8	0.1	1	U	1	0.22	1	U	1	0.48	1.7	UD	1.7	0.27	4	UD	4	0.64	2.5	UD	2.5	0.4
1,1-Dichloroethene	1	Quality Criteria, NJPQL	2.8	UD	2.8	0.077	1	U	1	0.28	1	U	1	0.47	1.7	UD	1.7	0.3	4	UD	4	0.72	2.5	UD	2.5	0.45
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	2.8	UD	2.8	0.065	1.5	U	1.5	0.45	1	U	1	0.35	**0.45**	**JD**	0.84	0.35	**1.2**	**JD**	2	0.84	**1.4**	**D**	1.2	0.52
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	2.8	UD	2.8	0.059	1.5	U	1.5	0.53	1	U	1	0.41	0.84	UD	0.84	0.27	2	UD	2	0.64	1.2	UD	1.2	0.4
1,2-Dichloropropane	1	NJPQL	2.8	UD	2.8	0.1	1	U	1	0.27	1	U	1	0.46	1.7	UD	1.7	0.25	4	UD	4	0.6	2.5	UD	2.5	0.38
cis-1,3-Dichloropropene	1	NJPQL	2.8	UD	2.8	0.049	1	U	1	0.15	1	U	1	0.31	1.7	UD	1.7	0.2	4	UD	4	0.48	2.5	UD	2.5	0.3
trans-1,3-Dichloropropene	1	NJPQL	2.8	UD	2.8	0.053	1	U	1	0.17	1	U	1	0.29	1.7	UD	1.7	0.28	4	UD	4	0.68	2.5	UD	2.5	0.42
Ethyl benzene	700	MCL, Quality Criteria, MCLG	2.8	UD	2.8	0.038	1	U	1	0.15	1	U	1	0.2	1.7	UD	1.7	0.32	4	UD	4	0.76	2.5	UD	2.5	0.48
2-Hexanone		NA	14	UD	14	0.29	5	U	5	0.5	5	U	5	1.9	17	UD	17	0.58	40	UD	40	1.4	25	UD	25	0.88
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	2.8	UD	2.8	0.036	NT				1	U	1	0.35	1.7	UD	1.7	0.3	4	UD	4	0.72	2.5	UD	2.5	0.45
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	14	UD	14	0.29	5	U	5	0.5	5	U	5	2.1	8.4	UD	8.4	0.53	20	UD	20	1.3	12	UD	12	0.8
Methylene chloride	3	NJMCL, Quality Criteria	2.8	UD	2.8	0.12	1	U	1	0.27	1	U	1	0.41	1.7	UD	1.7	0.32	4	(U)D	4	0.76	2.5	UD	2.5	0.48
Styrene	100	MCL, Quality Criteria, MCLG	2.8	UD	2.8	0.05	1	U	1	0.24	1	U	1	0.36	1.7	UD	1.7	0.22	4	UD	4	0.52	2.5	UD	2.5	0.32
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	2.8	UD	2.8	0.047	1	U	1	0.23	1	U	1	0.31	1.7	UD	1.7	0.37	4	UD	4	0.88	2.5	UD	2.5	0.55
Tetrachloroethene	1	NJMCL, NJPQL	2.8	UD	2.8	0.063	**0.252**	**J**	1	0.17	1	U	1	0.27	1.7	UD	1.7	0.32	4	UD	4	0.76	2.5	UD	2.5	0.48
Toluene	600	Quality Criteria	2.8	UD	2.8	0.041	1	U	1	0.19	1	U	1	0.37	**0.31**	**JD**	1.7	0.28	4	UD	4	0.68	2.5	UD	2.5	0.42
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	2.8	UD	2.8	0.041	**0.519**	**J**	1	0.29	1	U	1	0.4	1.7	UD	1.7	0.35	4	UD	4	0.84	2.5	UD	2.5	0.52
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	2.8	UD	2.8	0.072	1	U	1	0.26	1	U	1	0.38	1.7	UD	1.7	0.37	4	UD	4	0.88	2.5	UD	2.5	0.55
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**110**	**D**	2.8	0.058	**116**		1	0.5	**96**	**D**	10	2.8	**42**	**D**	1.7	0.47	**130**	**D**	4	1.1	**81**	**D**	2.5	0.7
Trichlorofluoromethane	2000	Quality Criteria	2.8	UD	2.8	0.067	1	U	1	0.25	1	U	1	0.35	3.3	UD	3.3	0.27	8	UD	8	0.64	5	UD	5	0.4
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	NT				**72.7**		1	0.33	**66**		1	0.45	**14**	**D**	1.7	0.43	**60**	**D**	4	1	**31**	**D**	2.5	0.65
Vinyl chloride	1	NJPQL	2.8	UD	2.8	0.062	1	U	1	0.2	1	U	1	0.34	3.3	UD	3.3	0.35	8	UD	8	0.84	5	UD	5	0.52
Total Xylenes	1000	NJMCL, Quality Criteria	2.8	UD	2.8	0.097	1	U	1	0.22	2	U	2	0.95	1.7	UD	1.7	0.73	4	UD	4	1.8	2.5	UD	2.5	1.1
Explosives																										
1,3-Dinitrobenzene	1	HA	NT				NT				NT				NT				NT				0.2	U	0.2	0.06
2,4-Dinitrotoluene	10	NJPQL	NT				NT				NT				NT				NT				0.2	U	0.2	0.066
2,6-Dinitrotoluene	10	NJPQL	NT				NT				NT				NT				NT				0.2	U	0.2	0.072
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				NT				NT				0.2	U	0.2	0.063
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				NT				NT				0.2	U	0.2	0.088
HMX	400	HA	NT				NT				NT				NT				NT				0.5	U	0.5	0.061
Nitrobenzene	6	NJPQL	NT				NT				NT				NT				NT				0.2	U	0.2	0.072
2-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				NT				0.2	U	0.2	0.12
3-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				NT				0.2	U	0.2	0.16
4-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				NT				0.2	U	0.2	0.12
RDX	0.5	NJPQL	NT				NT				NT				NT				NT				**0.18**	**J**	0.5	0.053
Tetryl	150	TWRBC	NT				NT				NT				NT				NT				0.2	U	0.2	0.078
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				NT				NT				NT				0.2	U	0.2	0.052
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				NT				NT				NT				NT				0.2	U	0.2	0.051

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-2				13MW-2DUP				13MW-2				13MW-2				13MW-2				13MW-2			
		Date Sampled:	3/1/2007				3/1/2007				6/20/2007				10/16/2007				5/10/2010				2/8/2011			
		Depth Sampled (ft):	165-190				165-190				165-190				165-190				165-190				165-190			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	50	UD	50	3.7	50	UD	50	3.7	67	(U)D	67	7.3	10	U	10	1.1	3.84	J	10	1.8	5	U	5	0.5
Acetonitrile	120	TWRBC	100	UD	100	7.5	100	UD	100	7.5	130	UD	130	23	20	U	20	3.5	5	U	5	1.67	NT			
Benzene	1	NJMCL, NJPQL	5	UD	5	1.1	5	UD	5	1.1	6.7	UD	6.7	0.87	1	U	1	0.13	1	U	1	0.14	1	U	1	0.32
Bromodichloromethane	1	NJPQL	5	UD	5	0.7	5	UD	5	0.7	6.7	UD	6.7	1	1	U	1	0.15	1	U	1	0.18	1	U	1	0.36
Bromoform	4	Quality Criteria	5	UD	5	0.85	5	UD	5	0.85	6.7	UD	6.7	4.3	1	U	1	0.64	1.5	U	1.5	0.5	1	U	1	0.47
Bromomethane	10	Quality Criteria	10	UD	10	1.8	10	UD	10	1.8	13	UD	13	2.7	2	U	2	0.41	2	U	2	0.32	1	U	1	0.2
2-Butanone	300	Quality Criteria	50	UD	50	2	50	UD	50	2	67	UD	67	3.8	10	U	10	0.57	5	U	5	1.6	5	U	5	1.3
Carbon disulfide	700	Quality Criteria	5	UD	5	1.4	5	UD	5	1.4	6.7	UD	6.7	0.87	1	U	1	0.13	1	U	1	0.26	1	U	1	0.2
Carbon tetrachloride	1	NJPQL	5	UD	5	0.95	5	UD	5	0.95	6.7	UD	6.7	0.87	1	U	1	0.13	1	U	1	0.24	1	U	1	0.2
Chlorobenzene	50	NJMCL, Quality Criteria	5	UD	5	1	5	UD	5	1	6.7	UD	6.7	1	1	U	1	0.15	1	U	1	0.21	1	U	1	0.49
Chloroethane	3.6	TWRBC	10	UD	10	1.2	10	UD	10	1.2	13	UD	13	1.9	2	U	2	0.29	1	U	1	0.27	1	U	1	0.2
Chloroform	70	Quality Criteria, MCLG	5	UD	5	0.8	5	UD	5	0.8	6.7	UD	6.7	1.1	1	U	1	0.16	1	U	1	0.23	1	U	1	0.34
Chloromethane	30	HA	10	UD	10	0.7	10	UD	10	0.7	13	UD	13	2	2	U	2	0.3	**0.66**	**J**	1	0.36	1	U	1	0.2
Dibromochloromethane	1	NJPQL	5	UD	5	0.95	5	UD	5	0.95	6.7	UD	6.7	1.2	1	U	1	0.18	1	U	1	0.18	1	U	1	0.2
Dichlorodifluoromethane	1000	Quality Criteria	10	UD	10	1.2	10	UD	10	1.2	13	UD	13	2.1	2	U	2	0.31	2	U	2	0.26	**2.8**		1	0.2
1,1-Dichloroethane	50	NJMCL, Quality Criteria	5	UD	5	1	5	UD	5	1	6.7	UD	6.7	1	1	U	1	0.15	1	U	1	0.24	1	U	1	0.36
1,2-Dichloroethane	2	NJMCL, NJPQL	5	UD	5	0.8	5	UD	5	0.8	6.7	UD	6.7	1.5	1	U	1	0.22	1	U	1	0.22	1	U	1	0.48
1,1-Dichloroethene	1	Quality Criteria, NJPQL	5	UD	5	0.9	5	UD	5	0.9	6.7	UD	6.7	1.3	1	U	1	0.19	1	U	1	0.28	1	U	1	0.47
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	**1.4**	**JD**	2.5	1	**1.5**	**JD**	2.5	1	**2**	**JD**	3.3	1.1	**2.2**		0.5	0.17	**1.29**	**J**	1.5	0.45	**2**		1	0.35
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	2.5	UD	2.5	0.8	2.5	UD	2.5	0.8	3.3	UD	3.3	1.3	**0.57**		0.5	0.19	1.5	U	1.5	0.53	**0.59**	**J**	1	0.41
1,2-Dichloropropane	1	NJPQL	5	UD	5	0.75	5	UD	5	0.75	6.7	UD	6.7	1.2	1	U	1	0.18	1	U	1	0.27	1	U	1	0.46
cis-1,3-Dichloropropene	1	NJPQL	5	UD	5	0.6	5	UD	5	0.6	6.7	UD	6.7	0.93	1	U	1	0.14	1	U	1	0.15	1	U	1	0.31
trans-1,3-Dichloropropene	1	NJPQL	5	UD	5	0.85	5	UD	5	0.85	6.7	UD	6.7	1.3	1	U	1	0.19	1	U	1	0.17	1	U	1	0.29
Ethyl benzene	700	MCL, Quality Criteria, MCLG	5	UD	5	0.95	5	UD	5	0.95	6.7	UD	6.7	1.1	1	U	1	0.17	1	U	1	0.15	1	U	1	0.2
2-Hexanone		NA	50	UD	50	1.8	50	UD	50	1.8	67	UD	67	2.7	10	U	10	0.41	5	U	5	0.5	5	U	5	1.9
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	5	UD	5	0.9	5	UD	5	0.9	33	UD	33	1.1	1	U	1	0.17	NT				1	U	1	0.35
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	25	UD	25	1.6	25	UD	25	1.6	33	UD	33	2.1	5	U	5	0.32	5	U	5	0.5	5	U	5	2.1
Methylene chloride	3	NJMCL, Quality Criteria	5	(U)D	5	0.95	5	(U)D	5	0.95	8.7	(U)D	6.7	2.2	1	U	1	0.33	1	U	1	0.27	1	U	1	0.41
Styrene	100	MCL, Quality Criteria, MCLG	5	UD	5	0.65	5	UD	5	0.65	6.7	UD	6.7	0.73	1	U	1	0.11	1	U	1	0.24	1	U	1	0.36
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	5	UD	5	1.1	5	UD	5	1.1	6.7	UD	6.7	1.2	1	U	1	0.18	1	U	1	0.23	1	U	1	0.31
Tetrachloroethene	1	NJMCL, NJPQL	5	UD	5	0.95	5	UD	5	0.95	6.7	UD	6.7	1.9	**0.4**	**J**	1	0.29	**0.446**	**J**	1	0.17	1	U	1	0.27
Toluene	600	Quality Criteria	5	UD	5	0.85	5	UD	5	0.85	6.7	UD	6.7	0.87	1	U	1	0.13	1	U	1	0.19	1	U	1	0.37
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	5	UD	5	1	5	UD	5	1	6.7	UD	6.7	1.5	**0.25**	**J**	1	0.22	**0.313**	**J**	1	0.29	1	U	1	0.4
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	5	UD	5	1.1	5	UD	5	1.1	6.7	UD	6.7	1.8	1	U	1	0.27	1	U	1	0.26	1	U	1	0.38
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**110**	**D**	5	1.4	**110**	**D**	5	1.4	**130**	**D**	6.7	1.1	**110**		5	0.85	**171**		1	0.5	**210**	**D**	10	2.8
Trichlorofluoromethane	2000	Quality Criteria	10	UD	10	0.8	10	UD	10	0.8	13	UD	13	1.4	2	U	2	0.21	1	U	1	0.25	1	U	1	0.35
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**45**	**D**	5	1.3	**51**	**D**	5	1.3	**52**	**D**	6.7	1.9	**41**		5	1.4	**81.3**		1	0.33	**64**		1	0.45
Vinyl chloride	1	NJPQL	10	UD	10	1	10	UD	10	1	13	UD	13	1.5	2	U	2	0.22	1	U	1	0.2	1	U	1	0.34
Total Xylenes	1000	NJMCL, Quality Criteria	5	UD	5	2.2	5	UD	5	2.2	6.7	UD	6.7	1.9	1	U	1	0.28	1	U	1	0.22	2	U	2	0.95
Explosives																										
1,3-Dinitrobenzene	1	HA	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.036	NT				NT			
2,4-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.062	NT				NT			
2,6-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.051	NT				NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.06	0.2	U	0.2	0.06	**0.066**	**J**	0.2	0.06	0.2	U	0.2	0.066	NT				NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.09	0.2	U	0.2	0.09	**0.096**	**J**	0.2	0.09	**0.091**	**J**	0.2	0.065	NT				NT			
HMX	400	HA	0.5	U	0.5	0.07	0.5	U	0.5	0.07	**0.092**	**J**	0.5	0.07	**0.086**	**J**	0.5	0.037	NT				NT			
Nitrobenzene	6	NJPQL	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.063	NT				NT			
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075	NT				NT			
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.042	NT				NT			
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075	NT				NT			
RDX	0.5	NJPQL	**0.23**	**J**	0.5	0.1	**0.22**	**J**	0.5	0.1	**0.2**	**J**	0.5	0.1	**0.18**	**J**	0.5	0.037	NT				NT			
Tetryl	150	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.065	NT				NT			
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.035	NT				NT			
2,4,6-Trinitrotoluene	1.2	Quality Criteria	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.05	NT				NT			

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-2				13MW-3				13MW-3				13MW-3				13MW-3				13MW-3			
		Date Sampled:	6/20/2008				5/9/2005				7/17/2006				11/1/2006				3/9/2007				6/26/2007			
		Depth Sampled (ft):	165-190				50-75				50-75				50-75				50-75				50-75			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	5	U	5	0.77	10	(U)	10	0.74	10	U	10	0.74	10	U	10	0.74	10	U	10	0.74	10	(U)	10	1.1
Acetonitrile	120	TWRBC	NT				20	R	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	3.5
Benzene	1	NJMCL, NJPQL	1	U	1	0.059	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.13
Bromodichloromethane	1	NJPQL	1	U	1	0.031	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.15
Bromoform	4	Quality Criteria	1	U	1	0.1	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.64
Bromomethane	10	Quality Criteria	1	U	1	0.29	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.41
2-Butanone	300	Quality Criteria	5	U	5	0.78	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.57
Carbon disulfide	700	Quality Criteria	1	U	1	0.045	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.13
Carbon tetrachloride	1	NJPQL	1	U	1	0.031	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.13
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.047	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.15
Chloroethane	3.6	TWRBC	1	U	1	0.15	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.29
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.041	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	30	HA	1	U	1	0.11	2	U	2	0.14	**0.2**	**J**	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.3
Dibromochloromethane	1	NJPQL	1	U	1	0.035	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.18
Dichlorodifluoromethane	1000	Quality Criteria	1	U	1	0.058	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.31
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.041	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.15
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.1	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.22
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.077	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.19
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	**1.5**		1	0.065	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.17
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	**0.38**	**J**	1	0.059	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.19
1,2-Dichloropropane	1	NJPQL	1	U	1	0.1	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.18
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.049	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.14
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.053	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.038	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17
2-Hexanone		NA	5	U	5	0.29	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.41
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	1	U	1	0.036	**3.8**		1	0.18	**2.9**		1	0.18	**3.6**		1	0.18	**2.3**		1	0.18	**1.1**	**J**	5	0.17
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.29	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.12	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.33
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.05	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.11
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.047	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.18
Tetrachloroethene	1	NJMCL, NJPQL	**0.35**	**J**	1	0.063	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.29
Toluene	600	Quality Criteria	1	U	1	0.041	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.13
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	**0.25**	**J**	1	0.041	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.22
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.072	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.27
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**130**	**D**	4.9	0.058	**9.5**		1	0.28	6.6		1	0.28	**10**		1	0.28	**24**		1	0.28	**17**		1	0.17
Trichlorofluoromethane	2000	Quality Criteria	1	U	1	0.067	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.21
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	NT				**4.7**		1	0.26	**2.4**		1	0.26	**2.8**		1	0.26	**9**		1	0.26	**5.5**		1	0.28
Vinyl chloride	1	NJPQL	1	U	1	0.062	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.22
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.097	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.28
Explosives																										
1,3-Dinitrobenzene	1	HA	NT				NT				0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.07	0.2	U	0.2	0.07
2,4-Dinitrotoluene	10	NJPQL	NT				NT				0.2	U	0.2	0.066	0.2	U	0.2	0.066	0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,6-Dinitrotoluene	10	NJPQL	NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.072	0.2	U	0.2	0.08	0.2	U	0.2	0.08
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				0.2	U	0.2	0.063	0.2	U	0.2	0.063	0.2	U	0.2	0.06	0.2	U	0.2	0.06
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				0.2	U	0.2	0.088	0.2	U	0.2	0.088	0.2	U	0.2	0.09	0.2	U	0.2	0.09
HMX	400	HA	NT				NT				0.5	U	0.5	0.061	0.5	U	0.5	0.061	**0.073**	**J**	0.5	0.07	**0.078**	**J**	0.5	0.07
Nitrobenzene	6	NJPQL	NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.072	0.2	U	0.2	0.07	0.2	U	0.2	0.07
2-Nitrotoluene	61	TWRBC	NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2
3-Nitrotoluene	61	TWRBC	NT				NT				0.2	U	0.2	0.16	0.2	U	0.2	0.16	0.2	U	0.2	0.1	0.2	U	0.2	0.1
4-Nitrotoluene	61	TWRBC	NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2
RDX	0.5	NJPQL	NT				NT				0.5	U	0.5	0.053	**0.12**	**J**	0.5	0.053	**0.29**	**J**	0.5	0.1	**0.26**	**J**	0.5	0.1
Tetryl	150	TWRBC	NT				NT				0.2	U	0.2	0.078	0.2	U	0.2	0.078	0.2	U	0.2	0.08	0.2	U	0.2	0.08
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				0.2	U	0.2	0.052	0.2	U	0.2	0.052	0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				NT				0.2	U	0.2	0.051	**0.11**	**J**	0.2	0.051	0.2	U	0.2	0.1	0.2	U	0.2	0.1

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-3				13MW-3				13MW-4				13MW-4DUP				13MW-4				13MW-4			
		Date Sampled:	10/23/2007				7/2/2008				5/9/2005				5/9/2005				7/24/2006				11/1/2006			
		Depth Sampled (ft):	50-75				50-75				168-193				168-193				168-193				168-193			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	10	U	10	1.1	5	U	5	0.77	14	UD	14	1.1	14	UD	14	1.1	10	U	10	0.74	10	(U)	10	0.74
Acetonitrile	120	TWRBC	20	U	20	3.5	NT				29	R	29	2.1	29	R	29	2.1	20	U	20	1.5	20	U	20	1.5
Benzene	1	NJMCL, NJPQL	1	U	1	0.13	1	U	1	0.059	1.4	UD	1.4	0.31	1.4	UD	1.4	0.31	1	U	1	0.22	1	U	1	0.22
Bromodichloromethane	1	NJPQL	1	U	1	0.15	1	U	1	0.031	1.4	UD	1.4	0.2	1.4	UD	1.4	0.2	1	U	1	0.14	1	U	1	0.14
Bromoform	4	Quality Criteria	1	U	1	0.64	1	U	1	0.1	1.4	UD	1.4	0.24	1.4	UD	1.4	0.24	1	U	1	0.17	1	U	1	0.17
Bromomethane	10	Quality Criteria	2	U	2	0.41	1	U	1	0.29	2.9	UD	2.9	0.51	2.9	UD	2.9	0.51	2	U	2	0.36	2	U	2	0.36
2-Butanone	300	Quality Criteria	10	U	10	0.57	5	U	5	0.78	14	UD	14	0.56	14	UD	14	0.56	10	U	10	0.39	10	U	10	0.39
Carbon disulfide	700	Quality Criteria	1	U	1	0.13	1	U	1	0.045	1.4	UD	1.4	0.4	1.4	UD	1.4	0.4	**1**		1	0.28	**0.49**	**J**	1	0.28
Carbon tetrachloride	1	NJPQL	1	U	1	0.13	1	U	1	0.031	1.4	UD	1.4	0.27	1.4	UD	1.4	0.27	1	U	1	0.19	1	U	1	0.19
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.15	1	U	1	0.047	1.4	UD	1.4	0.29	1.4	UD	1.4	0.29	1	U	1	0.2	1	U	1	0.2
Chloroethane	3.6	TWRBC	2	U	2	0.29	1	U	1	0.15	2.9	UD	2.9	0.34	2.9	UD	2.9	0.34	2	U	2	0.24	2	U	2	0.24
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.16	1	U	1	0.041	1.4	UD	1.4	0.23	1.4	UD	1.4	0.23	1	U	1	0.16	1	U	1	0.16
Chloromethane	30	HA	2	U	2	0.3	1	U	1	0.11	2.9	UD	2.9	0.2	2.9	UD	2.9	0.2	2	(U)	2	0.14	2	U	2	0.14
Dibromochloromethane	1	NJPQL	1	U	1	0.18	1	U	1	0.035	1.4	UD	1.4	0.27	1.4	UD	1.4	0.27	1	U	1	0.19	1	U	1	0.19
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.31	1	U	1	0.058	2.9	UD	2.9	0.36	2.9	UD	2.9	0.36	2	U	2	0.25	2	U	2	0.25
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.15	1	U	1	0.041	1.4	UD	1.4	0.3	1.4	UD	1.4	0.3	1	U	1	0.21	1	U	1	0.21
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.22	1	U	1	0.1	1.4	UD	1.4	0.23	1.4	UD	1.4	0.23	1	U	1	0.16	1	U	1	0.16
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.19	1	U	1	0.077	1.4	UD	1.4	0.26	1.4	UD	1.4	0.26	1	U	1	0.18	1	U	1	0.18
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.17	1	U	1	0.065	0.72	UD	0.72	0.3	0.72	UD	0.72	0.3	0.5	U	0.5	0.21	0.5	U	0.5	0.21
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.19	1	U	1	0.059	0.72	UD	0.72	0.23	0.72	UD	0.72	0.23	0.5	U	0.5	0.16	0.5	U	0.5	0.16
1,2-Dichloropropane	1	NJPQL	1	U	1	0.18	1	U	1	0.1	1.4	UD	1.4	0.21	1.4	UD	1.4	0.21	1	U	1	0.15	1	U	1	0.15
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.14	1	U	1	0.049	1.4	UD	1.4	0.17	1.4	UD	1.4	0.17	1	U	1	0.12	1	U	1	0.12
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.19	1	U	1	0.053	1.4	UD	1.4	0.24	1.4	UD	1.4	0.24	1	U	1	0.17	1	U	1	0.17
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.17	1	U	1	0.038	1.4	UD	1.4	0.27	1.4	UD	1.4	0.27	1	U	1	0.19	1	U	1	0.19
2-Hexanone		NA	10	U	10	0.41	5	U	5	0.29	14	UD	14	0.5	14	UD	14	0.5	10	U	10	0.35	10	U	10	0.35
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	**0.97**	**J**	1	0.17	**0.55**	**J**	1	0.036	**0.55**	**JD**	1.4	0.26	**0.56**	**JD**	1.4	0.26	**0.33**	**J**	1	0.18	**0.51**	**J**	1	0.18
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.32	5	U	5	0.29	7.2	UD	7.2	0.46	7.2	UD	7.2	0.46	5	U	5	0.32	5	U	5	0.32
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.33	1	U	1	0.12	1.4	UD	1.4	0.27	1.4	UD	1.4	0.27	1	U	1	0.19	1	U	1	0.19
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.11	1	U	1	0.05	1.4	UD	1.4	0.19	1.4	UD	1.4	0.19	1	U	1	0.13	1	U	1	0.13
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.18	1	U	1	0.047	1.4	UD	1.4	0.31	1.4	UD	1.4	0.31	1	U	1	0.22	1	U	1	0.22
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.29	1	U	1	0.063	1.4	UD	1.4	0.27	1.4	UD	1.4	0.27	1	U	1	0.19	1	U	1	0.19
Toluene	600	Quality Criteria	1	U	1	0.13	1	U	1	0.041	**8**	**D**	1.4	0.24	**7.5**	**D**	1.4	0.24	**0.61**	**J**	1	0.17	**0.62**	**J**	1	0.17
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.22	1	U	1	0.041	1.4	UD	1.4	0.3	1.4	UD	1.4	0.3	1	U	1	0.21	1	U	1	0.21
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.27	1	U	1	0.072	1.4	UD	1.4	0.31	1.4	UD	1.4	0.31	1	U	1	0.22	1	U	1	0.22
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**21**		1	0.17	**18**		1	0.058	**39**	**D**	1.4	0.4	**38**	**D**	1.4	0.4	**15**		1	0.28	**19**		1	0.28
Trichlorofluoromethane	2000	Quality Criteria	2	U	2	0.21	1	U	1	0.067	2.9	UD	2.9	0.23	2.9	UD	2.9	0.23	2	U	2	0.16	2	U	2	0.16
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**7.4**		1	0.28	NT				**28**	**D**	1.4	0.37	**29**	**D**	1.4	0.37	**7.4**		1	0.26	**8.8**		1	0.26
Vinyl chloride	1	NJPQL	2	U	2	0.22	1	U	1	0.062	2.9	UD	2.9	0.3	2.9	UD	2.9	0.3	**0.24**	**J**	2	0.21	2	U	2	0.21
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.28	1	U	1	0.097	1.4	UD	1.4	0.63	1.4	UD	1.4	0.63	1	U	1	0.44	1	U	1	0.44
Explosives																										
1,3-Dinitrobenzene	1	HA	0.2	U	0.2	0.036	0.25	U	0.25	0.04	NT				NT				NT				0.2	U	0.2	0.06
2,4-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.062	0.25	U	0.25	0.0097	NT				NT				NT				0.2	U	0.2	0.066
2,6-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.051	0.25	U	0.25	0.017	NT				NT				NT				0.2	U	0.2	0.072
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.066	0.25	U	0.25	0.018	NT				NT				NT				0.2	U	0.2	0.063
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.065	0.25	U	0.25	0.022	NT				NT				NT				0.2	U	0.2	0.088
HMX	400	HA	0.5	U	0.5	0.037	0.25	U	0.25	0.018	NT				NT				NT				0.5	U	0.5	0.061
Nitrobenzene	6	NJPQL	0.2	U	0.2	0.063	0.25	U	0.25	0.04	NT				NT				NT				0.2	U	0.2	0.072
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.075	0.25	U	0.25	0.017	NT				NT				NT				0.2	U	0.2	0.12
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.042	0.25	U	0.25	0.017	NT				NT				NT				0.2	U	0.2	0.16
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.075	0.25	U	0.25	0.026	NT				NT				NT				0.2	U	0.2	0.12
RDX	0.5	NJPQL	**0.3**	**J**	0.5	0.037	**0.36**		0.25	0.017	NT				NT				NT				0.5	U	0.5	0.053
Tetryl	150	TWRBC	0.2	U	0.2	0.065	0.25	U	0.25	0.04	NT				NT				NT				0.2	U	0.2	0.078
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.035	0.25	U	0.25	0.011	NT				NT				NT				**0.061**	**J**	0.2	0.052
2,4,6-Trinitrotoluene	1.2	Quality Criteria	0.2	U	0.2	0.05	0.25	U	0.25	0.012	NT				NT				NT				0.2	U	0.2	0.051

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-4				13MW-4				13MW-4				13MW-4				13MW-4				13MW-5			
		Date Sampled:	3/8/2007				6/26/2007				10/22/2007				7/1/2008				4/21/2010				7/26/2006			
		Depth Sampled (ft):	168-193				168-193				168-193				168-193				168-193				125-150			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	**1.4**	**JD**	14	1.1	10	U	10	1.1	10	(U)	10	1.1	5	U	5	0.77	**3.82**	**H1,J**	10	1.8	200	UD	200	15
Acetonitrile	120	TWRBC	29	UD	29	2.1	20	U	20	3.5	20	U	20	3.5	NT				5	H1,U	5	1.67	400	UD	400	30
Benzene	1	NJMCL, NJPQL	1.4	UD	1.4	0.31	1	U	1	0.13	1	U	1	0.13	1	U	1	0.059	1	H1,U	1	0.14	20	UD	20	4.4
Bromodichloromethane	1	NJPQL	1.4	UD	1.4	0.2	1	U	1	0.15	1	U	1	0.15	1	U	1	0.031	1	H1,U	1	0.18	20	UD	20	2.8
Bromoform	4	Quality Criteria	1.4	UD	1.4	0.24	1	U	1	0.64	1	U	1	0.64	1	U	1	0.1	1.5	H1,U	1.5	0.5	20	UD	20	3.4
Bromomethane	10	Quality Criteria	2.9	UD	2.9	0.51	2	U	2	0.41	2	U	2	0.41	1	U	1	0.29	2	H1,U	2	0.32	40	UD	40	7.2
2-Butanone	300	Quality Criteria	14	UD	14	0.56	10	U	10	0.57	10	U	10	0.57	5	U	5	0.78	5	H1,U	5	1.6	200	UD	200	7.8
Carbon disulfide	700	Quality Criteria	**0.8**	**JD**	1.4	0.4	**0.59**	**J**	1	0.13	**0.51**	**J**	1	0.13	**0.43**	**J**	1	0.045	1	H1,U	1	0.26	20	UD	20	5.6
Carbon tetrachloride	1	NJPQL	1.4	UD	1.4	0.27	1	U	1	0.13	1	U	1	0.13	1	U	1	0.031	1	H1,U	1	0.24	20	UD	20	3.8
Chlorobenzene	50	NJMCL, Quality Criteria	1.4	UD	1.4	0.29	1	U	1	0.15	1	U	1	0.15	1	U	1	0.047	1	H1,U	1	0.21	20	UD	20	4
Chloroethane	3.6	TWRBC	2.9	UD	2.9	0.34	2	U	2	0.29	2	U	2	0.29	1	U	1	0.15	1	H1,U	1	0.27	40	UD	40	4.8
Chloroform	70	Quality Criteria, MCLG	1.4	UD	1.4	0.23	1	U	1	0.16	1	U	1	0.16	1	U	1	0.041	1	H1,U	1	0.23	20	UD	20	3.2
Chloromethane	30	HA	2.9	UD	2.9	0.2	2	U	2	0.3	2	U	2	0.3	1	U	1	0.11	1	H1,U	1	0.36	40	UD	40	2.8
Dibromochloromethane	1	NJPQL	1.4	UD	1.4	0.27	1	U	1	0.18	1	U	1	0.18	1	U	1	0.035	1	H1,U	1	0.18	20	UD	20	3.8
Dichlorodifluoromethane	1000	Quality Criteria	2.9	UD	2.9	0.36	2	U	2	0.31	2	U	2	0.31	1	U	1	0.058	2	H1,U	2	0.26	40	UD	40	5
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1.4	UD	1.4	0.3	1	U	1	0.15	1	U	1	0.15	1	U	1	0.041	1	H1,U	1	0.24	20	UD	20	4.2
1,2-Dichloroethane	2	NJMCL, NJPQL	1.4	UD	1.4	0.23	1	U	1	0.22	1	U	1	0.22	1	U	1	0.1	1	H1,U	1	0.22	20	UD	20	3.2
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1.4	UD	1.4	0.26	1	U	1	0.19	1	U	1	0.19	1	U	1	0.077	1	H1,U	1	0.28	20	UD	20	3.6
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	0.72	UD	0.72	0.3	0.5	U	0.5	0.17	0.5	U	0.5	0.17	**0.34**	**J**	1	0.065	**4.51**	H1	1.5	0.45	10	UD	10	4.2
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	0.72	UD	0.72	0.23	0.5	U	0.5	0.19	0.5	U	0.5	0.19	1	U	1	0.059	1.5	H1,U	1.5	0.53	10	UD	10	3.2
1,2-Dichloropropane	1	NJPQL	1.4	UD	1.4	0.21	1	U	1	0.18	1	U	1	0.18	1	U	1	0.1	1	H1,U	1	0.27	20	UD	20	3
cis-1,3-Dichloropropene	1	NJPQL	1.4	UD	1.4	0.17	1	U	1	0.14	1	U	1	0.14	1	U	1	0.049	1	H1,U	1	0.15	20	UD	20	2.4
trans-1,3-Dichloropropene	1	NJPQL	1.4	UD	1.4	0.24	1	U	1	0.19	1	U	1	0.19	1	U	1	0.053	1	H1,U	1	0.17	20	UD	20	3.4
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1.4	UD	1.4	0.27	1	U	1	0.17	1	U	1	0.17	1	U	1	0.038	1	H1,U	1	0.15	20	UD	20	3.8
2-Hexanone		NA	14	UD	14	0.5	10	U	10	0.41	10	U	10	0.41	5	U	5	0.29	5	H1,U	5	0.5	200	UD	200	7
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	**0.56**	**JD**	1.4	0.26	**0.54**	**J**	5	0.17	**0.51**	**J**	1	0.17	**0.48**	**J**	1	0.036	1	H1,U	1	0.25	**130**	**D**	20	3.6
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	7.2	UD	7.2	0.46	5	U	5	0.32	5	U	5	0.32	5	U	5	0.29	5	H1,U	5	0.5	100	UD	100	6.4
Methylene chloride	3	NJMCL, Quality Criteria	1.4	UD	1.4	0.27	1	U	1	0.33	1	U	1	0.33	1	U	1	0.12	1	H1,U	1	0.27	20	(U)D	20	3.8
Styrene	100	MCL, Quality Criteria, MCLG	1.4	UD	1.4	0.19	1	U	1	0.11	1	U	1	0.11	1	U	1	0.05	1	H1,U	1	0.24	20	UD	20	2.6
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1.4	UD	1.4	0.31	1	U	1	0.18	1	U	1	0.18	1	U	1	0.047	1	H1,U	1	0.23	20	UD	20	4.4
Tetrachloroethene	1	NJMCL, NJPQL	1.4	UD	1.4	0.27	1	U	1	0.29	1	U	1	0.29	1	U	1	0.063	1	H1,U	1	0.17	20	UD	20	3.8
Toluene	600	Quality Criteria	**0.91**	**JD**	1.4	0.24	**0.38**	**J**	1	0.13	**0.31**	**J**	1	0.13	1	U	1	0.041	1	H1,U	1	0.19	20	UD	20	3.4
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1.4	UD	1.4	0.3	1	U	1	0.22	1	U	1	0.22	1	U	1	0.041	1	H1,U	1	0.29	20	UD	20	4.2
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1.4	UD	1.4	0.31	1	U	1	0.27	1	U	1	0.27	1	U	1	0.072	1	H1,U	1	0.26	20	UD	20	4.4
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**34**	**D**	1.4	0.4	**33**		1	0.17	**40**		1	0.17	**35**		1	0.058	**8.64**	**H1**	1	0.5	20	UD	20	5.6
Trichlorofluoromethane	2000	Quality Criteria	2.9	UD	2.9	0.23	2	U	2	0.21	2	U	2	0.21	1	U	1	0.067	1	H1,U	1	0.25	40	UD	40	3.2
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**9.3**	**D**	1.4	0.37	**9.8**		1	0.28	**8.2**		1	0.28	NT				**3.01**	**H1**	1	0.33	**730**	**D**	20	5.2
Vinyl chloride	1	NJPQL	2.9	UD	2.9	0.3	2	U	2	0.22	2	U	2	0.22	1	U	1	0.062	1	H1,U	1	0.2	40	UD	40	4.2
Total Xylenes	1000	NJMCL, Quality Criteria	1.4	UD	1.4	0.63	1	U	1	0.28	1	U	1	0.28	1	U	1	0.097	1	H1,U	1	0.22	20	UD	20	8.8
Explosives																										
1,3-Dinitrobenzene	1	HA	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.036	0.25	U	0.25	0.04	NT				0.2	UI	0.2	0.06
2,4-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.08	0.2	U	0.2	0.08	**0.88**		0.2	0.062	0.25	U	0.25	0.0097	NT				0.2	U	0.2	0.066
2,6-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.08	0.2	U	0.2	0.08	**0.2**		0.2	0.051	0.25	U	0.25	0.017	NT				0.2	U	0.2	0.072
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.066	0.25	U	0.25	0.018	NT				0.2	U	0.2	0.063
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.065	0.25	U	0.25	0.022	NT				0.2	U	0.2	0.088
HMX	400	HA	0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.037	0.25	U	0.25	0.018	NT				**0.33**	**J**	0.5	0.061
Nitrobenzene	6	NJPQL	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.063	0.25	U	0.25	0.04	NT				0.2	U	0.2	0.072
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	0.2	U	0.2	0.2	**0.68**		0.2	0.075	0.25	U	0.25	0.017	NT				0.2	U	0.2	0.12
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.042	0.25	U	0.25	0.017	NT				0.2	U	0.2	0.16
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	0.2	U	0.2	0.2	**0.88**		0.2	0.075	0.25	U	0.25	0.026	NT				0.2	U	0.2	0.12
RDX	0.5	NJPQL	0.5	U	0.5	0.1	**0.11**	**J**	0.5	0.1	0.5	U	0.5	0.037	0.25	U	0.25	0.017	NT				**1.1**		0.5	0.053
Tetryl	150	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.065	0.25	U	0.25	0.04	NT				0.2	U	0.2	0.078
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.035	0.25	U	0.25	0.011	NT				0.2	U	0.2	0.052
2,4,6-Trinitrotoluene	1.2	Quality Criteria	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.05	0.25	U	0.25	0.012	NT				0.2	U	0.2	0.051

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-5				13MW-5				13MW-5				13MW-5				13MW-5				13MW-5			
		Date Sampled:	10/31/2006				3/9/2007				6/14/2007				10/18/2007				6/17/2008				4/20/2010			
		Depth Sampled (ft):	125-150				125-150				125-150				125-150				125-150				125-150			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	200	UD	200	15	**7.5**	**JD**	91	6.7	**6**	**JD**	50	5.5	50	U	50	5.5	5	U	5	0.77	10	U	10	1.8
Acetonitrile	120	TWRBC	400	UD	400	30	180	UD	180	14	100	UD	100	18	100	U	100	18	NT				5	U	5	1.67
Benzene	1	NJMCL, NJPQL	20	UD	20	4.4	9.1	UD	9.1	2	5	UD	5	0.65	5	U	5	0.65	1	U	1	0.059	1	U	1	0.14
Bromodichloromethane	1	NJPQL	20	UD	20	2.8	9.1	UD	9.1	1.3	5	UD	5	0.75	5	U	5	0.75	1	U	1	0.031	1	U	1	0.18
Bromoform	4	Quality Criteria	20	UD	20	3.4	9.1	UD	9.1	1.5	5	UD	5	3.2	5	U	5	3.2	1	U	1	0.1	1.5	U	1.5	0.5
Bromomethane	10	Quality Criteria	40	UD	40	7.2	18	UD	18	3.3	10	UD	10	2	10	U	10	2	1	U	1	0.29	2	U	2	0.32
2-Butanone	300	Quality Criteria	200	UD	200	7.8	91	UD	91	3.5	50	UD	50	2.8	50	U	50	2.8	5	U	5	0.78	5	U	5	1.6
Carbon disulfide	700	Quality Criteria	20	UD	20	5.6	9.1	UD	9.1	2.5	5	UD	5	0.65	5	U	5	0.65	1	U	1	0.045	1	U	1	0.26
Carbon tetrachloride	1	NJPQL	20	UD	20	3.8	9.1	UD	9.1	1.7	5	UD	5	0.65	5	U	5	0.65	1	U	1	0.031	1	U	1	0.24
Chlorobenzene	50	NJMCL, Quality Criteria	20	UD	20	4	9.1	UD	9.1	1.8	5	UD	5	0.75	5	U	5	0.75	1	U	1	0.047	1	U	1	0.21
Chloroethane	3.6	TWRBC	40	UD	40	4.8	18	UD	18	2.2	10	UD	10	1.4	10	U	10	1.4	1	U	1	0.15	1	U	1	0.27
Chloroform	70	Quality Criteria, MCLG	20	UD	20	3.2	9.1	UD	9.1	1.5	5	UD	5	0.8	5	U	5	0.8	1	U	1	0.041	1	U	1	0.23
Chloromethane	30	HA	40	UD	40	2.8	18	UD	18	1.3	10	UD	10	1.5	10	U	10	1.5	1	U	1	0.11	1	U	1	0.36
Dibromochloromethane	1	NJPQL	20	UD	20	3.8	9.1	UD	9.1	1.7	5	UD	5	0.9	5	U	5	0.9	1	U	1	0.035	1	U	1	0.18
Dichlorodifluoromethane	1000	Quality Criteria	40	UD	40	5	18	UD	18	2.3	10	UD	10	1.6	10	U	10	1.6	1	U	1	0.058	2	U	2	0.26
1,1-Dichloroethane	50	NJMCL, Quality Criteria	20	UD	20	4.2	9.1	UD	9.1	1.9	5	UD	5	0.75	5	U	5	0.75	1	U	1	0.041	1	U	1	0.24
1,2-Dichloroethane	2	NJMCL, NJPQL	20	UD	20	3.2	9.1	UD	9.1	1.5	5	UD	5	1.1	5	U	5	1.1	1	U	1	0.1	1	U	1	0.22
1,1-Dichloroethene	1	Quality Criteria, NJPQL	20	UD	20	3.6	9.1	UD	9.1	1.6	5	UD	5	0.95	5	U	5	0.95	1	U	1	0.077	1	U	1	0.28
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	10	UD	10	4.2	4.5	UD	4.5	1.9	2.5	UD	2.5	0.85	2.5	U	2.5	0.85	1	U	1	0.065	1.5	U	1.5	0.45
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	10	UD	10	3.2	4.5	UD	4.5	1.5	2.5	UD	2.5	0.95	2.5	U	2.5	0.95	1	U	1	0.059	1.5	U	1.5	0.53
1,2-Dichloropropane	1	NJPQL	20	UD	20	3	9.1	UD	9.1	1.4	5	UD	5	0.9	5	U	5	0.9	1	U	1	0.1	1	U	1	0.27
cis-1,3-Dichloropropene	1	NJPQL	20	UD	20	2.4	9.1	UD	9.1	1.1	5	UD	5	0.7	5	U	5	0.7	1	U	1	0.049	1	U	1	0.15
trans-1,3-Dichloropropene	1	NJPQL	20	UD	20	3.4	9.1	UD	9.1	1.5	5	UD	5	0.95	5	U	5	0.95	1	U	1	0.053	1	U	1	0.17
Ethyl benzene	700	MCL, Quality Criteria, MCLG	20	UD	20	3.8	9.1	UD	9.1	1.7	5	UD	5	0.85	5	U	5	0.85	1	U	1	0.038	1	U	1	0.15
2-Hexanone		NA	200	UD	200	7	91	UD	91	3.2	50	UD	50	2	50	U	50	2	5	U	5	0.29	5	U	5	0.5
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	**140**	**D**	20	3.6	**51**	**D**	9.1	1.6	**35**	**D**	25	0.85	**21**		5	0.85	**10**		1	0.036	**7.26**		1	0.25
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	100	UD	100	6.4	45	UD	45	2.9	25	UD	25	1.6	25	U	25	1.6	5	U	5	0.29	5	U	5	0.5
Methylene chloride	3	NJMCL, Quality Criteria	20	UD	20	3.8	9.1	UD	9.1	1.7	**15**	**D**	5	1.6	5	U	5	1.6	1	U	1	0.12	1	U	1	0.27
Styrene	100	MCL, Quality Criteria, MCLG	20	UD	20	2.6	9.1	UD	9.1	1.2	5	UD	5	0.55	5	U	5	0.55	1	U	1	0.05	1	U	1	0.24
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	20	UD	20	4.4	9.1	UD	9.1	2	5	UD	5	0.9	5	U	5	0.9	1	U	1	0.047	1	U	1	0.23
Tetrachloroethene	1	NJMCL, NJPQL	20	UD	20	3.8	9.1	UD	9.1	1.7	5	UD	5	1.4	5	U	5	1.4	1	U	1	0.063	1	U	1	0.17
Toluene	600	Quality Criteria	20	UD	20	3.4	9.1	UD	9.1	1.5	5	UD	5	0.65	5	U	5	0.65	1	U	1	0.041	1	U	1	0.19
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	20	UD	20	4.2	9.1	UD	9.1	1.9	5	UD	5	1.1	5	U	5	1.1	1	U	1	0.041	1	U	1	0.29
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	20	UD	20	4.4	9.1	UD	9.1	2	5	UD	5	1.4	5	U	5	1.4	1	U	1	0.072	1	U	1	0.26
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	20	UD	20	5.6	9.1	UD	9.1	2.5	5	UD	5	0.85	5	U	5	0.85	1	U	1	0.058	1	U	1	0.5
Trichlorofluoromethane	2000	Quality Criteria	40	UD	40	3.2	18	UD	18	1.5	10	UD	10	1	10	U	10	1	1	U	1	0.067	1	U	1	0.25
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**490**	**D**	20	5.2	**190**	**D**	9.1	2.4	**170**	**D**	5	1.4	**100**		5	1.4	NT				**107**		1	0.33
Vinyl chloride	1	NJPQL	40	UD	40	4.2	18	UD	18	1.9	10	UD	10	1.1	10	U	10	1.1	1	U	1	0.062	1	U	1	0.2
Total Xylenes	1000	NJMCL, Quality Criteria	20	UD	20	8.8	9.1	UD	9.1	4	5	UD	5	1.4	5	U	5	1.4	1	U	1	0.097	1	U	1	0.22
Explosives																										
1,3-Dinitrobenzene	1	HA	0.2	U	0.2	0.06	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.036	0.25	U	0.25	0.04	NT			
2,4-Dinitrotoluene	10	NJPQL	**0.15**	**J**	0.2	0.066	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.062	0.25	U	0.25	0.0097	NT			
2,6-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.072	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.051	0.25	U	0.25	0.017	NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.063	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.066	0.25	U	0.25	0.018	NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.088	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.065	0.25	U	0.25	0.022	NT			
HMX	400	HA	**0.15**	**J**	0.5	0.061	**0.14**	**J**	0.5	0.07	**0.086**	**J**	0.5	0.07	0.5	U	0.5	0.037	0.25	U	0.25	0.018	NT			
Nitrobenzene	6	NJPQL	0.2	U	0.2	0.072	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.063	0.25	U	0.25	0.04	NT			
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075	0.25	U	0.25	0.017	NT			
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.16	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.042	0.25	U	0.25	0.017	NT			
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075	0.25	U	0.25	0.026	NT			
RDX	0.5	NJPQL	**0.38**	**J COL**	0.5	0.053	0.5	U	0.5	0.1	**0.13**	**J COL**	0.5	0.1	0.5	U	0.5	0.037	0.25	U	0.25	0.017	NT			
Tetryl	150	TWRBC	0.2	U	0.2	0.078	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.065	0.25	U	0.25	0.04	NT			
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.052	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.035	0.25	U	0.25	0.011	NT			
2,4,6-Trinitrotoluene	1.2	Quality Criteria	0.2	U	0.2	0.051	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.05	0.25	U	0.25	0.012	NT			

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-5 DUP				13MW-5				13MW-6				13MW-6				13MW-6				13MW-6			
		Date Sampled:	4/20/2010				2/9/2011				7/26/2006				10/30/2006				3/30/2007				6/22/2007			
		Depth Sampled (ft):	125-150				125-150				122-147				122-147				122-147				122-147			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	10	U	10	1.8	5	U	5	1	10	(U)	10	0.74	10	(U)	10	0.74	10	U	10	0.74	10	U	10	1.1
Acetonitrile	120	TWRBC	5	U	5	1.67	NT				20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	3.5
Benzene	1	NJMCL, NJPQL	1	U	1	0.14	1	U	1	0.32	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.13
Bromodichloromethane	1	NJPQL	1	U	1	0.18	1	U	1	0.36	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.15
Bromoform	4	Quality Criteria	1.5	U	1.5	0.5	1	U	1	0.47	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.64
Bromomethane	10	Quality Criteria	2	U	2	0.32	1	U	1	0.2	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.41
2-Butanone	300	Quality Criteria	5	U	5	1.6	5	U	5	1.3	10	(U)	10	0.39	**0.72**	**J**	10	0.39	10	U	10	0.39	10	U	10	0.57
Carbon disulfide	700	Quality Criteria	1	U	1	1.6	1	U	1	0.2	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.13
Carbon tetrachloride	1	NJPQL	1	U	1	0.24	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.13
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.21	1	U	1	0.49	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.15
Chloroethane	3.6	TWRBC	1	U	1	0.27	1	U	1	0.2	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.29
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.23	1	U	1	0.34	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	30	HA	1	U	1	0.36	1	U	1	0.2	2	(U)	2	0.14	**0.43**	**J**	2	0.14	**0.26**	**J**	2	0.14	2	U	2	0.3
Dibromochloromethane	1	NJPQL	1	U	1	0.18	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.18
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.26	1	U	1	0.2	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.31
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.24	1	U	1	0.36	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.15
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.22	1	U	1	0.48	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.22
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.28	1	U	1	0.47	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.19
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	1.5	U	1.5	0.45	1	U	1	0.35	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.17
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	1.5	U	1.5	0.53	1	U	1	0.41	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.19
1,2-Dichloropropane	1	NJPQL	1	U	1	0.27	1	U	1	0.46	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.18
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.15	1	U	1	0.31	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.14
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.17	1	U	1	0.29	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.15	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17
2-Hexanone		NA	5	U	5	0.5	5	U	5	1.9	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.41
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	**6.96**		1	0.25	**2.3**		1	0.35	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.17
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.5	5	U	5	2.1	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.27	1	U	1	0.41	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.33
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.24	1	U	1	0.36	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.11
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.23	1	U	1	0.31	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.18
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.17	1	U	1	0.27	1	U	1	0.19	**0.23**	**J**	1	0.19	**0.24**	**J**	1	0.19	1	U	1	0.29
Toluene	600	Quality Criteria	1	U	1	0.19	1	U	1	0.37	1	U	1	0.17	**0.17**	**J**	1	0.17	1	U	1	0.17	1	U	1	0.13
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.29	1	U	1	0.4	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.22
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.26	1	U	1	0.38	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.27
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.5	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.17
Trichlorofluoromethane	2000	Quality Criteria	1	U	1	0.25	1	U	1	0.35	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.21
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**109**		1	0.33	**56**		1	0.45	**0.74**	**J**	1	0.26	1	U	1	0.26	**0.99**	**J**	1	0.26	**0.45**	**J**	1	0.28
Vinyl chloride	1	NJPQL	1	U	1	0.2	1	U	1	0.34	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.22
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.22	2	U	2	0.95	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.28
Explosives																										
1,3-Dinitrobenzene	1	HA	NT				NT				NT				0.2	U	0.2	0.06	0.2	U	0.2	0.07	0.2	U	0.2	0.07
2,4-Dinitrotoluene	10	NJPQL	NT				NT				NT				0.2	U	0.2	0.066	0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,6-Dinitrotoluene	10	NJPQL	NT				NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.08	0.2	U	0.2	0.08
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				0.2	U	0.2	0.063	0.2	U	0.2	0.06	0.2	U	0.2	0.06
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				0.2	U	0.2	0.088	0.2	U	0.2	0.09	0.2	U	0.2	0.09
HMX	400	HA	NT				NT				NT				0.5	U	0.5	0.061	0.5	U	0.5	0.07	0.5	U	0.5	0.07
Nitrobenzene	6	NJPQL	NT				NT				NT				0.2	U	0.2	0.072	0.96	(U)	0.2	0.07	0.2	U	0.2	0.07
2-Nitrotoluene	61	TWRBC	NT				NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2
3-Nitrotoluene	61	TWRBC	NT				NT				NT				0.2	U	0.2	0.16	0.2	U	0.2	0.1	0.2	U	0.2	0.1
4-Nitrotoluene	61	TWRBC	NT				NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2
RDX	0.5	NJPQL	NT				NT				NT				0.5	U	0.5	0.053	**0.31**	**J**	0.5	0.1	0.5	U	0.5	0.1
Tetryl	150	TWRBC	NT				NT				NT				0.2	U	0.2	0.078	0.2	U	0.2	0.08	0.2	U	0.2	0.08
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				NT				0.2	U	0.2	0.052	0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				NT				NT				0.2	U	0.2	0.051	0.2	U	0.2	0.1	0.2	U	0.2	0.1

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-6				13MW-6				13MW-6				13MW-7				13MW-7				13MW-7			
		Date Sampled:	10/23/2007				4/20/2010				2/10/2011				7/24/2006				10/31/2006				3/6/2007			
		Depth Sampled (ft):	122-147				122-147				122-147				80-105				80-105				80-105			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	10	(U)	10	1.1	10	U	10	1.8	5	U	5	0.5	330	UD	330	25	400	UD	400	30	330	(U)D	330	25
Acetonitrile	120	TWRBC	20	U	20	3.5	5	U	5	1.67	NT				670	UD	670	50	800	UD	800	60	**55**	**JD**	670	50
Benzene	1	NJMCL, NJPQL	1	U	1	0.13	1	U	1	0.14	1	U	1	0.32	33	UD	33	7.3	40	UD	40	8.8	33	UD	33	7.3
Bromodichloromethane	1	NJPQL	1	U	1	0.15	1	U	1	0.18	1	U	1	0.36	33	UD	33	4.7	40	UD	40	5.6	33	UD	33	4.7
Bromoform	4	Quality Criteria	1	U	1	0.64	1.5	U	1.5	0.5	1	U	1	0.47	33	UD	33	5.7	40	UD	40	6.8	33	UD	33	5.7
Bromomethane	10	Quality Criteria	2	U	2	0.41	2	U	2	0.32	1	U	1	0.2	67	UD	67	12	80	UD	80	14	67	UD	67	12
2-Butanone	300	Quality Criteria	10	U	10	0.57	5	U	5	1.6	5	U	5	1.3	330	UD	330	13	400	UD	400	16	330	UD	330	13
Carbon disulfide	700	Quality Criteria	1	U	1	0.13	1	U	1	0.26	1	U	1	0.2	33	UD	33	9.3	40	UD	40	11	33	UD	33	9.3
Carbon tetrachloride	1	NJPQL	1	U	1	0.13	1	U	1	0.24	1	U	1	0.2	33	UD	33	6.3	40	UD	40	7.6	33	UD	33	6.3
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.15	1	U	1	0.21	1	U	1	0.49	33	UD	33	6.7	40	UD	40	8	33	UD	33	6.7
Chloroethane	3.6	TWRBC	2	U	2	0.29	1	U	1	0.27	1	U	1	0.2	67	UD	67	8	80	UD	80	9.6	67	UD	67	8
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.16	1	U	1	0.23	1	U	1	0.34	33	UD	33	5.3	40	UD	40	6.4	33	UD	33	5.3
Chloromethane	30	HA	2	U	2	0.3	1	U	1	0.36	1	U	1	0.2	67	UD	67	4.7	80	UD	80	5.6	67	UD	67	4.7
Dibromochloromethane	1	NJPQL	1	U	1	0.18	1	U	1	0.18	1	U	1	0.2	33	UD	33	6.3	40	UD	40	7.6	33	UD	33	6.3
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.31	2	U	2	0.26	1	U	1	0.2	67	UD	67	8.3	80	UD	80	10	67	UD	67	8.3
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.15	1	U	1	0.24	1	U	1	0.36	33	UD	33	7	40	UD	40	8.4	33	UD	33	7
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.22	1	U	1	0.22	1	U	1	0.48	33	UD	33	5.3	40	UD	40	6.4	33	UD	33	5.3
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.19	1	U	1	0.28	1	U	1	0.47	33	UD	33	6	40	UD	40	7.2	33	UD	33	6
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.17	1.5	U	1.5	0.45	1	U	1	0.35	17	UD	17	7	20	UD	20	8.4	17	UD	17	7
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.19	1.5	U	1.5	0.53	1	U	1	0.41	17	UD	17	5.3	20	UD	20	6.4	17	UD	17	5.3
1,2-Dichloropropane	1	NJPQL	1	U	1	0.18	1	U	1	0.27	1	U	1	0.46	33	UD	33	5	40	UD	40	6	33	UD	33	5
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.14	1	U	1	0.15	1	U	1	0.31	33	UD	33	4	40	UD	40	4.8	33	UD	33	4
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.19	1	U	1	0.17	1	U	1	0.29	33	UD	33	5.7	40	UD	40	6.8	33	UD	33	5.7
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.17	1	U	1	0.15	1	U	1	0.2	33	UD	33	6.3	40	UD	40	7.6	33	UD	33	6.3
2-Hexanone		NA	10	U	10	0.41	5	U	5	0.5	5	U	5	1.9	330	UD	330	12	400	UD	400	14	330	UD	330	12
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	1	U	1	0.17	1	U	1	0.25	1	U	1	0.35	33	UD	33	6	40	UD	40	7.2	33	UD	33	6
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.32	5	U	5	0.5	5	U	5	2.1	170	UD	170	11	200	UD	200	13	170	UD	170	11
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.33	**0.751**	**J**	1	0.27	1	U	1	0.41	33	(U)D	33	6.3	40	UD	40	7.6	33	UD	33	6.3
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.11	1	U	1	0.24	1	U	1	0.36	33	UD	33	4.3	40	UD	40	5.2	33	UD	33	4.3
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.18	1	U	1	0.23	1	U	1	0.31	33	UD	33	7.3	40	UD	40	8.8	33	UD	33	7.3
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.29	1	U	1	0.17	1	U	1	0.27	33	UD	33	6.3	40	UD	40	7.6	33	UD	33	6.3
Toluene	600	Quality Criteria	1	U	1	0.13	1	U	1	0.19	1	U	1	0.37	33	UD	33	5.7	40	UD	40	6.8	33	UD	33	5.7
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.22	1	U	1	0.29	1	U	1	0.4	33	UD	33	7	40	UD	40	8.4	33	UD	33	7
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.27	1	U	1	0.26	1	U	1	0.38	33	UD	33	7.3	40	UD	40	8.8	33	UD	33	7.3
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.17	1	U	1	0.5	1	U	1	0.28	33	UD	33	9.3	40	UD	40	11	33	UD	33	9.3
Trichlorofluoromethane	2000	Quality Criteria	2	U	2	0.21	1	U	1	0.25	1	U	1	0.35	67	UD	67	5.3	80	UD	80	6.4	67	UD	67	5.3
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**0.9**	**J**	1	0.28	**10.7**		1	0.33	**1.2**		1	0.45	**470**	**D**	33	8.7	**540**	**D**	40	10	**1200**	**D**	33	8.7
Vinyl chloride	1	NJPQL	2	U	2	0.22	1	U	1	0.2	1	U	1	0.34	67	(U)D	67	7	80	UD	80	8.4	67	UD	67	7
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.28	1	U	1	0.22	2	U	2	0.95	33	UD	33	15	40	UD	40	18	33	UD	33	15
Explosives																										
1,3-Dinitrobenzene	1	HA	**0.07**	**J**	0.2	0.036	NT				NT				NT				0.2	U	0.2	0.06	0.2	U	0.2	0.07
2,4-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.062	NT				NT				NT				0.2	U	0.2	0.066	0.2	U	0.2	0.08
2,6-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.051	NT				NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.08
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.066	NT				NT				NT				0.2	U	0.2	0.063	0.2	U	0.2	0.06
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.065	NT				NT				NT				0.2	U	0.2	0.088	0.2	U	0.2	0.09
HMX	400	HA	0.5	U	0.5	0.037	NT				NT				NT				**0.19**	**J**	0.5	0.061	**0.19**	**J**	0.5	0.07
Nitrobenzene	6	NJPQL	0.2	U	0.2	0.063	NT				NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.07
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.075	NT				NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.042	NT				NT				NT				**0.16**	**J**	0.2	0.16	0.2	U	0.2	0.1
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.075	NT				NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2
RDX	0.5	NJPQL	0.5	U	0.5	0.037	NT				NT				NT				**0.44**	**J**	0.5	0.053	**0.43**	**J**	0.5	0.1
Tetryl	150	TWRBC	0.2	U	0.2	0.065	NT				NT				NT				0.2	U	0.2	0.078	0.2	U	0.2	0.08
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.035	NT				NT				NT				0.2	U	0.2	0.052	0.2	U	0.2	0.08
2,4,6-Trinitrotoluene	1.2	Quality Criteria	0.2	U	0.2	0.05	NT				NT				NT				0.2	U	0.2	0.051	0.2	U	0.2	0.1

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-7				13MW-7				13MW-7DUP				13MW-7				13MW-7				13MW-7 DUP			
		Date Sampled:	6/22/2007				10/15/2007				10/15/2007				6/16/2008				5/11/2010				5/11/2010			
		Depth Sampled (ft):	80-105				80-105				80-105				80-105				80-105				80-105			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	400	(U)D	400	44	25	U	25	2.8	20	U	20	2.2	5	U	5	0.77	**3.47**	**J**	10	1.8	**2.67**	**J**	10	1.8
Acetonitrile	120	TWRBC	800	UD	800	140	50	U	50	8.8	40	U	40	7	NT				5	U	5	1.67	5	U	5	1.67
Benzene	1	NJMCL, NJPQL	40	UD	40	5.2	2.5	U	2.5	0.32	2	U	2	0.26	1	U	1	0.059	1	U	1	0.14	1	U	1	0.14
Bromodichloromethane	1	NJPQL	40	UD	40	6	2.5	U	2.5	0.38	2	U	2	0.3	1	U	1	0.031	1	U	1	0.18	1	U	1	0.18
Bromoform	4	Quality Criteria	40	UD	40	26	2.5	U	2.5	1.6	2	U	2	1.3	1	U	1	0.1	1.5	U	1.5	0.5	1.5	U	1.5	0.5
Bromomethane	10	Quality Criteria	80	UD	80	16	5	U	5	1	4	U	4	0.82	1	U	1	0.29	2	U	2	0.32	2	U	2	0.32
2-Butanone	300	Quality Criteria	400	UD	400	23	25	U	25	1.4	20	U	20	1.1	5	U	5	0.78	5	U	5	1.6	5	U	5	1.6
Carbon disulfide	700	Quality Criteria	40	UD	40	5.2	2.5	U	2.5	0.32	2	U	2	0.26	1	U	1	0.045	1	U	1	0.26	1	U	1	0.26
Carbon tetrachloride	1	NJPQL	40	UD	40	5.2	2.5	U	2.5	0.32	2	U	2	0.26	1	U	1	0.031	1	U	1	0.24	1	U	1	0.24
Chlorobenzene	50	NJMCL, Quality Criteria	40	UD	40	6	2.5	U	2.5	0.38	2	U	2	0.3	1	U	1	0.047	1	U	1	0.21	1	U	1	0.21
Chloroethane	3.6	TWRBC	80	UD	80	12	5	U	5	0.72	4	U	4	0.58	1	U	1	0.15	1	U	1	0.27	1	U	1	0.27
Chloroform	70	Quality Criteria, MCLG	40	UD	40	6.4	2.5	U	2.5	0.4	2	U	2	0.32	1	U	1	0.041	1	U	1	0.23	1	U	1	0.23
Chloromethane	30	HA	80	UD	80	12	5	U	5	0.75	4	U	4	0.6	1	U	1	0.11	**1.27**	**N**	1	0.36	**1.4**		1	0.36
Dibromochloromethane	1	NJPQL	40	UD	40	7.2	2.5	U	2.5	0.45	2	U	2	0.36	1	U	1	0.035	1	U	1	0.18	1	U	1	0.18
Dichlorodifluoromethane	1000	Quality Criteria	80	UD	80	12	5	U	5	0.78	4	U	4	0.62	1	U	1	0.058	2	U	2	0.26	2	U	2	0.26
1,1-Dichloroethane	50	NJMCL, Quality Criteria	40	UD	40	6	2.5	U	2.5	0.38	2	U	2	0.3	1	U	1	0.041	1	U	1	0.24	1	U	1	0.24
1,2-Dichloroethane	2	NJMCL, NJPQL	40	UD	40	8.8	2.5	U	2.5	0.55	2	U	2	0.44	1	U	1	0.1	1	U	1	0.22	1	U	1	0.22
1,1-Dichloroethene	1	Quality Criteria, NJPQL	40	UD	40	7.6	2.5	U	2.5	0.48	2	U	2	0.38	1	U	1	0.077	1	U	1	0.28	1	U	1	0.28
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	20	UD	20	6.8	1.2	U	1.2	0.42	1	U	1	0.34	1	U	1	0.065	1.5	U	1.5	0.45	1.5	U	1.5	0.45
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	20	UD	20	7.6	1.2	U	1.2	0.48	1	U	1	0.38	1	U	1	0.059	1.5	U	1.5	0.53	1.5	U	1.5	0.53
1,2-Dichloropropane	1	NJPQL	40	UD	40	7.2	2.5	U	2.5	0.45	2	U	2	0.36	1	U	1	0.1	1	U	1	0.27	1	U	1	0.27
cis-1,3-Dichloropropene	1	NJPQL	40	UD	40	5.6	2.5	U	2.5	0.35	2	U	2	0.28	1	U	1	0.049	1	U	1	0.15	1	U	1	0.15
trans-1,3-Dichloropropene	1	NJPQL	40	UD	40	7.6	2.5	U	2.5	0.48	2	U	2	0.38	1	U	1	0.053	1	U	1	0.17	1	U	1	0.17
Ethyl benzene	700	MCL, Quality Criteria, MCLG	40	UD	40	6.8	2.5	U	2.5	0.42	2	U	2	0.34	1	U	1	0.038	1	U	1	0.15	1	U	1	0.15
2-Hexanone		NA	400	UD	400	16	25	U	25	1	20	U	20	0.82	5	U	5	0.29	5	U	5	0.5	5	U	5	0.5
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	40	UD	40	6.8	2.5	U	2.5	0.42	2	U	2	0.34	1	U	1	0.036	NT				NT			
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	200	UD	200	13	12	U	12	0.8	10	U	10	0.64	5	U	5	0.29	5	U	5	0.5	5	U	5	0.5
Methylene chloride	3	NJMCL, Quality Criteria	43	(U)D	40	13	2.5	U	2.5	0.82	2	U	2	0.66	1	U	1	0.12	1	U	1	0.27	1	U	1	0.27
Styrene	100	MCL, Quality Criteria, MCLG	40	UD	40	4.4	2.5	U	2.5	0.28	2	U	2	0.22	1	U	1	0.05	1	U	1	0.24	1	U	1	0.24
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	40	UD	40	7.2	2.5	U	2.5	0.45	2	U	2	0.36	1	U	1	0.047	1	U	1	0.23	1	U	1	0.23
Tetrachloroethene	1	NJMCL, NJPQL	40	UD	40	12	2.5	U	2.5	0.72	2	U	2	0.58	1	U	1	0.063	1	U	1	0.27	1	U	1	0.17
Toluene	600	Quality Criteria	40	UD	40	5.2	2.5	U	2.5	0.32	2	U	2	0.26	1	U	1	0.041	1	U	1	0.19	1	U	1	0.19
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	40	UD	40	8.8	2.5	U	2.5	0.55	2	U	2	0.44	1	U	1	0.041	1	U	1	0.29	1	U	1	0.29
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	40	UD	40	11	2.5	U	2.5	0.68	2	U	2	0.54	1	U	1	0.072	1	U	1	0.26	1	U	1	0.26
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	40	UD	40	6.8	**0.76**	**J**	2.5	0.42	**0.68**	**J**	2	0.34	**0.49**	**J**	1	0.058	1	U	1	0.5	**0.506**	**J**	1	0.5
Trichlorofluoromethane	2000	Quality Criteria	80	UD	80	8.4	5	U	5	0.52	4	U	4	0.42	1	U	1	0.067	**0.278**	**J**	1	0.25	**0.288**	**J**	1	0.25
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**780**	**D**	40	11	**780**		25	7	**780**		20	5.6	NT				**875**	**N,D**	10	2	**465**	**D**	10	3.3
Vinyl chloride	1	NJPQL	80	UD	80	8.8	5	U	5	0.55	4	U	4	0.44	1	U	1	0.062	1	N, U	1	0.2	1	U	1	0.2
Total Xylenes	1000	NJMCL, Quality Criteria	40	UD	40	11	2.5	U	2.5	0.7	2	U	2	0.56	1	U	1	0.097	1	U	1	0.22	1	U	1	0.22
Explosives																										
1,3-Dinitrobenzene	1	HA	0.2	U	0.2	0.07	0.2	U	0.2	0.036	0.2	U	0.2	0.036	NT				NT				NT			
2,4-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.08	0.2	U	0.2	0.062	0.2	U	0.2	0.062	NT				NT				NT			
2,6-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.08	0.2	U	0.2	0.051	0.2	U	0.2	0.051	NT				NT				NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.06	0.2	U	0.2	0.066	0.2	U	0.2	0.066	NT				NT				NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.09	0.2	U	0.2	0.065	0.2	U	0.2	0.065	NT				NT				NT			
HMX	400	HA	**0.21**	**J**	0.5	0.07	**0.18**	**J**	0.5	0.037	**0.2**	**J**	0.5	0.037	NT				NT				NT			
Nitrobenzene	6	NJPQL	0.2	U	0.2	0.07	0.2	U	0.2	0.063	0.2	U	0.2	0.063	NT				NT				NT			
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	0.2	U	0.2	0.075	0.2	U	0.2	0.075	NT				NT				NT			
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.1	0.2	U	0.2	0.042	0.2	U	0.2	0.042	NT				NT				NT			
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	0.2	U	0.2	0.075	0.2	U	0.2	0.075	NT				NT				NT			
RDX	0.5	NJPQL	**0.45**	**J**	0.5	0.1	**0.47**	**J**	0.5	0.037	**0.48**	**J**	0.5	0.037	NT				NT				NT			
Tetryl	150	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.065	0.2	U	0.2	0.065	NT				NT				NT			
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.035	0.2	U	0.2	0.035	NT				NT				NT			
2,4,6-Trinitrotoluene	1.2	Quality Criteria	0.2	U	0.2	0.1	0.2	U	0.2	0.05	0.2	U	0.2	0.05	NT				NT				NT			

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-7				13MW-8				13MW-8				13MW-8				13MW-8				13MW-8			
		Date Sampled:	1/25/2011				7/31/2006				3/5/2007				6/20/2007				10/24/2007				6/18/2008			
		Depth Sampled (ft):	80-105				78-103				78-103				78-103				78-103				78-103			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	5	U	5	0.5	10	(U)	10	0.74	**8.5**	**J**	10	0.74	10	(U)	10	1.1	10	(U)	10	1.1	5	U	5	0.77
Acetonitrile	120	TWRBC	NT				20	U	20	1.5	**2.5**	**J**	20	1.5	20	U	20	3.5	20	U	20	3.5	NT			
Benzene	1	NJMCL, NJPQL	1	U	1	0.32	1	U	1	0.22	1	U	1	0.22	1	U	1	0.13	1	U	1	0.13	1	U	1	0.059
Bromodichloromethane	1	NJPQL	1	U	1	0.36	1	U	1	0.14	1	U	1	0.14	1	U	1	0.15	1	U	1	0.15	1	U	1	0.031
Bromoform	4	Quality Criteria	1	U	1	0.47	1	U	1	0.17	1	U	1	0.17	1	U	1	0.64	1	U	1	0.64	1	U	1	0.1
Bromomethane	10	Quality Criteria	1	U	1	0.2	2	U	2	0.36	**0.77**	**J**	2	0.36	2	U	2	0.41	2	U	2	0.41	1	U	1	0.29
2-Butanone	300	Quality Criteria	5	U	5	1.3	10	(U)	10	0.39	**1.6**	**J**	10	0.39	**1.7**	**J**	10	0.57	**1.9**	**J**	10	0.57	5	U	5	0.78
Carbon disulfide	700	Quality Criteria	1	U	1	0.2	1	U	1	0.28	1	U	1	0.28	1	U	1	0.13	1	U	1	0.13	1	U	1	0.045
Carbon tetrachloride	1	NJPQL	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.13	1	U	1	0.13	1	U	1	0.031
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.49	1	U	1	0.2	1	U	1	0.2	1	U	1	0.15	1	U	1	0.15	1	U	1	0.047
Chloroethane	3.6	TWRBC	1	U	1	0.2	2	U	2	0.24	2	U	2	0.24	2	U	2	0.29	2	U	2	0.29	1	U	1	0.15
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.34	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.041
Chloromethane	30	HA	1	U	1	0.2	2	(U)	2	0.14	**0.61**	**J**	2	0.14	**0.41**	**J**	2	0.3	**0.3**	**J**	2	0.3	1	U	1	0.11
Dibromochloromethane	1	NJPQL	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.18	1	U	1	0.18	1	U	1	0.035
Dichlorodifluoromethane	1000	Quality Criteria	1	U	1	0.2	2	U	2	0.25	2	U	2	0.25	2	U	2	0.31	2	U	2	0.31	1	U	1	0.058
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.36	1	U	1	0.21	1	U	1	0.21	1	U	1	0.15	1	U	1	0.15	1	U	1	0.041
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.48	1	U	1	0.16	1	U	1	0.16	1	U	1	0.22	1	U	1	0.22	1	U	1	0.1
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.47	1	U	1	0.18	1	U	1	0.18	1	U	1	0.19	1	U	1	0.19	1	U	1	0.077
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	1	U	1	0.35	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.17	0.5	U	0.5	0.17	1	U	1	0.065
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	1	U	1	0.41	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.19	0.5	U	0.5	0.19	1	U	1	0.059
1,2-Dichloropropane	1	NJPQL	1	U	1	0.46	1	U	1	0.15	1	U	1	0.15	1	U	1	0.18	1	U	1	0.18	1	U	1	0.1
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.31	1	U	1	0.12	1	U	1	0.12	1	U	1	0.14	1	U	1	0.14	1	U	1	0.049
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.29	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19	1	U	1	0.19	1	U	1	0.053
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17	1	U	1	0.17	1	U	1	0.038
2-Hexanone		NA	5	U	5	1.9	10	U	10	0.35	**0.59**	**J**	10	0.35	**0.62**	**J**	10	0.41	**0.58**	**J**	10	0.41	5	U	5	0.29
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	1	U	1	0.35	1	U	1	0.18	1	U	1	0.18	5	U	5	0.17	1	U	1	0.17	1	U	1	0.036
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	2.1	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.29
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.41	1	U	1	0.19	1	U	1	0.19	1	U	1	0.33	1	U	1	0.33	1	U	1	0.12
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.36	1	U	1	0.13	1	U	1	0.13	1	U	1	0.11	1	U	1	0.11	1	U	1	0.05
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.31	1	U	1	0.22	1	U	1	0.22	1	U	1	0.18	1	U	1	0.18	1	U	1	0.047
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.27	1	U	1	0.19	1	U	1	0.19	1	U	1	0.29	1	U	1	0.29	1	U	1	0.063
Toluene	600	Quality Criteria	1	U	1	0.37	**1.5**		1	0.17	**1.1**		1	0.17	**0.29**	**J**	1	0.13	**0.19**	**J**	1	0.13	1	U	1	0.041
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.4	1	U	1	0.21	1	U	1	0.21	1	U	1	0.22	1	U	1	0.22	1	U	1	0.041
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.38	1	U	1	0.22	1	U	1	0.22	1	U	1	0.27	1	U	1	0.27	1	U	1	0.072
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**0.76**	**J**	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.17	1	U	1	0.17	1	U	1	0.058
Trichlorofluoromethane	2000	Quality Criteria	1	U	1	0.35	2	U	2	0.16	2	U	2	0.16	2	U	2	0.21	2	U	2	0.21	1	U	1	0.067
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**740**	**D**	20	9	**0.6**	**J**	1	0.26	**1**		1	0.26	**0.49**	**J**	1	0.28	**0.65**	**J**	1	0.28	NT			
Vinyl chloride	1	NJPQL	1	U	1	0.34	2	U	2	0.21	2	U	2	0.21	2	U	2	0.22	2	U	2	0.22	1	U	1	0.062
Total Xylenes	1000	NJMCL, Quality Criteria	2	U	2	0.95	1	U	1	0.44	1	U	1	0.44	1	U	1	0.28	1	U	1	0.28	1	U	1	0.097
Explosives																										
1,3-Dinitrobenzene	1	HA	NT				NT				0.26	U	0.26	0.07	**0.25**		0.2	0.07	0.2	U	0.2	0.036	NT			
2,4-Dinitrotoluene	10	NJPQL	NT				NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.062	NT			
2,6-Dinitrotoluene	10	NJPQL	NT				NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.051	NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				0.2	U	0.2	0.06	**0.15**	**J**	0.2	0.06	0.2	U	0.2	0.066	NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				0.2	U	0.2	0.09	0.2	U	0.2	0.09	**0.16**	**J**	0.2	0.065	NT			
HMX	400	HA	NT				NT				0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.037	NT			
Nitrobenzene	6	NJPQL	NT				NT				0.2	U	0.2	0.07	0.2	U	0.2	0.07	**1.1**		0.2	0.063	NT			
2-Nitrotoluene	61	TWRBC	NT				NT				0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075	NT			
3-Nitrotoluene	61	TWRBC	NT				NT				0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.042	NT			
4-Nitrotoluene	61	TWRBC	NT				NT				0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075	NT			
RDX	0.5	NJPQL	NT				NT				0.5	U	0.5	0.1	0.5	U	0.5	0.1	0.5	U	0.5	0.037	NT			
Tetryl	150	TWRBC	NT				NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08	**0.42**		0.2	0.065	NT			
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.035	NT			
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				NT				0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.05	NT			

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-8				13MW-8				13MW-9				13MW-9DUP				13MW-9				13MW-9			
		Date Sampled:	5/12/2010				1/25/2011				7/26/2006				7/26/2006				12/12/2006				3/12/2007			
		Depth Sampled (ft):	78-103				78-103				25-45				25-45				25-45				25-45			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	10	U	10	1.8	5	U	5	0.5	10	U	10	0.74	10	U	10	0.74	NT				10	U	10	0.74
Acetonitrile	120	TWRBC	5	U	5	1.67	NT				20	U	20	1.5	20	U	20	1.5	NT				20	U	20	1.5
Benzene	1	NJMCL, NJPQL	1	U	1	0.14	1	U	1	0.32	1	U	1	0.22	1	U	1	0.22	NT				1	U	1	0.22
Bromodichloromethane	1	NJPQL	1	U	1	0.18	1	U	1	0.36	1	U	1	0.14	1	U	1	0.14	NT				1	U	1	0.14
Bromoform	4	Quality Criteria	1.5	U	1.5	0.5	1	U	1	0.47	1	U	1	0.17	1	U	1	0.17	NT				1	U	1	0.17
Bromomethane	10	Quality Criteria	2	U	2	0.32	1	U	1	0.2	2	U	2	0.36	2	U	2	0.36	NT				2	U	2	0.36
2-Butanone	300	Quality Criteria	5	U	5	1.6	5	U	5	1.3	10	U	10	0.39	10	U	10	0.39	NT				10	U	10	0.39
Carbon disulfide	700	Quality Criteria	1	U	1	0.26	1	U	1	0.2	1	U	1	0.28	1	U	1	0.28	NT				1	U	1	0.28
Carbon tetrachloride	1	NJPQL	1	U	1	0.24	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	NT				1	U	1	0.19
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.21	1	U	1	0.49	1	U	1	0.2	1	U	1	0.2	NT				1	U	1	0.2
Chloroethane	3.6	TWRBC	1	U	1	0.27	1	U	1	0.2	2	U	2	0.24	2	U	2	0.24	NT				2	U	2	0.24
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.23	1	U	1	0.34	1	U	1	0.16	1	U	1	0.16	NT				1	U	1	0.16
Chloromethane	30	HA	**1.42**		1	0.36	1	U	1	0.2	2	(U)	2	0.14	2	(U)	2	0.14	NT				2	U	2	0.14
Dibromochloromethane	1	NJPQL	1	U	1	0.18	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	NT				1	U	1	0.19
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.26	1	U	1	0.2	2	U	2	0.25	2	U	2	0.25	NT				2	U	2	0.25
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.24	1	U	1	0.36	1	U	1	0.21	1	U	1	0.21	NT				1	U	1	0.21
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.22	1	U	1	0.48	1	U	1	0.16	1	U	1	0.16	NT				1	U	1	0.16
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.28	1	U	1	0.47	1	U	1	0.18	1	U	1	0.18	NT				1	U	1	0.18
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	1.5	U	1.5	0.45	1	U	1	0.35	0.5	U	0.5	0.21	0.5	U	0.5	0.21	NT				0.5	U	0.5	0.21
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	1.5	U	1.5	0.53	1	U	1	0.41	0.5	U	0.5	0.16	0.5	U	0.5	0.16	NT				0.5	U	0.5	0.16
1,2-Dichloropropane	1	NJPQL	1	U	1	0.27	1	U	1	0.46	1	U	1	0.15	1	U	1	0.15	NT				1	U	1	0.15
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.15	1	U	1	0.31	1	U	1	0.12	1	U	1	0.12	NT				1	U	1	0.12
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.17	1	U	1	0.29	1	U	1	0.17	1	U	1	0.17	NT				1	U	1	0.17
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.15	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	NT				1	U	1	0.19
2-Hexanone		NA	5	U	5	0.5	5	U	5	1.9	10	U	10	0.35	10	U	10	0.35	NT				10	U	10	0.35
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	NT				1	U	1	0.35	1	U	1	0.18	1	U	1	0.18	NT				1	U	1	0.18
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.5	5	U	5	2.1	5	U	5	0.32	5	U	5	0.32	NT				5	U	5	0.32
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.27	1	U	1	0.41	1	U	1	0.19	1	U	1	0.19	NT				1	U	1	0.19
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.24	1	U	1	0.36	1	U	1	0.13	1	U	1	0.13	NT				1	U	1	0.13
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.23	1	U	1	0.31	1	U	1	0.22	1	U	1	0.22	NT				1	U	1	0.22
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.17	1	U	1	0.41	1	U	1	0.19	1	U	1	0.19	NT				1	U	1	0.19
Toluene	600	Quality Criteria	1	U	1	0.19	1	U	1	0.37	1	U	1	0.17	1	U	1	0.17	NT				1	U	1	0.17
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.29	1	U	1	0.4	1	U	1	0.21	1	U	1	0.21	NT				1	U	1	0.21
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.26	1	U	1	0.38	1	U	1	0.22	1	U	1	0.22	NT				1	U	1	0.22
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.5	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	NT				1	U	1	0.28
Trichlorofluoromethane	2000	Quality Criteria	1	U	1	0.25	1	U	1	0.35	2	U	2	0.16	2	U	2	0.16	NT				2	U	2	0.16
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**1.46**		1	0.33	**0.65**	**J**	1	0.45	**1.4**		1	0.26	**1.5**		1	0.26	NT				**0.31**	**J**	1	0.26
Vinyl chloride	1	NJPQL	1	U	1	0.2	1	U	1	0.34	2	U	2	0.21	2	U	2	0.21	NT				2	U	2	0.21
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.22	2	U	2	0.95	1	U	1	0.44	1	U	1	0.44	NT				1	U	1	0.44
Explosives																										
1,3-Dinitrobenzene	1	HA	NT				NT				NT				NT				0.2	U	0.2	0.07	0.2	U	0.2	0.07
2,4-Dinitrotoluene	10	NJPQL	NT				NT				NT				NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,6-Dinitrotoluene	10	NJPQL	NT				NT				NT				NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.06	0.2	U	0.2	0.06
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.09	0.2	U	0.2	0.09
HMX	400	HA	NT				NT				NT				NT				0.5	U	0.5	0.07	0.5	U	0.5	0.07
Nitrobenzene	6	NJPQL	NT				NT				NT				NT				0.2	U	0.2	0.07	0.2	U	0.2	0.07
2-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.2	0.2	U	0.2	0.2
3-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.1	0.2	U	0.2	0.1
4-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.2	0.2	U	0.2	0.2
RDX	0.5	NJPQL	NT				NT				NT				NT				0.5	U	0.5	0.1	0.5	U	0.5	0.1
Tetryl	150	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				NT				NT				NT				0.2	U	0.2	0.1	0.2	U	0.2	0.1

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-9				13MW-9				13MW-9				13MW-9				13MW-10				13MW-10			
		Date Sampled:	6/14/2007				10/18/2007				6/26/2008				4/19/2010				3/13/2007				6/19/2007			
		Depth Sampled (ft):	25-45				25-45				25-45				25-45				90-110				90-110			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	10	U	10	1.1	33	U	33	3.7	5	(U)	5	0.77	10	U	10	1.8	**7.7**	**J**	10	0.74	10	(U)	10	1.1
Acetonitrile	120	TWRBC	20	U	20	3.5	67	U	67	12	NT				5	U	5	1.67	20	U	20	1.5	20	U	20	3.5
Benzene	1	NJMCL, NJPQL	1	U	1	0.13	3.3	U	3.3	0.43	1	U	1	0.059	1	U	1	0.14	1	U	1	0.22	1	U	1	0.13
Bromodichloromethane	1	NJPQL	1	U	1	0.15	3.3	U	3.3	0.5	1	U	1	0.031	1	U	1	0.18	1	U	1	0.14	1	U	1	0.15
Bromoform	4	Quality Criteria	1	U	1	0.64	3.3	U	3.3	2.1	1	U	1	0.1	1.5	U	1.5	0.5	1	U	1	0.17	1	U	1	0.64
Bromomethane	10	Quality Criteria	2	U	2	0.41	6.7	U	6.7	1.4	1	U	1	0.29	2	U	2	0.32	2	U	2	0.36	2	U	2	0.41
2-Butanone	300	Quality Criteria	10	U	10	0.57	33	U	33	1.9	5	U	5	0.78	5	U	5	1.6	**0.83**	**J**	10	0.39	10	U	10	0.57
Carbon disulfide	700	Quality Criteria	1	U	1	0.13	3.3	U	3.3	0.43	1	U	1	0.045	1	U	1	0.26	1	U	1	0.28	1	U	1	0.13
Carbon tetrachloride	1	NJPQL	1	U	1	0.13	3.3	U	3.3	0.43	1	U	1	0.031	1	U	1	0.24	1	U	1	0.19	1	U	1	0.13
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.15	3.3	U	3.3	0.5	1	U	1	0.047	1	U	1	0.21	1	U	1	0.2	1	U	1	0.15
Chloroethane	3.6	TWRBC	2	U	2	0.29	6.7	U	6.7	0.97	1	U	1	0.15	1	U	1	0.27	2	U	2	0.24	2	U	2	0.29
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.16	3.3	U	3.3	0.53	1	U	1	0.041	1	U	1	0.23	1	U	1	0.16	1	U	1	0.16
Chloromethane	30	HA	2	U	2	0.3	6.7	U	6.7	1	1	U	1	0.11	1	U	1	0.36	2	U	2	0.14	2	U	2	0.3
Dibromochloromethane	1	NJPQL	1	U	1	0.18	3.3	U	3.3	0.6	1	U	1	0.035	1	U	1	0.18	1	U	1	0.19	1	U	1	0.18
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.31	6.7	U	6.7	1	1	U	1	0.058	2	U	2	0.26	2	U	2	0.25	2	U	2	0.31
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.15	3.3	U	3.3	0.5	1	U	1	0.041	1	U	1	0.24	1	U	1	0.21	1	U	1	0.15
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.22	3.3	U	3.3	0.73	1	U	1	0.1	1	U	1	0.22	1	U	1	0.16	1	U	1	0.22
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.19	3.3	U	3.3	0.63	1	U	1	0.077	1	U	1	0.28	1	U	1	0.18	1	U	1	0.19
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.17	1.7	U	1.7	0.57	1	U	1	0.065	1.5	U	1.5	0.45	0.5	U	0.5	0.21	0.5	U	0.5	0.17
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.19	1.7	U	1.7	0.63	1	U	1	0.059	1.5	U	1.5	0.53	0.5	U	0.5	0.16	0.5	U	0.5	0.19
1,2-Dichloropropane	1	NJPQL	1	U	1	0.18	3.3	U	3.3	0.6	1	U	1	0.1	1	U	1	0.27	1	U	1	0.15	1	U	1	0.18
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.14	3.3	U	3.3	0.47	1	U	1	0.049	1	U	1	0.15	1	U	1	0.12	1	U	1	0.14
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.19	3.3	U	3.3	0.63	1	U	1	0.053	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.17	3.3	U	3.3	0.57	1	U	1	0.038	1	U	1	0.15	1	U	1	0.19	1	U	1	0.17
2-Hexanone		NA	10	U	10	0.41	33	U	33	1.4	5	U	5	0.29	5	U	5	0.5	10	U	10	0.35	10	U	10	0.41
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	5	U	5	0.17	3.3	U	3.3	0.57	1	U	1	0.036	1	U	1	0.25	1	U	1	0.18	5	U	5	0.17
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.32	17	U	17	1.1	5	U	5	0.29	5	U	5	0.5	5	U	5	0.32	5	U	5	0.32
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.33	3.3	U	3.3	1.1	1	U	1	0.12	1	U	1	0.27	1	U	1	0.19	1	U	1	0.33
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.11	3.3	U	3.3	0.37	1	U	1	0.05	1	U	1	0.24	1	U	1	0.13	1	U	1	0.11
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.18	3.3	U	3.3	0.6	1	U	1	0.047	1	U	1	0.23	1	U	1	0.22	1	U	1	0.18
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.29	3.3	U	3.3	0.97	1	U	1	0.063	1	U	1	0.17	**0.33**	**J**	1	0.19	1	U	1	0.29
Toluene	600	Quality Criteria	1	U	1	0.13	3.3	U	3.3	0.43	1	U	1	0.041	1	U	1	0.19	1	U	1	0.17	1	U	1	0.13
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.22	3.3	U	3.3	0.73	1	U	1	0.041	1	U	1	0.29	1	U	1	0.21	1	U	1	0.22
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.27	3.3	U	3.3	0.9	1	U	1	0.072	1	U	1	0.26	1	U	1	0.22	1	U	1	0.27
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.17	3.3	U	3.3	0.57	1	U	1	0.058	1	U	1	0.5	1	U	1	0.28	1	U	1	0.17
Trichlorofluoromethane	2000	Quality Criteria	2	U	2	0.21	6.7	U	6.7	0.7	1	U	1	0.067	1	U	1	0.25	2	U	2	0.16	2	U	2	0.21
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**8.9**		1	0.28	**81**		3.3	0.93	NT				**3.79**		1	0.33	1	U	1	0.26	1	U	1	0.28
Vinyl chloride	1	NJPQL	2	U	2	0.22	6.7	U	6.7	0.73	1	U	1	0.062	1	U	1	0.2	2	U	2	0.21	2	U	2	0.22
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.28	3.3	U	3.3	0.93	1	U	1	0.097	1	U	1	0.22	1	U	1	0.44	1	U	1	0.28
Explosives																										
1,3-Dinitrobenzene	1	HA	0.2	U	0.2	0.07	0.2	U	0.2	0.036	0.25	U	0.25	0.04	NT				0.2	U	0.2	0.07	0.2	U	0.2	0.07
2,4-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.08	0.2	U	0.2	0.062	0.25	U	0.25	0.0097	NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,6-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.08	0.2	U	0.2	0.051	0.25	U	0.25	0.017	NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.06	0.2	U	0.2	0.066	0.25	U	0.25	0.018	NT				0.2	U	0.2	0.06	0.2	U	0.2	0.06
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.09	0.2	U	0.2	0.065	0.25	U	0.25	0.022	NT				0.2	U	0.2	0.09	0.2	U	0.2	0.09
HMX	400	HA	0.5	U	0.5	0.07	0.5	U	0.5	0.037	0.25	U	0.25	0.018	NT				0.5	U	0.5	0.07	0.5	U	0.5	0.07
Nitrobenzene	6	NJPQL	0.2	U	0.2	0.07	0.2	U	0.2	0.063	0.25	U	0.25	0.04	NT				0.2	U	0.2	0.07	0.2	U	0.2	0.07
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	0.2	U	0.2	0.075	0.25	U	0.25	0.017	NT				0.2	U	0.2	0.2	0.2	U	0.2	0.2
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.1	0.2	U	0.2	0.042	0.25	U	0.25	0.017	NT				0.2	U	0.2	0.1	0.2	U	0.2	0.1
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	0.2	U	0.2	0.075	0.25	U	0.25	0.026	NT				0.2	U	0.2	0.2	0.2	U	0.2	0.2
RDX	0.5	NJPQL	0.5	U	0.5	0.1	0.5	U	0.5	0.037	0.25	U	0.25	0.017	NT				0.5	U	0.5	0.1	0.5	U	0.5	0.1
Tetryl	150	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.065	0.25	U	0.25	0.04	NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.035	0.25	U	0.25	0.011	NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,4,6-Trinitrotoluene	1.2	Quality Criteria	0.2	U	0.2	0.1	0.2	U	0.2	0.05	0.25	U	0.25	0.012	NT				0.2	U	0.2	0.1	0.2	U	0.2	0.1

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-10				13MW-10				13MW-10				13MW-10				13MW-11				13MW-11			
		Date Sampled:	10/16/2007				6/17/2008				5/11/2010				1/25/2011				3/13/2007				6/26/2007			
		Depth Sampled (ft):	90-110				90-110				90-110				90-110				17-27				17-27			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	10	(U)	10	1.1	5	U	5	0.77	10	U	10	1.8	5	U	5	0.5	10	U	10	0.74	10	U	10	1.1
Acetonitrile	120	TWRBC	20	U	20	3.5	NT				5	U	5	1.67	NT				20	U	20	1.5	20	U	20	3.5
Benzene	1	NJMCL, NJPQL	1	U	1	0.13	1	U	1	0.059	1	U	1	0.14	1	U	1	0.32	1	U	1	0.22	1	U	1	0.13
Bromodichloromethane	1	NJPQL	1	U	1	0.15	1	U	1	0.031	1	U	1	0.18	1	U	1	0.36	1	U	1	0.14	1	U	1	0.15
Bromoform	4	Quality Criteria	1	U	1	0.64	1	U	1	0.1	1.5	U	1.5	0.5	1	U	1	0.47	1	U	1	0.17	1	U	1	0.64
Bromomethane	10	Quality Criteria	2	U	2	0.41	1	U	1	0.29	2	U	2	0.32	1	U	1	0.2	2	U	2	0.36	2	U	2	0.41
2-Butanone	300	Quality Criteria	10	U	10	0.57	**3.8**	**J**	5	0.78	5	U	5	1.6	5	U	5	1.3	10	U	10	0.39	10	U	10	0.57
Carbon disulfide	700	Quality Criteria	1	U	1	0.13	1	U	1	0.045	1	U	1	0.26	1	U	1	0.2	1	U	1	0.28	1	U	1	0.13
Carbon tetrachloride	1	NJPQL	1	U	1	0.13	1	U	1	0.031	1	U	1	0.24	1	U	1	0.2	1	U	1	0.19	1	U	1	0.13
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.15	1	U	1	0.047	1	U	1	0.21	1	U	1	0.49	1	U	1	0.2	1	U	1	0.15
Chloroethane	3.6	TWRBC	2	U	2	0.29	1	U	1	0.15	1	U	1	0.27	1	U	1	0.2	2	U	2	0.24	2	U	2	0.29
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.16	1	U	1	0.041	1	U	1	0.23	1	U	1	0.34	1	U	1	0.16	1	U	1	0.16
Chloromethane	30	HA	2	U	2	0.3	1	U	1	0.11	**1.73**		1	0.36	1	U	1	0.2	2	U	2	0.14	2	U	2	0.3
Dibromochloromethane	1	NJPQL	1	U	1	0.18	1	U	1	0.035	1	U	1	0.18	1	U	1	0.2	1	U	1	0.19	1	U	1	0.18
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.31	1	U	1	0.058	2	U	2	0.26	1	U	1	0.2	2	U	2	0.25	2	U	2	0.31
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.15	1	U	1	0.041	1	U	1	0.24	1	U	1	0.36	1	U	1	0.21	1	U	1	0.15
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.22	1	U	1	0.1	1	U	1	0.22	1	U	1	0.48	1	U	1	0.16	1	U	1	0.22
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.19	1	U	1	0.077	1	U	1	0.28	1	U	1	0.47	1	U	1	0.18	1	U	1	0.19
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.17	1	U	1	0.065	1.5	U	1.5	0.45	1	U	1	0.35	0.5	U	0.5	0.21	0.5	U	0.5	0.17
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.19	1	U	1	0.059	1.5	U	1.5	0.53	1	U	1	0.41	0.5	U	0.5	0.16	0.5	U	0.5	0.19
1,2-Dichloropropane	1	NJPQL	1	U	1	0.18	1	U	1	0.1	1	U	1	0.27	1	U	1	0.46	1	U	1	0.15	1	U	1	0.18
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.14	1	U	1	0.049	1	U	1	0.15	1	U	1	0.31	1	U	1	0.12	1	U	1	0.14
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.19	1	U	1	0.053	1	U	1	0.17	1	U	1	0.29	1	U	1	0.17	1	U	1	0.19
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.17	1	U	1	0.038	1	U	1	0.15	1	U	1	0.2	1	U	1	0.19	1	U	1	0.17
2-Hexanone		NA	10	U	10	0.41	5	U	5	0.29	5	U	5	0.5	5	U	5	1.9	10	U	10	0.35	10	U	10	0.41
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	1	U	1	0.17	1	U	1	0.036	NT				1	U	1	0.35	1	U	1	0.18	5	U	5	0.17
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.32	5	U	5	0.29	5	U	5	0.5	5	U	5	2.1	5	U	5	0.32	5	U	5	0.32
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.33	1	U	1	0.12	**0.504**	**J**	1	0.27	1	U	1	0.41	1	U	1	0.19	1	U	1	0.33
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.11	1	U	1	0.05	1	U	1	0.24	1	U	1	0.36	1	U	1	0.13	1	U	1	0.11
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.18	1	U	1	0.047	1	U	1	0.23	1	U	1	0.31	1	U	1	0.22	1	U	1	0.18
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.29	1	U	1	0.063	1	U	1	0.17	1	U	1	0.27	1	U	1	0.19	1	U	1	0.29
Toluene	600	Quality Criteria	1	U	1	0.13	1	U	1	0.041	1	U	1	0.19	1	U	1	0.37	1	U	1	0.17	1	U	1	0.13
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.22	1	U	1	0.041	1	U	1	0.29	1	U	1	0.4	1	U	1	0.21	1	U	1	0.22
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.27	1	U	1	0.072	1	U	1	0.26	1	U	1	0.38	1	U	1	0.22	1	U	1	0.27
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.17	1	U	1	0.058	1	U	1	0.5	1	U	1	0.28	**7.9**		1	0.28	**29**		1	0.17
Trichlorofluoromethane	2000	Quality Criteria	2	U	2	0.21	1	U	1	0.067	1	U	1	0.25	1	U	1	0.35	2	U	2	0.16	2	U	2	0.21
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	1	U	1	0.28	NT				**1.33**		1	0.33	1	U	1	0.45	1	U	1	0.26	**0.81**	**J**	1	0.28
Vinyl chloride	1	NJPQL	2	U	2	0.22	1	U	1	0.062	1	U	1	0.2	1	U	1	0.34	2	U	2	0.21	2	U	2	0.22
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.28	1	U	1	0.097	1	U	1	0.22	2	U	2	0.95	1	U	1	0.44	1	U	1	0.28
Explosives																										
1,3-Dinitrobenzene	1	HA	0.2	U	0.2	0.036	NT				NT				NT				0.2	U	0.2	0.07	0.2	U	0.2	0.07
2,4-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.062	NT				NT				NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,6-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.051	NT				NT				NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.066	NT				NT				NT				0.2	U	0.2	0.06	0.2	U	0.2	0.06
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.065	NT				NT				NT				0.2	U	0.2	0.09	0.2	U	0.2	0.09
HMX	400	HA	0.5	U	0.5	0.037	NT				NT				NT				0.5	U	0.5	0.07	0.5	U	0.5	0.07
Nitrobenzene	6	NJPQL	0.2	U	0.2	0.063	NT				NT				NT				0.2	U	0.2	0.07	0.2	U	0.2	0.07
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.075	NT				NT				NT				0.2	U	0.2	0.2	0.2	U	0.2	0.2
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.042	NT				NT				NT				0.2	U	0.2	0.1	0.2	U	0.2	0.1
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.075	NT				NT				NT				0.2	U	0.2	0.2	0.2	U	0.2	0.2
RDX	0.5	NJPQL	0.5	U	0.5	0.037	NT				NT				NT				0.5	U	0.5	0.1	0.5	U	0.5	0.1
Tetryl	150	TWRBC	0.2	U	0.2	0.065	NT				NT				NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.035	NT				NT				NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,4,6-Trinitrotoluene	1.2	Quality Criteria	0.2	U	0.2	0.05	NT				NT				NT				0.2	U	0.2	0.1	0.2	U	0.2	0.1

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-11DUP				13MW-11				13MW-11				13MW-11 DUP				13MW-11				13MW-11			
		Date Sampled:	6/26/2007				10/17/2007				6/26/2008				6/26/2008				4/21/2010				2/9/2011			
		Depth Sampled (ft):	17-27				17-27				17-27				17-27				17-27				17-27			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	10	U	10	1.1	14	U	14	1.6	5	U	5	0.77	5	U	5	0.77	10	H1,U	10	1.8	5	U	5	0.5
Acetonitrile	120	TWRBC	20	U	20	3.5	29	U	29	5	NT				NT				5	H1,U	5	1.67	NT			
Benzene	1	NJMCL, NJPQL	1	U	1	0.13	1.4	U	1.4	0.19	1	U	1	0.059	1	U	1	0.059	1	H1,U	1	0.14	1	U	1	0.32
Bromodichloromethane	1	NJPQL	1	U	1	0.15	1.4	U	1.4	0.21	1	U	1	0.031	1	U	1	0.031	**0.228**	**H1, J**	1	0.18	1	U	1	0.36
Bromoform	4	Quality Criteria	1	U	1	0.64	1.4	U	1.4	0.92	1	U	1	0.1	1	U	1	0.1	1.5	H1,U	1.5	0.5	1	U	1	0.47
Bromomethane	10	Quality Criteria	2	U	2	0.41	2.9	U	2.9	0.59	1	U	1	0.29	1	U	1	0.29	2	H1,U	2	0.32	1	U	1	0.2
2-Butanone	300	Quality Criteria	10	U	10	0.57	14	U	14	0.82	5	U	5	0.78	5	U	5	0.78	5	H1,U	5	1.6	5	U	5	1.3
Carbon disulfide	700	Quality Criteria	1	U	1	0.13	1.4	U	1.4	0.19	1	U	1	0.045	1	U	1	0.045	1	H1,U	1	0.26	1	U	1	0.2
Carbon tetrachloride	1	NJPQL	1	U	1	0.13	1.4	U	1.4	0.19	1	U	1	0.031	1	U	1	0.031	1	H1,U	1	0.24	1	U	1	0.2
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.15	1.4	U	1.4	0.21	1	U	1	0.047	1	U	1	0.047	1	H1,U	1	0.21	1	U	1	0.49
Chloroethane	3.6	TWRBC	2	U	2	0.29	2.9	U	2.9	0.41	1	U	1	0.15	1	U	1	0.15	1	H1,U	1	0.27	1	U	1	0.2
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.16	1.4	U	1.4	0.23	1	U	1	0.041	1	U	1	0.041	1	H1,U	1	0.23	1	U	1	0.34
Chloromethane	30	HA	2	U	2	0.3	2.9	U	2.9	0.43	1	U	1	0.11	1	U	1	0.11	1	H1,U	1	0.36	1	U	1	0.2
Dibromochloromethane	1	NJPQL	1	U	1	0.18	1.4	U	1.4	0.26	1	U	1	0.035	1	U	1	0.035	1	H1,U	1	0.18	1	U	1	0.2
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.31	2.9	U	2.9	0.44	1	U	1	0.058	1	U	1	0.058	2	H1,U	2	0.26	1	U	1	0.2
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.15	1.4	U	1.4	0.21	1	U	1	0.041	1	U	1	0.041	1	H1,U	1	0.24	1	U	1	0.36
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.22	1.4	U	1.4	0.31	1	U	1	0.1	1	U	1	0.1	1	H1,U	1	0.22	1	U	1	0.46
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.19	1.4	U	1.4	0.27	1	U	1	0.077	1	U	1	0.077	1	H1,U	1	0.28	1	U	1	0.47
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.17	0.72	U	0.72	0.24	1	U	1	0.065	1	U	1	0.065	1.5	H1,U	1.5	0.45	1	U	1	0.35
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.19	0.72	U	0.72	0.27	1	U	1	0.059	1	U	1	0.059	1.5	H1,U	1.5	0.53	1	U	1	0.41
1,2-Dichloropropane	1	NJPQL	1	U	1	0.18	1.4	U	1.4	0.26	1	U	1	0.1	1	U	1	0.1	1	H1,U	1	0.27	1	U	1	0.46
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.14	1.4	U	1.4	0.2	1	U	1	0.049	1	U	1	0.049	1	H1,U	1	0.15	1	U	1	0.31
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.19	1.4	U	1.4	0.27	1	U	1	0.053	1	U	1	0.053	1	H1,U	1	0.17	1	U	1	0.29
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.17	1.4	U	1.4	0.24	1	U	1	0.038	1	U	1	0.038	1	H1,U	1	0.15	1	U	1	0.2
2-Hexanone		NA	10	U	10	0.41	14	U	14	0.59	5	U	5	0.29	5	U	5	0.29	5	H1,U	5	0.5	5	U	5	1.9
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	5	U	5	0.17	1.4	U	1.4	0.24	1	U	1	0.036	1	U	1	0.036	1	H1,U	1	0.25	1	U	1	0.35
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.32	7.2	U	7.2	0.46	5	U	5	0.29	5	U	5	0.29	5	H1,U	5	0.5	5	U	5	2.1
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.33	1.4	U	1.4	0.47	1	U	1	0.12	1	U	1	0.12	1	H1,U	1	0.27	1	U	1	0.41
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.11	1.4	U	1.4	0.16	1	U	1	0.05	1	U	1	0.05	1	H1,U	1	0.24	1	U	1	0.36
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.18	1.4	U	1.4	0.26	1	U	1	0.047	1	U	1	0.047	1	H1,U	1	0.23	1	U	1	0.31
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.29	1.4	U	1.4	0.41	1	U	1	0.063	1	U	1	0.063	1	H1,U	1	0.27	1	U	1	0.27
Toluene	600	Quality Criteria	1	U	1	0.13	1.4	U	1.4	0.19	1	U	1	0.041	1	U	1	0.041	1	H1,U	1	0.19	1	U	1	0.37
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.22	1.4	U	1.4	0.31	1	U	1	0.041	1	U	1	0.041	1	H1,U	1	0.29	1	U	1	0.4
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.27	1.4	U	1.4	0.39	1	U	1	0.072	1	U	1	0.072	1	H1,U	1	0.26	1	U	1	0.38
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**29**		1	0.17	**31**		1.4	0.24	**19**		1	0.058	**19**		1	0.058	**24.7**	**H1**	1	0.5	**9.9**		1	0.28
Trichlorofluoromethane	2000	Quality Criteria	2	U	2	0.21	2.9	U	2.9	0.3	1	U	1	0.067	1	U	1	0.067	1	H1,U	1	0.25	1	U	1	0.35
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**0.72**	**J**	1	0.28	1.4	(U)	1.4	0.4	NT				NT				1	H1,U	1	0.33	1	U	1	0.45
Vinyl chloride	1	NJPQL	2	U	2	0.22	2.9	U	2.9	0.31	1	U	1	0.062	1	U	1	0.062	1	H1,U	1	0.2	1	U	1	0.34
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.28	1.4	U	1.4	0.4	1	U	1	0.097	1	U	1	0.097	1	H1,U	1	0.22	2	U	2	0.95
Explosives																										
1,3-Dinitrobenzene	1	HA	0.2	U	0.2	0.07	0.2	U	0.2	0.036	0.25	U	0.25	0.04	0.25	U	0.25	0.04	NT				NT			
2,4-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.08	0.2	U	0.2	0.062	0.25	U	0.25	0.0097	0.25	U	0.25	0.0097	NT				NT			
2,6-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.08	0.2	U	0.2	0.051	0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.06	0.2	U	0.2	0.066	0.25	U	0.25	0.018	0.25	U	0.25	0.018	NT				NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.09	0.2	U	0.2	0.065	0.25	U	0.25	0.022	0.25	U	0.25	0.022	NT				NT			
HMX	400	HA	0.5	U	0.5	0.07	0.5	U	0.5	0.037	0.25	U	0.25	0.018	0.25	U	0.25	0.018	NT				NT			
Nitrobenzene	6	NJPQL	0.2	U	0.2	0.07	0.2	U	0.2	0.063	0.25	U	0.25	0.04	0.25	U	0.25	0.04	NT				NT			
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	0.2	U	0.2	0.075	0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT			
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.1	0.2	U	0.2	0.042	0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT			
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	0.2	U	0.2	0.075	0.25	U	0.25	0.026	0.25	U	0.25	0.026	NT				NT			
RDX	0.5	NJPQL	0.5	U	0.5	0.1	0.5	U	0.5	0.037	0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT			
Tetryl	150	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.065	0.25	U	0.25	0.04	0.25	U	0.25	0.04	NT				NT			
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.035	0.25	U	0.25	0.011	0.25	U	0.25	0.011	NT				NT			
2,4,6-Trinitrotoluene	1.2	Quality Criteria	0.2	U	0.2	0.1	0.2	U	0.2	0.05	0.25	U	0.25	0.012	0.25	U	0.25	0.012	NT				NT			

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	13MW-12				13MW-13				AWDF-IN				AWDF-INDUP				AWDF-OUT				AWDF-IN			
		Date Sampled:	4/19/2010				4/20/2010				4/22/2004				4/22/2004				4/22/2004				7/19/2004			
		Depth Sampled (ft):	25.5-35.5				156-176																			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	10	U	10	1.8	**19.7**		10	1.8	50	(U)D	50	3.3	50	UD	50	3.3	10	(U)	10	0.66	33	UD	33	2.5
Acetonitrile	120	TWRBC	5	U	5	1.67	5	U	5	1.67	100	UD	100	14	100	UD	100	14	20	U	20	2.9	67	UD	67	5
Benzene	1	NJMCL, NJPQL	1	U	1	0.14	1	U	1	0.14	5	UD	5	1	5	UD	5	1	1	U	1	0.2	3.3	UD	3.3	0.73
Bromodichloromethane	1	NJPQL	1	U	1	0.18	1	U	1	0.18	5	UD	5	1	5	UD	5	1	1	U	1	0.2	3.3	UD	3.3	0.47
Bromoform	4	Quality Criteria	1.5	U	1.5	0.5	1.5	U	1.5	0.5	5	UD	5	1.6	5	UD	5	1.6	1	U	1	0.32	3.3	UD	3.3	0.57
Bromomethane	10	Quality Criteria	2	U	2	0.32	2	U	2	0.32	10	UD	10	0.8	10	UD	10	0.8	2	U	2	0.16	6.7	UD	6.7	1.2
2-Butanone	300	Quality Criteria	5	U	5	1.6	5	U	5	1.6	50	UD	50	1.8	50	UD	50	1.8	10	U	10	0.36	33	UD	33	1.3
Carbon disulfide	700	Quality Criteria	1	U	1	0.26	1	U	1	0.26	5	UD	5	1	5	UD	5	1	1	U	1	0.21	3.3	UD	3.3	0.93
Carbon tetrachloride	1	NJPQL	1	U	1	0.24	1	U	1	0.24	5	UD	5	0.9	5	UD	5	0.9	1	U	1	0.18	3.3	UD	3.3	0.63
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.21	1	U	1	0.21	5	UD	5	0.8	5	UD	5	0.8	1	U	1	0.16	3.3	UD	3.3	0.67
Chloroethane	3.6	TWRBC	1	U	1	0.27	1	U	1	0.27	10	UD	10	1.1	10	UD	10	1.1	2	U	2	0.22	6.7	UD	6.7	0.8
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.23	1	U	1	0.23	5	UD	5	1	5	UD	5	1	1	U	1	0.21	3.3	UD	3.3	0.53
Chloromethane	30	HA	1	U	1	0.36	1	U	1	0.36	10	UD	10	1.3	10	UD	10	1.3	2	U	2	0.26	6.7	UD	6.7	0.47
Dibromochloromethane	1	NJPQL	1	U	1	0.18	1	U	1	0.18	5	UD	5	1.2	5	UD	5	1.2	1	U	1	0.25	3.3	UD	3.3	0.63
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.26	**2.22**		2	0.26	10	UD	10	1.2	10	UD	10	1.2	2	U	2	0.23	6.7	UD	6.7	0.83
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.24	1	U	1	0.24	5	UD	5	1.3	5	UD	5	1.3	1	U	1	0.26	3.3	UD	3.3	0.7
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.22	1	U	1	0.22	5	UD	5	1.1	5	UD	5	1.1	1	U	1	0.22	3.3	UD	3.3	0.53
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.28	1	U	1	0.28	5	UD	5	1.1	5	UD	5	1.1	1	U	1	0.22	3.3	UD	3.3	0.6
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	1.5	U	1.5	0.45	1.5	U	1.5	0.45	2.5	UD	2.5	1.2	2.5	UD	2.5	1.2	0.5	U	0.5	0.25	1.7	UD	1.7	0.7
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	1.5	U	1.5	0.53	1.5	U	1.5	0.53	2.5	UD	2.5	1.2	2.5	UD	2.5	1.2	0.5	U	0.5	0.24	1.7	UD	1.7	0.53
1,2-Dichloropropane	1	NJPQL	1	U	1	0.27	1	U	1	0.27	5	UD	5	0.9	5	UD	5	0.9	1	U	1	0.18	3.3	UD	3.3	0.5
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.15	1	U	1	0.15	5	UD	5	0.75	5	UD	5	0.75	1	U	1	0.15	3.3	UD	3.3	0.4
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.17	1	U	1	0.17	5	UD	5	0.85	5	UD	5	0.85	1	U	1	0.17	3.3	UD	3.3	0.57
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.15	1	U	1	0.15	5	UD	5	0.95	5	UD	5	0.95	1	U	1	0.19	3.3	UD	3.3	0.63
2-Hexanone		NA	5	U	5	0.5	5	U	5	0.5	50	UD	50	1.6	50	UD	50	1.6	10	U	10	0.31	33	UD	33	1.2
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	1	U	1	0.25	**3.65**		1	0.25	5	UD	5	1	5	UD	5	1	**0.31**	**J**	1	0.21	3.3	(U)D	3.3	0.6
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.5	5	U	5	0.5	25	UD	25	1.7	25	UD	25	1.7	5	U	5	0.34	17	UD	17	1.1
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.27	1	U	1	0.27	5	UD	5	1.4	5	UD	5	1.4	1	U	1	0.28	3.3	UD	3.3	0.63
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.24	1	U	1	0.24	5	UD	5	0.8	5	UD	5	0.8	1	U	1	0.16	3.3	UD	3.3	0.43
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.23	1	U	1	0.23	5	UD	5	1.2	5	UD	5	1.2	1	U	1	0.23	3.3	UD	3.3	0.73
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.17	1	U	1	0.17	5	UD	5	0.6	5	UD	5	0.6	1	U	1	0.12	3.3	UD	3.3	0.63
Toluene	600	Quality Criteria	1	U	1	0.19	1	U	1	0.19	5	UD	5	0.85	5	UD	5	0.85	1	U	1	0.17	3.3	UD	3.3	0.57
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.29	1	U	1	0.29	5	UD	5	0.9	5	UD	5	0.9	1	U	1	0.18	3.3	UD	3.3	0.7
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.26	1	U	1	0.26	5	UD	5	1	5	UD	5	1	1	U	1	0.21	3.3	UD	3.3	0.73
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.5	1	U	1	0.5	**100**	**D**	5	1.1	**110**	**D**	5	1.1	**1.3**		1	0.22	**94**	**D**	3.3	0.93
Trichlorofluoromethane	2000	Quality Criteria	1	U	1	0.25	1	U	1	0.25	10	UD	10	1.2	10	UD	10	1.2	2	U	2	0.25	6.7	UD	6.7	0.53
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	1	U	1	0.33	**2,750**	**H1,D**	50	16.5	**28**	**D**	5	1.2	**33**	**D**	5	1.2	1	U	1	0.23	**20**	**D**	3.3	0.87
Vinyl chloride	1	NJPQL	1	U	1	0.2	1	U	1	0.2	10	UD	10	1.3	10	UD	10	1.3	2	U	2	0.26	6.7	UD	6.7	0.7
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.22	1	U	1	0.22	5	UD	5	2.2	5	UD	5	2.2	1	U	1	0.45	3.3	UD	3.3	1.5
Explosives																										
1,3-Dinitrobenzene	1	HA	NT				NT				0.2	U	0.2	0.04	0.2	U	0.2	0.04	0.2	U	0.2	0.04	NT			
2,4-Dinitrotoluene	10	NJPQL	NT				NT				0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.09	NT			
2,6-Dinitrotoluene	10	NJPQL	NT				NT				0.2	U	0.2	0.073	0.2	U	0.2	0.073	0.2	U	0.2	0.073	NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				0.2	U	0.2	0.077	0.2	U	0.2	0.077	0.2	U	0.2	0.077	NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	NT			
HMX	400	HA	NT				NT				**0.12**	**J**	0.5	0.082	**0.11**	**J**	0.5	0.082	**0.15**	**J**	0.5	0.082	NT			
Nitrobenzene	6	NJPQL	NT				NT				0.2	U	0.2	0.049	0.2	U	0.2	0.049	0.2	U	0.2	0.049	NT			
2-Nitrotoluene	61	TWRBC	NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.12	0.2	U	0.2	0.12	NT			
3-Nitrotoluene	61	TWRBC	NT				NT				0.2	U	0.2	0.13	0.2	U	0.2	0.13	0.2	U	0.2	0.13	NT			
4-Nitrotoluene	61	TWRBC	NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.12	0.2	U	0.2	0.12	NT			
RDX	0.5	NJPQL	NT				NT				**0.49**	**J**	0.5	0.067	**0.49**	**J**	0.5	0.067	**0.48**	**J**	0.5	0.067	NT			
Tetryl	150	TWRBC	NT				NT				0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.06	NT			
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				0.2	U	0.2	0.049	0.2	U	0.2	0.049	0.2	U	0.2	0.049	NT			
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				NT				0.2	U	0.2	0.13	0.2	U	0.2	0.13	0.2	U	0.2	0.13	NT			

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	AWDF-WELL				AWDF				AWDF-IN				AWDF				AWDF				AWDF			
		Date Sampled:	8/10/2006				12/12/2006				3/15/2007				6/15/2007				10/23/2007				6/18/2008			
		Depth Sampled (ft):																	--				--			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	25	UD	25	1.8	25	UD	25	1.8	**7.6**	**JD**	33	2.5	33	UD	33	3.7	20	(U)	20	2.2	5	U	5	0.77
Acetonitrile	120	TWRBC	50	UD	50	3.8	50	UD	50	3.8	67	UD	67	5	67	UD	67	12	40	U	40	7	NT			
Benzene	1	NJMCL, NJPQL	2.5	UD	2.5	0.55	2.5	UD	2.5	0.55	3.3	UD	3.3	0.73	3.3	UD	3.3	0.43	2	U	2	0.26	1	U	1	0.059
Bromodichloromethane	1	NJPQL	2.5	UD	2.5	0.35	2.5	UD	2.5	0.35	3.3	UD	3.3	0.47	3.3	UD	3.3	0.5	2	U	2	0.3	1	U	1	0.031
Bromoform	4	Quality Criteria	2.5	UD	2.5	0.42	2.5	UD	2.5	0.42	3.3	UD	3.3	0.57	3.3	UD	3.3	2.1	2	U	2	1.3	1	U	1	0.1
Bromomethane	10	Quality Criteria	5	UD	5	0.9	5	UD	5	0.9	6.7	UD	6.7	1.2	6.7	UD	6.7	1.4	4	U	4	0.82	1	U	1	0.29
2-Butanone	300	Quality Criteria	25	UD	25	0.98	**1.9**	**JD**	25	0.98	33	UD	33	1.3	33	UD	33	1.9	20	U	20	1.1	5	U	5	0.78
Carbon disulfide	700	Quality Criteria	2.5	UD	2.5	0.7	2.5	UD	2.5	0.7	3.3	UD	3.3	0.93	3.3	UD	3.3	0.43	2	U	2	0.26	1	U	1	0.045
Carbon tetrachloride	1	NJPQL	2.5	UD	2.5	0.48	2.5	UD	2.5	0.48	3.3	UD	3.3	0.63	3.3	UD	3.3	0.43	2	U	2	0.26	1	U	1	0.031
Chlorobenzene	50	NJMCL, Quality Criteria	2.5	UD	2.5	0.5	2.5	UD	2.5	0.5	3.3	UD	3.3	0.67	3.3	UD	3.3	0.5	2	U	2	0.3	1	U	1	0.047
Chloroethane	3.6	TWRBC	5	UD	5	0.6	5	UD	5	0.6	6.7	UD	6.7	0.8	6.7	UD	6.7	0.97	4	U	4	0.58	1	U	1	0.15
Chloroform	70	Quality Criteria, MCLG	2.5	UD	2.5	0.4	2.5	UD	2.5	0.4	3.3	UD	3.3	0.53	3.3	UD	3.3	0.53	2	U	2	0.32	1	U	1	0.041
Chloromethane	30	HA	5	UD	5	0.35	5	UD	5	0.35	6.7	UD	6.7	0.47	6.7	UD	6.7	1	4	U	4	0.6	1	U	1	0.11
Dibromochloromethane	1	NJPQL	2.5	UD	2.5	0.48	2.5	UD	2.5	0.48	3.3	UD	3.3	0.63	3.3	UD	3.3	0.6	2	U	2	0.36	1	U	1	0.035
Dichlorodifluoromethane	1000	Quality Criteria	5	UD	5	0.62	5	UD	5	0.62	6.7	UD	6.7	0.83	6.7	UD	6.7	1	4	U	4	0.62	1	U	1	0.058
1,1-Dichloroethane	50	NJMCL, Quality Criteria	2.5	UD	2.5	0.52	2.5	UD	2.5	0.52	3.3	UD	3.3	0.7	3.3	UD	3.3	0.5	2	U	2	0.3	1	U	1	0.041
1,2-Dichloroethane	2	NJMCL, NJPQL	2.5	UD	2.5	0.4	2.5	UD	2.5	0.4	3.3	UD	3.3	0.53	3.3	UD	3.3	0.73	2	U	2	0.44	1	U	1	0.1
1,1-Dichloroethene	1	Quality Criteria, NJPQL	2.5	UD	2.5	0.45	2.5	UD	2.5	0.45	3.3	UD	3.3	0.6	3.3	UD	3.3	0.63	2	U	2	0.38	1	U	1	0.077
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	1.2	UD	1.2	0.52	1.2	UD	1.2	0.52	1.7	UD	1.7	0.7	1.7	UD	1.7	0.57	1	U	1	0.34	**0.51**	**J**	1	0.065
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	1.2	UD	1.2	0.4	1.2	UD	1.2	0.4	1.7	UD	1.7	0.53	1.7	UD	1.7	0.63	1	U	1	0.38	1	U	1	0.059
1,2-Dichloropropane	1	NJPQL	2.5	UD	2.5	0.38	2.5	UD	2.5	0.38	3.3	UD	3.3	0.5	3.3	UD	3.3	0.6	2	U	2	0.36	1	U	1	0.1
cis-1,3-Dichloropropene	1	NJPQL	2.5	UD	2.5	0.3	2.5	UD	2.5	0.3	3.3	UD	3.3	0.4	3.3	UD	3.3	0.47	2	U	2	0.28	1	U	1	0.049
trans-1,3-Dichloropropene	1	NJPQL	2.5	UD	2.5	0.42	2.5	UD	2.5	0.42	3.3	UD	3.3	0.57	3.3	UD	3.3	0.63	2	U	2	0.38	1	U	1	0.053
Ethyl benzene	700	MCL, Quality Criteria, MCLG	2.5	UD	2.5	0.48	2.5	UD	2.5	0.48	3.3	UD	3.3	0.63	3.3	UD	3.3	0.57	2	U	2	0.34	1	U	1	0.038
2-Hexanone		NA	25	UD	25	0.88	25	UD	25	0.88	33	UD	33	1.2	33	UD	33	1.4	20	U	20	0.82	5	U	5	0.29
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	2.5	UD	2.5	0.45	2.5	UD	2.5	0.45	3.3	UD	3.3	0.6	17	UD	17	0.57	2	U	2	0.34	**0.28**	**J**	1	0.036
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	12	UD	12	0.8	12	UD	12	0.8	17	UD	17	1.1	17	UD	17	1.1	10	U	10	0.64	5	U	5	0.29
Methylene chloride	3	NJMCL, Quality Criteria	2.5	UD	2.5	0.48	3.7	(U)D	2.5	0.48	3.3	UD	3.3	0.63	3.3	UD	3.3	1.1	2	U	2	0.66	1	U	1	0.12
Styrene	100	MCL, Quality Criteria, MCLG	2.5	UD	2.5	0.32	2.5	UD	2.5	0.32	3.3	UD	3.3	0.43	3.3	UD	3.3	0.37	2	U	2	0.22	1	U	1	0.05
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	2.5	UD	2.5	0.55	2.5	UD	2.5	0.55	3.3	UD	3.3	0.73	3.3	UD	3.3	0.6	2	U	2	0.36	1	U	1	0.047
Tetrachloroethene	1	NJMCL, NJPQL	2.5	UD	2.5	0.48	2.5	UD	2.5	0.48	3.3	UD	3.3	0.63	3.3	UD	3.3	0.97	2	U	2	0.58	1	U	1	0.063
Toluene	600	Quality Criteria	2.5	UD	2.5	0.42	2.5	UD	2.5	0.42	3.3	UD	3.3	0.57	3.3	UD	3.3	0.43	2	U	2	0.26	1	U	1	0.041
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	2.5	UD	2.5	0.52	2.5	UD	2.5	0.52	3.3	UD	3.3	0.7	3.3	UD	3.3	0.73	2	U	2	0.44	1	U	1	0.041
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	2.5	UD	2.5	0.55	2.5	UD	2.5	0.55	3.3	UD	3.3	0.73	3.3	UD	3.3	0.9	2	U	2	0.54	1	U	1	0.072
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**81**	**D**	2.5	0.7	**87**	**D**	2.5	0.7	**120**	**D**	3.3	0.93	**61**	**D**	3.3	0.57	**58**		2	0.34	**86**	**D**	1	0.058
Trichlorofluoromethane	2000	Quality Criteria	5	UD	5	0.4	5	UD	5	0.4	6.7	UD	6.7	0.53	6.7	UD	6.7	0.7	4	U	4	0.42	1	U	1	0.067
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**15**	**D**	2.5	0.65	**12**	**D**	2.5	0.65	**29**	**D**	3.3	0.87	**8**	**D**	3.3	0.93	**6.4**		2	0.56	NT			
Vinyl chloride	1	NJPQL	5	UD	5	0.52	5	UD	5	0.52	6.7	UD	6.7	0.7	6.7	UD	6.7	0.73	4	U	4	0.44	1	U	1	0.062
Total Xylenes	1000	NJMCL, Quality Criteria	2.5	UD	2.5	1.1	2.5	UD	2.5	1.1	3.3	UD	3.3	1.5	3.3	UD	3.3	0.93	2	U	2	0.56	1	U	1	0.097
Explosives																										
1,3-Dinitrobenzene	1	HA	NT				0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.036	NT			
2,4-Dinitrotoluene	10	NJPQL	NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.062	NT			
2,6-Dinitrotoluene	10	NJPQL	NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.051	NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.066	NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.065	NT			
HMX	400	HA	NT				0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.037	NT			
Nitrobenzene	6	NJPQL	NT				0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.063	NT			
2-Nitrotoluene	61	TWRBC	NT				0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075	NT			
3-Nitrotoluene	61	TWRBC	NT				0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.042	NT			
4-Nitrotoluene	61	TWRBC	NT				0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075	NT			
RDX	0.5	NJPQL	NT				**0.11**	**J COL**	0.5	0.1	**0.34**	**J**	0.5	0.1	**0.23**	**J**	0.5	0.1	**0.2**	**J**	0.5	0.037	NT			
Tetryl	150	TWRBC	NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.065	NT			
1,3,5-Trinitrobenzene	1100	TWRBC	NT				0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.035	NT			
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.05	NT			

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	AWDF				AWDF				DM10-1				DM10-2				DM13-1				DM13-1			
		Date Sampled:	5/10/2010				1/28/2011				6/9/2008				6/10/2008				4/26/2004				5/9/2005			
		Depth Sampled (ft):	--				--				36-46				--				11-21				11-21			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	**1.86**	**J**	10	1.8	5	U	5	0.5	NT				NT				10	(U)	10	0.66	10	U	10	0.74
Acetonitrile	120	TWRBC	5	U	5	1.67	NT				NT				NT				20	U	20	2.9	20	R	20	1.5
Benzene	1	NJMCL, NJPQL	1	U	1	0.14	1	U	1	0.32	NT				NT				1	U	1	0.2	1	U	1	0.22
Bromodichloromethane	1	NJPQL	1	U	1	0.18	1	U	1	0.36	NT				NT				1	U	1	0.2	1	U	1	0.14
Bromoform	4	Quality Criteria	1.5	U	1.5	0.5	1	U	1	0.47	NT				NT				1	U	1	0.32	1	U	1	0.17
Bromomethane	10	Quality Criteria	2	U	2	0.32	1	U	1	0.2	NT				NT				2	U	2	0.16	2	U	2	0.36
2-Butanone	300	Quality Criteria	5	U	5	1.6	5	U	5	1.3	NT				NT				10	U	10	0.36	10	U	10	0.39
Carbon disulfide	700	Quality Criteria	1	U	1	0.26	1	U	1	0.2	NT				NT				1	U	1	0.21	1	U	1	0.28
Carbon tetrachloride	1	NJPQL	1	U	1	0.24	1	U	1	0.2	NT				NT				1	U	1	0.18	1	U	1	0.19
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.21	1	U	1	0.49	NT				NT				1	U	1	0.16	1	U	1	0.2
Chloroethane	3.6	TWRBC	1	U	1	0.27	1	U	1	0.2	NT				NT				2	U	2	0.22	2	U	2	0.24
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.23	1	U	1	0.34	NT				NT				1	U	1	0.21	1	U	1	0.16
Chloromethane	30	HA	**0.606**	**J**	1	0.36	1	U	1	0.2	NT				NT				2	U	2	0.26	2	U	2	0.14
Dibromochloromethane	1	NJPQL	1	U	1	0.18	1	U	1	0.2	NT				NT				1	U	1	0.25	1	U	1	0.19
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.26	1	U	1	0.2	NT				NT				2	U	2	0.23	2	U	2	0.25
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.24	1	U	1	0.41	NT				NT				1	U	1	0.26	1	U	1	0.21
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.22	1	U	1	0.48	NT				NT				1	U	1	0.22	1	U	1	0.16
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.28	1	U	1	0.47	NT				NT				1	U	1	0.22	1	U	1	0.18
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	1.5	U	1.5	0.45	1	U	1	0.35	NT				NT				0.5	U	0.5	0.25	**0.23**	**J**	0.5	0.21
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	1.5	U	1.5	0.53	1	U	1	0.41	NT				NT				0.5	U	0.5	0.24	0.5	U	0.5	0.16
1,2-Dichloropropane	1	NJPQL	1	U	1	0.27	1	U	1	0.46	NT				NT				1	U	1	0.18	1	U	1	0.15
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.15	1	U	1	0.31	NT				NT				1	U	1	0.15	1	U	1	0.12
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.17	1	U	1	0.29	NT				NT				1	U	1	0.17	1	U	1	0.17
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.15	1	U	1	0.2	NT				NT				1	U	1	0.19	1	U	1	0.19
2-Hexanone		NA	5	U	5	0.5	5	U	5	1.9	NT				NT				10	U	10	0.31	10	U	10	0.35
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	NT				1	U	1	0.35	NT				NT				1	U	1	0.21	1	U	1	0.18
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.5	5	U	5	2.1	NT				NT				5	U	5	0.34	5	U	5	0.32
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.27	1	U	1	0.41	NT				NT				1	U	1	0.28	1	U	1	0.19
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.24	1	U	1	0.36	NT				NT				1	U	1	0.16	1	U	1	0.13
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.23	1	U	1	0.31	NT				NT				1	U	1	0.23	1	U	1	0.22
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.17	1	U	1	0.27	NT				NT				1	U	1	0.12	1	U	1	0.19
Toluene	600	Quality Criteria	1	U	1	0.19	1	U	1	0.37	NT				NT				1	U	1	0.17	1	U	1	0.17
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.29	1	U	1	0.4	NT				NT				1	U	1	0.18	1	U	1	0.21
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.26	1	U	1	0.38	NT				NT				1	U	1	0.21	1	U	1	0.22
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**95.9**		1	0.5	**62**		1	0.28	NT				NT				**33**		1	0.22	**17**		1	0.28
Trichlorofluoromethane	2000	Quality Criteria	1	U	1	0.25	1	U	1	0.35	NT				NT				2	U	2	0.25	2	U	2	0.16
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**15.4**		1	0.33	**10**		1	0.45	NT				NT				**5.4**		1	0.23	**3.3**		1	0.26
Vinyl chloride	1	NJPQL	1	U	1	0.2	1	U	1	0.34	NT				NT				2	U	2	0.26	2	U	2	0.21
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.22	2	U	2	0.95	NT				NT				1	U	1	0.45	1	U	1	0.44
Explosives																										
1,3-Dinitrobenzene	1	HA	NT				NT				0.25	U	0.25	0.04	0.25	U	0.25	0.04	NT				NT			
2,4-Dinitrotoluene	10	NJPQL	NT				NT				0.25	U	0.25	0.0097	0.25	U	0.25	0.0097	NT				NT			
2,6-Dinitrotoluene	10	NJPQL	NT				NT				0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				0.25	U	0.25	0.018	0.25	U	0.25	0.018	NT				NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				0.25	U	0.25	0.022	0.25	U	0.25	0.022	NT				NT			
HMX	400	HA	NT				NT				0.25	U	0.25	0.018	0.25	U	0.25	0.018	NT				NT			
Nitrobenzene	6	NJPQL	NT				NT				0.25	U	0.25	0.04	0.25	U	0.25	0.04	NT				NT			
2-Nitrotoluene	61	TWRBC	NT				NT				0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT			
3-Nitrotoluene	61	TWRBC	NT				NT				0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT			
4-Nitrotoluene	61	TWRBC	NT				NT				0.25	U	0.25	0.026	0.25	U	0.25	0.026	NT				NT			
RDX	0.5	NJPQL	NT				NT				0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT			
Tetryl	150	TWRBC	NT				NT				0.25	U	0.25	0.04	0.25	U	0.25	0.04	NT				NT			
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				0.25	U	0.25	0.011	0.25	U	0.25	0.011	NT				NT			
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				NT				0.25	U	0.25	0.012	0.25	U	0.25	0.012	NT				NT			

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	DM13-1				DM13-1				DM13-1DUP				DM13-1				DM13-1				DM13-1			
		Date Sampled:	7/25/2006				11/2/2006				11/2/2006				3/7/2007				6/21/2007				10/23/2007			
		Depth Sampled (ft):	11-21				11-21				11-21				11-21				11-21				7.5-17.5			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	10	U	10	0.74	10	U	10	0.74	10	U	10	0.74	10	U	10	0.74	10	U	10	1.1	10	U	10	1.1
Acetonitrile	120	TWRBC	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	3.5	20	U	20	3.5
Benzene	1	NJMCL, NJPQL	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.13	1	U	1	0.13
Bromodichloromethane	1	NJPQL	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.15	1	U	1	0.15
Bromoform	4	Quality Criteria	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.64	1	U	1	0.64
Bromomethane	10	Quality Criteria	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.41	2	U	2	0.41
2-Butanone	300	Quality Criteria	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.57	10	U	10	0.57
Carbon disulfide	700	Quality Criteria	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.13	1	U	1	0.13
Carbon tetrachloride	1	NJPQL	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.13	1	U	1	0.13
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.15	1	U	1	0.15
Chloroethane	3.6	TWRBC	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.29	2	U	2	0.29
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	30	HA	2	(U)	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.3	2	U	2	0.3
Dibromochloromethane	1	NJPQL	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.18	1	U	1	0.18
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.31	2	U	2	0.31
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.15	1	U	1	0.15
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.22	1	U	1	0.22
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.19	1	U	1	0.19
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	**0.28**	**J**	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.17	0.5	U	0.5	0.17
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.19	0.5	U	0.5	0.19
1,2-Dichloropropane	1	NJPQL	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.18	1	U	1	0.18
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.14	1	U	1	0.14
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19	1	U	1	0.19
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17	1	U	1	0.17
2-Hexanone		NA	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.41	10	U	10	0.41
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.17	1	U	1	0.17
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.33	1	U	1	0.33
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.11	1	U	1	0.11
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.18	1	U	1	0.18
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.29	1	U	1	0.29
Toluene	600	Quality Criteria	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.13	1	U	1	0.13
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.22	1	U	1	0.22
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.27	1	U	1	0.27
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**22**		1	0.28	**19**		1	0.28	**20**		1	0.28	**20**		1	0.28	**16**		1	0.17	**8.5**		1	0.17
Trichlorofluoromethane	2000	Quality Criteria	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.21	2	U	2	0.21
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**3.9**		1	0.26	**3.1**		1	0.26	**3**		1	0.26	**2.6**		1	0.26	**2.8**		1	0.28	**2.2**		1	0.28
Vinyl chloride	1	NJPQL	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.22	2	U	2	0.22
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.28	1	U	1	0.28
Explosives																										
1,3-Dinitrobenzene	1	HA	NT				0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.036
2,4-Dinitrotoluene	10	NJPQL	NT				0.2	U	0.2	0.066	0.2	U	0.2	0.066	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.062
2,6-Dinitrotoluene	10	NJPQL	NT				0.2	U	0.2	0.072	0.2	U	0.2	0.072	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.051
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				0.2	U	0.2	0.063	0.2	U	0.2	0.063	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.066
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				0.2	U	0.2	0.088	0.2	U	0.2	0.088	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.065
HMX	400	HA	NT				0.5	U	0.5	0.061	0.5	U	0.5	0.061	0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.037
Nitrobenzene	6	NJPQL	NT				0.2	U	0.2	0.072	0.2	U	0.2	0.072	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.063
2-Nitrotoluene	61	TWRBC	NT				0.2	U	0.2	0.12	0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075
3-Nitrotoluene	61	TWRBC	NT				0.2	U	0.2	0.16	0.2	U	0.2	0.16	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.042
4-Nitrotoluene	61	TWRBC	NT				0.2	U	0.2	0.12	0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075
RDX	0.5	NJPQL	NT				0.5	U	0.5	0.053	0.5	U	0.5	0.053	0.5	U	0.5	0.1	0.5	U	0.5	0.1	0.5	U	0.5	0.037
Tetryl	150	TWRBC	NT				0.2	U	0.2	0.078	0.2	U	0.2	0.078	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.065
1,3,5-Trinitrobenzene	1100	TWRBC	NT				0.2	U	0.2	0.052	0.2	U	0.2	0.052	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.035
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				0.2	U	0.2	0.051	0.2	U	0.2	0.051	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.05

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	DM13-1				DM13-1				DM13-1				DM13-2				DM13-2				DM13-2			
		Date Sampled:	6/30/2008				5/12/2010				2/8/2011				4/26/2004				5/20/2005				7/19/2006			
		Depth Sampled (ft):	11-21				11-21				11-21				7.5-17.5				7.5-17.5				7.5-17.5			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	5	U	5	0.77	10	U	10	1.8	5	U	5	0.5	10	(U)	10	0.66	10	U	10	0.74	10	U	10	0.74
Acetonitrile	120	TWRBC	NT				5	U	5	1.67	NT				20	U	20	2.9	20	R	20	1.5	20	U	20	1.5
Benzene	1	NJMCL, NJPQL	1	U	1	0.059	1	U	1	0.14	1	U	1	0.32	1	U	1	0.2	1	U	1	0.22	1	U	1	0.22
Bromodichloromethane	1	NJPQL	1	U	1	0.031	1	U	1	0.18	1	U	1	0.36	1	U	1	0.2	1	U	1	0.14	1	U	1	0.14
Bromoform	4	Quality Criteria	1	U	1	0.1	5	U	5	1.5	1	U	1	0.47	1	U	1	0.32	1	U	1	0.17	1	U	1	0.17
Bromomethane	10	Quality Criteria	1	U	1	0.29	2	U	2	0.32	1	U	1	0.2	2	U	2	0.16	2	U	2	0.36	2	U	2	0.36
2-Butanone	300	Quality Criteria	5	U	5	0.78	5	U	5	1.6	5	U	5	1.3	10	U	10	0.36	10	U	10	0.39	10	U	10	0.39
Carbon disulfide	700	Quality Criteria	1	U	1	0.045	1	U	1	0.26	1	U	1	0.2	1	U	1	0.21	1	U	1	0.28	1	U	1	0.28
Carbon tetrachloride	1	NJPQL	1	U	1	0.031	1	U	1	0.24	1	U	1	0.2	1	U	1	0.18	1	U	1	0.19	1	U	1	0.19
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.047	1	U	1	0.21	1	U	1	0.49	1	U	1	0.16	1	U	1	0.2	1	U	1	0.2
Chloroethane	3.6	TWRBC	1	U	1	0.15	1	U	1	0.27	1	U	1	0.2	2	U	2	0.22	2	U	2	0.24	2	U	2	0.24
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.041	1	U	1	0.23	1	U	1	0.34	1	U	1	0.21	1	U	1	0.16	1	U	1	0.16
Chloromethane	30	HA	1	U	1	0.11	**0.716**	**J**	1	0.36	1	U	1	0.2	2	U	2	0.26	2	U	2	0.14	2	(U)	2	0.14
Dibromochloromethane	1	NJPQL	1	U	1	0.035	1	U	1	0.18	1	U	1	0.2	1	U	1	0.25	1	U	1	0.19	1	U	1	0.19
Dichlorodifluoromethane	1000	Quality Criteria	1	U	1	0.058	2	U	2	0.26	1	U	1	0.2	2	U	2	0.23	2	U	2	0.25	2	U	2	0.25
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.041	1	U	1	0.24	1	U	1	0.36	1	U	1	0.26	1	U	1	0.21	1	U	1	0.21
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.1	1	U	1	0.22	1	U	1	0.48	1	U	1	0.22	1	U	1	0.16	1	U	1	0.16
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.077	1	U	1	0.28	1	U	1	0.47	1	U	1	0.22	1	U	1	0.18	1	U	1	0.18
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	1	U	1	0.065	1.5	U	1.5	0.45	1	U	1	0.35	0.5	U	0.5	0.25	0.5	U	0.5	0.21	0.5	U	0.5	0.21
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	1	U	1	0.059	1.5	U	1.5	0.53	1	U	1	0.41	0.5	U	0.5	0.24	0.5	U	0.5	0.16	0.5	U	0.5	0.16
1,2-Dichloropropane	1	NJPQL	1	U	1	0.1	1	U	1	0.27	1	U	1	0.46	1	U	1	0.18	1	U	1	0.15	1	U	1	0.15
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.049	1	U	1	0.15	1	U	1	0.31	1	U	1	0.15	1	U	1	0.12	1	U	1	0.12
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.053	1	U	1	0.17	1	U	1	0.29	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.038	1	U	1	0.15	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
2-Hexanone		NA	5	U	5	0.29	5	U	5	0.5	5	U	5	1.9	10	U	10	0.31	10	U	10	0.35	10	U	10	0.35
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	1	U	1	0.036	NT				1	U	1	0.35	1	U	1	0.21	1	U	1	0.18	1	U	1	0.18
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.29	5	U	5	0.5	5	U	5	2.1	5	U	5	0.34	5	U	5	0.32	5	U	5	0.32
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.12	1	U	1	0.27	1	U	1	0.41	1	U	1	0.28	1	U	1	0.19	1	U	1	0.19
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.05	1	U	1	0.24	1	U	1	0.36	1	U	1	0.16	1	U	1	0.13	1	U	1	0.13
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.047	1	U	1	0.23	1	U	1	0.31	1	U	1	0.23	1	U	1	0.22	1	U	1	0.22
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.063	1	U	1	0.17	1	U	1	0.27	1	U	1	0.12	1	U	1	0.19	1	U	1	0.19
Toluene	600	Quality Criteria	1	U	1	0.041	1	U	1	0.19	1	U	1	0.37	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.041	1	U	1	0.29	1	U	1	0.4	1	U	1	0.18	1	U	1	0.21	1	U	1	0.21
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.072	1	U	1	0.26	1	U	1	0.38	1	U	1	0.21	1	U	1	0.22	1	U	1	0.22
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**12**		1	0.058	**11**		1	0.5	**13**		1	0.28	**15**		1	0.22	**5.2**		1	0.28	**8.6**		1	0.28
Trichlorofluoromethane	2000	Quality Criteria	1	U	1	0.067	1	U	1	0.25	1	U	1	0.35	2	U	2	0.25	2	U	2	0.16	2	U	2	0.16
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	NT				**1.68**		1	0.33	**1.7**		1	0.45	**12**		1	0.23	**6.5**		1	0.26	**10**		1	0.26
Vinyl chloride	1	NJPQL	1	U	1	0.062	1	U	1	0.2	1	U	1	0.34	2	U	2	0.26	2	U	2	0.21	2	U	2	0.21
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.097	1	U	1	0.22	2	U	2	0.95	1	U	1	0.45	1	U	1	0.44	1	U	1	0.44
Explosives																										
1,3-Dinitrobenzene	1	HA	NT				NT				NT				NT				NT				NT			
2,4-Dinitrotoluene	10	NJPQL	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	10	NJPQL	NT				NT				NT				NT				NT				NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				NT				NT				NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				NT				NT				NT			
HMX	400	HA	NT				NT				NT				NT				NT				NT			
Nitrobenzene	6	NJPQL	NT				NT				NT				NT				NT				NT			
2-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				NT				NT			
3-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				NT				NT			
4-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				NT				NT			
RDX	0.5	NJPQL	NT				NT				NT				NT				NT				NT			
Tetryl	150	TWRBC	NT				NT				NT				NT				NT				NT			
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				NT				NT				NT				NT			
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				NT				NT				NT				NT				NT			

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	DM13-2				DM13-2				DM13-2				DM13-2				DM13-2				DM13-2			
		Date Sampled:	10/31/2006				3/6/2007				6/22/2007				6/13/2008				5/11/2010				1/28/2011			
		Depth Sampled (ft):	7.5-17.5				7.5-17.5				7.5-17.5				7.5-17.5				7.5-17.5				7.5-17.5			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	10	U	10	0.74	10	U	10	0.74	10	U	10	1.1	5	U	5	0.77	10	U	10	1.8	5	U	5	0.5
Acetonitrile	120	TWRBC	20	U	20	1.5	20	U	20	1.5	20	U	20	3.5	NT				5	U	5	1.67	NT			
Benzene	1	NJMCL, NJPQL	1	U	1	0.22	1	U	1	0.22	1	U	1	0.13	1	U	1	0.059	1	U	1	0.14	1	U	1	0.32
Bromodichloromethane	1	NJPQL	1	U	1	0.14	1	U	1	0.14	1	U	1	0.15	1	U	1	0.031	1	U	1	0.18	1	U	1	0.36
Bromoform	4	Quality Criteria	1	U	1	0.17	1	U	1	0.17	1	U	1	0.64	1	U	1	0.1	1.5	U	1.5	0.5	1	U	1	0.47
Bromomethane	10	Quality Criteria	2	U	2	0.36	2	U	2	0.36	2	U	2	0.41	1	U	1	0.29	2	U	2	0.32	1	U	1	0.2
2-Butanone	300	Quality Criteria	10	U	10	0.39	**0.54**	**J**	10	0.39	10	U	10	0.57	5	U	5	0.78	5	U	5	1.6	5	U	5	1.3
Carbon disulfide	700	Quality Criteria	1	U	1	0.28	1	U	1	0.28	1	U	1	0.13	1	U	1	0.045	1	U	1	0.26	1	U	1	0.2
Carbon tetrachloride	1	NJPQL	1	U	1	0.19	1	U	1	0.19	1	U	1	0.13	1	U	1	0.031	1	U	1	0.24	1	U	1	0.2
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.2	1	U	1	0.2	1	U	1	0.15	1	U	1	0.047	1	U	1	0.21	1	U	1	0.49
Chloroethane	3.6	TWRBC	2	U	2	0.24	2	U	2	0.24	2	U	2	0.29	1	U	1	0.15	1	U	1	0.27	1	U	1	0.2
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.041	1	U	1	0.23	1	U	1	0.34
Chloromethane	30	HA	2	U	2	0.14	2	U	2	0.14	2	U	2	0.3	1	U	1	0.11	**0.403**	**J**	1	0.36	1	U	1	0.2
Dibromochloromethane	1	NJPQL	1	U	1	0.19	1	U	1	0.19	1	U	1	0.18	1	U	1	0.035	1	U	1	0.18	1	U	1	0.2
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.25	2	U	2	0.25	2	U	2	0.31	1	U	1	0.058	2	U	2	0.26	1	U	1	0.2
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.21	1	U	1	0.21	1	U	1	0.15	1	U	1	0.041	1	U	1	0.24	1	U	1	0.36
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.16	1	U	1	0.16	1	U	1	0.22	1	U	1	0.1	1	U	1	0.22	1	U	1	0.48
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.18	1	U	1	0.18	1	U	1	0.19	1	U	1	0.077	1	U	1	0.28	1	U	1	0.47
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.17	1	U	1	0.065	1.5	U	1.5	0.45	1	U	1	0.35
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.19	1	U	1	0.059	1.5	U	1.5	0.53	1	U	1	0.41
1,2-Dichloropropane	1	NJPQL	1	U	1	0.15	1	U	1	0.15	1	U	1	0.18	1	U	1	0.1	1	U	1	0.27	1	U	1	0.46
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.12	1	U	1	0.12	1	U	1	0.14	1	U	1	0.049	1	U	1	0.15	1	U	1	0.31
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19	1	U	1	0.053	1	U	1	0.17	1	U	1	0.29
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17	1	U	1	0.038	1	U	1	0.15	1	U	1	0.2
2-Hexanone		NA	10	U	10	0.35	10	U	10	0.35	10	U	10	0.41	5	U	5	0.29	5	U	5	0.5	5	U	5	1.9
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	1	U	1	0.18	1	U	1	0.18	1	U	1	0.17	1	U	1	0.036	NT				1	U	1	0.35
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.29	5	U	5	0.5	5	U	5	2.1
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.19	1	U	1	0.19	1	U	1	0.33	1	U	1	0.12	1	U	1	0.27	1	U	1	0.41
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.13	1	U	1	0.13	1	U	1	0.11	1	U	1	0.05	1	U	1	0.24	1	U	1	0.36
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.22	1	U	1	0.22	1	U	1	0.18	1	U	1	0.047	1	U	1	0.23	1	U	1	0.31
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.19	1	U	1	0.19	1	U	1	0.29	1	U	1	0.063	1	U	1	0.17	1	U	1	0.27
Toluene	600	Quality Criteria	1	U	1	0.17	1	U	1	0.17	1	U	1	0.13	1	U	1	0.041	1	U	1	0.19	1	U	1	0.37
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.21	1	U	1	0.21	1	U	1	0.22	1	U	1	0.041	1	U	1	0.29	1	U	1	0.4
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.22	1	U	1	0.22	1	U	1	0.27	1	U	1	0.072	1	U	1	0.26	1	U	1	0.38
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**0.77**	**J**	1	0.28	**0.4**	**J**	1	0.28	**2.6**		1	0.17	**4.9**		1	0.058	**14.3**		1	0.5	**15**		1	0.28
Trichlorofluoromethane	2000	Quality Criteria	2	U	2	0.16	2	U	2	0.16	2	U	2	0.21	1	U	1	0.067	1	U	1	0.25	1	U	1	0.35
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**1.2**		1	0.26	**1.4**		1	0.26	**3.8**		1	0.28	NT				**11.1**		1	0.33	**11**		1	0.45
Vinyl chloride	1	NJPQL	2	U	2	0.21	2	U	2	0.21	2	U	2	0.22	1	U	1	0.062	1	U	1	0.2	1	U	1	0.34
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.44	1	U	1	0.44	1	U	1	0.28	1	U	1	0.097	1	U	1	0.22	2	U	2	0.95
Explosives																										
1,3-Dinitrobenzene	1	HA	0.2	U	0.2	0.06	0.2	U	0.2	0.07	0.2	U	0.2	0.07	NT				NT				NT			
2,4-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.066	0.2	U	0.2	0.08	0.2	U	0.2	0.08	NT				NT				NT			
2,6-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.072	0.2	U	0.2	0.08	0.2	U	0.2	0.08	NT				NT				NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.063	0.2	U	0.2	0.06	0.2	U	0.2	0.06	NT				NT				NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.088	0.2	U	0.2	0.09	0.2	U	0.2	0.09	NT				NT				NT			
HMX	400	HA	0.5	U	0.5	0.061	0.5	U	0.5	0.07	0.5	U	0.5	0.07	NT				NT				NT			
Nitrobenzene	6	NJPQL	0.2	U	0.2	0.072	0.2	U	0.2	0.07	0.2	U	0.2	0.07	NT				NT				NT			
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	NT				NT				NT			
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.16	0.2	U	0.2	0.1	0.2	U	0.2	0.1	NT				NT				NT			
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	NT				NT				NT			
RDX	0.5	NJPQL	0.5	U	0.5	0.053	0.5	U	0.5	0.1	0.5	U	0.5	0.1	NT				NT				NT			
Tetryl	150	TWRBC	0.2	U	0.2	0.078	0.2	U	0.2	0.08	0.2	U	0.2	0.08	NT				NT				NT			
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.052	0.2	U	0.2	0.08	0.2	U	0.2	0.08	NT				NT				NT			
2,4,6-Trinitrotoluene	1.2	Quality Criteria	0.2	U	0.2	0.051	0.2	U	0.2	0.1	0.2	U	0.2	0.1	NT				NT				NT			

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																							
		Sample ID:	DM13-3				DM13-3				DM13-3				DM13-3				DM13-3				DM13-3			
		Date Sampled:	4/26/2004				5/10/2005				7/19/2006				11/2/2006				3/6/2007				6/21/2007			
		Depth Sampled (ft):	12.5-22.5				12.5-22.5				12.5-22.5				12.5-22.5				12.5-22.5				12.5-22.5			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	6000	Quality Criteria	10	(U)	10	0.66	10	U	10	0.74	10	U	10	0.74	10	U	10	0.74	10	U	10	0.74	10	U	10	1.1
Acetonitrile	120	TWRBC	20	U	20	2.9	20	R	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	3.5
Benzene	1	NJMCL, NJPQL	1	U	1	0.2	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.13
Bromodichloromethane	1	NJPQL	1	U	1	0.2	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.15
Bromoform	4	Quality Criteria	1	U	1	0.32	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.64
Bromomethane	10	Quality Criteria	2	U	2	0.16	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.41
2-Butanone	300	Quality Criteria	10	U	10	0.36	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.57
Carbon disulfide	700	Quality Criteria	1	U	1	0.21	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.13
Carbon tetrachloride	1	NJPQL	1	U	1	0.18	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.13
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.16	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.15
Chloroethane	3.6	TWRBC	2	U	2	0.22	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.29
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.21	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	30	HA	2	U	2	0.26	2	U	2	0.14	2	(U)	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.3
Dibromochloromethane	1	NJPQL	1	U	1	0.25	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.18
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.23	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.31
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.26	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.15
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.22	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.22
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.22	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.19
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.25	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.17
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.24	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.19
1,2-Dichloropropane	1	NJPQL	1	U	1	0.18	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.18
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.15	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.14
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17
2-Hexanone		NA	10	U	10	0.31	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.41
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	1	U	1	0.21	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.17
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.34	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.28	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.33
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.16	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.11
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.23	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.18
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.12	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.29
Toluene	600	Quality Criteria	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.13
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.18	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.22
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.21	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.27
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	**0.22**	**J**	1	0.22	1	U	1	0.28	**0.3**	**J**	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.17
Trichlorofluoromethane	2000	Quality Criteria	2	U	2	0.25	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.21
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**2.3**		1	0.23	**2.2**		1	0.26	**1.2**		1	0.26	**1.7**		1	0.26	**1.9**		1	0.26	1	U	1	0.28
Vinyl chloride	1	NJPQL	2	U	2	0.26	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.22
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.45	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.28
Explosives																										
1,3-Dinitrobenzene	1	HA	NT				NT				NT				0.2	U	0.2	0.06	0.2	U	0.2	0.07	0.2	U	0.2	0.07
2,4-Dinitrotoluene	10	NJPQL	NT				NT				NT				0.2	U	0.2	0.066	0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,6-Dinitrotoluene	10	NJPQL	NT				NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.08	0.2	U	0.2	0.08
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				0.2	U	0.2	0.063	0.2	U	0.2	0.06	0.2	U	0.2	0.06
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				0.2	U	0.2	0.088	0.2	U	0.2	0.09	0.2	U	0.2	0.09
HMX	400	HA	NT				NT				NT				0.5	U	0.5	0.061	0.5	U	0.5	0.07	0.5	U	0.5	0.07
Nitrobenzene	6	NJPQL	NT				NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.07	0.2	U	0.2	0.07
2-Nitrotoluene	61	TWRBC	NT				NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2
3-Nitrotoluene	61	TWRBC	NT				NT				NT				0.2	U	0.2	0.16	0.2	U	0.2	0.1	0.2	U	0.2	0.1
4-Nitrotoluene	61	TWRBC	NT				NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2
RDX	0.5	NJPQL	NT				NT				NT				0.5	U	0.5	0.053	0.5	U	0.5	0.1	0.5	U	0.5	0.1
Tetryl	150	TWRBC	NT				NT				NT				0.2	U	0.2	0.078	0.2	U	0.2	0.08	0.2	U	0.2	0.08
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				NT				0.2	U	0.2	0.052	0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				NT				NT				0.2	U	0.2	0.051	0.2	U	0.2	0.1	0.2	U	0.2	0.1

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results																			
		Sample ID:	DM13-3				DM13-3				DM13-3				DM13-3				MW-2N			
		Date Sampled:	10/18/2007				6/13/2008				5/11/2010				1/25/2011				7/3/2008			
		Depth Sampled (ft):	12.5-22.5				12.5-22.5				12.5-22.5				12.5-22.5				--			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																						
Acetone	6000	Quality Criteria	10	U	10	1.1	5	U	5	0.77	10	U	10	1.8	5	U	5	0.5	NT			
Acetonitrile	120	TWRBC	20	U	20	3.5	NT				5	U	5	1.67	NT				NT			
Benzene	1	NJMCL, NJPQL	1	U	1	0.13	1	U	1	0.059	1	U	1	0.14	1	U	1	0.32	NT			
Bromodichloromethane	1	NJPQL	1	U	1	0.15	1	U	1	0.031	1	U	1	0.18	1	U	1	0.36	NT			
Bromoform	4	Quality Criteria	1	U	1	0.64	1	U	1	0.1	1.5	U	1.5	0.5	1	U	1	0.47	NT			
Bromomethane	10	Quality Criteria	2	U	2	0.41	1	U	1	0.29	2	U	2	0.32	1	U	1	0.2	NT			
2-Butanone	300	Quality Criteria	10	U	10	0.57	5	U	5	0.78	5	U	5	1.6	5	U	5	1.3	NT			
Carbon disulfide	700	Quality Criteria	1	U	1	0.13	1	U	1	0.045	1	U	1	0.26	1	U	1	0.2	NT			
Carbon tetrachloride	1	NJPQL	1	U	1	0.13	1	U	1	0.031	1	U	1	0.24	1	U	1	0.2	NT			
Chlorobenzene	50	NJMCL, Quality Criteria	1	U	1	0.15	1	U	1	0.047	1	U	1	0.21	1	U	1	0.49	NT			
Chloroethane	3.6	TWRBC	2	U	2	0.29	1	U	1	0.15	1	U	1	0.27	1	U	1	0.2	NT			
Chloroform	70	Quality Criteria, MCLG	1	U	1	0.16	1	U	1	0.041	**0.281**	**J**	1	0.23	1	U	1	0.34	NT			
Chloromethane	30	HA	2	U	2	0.3	1	U	1	0.11	**0.534**	**J**	1	0.36	1	U	1	0.2	NT			
Dibromochloromethane	1	NJPQL	1	U	1	0.18	1	U	1	0.035	1	U	1	0.18	1	U	1	0.2	NT			
Dichlorodifluoromethane	1000	Quality Criteria	2	U	2	0.31	1	U	1	0.058	2	U	2	0.26	1	U	1	0.2	NT			
1,1-Dichloroethane	50	NJMCL, Quality Criteria	1	U	1	0.15	1	U	1	0.041	1	U	1	0.24	1	U	1	0.36	NT			
1,2-Dichloroethane	2	NJMCL, NJPQL	1	U	1	0.22	1	U	1	0.1	1	U	1	0.22	1	U	1	0.48	NT			
1,1-Dichloroethene	1	Quality Criteria, NJPQL	1	U	1	0.19	1	U	1	0.077	1	U	1	0.28	1	U	1	0.47	NT			
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.17	1	U	1	0.065	1.5	U	1.5	0.45	1	U	1	0.35	NT			
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	0.5	U	0.5	0.19	1	U	1	0.059	1.5	U	1.5	0.53	1	U	1	0.41	NT			
1,2-Dichloropropane	1	NJPQL	1	U	1	0.18	1	U	1	0.1	1	U	1	0.27	1	U	1	0.46	NT			
cis-1,3-Dichloropropene	1	NJPQL	1	U	1	0.14	1	U	1	0.049	1	U	1	0.15	1	U	1	0.31	NT			
trans-1,3-Dichloropropene	1	NJPQL	1	U	1	0.19	1	U	1	0.053	1	U	1	0.17	1	U	1	0.29	NT			
Ethyl benzene	700	MCL, Quality Criteria, MCLG	1	U	1	0.17	1	U	1	0.038	1	U	1	0.15	1	U	1	0.2	NT			
2-Hexanone		NA	10	U	10	0.41	5	U	5	0.29	5	U	5	0.5	5	U	5	1.9	NT			
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	1	U	1	0.17	1	U	1	0.036	NT				1	U	1	0.35	NT			
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.32	5	U	5	0.29	5	U	5	0.5	5	U	5	2.1	NT			
Methylene chloride	3	NJMCL, Quality Criteria	1	U	1	0.33	1	U	1	0.12	1	U	1	0.27	1	U	1	0.41	NT			
Styrene	100	MCL, Quality Criteria, MCLG	1	U	1	0.11	1	U	1	0.05	1	U	1	0.24	1	U	1	0.36	NT			
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.18	1	U	1	0.047	1	U	1	0.23	1	U	1	0.31	NT			
Tetrachloroethene	1	NJMCL, NJPQL	1	U	1	0.29	1	U	1	0.063	1	U	1	0.17	1	U	1	0.27	NT			
Toluene	600	Quality Criteria	1	U	1	0.13	1	U	1	0.041	1	U	1	0.19	1	U	1	0.37	NT			
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	1	U	1	0.22	1	U	1	0.041	1	U	1	0.29	1	U	1	0.4	NT			
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	1	U	1	0.27	1	U	1	0.072	1	U	1	0.26	1	U	1	0.38	NT			
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	1	U	1	0.17	1	U	1	0.058	1	U	1	0.5	1	U	1	0.28	NT			
Trichlorofluoromethane	2000	Quality Criteria	2	U	2	0.21	1	U	1	0.067	1	U	1	0.25	1	U	1	0.35	NT			
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**0.38**	**J**	1	0.28	NT				**1.95**		1	0.33	**0.6**	**J**	1	0.45	NT			
Vinyl chloride	1	NJPQL	2	U	2	0.22	1	U	1	0.062	1	U	1	0.2	1	U	1	0.34	NT			
Total Xylenes	1000	NJMCL, Quality Criteria	1	U	1	0.28	1	U	1	0.097	1	U	1	0.22	2	U	2	0.95	NT			
Explosives																						
1,3-Dinitrobenzene	1	HA	0.2	U	0.2	0.036	NT				NT				NT				0.25	U	0.25	0.04
2,4-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.062	NT				NT				NT				0.25	U	0.25	0.0097
2,6-Dinitrotoluene	10	NJPQL	0.2	U	0.2	0.051	NT				NT				NT				0.25	U	0.25	0.017
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.066	NT				NT				NT				0.25	U	0.25	0.018
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.065	NT				NT				NT				0.25	U	0.25	0.022
HMX	400	HA	0.5	U	0.5	0.037	NT				NT				NT				0.25	U	0.25	0.018
Nitrobenzene	6	NJPQL	0.2	U	0.2	0.063	NT				NT				NT				0.25	U	0.25	0.04
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.075	NT				NT				NT				0.25	U	0.25	0.017
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.042	NT				NT				NT				0.25	U	0.25	0.017
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.075	NT				NT				NT				0.25	U	0.25	0.026
RDX	0.5	NJPQL	0.5	U	0.5	0.037	NT				NT				NT				0.25	U	0.25	0.017
Tetryl	150	TWRBC	0.2	U	0.2	0.065	NT				NT				NT				0.25	U	0.25	0.04
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.035	NT				NT				NT				0.25	U	0.25	0.011
2,4,6-Trinitrotoluene	1.2	Quality Criteria	0.2	U	0.2	0.05	NT				NT				NT				0.25	U	0.25	0.012

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

			Analytical Results															
		Sample ID:	13MW14-128				13MW14-128DUP				13MW14-270				13MW14-325			
		Date Sampled:	1/30/2013				1/30/2013				1/30/2013				1/30/2013			
		Depth Sampled (ft):	128				128				270				11/20/1900			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																		
Acetone	6000	Quality Criteria	2.5	U	2.5	10	2.5	U	2.5	10	2.5	U	2.5	10	2.5	U	2.5	10
Acetonitrile	120	TWRBC	NT				NT				NT				NT			
Benzene	1	NJMCL, NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Bromodichloromethane	1	NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Bromoform	4	Quality Criteria	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Bromomethane	10	Quality Criteria	0.5	U	0.5	2	0.5	U	0.5	2	0.5	U	0.5	2	0.5	U	0.5	2
2-Butanone	300	Quality Criteria	2.5	U	2.5	10	2.5	U	2.5	10	2.5	U	2.5	10	2.5	U	2.5	10
Carbon disulfide	700	Quality Criteria	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Carbon tetrachloride	1	NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Chlorobenzene	50	NJMCL, Quality Criteria	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Chloroethane	3.6	TWRBC	0.5	U	0.5	2	0.5	U	0.5	2	0.5	U	0.5	2	0.5	U	0.5	2
Chloroform	70	Quality Criteria, MCLG	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Chloromethane	30	HA	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Dibromochloromethane	1	NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Dichlorodifluoromethane	1000	Quality Criteria	0.5	U	0.5	2	0.5	U	0.5	2	0.5	U	0.5	2	0.5	U	0.5	2
1,1-Dichloroethane	50	NJMCL, Quality Criteria	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
1,2-Dichloroethane	2	NJMCL, NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
1,1-Dichloroethene	1	Quality Criteria, NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
cis-1,2-Dichloroethene	70	MCL, Quality Criteria, MCLG	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
trans-1,2-Dichloroethene	100	MCL, Quality Criteria, MCLG	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
1,2-Dichloropropane	1	NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
cis-1,3-Dichloropropene	1	NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
trans-1,3-Dichloropropene	1	NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Ethyl benzene	700	MCL, Quality Criteria, MCLG	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
2-Hexanone		NA	1.25	U	1.25	5	1.25	U	1.25	5	1.25	U	1.25	5	1.25	U	1.25	5
Methyl tert-Butyl ether	70	NJMCL, Quality Criteria	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	1.25	U	1.25	5	1.25	U	1.25	5	1.25	U	1.25	5	1.25	U	1.25	5
Methylene chloride	3	NJMCL, Quality Criteria	0.5	U	0.5	2	0.5	U	0.5	2	0.5	U	0.5	2	0.5	U	0.5	2
Styrene	100	MCL, Quality Criteria, MCLG	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
1,1,2,2-Tetrachloroethane	1	NJMCL, Quality Criteria, NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Tetrachloroethene	1	NJMCL, NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Toluene	600	Quality Criteria	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
1,1,1-Trichloroethane	30	NJMCL, Quality Criteria	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
1,1,2-Trichloroethane	3	NJMCL, Quality Criteria, MCLG	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Trichloroethene	1	NJMCL, Quality Criteria, NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Trichlorofluoromethane	2000	Quality Criteria	0.5	U	0.5	2	0.5	U	0.5	2	0.5	U	0.5	2	0.5	U	0.5	2
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**40.1**		0.5	2	**41.4**		0.5	2	**34.8**		0.5	2	**10.8**		2.5	2
Vinyl chloride	1	NJPQL	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1	0.25	U	0.25	1
Total Xylenes	1000	NJMCL, Quality Criteria	0.5	U	0.5	2	0.5	U	0.5	2	0.5	U	0.5	2	0.5	U	0.5	2
Explosives																		
1,3-Dinitrobenzene	1	HA	NT				NT				NT				NT			
2,4-Dinitrotoluene	10	NJPQL	NT				NT				NT				NT			
2,6-Dinitrotoluene	10	NJPQL	NT				NT				NT				NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				NT			
HMX	400	HA	NT				NT				NT				NT			
Nitrobenzene	6	NJPQL	NT				NT				NT				NT			
2-Nitrotoluene	61	TWRBC	NT				NT				NT				NT			
3-Nitrotoluene	61	TWRBC	NT				NT				NT				NT			
4-Nitrotoluene	61	TWRBC	NT				NT				NT				NT			
RDX	0.5	NJPQL	NT				NT				NT				NT			
Tetryl	150	TWRBC	NT				NT				NT				NT			
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				NT				NT			
2,4,6-Trinitrotoluene	1.2	Quality Criteria	NT				NT				NT				NT			

Table 4-1
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Ground Water (µg/L)

(a) See the "ARARs and Other Guidance to be Considered for Picatinny Arsenal Groundwater" table (**Table 7-2**) for a complete list of LOC values. Groundwater samples were compared to the lower of the Federal MCLs, the New Jersey State MCLs, the New Jersey Groundwater Quality Criteria or PQLs (whichever is higher), or any non-zero Federal MCLG. If the above are not available, groundwater comparison criteria are based on the lower of the following TBC: Federal Drinking Water Health Advisories or USEPA Region III Tap Water (noncarcinogenic or carcinogenic 10^{-6}) RBCs.

Bolded values indicate a detection.
Bolded and shaded values indicate the detected result is above the Level of Concern (LOC).
HA = Federal Drinking Water Health Advisories
MCL = Federal Maximum Contaminant Level
MCLG = Federal Maximum Contaminant Level Goal
NA = No value available.
NJMCL = New Jersey State Maximum Contaminant Level
NJPQL = New Jersey State Practical Quantitation Limit
NT = Not tested.
Q = Flags/Qualifiers (QA/QC):
COL = More than 40% RPD between primary and confirmatory detector results.
D = Result was obtained from the analysis of a dilution.
J = Detect, value is an estimate.
N = The matrix spikes are outside of precision and/or accuracy criteria.
R = Rejected result, value should not be used for any purpose.
U = Non-detect, value is the detection limit.
(U) = Non-detect, chemical was detected in blank.
UJ = Non-detect, value is an estimated detection limit.
Quality Criteria = New Jersey Groundwater Quality Criteria
RL/EQL = Reporting Limit / Estimated Quantitation Limit
SQL = Sample Quantitation Limit
TWRBC = USEPA Region III Tap Water Risk Based Concentration

Table 4-2
Groundwater Data Tally Table

Compound	Frequency of Detection	Range of Detected Concentrations	Location of Maximum Concentration	LOC	LOC Source	UOM	Exceed LOC?	Number of Hits Exceeding LOC
Acetone	11 / 124	1.4 / 19.7	13MW-13 04/20/2010	6000	Quality Criteria	µg/L	No	--
Acetonitrile	2 / 91	2.5 / 55	13MW-7 03/06/2007	120	TWRBC	µg/L	No	--
Benzene	0 / 124	--	--	1	NJMCL, NJPQL	µg/L	No	--
Bromodichloromethane	1 / 124	0.228 / 0.228	13MW-11 04/21/2010	1	NJPQL	µg/L	No	--
Bromoform	0 / 124	--	--	4	Quality Criteria	µg/L	No	--
Bromomethane	1 / 124	0.77 / 0.77	13MW-8 03/05/2007	10	Quality Criteria	µg/L	No	--
2-Butanone	8 / 124	0.54 / 3.8	13MW-10 06/17/2008	300	Quality Criteria	µg/L	No	--
Carbon disulfide	6 / 124	0.43 / 1	13MW-4 07/24/2006	700	Quality Criteria	µg/L	No	--
Carbon tetrachloride	0 / 124	--	--	1	NJPQL	µg/L	No	--
Chlorobenzene	0 / 124	--	--	50	NJMCL, Quality Criteria	µg/L	No	--
Chloroethane	0 / 124	--	--	3.6	TWRBC	µg/L	No	--
Chloroform	2 / 124	0.281 / 43	13MW-1 10/24/2007	70	Quality Criteria, MCLG	µg/L	No	--
Chloromethane	15 / 124	0.2 / 1.73	13MW-8 03/05/2007	30	HA	µg/L	No	--
Dibromochloromethane	0 / 124	--	--	1	NJPQL	µg/L	No	--
Dichlorodifluoromethane	2 / 124	2.22 / 2.8	13MW-2 02/08/2011	1000	Quality Criteria	µg/L	No	--
1,1-Dichloroethane	0 / 124	--	--	50	NJMCL, Quality Criteria	µg/L	No	--
1,2-Dichloroethane	1 / 124	20 / 20	13MW-1 10/24/2007	2	NJMCL, NJPQL	µg/L	**Yes**	1
1,1-Dichloroethene	0 / 124	--	--	1	Quality Criteria, NJPQL	µg/L	No	--
cis-1,2-Dichloroethene	15 / 124	0.23 / 4.51	13MW-4 04/21/2010	70	MCL, Quality Criteria, MCLG	µg/L	No	--
trans-1,2-Dichloroethene	3 / 124	0.38 / 0.59	13MW-2 02/08/2011	100	MCL, Quality Criteria, MCLG	µg/L	No	--
1,2-Dichloropropane	0 / 124	--	--	1	NJPQL	µg/L	No	--
cis-1,3-Dichloropropene	0 / 124	--	--	1	NJPQL	µg/L	No	--
trans-1,3-Dichloropropene	0 / 124	--	--	1	NJPQL	µg/L	No	--
Ethyl benzene	0 / 124	--	--	700	MCL, Quality Criteria, MCLG	µg/L	No	--
2-Hexanone	3 / 124	0.58 / 0.62	13MW-8 06/20/2007		NLA	µg/L	No	--
Methyl tert-Butyl ether	25 / 115	0.28 / 140	13MW-5 10/31/2006	70	NJMCL, Quality Criteria	µg/L	**Yes**	2
4-Methyl-2-pentanone (MIBK)	0 / 124	--	--	6300	TWRBC	µg/L	No	--
Methylene chloride	3 / 124	0.504 / 15	13MW-5 06/14/2007	3	NJMCL, Quality Criteria	µg/L	**Yes**	1
Styrene	0 / 124	--	--	100	MCL, Quality Criteria, MCLG	µg/L	No	--

Table 4-2
Groundwater Data Tally Table

Compound	Frequency of Detection	Range of Detected Concentrations	Location of Maximum Concentration	LOC	LOC Source	UOM	Exceed LOC?	Number of Hits Exceeding LOC
1,1,2,2-Tetrachloroethane	1 / 124	5.1 / 5.1	13MW-1 10/24/2007	1	NJMCL, Quality Criteria, NJPQL	µg/L	**Yes**	1
Tetrachloroethene	8 / 124	0.23 / 2.2	13MW-1 07/31/2006	1	NJMCL, NJPQL	µg/L	**Yes**	1
Toluene	12 / 124	0.17 / 8	13MW-4 05/09/2005	600	Quality Criteria	µg/L	No	--
1,1,1-Trichloroethane	4 / 124	0.25 / 0.519	13MW-1 05/10/2010	30	NJMCL, Quality Criteria	µg/L	No	--
1,1,2-Trichloroethane	0 / 124	--	--	3	NJMCL, Quality Criteria, MCLG	µg/L	No	--
Trichloroethene	74 / 124	0.22 / 210	13MW-2 02/08/2011	1	NJMCL, Quality Criteria, NJPQL	µg/L	**Yes**	67
Trichlorofluoromethane	1 / 124	0.278 / 0.278	13MW-7 05/11/2011	2000	Quality Criteria	µg/L	No	--
1,1,2-Trichloro-1,2,2-trifluoroethane	97 / 124	0.31 / 2750	13MW-13 04/20/2010	59000	TWRBC	µg/L	No	--
Vinyl chloride	1 / 124	0.24 / 0.24	13MW-4 07/24/2006	1	NJPQL	µg/L	No	--
Total Xylenes	0 / 124	--	--	1000	NJMCL, Quality Criteria	µg/L	No	--
1,3-Dinitrobenzene	3 / 68	0.07 / 0.25	13MW-8 06/20/2007	1	HA	µg/L	No	--
2,4-Dinitrotoluene	2 / 68	0.15 / 0.88	13MW-4 10/22/2007	10	NJPQL	µg/L	No	--
2,6-Dinitrotoluene	1 / 68	0.2 / 0.2	13MW-4 10/22/2007	10	NJPQL	µg/L	No	--
2-amino-4,6-Dinitrotoluene	2 / 68	0.066 / 0.15	13MW-8 06/20/2007	73	TWRBC	µg/L	No	--
4-amino-2,6-Dinitrotoluene	3 / 68	0.091 / 0.16	13MW-8 10/24/2007	73	TWRBC	µg/L	No	--
HMX	18 / 68	0.073 / 0.33	13MW-5 07/26/2006	400	HA	µg/L	No	--
Nitrobenzene	1 / 68	1.1 / 1.1	13MW-8 10/24/2007	6	NJPQL	µg/L	No	--
2-Nitrotoluene	1 / 68	0.68 / 0.68	13MW-4 10/22/2007	61	TWRBC	µg/L	No	--
3-Nitrotoluene	1 / 68	0.16 / 0.16	13MW-7 10/31/2006	61	TWRBC	µg/L	No	--
4-Nitrotoluene	1 / 68	0.88 / 0.88	13MW-4 10/22/2007	61	TWRBC	µg/L	No	--
RDX	28 / 68	0.11 / 1.1	13MW-5 07/26/2006	0.5	NJPQL	µg/L	**Yes**	5
Tetryl	1 / 68	0.42 / 0.42	13MW-8 10/24/2007	150	TWRBC	µg/L	No	--
1,3,5-Trinitrobenzene	1 / 68	0.061 / 0.061	13MW-4 11/01/2006	1100	TWRBC	µg/L	No	--
2,4,6-Trinitrotoluene	2 / 68	0.11 / 0.3	13MW-1 11/01/2006	1.2	Quality Criteria	µg/L	No	--

Table 4-3
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Water (µg/L)

			Analytical Results																											
		Sample ID:	11SW-1				11SW-1				11SW-1				11SW-1				11SW-1				11SW-1				11SW-1			
		Date Sampled:	11/9/2004				1/11/2006				8/10/2006				10/30/2006				3/30/2007				6/25/2007				10/16/2007			
		Depth Sampled (ft):																												
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																														
Acetone	5500	TWRBC	10	(U)	10	0.74	10	U	10	0.74	10	(U)	10	0.74	**3.5**	**J**	10	0.74	**1.2**	**J**	10	0.74	10	(U)	10	1.1	10	(U)	10	1.1
Acetonitrile	120	TWRBC	20	R	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	3.5	20	U	20	3.5
Benzene	0.15	SWQC	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.13	1	U	1	0.13
Bromodichloromethane	0.266	SWQC	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.15	1	U	1	0.15
Bromoform	4.3	Water & Organisms	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.64	1	U	1	0.64
Bromomethane	47	Water & Organisms	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.41	2	U	2	0.41
2-Butanone	7000	TWRBC	10	(U)	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.57	10	U	10	0.57
Carbon disulfide	1000	TWRBC	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.13	1	U	1	0.13
Carbon tetrachloride	0.23	Water & Organisms	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.13	1	U	1	0.13
Chlorobenzene	22	SWQC	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.15	1	U	1	0.15
Chloroethane	3.6	TWRBC	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.29	2	U	2	0.29
Chloroform	5.67	SWQC	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	190	TWRBC	2	U	2	0.14	**0.2**	**J**	2	0.14	2	(U)	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.3	2	U	2	0.3
Dibromochloromethane	0.4	Water & Organisms	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.18	1	U	1	0.18
Dichlorodifluoromethane	350	TWRBC	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.31	2	U	2	0.31
1,1-Dichloroethane	0.291	SWQC	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.15	1	U	1	0.15
1,2-Dichloroethane	0.291	SWQC	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.22	1	U	1	0.22
1,1-Dichloroethene	4.81	SWQC	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.19	1	U	1	0.19
cis-1,2-Dichloroethene	592	SWQC	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.17	0.5	U	0.5	0.17
trans-1,2-Dichloroethene	140	Water & Organisms	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.19	0.5	U	0.5	0.19
1,2-Dichloropropane	0.5	Water & Organisms	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.18	1	U	1	0.18
cis-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.14	1	U	1	0.14
trans-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19	1	U	1	0.19
Ethyl benzene	530	Water & Organisms	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17	1	U	1	0.17
2-Hexanone		NA	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.41	10	U	10	0.41
Methyl tert-Butyl ether	2.6	TWRBC	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	5	U	5	0.17	1	U	1	0.17
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	2.49	SWQC	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.33	1	U	1	0.33
Styrene	1600	TWRBC	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.11	1	U	1	0.11
1,1,2,2-Tetrachloroethane	0.17	Water & Organisms	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.18	1	U	1	0.18
Tetrachloroethene	0.388	SWQC	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.29	1	U	1	0.29
Toluene	1300	Water & Organisms	1	U	1	0.17	1	U	1	0.17	**0.22**	**J**	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.13	1	U	1	0.13
1,1,1-Trichloroethane	127	SWQC	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.22	1	U	1	0.22
1,1,2-Trichloroethane	0.59	Water & Organisms	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.27	1	U	1	0.27
Trichloroethene	1.09	SWQC	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.17	1	U	1	0.17
Trichlorofluoromethane	1300	TWRBC	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.21	2	U	2	0.21
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.28	1	U	1	0.28
Vinyl chloride	0.025	Water & Organisms	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.22	2	U	2	0.22
Total Xylenes	210	TWRBC	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.28	1	U	1	0.28
Explosives																														
1,3-Dinitrobenzene	3.7	TWRBC	NT				NT				NT				0.2	U	0.2	0.06	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.036
2,4-Dinitrotoluene	0.11	Water & Organisms, SWQC	NT				NT				NT				0.2	U	0.2	0.066	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.062
2,6-Dinitrotoluene	37	TWRBC	NT				NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.051
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				0.2	U	0.2	0.063	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.066
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				0.2	U	0.2	0.088	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.065
HMX	1800	TWRBC	NT				NT				NT				**2.1**		0.5	0.061	0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.037
Nitrobenzene	16	SWQC	NT				NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.063
2-Nitrotoluene	61	TWRBC	NT				NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075
3-Nitrotoluene	61	TWRBC	NT				NT				NT				0.2	U	0.2	0.16	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.042
4-Nitrotoluene	61	TWRBC	NT				NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	(U)	0.2	0.075
RDX	0.5	NJPQL	NT				NT				NT				**10**	**D**	1	0.11	**0.31**	**J**	0.5	0.1	0.5	U	0.5	0.1	**0.39**	**J**	0.5	0.037
Tetryl	150	TWRBC	NT				NT				NT				0.2	U	0.2	0.078	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.065
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				NT				0.2	U	0.2	0.052	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.035
2,4,6-Trinitrotoluene	2.2	TWRBC	NT				NT				NT				0.2	U	0.2	0.051	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.05

Table 4-3
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Water (µg/L)

		Sample ID:	Analytical Results																											
		Date Sampled:	11SW-1				11SW-1 DUP				11SW-1				11SW-1 DUP				11SW-2				11SW-2				11SW-2			
		Depth Sampled (ft):	6/24/2008				6/24/2008				4/19/2010				4/19/2010				11/9/2004				1/11/2006				10/30/2006			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																														
Acetone	5500	TWRBC	6.7	(U)	5	0.77	5.6	(U)	5	0.77	**3.81**	**J**	10	1.8	**5.05**	**J**	10	1.8	10	(U)	10	0.74	10	(U)	10	0.74	**1.4**	**J**	10	0.74
Acetonitrile	120	TWRBC	NT				NT				5	U	5	1.67	5	U	5	1.67	20	R	20	1.5	20	U	20	1.5	20	U	20	1.5
Benzene	0.15	SWQC	1	U	1	0.059	1	U	1	0.059	1	U	1	0.14	1	U	1	0.14	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Bromodichloromethane	0.266	SWQC	1	U	1	0.031	1	U	1	0.031	1	U	1	0.18	1	U	1	0.18	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14
Bromoform	4.3	Water & Organisms	1	U	1	0.1	1	U	1	0.1	1.5	U	1.5	0.5	1.5	U	1.5	0.5	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Bromomethane	47	Water & Organisms	1	U	1	0.29	1	U	1	0.29	2	U	2	0.32	2	U	2	0.32	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36
2-Butanone	7000	TWRBC	5	U	5	0.78	5	U	5	0.78	5	U	5	1.6	5	U	5	1.6	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39
Carbon disulfide	1000	TWRBC	1	U	1	0.045	1	U	1	0.045	1	U	1	0.26	1	U	1	0.26	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
Carbon tetrachloride	0.23	Water & Organisms	1	U	1	0.031	1	U	1	0.031	1	U	1	0.24	1	U	1	0.24	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Chlorobenzene	22	SWQC	1	U	1	0.047	1	U	1	0.047	1	U	1	0.21	1	U	1	0.21	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2
Chloroethane	3.6	TWRBC	1	U	1	0.15	1	U	1	0.15	1	U	1	0.27	1	U	1	0.27	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24
Chloroform	5.67	SWQC	1	U	1	0.041	1	U	1	0.041	1	U	1	0.23	1	U	1	0.23	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	190	TWRBC	1	U	1	0.11	1	U	1	0.11	1	U	1	0.36	1	U	1	0.36	2	U	2	0.14	**0.17**	**J**	2	0.14	2	U	2	0.14
Dibromochloromethane	0.4	Water & Organisms	1	U	1	0.035	1	U	1	0.035	1	U	1	0.18	1	U	1	0.18	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Dichlorodifluoromethane	350	TWRBC	1	U	1	0.058	1	U	1	0.058	2	U	2	0.26	2	U	2	0.26	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25
1,1-Dichloroethane	0.291	SWQC	1	U	1	0.041	1	U	1	0.041	1	U	1	0.24	1	U	1	0.24	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
1,2-Dichloroethane	0.291	SWQC	1	U	1	0.1	1	U	1	0.1	1	U	1	0.22	1	U	1	0.22	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
1,1-Dichloroethene	4.81	SWQC	1	U	1	0.077	1	U	1	0.077	1	U	1	0.28	1	U	1	0.28	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
cis-1,2-Dichloroethene	592	SWQC	1	U	1	0.065	1	U	1	0.065	1.5	U	1.5	0.45	1.5	U	1.5	0.45	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21
trans-1,2-Dichloroethene	140	Water & Organisms	1	U	1	0.059	1	U	1	0.059	1.5	U	1.5	0.53	1.5	U	1.5	0.53	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16
1,2-Dichloropropane	0.5	Water & Organisms	1	U	1	0.1	1	U	1	0.1	1	U	1	0.27	1	U	1	0.27	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
cis-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.049	1	U	1	0.049	1	U	1	0.15	1	U	1	0.15	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12
trans-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.053	1	U	1	0.053	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Ethyl benzene	530	Water & Organisms	1	U	1	0.038	1	U	1	0.038	1	U	1	0.15	1	U	1	0.15	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
2-Hexanone		NA	5	U	5	0.29	5	U	5	0.29	5	U	5	0.5	5	U	5	0.5	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35
Methyl tert-Butyl ether	2.6	TWRBC	1	U	1	0.036	1	U	1	0.036	1	U	1	0.25	1	U	1	0.25	**0.36**	**J**	1	0.18	**1.8**		1	0.18	1	U	1	0.18
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.29	5	U	5	0.29	5	U	5	0.5	5	U	5	0.5	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	2.49	SWQC	1	U	1	0.12	1	U	1	0.12	1	U	1	0.27	1	U	1	0.27	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Styrene	1600	TWRBC	1	U	1	0.05	1	U	1	0.05	1	U	1	0.24	1	U	1	0.24	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
1,1,2,2-Tetrachloroethane	0.17	Water & Organisms	1	U	1	0.047	1	U	1	0.047	1	U	1	0.23	1	U	1	0.23	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Tetrachloroethene	0.388	SWQC	1	U	1	0.063	1	U	1	0.063	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Toluene	1300	Water & Organisms	**0.23**	**J**	1	0.041	1	U	1	0.041	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
1,1,1-Trichloroethane	127	SWQC	1	U	1	0.041	1	U	1	0.041	1	U	1	0.29	1	U	1	0.29	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
1,1,2-Trichloroethane	0.59	Water & Organisms	1	U	1	0.072	1	U	1	0.072	1	U	1	0.26	1	U	1	0.26	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Trichloroethene	1.09	SWQC	1	U	1	0.058	1	U	1	0.058	1	U	1	0.5	1	U	1	0.5	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
Trichlorofluoromethane	1300	TWRBC	1	U	1	0.067	1	U	1	0.067	1	U	1	0.25	1	U	1	0.25	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	NT				NT				1	U	1	0.33	1	U	1	0.33	**1.5**		1	0.26	**1.1**		1	0.26	1	U	1	0.26
Vinyl chloride	0.025	Water & Organisms	1	U	1	0.062	1	U	1	0.062	1	U	1	0.2	1	U	1	0.2	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21
Total Xylenes	210	TWRBC	1	U	1	0.097	1	U	1	0.097	1	U	1	0.22	1	U	1	0.22	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44
Explosives																														
1,3-Dinitrobenzene	3.7	TWRBC	0.25	U	0.25	0.04	0.25	U	0.25	0.04	NT				NT				NT				NT				0.2	U	0.2	0.06
2,4-Dinitrotoluene	0.11	Water & Organisms, SWQC	0.25	U	0.25	0.0097	0.25	U	0.25	0.0097	NT				NT				NT				NT				0.2	U	0.2	0.066
2,6-Dinitrotoluene	37	TWRBC	0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT				NT				NT				0.2	U	0.2	0.072
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.25	U	0.25	0.018	0.25	U	0.25	0.018	NT				NT				NT				NT				0.2	U	0.2	0.063
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.25	U	0.25	0.022	0.25	U	0.25	0.022	NT				NT				NT				NT				0.2	U	0.2	0.088
HMX	1800	TWRBC	0.25	U	0.25	0.018	0.25	U	0.25	0.018	NT				NT				NT				NT				**1.2**		0.5	0.061
Nitrobenzene	16	SWQC	0.25	U	0.25	0.04	0.25	U	0.25	0.04	NT				NT				NT				NT				0.2	U	0.2	0.072
2-Nitrotoluene	61	TWRBC	0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT				NT				NT				0.2	U	0.2	0.12
3-Nitrotoluene	61	TWRBC	0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT				NT				NT				0.2	U	0.2	0.16
4-Nitrotoluene	61	TWRBC	0.25	U	0.25	0.026	0.25	U	0.25	0.026	NT				NT				NT				NT				0.2	U	0.2	0.12
RDX	0.5	NJPQL	0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT				NT				NT				**3.7**		0.5	0.053
Tetryl	150	TWRBC	0.25	U	0.25	0.04	0.25	U	0.25	0.04	NT				NT				NT				NT				0.2	U	0.2	0.078
1,3,5-Trinitrobenzene	1100	TWRBC	0.25	U	0.25	0.011	0.25	U	0.25	0.011	NT				NT				NT				NT				0.2	U	0.2	0.052
2,4,6-Trinitrotoluene	2.2	TWRBC	0.25	U	0.25	0.012	0.25	U	0.25	0.012	NT				NT				NT				NT				0.2	U	0.2	0.051

Table 4-3
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Water (µg/L)

			Analytical Results																											
		Sample ID:	11SW-2				11SW-2				11SW-3				11SW-3				11SW-3				11SW-3				11SW-3			
		Date Sampled:	3/30/2007				4/19/2010				11/9/2004				1/11/2006				8/10/2006				10/30/2006				3/30/2007			
		Depth Sampled (ft):																												
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																														
Acetone	5500	TWRBC	10	U	10	0.74	10	U	10	1.8	10	(U)	10	0.74	10	(U)	10	0.74	10	(U)	10	0.74	10	U	10	0.74	10	U	10	0.74
Acetonitrile	120	TWRBC	20	U	20	1.5	5	U	5	1.67	20	R	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5
Benzene	0.15	SWQC	1	U	1	0.22	1	U	1	0.14	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Bromodichloromethane	0.266	SWQC	1	U	1	0.14	1	U	1	0.18	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14
Bromoform	4.3	Water & Organisms	1	U	1	0.17	1.5	U	1.5	0.5	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Bromomethane	47	Water & Organisms	2	U	2	0.36	2	U	2	0.32	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36
2-Butanone	7000	TWRBC	10	U	10	0.39	5	U	5	1.6	10	(U)	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39
Carbon disulfide	1000	TWRBC	1	U	1	0.28	1	U	1	0.26	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
Carbon tetrachloride	0.23	Water & Organisms	1	U	1	0.19	1	U	1	0.24	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Chlorobenzene	22	SWQC	1	U	1	0.2	1	U	1	0.21	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2
Chloroethane	3.6	TWRBC	2	U	2	0.24	1	U	1	0.27	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24
Chloroform	5.67	SWQC	1	U	1	0.16	1	U	1	0.23	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	190	TWRBC	2	U	2	0.14	1	U	1	0.36	2	U	2	0.14	**0.18**	**J**	2	0.14	2	(U)	2	0.14	2	U	2	0.14	2	U	2	0.14
Dibromochloromethane	0.4	Water & Organisms	1	U	1	0.19	1	U	1	0.18	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Dichlorodifluoromethane	350	TWRBC	2	U	2	0.25	2	U	2	0.26	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25
1,1-Dichloroethane	0.291	SWQC	1	U	1	0.21	1	U	1	0.24	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
1,2-Dichloroethane	0.291	SWQC	1	U	1	0.16	1	U	1	0.22	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
1,1-Dichloroethene	4.81	SWQC	1	U	1	0.18	1	U	1	0.28	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
cis-1,2-Dichloroethene	592	SWQC	0.5	U	0.5	0.21	1.5	U	1.5	0.45	**0.43**	**J**	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21
trans-1,2-Dichloroethene	140	Water & Organisms	0.5	U	0.5	0.16	1.5	U	1.5	0.53	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16
1,2-Dichloropropane	0.5	Water & Organisms	1	U	1	0.15	1	U	1	0.27	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
cis-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.12	1	U	1	0.15	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12
trans-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Ethyl benzene	530	Water & Organisms	1	U	1	0.19	1	U	1	0.15	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
2-Hexanone		NA	10	U	10	0.35	5	U	5	0.5	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35
Methyl tert-Butyl ether	2.6	TWRBC	1	U	1	0.18	1	U	1	0.25	**0.98**	**J**	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.32	5	U	5	0.5	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	2.49	SWQC	1	U	1	0.19	1	U	1	0.27	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Styrene	1600	TWRBC	1	U	1	0.13	1	U	1	0.24	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
1,1,2,2-Tetrachloroethane	0.17	Water & Organisms	1	U	1	0.22	1	U	1	0.23	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Tetrachloroethene	0.388	SWQC	1	U	1	0.19	1	U	1	0.17	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Toluene	1300	Water & Organisms	1	U	1	0.17	1	U	1	0.19	**1.2**		1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
1,1,1-Trichloroethane	127	SWQC	1	U	1	0.21	1	U	1	0.29	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
1,1,2-Trichloroethane	0.59	Water & Organisms	1	U	1	0.22	1	U	1	0.26	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Trichloroethene	1.09	SWQC	1	U	1	0.28	1	U	1	0.5	**1.1**		1	0.28	**7.6**		1	0.28	1	U	1	0.28	**2.8**		1	0.28	**4.4**		1	0.28
Trichlorofluoromethane	1300	TWRBC	2	U	2	0.16	1	U	1	0.25	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	1	U	1	0.26	1	U	1	0.33	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	**1.2**		1	0.26	**6.2**		1	0.26
Vinyl chloride	0.025	Water & Organisms	2	U	2	0.21	1	U	1	0.2	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21
Total Xylenes	210	TWRBC	1	U	1	0.44	1	U	1	0.22	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44
Explosives																														
1,3-Dinitrobenzene	3.7	TWRBC	0.2	U	0.2	0.07	NT				NT				NT				NT				0.2	U	0.2	0.06	0.2	U	0.2	0.07
2,4-Dinitrotoluene	0.11	Water & Organisms, SWQC	0.2	U	0.2	0.08	NT				NT				NT				NT				0.2	U	0.2	0.066	0.2	U	0.2	0.08
2,6-Dinitrotoluene	37	TWRBC	0.2	U	0.2	0.08	NT				NT				NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.08
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.06	NT				NT				NT				NT				0.2	U	0.2	0.063	0.2	U	0.2	0.06
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.09	NT				NT				NT				NT				0.2	U	0.2	0.088	0.2	U	0.2	0.09
HMX	1800	TWRBC	**0.17**	**J**	0.5	0.07	NT				NT				NT				NT				**1.2**		0.5	0.061	**0.46**	**J**	0.5	0.07
Nitrobenzene	16	SWQC	0.2	U	0.2	0.07	NT				NT				NT				NT				**0.092**	**J**	0.2	0.072	0.2	U	0.2	0.07
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	NT				NT				NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.1	NT				NT				NT				NT				0.2	U	0.2	0.16	0.2	U	0.2	0.1
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	NT				NT				NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2
RDX	0.5	NJPQL	**0.86**		0.5	0.1	NT				NT				NT				NT				**0.22**	**J**	0.5	0.053	**0.26**	**J**	0.5	0.1
Tetryl	150	TWRBC	0.2	U	0.2	0.08	NT				NT				NT				NT				0.2	U	0.2	0.078	0.2	U	0.2	0.08
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.08	NT				NT				NT				NT				0.2	U	0.2	0.052	0.2	U	0.2	0.08
2,4,6-Trinitrotoluene	2.2	TWRBC	0.2	U	0.2	0.1	NT				NT				NT				NT				0.2	U	0.2	0.051	0.2	U	0.2	0.1

Table 4-3
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Water (µg/L)

			Analytical Results																											
		Sample ID:	11SW-3				11SW-3				11SW-3				11SW-3				11SW-3				13SW-4				13SW-4			
		Date Sampled:	6/25/2007				10/15/2007				6/24/2008				4/19/2010				1/24/2011				11/9/2004				1/11/2006			
		Depth Sampled (ft):																												
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																														
Acetone	5500	TWRBC	10	U	10	1.1	10	U	10	1.1	5	U	5	0.77	**4.01**	**J**	10	1.8	5	U	5	0.5	10	(U)	10	0.74	10	(U)	10	0.74
Acetonitrile	120	TWRBC	20	U	20	3.5	20	U	20	3.5	NT				5	U	5	1.67	NT				20	R	20	1.5	20	U	20	1.5
Benzene	0.15	SWQC	1	U	1	0.13	1	U	1	0.13	1	U	1	0.059	1	U	1	0.14	1	U	1	0.32	1	U	1	0.22	1	U	1	0.22
Bromodichloromethane	0.266	SWQC	1	U	1	0.15	1	U	1	0.15	1	U	1	0.031	1	U	1	0.18	1	U	1	0.36	1	U	1	0.14	1	U	1	0.14
Bromoform	4.3	Water & Organisms	1	U	1	0.64	1	U	1	0.64	1	U	1	0.1	1.5	U	1.5	0.5	1	U	1	0.47	1	U	1	0.17	1	U	1	0.17
Bromomethane	47	Water & Organisms	2	U	2	0.41	2	U	2	0.41	1	U	1	0.29	2	U	2	0.32	1	U	1	0.2	2	U	2	0.36	2	U	2	0.36
2-Butanone	7000	TWRBC	10	U	10	0.57	10	U	10	0.57	5	U	5	0.78	5	U	5	1.6	5	U	5	1.3	10	(U)	10	0.39	10	U	10	0.39
Carbon disulfide	1000	TWRBC	1	U	1	0.13	1	U	1	0.13	1	U	1	0.045	1	U	1	0.26	1	U	1	0.2	1	U	1	0.28	1	U	1	0.28
Carbon tetrachloride	0.23	Water & Organisms	1	U	1	0.13	1	U	1	0.13	1	U	1	0.031	1	U	1	0.24	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19
Chlorobenzene	22	SWQC	1	U	1	0.15	1	U	1	0.15	1	U	1	0.047	1	U	1	0.21	1	U	1	0.49	1	U	1	0.2	1	U	1	0.2
Chloroethane	3.6	TWRBC	2	U	2	0.29	2	U	2	0.29	1	U	1	0.15	1	U	1	0.27	1	U	1	0.2	2	U	2	0.24	2	U	2	0.24
Chloroform	5.67	SWQC	1	U	1	0.16	1	U	1	0.16	1	U	1	0.041	1	U	1	0.23	1	U	1	0.34	1	U	1	0.16	1	U	1	0.16
Chloromethane	190	TWRBC	2	U	2	0.3	2	U	2	0.3	1	U	1	0.11	1	U	1	0.36	1	U	1	0.2	2	U	2	0.14	**0.19**	**J**	2	0.14
Dibromochloromethane	0.4	Water & Organisms	1	U	1	0.18	1	U	1	0.18	1	U	1	0.035	1	U	1	0.18	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19
Dichlorodifluoromethane	350	TWRBC	2	U	2	0.31	2	U	2	0.31	1	U	1	0.058	2	U	2	0.26	1	U	1	0.2	2	U	2	0.25	2	U	2	0.25
1,1-Dichloroethane	0.291	SWQC	1	U	1	0.15	1	U	1	0.15	1	U	1	0.041	1	U	1	0.24	1	U	1	0.36	1	U	1	0.21	1	U	1	0.21
1,2-Dichloroethane	0.291	SWQC	1	U	1	0.22	1	U	1	0.22	1	U	1	0.1	1	U	1	0.22	1	U	1	0.48	1	U	1	0.16	1	U	1	0.16
1,1-Dichloroethene	4.81	SWQC	1	U	1	0.19	1	U	1	0.19	1	U	1	0.077	1	U	1	0.28	1	U	1	0.47	1	U	1	0.18	1	U	1	0.18
cis-1,2-Dichloroethene	592	SWQC	0.5	U	0.5	0.17	**0.71**		0.5	0.17	**0.3**	**J**	1	0.065	1.5	U	1.5	0.45	1	U	1	0.35	0.5	U	0.5	0.21	**0.41**	**J**	0.5	0.21
trans-1,2-Dichloroethene	140	Water & Organisms	0.5	U	0.5	0.19	0.5	U	0.5	0.19	1	U	1	0.059	1.5	U	1.5	0.53	1	U	1	0.41	0.5	U	0.5	0.16	0.5	U	0.5	0.16
1,2-Dichloropropane	0.5	Water & Organisms	1	U	1	0.18	1	U	1	0.18	1	U	1	0.1	1	U	1	0.27	1	U	1	0.46	1	U	1	0.15	1	U	1	0.15
cis-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.14	1	U	1	0.14	1	U	1	0.049	1	U	1	0.15	1	U	1	0.31	1	U	1	0.12	1	U	1	0.12
trans-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.19	1	U	1	0.19	1	U	1	0.053	1	U	1	0.17	1	U	1	0.29	1	U	1	0.17	1	U	1	0.17
Ethyl benzene	530	Water & Organisms	1	U	1	0.17	1	U	1	0.17	1	U	1	0.038	1	U	1	0.15	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19
2-Hexanone		NA	10	U	10	0.41	10	U	10	0.41	5	U	5	0.29	5	U	5	0.5	5	U	5	1.9	10	U	10	0.35	10	U	10	0.35
Methyl tert-Butyl ether	2.6	TWRBC	**0.41**	**J**	5	0.17	**1.7**		1	0.17	**1.2**		1	0.036	1	U	1	0.25	1	U	1	0.35	1	U	1	0.18	1	U	1	0.18
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.32	5	U	5	0.32	5	U	5	0.29	5	U	5	0.5	5	U	5	2.1	5	U	5	0.32	5	U	5	0.32
Methylene chloride	2.49	SWQC	1	U	1	0.33	1	U	1	0.33	1	U	1	0.12	1	U	1	0.27	1	U	1	0.41	1	U	1	0.19	1	U	1	0.19
Styrene	1600	TWRBC	1	U	1	0.11	1	U	1	0.11	1	U	1	0.05	1	U	1	0.24	1	U	1	0.36	1	U	1	0.13	1	U	1	0.13
1,1,2,2-Tetrachloroethane	0.17	Water & Organisms	1	U	1	0.18	1	U	1	0.18	1	U	1	0.047	1	U	1	0.23	1	U	1	0.31	1	U	1	0.22	1	U	1	0.22
Tetrachloroethene	0.388	SWQC	1	U	1	0.29	1	U	1	0.29	1	U	1	0.063	1	U	1	0.17	1	U	1	0.27	1	U	1	0.19	1	U	1	0.19
Toluene	1300	Water & Organisms	1	U	1	0.13	1	U	1	0.13	1	U	1	0.041	1	U	1	0.19	1	U	1	0.37	**0.74**	**J**	1	0.17	1	U	1	0.17
1,1,1-Trichloroethane	127	SWQC	1	U	1	0.22	1	U	1	0.22	1	U	1	0.041	1	U	1	0.29	1	U	1	0.4	1	U	1	0.21	1	U	1	0.21
1,1,2-Trichloroethane	0.59	Water & Organisms	1	U	1	0.27	1	U	1	0.27	1	U	1	0.072	1	U	1	0.26	1	U	1	0.38	1	U	1	0.22	1	U	1	0.22
Trichloroethene	1.09	SWQC	**12**		1	0.17	**14**		1	0.17	**6.4**		1	0.058	**4.22**		1	0.5	**5.2**		1	0.28	1	U	1	0.28	**9.6**		1	0.28
Trichlorofluoromethane	1300	TWRBC	2	U	2	0.21	2	U	2	0.21	1	U	1	0.067	1	U	1	0.25	1	U	1	0.35	2	U	2	0.16	2	U	2	0.16
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**30**		1	0.28	**82**		4	1.1	NT				**4.59**		1	0.33	**55**		1	0.45	1	U	1	0.26	**3.9**		1	0.26
Vinyl chloride	0.025	Water & Organisms	2	U	2	0.22	2	U	2	0.22	1	U	1	0.062	1	U	1	0.2	1	U	1	0.34	2	U	2	0.21	2	U	2	0.21
Total Xylenes	210	TWRBC	1	U	1	0.28	1	U	1	0.28	1	U	1	0.097	1	U	1	0.22	2	U	2	0.95	1	U	1	0.44	1	U	1	0.44
Explosives																														
1,3-Dinitrobenzene	3.7	TWRBC	0.2	U	0.2	0.07	0.2	U	0.2	0.036	0.25	U	0.25	0.04	NT				NT				NT				NT			
2,4-Dinitrotoluene	0.11	Water & Organisms, SWQC	0.2	U	0.2	0.08	0.2	U	0.2	0.062	0.25	U	0.25	0.0097	NT				NT				NT				NT			
2,6-Dinitrotoluene	37	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.051	0.25	U	0.25	0.017	NT				NT				NT				NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.06	0.2	U	0.2	0.066	0.25	U	0.25	0.018	NT				NT				NT				NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	0.2	U	0.2	0.09	0.2	U	0.2	0.065	0.25	U	0.25	0.022	NT				NT				NT				NT			
HMX	1800	TWRBC	**0.8**		0.5	0.07	**0.93**		0.5	0.037	**1.1**		0.25	0.018	NT				NT				NT				NT			
Nitrobenzene	16	SWQC	0.2	U	0.2	0.07	0.2	U	0.2	0.063	0.25	U	0.25	0.04	NT				NT				NT				NT			
2-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	0.2	U	0.2	0.075	0.25	U	0.25	0.017	NT				NT				NT				NT			
3-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.1	0.2	U	0.2	0.042	0.25	U	0.25	0.017	NT				NT				NT				NT			
4-Nitrotoluene	61	TWRBC	0.2	U	0.2	0.2	0.2	U	0.2	0.075	0.25	U	0.25	0.026	NT				NT				NT				NT			
RDX	0.5	NJPQL	**0.22**	**J**	0.5	0.1	**0.08**	**J**	0.5	0.037	**0.32**		0.25	0.017	NT				NT				NT				NT			
Tetryl	150	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.065	0.25	U	0.25	0.04	NT				NT				NT				NT			
1,3,5-Trinitrobenzene	1100	TWRBC	0.2	U	0.2	0.08	0.2	U	0.2	0.035	0.25	U	0.25	0.011	NT				NT				NT				NT			
2,4,6-Trinitrotoluene	2.2	TWRBC	0.2	U	0.2	0.1	0.2	U	0.2	0.05	0.25	U	0.25	0.012	NT				NT				NT				NT			

Table 4-3
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Water (µg/L)

			Analytical Results																											
		Sample ID:	13SW-4				13SW-4				13SW-4				13SW-4				13SW-4				13SW-4				13SW-4			
		Date Sampled:	8/10/2006				10/30/2006				3/30/2007				6/25/2007				10/16/2007				6/24/2008				5/11/2010			
		Depth Sampled (ft):																												
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																														
Acetone	5500	TWRBC	10	U	10	0.74	**1.3**	**J**	10	0.74	**7.3**	**J**	10	0.74	10	(U)	10	1.1	10	U	10	1.1	5	(U)	5	0.77	**3.02**	**J**	10	1.8
Acetonitrile	120	TWRBC	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	3.5	20	U	20	3.5	NT				5	U	5	1.67
Benzene	0.15	SWQC	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.13	1	U	1	0.13	1	U	1	0.059	1	U	1	0.14
Bromodichloromethane	0.266	SWQC	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.15	1	U	1	0.15	1	U	1	0.031	1	U	1	0.18
Bromoform	4.3	Water & Organisms	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.64	1	U	1	0.64	1	U	1	0.1	1.5	U	1.5	0.5
Bromomethane	47	Water & Organisms	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.41	2	U	2	0.41	1	U	1	0.29	2	U	2	0.32
2-Butanone	7000	TWRBC	10	U	10	0.39	10	U	10	0.39	**1.4**	**J**	10	0.39	10	U	10	0.57	10	U	10	0.57	5	U	5	0.78	5	U	5	1.6
Carbon disulfide	1000	TWRBC	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.13	1	U	1	0.13	1	U	1	0.045	1	U	1	0.26
Carbon tetrachloride	0.23	Water & Organisms	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.13	1	U	1	0.13	1	U	1	0.031	1	U	1	0.24
Chlorobenzene	22	SWQC	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.15	1	U	1	0.15	1	U	1	0.047	1	U	1	0.21
Chloroethane	3.6	TWRBC	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.29	2	U	2	0.29	1	U	1	0.15	1	U	1	0.27
Chloroform	5.67	SWQC	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.041	1	U	1	0.23
Chloromethane	190	TWRBC	2	(U)	2	0.14	**0.14**	**J**	2	0.14	2	U	2	0.14	2	U	2	0.3	2	U	2	0.3	1	U	1	0.11	**0.577**	**N,J**	1	0.36
Dibromochloromethane	0.4	Water & Organisms	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.18	1	U	1	0.18	1	U	1	0.035	1	U	1	0.18
Dichlorodifluoromethane	350	TWRBC	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.31	2	U	2	0.31	1	U	1	0.058	**0.278**	**N,J**	2	0.26
1,1-Dichloroethane	0.291	SWQC	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.15	1	U	1	0.15	1	U	1	0.041	1	U	1	0.24
1,2-Dichloroethane	0.291	SWQC	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.22	1	U	1	0.22	1	U	1	0.1	1	U	1	0.22
1,1-Dichloroethene	4.81	SWQC	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.19	1	U	1	0.19	1	U	1	0.077	1	U	1	0.28
cis-1,2-Dichloroethene	592	SWQC	0.5	U	0.5	0.21	**0.71**		0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.17	0.5	U	0.5	0.17	1	U	1	0.065	1.5	U	1.5	0.45
trans-1,2-Dichloroethene	140	Water & Organisms	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.19	0.5	U	0.5	0.19	1	U	1	0.059	1.5	U	1.5	0.53
1,2-Dichloropropane	0.5	Water & Organisms	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.18	1	U	1	0.18	1	U	1	0.1	1	U	1	0.27
cis-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.14	1	U	1	0.14	1	U	1	0.049	1	U	1	0.15
trans-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19	1	U	1	0.19	1	U	1	0.053	1	U	1	0.17
Ethyl benzene	530	Water & Organisms	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17	1	U	1	0.17	1	U	1	0.038	1	U	1	0.15
2-Hexanone		NA	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.41	10	U	10	0.41	5	U	5	0.29	5	U	5	0.5
Methyl tert-Butyl ether	2.6	TWRBC	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	5	U	5	0.17	1	U	1	0.17	1	U	1	0.036	NT			
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.29	5	U	5	0.5
Methylene chloride	2.49	SWQC	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.33	1	U	1	0.33	1	U	1	0.12	1	U	1	0.27
Styrene	1600	TWRBC	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.11	1	U	1	0.11	1	U	1	0.05	1	U	1	0.24
1,1,2,2-Tetrachloroethane	0.17	Water & Organisms	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.18	1	U	1	0.18	1	U	1	0.047	1	U	1	0.23
Tetrachloroethene	0.388	SWQC	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.29	1	U	1	0.29	1	U	1	0.063	1	U	1	0.17
Toluene	1300	Water & Organisms	1	U	1	0.17	1	U	1	0.17	**0.34**	**J**	1	0.17	1	U	1	0.13	1	U	1	0.13	1	U	1	0.041	1	U	1	0.19
1,1,1-Trichloroethane	127	SWQC	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.22	1	U	1	0.22	1	U	1	0.041	1	U	1	0.29
1,1,2-Trichloroethane	0.59	Water & Organisms	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.27	1	U	1	0.27	1	U	1	0.072	1	U	1	0.26
Trichloroethene	1.09	SWQC	1	U	1	0.28	**5**		1	0.28	**0.97**	**J**	1	0.28	1	U	1	0.17	1	U	1	0.17	1	U	1	0.058	1	U	1	0.5
Trichlorofluoromethane	1300	TWRBC	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.21	2	U	2	0.21	1	U	1	0.067	1	U	1	0.25
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	1	U	1	0.26	**1.8**		1	0.26	**1.8**		1	0.26	1	U	1	0.28	**4.7**		1	0.28	NT				**0.419**	**J**	1	0.33
Vinyl chloride	0.025	Water & Organisms	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.22	2	U	2	0.22	1	U	1	0.062	1	N,U	1	0.2
Total Xylenes	210	TWRBC	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.28	1	U	1	0.28	1	U	1	0.097	1	U	1	0.22
Explosives																														
1,3-Dinitrobenzene	3.7	TWRBC	NT				0.2	U	0.2	0.06	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.036	NT				NT			
2,4-Dinitrotoluene	0.11	Water & Organisms, SWQC	NT				0.2	U	0.2	0.066	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.062	NT				NT			
2,6-Dinitrotoluene	37	TWRBC	NT				0.2	U	0.2	0.072	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.051	NT				NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				0.2	U	0.2	0.063	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.066	NT				NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				0.2	U	0.2	0.088	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.065	NT				NT			
HMX	1800	TWRBC	NT				0.5	U	0.5	0.061	0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.037	NT				NT			
Nitrobenzene	16	SWQC	NT				0.2	U	0.2	0.072	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.063	NT				NT			
2-Nitrotoluene	61	TWRBC	NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075	NT				NT			
3-Nitrotoluene	61	TWRBC	NT				0.2	U	0.2	0.16	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	(U)	0.2	0.042	NT				NT			
4-Nitrotoluene	61	TWRBC	NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075	NT				NT			
RDX	0.5	NJPQL	NT				0.5	U	0.5	0.053	0.5	U	0.5	0.1	0.5	U	0.5	0.1	0.5	U	0.5	0.037	NT				NT			
Tetryl	150	TWRBC	NT				0.2	U	0.2	0.078	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.065	NT				NT			
1,3,5-Trinitrobenzene	1100	TWRBC	NT				0.2	U	0.2	0.052	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.035	NT				NT			
2,4,6-Trinitrotoluene	2.2	TWRBC	NT				0.2	U	0.2	0.051	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.05	NT				NT			

Table 4-3
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Water (µg/L)

			Analytical Results																											
		Sample ID:	13SW-4 DUP				13SW-4				13SW-5				13SW-5				13SW-5				13SW-5				13SW-5			
		Date Sampled:	5/11/2010				1/24/2011				11/9/2004				1/11/2006				10/30/2006				3/30/2007				10/15/2007			
		Depth Sampled (ft):																												
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																														
Acetone	5500	TWRBC	**3.22**	**J**	10	1.8	5	U	5	0.5	10	(U)	10	0.74	10	(U)	10	0.74	**1.3**	**J**	10	0.74	10	U	10	0.74	10	U	10	1.1
Acetonitrile	120	TWRBC	5	U	5	1.67	NT				20	R	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	3.5
Benzene	0.15	SWQC	1	U	1	0.14	1	U	1	0.32	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.13
Bromodichloromethane	0.266	SWQC	1	U	1	0.18	1	U	1	0.36	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.15
Bromoform	4.3	Water & Organisms	1.5	U	1.5	0.5	1	U	1	0.47	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.64
Bromomethane	47	Water & Organisms	2	U	2	0.32	1	U	1	0.2	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.41
2-Butanone	7000	TWRBC	5	U	5	1.6	5	U	5	1.3	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.57
Carbon disulfide	1000	TWRBC	1	U	1	0.26	1	U	1	0.2	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.13
Carbon tetrachloride	0.23	Water & Organisms	1	U	1	0.24	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.13
Chlorobenzene	22	SWQC	1	U	1	0.21	1	U	1	0.49	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.15
Chloroethane	3.6	TWRBC	1	U	1	0.27	1	U	1	0.2	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.29
Chloroform	5.67	SWQC	1	U	1	0.23	1	U	1	0.34	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	190	TWRBC	**0.507**	**J**	1	0.36	1	U	1	0.2	2	U	2	0.14	**0.21**	**J**	2	0.14	**0.14**	**J**	2	0.14	2	U	2	0.14	2	U	2	0.3
Dibromochloromethane	0.4	Water & Organisms	1	U	1	0.18	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.18
Dichlorodifluoromethane	350	TWRBC	2	U	2	0.26	1	U	1	0.2	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.31
1,1-Dichloroethane	0.291	SWQC	1	U	1	0.24	1	U	1	0.36	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.15
1,2-Dichloroethane	0.291	SWQC	1	U	1	0.22	1	U	1	0.48	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.22
1,1-Dichloroethene	4.81	SWQC	1	U	1	0.28	1	U	1	0.47	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.19
cis-1,2-Dichloroethene	592	SWQC	1.5	U	1.5	0.45	1	U	1	0.35	**0.4**	**J**	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.17
trans-1,2-Dichloroethene	140	Water & Organisms	1.5	U	1.5	0.53	1	U	1	0.41	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.19
1,2-Dichloropropane	0.5	Water & Organisms	1	U	1	0.27	1	U	1	0.46	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.18
cis-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.15	1	U	1	0.31	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.14
trans-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.17	1	U	1	0.29	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19
Ethyl benzene	530	Water & Organisms	1	U	1	0.15	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17
2-Hexanone		NA	5	U	5	0.5	5	U	5	1.9	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.41
Methyl tert-Butyl ether	2.6	TWRBC	NT				1	U	1	0.35	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.17
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.5	5	U	5	2.1	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	2.49	SWQC	1	U	1	0.27	1	U	1	0.41	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.33
Styrene	1600	TWRBC	1	U	1	0.24	1	U	1	0.36	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.11
1,1,2,2-Tetrachloroethane	0.17	Water & Organisms	1	U	1	0.23	1	U	1	0.31	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.18
Tetrachloroethene	0.388	SWQC	1	U	1	0.17	1	U	1	0.27	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.29
Toluene	1300	Water & Organisms	1	U	1	0.19	1	U	1	0.37	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.13
1,1,1-Trichloroethane	127	SWQC	1	U	1	0.29	1	U	1	0.4	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.22
1,1,2-Trichloroethane	0.59	Water & Organisms	1	U	1	0.26	1	U	1	0.38	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.27
Trichloroethene	1.09	SWQC	1	U	1	0.5	**4.3**		1	0.28	**1.2**		1	0.28	**0.59**	**J**	1	0.28	**0.33**	**J**	1	0.28	**0.35**	**J**	1	0.28	1	U	1	0.17
Trichlorofluoromethane	1300	TWRBC	1	U	1	0.25	1	U	1	0.35	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.21
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**0.818**	**J**	1	0.33	**2.7**		1	0.45	1	U	1	0.26	**0.82**	**J**	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.28
Vinyl chloride	0.025	Water & Organisms	1	N,U	1	0.2	1	U	1	0.34	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.22
Total Xylenes	210	TWRBC	1	U	1	0.22	2	U	2	0.95	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.28
Explosives																														
1,3-Dinitrobenzene	3.7	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.06	0.2	U	0.2	0.07	0.2	U	0.2	0.036
2,4-Dinitrotoluene	0.11	Water & Organisms, SWQC	NT				NT				NT				NT				0.2	U	0.2	0.066	0.2	U	0.2	0.08	0.2	U	0.2	0.062
2,6-Dinitrotoluene	37	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.072	0.2	U	0.2	0.08	0.2	U	0.2	0.051
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.063	0.2	U	0.2	0.06	0.2	U	0.2	0.066
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.088	0.2	U	0.2	0.09	0.2	U	0.2	0.065
HMX	1800	TWRBC	NT				NT				NT				NT				0.5	U	0.5	0.061	0.5	U	0.5	0.07	0.5	U	0.5	0.037
Nitrobenzene	16	SWQC	NT				NT				NT				NT				0.2	U	0.2	0.072	**0.89**	**COL**	0.2	0.07	0.2	U	0.2	0.063
2-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.075
3-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.16	0.2	U	0.2	0.1	0.2	U	0.2	0.042
4-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.075
RDX	0.5	NJPQL	NT				NT				NT				NT				**0.087**	**J**	0.5	0.053	0.5	U	0.5	0.1	0.5	U	0.5	0.037
Tetryl	150	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.078	0.2	U	0.2	0.08	0.2	U	0.2	0.065
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.052	0.2	U	0.2	0.08	0.2	U	0.2	0.035
2,4,6-Trinitrotoluene	2.2	TWRBC	NT				NT				NT				NT				0.2	U	0.2	0.051	0.2	U	0.2	0.1	0.2	U	0.2	0.05

Table 4-3
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Water (µg/L)

			Analytical Results																											
		Sample ID:	13SW-5				13SW-5				13SW-5 DUP				13SW-6				13SW-6				13SW-6				13SW-6			
		Date Sampled:	5/11/2010				1/24/2011				1/24/2011				10/15/2007				6/24/2008				1/11/2006				4/19/2010			
		Depth Sampled (ft):																												
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																														
Acetone	5500	TWRBC	**2**	**J**	10	1.8	5	U	5	0.5	5	U	5	0.5	10	U	10	1.1	5	U	5	0.77	10	U	10	0.74	10	U	10	1.8
Acetonitrile	120	TWRBC	5	U	5	1.67	NT				NT				20	U	20	3.5	NT				20	U	20	1.5	5	U	5	1.67
Benzene	0.15	SWQC	1	U	1	0.14	1	U	1	0.32	1	U	1	0.32	1	U	1	0.13	1	U	1	0.059	1	U	1	0.22	1	U	1	0.14
Bromodichloromethane	0.266	SWQC	1	U	1	0.18	1	U	1	0.36	1	U	1	0.36	1	U	1	0.15	1	U	1	0.031	1	U	1	0.14	1	U	1	0.18
Bromoform	4.3	Water & Organisms	1.5	U	1.5	0.5	1	U	1	0.47	1	U	1	0.47	1	U	1	0.64	1	U	1	0.1	1	U	1	0.17	1.5	U	1.5	0.5
Bromomethane	47	Water & Organisms	2	U	2	0.32	1	U	1	0.2	1	U	1	0.2	2	U	2	0.41	1	U	1	0.29	2	U	2	0.36	2	U	2	0.32
2-Butanone	7000	TWRBC	5	U	5	1.6	5	U	5	1.3	5	U	5	1.3	10	U	10	0.57	5	U	5	0.78	10	U	10	0.39	5	U	5	1.6
Carbon disulfide	1000	TWRBC	1	U	1	0.26	1	U	1	0.2	1	U	1	0.2	1	U	1	0.13	1	U	1	0.045	1	U	1	0.28	1	U	1	0.26
Carbon tetrachloride	0.23	Water & Organisms	1	U	1	0.24	1	U	1	0.2	1	U	1	0.2	1	U	1	0.13	1	U	1	0.031	1	U	1	0.19	1	U	1	0.24
Chlorobenzene	22	SWQC	1	U	1	0.21	1	U	1	0.49	1	U	1	0.49	1	U	1	0.15	1	U	1	0.047	1	U	1	0.2	1	U	1	0.21
Chloroethane	3.6	TWRBC	1	U	1	0.27	1	U	1	0.2	1	U	1	0.2	2	U	2	0.29	1	U	1	0.15	2	U	2	0.24	1	U	1	0.27
Chloroform	5.67	SWQC	1	U	1	0.23	1	U	1	0.34	1	U	1	0.34	1	U	1	0.16	1	U	1	0.041	1	U	1	0.16	1	U	1	0.23
Chloromethane	190	TWRBC	**0.498**	**J**	1	0.36	1	U	1	0.2	1	U	1	0.2	2	U	2	0.3	1	U	1	0.11	**0.19**	**J**	2	0.14	1	U	1	0.36
Dibromochloromethane	0.4	Water & Organisms	1	U	1	0.18	1	U	1	0.2	1	U	1	0.2	1	U	1	0.18	1	U	1	0.035	1	U	1	0.19	1	U	1	0.18
Dichlorodifluoromethane	350	TWRBC	2	U	2	0.26	1	U	1	0.2	1	U	1	0.2	2	U	2	0.31	1	U	1	0.058	2	U	2	0.25	2	U	2	0.26
1,1-Dichloroethane	0.291	SWQC	1	U	1	0.24	1	U	1	0.36	1	U	1	0.36	1	U	1	0.15	1	U	1	0.041	1	U	1	0.21	1	U	1	0.24
1,2-Dichloroethane	0.291	SWQC	1	U	1	0.22	1	U	1	0.48	1	U	1	0.48	1	U	1	0.22	1	U	1	0.1	1	U	1	0.16	1	U	1	0.22
1,1-Dichloroethene	4.81	SWQC	1	U	1	0.28	1	U	1	0.47	1	U	1	0.47	1	U	1	0.19	1	U	1	0.077	1	U	1	0.18	1	U	1	0.28
cis-1,2-Dichloroethene	592	SWQC	1.5	U	1.5	0.45	1	U	1	0.35	1	U	1	0.35	0.5	U	0.5	0.17	1	U	1	0.065	0.5	U	0.5	0.21	1.5	U	1.5	0.45
trans-1,2-Dichloroethene	140	Water & Organisms	1.5	U	1.5	0.53	1	U	1	0.41	1	U	1	0.41	0.5	U	0.5	0.19	1	U	1	0.059	0.5	U	0.5	0.16	1.5	U	1.5	0.53
1,2-Dichloropropane	0.5	Water & Organisms	1	U	1	0.27	1	U	1	0.46	1	U	1	0.46	1	U	1	0.18	1	U	1	0.1	1	U	1	0.15	1	U	1	0.27
cis-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.15	1	U	1	0.31	1	U	1	0.31	1	U	1	0.14	1	U	1	0.049	1	U	1	0.12	1	U	1	0.15
trans-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.17	1	U	1	0.29	1	U	1	0.29	1	U	1	0.19	1	U	1	0.053	1	U	1	0.17	1	U	1	0.17
Ethyl benzene	530	Water & Organisms	1	U	1	0.15	1	U	1	0.2	1	U	1	0.2	1	U	1	0.17	1	U	1	0.038	1	U	1	0.19	1	U	1	0.15
2-Hexanone		NA	5	U	5	0.5	5	U	5	1.9	5	U	5	1.9	10	U	10	0.41	5	U	5	0.29	10	U	10	0.35	5	U	5	0.5
Methyl tert-Butyl ether	2.6	TWRBC	NT				1	U	1	0.35	1	U	1	0.35	**0.39**	**J**	1	0.17	**0.22**	**J**	1	0.036	**3.9**		1	0.18	1	U	1	0.25
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	0.5	5	U	5	2.1	5	U	5	2.1	5	U	5	0.32	5	U	5	0.29	5	U	5	0.32	5	U	5	0.5
Methylene chloride	2.49	SWQC	1	U	1	0.27	1	U	1	0.41	1	U	1	0.41	1	U	1	0.33	1	U	1	0.12	1	U	1	0.19	1	U	1	0.27
Styrene	1600	TWRBC	1	U	1	0.24	1	U	1	0.36	1	U	1	0.36	1	U	1	0.11	1	U	1	0.05	1	U	1	0.13	1	U	1	0.24
1,1,2,2-Tetrachloroethane	0.17	Water & Organisms	1	U	1	0.23	1	U	1	0.31	1	U	1	0.31	1	U	1	0.18	1	U	1	0.047	1	U	1	0.22	1	U	1	0.23
Tetrachloroethene	0.388	SWQC	1	U	1	0.17	1	U	1	0.27	1	U	1	0.27	1	U	1	0.29	1	U	1	0.063	1	U	1	0.19	1	U	1	0.17
Toluene	1300	Water & Organisms	1	U	1	0.19	1	U	1	0.37	1	U	1	0.37	1	U	1	0.13	1	U	1	0.041	1	U	1	0.17	1	U	1	0.19
1,1,1-Trichloroethane	127	SWQC	1	U	1	0.29	1	U	1	0.4	1	U	1	0.4	1	U	1	0.22	1	U	1	0.041	1	U	1	0.21	1	U	1	0.29
1,1,2-Trichloroethane	0.59	Water & Organisms	1	U	1	0.26	1	U	1	0.38	1	U	1	0.38	1	U	1	0.27	1	U	1	0.072	1	U	1	0.22	1	U	1	0.26
Trichloroethene	1.09	SWQC	1	U	1	0.5	1	U	1	0.28	1	U	1	0.28	**0.88**	**J**	1	0.17	**0.74**	**J**	1	0.058	**2.2**		1	0.28	1	U	1	0.5
Trichlorofluoromethane	1300	TWRBC	1	U	1	0.25	1	U	1	0.35	1	U	1	0.35	2	U	2	0.21	1	U	1	0.067	2	U	2	0.16	1	U	1	0.25
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**0.726**	**J**	1	0.33	1	U	1	0.45	1	U	1	0.45	**2**		1	0.28	NT				**6.7**		1	0.26	**6.9**		1	0.33
Vinyl chloride	0.025	Water & Organisms	1	N,U	1	0.2	1	U	1	0.34	1	U	1	0.34	2	U	2	0.22	1	U	1	0.062	2	U	2	0.21	1	U	1	0.2
Total Xylenes	210	TWRBC	1	U	1	0.22	2	U	2	0.95	2	U	2	0.95	1	U	1	0.28	1	U	1	0.097	1	U	1	0.44	1	U	1	0.22
Explosives																														
1,3-Dinitrobenzene	3.7	TWRBC	NT				NT				NT				0.2	U	0.2	0.036	0.25	U	0.25	0.04	NT				NT			
2,4-Dinitrotoluene	0.11	Water & Organisms, SWQC	NT				NT				NT				0.2	U	0.2	0.062	0.25	U	0.25	0.0097	NT				NT			
2,6-Dinitrotoluene	37	TWRBC	NT				NT				NT				0.2	U	0.2	0.051	0.25	U	0.25	0.017	NT				NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				0.2	U	0.2	0.066	0.25	U	0.25	0.018	NT				NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				0.2	U	0.2	0.065	0.25	U	0.25	0.022	NT				NT			
HMX	1800	TWRBC	NT				NT				NT				**0.69**		0.5	0.037	**0.98**		0.25	0.018	NT				NT			
Nitrobenzene	16	SWQC	NT				NT				NT				0.2	U	0.2	0.063	0.25	U	0.25	0.04	NT				NT			
2-Nitrotoluene	61	TWRBC	NT				NT				NT				0.2	U	0.2	0.075	0.25	U	0.25	0.017	NT				NT			
3-Nitrotoluene	61	TWRBC	NT				NT				NT				0.2	U	0.2	0.042	0.25	U	0.25	0.017	NT				NT			
4-Nitrotoluene	61	TWRBC	NT				NT				NT				0.2	U	0.2	0.075	0.25	U	0.25	0.026	NT				NT			
RDX	0.5	NJPQL	NT				NT				NT				**0.049**	**J**	0.5	0.037	0.25	U	0.25	0.017	NT				NT			
Tetryl	150	TWRBC	NT				NT				NT				0.2	U	0.2	0.065	0.25	U	0.25	0.04	NT				NT			
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				NT				0.2	U	0.2	0.035	0.25	U	0.25	0.011	NT				NT			
2,4,6-Trinitrotoluene	2.2	TWRBC	NT				NT				NT				0.2	U	0.2	0.05	0.25	U	0.25	0.012	NT				NT			

Table 4-3
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Water (µg/L)

			Analytical Results																							
		Sample ID:	13SW-6				13SW-7				13SW-8				13SW-9				11SW-10				11SW-10			
		Date Sampled:	1/24/2011				1/11/2006				3/14/2006				1/11/2006				4/19/2010				1/24/2011			
		Depth Sampled (ft):																								
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	5500	TWRBC	5	U	5	0.5	10	(U)	10	0.74	10	U	10	0.74	10	(U)	10	0.74	**11.1**		10	1.8	5	U	5	0.5
Acetonitrile	120	TWRBC	NT				20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	5	U	5	1.67	NT			
Benzene	0.15	SWQC	1	U	1	0.32	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.14	1	U	1	0.32
Bromodichloromethane	0.266	SWQC	1	U	1	0.36	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.18	1	U	1	0.36
Bromoform	4.3	Water & Organisms	1	U	1	0.47	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1.5	U	1.5	0.5	1	U	1	0.47
Bromomethane	47	Water & Organisms	1	U	1	0.2	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.32	1	U	1	0.2
2-Butanone	7000	TWRBC	5	U	5	1.3	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	5	U	5	1.6	5	U	5	1.3
Carbon disulfide	1000	TWRBC	1	U	1	0.2	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.26	1	U	1	0.2
Carbon tetrachloride	0.23	Water & Organisms	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.24	1	U	1	0.2
Chlorobenzene	22	SWQC	1	U	1	0.49	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.21	1	U	1	0.49
Chloroethane	3.6	TWRBC	1	U	1	0.2	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	1	U	1	0.27	1	U	1	0.2
Chloroform	5.67	SWQC	1	U	1	0.34	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.23	1	U	1	0.34
Chloromethane	190	TWRBC	1	U	1	0.2	**0.21**	**J**	2	0.14	2	U	2	0.14	2	U	2	0.14	1	U	1	0.36	1	U	1	0.2
Dibromochloromethane	0.4	Water & Organisms	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.18	1	U	1	0.2
Dichlorodifluoromethane	350	TWRBC	1	U	1	0.2	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.26	1	U	1	0.2
1,1-Dichloroethane	0.291	SWQC	1	U	1	0.36	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.24	1	U	1	0.36
1,2-Dichloroethane	0.291	SWQC	1	U	1	0.48	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.22	1	U	1	0.48
1,1-Dichloroethene	4.81	SWQC	1	U	1	0.47	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.28	1	U	1	0.47
cis-1,2-Dichloroethene	592	SWQC	1	U	1	0.35	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	1.5	U	1.5	0.45	1	U	1	0.35
trans-1,2-Dichloroethene	140	Water & Organisms	1	U	1	0.41	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	1.5	U	1.5	0.53	1	U	1	0.41
1,2-Dichloropropane	0.5	Water & Organisms	1	U	1	0.46	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.27	1	U	1	0.46
cis-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.31	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.15	1	U	1	0.31
trans-1,3-Dichloropropene	0.193	SWQC	1	U	1	0.29	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.29
Ethyl benzene	530	Water & Organisms	1	U	1	0.2	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.15	1	U	1	0.2
2-Hexanone		NA	5	U	5	1.9	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	5	U	5	0.5	5	U	5	1.9
Methyl tert-Butyl ether	2.6	TWRBC	1	U	1	0.35	**0.23**	**J**	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.25	1	U	1	0.35
4-Methyl-2-pentanone (MIBK)	6300	TWRBC	5	U	5	2.1	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.5	5	U	5	2.1
Methylene chloride	2.49	SWQC	1	U	1	0.41	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.27	1	U	1	0.41
Styrene	1600	TWRBC	1	U	1	0.36	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.24	1	U	1	0.36
1,1,2,2-Tetrachloroethane	0.17	Water & Organisms	1	U	1	0.31	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.19	1	U	1	0.31
Tetrachloroethene	0.388	SWQC	1	U	1	0.27	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17	1	U	1	0.27
Toluene	1300	Water & Organisms	1	U	1	0.37	1	U	1	0.17	**0.2**	**J**	1	0.17	1	U	1	0.17	**1**	U	1	0.19	1	U	1	0.37
1,1,1-Trichloroethane	127	SWQC	1	U	1	0.4	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.29	1	U	1	0.4
1,1,2-Trichloroethane	0.59	Water & Organisms	1	U	1	0.38	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.26	1	U	1	0.38
Trichloroethene	1.09	SWQC	**3.4**		1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.5	1	U	1	0.28
Trichlorofluoromethane	1300	TWRBC	1	U	1	0.35	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	1	U	1	0.25	1	U	1	0.35
1,1,2-Trichloro-1,2,2-trifluoroethane	59000	TWRBC	**29**		1	0.45	**0.82**	**J**	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.33	**2**		1	0.45
Vinyl chloride	0.025	Water & Organisms	1	U	1	0.34	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	1	U	1	0.2	1	U	1	0.34
Total Xylenes	210	TWRBC	2	U	2	0.95	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.22	2	U	2	0.95
Explosives																										
1,3-Dinitrobenzene	3.7	TWRBC	NT				NT				NT				NT				NT				NT			
2,4-Dinitrotoluene	0.11	Water & Organisms, SWQC	NT				NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	37	TWRBC	NT				NT				NT				NT				NT				NT			
2-amino-4,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				NT				NT				NT			
4-amino-2,6-Dinitrotoluene	73	TWRBC	NT				NT				NT				NT				NT				NT			
HMX	1800	TWRBC	NT				NT				NT				NT				NT				NT			
Nitrobenzene	16	SWQC	NT				NT				NT				NT				NT				NT			
2-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				NT				NT			
3-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				NT				NT			
4-Nitrotoluene	61	TWRBC	NT				NT				NT				NT				NT				NT			
RDX	0.5	NJPQL	NT				NT				NT				NT				NT				NT			
Tetryl	150	TWRBC	NT				NT				NT				NT				NT				NT			
1,3,5-Trinitrobenzene	1100	TWRBC	NT				NT				NT				NT				NT				NT			
2,4,6-Trinitrotoluene	2.2	TWRBC	NT				NT				NT				NT				NT				NT			

Table 4-3
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Water (µg/L)

(a) See the "ARARs and Other Guidance to be Considered for Picatinny Arsenal Surface Water" table for a complete list of LOC values. Surface water samples were compared to the lower of the USEPA Water Quality Criteria or the New Jersey Surface Water Quality Criteria. If the above are not available, surface water comparison criteria are USEPA Region III Tap Water (noncarcinogenic or carcinogenic 10^{-6}) RBCs. The background value is the comparison criteria where the background value exceeds the aforementioned criteria. Value in italics is the screening value.

Bolded values indicate a detection.
Bolded and shaded values indicate the detected result is above the Level of Concern (LOC).
AWQC = USEPA Water Quality Criteria
BG Value = Surface Water Background value
NA = No value available.
Quality Criteria = New Jersey Groundwater Quality Criteria
NT = Not tested.
Q = Flags/Qualifiers (QA/QC):
COL = More than 40% RPD between primary and confirmatory detector results.
J = Detect, value is an estimate.
R = Rejected result, value should not be used for any purpose.
N = The matrix spikes are outside of precision and/or accuracy criteria.
U = Non-detect, value is the detection limit.
(U) = Non-detect, chemical was detected in blank.
UJ = Non-detect, value is an estimated detection limit.
RL/EQL = Reporting Limit / Estimated Quantitation Limit
SQL = Sample Quantitation Limit
SWQC = New Jersey Surface Water Quality Criteria
TWRBC = USEPA Region III Tap Water Risk Based Concentration

Table 4-4
Surface Water Data Tally Table

Compound	Frequency of Detection	Range of Detected Concentrations	Location of Maximum Concentration	LOC	LOC Source	UOM	Exceed LOC?	Number of Hits Exceeding LOC
Acetone	11 / 51	1.2 / 11.1	11SW-10 04/19/2010	5500	TWRBC	µg/L	No	--
Acetonitrile	0 / 37	--	--	120	TWRBC	µg/L	No	--
Benzene	0 / 51	--	--	0.15	SWQC	µg/L	No	--
Bromodichloromethane	0 / 51	--	--	0.266	SWQC	µg/L	No	--
Bromoform	1 / 51	--	--	4.3	Water & Organisms	µg/L	No	--
Bromomethane	0 / 51	--	--	47	Water & Organisms	µg/L	No	--
2-Butanone	0 / 51	1.4 / 1.4	13SW-4 03/30/2007	7000	TWRBC	µg/L	No	--
Carbon disulfide	0 / 51	--	--	1000	TWRBC	µg/L	No	--
Carbon tetrachloride	0 / 51	--	--	0.23	Water & Organisms	µg/L	No	--
Chlorobenzene	0 / 51	--	--	22	SWQC	µg/L	No	--
Chloroethane	0 / 51	--	--	3.6	TWRBC	µg/L	No	--
Chloroform	0 / 51	--	--	5.67	SWQC	µg/L	No	--
Chloromethane	11 / 51	0.14 / 0.577	13SW-4 05/11/2010	190	TWRBC	µg/L	No	--
Dibromochloromethane	0 / 51	--	--	0.4	Water & Organisms	µg/L	No	--
Dichlorodifluoromethane	1 / 51	0.278	13SW-4 05/11/2010	350	TWRBC	µg/L	No	--
1,1-Dichloroethane	0 / 51	--	--	0.291	SWQC	µg/L	No	--
1,2-Dichloroethane	0 / 51	--	--	0.291	SWQC	µg/L	No	--
1,1-Dichloroethene	0 / 51	--	--	4.81	SWQC	µg/L	No	--
cis-1,2-Dichloroethene	6 / 51	0.4 / 0.71	13SW-4 10/30/2006 11SW-3 10/15/2007	592	SWQC	µg/L	No	--
trans-1,2-Dichloroethene	0 / 51	--	--	140	Water & Organisms	µg/L	No	--
1,2-Dichloropropane	0 / 51	--	--	0.5	Water & Organisms	µg/L	No	--
cis-1,3-Dichloropropene	0 / 51	--	--	0.193	SWQC	µg/L	No	--
trans-1,3-Dichloropropene	0 / 51	--	--	0.193	SWQC	µg/L	No	--
Ethyl benzene	0 / 51	--	--	530	Water & Organisms	µg/L	No	--
2-Hexanone	0 / 51	--	--	--	NLA	µg/L	No	--
Methyl tert-Butyl ether	10 / 49	0.22 / 3.9	13SW-6 01/11/2006	2.6	TWRBC	µg/L	**Yes**	1
4-Methyl-2-pentanone (MIBK)	0 / 51	--	--	6300	TWRBC	µg/L	No	--
Methylene chloride	0 / 51	--	--	2.49	SWQC	µg/L	No	--

Table 4-4
Surface Water Data Tally Table

Compound	Frequency of Detection	Range of Detected Concentrations	Location of Maximum Concentration	LOC	LOC Source	UOM	Exceed LOC?	Number of Hits Exceeding LOC
Styrene	0 / 51	--	--	1600	TWRBC	µg/L	No	--
1,1,2,2-Tetrachloroethane	0 / 51	--	--	0.17	Water & Organisms	µg/L	No	--
Tetrachloroethene	0 / 51	--	--	0.388	SWQC	µg/L	No	--
Toluene	6 / 51	0.2 / 1.2	11SW-3 11/09/2004	1300	Water & Organisms	µg/L	No	--
1,1,1-Trichloroethane	0 / 51	--	--	127	SWQC	µg/L	No	--
1,1,2-Trichloroethane	0 / 51	--	--	0.59	Water & Organisms	µg/L	No	--
Trichloroethene	21 / 51	0.33 / 14	11SW-3 10/15/2007	1.09	SWQC	µg/L	**Yes**	15
Trichlorofluoromethane	0 / 51	--	--	1300	TWRBC	µg/L	No	--
1,1,2-Trichloro-1,2,2-trifluoroethane	22 / 51	0.419 / 82	11SW-3 10/15/2007	59000	TWRBC	µg/L	No	--
Vinyl chloride	0 / 51	--	--	0.025	Water & Organisms	µg/L	No	--
Total Xylenes	0 / 51	--	--	210	TWRBC	µg/L	No	--
1,3-Dinitrobenzene	0 / 21	--	--	3.7	TWRBC	µg/L	No	--
2,4-Dinitrotoluene	0 / 21	--	--	0.11	Water & Organisms, SWQC	µg/L	No	--
2,6-Dinitrotoluene	0 / 21	--	--	37	TWRBC	µg/L	No	--
2-amino-4,6-Dinitrotoluene	0 / 21	--	--	73	TWRBC	µg/L	No	--
4-amino-2,6-Dinitrotoluene	0 / 21	--	--	73	TWRBC	µg/L	No	--
HMX	10 / 21	0.17 / 2.1	11SW-1 10/30/2006	1800	TWRBC	µg/L	No	--
Nitrobenzene	2 / 21	0.092 / 0.89	13SW-5 03/30/2007	16	SWQC	µg/L	No	--
2-Nitrotoluene	0 / 21	--	--	61	TWRBC	µg/L	No	--
3-Nitrotoluene	0 / 21	--	--	61	TWRBC	µg/L	No	--
4-Nitrotoluene	0 / 21	--	--	61	TWRBC	µg/L	No	--
RDX	12 / 21	0.049 / 10	11SW-1 10/30/2006	0.5	NJPQL	µg/L	**Yes**	3
Tetryl	0 / 21	--	--	150	TWRBC	µg/L	No	--
1,3,5-Trinitrobenzene	0 / 21	--	--	1100	TWRBC	µg/L	No	--
2,4,6-Trinitrotoluene	0 / 21	--	--	2.2	TWRBC	µg/L	No	--

Table 4-5
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Sediment (mg/kg)

			Analytical Results																							
		Sample ID:	11SD-1				11SD-1				11SD-1				11SD-1				11SD-1				11SD-1DUP			
		Date Sampled:	11/9/2004				1/11/2006				12/13/2006				3/23/2007				6/23/2008				6/23/2008			
		Depth Sampled (ft):	0-1				0-1				0-1				0-1				0-1				0-1			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	0.0087	SQB	0.19	(U)	0.15	0.021	0.5	U	0.5	0.07599	NT				NT				NT				NT			
Acetonitrile		NA	0.77	R	0.77	0.043	0.77	U	0.77	0.043	NT				NT				NT				NT			
Benzene	0.16	SQB	0.039	U	0.039	0.0018	0.039	U	0.039	0.0018	NT				NT				NT				NT			
Bromodichloromethane	46	NJNR, IRBC	0.039	U	0.039	0.0037	0.039	U	0.039	0.0037	NT				NT				NT				NT			
Bromoform	360	IRBC	0.039	U	0.039	0.005	0.039	U	0.039	0.005	NT				NT				NT				NT			
Bromomethane	1000	NJNR	0.039	U	0.039	0.0047	0.039	U	0.039	0.0047	NT				NT				NT				NT			
2-Butanone	0.27	SQB	0.15	(U)	0.15	0.0077	0.15	(U)	0.15	0.0077	NT				NT				NT				NT			
Carbon disulfide	0.00085	SQB	0.039	U	0.039	0.0015	0.039	U	0.039	0.0015	NT				NT				NT				NT			
Carbon tetrachloride	0.047	SQB	0.039	U	0.039	0.0035	0.039	U	0.039	0.0035	NT				NT				NT				NT			
Chlorobenzene	0.035	NYSDEC	0.039	U	0.039	0.0022	0.039	U	0.039	0.0022	NT				NT				NT				NT			
Chloroethane	990	IRBC	0.039	U	0.039	0.0042	0.039	U	0.039	0.0042	NT				NT				NT				NT			
Chloroform	0.022	SQB	0.039	U	0.039	0.0031	0.039	U	0.039	0.0031	NT				NT				NT				NT			
Chloromethane	1000	NJNR	0.039	U	0.039	0.0019	0.039	U	0.039	0.0019	NT				NT				NT				NT			
Dibromochloromethane	34	IRBC	0.039	U	0.039	0.0028	0.039	U	0.039	0.0028	NT				NT				NT				NT			
Dichlorodifluoromethane	200000	IRBC	0.039	U	0.039	0.0031	0.039	U	0.039	0.0031	NT				NT				NT				NT			
1,1-Dichloroethane	0.027	SQB	0.039	U	0.039	0.0025	0.039	U	0.039	0.0025	NT				NT				NT				NT			
1,2-Dichloroethane	0.25	SQB	0.039	U	0.039	0.0037	0.039	U	0.039	0.0037	NT				NT				NT				NT			
1,1-Dichloroethene	0.031	SQB	0.039	U	0.039	0.0046	0.039	U	0.039	0.0046	NT				NT				NT				NT			
cis-1,2-Dichloroethene	0.4	SQB	0.039	U	0.039	0.0032	0.039	U	0.039	0.0032	NT				NT				NT				NT			
trans-1,2-Dichloroethene	0.4	SQB	0.039	U	0.039	0.0042	0.039	U	0.039	0.0043	NT				NT				NT				NT			
1,2-Dichloropropane	42	IRBC	0.039	U	0.039	0.0027	0.039	U	0.039	0.0027	NT				NT				NT				NT			
cis-1,3-Dichloropropene	0.000051	SQB	0.039	U	0.039	0.0027	0.039	U	0.039	0.0027	NT				NT				NT				NT			
trans-1,3-Dichloropropene	0.000051	SQB	0.039	U	0.039	0.0027	0.039	U	0.039	0.0027	NT				NT				NT				NT			
Ethyl benzene	0.089	SQB	0.039	U	0.039	0.0041	0.039	U	0.039	0.0041	NT				NT				NT				NT			
2-Hexanone	0.022	SQB	0.15	U	0.15	0.0065	0.15	U	0.15	0.0065	NT				NT				NT				NT			
Methyl tert-Butyl ether	720	IRBC	0.15	U	0.15	0.0022	0.15	U	0.15	0.0022	NT				NT				NT				NT			
4-Methyl-2-pentanone (MIBK)	0.033	SQB	0.15	U	0.15	0.0042	0.15	U	0.15	0.0042	NT				NT				NT				NT			
Methylene chloride	0.37	SQB	0.039	U	0.039	0.01	0.039	U	0.039	0.01	NT				NT				NT				NT			
Styrene	97	NJNR	0.039	U	0.039	0.0015	0.039	U	0.039	0.0015	NT				NT				NT				NT			
1,1,2,2-Tetrachloroethane	1.4	SQB	0.039	U	0.039	0.0035	0.039	U	0.039	0.0036	NT				NT				NT				NT			
Tetrachloroethene	0.41	SQB	0.039	U	0.039	0.0064	0.039	U	0.039	0.0064	NT				NT				NT				NT			
Toluene	0.05	SQB	**0.12**		0.039	0.0022	**0.071**		0.039	0.0022	NT				NT				NT				NT			
1,1,1-Trichloroethane	0.03	SQB	0.039	U	0.039	0.0059	0.039	U	0.039	0.0059	NT				NT				NT				NT			
1,1,2-Trichloroethane	1.2	SQB	0.039	U	0.039	0.0032	0.039	U	0.039	0.0032	NT				NT				NT				NT			
Trichloroethene	0.22	SQB	0.039	U	0.039	0.0032	0.039	U	0.039	0.0032	NT				NT				NT				NT			
Trichlorofluoromethane	310000	IRBC	0.039	U	0.039	0.0032	0.039	U	0.039	0.0032	NT				NT				NT				NT			
1,1,2-Trichloro-1,2,2-trifluoroethane	31000000	IRBC	0.039	U	0.039	0.0062	0.039	U	0.039	0.0062	NT				NT				NT				NT			
Vinyl chloride	4	IRBC	0.039	U	0.039	0.0034	0.039	U	0.039	0.0034	NT				NT				NT				NT			
Total Xylenes	0.16	SQB	0.077	U	0.077	0.0059	0.077	U	0.077	0.0059	NT				NT				NT				NT			
Explosives																										
1,3-Dinitrobenzene	100	IRBC	NT				NT				0.25	U	0.25	0.02	0.25	U	0.25	0.02	0.12	U	0.12	0.011	0.12	U	0.12	0.011
2,4-Dinitrotoluene	4.2	NJNR	NT				NT				0.25	U	0.25	0.03	0.25	U	0.25	0.03	0.12	U	0.12	0.014	0.12	U	0.12	0.014
2,6-Dinitrotoluene	4.2	NJNR	NT				NT				0.25	U	0.25	0.04	0.25	U	0.25	0.04	0.12	U	0.12	0.022	0.12	U	0.12	0.022
2-amino-4,6-Dinitrotoluene	2000	IRBC	NT				NT				0.25	U	0.25	0.1	0.25	U	0.25	0.1	0.12	U	0.12	0.013	0.12	U	0.12	0.013
4-amino-2,6-Dinitrotoluene	2000	IRBC	NT				NT				0.25	U	0.25	0.06	0.25	U	0.25	0.06	0.12	U	0.12	0.013	0.12	U	0.12	0.013
HMX	10000	NJNR	NT				NT				0.5	U	0.5	0.05	0.5	U	0.5	0.05	0.12	U	0.12	0.013	0.12	U	0.12	0.013
Nitrobenzene	510	IRBC	NT				NT				0.25	U	0.25	0.02	0.25	U	0.25	0.02	0.12	U	0.12	0.011	0.12	U	0.12	0.011
2-Nitrotoluene	10000	IRBC	NT				NT				0.25	U	0.25	0.1	0.25	U	0.25	0.1	0.12	U	0.12	0.031	0.12	U	0.12	0.031
3-Nitrotoluene	10000	IRBC	NT				NT				0.25	U	0.25	0.08	0.25	U	0.25	0.08	0.12	U	0.12	0.023	0.12	U	0.12	0.023
4-Nitrotoluene	10000	IRBC	NT				NT				0.25	U	0.25	0.1	0.25	U	0.25	0.1	0.12	U	0.12	0.022	0.12	U	0.12	0.022
RDX	26	NJNR, IRBC	NT				NT				0.5	U	0.5	0.06	0.5	U	0.5	0.06	0.12	U	0.12	0.015	0.12	U	0.12	0.015
Tetryl	4100	IRBC	NT				NT				0.65	U	0.65	0.05	0.65	U	0.65	0.05	0.12	U	0.12	0.015	0.12	U	0.12	0.015
1,3,5-Trinitrobenzene	31000	IRBC	NT				NT				0.25	U	0.25	0.03	0.25	U	0.25	0.03	0.12	U	0.12	0.02	0.12	U	0.12	0.02
2,4,6-Trinitrotoluene	95	NJNR, IRBC	NT				NT				0.25	U	0.25	0.03	0.25	U	0.25	0.03	0.12	U	0.12	0.011	0.12	U	0.12	0.011

Table 4-5
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Sediment (mg/kg)

			Analytical Results																							
		Sample ID:	11SD-1A				11SD-2				11SD-2				11SD-2				11SD-3				11SD-3			
		Date Sampled:	12/13/2006				11/9/2004				1/11/2006				6/23/2008				11/9/2004				1/11/2006			
		Depth Sampled (ft):	0-1				0-1				0-1				0-1				0-1				0-1			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	0.0087	SQB	NT				0.033	U	0.033	0.0045	0.027	U	0.027	0.0036	NT				0.084	(U)	0.041	0.0055	0.029	U	0.029	0.0039
Acetonitrile		NA	NT				0.17	R	0.17	0.0092	0.13	U	0.13	0.0074	NT				0.2	R	0.2	0.011	0.14	U	0.14	0.008
Benzene	0.16	SQB	NT				0.0083	U	0.0083	0.00038	0.0066	U	0.0066	0.00031	NT				**0.00063**	**J**	0.01	0.00047	0.0072	U	0.0072	0.00033
Bromodichloromethane	46	NJNR, IRBC	NT				0.0083	U	0.0083	0.00079	0.0066	U	0.0066	0.00064	NT				0.01	U	0.01	0.00098	0.0072	U	0.0072	0.00069
Bromoform	360	IRBC	NT				0.0083	U	0.0083	0.0011	0.0066	U	0.0066	0.00086	NT				0.01	U	0.01	0.0013	0.0072	U	0.0072	0.00093
Bromomethane	1000	NJNR	NT				0.0083	U	0.0083	0.001	0.0066	U	0.0066	0.00081	NT				0.01	U	0.01	0.0012	0.0072	U	0.0072	0.00087
2-Butanone	0.27	SQB	NT				0.033	U	0.033	0.0017	0.027	U	0.027	0.0013	NT				0.041	(U)	0.041	0.002	0.029	U	0.029	0.0014
Carbon disulfide	0.00085	SQB	NT				0.0083	U	0.0083	0.00033	0.0066	U	0.0066	0.00027	NT				0.01	U	0.01	0.00041	0.0072	U	0.0072	0.00029
Carbon tetrachloride	0.047	SQB	NT				0.0083	U	0.0083	0.00074	0.0066	U	0.0066	0.0006	NT				0.01	U	0.01	0.00092	0.0072	U	0.0072	0.00064
Chlorobenzene	0.035	NYSDEC	NT				0.0083	U	0.0083	0.00046	0.0066	U	0.0066	0.00037	NT				0.01	U	0.01	0.00057	0.0072	U	0.0072	0.0004
Chloroethane	990	IRBC	NT				0.0083	U	0.0083	0.00089	0.0066	U	0.0066	0.00072	NT				0.01	U	0.01	0.0011	0.0072	U	0.0072	0.00077
Chloroform	0.022	SQB	NT				0.0083	U	0.0083	0.00066	0.0066	U	0.0066	0.00053	NT				0.01	U	0.01	0.00082	0.0072	U	0.0072	0.00057
Chloromethane	1000	NJNR	NT				0.0083	U	0.0083	0.00041	0.0066	U	0.0066	0.00033	NT				0.01	U	0.01	0.00051	0.0072	U	0.0072	0.00036
Dibromochloromethane	34	IRBC	NT				0.0083	U	0.0083	0.00059	0.0066	U	0.0066	0.00048	NT				0.01	U	0.01	0.00073	0.0072	U	0.0072	0.00052
Dichlorodifluoromethane	200000	IRBC	NT				0.0083	U	0.0083	0.00066	0.0066	U	0.0066	0.00053	NT				0.01	U	0.01	0.00082	0.0072	U	0.0072	0.00057
1,1-Dichloroethane	0.027	SQB	NT				0.0083	U	0.0083	0.00053	0.0066	U	0.0066	0.00042	NT				0.01	U	0.01	0.00065	0.0072	U	0.0072	0.00046
1,2-Dichloroethane	0.25	SQB	NT				0.0083	U	0.0083	0.00079	0.0066	U	0.0066	0.00064	NT				0.01	U	0.01	0.00098	0.0072	U	0.0072	0.00069
1,1-Dichloroethene	0.031	SQB	NT				0.0083	U	0.0083	0.00099	0.0066	U	0.0066	0.0008	NT				0.01	U	0.01	0.0012	0.0072	U	0.0072	0.00086
cis-1,2-Dichloroethene	0.4	SQB	NT				0.0083	U	0.0083	0.00068	0.0066	U	0.0066	0.00054	NT				0.01	U	0.01	0.00084	0.0072	U	0.0072	0.00059
trans-1,2-Dichloroethene	0.4	SQB	NT				0.0083	U	0.0083	0.00091	0.0066	U	0.0066	0.00073	NT				0.01	U	0.01	0.0011	0.0072	U	0.0072	0.00079
1,2-Dichloropropane	42	IRBC	NT				0.0083	U	0.0083	0.00058	0.0066	U	0.0066	0.00046	NT				0.01	U	0.01	0.00071	0.0072	U	0.0072	0.0005
cis-1,3-Dichloropropene	0.000051	SQB	NT				0.0083	U	0.0083	0.00058	0.0066	U	0.0066	0.00046	NT				0.01	U	0.01	0.00071	0.0072	U	0.0072	0.0005
trans-1,3-Dichloropropene	0.000051	SQB	NT				0.0083	U	0.0083	0.00058	0.0066	U	0.0066	0.00046	NT				0.01	U	0.01	0.00071	0.0072	U	0.0072	0.0005
Ethyl benzene	0.089	SQB	NT				0.0083	U	0.0083	0.00087	0.0066	U	0.0066	0.0007	NT				0.01	U	0.01	0.0011	0.0072	U	0.0072	0.00076
2-Hexanone	0.022	SQB	NT				0.033	U	0.033	0.0014	0.027	U	0.027	0.0011	NT				0.041	U	0.041	0.0017	0.029	U	0.029	0.0012
Methyl tert-Butyl ether	720	IRBC	NT				0.033	U	0.033	0.00046	**0.00046**	**J**	0.027	0.00037	NT				0.041	U	0.041	0.00057	0.029	U	0.029	0.0004
4-Methyl-2-pentanone (MIBK)	0.033	SQB	NT				0.033	U	0.033	0.00089	0.027	U	0.027	0.00072	NT				0.041	U	0.041	0.0011	0.029	U	0.029	0.00077
Methylene chloride	0.37	SQB	NT				0.0083	U	0.0083	0.0021	0.0066	U	0.0066	0.0017	NT				0.012	(U)	0.01	0.0027	0.0072	U	0.0072	0.0019
Styrene	97	NJNR	NT				0.0083	U	0.0083	0.00033	0.0066	U	0.0066	0.00027	NT				0.01	U	0.01	0.00041	0.0072	U	0.0072	0.00029
1,1,2,2-Tetrachloroethane	1.4	SQB	NT				0.0083	U	0.0083	0.00076	0.0066	U	0.0066	0.00061	NT				0.01	U	0.01	0.00094	0.0072	U	0.0072	0.00066
Tetrachloroethene	0.41	SQB	NT				0.0083	U	0.0083	0.0014	0.0066	U	0.0066	0.0011	NT				0.01	U	0.01	0.0017	0.0072	U	0.0072	0.0012
Toluene	0.05	SQB	NT				0.0083	U	0.0083	0.00048	0.0066	U	0.0066	0.00038	NT				**0.0021**	**J**	0.01	0.00059	0.0072	U	0.0072	0.00042
1,1,1-Trichloroethane	0.03	SQB	NT				0.0083	U	0.0083	0.0013	0.0066	U	0.0066	0.001	NT				0.01	U	0.01	0.0016	0.0072	U	0.0072	0.0011
1,1,2-Trichloroethane	1.2	SQB	NT				0.0083	U	0.0083	0.00068	0.0066	U	0.0066	0.00054	NT				0.01	U	0.01	0.00084	0.0072	U	0.0072	0.00059
Trichloroethene	0.22	SQB	NT				0.0083	U	0.0083	0.00068	0.0066	U	0.0066	0.00054	NT				0.01	U	0.01	0.00084	**0.0048**	**J**	0.0072	0.00059
Trichlorofluoromethane	310000	IRBC	NT				0.0083	U	0.0083	0.00068	0.0066	U	0.0066	0.00054	NT				0.01	U	0.01	0.00084	0.0072	U	0.0072	0.00059
1,1,2-Trichloro-1,2,2-trifluoroethane	31000000	IRBC	NT				**0.012**		0.0083	0.0013	**0.0014**	**J**	0.0066	0.0011	NT				0.01	U	0.01	0.0016	0.0072	U	0.0072	0.0011
Vinyl chloride	4	IRBC	NT				0.0083	U	0.0083	0.00073	0.0066	U	0.0066	0.00058	NT				0.01	U	0.01	0.0009	0.0072	U	0.0072	0.00063
Total Xylenes	0.16	SQB	NT				0.017	U	0.017	0.0013	0.013	U	0.013	0.001	NT				0.02	U	0.02	0.0016	0.014	U	0.014	0.0011
Explosives																										
1,3-Dinitrobenzene	100	IRBC	0.25	U	0.25	0.02	NT				NT				0.12	U	0.12	0.011	NT				NT			
2,4-Dinitrotoluene	4.2	NJNR	0.25	U	0.25	0.03	NT				NT				0.12	U	0.12	0.014	NT				NT			
2,6-Dinitrotoluene	4.2	NJNR	0.25	U	0.25	0.04	NT				NT				0.12	U	0.12	0.022	NT				NT			
2-amino-4,6-Dinitrotoluene	2000	IRBC	0.25	U	0.25	0.1	NT				NT				0.12	U	0.12	0.013	NT				NT			
4-amino-2,6-Dinitrotoluene	2000	IRBC	0.25	U	0.25	0.06	NT				NT				0.12	U	0.12	0.013	NT				NT			
HMX	10000	NJNR	0.5	U	0.5	0.05	NT				NT				0.12	U	0.12	0.013	NT				NT			
Nitrobenzene	510	IRBC	**0.033**	**J**	0.25	0.02	NT				NT				0.12	U	0.12	0.011	NT				NT			
2-Nitrotoluene	10000	IRBC	0.25	U	0.25	0.1	NT				NT				0.12	U	0.12	0.031	NT				NT			
3-Nitrotoluene	10000	IRBC	0.25	U	0.25	0.08	NT				NT				0.12	U	0.12	0.023	NT				NT			
4-Nitrotoluene	10000	IRBC	0.25	U	0.25	0.1	NT				NT				0.12	U	0.12	0.022	NT				NT			
RDX	26	NJNR, IRBC	0.5	U	0.5	0.06	NT				NT				0.12	U	0.12	0.015	NT				NT			
Tetryl	4100	IRBC	0.65	U	0.65	0.05	NT				NT				0.12	U	0.12	0.015	NT				NT			
1,3,5-Trinitrobenzene	31000	IRBC	0.25	U	0.25	0.03	NT				NT				0.12	U	0.12	0.02	NT				NT			
2,4,6-Trinitrotoluene	95	NJNR, IRBC	0.25	U	0.25	0.03	NT				NT				0.12	U	0.12	0.011	NT				NT			

Table 4-5
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Sediment (mg/kg)

			Analytical Results																							
		Sample ID:	11SD-3				13SD-4				13SD-4				13SD-5				13SD-5				13SD-6			
		Date Sampled:	6/23/2008				11/9/2004				1/11/2006				11/9/2004				1/11/2006				1/11/2006			
		Depth Sampled (ft):	0-1				0-1				0-1				0-1				0-1				0-1			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																										
Acetone	0.0087	SQB	NT				0.03	(U)	0.03	0.004	0.076	U	0.076	0.01	0.028	(U)	0.028	0.0038	0.071	U	0.071	0.0096	0.029	U	0.029	0.0039
Acetonitrile		NA	NT				0.15	R	0.15	0.0084	0.38	U	0.38	0.021	0.14	R	0.14	0.0078	0.36	U	0.36	0.02	0.15	U	0.15	0.0082
Benzene	0.16	SQB	NT				0.0075	U	0.0075	0.00034	0.019	U	0.019	0.00087	0.0069	U	0.0069	0.00032	0.018	U	0.018	0.00082	0.0073	U	0.0073	0.00033
Bromodichloromethane	46	NJNR, IRBC	NT				0.0075	U	0.0075	0.00072	0.019	U	0.019	0.0018	0.0069	U	0.0069	0.00067	0.018	U	0.018	0.0017	0.0073	U	0.0073	0.0007
Bromoform	360	IRBC	NT				0.0075	U	0.0075	0.00097	0.019	U	0.019	0.0025	0.0069	U	0.0069	0.0009	0.018	U	0.018	0.0023	0.0073	U	0.0073	0.00095
Bromomethane	1000	NJNR	NT				0.0075	U	0.0075	0.00091	0.019	U	0.019	0.0023	0.0069	U	0.0069	0.00085	0.018	U	0.018	0.0022	0.0073	U	0.0073	0.00089
2-Butanone	0.27	SQB	NT				0.03	(U)	0.03	0.0015	0.076	U	0.076	0.0038	0.028	(U)	0.028	0.0014	0.071	U	0.071	0.0036	0.029	U	0.029	0.0015
Carbon disulfide	0.00085	SQB	NT				0.0075	U	0.0075	0.0003	0.019	U	0.019	0.00076	0.0069	U	0.0069	0.00028	0.018	U	0.018	0.00071	0.0073	U	0.0073	0.00029
Carbon tetrachloride	0.047	SQB	NT				0.0075	U	0.0075	0.00067	0.019	U	0.019	0.0017	0.0069	U	0.0069	0.00063	0.018	U	0.018	0.0016	0.0073	U	0.0073	0.00066
Chlorobenzene	0.035	NYSDEC	NT				0.0075	U	0.0075	0.00042	0.019	U	0.019	0.0011	0.0069	U	0.0069	0.00039	0.018	U	0.018	0.001	0.0073	U	0.0073	0.00041
Chloroethane	990	IRBC	NT				0.0075	U	0.0075	0.00081	0.019	U	0.019	0.002	0.0069	U	0.0069	0.00075	0.018	U	0.018	0.0019	0.0073	U	0.0073	0.00079
Chloroform	0.022	SQB	NT				0.0075	U	0.0075	0.0006	0.019	U	0.019	0.0015	0.0069	U	0.0069	0.00056	0.018	U	0.018	0.0014	0.0073	U	0.0073	0.00058
Chloromethane	1000	NJNR	NT				0.0075	U	0.0075	0.00037	0.019	U	0.019	0.00094	0.0069	U	0.0069	0.00035	0.018	U	0.018	0.00089	0.0073	U	0.0073	0.00036
Dibromochloromethane	34	IRBC	NT				0.0075	U	0.0075	0.00054	0.019	U	0.019	0.0014	0.0069	U	0.0069	0.0005	0.018	U	0.018	0.0013	0.0073	U	0.0073	0.00052
Dichlorodifluoromethane	200000	IRBC	NT				0.0075	U	0.0075	0.0006	0.019	U	0.019	0.0015	0.0069	U	0.0069	0.00056	0.018	U	0.018	0.0014	0.0073	U	0.0073	0.00058
1,1-Dichloroethane	0.027	SQB	NT				0.0075	U	0.0075	0.00048	0.019	U	0.019	0.0012	0.0069	U	0.0069	0.00044	0.018	U	0.018	0.0011	0.0073	U	0.0073	0.00047
1,2-Dichloroethane	0.25	SQB	NT				0.0075	U	0.0075	0.00072	0.019	U	0.019	0.0018	0.0069	U	0.0069	0.00067	0.018	U	0.018	0.0017	0.0073	U	0.0073	0.0007
1,1-Dichloroethene	0.031	SQB	NT				0.0075	U	0.0075	0.0009	0.019	U	0.019	0.0023	0.0069	U	0.0069	0.00083	0.018	U	0.018	0.0021	0.0073	U	0.0073	0.00087
cis-1,2-Dichloroethene	0.4	SQB	NT				0.0075	U	0.0075	0.00061	**0.0047**	**J**	0.019	0.0015	0.0069	U	0.0069	0.00057	0.018	U	0.018	0.0015	0.0073	U	0.0073	0.0006
trans-1,2-Dichloroethene	0.4	SQB	NT				0.0075	U	0.0075	0.00082	0.019	U	0.019	0.0021	0.0069	U	0.0069	0.00076	0.018	U	0.018	0.002	0.0073	U	0.0073	0.0008
1,2-Dichloropropane	42	IRBC	NT				0.0075	U	0.0075	0.00052	0.019	U	0.019	0.0013	0.0069	U	0.0069	0.00049	0.018	U	0.018	0.0012	0.0073	U	0.0073	0.00051
cis-1,3-Dichloropropene	0.000051	SQB	NT				0.0075	U	0.0075	0.00052	0.019	U	0.019	0.0013	0.0069	U	0.0069	0.00049	0.018	U	0.018	0.0012	0.0073	U	0.0073	0.00051
trans-1,3-Dichloropropene	0.000051	SQB	NT				0.0075	U	0.0075	0.00052	0.019	U	0.019	0.0013	0.0069	U	0.0069	0.00049	0.018	U	0.018	0.0012	0.0073	U	0.0073	0.00051
Ethyl benzene	0.089	SQB	NT				0.0075	U	0.0075	0.00079	0.019	U	0.019	0.002	0.0069	U	0.0069	0.00074	0.018	U	0.018	0.0019	0.0073	U	0.0073	0.00077
2-Hexanone	0.022	SQB	NT				0.03	U	0.03	0.0013	0.076	U	0.076	0.0032	0.028	U	0.028	0.0012	0.071	U	0.071	0.003	0.029	U	0.029	0.0012
Methyl tert-Butyl ether	720	IRBC	NT				0.03	U	0.03	0.00042	0.076	U	0.076	0.0011	0.028	U	0.028	0.00039	0.071	U	0.071	0.001	**0.0014**	**J**	0.029	0.00041
4-Methyl-2-pentanone (MIBK)	0.033	SQB	NT				0.03	U	0.03	0.00081	0.076	U	0.076	0.002	0.028	U	0.028	0.00075	0.071	U	0.071	0.0019	0.029	U	0.029	0.00079
Methylene chloride	0.37	SQB	NT				0.0075	U	0.0075	0.0019	**0.021**		0.019	0.0049	0.0069	U	0.0069	0.0018	0.018	U	0.018	0.0046	0.0073	(U)	0.0073	0.0019
Styrene	97	NJNR	NT				0.0075	U	0.0075	0.0003	0.019	U	0.019	0.00076	0.0069	U	0.0069	0.00028	0.018	U	0.018	0.00071	0.0073	U	0.0073	0.00029
1,1,2,2-Tetrachloroethane	1.4	SQB	NT				0.0075	U	0.0075	0.00069	0.019	U	0.019	0.0017	0.0069	U	0.0069	0.00064	0.018	U	0.018	0.0016	0.0073	U	0.0073	0.00067
Tetrachloroethene	0.41	SQB	NT				0.0075	U	0.0075	0.0012	0.019	U	0.019	0.0031	0.0069	U	0.0069	0.0012	0.018	U	0.018	0.003	0.0073	U	0.0073	0.0012
Toluene	0.05	SQB	NT				**0.0013**	**J**	0.0075	0.00043	0.019	U	0.019	0.0011	**0.0056**	**J**	0.0069	0.0004	0.018	U	0.018	0.001	0.0073	U	0.0073	0.00042
1,1,1-Trichloroethane	0.03	SQB	NT				0.0075	U	0.0075	0.0011	0.019	U	0.019	0.0029	0.0069	U	0.0069	0.0011	0.018	U	0.018	0.0027	0.0073	U	0.0073	0.0011
1,1,2-Trichloroethane	1.2	SQB	NT				0.0075	U	0.0075	0.00061	0.019	U	0.019	0.0015	0.0069	U	0.0069	0.00057	0.018	U	0.018	0.0015	0.0073	U	0.0073	0.0006
Trichloroethene	0.22	SQB	NT				0.0075	U	0.0075	0.00061	**0.074**		0.019	0.0015	**0.0011**	**J**	0.0069	0.00057	**0.0018**	**J**	0.018	0.0015	**0.0026**	**J**	0.0073	0.0006
Trichlorofluoromethane	310000	IRBC	NT				0.0075	U	0.0075	0.00061	0.019	U	0.019	0.0015	0.0069	U	0.0069	0.00057	0.018	U	0.018	0.0015	0.0073	U	0.0073	0.0006
1,1,2-Trichloro-1,2,2-trifluoroethane	31000000	IRBC	NT				0.0075	U	0.0075	0.0012	**0.012**	**J**	0.019	0.003	0.0069	U	0.0069	0.0011	**0.0041**	**J**	0.018	0.0028	**0.0074**		0.0073	0.0012
Vinyl chloride	4	IRBC	NT				0.0075	U	0.0075	0.00066	0.019	U	0.019	0.0017	0.0069	U	0.0069	0.00061	0.018	U	0.018	0.0016	0.0073	U	0.0073	0.00064
Total Xylenes	0.16	SQB	NT				0.015	U	0.015	0.0011	0.038	U	0.038	0.0029	0.014	U	0.014	0.0011	0.036	U	0.036	0.0027	0.015	U	0.015	0.0011
Explosives																										
1,3-Dinitrobenzene	100	IRBC	0.12	U	0.12	0.011	NT				NT				NT				NT				NT			
2,4-Dinitrotoluene	4.2	NJNR	0.12	U	0.12	0.014	NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	4.2	NJNR	0.12	U	0.12	0.022	NT				NT				NT				NT				NT			
2-amino-4,6-Dinitrotoluene	2000	IRBC	0.12	U	0.12	0.013	NT				NT				NT				NT				NT			
4-amino-2,6-Dinitrotoluene	2000	IRBC	0.12	U	0.12	0.013	NT				NT				NT				NT				NT			
HMX	10000	NJNR	0.12	U	0.12	0.013	NT				NT				NT				NT				NT			
Nitrobenzene	510	IRBC	0.12	U	0.12	0.011	NT				NT				NT				NT				NT			
2-Nitrotoluene	10000	IRBC	0.12	U	0.12	0.031	NT				NT				NT				NT				NT			
3-Nitrotoluene	10000	IRBC	0.12	U	0.12	0.023	NT				NT				NT				NT				NT			
4-Nitrotoluene	10000	IRBC	0.12	U	0.12	0.022	NT				NT				NT				NT				NT			
RDX	26	NJNR, IRBC	0.12	U	0.12	0.015	NT				NT				NT				NT				NT			
Tetryl	4100	IRBC	0.12	U	0.12	0.015	NT				NT				NT				NT				NT			
1,3,5-Trinitrobenzene	31000	IRBC	0.12	U	0.12	0.02	NT				NT				NT				NT				NT			
2,4,6-Trinitrotoluene	95	NJNR, IRBC	0.12	U	0.12	0.011	NT				NT				NT				NT				NT			

Table 4-5
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Sediment (mg/kg)

			Analytical Results							
		Sample ID:	13SD-7				13SD-9			
		Date Sampled:	1/11/2006				1/11/2006			
		Depth Sampled (ft):	0-1				0-1			
Chemical	**LOC (a):**	**Source**	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles										
Acetone	0.0087	SQB	0.028	U	0.028	0.0037	0.044	U	0.044	0.0059
Acetonitrile		NA	0.14	U	0.14	0.0077	0.22	U	0.22	0.012
Benzene	0.16	SQB	0.0069	U	0.0069	0.00032	0.011	U	0.011	0.0005
Bromodichloromethane	46	NJNR, IRBC	0.0069	U	0.0069	0.00066	0.011	U	0.011	0.0011
Bromoform	360	IRBC	0.0069	U	0.0069	0.0009	0.011	U	0.011	0.0014
Bromomethane	1000	NJNR	0.0069	U	0.0069	0.00084	0.011	U	0.011	0.0013
2-Butanone	0.27	SQB	0.028	U	0.028	0.0014	0.044	U	0.044	0.0022
Carbon disulfide	0.00085	SQB	0.0069	U	0.0069	0.00028	0.011	U	0.011	0.00044
Carbon tetrachloride	0.047	SQB	0.0069	U	0.0069	0.00062	0.011	U	0.011	0.00099
Chlorobenzene	0.035	NYSDEC	0.0069	U	0.0069	0.00039	0.011	U	0.011	0.00061
Chloroethane	990	IRBC	0.0069	U	0.0069	0.00074	0.011	U	0.011	0.0012
Chloroform	0.022	SQB	0.0069	U	0.0069	0.00055	0.011	U	0.011	0.00088
Chloromethane	1000	NJNR	0.0069	U	0.0069	0.00034	0.011	U	0.011	0.00055
Dibromochloromethane	34	IRBC	0.0069	U	0.0069	0.0005	0.011	U	0.011	0.00079
Dichlorodifluoromethane	200000	IRBC	0.0069	U	0.0069	0.00055	0.011	U	0.011	0.00088
1,1-Dichloroethane	0.027	SQB	0.0069	U	0.0069	0.00044	0.011	U	0.011	0.0007
1,2-Dichloroethane	0.25	SQB	0.0069	U	0.0069	0.00066	0.011	U	0.011	0.0011
1,1-Dichloroethene	0.031	SQB	0.0069	U	0.0069	0.00083	0.011	U	0.011	0.0013
cis-1,2-Dichloroethene	0.4	SQB	0.0069	U	0.0069	0.00056	0.011	U	0.011	0.0009
trans-1,2-Dichloroethene	0.4	SQB	0.0069	U	0.0069	0.00076	0.011	U	0.011	0.0012
1,2-Dichloropropane	42	IRBC	0.0069	U	0.0069	0.00048	0.011	U	0.011	0.00077
cis-1,3-Dichloropropene	0.000051	SQB	0.0069	U	0.0069	0.00048	0.011	U	0.011	0.00077
trans-1,3-Dichloropropene	0.000051	SQB	0.0069	U	0.0069	0.00048	0.011	U	0.011	0.00077
Ethyl benzene	0.089	SQB	0.0069	U	0.0069	0.00073	0.011	U	0.011	0.0012
2-Hexanone	0.022	SQB	0.028	U	0.028	0.0012	0.044	U	0.044	0.0018
Methyl tert-Butyl ether	720	IRBC	0.028	U	0.028	0.00039	0.044	U	0.044	0.00061
4-Methyl-2-pentanone (MIBK)	0.033	SQB	0.028	U	0.028	0.00074	0.044	U	0.044	0.0012
Methylene chloride	0.37	SQB	0.0069	U	0.0069	0.0018	0.011	(U)	0.011	0.0028
Styrene	97	NJNR	0.0069	U	0.0069	0.00028	0.011	U	0.011	0.00044
1,1,2,2-Tetrachloroethane	1.4	SQB	0.0069	U	0.0069	0.00063	0.011	U	0.011	0.001
Tetrachloroethene	0.41	SQB	0.0069	U	0.0069	0.0011	0.011	U	0.011	0.0018
Toluene	0.05	SQB	0.0069	U	0.0069	0.0004	**0.001**	**J**	0.011	0.00064
1,1,1-Trichloroethane	0.03	SQB	0.0069	U	0.0069	0.001	0.011	U	0.011	0.0017
1,1,2-Trichloroethane	1.2	SQB	0.0069	U	0.0069	0.00056	0.011	U	0.011	0.0009
Trichloroethene	0.22	SQB	0.0069	U	0.0069	0.00056	0.011	U	0.011	0.0009
Trichlorofluoromethane	310000	IRBC	0.0069	U	0.0069	0.00056	0.011	U	0.011	0.0009
1,1,2-Trichloro-1,2,2-trifluoroethane	31000000	IRBC	0.0069	U	0.0069	0.0011	0.011	U	0.011	0.0018
Vinyl chloride	4	IRBC	0.0069	U	0.0069	0.00061	0.011	U	0.011	0.00096
Total Xylenes	0.16	SQB	0.014	U	0.014	0.001	0.022	U	0.022	0.0017
Explosives										
1,3-Dinitrobenzene	100	IRBC	NT				NT			
2,4-Dinitrotoluene	4.2	NJNR	NT				NT			
2,6-Dinitrotoluene	4.2	NJNR	NT				NT			
2-amino-4,6-Dinitrotoluene	2000	IRBC	NT				NT			
4-amino-2,6-Dinitrotoluene	2000	IRBC	NT				NT			
HMX	10000	NJNR	NT				NT			
Nitrobenzene	510	IRBC	NT				NT			
2-Nitrotoluene	10000	IRBC	NT				NT			
3-Nitrotoluene	10000	IRBC	NT				NT			
4-Nitrotoluene	10000	IRBC	NT				NT			
RDX	26	NJNR, IRBC	NT				NT			
Tetryl	4100	IRBC	NT				NT			
1,3,5-Trinitrobenzene	31000	IRBC	NT				NT			
2,4,6-Trinitrotoluene	95	NJNR, IRBC	NT				NT			

Table 4-5
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Sediment (mg/kg)

(a) See the "ARARs and Other Guidance to be Considered for Picatinny Arsenal Sediment" table for a complete list of LOC values. Sediment samples were compared to the lower of the ISQG, the NYSDEC guidance, and the SQB.
In the absence of these criteria, the ER-L was used. The lower of the NJNR and USEPA Surface Soil Industrial (noncarcinogenic or carcinogenic 10^{-6}) RBCs were used only if there were no sediment criteria available.
The background value is the comparison criteria where the background value exceeds the aforementioned criteria.
Bolded values indicate a detection.
Bolded and shaded values indicate the detected result is above the Level of Concern (LOC).
BG Value = Sediment Background value
IRBC = USEPA Region III Industrial Surface Soil Risk Based Concentration
NA = No value available.
NJNR = NJDEP Non-Residential Direct Contact Soil Cleanup Criteria
NT = Not Tested
NYSDEC = New York State Department of Environmental Conservation Sediment Criteria
Q = Flags/Qualifiers (QA/QC):
- J = Detect, value is an estimate.
- R = Rejected result, value should not be used for any purpose.
- U = Non-detect, value is the detection limit.
- (U) = Non-detect, chemical was detected in blank.
- UJ = Non-detect, value is an estimated detection limit.

RL/EQL = Reporting Limit / Estimated Quantitation Limit
SQB = USEPA Sediment Quality Benchmark
SQL = Sample Quantitation Limit

Table 4-6
Sediment Data Tally Table

Compound	Frequency of Detections	Range of Detected Concentrations	Location of Maximum Concentration	LOC	LOC Source	UOM	Exceed LOC?	Number of Hits Exceeding LOC
Acetone	0 / 13	--	--	0.0087	SQB	mg/kg	No	--
Acetonitrile	0 / 8	--	--	--	NA	mg/kg	No	--
Benzene	1 / 13	0.00063 / 0.00063	11SD-3 11/09/2004	0.16	SQB	mg/kg	No	--
Bromodichloromethane	0 / 13	--	--	46	NJNR, IRBC	mg/kg	No	--
Bromoform	0 / 13	--	--	360	IRBC	mg/kg	No	--
Bromomethane	0 / 13	--	--	1000	NJNR	mg/kg	No	--
2-Butanone	0 / 13	--	--	0.27	SQB	mg/kg	No	--
Carbon disulfide	0 / 13	--	--	0.00085	SQB	mg/kg	No	--
Carbon tetrachloride	0 / 13	--	--	0.047	SQB	mg/kg	No	--
Chlorobenzene	0 / 13	--	--	0.035	NYSDEC	mg/kg	No	--
Chloroethane	0 / 13	--	--	990	IRBC	mg/kg	No	--
Chloroform	0 / 13	--	--	0.022	SQB	mg/kg	No	--
Chloromethane	0 / 13	--	--	1000	NJNR	mg/kg	No	--
Dibromochloromethane	0 / 13	--	--	34	IRBC	mg/kg	No	--
Dichlorodifluoromethane	0 / 13	--	--	200000	IRBC	mg/kg	No	--
1,1-Dichloroethane	0 / 13	--	--	0.027	SQB	mg/kg	No	--
1,2-Dichloroethane	0 / 13	--	--	0.25	SQB	mg/kg	No	--
1,1-Dichloroethene	0 / 13	--	--	0.031	SQB	mg/kg	No	--
cis-1,2-Dichloroethene	1 / 13	0.0047 / 0.0047	13SD-4 01/11/2006	0.4	SQB	mg/kg	No	--
trans-1,2-Dichloroethene	0 / 13	--	--	0.4	SQB	mg/kg	No	--
1,2-Dichloropropane	0 / 13	--	--	42	IRBC	mg/kg	No	--
cis-1,3-Dichloropropene	0 / 13	--	--	0.000051	SQB	mg/kg	No	--
trans-1,3-Dichloropropene	0 / 13	--	--	0.000051	SQB	mg/kg	No	--
Ethyl benzene	0 / 13	--	--	0.089	SQB	mg/kg	No	--
2-Hexanone	0 / 13	--	--	0.022	SQB	mg/kg	No	--
Methyl tert-Butyl ether	2 / 13	0.00046 / 0.0014	13SD-6 01/11/2006	720	IRBC	mg/kg	No	--
4-Methyl-2-pentanone (MIBK)	0 / 13	--	--	0.033	SQB	mg/kg	No	--
Methylene chloride	1 / 13	0.021 / 0.021	13SD-4 01/11/2006	0.37	SQB	mg/kg	No	--
Styrene	0 / 13	--	--	97	NJNR	mg/kg	No	--

Table 4-6
Sediment Data Tally Table

Compound	Frequency of Detections	Range of Detected Concentrations	Location of Maximum Concentration	LOC	LOC Source	UOM	Exceed LOC?	Number of Hits Exceeding LOC
1,1,2,2-Tetrachloroethane	0 / 13	--	--	1.4	SQB	mg/kg	No	--
Tetrachloroethene	0 / 13	--	--	0.41	SQB	mg/kg	No	--
Toluene	6 / 13	0.001 / 0.12	11SD-1 11/09/2004	0.05	SQB	mg/kg	**Yes**	2
1,1,1-Trichloroethane	0 / 13	--	--	0.03	SQB	mg/kg	No	--
1,1,2-Trichloroethane	0 / 13	--	--	1.2	SQB	mg/kg	No	--
Trichloroethene	5 / 13	0.0011 / 0.074	13SD-4 01/11/2006	0.22	SQB	mg/kg	No	--
Trichlorofluoromethane	0 / 13	--	--	310000	IRBC	mg/kg	No	--
1,1,2-Trichloro-1,2,2-trifluoroethane	5 / 13	0.0014 / 0.012	11SD-2 11/09/2004	31000000	IRBC	mg/kg	No	--
Vinyl chloride	0 / 13	--	--	4	IRBC	mg/kg	No	--
Total Xylenes	0 / 13	--	--	0.16	SQB	mg/kg	No	--
1,3-Dinitrobenzene	0 / 6	--	--	100	IRBC	mg/kg	No	--
2,4-Dinitrotoluene	0 / 6	--	--	4.2	NJNR	mg/kg	No	--
2,6-Dinitrotoluene	0 / 6	--	--	4.2	NJNR	mg/kg	No	--
2-amino-4,6-Dinitrotoluene	0 / 6	--	--	2000	IRBC	mg/kg	No	--
4-amino-2,6-Dinitrotoluene	0 / 6	--	--	2000	IRBC	mg/kg	No	--
HMX	0 / 6	--	--	10000	NJNR	mg/kg	No	--
Nitrobenzene	1 / 6	0.033 / 0.033	11SD-1A 12/13/2006	510	IRBC	mg/kg	No	--
2-Nitrotoluene	0 / 6	--	--	10000	IRBC	mg/kg	No	--
3-Nitrotoluene	0 / 6	--	--	10000	IRBC	mg/kg	No	--
4-Nitrotoluene	0 / 6	--	--	10000	IRBC	mg/kg	No	--
RDX	0 / 6	--	--	26	NJNR, IRBC	mg/kg	No	--
Tetryl	0 / 6	--	--	4100	IRBC	mg/kg	No	--
1,3,5-Trinitrobenzene	0 / 6	--	--	31000	IRBC	mg/kg	No	--
2,4,6-Trinitrotoluene	0 / 6	--	--	95	NJNR, IRBC	mg/kg	No	--

Table 4-7a
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Soil (mg/kg)

			Analytical Results																			
		Sample ID:	13SS-1A				13SS-1B				13SS-2A				13SS-2B				13SS-3A			
		Date Sampled:	3/23/2007				3/23/2007				3/23/2007				3/23/2007				3/23/2007			
		Depth Sampled (ft):	0.5-0.0				0.0-0.5				0.5-0.0				0.0-0.5				0.5-0.0			
Chemical	**LOC (a):**	**Source**	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																						
Acetone	100	NJIGW	0.023	U	0.023	0.0031	0.019	U	0.019	0.0025	0.023	U	0.023	0.003	**0.011**	**J**	0.023	0.0031	0.025	UD	0.025	0.0034
Acrylonitrile	1	NJIGW	0.12	U	0.12	0.0029	0.093	U	0.093	0.0023	0.11	U	0.11	0.0028	0.11	U	0.11	0.0029	0.12	UD	0.12	0.0031
Benzene	1	NJIGW	0.0058	U	0.0058	0.00027	0.0046	U	0.0046	0.00021	0.0056	U	0.0056	0.00026	0.0057	U	0.0057	0.00026	0.0062	UD	0.0062	0.00029
Bromodichloromethane	1	NJIGW	0.0058	U	0.0058	0.00056	0.0046	U	0.0046	0.00045	0.0056	U	0.0056	0.00054	0.0057	U	0.0057	0.00055	0.0062	UD	0.0062	0.0006
Bromoform	1	NJIGW	0.0058	U	0.0058	0.00076	0.0046	U	0.0046	0.0006	0.0056	U	0.0056	0.00073	0.0057	U	0.0057	0.00074	0.0062	UD	0.0062	0.00081
Bromomethane	1	NJIGW	0.0058	U	0.0058	0.00071	0.0046	U	0.0046	0.00057	0.0056	U	0.0056	0.00069	0.0057	U	0.0057	0.0007	0.0062	UD	0.0062	0.00076
2-Butanone	50	NJIGW	0.023	U	0.023	0.0012	0.019	U	0.019	0.00093	0.023	U	0.023	0.0011	0.023	U	0.023	0.0011	0.025	UD	0.025	0.0012
Carbon disulfide	100000	IRBC	0.0058	U	0.0058	0.00023	0.0046	U	0.0046	0.00019	0.0056	U	0.0056	0.00023	0.0057	U	0.0057	0.00023	0.0062	UD	0.0062	0.00025
Carbon tetrachloride	1	NJIGW	0.0058	U	0.0058	0.00052	0.0046	U	0.0046	0.00042	0.0056	U	0.0056	0.00051	0.0057	U	0.0057	0.00051	0.0062	UD	0.0062	0.00056
Chlorobenzene	1	NJIGW	0.0058	U	0.0058	0.00033	0.0046	U	0.0046	0.00026	0.0056	U	0.0056	0.00032	0.0057	U	0.0057	0.00032	0.0062	UD	0.0062	0.00035
Chloroethane	990	IRBC	0.0058	U	0.0058	0.00063	0.0046	U	0.0046	0.0005	0.0056	U	0.0056	0.00061	0.0057	U	0.0057	0.00062	0.0062	UD	0.0062	0.00067
Chloroform	1	NJIGW	0.0058	U	0.0058	0.00047	0.0046	U	0.0046	0.00037	0.0056	U	0.0056	0.00045	0.0057	U	0.0057	0.00046	0.0062	UD	0.0062	0.0005
Chloromethane	10	NJIGW	0.0058	U	0.0058	0.00029	0.0046	U	0.0046	0.00023	0.0056	U	0.0056	0.00028	0.0057	U	0.0057	0.00029	0.0062	UD	0.0062	0.00031
Dibromochloromethane	1	NJIGW	0.0058	U	0.0058	0.00042	0.0046	U	0.0046	0.00033	0.0056	U	0.0056	0.00041	0.0057	U	0.0057	0.00041	0.0062	UD	0.0062	0.00045
Dichlorodifluoromethane	200000	IRBC	0.0058	U	0.0058	0.00047	0.0046	U	0.0046	0.00037	0.0056	U	0.0056	0.00045	0.0057	U	0.0057	0.00046	0.0062	UD	0.0062	0.0005
1,1-Dichloroethane	10	NJIGW	0.0058	U	0.0058	0.00037	0.0046	U	0.0046	0.0003	0.0056	U	0.0056	0.00036	0.0057	U	0.0057	0.00037	0.0062	UD	0.0062	0.0004
1,2-Dichloroethane	1	NJIGW	0.0058	U	0.0058	0.00056	0.0046	U	0.0046	0.00045	0.0056	U	0.0056	0.00054	0.0057	U	0.0057	0.00055	0.0062	UD	0.0062	0.0006
1,1-Dichloroethene	10	NJIGW	0.0058	U	0.0058	0.0007	0.0046	U	0.0046	0.00056	0.0056	U	0.0056	0.00068	0.0057	U	0.0057	0.00068	0.0062	UD	0.0062	0.00075
cis-1,2-Dichloroethene	1	NJIGW	0.0058	U	0.0058	0.00048	0.0046	U	0.0046	0.00038	0.0056	U	0.0056	0.00046	0.0057	U	0.0057	0.00047	0.0062	UD	0.0062	0.00051
trans-1,2-Dichloroethene	50	NJIGW	0.0058	U	0.0058	0.00064	0.0046	U	0.0046	0.00051	0.0056	U	0.0056	0.00062	0.0057	U	0.0057	0.00063	0.0062	UD	0.0062	0.00068
1,2-Dichloropropane	43	NJNR	0.0058	U	0.0058	0.00041	0.0046	U	0.0046	0.00033	0.0056	U	0.0056	0.0004	0.0057	U	0.0057	0.0004	0.0062	UD	0.0062	0.00044
cis-1,3-Dichloropropene	1	NJIGW	0.0058	U	0.0058	0.00041	0.0046	U	0.0046	0.00033	0.0056	U	0.0056	0.0004	0.0057	U	0.0057	0.0004	0.0062	UD	0.0062	0.00044
trans-1,3-Dichloropropene	1	NJIGW	0.0058	U	0.0058	0.00041	0.0046	U	0.0046	0.00033	0.0056	U	0.0056	0.0004	0.0057	U	0.0057	0.0004	0.0062	UD	0.0062	0.00044
Ethyl benzene	100	NJIGW	0.0058	U	0.0058	0.00062	0.0046	U	0.0046	0.00049	0.0056	U	0.0056	0.0006	0.0057	U	0.0057	0.0006	0.0062	UD	0.0062	0.00066
2-Hexanone		NA	0.023	U	0.023	0.00098	0.019	U	0.019	0.00078	0.023	U	0.023	0.00095	0.023	U	0.023	0.00096	0.025	UD	0.025	0.001
Methyl tert-Butyl ether		NA	0.023	U	0.023	0.00033	0.019	U	0.019	0.00026	0.023	U	0.023	0.00032	0.023	U	0.023	0.00032	0.025	UD	0.025	0.00035
4-Methyl-2-pentanone (MIBK)	50	NJIGW	0.023	U	0.023	0.00063	0.019	U	0.019	0.0005	0.023	U	0.023	0.00061	0.023	U	0.023	0.00062	0.025	UD	0.025	0.00067
Methylene chloride	1	NJIGW	0.0058	(U)	0.0058	0.0015	0.0046	(U)	0.0046	0.0012	0.0056	(U)	0.0056	0.0015	0.0057	U	0.0057	0.0015	0.0062	(U)D	0.0062	0.0016
Styrene	97	NJNR	0.0058	U	0.0058	0.00023	0.0046	U	0.0046	0.00019	0.0056	U	0.0056	0.00023	0.0057	U	0.0057	0.00023	0.0062	UD	0.0062	0.00025
1,1,2,2-Tetrachloroethane	1	NJIGW	0.0058	U	0.0058	0.00054	0.0046	U	0.0046	0.00043	0.0056	U	0.0056	0.00052	0.0057	U	0.0057	0.00053	0.0062	UD	0.0062	0.00057
Tetrachloroethene	1	NJIGW	0.0058	U	0.0058	0.00097	0.0046	U	0.0046	0.00077	0.0056	U	0.0056	0.00094	0.0057	U	0.0057	0.00095	0.0062	UD	0.0062	0.001
Toluene	500	NJIGW	0.0058	U	0.0058	0.00034	0.0046	U	0.0046	0.00027	0.0056	U	0.0056	0.00033	0.0057	U	0.0057	0.00033	0.0062	UD	0.0062	0.00036
1,1,1-Trichloroethane	50	NJIGW	0.0058	U	0.0058	0.00088	0.0046	U	0.0046	0.00071	0.0056	U	0.0056	0.00086	0.0057	U	0.0057	0.00087	0.0062	UD	0.0062	0.00095
1,1,2-Trichloroethane	1	NJIGW	0.0058	U	0.0058	0.00048	0.0046	U	0.0046	0.00038	0.0056	U	0.0056	0.00046	0.0057	U	0.0057	0.00047	0.0062	UD	0.0062	0.00051
Trichloroethene	1	NJIGW	**0.0028**	**J**	0.0058	0.00048	**0.0018**	**J**	0.0046	0.00038	**0.0063**		0.0056	0.00046	**0.0045**	**J**	0.0057	0.00047	**0.0021**	**JD**	0.0062	0.00051
Trichlorofluoromethane	310000	IRBC	0.0058	U	0.0058	0.00048	0.0046	U	0.0046	0.00038	0.0056	U	0.0056	0.00046	0.0057	U	0.0057	0.00047	0.0062	UD	0.0062	0.00051
1,1,2-Trichloro-1,2,2-trifluoroethane	31000000	IRBC	0.0058	U	0.0058	0.00093	0.0046	U	0.0046	0.00074	0.0056	U	0.0056	0.0009	0.0057	U	0.0057	0.00091	0.0062	UD	0.0062	0.001
Vinyl chloride	7	NJNR	0.0058	U	0.0058	0.00051	0.0046	U	0.0046	0.00041	0.0056	U	0.0056	0.0005	0.0057	U	0.0057	0.0005	0.0062	UD	0.0062	0.00055
Total Xylenes	67	NJIGW	0.012	U	0.012	0.00088	0.0093	U	0.0093	0.00071	0.011	U	0.011	0.00086	0.011	U	0.011	0.00087	0.012	UD	0.012	0.00095
Explosives																						
1,3-Dinitrobenzene	100	IRBC	NT				NT				NT				NT				NT			
2,4-Dinitrotoluene	4.2	NJNR	NT				NT				NT				NT				NT			
2,6-Dinitrotoluene	4.2	NJNR	NT				NT				NT				NT				NT			
2-amino-4,6-Dinitrotoluene	2000	IRBC	NT				NT				NT				NT				NT			
4-amino-2,6-Dinitrotoluene	2000	IRBC	NT				NT				NT				NT				NT			
HMX	10000	NJNR	NT				NT				NT				NT				NT			
Nitrobenzene	10	NJIGW	NT				NT				NT				NT				NT			
2-Nitrotoluene	10000	IRBC	NT				NT				NT				NT				NT			
3-Nitrotoluene	10000	IRBC	NT				NT				NT				NT				NT			
4-Nitrotoluene	10000	IRBC	NT				NT				NT				NT				NT			
RDX	26	NJNR	NT				NT				NT				NT				NT			
Tetryl	10000	NJNR	NT				NT				NT				NT				NT			
1,3,5-Trinitrobenzene	31000	IRBC	NT				NT				NT				NT				NT			
2,4,6-Trinitrotoluene	95	NJNR	NT				NT				NT				NT				NT			

Table 4-7a
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Soil (mg/kg)

			Analytical Results																			
		Sample ID:	13SS-3B				13SS-4A				13SS-4B				11SS-1A				11SS-1B			
		Date Sampled:	3/23/2007				3/23/2007				3/23/2007				6/23/2008				6/23/2008			
		Depth Sampled (ft):	0.0-0.5				0.5-0.0				0.0-0.5				0.0-0.5				1.0-1.5			
	LOC (a):	**Source**	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																						
Acetone	100	NJIGW	0.019	U	0.019	0.0025	0.025	UD	0.025	0.0034	0.018	U	0.018	0.0024	NT				NT			
Acrylonitrile	1	NJIGW	0.093	U	0.093	0.0023	0.12	UD	0.12	0.0031	0.089	U	0.089	0.0022	NT				NT			
Benzene	1	NJIGW	0.0046	U	0.0046	0.00021	0.0062	UD	0.0062	0.00029	0.0045	U	0.0045	0.00021	NT				NT			
Bromodichloromethane	1	NJIGW	0.0046	U	0.0046	0.00044	0.0062	UD	0.0062	0.0006	0.0045	U	0.0045	0.00043	NT				NT			
Bromoform	1	NJIGW	0.0046	U	0.0046	0.0006	0.0062	UD	0.0062	0.00081	0.0045	U	0.0045	0.00058	NT				NT			
Bromomethane	1	NJIGW	0.0046	U	0.0046	0.00056	0.0062	UD	0.0062	0.00076	0.0045	U	0.0045	0.00054	NT				NT			
2-Butanone	50	NJIGW	0.019	U	0.019	0.00093	0.025	UD	0.025	0.0012	0.018	U	0.018	0.00089	NT				NT			
Carbon disulfide	100000	IRBC	0.0046	U	0.0046	0.00019	0.0062	UD	0.0062	0.00025	0.0045	U	0.0045	0.00018	NT				NT			
Carbon tetrachloride	1	NJIGW	0.0046	U	0.0046	0.00042	0.0062	UD	0.0062	0.00056	0.0045	U	0.0045	0.0004	NT				NT			
Chlorobenzene	1	NJIGW	0.0046	U	0.0046	0.00026	0.0062	UD	0.0062	0.00035	0.0045	U	0.0045	0.00025	NT				NT			
Chloroethane	990	IRBC	0.0046	U	0.0046	0.0005	0.0062	UD	0.0062	0.00067	0.0045	U	0.0045	0.00048	NT				NT			
Chloroform	1	NJIGW	0.0046	U	0.0046	0.00037	0.0062	UD	0.0062	0.0005	0.0045	U	0.0045	0.00036	NT				NT			
Chloromethane	10	NJIGW	0.0046	U	0.0046	0.00023	0.0062	UD	0.0062	0.00031	0.0045	U	0.0045	0.00022	NT				NT			
Dibromochloromethane	1	NJIGW	0.0046	U	0.0046	0.00033	0.0062	UD	0.0062	0.00045	0.0045	U	0.0045	0.00032	NT				NT			
Dichlorodifluoromethane	200000	IRBC	0.0046	U	0.0046	0.00037	0.0062	UD	0.0062	0.0005	0.0045	U	0.0045	0.00036	NT				NT			
1,1-Dichloroethane	10	NJIGW	0.0046	U	0.0046	0.0003	0.0062	UD	0.0062	0.0004	0.0045	U	0.0045	0.00029	NT				NT			
1,2-Dichloroethane	1	NJIGW	0.0046	U	0.0046	0.00044	0.0062	UD	0.0062	0.0006	0.0045	U	0.0045	0.00043	NT				NT			
1,1-Dichloroethene	10	NJIGW	0.0046	U	0.0046	0.00056	0.0062	UD	0.0062	0.00075	0.0045	U	0.0045	0.00054	NT				NT			
cis-1,2-Dichloroethene	1	NJIGW	0.0046	U	0.0046	0.00038	0.0062	UD	0.0062	0.00051	**0.0013**	**J**	0.0045	0.00037	NT				NT			
trans-1,2-Dichloroethene	50	NJIGW	0.0046	U	0.0046	0.00051	0.0062	UD	0.0062	0.00069	0.0045	U	0.0045	0.00049	NT				NT			
1,2-Dichloropropane	43	NJNR	0.0046	U	0.0046	0.00032	0.0062	UD	0.0062	0.00044	0.0045	U	0.0045	0.00031	NT				NT			
cis-1,3-Dichloropropene	1	NJIGW	0.0046	U	0.0046	0.00032	0.0062	UD	0.0062	0.00044	0.0045	U	0.0045	0.00031	NT				NT			
trans-1,3-Dichloropropene	1	NJIGW	0.0046	U	0.0046	0.00032	0.0062	UD	0.0062	0.00044	0.0045	U	0.0045	0.00031	NT				NT			
Ethyl benzene	100	NJIGW	0.0046	U	0.0046	0.00049	0.0062	UD	0.0062	0.00066	0.0045	U	0.0045	0.00047	NT				NT			
2-Hexanone		NA	0.019	U	0.019	0.00078	0.025	UD	0.025	0.001	0.018	U	0.018	0.00075	NT				NT			
Methyl tert-Butyl ether		NA	0.019	U	0.019	0.00026	0.025	UD	0.025	0.00035	0.018	U	0.018	0.00025	NT				NT			
4-Methyl-2-pentanone (MIBK)	50	NJIGW	0.019	U	0.019	0.0005	0.025	UD	0.025	0.00067	0.018	U	0.018	0.00048	NT				NT			
Methylene chloride	1	NJIGW	0.0046	(U)	0.0046	0.0012	0.0062	(U)D	0.0062	0.0016	0.0045	(U)	0.0045	0.0012	NT				NT			
Styrene	97	NJNR	0.0046	U	0.0046	0.00019	0.0062	UD	0.0062	0.00025	0.0045	U	0.0045	0.00018	NT				NT			
1,1,2,2-Tetrachloroethane	1	NJIGW	0.0046	U	0.0046	0.00043	0.0062	UD	0.0062	0.00057	0.0045	U	0.0045	0.00041	NT				NT			
Tetrachloroethene	1	NJIGW	0.0046	U	0.0046	0.00077	0.0062	UD	0.0062	0.001	0.0045	U	0.0045	0.00074	NT				NT			
Toluene	500	NJIGW	0.0046	U	0.0046	0.00027	0.0062	UD	0.0062	0.00036	0.0045	U	0.0045	0.00026	NT				NT			
1,1,1-Trichloroethane	50	NJIGW	0.0046	U	0.0046	0.0007	0.0062	UD	0.0062	0.00095	0.0045	U	0.0045	0.00068	NT				NT			
1,1,2-Trichloroethane	1	NJIGW	0.0046	U	0.0046	0.00038	0.0062	UD	0.0062	0.00051	0.0045	U	0.0045	0.00037	NT				NT			
Trichloroethene	1	NJIGW	**0.0024**	**J**	0.0046	0.00038	**0.0011**	**JD**	0.0062	0.00051	**0.0029**	**J**	0.0045	0.00037	NT				NT			
Trichlorofluoromethane	310000	IRBC	0.0046	U	0.0046	0.00038	0.0062	UD	0.0062	0.00051	0.0045	U	0.0045	0.00037	NT				NT			
1,1,2-Trichloro-1,2,2-trifluoroethane	31000000	IRBC	0.0046	U	0.0046	0.00074	0.0062	UD	0.0062	0.001	0.0045	U	0.0045	0.00071	NT				NT			
Vinyl chloride	7	NJNR	0.0046	U	0.0046	0.00041	0.0062	UD	0.0062	0.00055	0.0045	U	0.0045	0.00039	NT				NT			
Total Xylenes	67	NJIGW	0.0093	U	0.0093	0.0007	0.012	UD	0.012	0.00095	0.0089	U	0.0089	0.00068	NT				NT			
Explosives																						
1,3-Dinitrobenzene	100	IRBC	NT				NT				NT				0.12	U	0.12	0.011	0.12	U	0.12	0.011
2,4-Dinitrotoluene	4.2	NJNR	NT				NT				NT				0.12	U	0.12	0.014	0.12	U	0.12	0.014
2,6-Dinitrotoluene	4.2	NJNR	NT				NT				NT				0.12	U	0.12	0.022	0.12	U	0.12	0.022
2-amino-4,6-Dinitrotoluene	2000	IRBC	NT				NT				NT				0.12	U	0.12	0.013	0.12	U	0.12	0.013
4-amino-2,6-Dinitrotoluene	2000	IRBC	NT				NT				NT				0.12	U	0.12	0.013	0.12	U	0.12	0.013
HMX	10000	NJNR	NT				NT				NT				0.12	U	0.12	0.013	0.12	U	0.12	0.013
Nitrobenzene	10	NJIGW	NT				NT				NT				0.12	U	0.12	0.011	0.12	U	0.12	0.011
2-Nitrotoluene	10000	IRBC	NT				NT				NT				0.12	U	0.12	0.031	0.12	U	0.12	0.031
3-Nitrotoluene	10000	IRBC	NT				NT				NT				0.12	U	0.12	0.023	0.12	U	0.12	0.023
4-Nitrotoluene	10000	IRBC	NT				NT				NT				0.12	U	0.12	0.022	0.12	U	0.12	0.022
RDX	26	NJNR	NT				NT				NT				0.12	U	0.12	0.015	0.12	U	0.12	0.015
Tetryl	10000	NJNR	NT				NT				NT				0.12	U	0.12	0.015	0.12	U	0.12	0.015
1,3,5-Trinitrobenzene	31000	IRBC	NT				NT				NT				0.12	U	0.12	0.02	0.12	U	0.12	0.02
2,4,6-Trinitrotoluene	95	NJNR	NT				NT				NT				0.12	U	0.12	0.011	0.12	U	0.12	0.011

Table 4-7a
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Soil (mg/kg)

			Analytical Results																			
		Sample ID:	11SS-2A				11SS-2B				11SS-3A				11SS-3B				11SS-4A			
		Date Sampled:	6/23/2008				6/23/2008				6/23/2008				6/23/2008				6/23/2008			
		Depth Sampled (ft):	0.0-0.5				1.0-1.5				0.0-0.5				1.0-1.5				0.0-0.5			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																						
Acetone	100	NJIGW	NT				NT				NT				NT				NT			
Acrylonitrile	1	NJIGW	NT				NT				NT				NT				NT			
Benzene	1	NJIGW	NT				NT				NT				NT				NT			
Bromodichloromethane	1	NJIGW	NT				NT				NT				NT				NT			
Bromoform	1	NJIGW	NT				NT				NT				NT				NT			
Bromomethane	1	NJIGW	NT				NT				NT				NT				NT			
2-Butanone	50	NJIGW	NT				NT				NT				NT				NT			
Carbon disulfide	100000	IRBC	NT				NT				NT				NT				NT			
Carbon tetrachloride	1	NJIGW	NT				NT				NT				NT				NT			
Chlorobenzene	1	NJIGW	NT				NT				NT				NT				NT			
Chloroethane	990	IRBC	NT				NT				NT				NT				NT			
Chloroform	1	NJIGW	NT				NT				NT				NT				NT			
Chloromethane	10	NJIGW	NT				NT				NT				NT				NT			
Dibromochloromethane	1	NJIGW	NT				NT				NT				NT				NT			
Dichlorodifluoromethane	200000	IRBC	NT				NT				NT				NT				NT			
1,1-Dichloroethane	10	NJIGW	NT				NT				NT				NT				NT			
1,2-Dichloroethane	1	NJIGW	NT				NT				NT				NT				NT			
1,1-Dichloroethene	10	NJIGW	NT				NT				NT				NT				NT			
cis-1,2-Dichloroethene	1	NJIGW	NT				NT				NT				NT				NT			
trans-1,2-Dichloroethene	50	NJIGW	NT				NT				NT				NT				NT			
1,2-Dichloropropane	43	NJNR	NT				NT				NT				NT				NT			
cis-1,3-Dichloropropene	1	NJIGW	NT				NT				NT				NT				NT			
trans-1,3-Dichloropropene	1	NJIGW	NT				NT				NT				NT				NT			
Ethyl benzene	100	NJIGW	NT				NT				NT				NT				NT			
2-Hexanone		NA	NT				NT				NT				NT				NT			
Methyl tert-Butyl ether		NA	NT				NT				NT				NT				NT			
4-Methyl-2-pentanone (MIBK)	50	NJIGW	NT				NT				NT				NT				NT			
Methylene chloride	1	NJIGW	NT				NT				NT				NT				NT			
Styrene	97	NJNR	NT				NT				NT				NT				NT			
1,1,2,2-Tetrachloroethane	1	NJIGW	NT				NT				NT				NT				NT			
Tetrachloroethene	1	NJIGW	NT				NT				NT				NT				NT			
Toluene	500	NJIGW	NT				NT				NT				NT				NT			
1,1,1-Trichloroethane	50	NJIGW	NT				NT				NT				NT				NT			
1,1,2-Trichloroethane	1	NJIGW	NT				NT				NT				NT				NT			
Trichloroethene	1	NJIGW	NT				NT				NT				NT				NT			
Trichlorofluoromethane	310000	IRBC	NT				NT				NT				NT				NT			
1,1,2-Trichloro-1,2,2-trifluoroethane	31000000	IRBC	NT				NT				NT				NT				NT			
Vinyl chloride	7	NJNR	NT				NT				NT				NT				NT			
Total Xylenes	67	NJIGW	NT				NT				NT				NT				NT			
Explosives																						
1,3-Dinitrobenzene	100	IRBC	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011
2,4-Dinitrotoluene	4.2	NJNR	0.12	U	0.12	0.014	0.12	U	0.12	0.014	0.12	U	0.12	0.014	0.12	U	0.12	0.014	0.12	U	0.12	0.014
2,6-Dinitrotoluene	4.2	NJNR	0.12	U	0.12	0.022	0.12	U	0.12	0.022	0.12	U	0.12	0.022	0.12	U	0.12	0.022	0.12	U	0.12	0.022
2-amino-4,6-Dinitrotoluene	2000	IRBC	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013
4-amino-2,6-Dinitrotoluene	2000	IRBC	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013
HMX	10000	NJNR	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013
Nitrobenzene	10	NJIGW	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011
2-Nitrotoluene	10000	IRBC	0.12	U	0.12	0.031	0.12	U	0.12	0.031	0.12	U	0.12	0.031	0.12	U	0.12	0.031	0.12	U	0.12	0.031
3-Nitrotoluene	10000	IRBC	0.12	U	0.12	0.023	0.12	U	0.12	0.023	0.12	U	0.12	0.023	0.12	U	0.12	0.023	0.12	U	0.12	0.023
4-Nitrotoluene	10000	IRBC	0.12	U	0.12	0.022	0.12	U	0.12	0.022	0.12	U	0.12	0.022	0.12	U	0.12	0.022	0.12	U	0.12	0.022
RDX	26	NJNR	0.12	U	0.12	0.015	0.12	U	0.12	0.015	0.12	U	0.12	0.015	0.12	U	0.12	0.015	0.12	U	0.12	0.015
Tetryl	10000	NJNR	0.12	U	0.12	0.015	0.12	U	0.12	0.015	0.12	U	0.12	0.015	0.12	U	0.12	0.015	0.12	U	0.12	0.015
1,3,5-Trinitrobenzene	31000	IRBC	0.12	U	0.12	0.02	0.12	U	0.12	0.02	0.12	U	0.12	0.02	0.12	U	0.12	0.02	0.12	U	0.12	0.02
2,4,6-Trinitrotoluene	95	NJNR	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011

Table 4-7a
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Soil (mg/kg)

			Analytical Results															
		Sample ID:	11SS-4ADUP				11SS-4B				11SS-5A				11SS-6A			
		Date Sampled:	6/23/2008				6/23/2008				6/23/2008				6/23/2008			
		Depth Sampled (ft):	0.0-0.5				1.0-1.5				0.0-0.5				0.0-0.5			
Chemical	LOC (a):	Source	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																		
Acetone	100	NJIGW	NT				NT				NT				NT			
Acrylonitrile	1	NJIGW	NT				NT				NT				NT			
Benzene	1	NJIGW	NT				NT				NT				NT			
Bromodichloromethane	1	NJIGW	NT				NT				NT				NT			
Bromoform	1	NJIGW	NT				NT				NT				NT			
Bromomethane	1	NJIGW	NT				NT				NT				NT			
2-Butanone	50	NJIGW	NT				NT				NT				NT			
Carbon disulfide	100000	IRBC	NT				NT				NT				NT			
Carbon tetrachloride	1	NJIGW	NT				NT				NT				NT			
Chlorobenzene	1	NJIGW	NT				NT				NT				NT			
Chloroethane	990	IRBC	NT				NT				NT				NT			
Chloroform	1	NJIGW	NT				NT				NT				NT			
Chloromethane	10	NJIGW	NT				NT				NT				NT			
Dibromochloromethane	1	NJIGW	NT				NT				NT				NT			
Dichlorodifluoromethane	200000	IRBC	NT				NT				NT				NT			
1,1-Dichloroethane	10	NJIGW	NT				NT				NT				NT			
1,2-Dichloroethane	1	NJIGW	NT				NT				NT				NT			
1,1-Dichloroethene	10	NJIGW	NT				NT				NT				NT			
cis-1,2-Dichloroethene	1	NJIGW	NT				NT				NT				NT			
trans-1,2-Dichloroethene	50	NJIGW	NT				NT				NT				NT			
1,2-Dichloropropane	43	NJNR	NT				NT				NT				NT			
cis-1,3-Dichloropropene	1	NJIGW	NT				NT				NT				NT			
trans-1,3-Dichloropropene	1	NJIGW	NT				NT				NT				NT			
Ethyl benzene	100	NJIGW	NT				NT				NT				NT			
2-Hexanone		NA	NT				NT				NT				NT			
Methyl tert-Butyl ether		NA	NT				NT				NT				NT			
4-Methyl-2-pentanone (MIBK)	50	NJIGW	NT				NT				NT				NT			
Methylene chloride	1	NJIGW	NT				NT				NT				NT			
Styrene	97	NJNR	NT				NT				NT				NT			
1,1,2,2-Tetrachloroethane	1	NJIGW	NT				NT				NT				NT			
Tetrachloroethene	1	NJIGW	NT				NT				NT				NT			
Toluene	500	NJIGW	NT				NT				NT				NT			
1,1,1-Trichloroethane	50	NJIGW	NT				NT				NT				NT			
1,1,2-Trichloroethane	1	NJIGW	NT				NT				NT				NT			
Trichloroethene	1	NJIGW	NT				NT				NT				NT			
Trichlorofluoromethane	310000	IRBC	NT				NT				NT				NT			
1,1,2-Trichloro-1,2,2-trifluoroethane	31000000	IRBC	NT				NT				NT				NT			
Vinyl chloride	7	NJNR	NT				NT				NT				NT			
Total Xylenes	67	NJIGW	NT				NT				NT				NT			
Explosives																		
1,3-Dinitrobenzene	100	IRBC	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011
2,4-Dinitrotoluene	4.2	NJNR	0.12	U	0.12	0.014	0.12	U	0.12	0.014	0.12	U	0.12	0.014	0.12	U	0.12	0.014
2,6-Dinitrotoluene	4.2	NJNR	0.12	U	0.12	0.022	0.12	U	0.12	0.022	0.12	U	0.12	0.022	0.12	U	0.12	0.022
2-amino-4,6-Dinitrotoluene	2000	IRBC	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013
4-amino-2,6-Dinitrotoluene	2000	IRBC	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013
HMX	10000	NJNR	0.12	U	0.12	0.013	0.12	U	0.12	0.013	0.12	U	0.12	0.013	**0.14**		0.12	0.013
Nitrobenzene	10	NJIGW	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011
2-Nitrotoluene	10000	IRBC	0.12	U	0.12	0.031	0.12	U	0.12	0.031	0.12	U	0.12	0.031	0.12	U	0.12	0.031
3-Nitrotoluene	10000	IRBC	0.12	U	0.12	0.023	0.12	U	0.12	0.023	0.12	U	0.12	0.023	0.12	U	0.12	0.023
4-Nitrotoluene	10000	IRBC	0.12	U	0.12	0.022	0.12	U	0.12	0.022	0.12	U	0.12	0.022	0.12	U	0.12	0.022
RDX	26	NJNR	0.12	U	0.12	0.015	0.12	U	0.12	0.015	0.12	U	0.12	0.015	**0.76**		0.12	0.015
Tetryl	10000	NJNR	0.12	U	0.12	0.015	0.12	U	0.12	0.015	0.12	U	0.12	0.015	0.12	U	0.12	0.015
1,3,5-Trinitrobenzene	31000	IRBC	0.12	U	0.12	0.02	0.12	U	0.12	0.02	0.12	U	0.12	0.02	0.12	U	0.12	0.02
2,4,6-Trinitrotoluene	95	NJNR	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011	0.12	U	0.12	0.011

Table 4-7a
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Surface Soil (mg/kg)

(a) See the "ARARs and Other Guidance to be Considered for Picatinny Arsenal Surface and Subsurface Soil" table for a complete list of LOC values. Subsurface soil samples were compared to the NJDEP Impact-to-Groundwater Soil Cleanup Criteria (NJIGW). If NJIGW criteria were not available, the NJDEP Non-Residential Soil Cleanup Criteria (NJNR) were used. If NJIGW and NJNR criteria were not available, the USEPA Region III Industrial (noncarcinogenic or carcinogenic 10^{-6}) Soil RBCs were used for comparison.

Bolded values indicate a detection.
Bolded and shaded values indicate the detected result is above the Level of Concern (LOC).
IRBC = USEPA Region III Industrial Surface Soil Risk Based Concentration
NA = No value available.
NJIGW = NJDEP Impact-to-Groundwater Soil Cleanup Criteria
NJNR = NJDEP Non-Residential Soil Cleanup Criteria
NT = Not Tested
OS = Onsite Environmental Laboratories, Inc.
Q = Flags/Qualifiers (QA/QC):
D = Result was obtained from the analysis of a dilution.
J = Detect, value is an estimate of the concentration.
R = Rejected result, value should not be used for any purpose.
U = Non-detect, value is the detection limit.
(U) = Non-detect, chemical was detected in blank.
QST = QST Laboratories, Inc.
RL/EQL = Reporting Limit / Estimated Quantitation Limit
SQL = Sample Quantitation Limit

Table 4-7b
Picatinny Arsenal 600 Area Source Investigation
Summary of All Soil Analyte Detections

Analyte		Sample ID	13TP-1 (1-1.5)				13TP-1 (7-7.5)				13TP-1 (11.5-12)				13TP-2 (1-1.5)				13TP-2 (5-5.5)				13TP-2 (11.5-12)				13TR2-1 (1.5-2)			
		Sample Date	6/21/2011				6/21/2011				6/21/2011				6/22/2011				6/22/2011				6/22/2011				6/22/2011			
		Sample Depth (ft bgs)	1.5-2				7-7.5				11.5-12				1-1.5				5-5.5				11.5-12				1.5-2			
	NJDEP Non-Residential Soil Remediation Standard (mg/kg)	**USEPA Industrial Soil Regional Screening Level (mg/kg)**	Result	LQ	RL/EQL	SQL	Result	LQ	RL/EQL	SQL	Result	LQ	RL/EQL	SQL	Result	LQ	RL/EQL	SQL	Result	LQ	RL/EQL	SQL	Result	LQ	RL/EQL	SQL	Result	LQ	RL/EQL	SQL
Volatile Organics (mg/kg)																														
Acetone	NA	630,000	0.0207	U	0.0207	0.00517	**0.00802**	**J**	0.0228	0.00569	**0.0079**	**J**	0.0243	0.00607	0.0216	U	0.0216	0.00539	0.0206	U	0.0206	0.00514	0.0224	U	0.0224	0.00561	0.0186	U	0.0186	0.00465
2-Butanone	44,000	200,000	0.0103	U	0.0103	0.00258	0.0114	U	0.0114	0.0029	0.0121	U	0.0121	0.0030	0.0108	U	0.0108	0.0027	0.0103	U	0.0103	0.00257	0.0112	U	0.0112	0.00281	0.00929	U	0.00929	0.00232
2-Chlorotoluene	-	20,000	0.00517	U	0.00517	0.00129	**0.00435**	**J**	0.00569	0.00142	0.00607	U	0.00607	0.00152	0.00539	U	0.00539	0.00135	0.00514	U	0.00514	0.00129	0.00561	U	0.00561	0.0014	0.00465	U	0.00465	0.00116
4-Chlorotoluene	-	20,000	0.00517	U	0.00517	0.00129	**0.00426**	**J**	0.00569	0.00142	0.00607	U	0.00607	0.00152	0.00539	U	0.00539	0.00135	0.00514	U	0.00514	0.00129	0.00561	U	0.00561	0.0014	0.00465	U	0.00465	0.00116
1,2-Dichlorobenzene	59,000	9,800	0.00517	U	0.00517	0.00129	**0.00346**	**J**	0.00569	0.00142	0.00607	U	0.00607	0.00152	0.00539	U	0.00539	0.00135	0.00514	U	0.00514	0.00129	0.00561	U	0.00561	0.0014	0.00465	U	0.00465	0.00116
cis-1,2-Dichloroethene	560	2,000	0.00517	U	0.00517	0.00129	0.00569	U	0.00569	0.00142	0.00607	U	0.00607	0.00152	0.00539	U	0.00539	0.00135	0.00514	U	0.00514	0.00129	0.00561	U	0.00561	0.0014	0.00465	U	0.00465	0.00116
p-Isopropyltoluene	-	-	0.00517	U	0.00517	0.00129	**0.00781**		0.00569	0.00142	0.00607	U	0.00607	0.00152	0.00539	U	0.00539	0.00135	0.00514	U	0.00514	0.00129	0.00561	U	0.00561	0.0014	0.00465	U	0.00465	0.00116
4-Metyl-2-pentanone	-	53,000	0.00517	U	0.00517	0.00129	**0.00227**	**J**	0.00569	0.00142	0.00607	U	0.00607	0.00152	0.00539	U	0.00539	0.00135	0.00514	U	0.00514	0.00129	0.00561	U	0.00561	0.0014	0.00465	U	0.00465	0.00116
Naphthalene	17	18	0.00517	U	0.00517	0.00129	**0.00258**	**J**	0.00569	0.00142	0.00607	U	0.00607	0.00152	0.00539	U	0.00539	0.00135	0.00514	U	0.00514	0.00129	0.00561	U	0.00561	0.0014	0.00465	U	0.00465	0.00116
Tetrachloroethene	5	110	0.00517	U	0.00517	0.00129	0.00569	U	0.00569	0.00142	0.00607	U	0.00607	0.00152	0.00539	U	0.00539	0.00135	0.00514	U	0.00514	0.00129	0.00561	U	0.00561	0.0014	0.00465	U	0.00465	0.00116
Trichloroethene	20	6.4	0.00517	U	0.00517	0.00129	0.00569	U	0.00569	0.00142	0.00607	U	0.00607	0.00152	0.00539	U	0.00539	0.00135	0.00514	U	0.00514	0.00129	0.00561	U	0.00561	0.0014	0.00465	U	0.00465	0.00116
1,3,5-Trimethylbenzene	-	10,000	0.00517	U	0.00517	0.00129	**0.00604**		0.00569	0.00142	0.00607	U	0.00607	0.00152	0.00539	U	0.00539	0.00135	0.00514	U	0.00514	0.00129	0.00561	U	0.00561	0.0014	0.00465	U	0.00465	0.00116
1,2,4-Trimethylbenzene	-	260	0.00517	U	0.00517	0.00129	**0.00274**	**J**	0.00569	0.00142	0.00607	U	0.00607	0.00152	0.00539	U	0.00539	0.00135	0.00514	U	0.00514	0.00129	0.00561	U	0.00561	0.0014	0.00465	U	0.00465	0.00116
Explosives (mg/kg)																														
RDX	-	24	0.4	U	0.4	0.16	NT				0.348	U	0.348	0.087	NT				NT				0.308	U	0.308	0.246	0.333	U	0.333	0.133
Metals (mg/kg)																														
Aluminum	NA	990,000	**6,640**		41.1	10.3	NT				**14,800**		42.1	10.5	NT				NT				**10,600**		48.7	12.2	**6,770**		43.4	10.8
Arsenic	19	1.6	**4.3**		2.05	0.616	NT				**7.7**		2.1	0.631	NT				NT				**4.98**		2.44	0.731	**3.54**		2.17	0.651
Barium	59,000	190,000	**25.9**		8.22	1.03	NT				**45.5**		8.42	1.05	NT				NT				**38.8**		9.75	1.22	**23.3**		8.67	1.08
Beryllium	140	2,000	**0.557**	**J**	1.03	0.205	NT				**0.756**	**J**	1.05	0.21	NT				NT				**0.66**	**J**	1.22	0.244	**0.621**	**J**	1.08	0.217
Cadmium	78	800	1.03	U	1.03	0.205	NT				1.05	U	1.05	0.21	NT				NT				**2.34**		1.22	0.244	**0.254**	**J**	1.08	0.217
Calcium	-	-	**3,090**		1,030	205	NT				**806**	**J**	1,050	210	NT				NT				**4,950**		1,220	244	**6,470**		1,080	217
Chromium	-	-	**11.3**		2.05	0.411	NT				**15.6**		2.1	0.421	NT				NT				**16.2**		2.44	0.487	**9.21**		2.17	0.434
Cobalt	590	300	**4.66**		2.57	1.03	NT				**7.8**		2.63	1.05	NT				NT				**5.66**		3.05	1.22	**4.73**		2.71	1.08
Copper	45,000	41,000	**18.6**		2.05	0.822	NT				**14.7**		2.1	0.842	NT				NT				**54.4**		2.44	0.975	**21.2**		2.17	0.867
Iron	-	720,000	**13,400**		20.5	6.16	NT				**23,500**		21	6.31	NT				NT				**20,000**		24.4	7.31	**14,600**		21.7	6.51
Lead	800	800	**12.9**		0.616	0.308	NT				**10.5**		0.631	0.316	NT				NT				**25.9**		0.731	0.366	**8.52**		0.651	0.325
Magnesium	-	-	**1,780**		1,030	205	NT				**3,450**		1,050	210	NT				NT				**4,220**		1,220	244	**4,540**		1,080	217
Manganese	5,900	23,000	**167**		3.08	0.616	NT				**303**		3.16	0.631	NT				NT				**243**		3.66	0.731	**258**		3.25	0.651
Mercury	65	43	**0.0502**		0.0366	0.0144	NT				**0.0231**	**J**	0.0347	0.0137	NT				NT				**0.216**		0.0369	0.0146	**0.19**		0.0335	0.0132
Molybdenum	-	5,100	4.11	U	4.11	1.03	NT				4.21	U	4.21	1.05	NT				NT				4.87	U	4.87	1.22	4.34	U	4.34	1.08
Nickel	23,000	20,000	**9.83**		2.05	0.616	NT				**17.8**		2.1	0.631	NT				NT				**17.2**		2.44	0.731	**11.9**		2.17	0.651
Potassium	-	-	**778**	**J**	1,030	205	NT				**733**	**J**	1,050	210	NT				NT				**790**	**J**	1,220	244	**641**	**J**	1,080	217
Selenium	5,700	5,100	2.05	U	2.05	0.616	NT				2.1	U	2.1	0.631	NT				NT				2.44	U	2.44	0.731	2.17	U	2.17	0.651
Sodium	-	-	**249**	**J**	1,030	205	NT				1,050	U	1,050	210	NT				NT				1,220	U	1,220	244	1,080	U	1,080	217
Vanadium	1,100	5,200	**20.3**		2.57	1.03	NT				**25.8**		2.63	1.05	NT				NT				**29.8**		3.05	1.22	**14.7**		2.71	1.08
Zinc	110,000	310,000	**36.1**		4.11	1.03	NT				**56**		4.21	1.05	NT				NT				**72.4**		4.87	1.22	**53**		4.34	1.08
Semivolatile Organics (mg/kg)																														
Benz(a)anthracene	2	2.1	**0.765**	**J**	1.75	0.442	NT				0.372	U	0.372	0.0939	NT				NT				0.379	U	0.379	0.0957	0.354	U	0.354	0.0895
Benzo(a)pyrene	0.2	0.21	**0.601**	**J**	1.75	0.442	NT				0.372	U	0.372	0.0939	NT				NT				0.379	U	0.379	0.0957	0.354	U	0.354	0.0895
Benzo(b)fluoranthene	2	2.1	**0.802**	**J**	1.75	0.442	NT				0.372	U	0.372	0.0939	NT				NT				0.379	U	0.379	0.0957	**0.0932**	**J**	0.354	0.0895
Chrysene	230	210	**0.649**	**J**	1.75	0.442	NT				0.372	U	0.372	0.0939	NT				NT				0.379	U	0.379	0.0957	0.354	U	0.354	0.0895
Fluoranthene	24,000	22,000	**1.36**	**J**	1.75	0.442	NT				0.372	U	0.372	0.0939	NT				NT				0.379	U	0.379	0.0957	**0.167**	**J**	0.354	0.0895
Phenanthrene	300,000	-	**0.974**	**J**	1.75	0.442	NT				0.372	U	0.372	0.0939	NT				NT				0.379	U	0.379	0.0957	**0.134**	**J**	0.354	0.0895
Pyrene	18,000	17,000	**1.11**	**J**	1.75	0.442	NT				0.372	U	0.372	0.0939	NT				NT				0.379	U	0.379	0.0957	**0.167**	**J**	0.354	0.0895

ft - feet
bgs - bleow ground surface
mg/kg - milligrams per kilogram

LQ - Lab Qualifier
NA - Not Available (for Non-Residetial Contact)
J - Value is estimated

- No standard/screening value published for the analyte
OR
Analyte was not detected I the sample identified

Bold values indicate a detection
Shaded values exceeded the NJDEP Non-Residential Soil Remediation Standard or USEPA Industrial Soil Regional Screening Level

Table 4-7b
Picatinny Arsenal 600 Area Source Investigation
Summary of All Soil Analyte Detections

Analyte		Sample ID	13TR2-1 (4.5-5)				13TR2-1 (4.5-5)				13TR1-1 (1-1.5)				13TR1-1 (10.5-11)				13TR1-1 (19-20)				13TR1-1 (24-24.5)			
		Sample Date	6/22/2011				6/23/2011				5/22/2012				5/22/2012				5/23/2012				5/24/2012			
		Sample Depth (ft bgs)	4.5-5				4.5-5				1-1.5				10.5-11				19-20				24-24.5			
	NJDEP Non-Residential Soil Remediation Standard (mg/kg)	**USEPA Industrial Soil Regional Screening Level (mg/kg)**	Result	LQ	RL/EQL	SQL	Result	LQ	RL/EQL	SQL	Result	LQ	RL/EQL	SQL	Result	LQ	RL/EQL	SQL	Result	LQ	RL/EQL	SQL	Result	LQ	RL/EQL	SQL
Volatile Organics (mg/kg)																										
Acetone	NA	630,000	**0.0099**	**J**	0.0198	0.00494	**0.0186**	**J**	0.0213	0.00532	**0.0757**		0.021	0.00525	**0.00798**	**J**	0.0185	0.00462	1.13	U	1.13	0.283	0.992	U	0.992	0.248
2-Butanone	44,000	200,000	0.00988	U	0.00988	0.00247	0.0106	U	0.0106	0.00266	**0.0227**		0.0105	0.00263	9.24	U	9.24	0.00231	0.566	U	0.566	0.142	0.496	U	0.496	0.124
2-Chlorotoluene	-	20,000	0.00494	U	0.00494	0.00123	0.00532	U	0.00532	0.00133	0.00525	U	0.00525	0.00131	0.00462	U	0.00462	0.00116	0.283	U	0.283	0.0708	0.248	U	0.248	0.062
4-Chlorotoluene	-	20,000	0.00494	U	0.00494	0.00123	0..532	U	0.00532	0.00133	0.00525	U	0.00525	0.00131	0.00462	U	0.00462	0.00116	0.283	U	0.283	0.0708	0.248	U	0.248	0.062
1,2-Dichlorobenzene	59,000	9,800	0.00494	U	0.00494	0.00123	0.00532	U	0.00532	0.00133	0.00525	U	0.00525	0.00131	0.00462	U	0.00462	0.00116	0.283	U	0.283	0.0708	0.248	U	0.248	0.062
cis-1,2-Dichloroethene	560	2,000	0.00494	U	0.00494	0.00123	0.00532	U	0.00532	0.00133	0.00525	U	0.00525	0.00131	0.00462	U	0.00462	0.00116	**17.9**	**D**	1.42	0.354	**0.623**		0.248	0.062
p-Isopropyltoluene	-	-	0.00494	U	0.00494	0.00123	0.00532	U	0.00532	0.00133	0.00525	U	0.00525	0.00131	0.00462	U	0.00462	0.00116	0.283	U	0.283	0.0708	**0.134**	**J**	0.248	0.062
4-Metyl-2-pentanone	-	53,000	0.00494	U	0.00494	0.00123	0.00532	U	0.00532	0.00133	0.00525	U	0.00525	0.00131	0.00462	U	0.00462	0.00116	0.283	U	0.283	0.0708	0.248	U	0.248	0.062
Naphthalene	17	18	0.00494	U	0.00494	0.00123	0.00532	U	0.00532	0.00133	0.00525	U	0.00525	0.00131	0.00462	U	0.00462	0.00116	**0.522**		0.283	0.0708	**0.201**	**J**	0.248	0.062
Tetrachloroethene	5	110	0.00494	U	0.00494	0.00123	0.00532	U	0.00532	0.00133	0.00525	U	0.00525	0.00131	0.00462	U	0.00462	0.00116	0.283	U	0.283	0.0708	**0.121**	**J**	0.248	0.062
Trichloroethene	20	6.4	0.00494	U	0.00494	0.00123	**0.0051**	**J**	0.00532	0.00133	0.00525	U	0.00525	0.00131	0.00462	U	0.00462	0.00116	**1.24**		0.283	0.0708	**23.9**	**D**	1.24	0.31
1,3,5-Trimethylbenzene	-	10,000	0.00494	U	0.00494	0.00123	0.00532	U	0.00532	0.00133	0.00525	U	0.00525	0.00131	0.00462	U	0.00462	0.00116	0.283	U	0.283	0.0708	0.248	U	0.248	0.062
1,2,4-Trimethylbenzene	-	260	0.00494	U	0.00494	0.00123	0.00532	U	0.00532	0.00133	0.00525	U	0.00525	0.00131	0.00462	U	0.00462	0.00116	**0.081**	**J**	0.283	0.0708	**0.0664**	**J**	0.248	0.062
Explosives (mg/kg)																										
RDX	-	24	0.286	U	0.286	0.0714	0.364	U	0.364	0.2	NT				NT				0.16	J	0.333	0.0833	NT			
Metals (mg/kg)																										
Aluminum	NA	990,000	**6,580**		43.3	10.8	**5,140**		49.4	11.2	NT				NT				**14,200**		12.5	3.13	NT			
Arsenic	19	1.6	**3.35**		2.16	0.649	**2.52**		2.52	0.674	NT				NT				**5.47**		0.627	0.188	NT			
Barium	59,000	190,000	**54.1**		8.65	1.08	**109**		8.98	1.12	NT				NT				**50.5**		2.51	0.313	NT			
Beryllium	140	2,000	**0.676**	**J**	1.08	0.216	**0.662**		1.12	0.225	NT				NT				**0.392**		0.313	0.0627	NT			
Cadmium	78	800	**0.602**	**J**	1.08	0.216	**6.73**		1.12	0.225	NT				NT				**6.81**		0.313	0.0627	NT			
Calcium	-	-	**18,300**		1,080	216	**1,900**		1,120	225	NT				NT				**1,150**		313	62.7	NT			
Chromium	-	-	**12.3**		2.16	0.433	**8.86**		2.25	0.449	NT				NT				**13.5**		0.627	0.125	NT			
Cobalt	590	300	**4.86**		2.7	1.08	**4.13**		2.81	1.12	NT				NT				**8.59**		0.783	0.313	NT			
Copper	45,000	41,000	**26.9**		2.16	0.865	**45.9**		2.25	0.898	NT				NT				**39.1**		0.627	0.251	NT			
Iron	-	720,000	**21,800**		21.6	6.49	**20,100**		22.5	6.74	NT				NT				**20,200**		6.27	1.88	NT			
Lead	800	800	**10**		0.649	0.324	**22.6**		0.674	0.337	NT				NT				**19.9**		0.188	0.094	NT			
Magnesium	-	-	**2,950**		1,080	216	**1,970**		1,120	225	NT				NT				**2,340**		313	62.7	NT			
Manganese	5,900	23,000	**320**		3.24	0.649	**271**		3.37	0.674	NT				NT				**640**	**D**	1.88	0.376	NT			
Mercury	65	43	**0.211**		0.0338	0.0133	**0.333**		0.033	0.012	NT				NT				**0.0794**		0.0457	0.018	NT			
Molybdenum	-	5,100	**1.93**	**J**	4.33	1.08	4.49	U	4.49	1.12	NT				NT				NT				NT			
Nickel	23,000	20,000	**14.5**		2.16	0.649	**9.22**		2.25	0.674	NT				NT				**16.1**		0.627	0.188	NT			
Potassium	-	-	**706**	**J**	1,080	216	**530**		1,120	225	NT				NT				**815**		313	62.7	NT			
Selenium	5,700	5,100	2.16	U	2.16	0.649	2.25	U	2.25	0.674	NT				NT				**0.587**	**J**	0.627	0.0627	NT			
Sodium	-	-	1,080	U	1080	216	1,120	U	1,120	225	NT				NT				313	U	313	62.7	NT			
Vanadium	1,100	5,200	**14.8**		2.7	1.08	**13.1**		2.81	1.12	NT				NT				**23**		0.783	0.313	NT			
Zinc	110,000	310,000	**87.8**		4.33	1.08	**229**		4.49	1.12	NT				NT				**105**		1.25	0.313	NT			
Semivolatile Organics (mg/kg)																										
Benz(a)anthracene	2	2.1	0.349	U	0.349	0.0881	0.348	U	0.348	0.0879	NT				NT				0.42	U	0.42	0.106	NT			
Benzo(a)pyrene	0.2	0.21	0.349	U	0.349	0.0881	0.348	U	0.348	0.0879	NT				NT				0.42	U	0.42	0.106	NT			
Benzo(b)fluoranthene	2	2.1	0.349	U	0.349	0.0881	0.348	U	0.348	0.0879	NT				NT				0.42	U	0.42	0.106	NT			
Chrysene	230	210	0.349	U	0.349	0.0881	0.348	U	0.348	0.0879	NT				NT				0.42	U	0.42	0.106	NT			
Fluoranthene	24,000	22,000	0.349	U	0.349	0.0881	0.348	U	0.348	0.0879	NT				NT				0.42	U	0.42	0.106	NT			
Phenanthrene	300,000	-	0.349	U	0.349	0.0881	0.198	J	0.348	0.0879	NT				NT				0.42	U	0.42	0.106	NT			
Pyrene	18,000	17,000	**0.104**	**J**	0.349	0.0881	0.348	U	0.348	0.0879	NT				NT				0.42	U	0.42	0.106	NT			

ft - feet
bgs - bleow ground surface
mg/kg - milligrams per kilogram

LQ - Lab Qualifier
NA - Not Available (for Non-Residetial Cc
J - Value is estimated

- No standard/screening value published for the analyte
OR
Analyte was not detected I the sample identified

Bold values indicate a detection
Shaded values exceeded the NJDEP Non-Residential Soil Remediation Standard or USEPA Industrial Soil Regional Screening Level

Table 4-8a
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Trip Blanks (µg/L)

	Analytical Results																											
Sample ID:	GW042204T1				GW071904T2				SD110904T1				GW050905T1				GW052005T1				SD011106T1				GW031406T1			
Date Sampled:	4/22/2004				7/19/2004				11/9/2004				5/9/2005				5/20/2005				1/11/2006				3/14/2006			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																												
Acetone	1.7	J	10	0.66	10	U	10	0.74	2.1	J	10	0.74	10	U	10	0.74	10	U	10	0.74	0.89	J	10	0.74	6.9	J	10	0.74
Acetonitrile	20	U	20	2.9	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5
Benzene	1	U	1	0.2	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Bromodichloromethane	1	U	1	0.2	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14
Bromoform	1	U	1	0.32	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Bromomethane	2	U	2	0.16	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36
2-Butanone	0.52	J	10	0.36	10	U	10	0.39	0.58	J	10	0.39	0.51	J	10	0.39	10	U	10	0.39	10	U	10	0.39	1.6	J	10	0.39
Carbon disulfide	1	U	1	0.21	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
Carbon tetrachloride	1	U	1	0.18	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Chlorobenzene	0.49	J	1	0.16	0.47	J	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2
Chloroethane	2	U	2	0.22	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24
Chloroform	1	U	1	0.21	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	2	U	2	0.26	2	U	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.14
Dibromochloromethane	1	U	1	0.25	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Dichlorodifluoromethane	2	U	2	0.23	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25
1,1-Dichloroethane	1	U	1	0.26	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
1,2-Dichloroethane	1	U	1	0.22	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
1,1-Dichloroethene	1	U	1	0.22	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
cis-1,2-Dichloroethene	0.5	U	0.5	0.25	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21
trans-1,2-Dichloroethene	0.5	U	0.5	0.24	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16
1,2-Dichloropropane	1	U	1	0.18	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
cis-1,3-Dichloropropene	1	U	1	0.15	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12
trans-1,3-Dichloropropene	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Ethyl benzene	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
2-Hexanone	10	U	10	0.31	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35
Methyl tert-Butyl ether	1	U	1	0.21	0.75	J	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	NT			
4-Methyl-2-pentanone (MIBK)	5	U	5	0.34	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	1.7		1	0.28	1.5		1	0.19	4.6		1	0.19	0.35	J	1	0.19	1.4		1	0.19	1.7		1	0.19	1	U	1	0.19
Styrene	1	U	1	0.16	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
1,1,2,2-Tetrachloroethane	1	U	1	0.23	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Tetrachloroethene	1	U	1	0.12	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Toluene	1.1		1	0.17	0.97	J	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
1,1,1-Trichloroethane	1	U	1	0.18	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
1,1,2-Trichloroethane	1	U	1	0.21	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Trichloroethene	1	U	1	0.22	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
Trichlorofluoromethane	2	U	2	0.25	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16
1,1,2-Trichloro-1,2,2-trifluoroethane	1	U	1	0.23	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26
Vinyl chloride	2	U	2	0.26	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21
o-Xylene	NT				NT				NT				NT				NT				NT				NT			
Total Xylenes	1	U	1	0.45	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44

Table 4-8a
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Trip Blanks (µg/L)

	Analytical Results																											
Sample ID:	GW071706T1				GW071906T1				GW072506T1				GW073106T1				SW081006T1				GW103006T1				GW110106T1			
Date Sampled:	7/17/2006				7/19/2006				7/25/2006				7/31/2006				8/10/2006				10/30/2006				11/1/2006			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																												
Acetone	NT				67		10	0.74	110	D	20	1.5	26		10	0.74	37		10	0.74	10	U	10	0.74	4.7	J	10	0.74
Acetonitrile	NT				20	U	20	1.5	40	UD	40	3	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5
Benzene	1	U	1	0.22	1	U	1	0.22	2	UD	2	0.44	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Bromodichloromethane	NT				0.86	J	1	0.14	0.33	JD	2	0.28	1.2		1	0.14	0.64	J	1	0.14	1.2		1	0.14	1	U	1	0.14
Bromoform	NT				1	U	1	0.17	2	UD	2	0.34	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Bromomethane	NT				2	U	2	0.36	4	UD	4	0.72	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36
2-Butanone	NT				16		10	0.39	40	D	20	0.78	6.6	J	10	0.39	12		10	0.39	10	U	10	0.39	10	U	10	0.39
Carbon disulfide	NT				1	U	1	0.28	2	UD	2	0.56	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
Carbon tetrachloride	NT				1	U	1	0.19	2	UD	2	0.38	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Chlorobenzene	NT				1	U	1	0.2	2	UD	2	0.4	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2
Chloroethane	NT				2	U	2	0.24	4	UD	4	0.48	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24
Chloroform	NT				2		1	0.16	0.47	JD	2	0.32	3.7		1	0.16	1.3		1	0.16	4.6		1	0.16	1	U	1	0.16
Chloromethane	NT				0.38	J	2	0.14	1.1	JD	4	0.28	2	U	2	0.14	0.93	J	2	0.14	2	U	2	0.14	2	U	2	0.14
Dibromochloromethane	NT				0.2	J	1	0.19	2	UD	2	0.38	0.22	J	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Dichlorodifluoromethane	NT				2	U	2	0.25	4	UD	4	0.5	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25
1,1-Dichloroethane	NT				1	U	1	0.21	2	UD	2	0.42	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
1,2-Dichloroethane	NT				1	U	1	0.16	2	UD	2	0.32	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
1,1-Dichloroethene	NT				1	U	1	0.18	2	UD	2	0.36	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
cis-1,2-Dichloroethene	NT				0.5	U	0.5	0.21	1	UD	1	0.42	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21
trans-1,2-Dichloroethene	NT				0.5	U	0.5	0.16	1	UD	1	0.32	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16
1,2-Dichloropropane	NT				1	U	1	0.15	2	UD	2	0.3	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
cis-1,3-Dichloropropene	NT				1	U	1	0.12	2	UD	2	0.24	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12
trans-1,3-Dichloropropene	NT				1	U	1	0.17	2	UD	2	0.34	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Ethyl benzene	1	U	1	0.19	1	U	1	0.19	2	UD	2	0.38	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
2-Hexanone	NT				0.74	J	10	0.35	2	JD	20	0.7	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35
Methyl tert-Butyl ether	5	U	5	0.18	1	U	1	0.18	2	UD	2	0.36	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
4-Methyl-2-pentanone (MIBK)	NT				5	U	5	0.32	10	UD	10	0.64	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	NT				0.42	J	1	0.19	0.74	JD	2	0.38	0.39	J	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Styrene	NT				1	U	1	0.13	2	UD	2	0.26	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
1,1,2,2-Tetrachloroethane	NT				1	U	1	0.22	2	UD	2	0.44	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Tetrachloroethene	NT				1	U	1	0.19	2	UD	2	0.38	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Toluene	1	U	1	0.17	1	U	1	0.17	2	UD	2	0.34	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
1,1,1-Trichloroethane	NT				1	U	1	0.21	2	UD	2	0.42	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
1,1,2-Trichloroethane	NT				1	U	1	0.22	2	UD	2	0.44	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Trichloroethene	NT				1	U	1	0.28	2	UD	2	0.56	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
Trichlorofluoromethane	NT				2	U	2	0.16	4	UD	4	0.32	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16
1,1,2-Trichloro-1,2,2-trifluoroethane	NT				1	U	1	0.26	2	UD	2	0.52	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26
Vinyl chloride	NT				2	U	2	0.21	4	UD	4	0.42	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21
o-Xylene	NT				NT				NT				NT				NT				NT				NT			
Total Xylenes	2	U	2	0.44	1	U	1	0.44	2	UD	2	0.88	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44

Table 4-8a
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Trip Blanks (µg/L)

	Analytical Results																											
Sample ID:	GW121206T1				GW030507T1				GW030607T1				GW030707T1				GW030807T1				GW030907T1				AWDF031507T1			
Date Sampled:	12/12/2006				3/5/2007				3/6/2007				3/7/2007				3/8/2007				3/9/2007				3/15/2007			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																												
Acetone	10	U	10	0.74	10	U	10	0.74	10	U	10	0.74	10	U	10	0.74	10	U	10	0.74	10	U	10	0.74	4.1	J	10	0.74
Acetonitrile	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5
Benzene	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Bromodichloromethane	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14
Bromoform	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Bromomethane	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36
2-Butanone	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	0.58	J	10	0.39
Carbon disulfide	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
Carbon tetrachloride	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Chlorobenzene	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2
Chloroethane	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24
Chloroform	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	2	U	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.14
Dibromochloromethane	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Dichlorodifluoromethane	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25
1,1-Dichloroethane	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
1,2-Dichloroethane	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
1,1-Dichloroethene	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
cis-1,2-Dichloroethene	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21
trans-1,2-Dichloroethene	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16
1,2-Dichloropropane	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
cis-1,3-Dichloropropene	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12
trans-1,3-Dichloropropene	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Ethyl benzene	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
2-Hexanone	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35
Methyl tert-Butyl ether	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
4-Methyl-2-pentanone (MIBK)	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	0.56	J	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	0.59	J	1	0.19
Styrene	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
1,1,2,2-Tetrachloroethane	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Tetrachloroethene	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Toluene	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
1,1,1-Trichloroethane	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
1,1,2-Trichloroethane	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Trichloroethene	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
Trichlorofluoromethane	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16
1,1,2-Trichloro-1,2,2-trifluoroethane	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26
Vinyl chloride	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21
o-Xylene	NT				NT				NT				NT				NT				NT				NT			
Total Xylenes	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44

Table 4-8a
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Trip Blanks (µg/L)

	Analytical Results																											
Sample ID:	SS032307T1				GW033007T1				SW033007T1				GW061407T1				GW061907T1				GW062207T1				GW062507T1			
Date Sampled:	3/23/2007				3/30/2007				3/30/2007				6/14/2007				6/19/2007				6/22/2007				6/25/2007			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																												
Acetone	10	U	10	0.74	10	U	10	0.74	0.95	J	10	0.74	10	U	10	1.1	1.3	J	10	1.1	10	U	10	1.1	1.3	J	10	1.1
Acetonitrile	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	20	U	20	3.5	20	U	20	3.5	20	U	20	3.5	20	U	20	3.5
Benzene	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
Bromodichloromethane	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
Bromoform	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.64	1	U	1	0.64	1	U	1	0.64	1	U	1	0.64
Bromomethane	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	2	U	2	0.41	2	U	2	0.41	2	U	2	0.41	2	U	2	0.41
2-Butanone	10	U	10	0.39	10	U	10	0.39	10	U	10	0.39	10	U	10	0.57	10	U	10	0.57	10	U	10	0.57	10	U	10	0.57
Carbon disulfide	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
Carbon tetrachloride	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
Chlorobenzene	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
Chloroethane	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	2	U	2	0.29	2	U	2	0.29	2	U	2	0.29	2	U	2	0.29
Chloroform	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	2	U	2	0.14	2	U	2	0.14	2	U	2	0.14	2	U	2	0.3	2	U	2	0.3	2	U	2	0.3	2	U	2	0.3
Dibromochloromethane	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
Dichlorodifluoromethane	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	2	U	2	0.31	2	U	2	0.31	2	U	2	0.31	2	U	2	0.31
1,1-Dichloroethane	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
1,2-Dichloroethane	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
1,1-Dichloroethene	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
cis-1,2-Dichloroethene	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.17	0.5	U	0.5	0.17	0.5	U	0.5	0.17	0.5	U	0.5	0.17
trans-1,2-Dichloroethene	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.19	0.5	U	0.5	0.19	0.5	U	0.5	0.19	0.5	U	0.5	0.19
1,2-Dichloropropane	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
cis-1,3-Dichloropropene	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14
trans-1,3-Dichloropropene	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Ethyl benzene	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
2-Hexanone	10	U	10	0.35	10	U	10	0.35	10	U	10	0.35	10	U	10	0.41	10	U	10	0.41	10	U	10	0.41	10	U	10	0.41
Methyl tert-Butyl ether	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	5	U	5	0.17	5	U	5	0.17	1	U	1	0.17	5	U	5	0.17
4-Methyl-2-pentanone (MIBK)	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	0.45	J	1	0.19	1	U	1	0.19	0.75	J	1	0.19	1	U	1	0.33	0.49	J	1	0.33	1	U	1	0.33	0.38	J	1	0.33
Styrene	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.11	1	U	1	0.11	1	U	1	0.11	1	U	1	0.11
1,1,2,2-Tetrachloroethane	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
Tetrachloroethene	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29
Toluene	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
1,1,1-Trichloroethane	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
1,1,2-Trichloroethane	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27
Trichloroethene	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Trichlorofluoromethane	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21
1,1,2-Trichloro-1,2,2-trifluoroethane	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
Vinyl chloride	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.22	2	U	2	0.22	2	U	2	0.22	2	U	2	0.22
o-Xylene	NT				NT				NT				NT				NT				NT				NT			
Total Xylenes	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28

Table 4-8a
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Trip Blanks (µg/L)

	Analytical Results																											
Sample ID:	GW101507T1				GW101707T1				GW102207T1				GW102407T1				061808T1				GW060908T1				GW061708T1			
Date Sampled:	10/15/2007				10/17/2007				10/22/2007				10/24/2007				6/18/2008				6/9/2008				6/17/2008			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																												
Acetone	6	J	10	1.1	1.1	J	10	1.1	5.1	J	10	1.1	2.5	J	10	1.1	2.1	J	5	0.77	5	U	5	0.77	5	U	5	0.77
Acetonitrile	20	U	20	3.5	20	U	20	3.5	20	U	20	3.5	20	U	20	3.5	NT				NT				NT			
Benzene	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.059	1	U	1	0.059	1	U	1	0.059
Bromodichloromethane	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.031	1	U	1	0.031	1	U	1	0.031
Bromoform	1	U	1	0.64	1	U	1	0.64	1	U	1	0.64	1	U	1	0.64	1	U	1	0.1	1	U	1	0.1	1	U	1	0.1
Bromomethane	2	U	2	0.41	2	U	2	0.41	2	U	2	0.41	2	U	2	0.41	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29
2-Butanone	10	U	10	0.57	10	U	10	0.57	10	U	10	0.57	10	U	10	0.57	5	U	5	0.78	5	U	5	0.78	5	U	5	0.78
Carbon disulfide	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.045	1	U	1	0.045	1	U	1	0.045
Carbon tetrachloride	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.031	1	U	1	0.031	1	U	1	0.031
Chlorobenzene	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.047	1	U	1	0.047	1	U	1	0.047
Chloroethane	2	U	2	0.29	2	U	2	0.29	2	U	2	0.29	2	U	2	0.29	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
Chloroform	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.041	1	U	1	0.041	1	U	1	0.041
Chloromethane	2	U	2	0.3	2	U	2	0.3	2	U	2	0.3	2	U	2	0.3	1	U	1	0.11	1	U	1	0.11	1	U	1	0.11
Dibromochloromethane	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.035	1	U	1	0.035	1	U	1	0.035
Dichlorodifluoromethane	2	U	2	0.31	2	U	2	0.31	2	U	2	0.31	2	U	2	0.31	1	U	1	0.058	1	U	1	0.058	1	U	1	0.058
1,1-Dichloroethane	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.041	1	U	1	0.041	1	U	1	0.041
1,2-Dichloroethane	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.1	1	U	1	0.1	1	U	1	0.1
1,1-Dichloroethene	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.077	1	U	1	0.077	1	U	1	0.077
cis-1,2-Dichloroethene	0.5	U	0.5	0.17	0.5	U	0.5	0.17	0.5	U	0.5	0.17	0.5	U	0.5	0.17	1	U	1	0.065	1	U	1	0.065	1	U	1	0.065
trans-1,2-Dichloroethene	0.5	U	0.5	0.19	0.5	U	0.5	0.19	0.5	U	0.5	0.19	0.5	U	0.5	0.19	1	U	1	0.059	1	U	1	0.059	1	U	1	0.059
1,2-Dichloropropane	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.1	1	U	1	0.1	1	U	1	0.1
cis-1,3-Dichloropropene	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.049	1	U	1	0.049	1	U	1	0.049
trans-1,3-Dichloropropene	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.053	1	U	1	0.053	1	U	1	0.053
Ethyl benzene	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.038	1	U	1	0.038	1	U	1	0.038
2-Hexanone	10	U	10	0.41	10	U	10	0.41	10	U	10	0.41	10	U	10	0.41	5	U	5	0.29	5	U	5	0.29	5	U	5	0.29
Methyl tert-Butyl ether	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.036	1	U	1	0.036	1	U	1	0.036
4-Methyl-2-pentanone (MIBK)	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.29	5	U	5	0.29	5	U	5	0.29
Methylene chloride	2		1	0.33	1	U	1	0.33	1		1	0.33	0.58	J	1	0.33	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12
Styrene	1	U	1	0.11	1	U	1	0.11	1	U	1	0.11	1	U	1	0.11	1	U	1	0.05	1	U	1	0.05	1	U	1	0.05
1,1,2,2-Tetrachloroethane	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.047	1	U	1	0.047	1	U	1	0.047
Tetrachloroethene	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29	1	U	1	0.063	1	U	1	0.063	1	U	1	0.063
Toluene	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.041	1	U	1	0.041	1	U	1	0.041
1,1,1-Trichloroethane	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.041	1	U	1	0.041	1	U	1	0.041
1,1,2-Trichloroethane	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27	1	U	1	0.072	1	U	1	0.072	1	U	1	0.072
Trichloroethene	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.058	1	U	1	0.058	1	U	1	0.058
Trichlorofluoromethane	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	1	U	1	0.067	1	U	1	0.067	1	U	1	0.067
1,1,2-Trichloro-1,2,2-trifluoroethane	0.34	J	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	NT				NT				NT			
Vinyl chloride	2	U	2	0.22	2	U	2	0.22	2	U	2	0.22	2	U	2	0.22	1	U	1	0.062	1	U	1	0.062	1	U	1	0.062
o-Xylene	NT				NT				NT				NT				1	U	1	0.06	1	U	1	0.06	1	U	1	0.06
Total Xylenes	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.097	1	U	1	0.097	1	U	1	0.097

Table 4-8a
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Trip Blanks (µg/L)

	Analytical Results																											
Sample ID:	GW062608T1				GW063008T1				GW041910T1				GW051010T1				GW051110T1				GW012411T1				GW012811TB			
Date Sampled:	6/26/2008				6/30/2008				4/19/2010				5/10/2010				5/11/2010				1/24/2011							
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																												
Acetone	6.9		5	0.77	5	U	5	0.77	10	U	10	1.8	10	U	10	1.8	10	U	10	1.8	5	U	5	0.5	5	U	5	0.5
Acetonitrile	NT				NT				5	U	5	1.67	5	U	5	1.67	5	U	5	1.67	NT				NT			
Benzene	1	U	1	0.059	1	U	1	0.059	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.32	1	U	1	0.32
Bromodichloromethane	1	U	1	0.031	1	U	1	0.031	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.36	1	U	1	0.36
Bromoform	1	U	1	0.1	1	U	1	0.1	1.5	U	1.5	0.5	1.5	U	1.5	0.5	5	U	5	1.5	1	U	1	0.47	1	U	1	0.47
Bromomethane	1	U	1	0.29	1	U	1	0.29	2	U	2	0.32	2	U	2	0.32	2	U	2	0.32	1	U	1	0.2	1	U	1	0.2
2-Butanone	5	U	5	0.78	5	U	5	0.78	5	U	5	1.6	5	U	5	1.6	5	U	5	1.6	5	U	5	1.3	5	U	5	1.3
Carbon disulfide	1	U	1	0.045	1	U	1	0.045	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.2	1	U	1	0.2
Carbon tetrachloride	1	U	1	0.031	1	U	1	0.031	1	U	1	0.24	1	U	1	0.24	1	U	1	0.24	1	U	1	0.2	1	U	1	0.2
Chlorobenzene	1	U	1	0.047	1	U	1	0.047	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.49	1	U	1	0.49
Chloroethane	1	U	1	0.15	1	U	1	0.15	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27	1	U	1	0.2	1	U	1	0.2
Chloroform	1	U	1	0.041	1	U	1	0.041	0.687	J	1	0.23	1	U	1	0.23	1	U	1	0.23	1	U	1	0.34	1	U	1	0.34
Chloromethane	1	U	1	0.11	1	U	1	0.11	1	U	1	0.36	1	U	1	0.36	1	U	1	0.36	1	U	1	0.2	1	U	1	0.2
Dibromochloromethane	1	U	1	0.035	1	U	1	0.035	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.2	1	U	1	0.2
Dichlorodifluoromethane	1	U	1	0.058	1	U	1	0.058	2	U	2	0.26	2	U	2	0.26	2	U	2	0.26	1	U	1	0.2	1	U	1	0.2
1,1-Dichloroethane	1	U	1	0.041	1	U	1	0.041	1	U	1	0.24	1	U	1	0.24	1	U	1	0.24	1	U	1	0.36	1	U	1	0.36
1,2-Dichloroethane	1	U	1	0.1	1	U	1	0.1	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.48	1	U	1	0.48
1,1-Dichloroethene	1	U	1	0.077	1	U	1	0.077	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.47	1	U	1	0.47
cis-1,2-Dichloroethene	1	U	1	0.065	1	U	1	0.065	1.5	U	1.5	0.45	1.5	U	1.5	0.45	1.5	U	1.5	0.45	1	U	1	0.35	1	U	1	0.35
trans-1,2-Dichloroethene	1	U	1	0.059	1	U	1	0.059	1.5	U	1.5	0.53	1.5	U	1.5	0.53	1.5	U	1.5	0.53	1	U	1	0.41	1	U	1	0.41
1,2-Dichloropropane	1	U	1	0.1	1	U	1	0.1	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27	1	U	1	0.46	1	U	1	0.46
cis-1,3-Dichloropropene	1	U	1	0.049	1	U	1	0.049	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.31	1	U	1	0.31
trans-1,3-Dichloropropene	1	U	1	0.053	1	U	1	0.053	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.29	1	U	1	0.29
Ethyl benzene	1	U	1	0.038	1	U	1	0.038	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.2	1	U	1	0.2
2-Hexanone	5	U	5	0.29	5	U	5	0.29	5	U	5	0.5	5	U	5	0.5	5	U	5	0.5	5	U	5	1.9	5	U	5	1.9
Methyl tert-Butyl ether	1	U	1	0.036	1	U	1	0.036	1	U	1	0.25	NT				NT				1	U	1	0.35	1	U	1	0.35
4-Methyl-2-pentanone (MIBK)	5	U	5	0.29	5	U	5	0.29	5	U	5	0.5	5	U	5	0.5	5	U	5	0.5	5	U	5	2.1	5	U	5	2.1
Methylene chloride	1	U	1	0.12	0.36	J	1	0.12	2.3		1	0.27	1	U	1	0.27	1	U	1	0.27	1	U	1	0.41	1	U	1	0.41
Styrene	1	U	1	0.05	1	U	1	0.05	1	U	1	0.24	1	U	1	0.24	1	U	1	0.24	1	U	1	0.36	1	U	1	0.36
1,1,2,2-Tetrachloroethane	1	U	1	0.047	1	U	1	0.047	1	U	1	0.23	1	U	1	0.23	1	U	1	0.23	1	U	1	0.31	1	U	1	0.31
Tetrachloroethene	1	U	1	0.063	1	U	1	0.063	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.27	1	U	1	0.27
Toluene	1	U	1	0.041	1	U	1	0.041	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.37	1	U	1	0.37
1,1,1-Trichloroethane	1	U	1	0.041	1	U	1	0.041	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29	1	U	1	0.4	1	U	1	0.4
1,1,2-Trichloroethane	1	U	1	0.072	1	U	1	0.072	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.38	1	U	1	0.38
Trichloroethene	1	U	1	0.058	1	U	1	0.058	1	U	1	0.5	1	U	1	0.5	1	U	1	0.5	1	U	1	0.28	1	U	1	0.28
Trichlorofluoromethane	1	U	1	0.067	1	U	1	0.067	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.35	1	U	1	0.35
1,1,2-Trichloro-1,2,2-trifluoroethane	NT				NT				1	U	1	0.33	1	U	1	0.33	1	U	1	0.33	1	U	1	0.45	1	U	1	0.45
Vinyl chloride	1	U	1	0.062	1	U	1	0.062	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.34	1	U	1	0.34
o-Xylene	1	U	1	0.06	1	U	1	0.06	NT				NT				NT				1	U	1	0.43	1	U	1	0.43
Total Xylenes	1	U	1	0.097	1	U	1	0.097	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	2	U	2	0.95	2	U	2	0.95

Table 4-8a
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Trip Blanks (µg/L)

	Analytical Results																							
Sample ID:	GW021011TB				Trip Blank #9880				Trip Blank #9881				TR052212TB1				TR052312TB2				GW013013TB			
Date Sampled:	2/10/2011				6/22/2011				6/23/2011				5/22/2012				5/23/2012				1/30/2013			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																								
Acetone	5	U	5	0.5	10	U	10	2.5	10	U	10	2.5	10	U	10	2.5	3.75	J	10	2.5	2.5	U	2.5	10
Acetonitrile	NT				NT				NT				NT				NT				NT			
Benzene	1	U	1	0.32	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Bromodichloromethane	1	U	1	0.36	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Bromoform	1	U	1	0.47	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Bromomethane	1	U	1	0.2	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	0.5	U	0.5	2
2-Butanone	5	U	5	1.3	10	U	10	2.5	10	U	10	2.5	10	U	10	2.5	10	U	10	2.5	2.5	U	2.5	10
Carbon disulfide	1	U	1	0.2	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Carbon tetrachloride	1	U	1	0.2	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Chlorobenzene	1	U	1	0.49	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Chloroethane	1	U	1	0.2	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	0.5	U	0.5	2
Chloroform	1	U	1	0.34	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Chloromethane	1	U	1	0.2	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Dibromochloromethane	1	U	1	0.2	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Dichlorodifluoromethane	1	U	1	0.2	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	0.5	U	0.5	2
1,1-Dichloroethane	1	U	1	0.36	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
1,2-Dichloroethane	1.1		1	0.48	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
1,1-Dichloroethene	1	U	1	0.47	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
cis-1,2-Dichloroethene	1	U	1	0.35	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
trans-1,2-Dichloroethene	1	U	1	0.41	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
1,2-Dichloropropane	1	U	1	0.46	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
cis-1,3-Dichloropropene	1	U	1	0.31	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
trans-1,3-Dichloropropene	1	U	1	0.29	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Ethyl benzene	1	U	1	0.2	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
2-Hexanone	5	U	5	1.9	5	U	5	1.25	5	U	5	1.25	5	U	5	1.25	5	U	5	1.25	1.25	U	1.25	5
Methyl tert-Butyl ether	1	U	1	0.35	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
4-Methyl-2-pentanone (MIBK)	5	U	5	2.1	5	U	5	1.25	5	U	5	1.25	5	U	5	1.25	5	U	5	1.25	1.25	U	1.25	5
Methylene chloride	1	U	1	0.41	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	0.5	U	0.5	2
Styrene	1	U	1	0.36	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
1,1,2,2-Tetrachloroethane	1	U	1	0.31	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Tetrachloroethene	1	U	1	0.27	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Toluene	1	U	1	0.37	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
1,1,1-Trichloroethane	1	U	1	0.4	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
1,1,2-Trichloroethane	1	U	1	0.38	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Trichloroethene	1	U	1	0.28	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Trichlorofluoromethane	1	U	1	0.35	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	0.5	U	0.5	2
1,1,2-Trichloro-1,2,2-trifluoroethane	1	U	1	0.45	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	0.5	U	0.5	2
Vinyl chloride	1	U	1	0.34	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
o-Xylene	1	U	1	0.43	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	0.25	U	0.25	1
Total Xylenes	2	U	2	0.95	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	2	U	2	0.5	0.5	U	0.5	2

NT = Not tested.
Q = Flags/Qualifiers (QA/QC):
J = Detect, value is an estimate of the concentration.
R = Rejected result, value should not be used for any purpose.

U = Non-detect, value is the detection limit.
(U) = Non-detect, chemical was detected in blank.
RL/EQL = Reporting Limit / Estimated Quantitation Limit
SQL = Sample Quantitation Limit

Table 4-8b
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Rinse Blanks (µg/L)

	Analytical Results																											
Sample ID:	GW042604R1				SD110904R1				GW050905R1				SD011106R1				GW071706R1				GW072506R1				GW073106R1			
Date Sampled:	4/26/2004				11/9/2004				5/9/2005				1/11/2006				7/17/2006				7/25/2006				7/31/2006			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																												
Acetone	19		10	0.66	5.4	J	10	0.74	19		10	0.74	66	D	25	1.8	NT				140	D	20	1.5	10	U	10	0.74
Acetonitrile	20	U	20	2.9	20	U	20	1.5	20	U	20	1.5	20	U	20	1.5	NT				40	UD	40	3	20	U	20	1.5
Benzene	1	U	1	0.2	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	2	UD	2	0.44	1	U	1	0.22
Bromodichloromethane	1	U	1	0.2	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	NT				0.35	JD	2	0.28	1.4		1	0.14
Bromoform	1	U	1	0.32	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	NT				2	UD	2	0.34	1	U	1	0.17
Bromomethane	2	U	2	0.16	2	U	2	0.36	2	U	2	0.36	2	U	2	0.36	NT				4	UD	4	0.72	2	U	2	0.36
2-Butanone	5.7	J	10	0.36	1.9	J	10	0.39	6.2	J	10	0.39	50		10	0.39	NT				47	D	20	0.78	10	U	10	0.39
Carbon disulfide	1	U	1	0.21	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	NT				2	UD	2	0.56	1	U	1	0.28
Carbon tetrachloride	1	U	1	0.18	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	NT				2	UD	2	0.38	1	U	1	0.19
Chlorobenzene	1	U	1	0.16	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	NT				2	UD	2	0.4	1	U	1	0.2
Chloroethane	2	U	2	0.22	2	U	2	0.24	2	U	2	0.24	2	U	2	0.24	NT				4	UD	4	0.48	2	U	2	0.24
Chloroform	1	U	1	0.21	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	NT				0.5	JD	2	0.32	4.7		1	0.16
Chloromethane	2	U	2	0.26	2	U	2	0.14	0.34	J	2	0.14	0.38	J	2	0.14	NT				1.1	JD	4	0.28	0.43	J	2	0.14
Dibromochloromethane	1	U	1	0.25	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	NT				2	UD	2	0.38	0.25	J	1	0.19
Dichlorodifluoromethane	2	U	2	0.23	2	U	2	0.25	2	U	2	0.25	2	U	2	0.25	NT				4	UD	4	0.5	2	U	2	0.25
1,1-Dichloroethane	1	U	1	0.26	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	NT				2	UD	2	0.42	1	U	1	0.21
1,2-Dichloroethane	1	U	1	0.22	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	NT				2	UD	2	0.32	1	U	1	0.16
1,1-Dichloroethene	1	U	1	0.22	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	NT				2	UD	2	0.36	1	U	1	0.18
cis-1,2-Dichloroethene	0.5	U	0.5	0.25	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21	NT				1	UD	1	0.42	0.5	U	0.5	0.21
trans-1,2-Dichloroethene	0.5	U	0.5	0.24	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16	NT				1	UD	1	0.32	0.5	U	0.5	0.16
1,2-Dichloropropane	1	U	1	0.18	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	NT				2	UD	2	0.3	1	U	1	0.15
cis-1,3-Dichloropropene	1	U	1	0.15	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	NT				2	UD	2	0.24	1	U	1	0.12
trans-1,3-Dichloropropene	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	NT				2	UD	2	0.34	1	U	1	0.17
Ethyl benzene	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	2	UD	2	0.38	1	U	1	0.19
2-Hexanone	10	U	10	0.31	10	U	10	0.35	10	U	10	0.35	7.8	J	10	0.35	NT				2.1	JD	20	0.7	10	U	10	0.35
Methyl tert-Butyl ether	1	U	1	0.21	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	5	U	5	0.18	2	UD	2	0.36	1	U	1	0.18
4-Methyl-2-pentanone (MIBK)	5	U	5	0.34	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	NT				10	UD	10	0.64	5	U	5	0.32
Methylene chloride	1	U	1	0.28	0.51	J	1	0.19	1	U	1	0.19	0.66	J	1	0.19	NT				0.68	JD	2	0.38	0.49	J	1	0.19
Styrene	1	U	1	0.16	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	NT				2	UD	2	0.26	1	U	1	0.13
1,1,2,2-Tetrachloroethane	1	U	1	0.23	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	NT				2	UD	2	0.44	1	U	1	0.22
Tetrachloroethene	1	U	1	0.12	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	NT				2	UD	2	0.38	1	U	1	0.19
Toluene	0.18	J	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	2	UD	2	0.34	1	U	1	0.17
1,1,1-Trichloroethane	1	U	1	0.18	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	NT				2	UD	2	0.42	1	U	1	0.21
1,1,2-Trichloroethane	1	U	1	0.21	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	NT				2	UD	2	0.44	1	U	1	0.22
Trichloroethene	1	U	1	0.22	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	NT				2	UD	2	0.56	1	U	1	0.28
Trichlorofluoromethane	2	U	2	0.25	2	U	2	0.16	2	U	2	0.16	2	U	2	0.16	NT				4	UD	4	0.32	2	U	2	0.16
1,1,2-Trichloro-1,2,2-trifluoroethane	1	U	1	0.23	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	NT				2	UD	2	0.52	1	U	1	0.26
Vinyl chloride	2	U	2	0.26	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	NT				4	UD	4	0.42	2	U	2	0.21
o-Xylene	NT				NT				NT				NT				NT				NT				NT			
Total Xylenes	1	U	1	0.45	1	U	1	0.44	1	U	1	0.44	1	U	1	0.44	2	U	2	0.44	2	UD	2	0.88	1	U	1	0.44
Explosives																												
1,3-Dinitrobenzene	NT				NT				NT				NT				0.2	U	0.2	0.06	NT				NT			
2,4-Dinitrotoluene	NT				NT				NT				NT				0.2	U	0.2	0.066	NT				NT			
2,6-Dinitrotoluene	NT				NT				NT				NT				0.2	U	0.2	0.072	NT				NT			
2-amino-4,6-Dinitrotoluene	NT				NT				NT				NT				0.2	U	0.2	0.063	NT				NT			
4-amino-2,6-Dinitrotoluene	NT				NT				NT				NT				0.2	U	0.2	0.088	NT				NT			
HMX	NT				NT				NT				NT				0.5	U	0.5	0.061	NT				NT			
Nitrobenzene	NT				NT				NT				NT				0.19	J	0.2	0.072	NT				NT			
2-Nitrotoluene	NT				NT				NT				NT				0.2	U	0.2	0.12	NT				NT			
3-Nitrotoluene	NT				NT				NT				NT				0.2	U	0.2	0.16	NT				NT			
4-Nitrotoluene	NT				NT				NT				NT				0.2	U	0.2	0.12	NT				NT			
RDX	NT				NT				NT				NT				0.5	U	0.5	0.053	NT				NT			
Tetryl	NT				NT				NT				NT				0.2	U	0.2	0.078	NT				NT			
1,3,5-Trinitrobenzene	NT				NT				NT				NT				0.2	U	0.2	0.052	NT				NT			
2,4,6-Trinitrotoluene	NT				NT				NT				NT				0.2	U	0.2	0.051	NT				NT			

Table 4-8b
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Rinse Blanks (µg/L)

Sample ID:	Analytical Results																											
Date Sampled:	GW103006R1 10/30/2006				GW110106R1 11/1/2006				GW121206R1 12/12/2006				SD121306R1 12/13/2006				GW122106R1 12/21/2006				GW030507R1 3/5/2007				GW030707R1 3/7/2007			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																												
Acetone	1.9	J	10	0.74	11		10	0.74	NT				NT				10	U	10	0.74	10	U	10	0.74	10	U	10	0.74
Acetonitrile	20	U	20	1.5	20	U	20	1.5	NT				NT				20	U	20	1.5	20	U	20	1.5	2	J	20	1.5
Benzene	1	U	1	0.22	1	U	1	0.22	NT				NT				1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Bromodichloromethane	1.2		1	0.14	0.88	J	1	0.14	NT				NT				0.74	J	1	0.14	1	U	1	0.14	1	U	1	0.14
Bromoform	1	U	1	0.17	1	U	1	0.17	NT				NT				1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Bromomethane	2	U	2	0.36	2	U	2	0.36	NT				NT				2	U	2	0.36	2	U	2	0.36	2	U	2	0.36
2-Butanone	10	U	10	0.39	3	J	10	0.39	NT				NT				10	U	10	0.39	10	U	10	0.39	10	U	10	0.39
Carbon disulfide	1	U	1	0.28	1	U	1	0.28	NT				NT				1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
Carbon tetrachloride	1	U	1	0.19	1	U	1	0.19	NT				NT				1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Chlorobenzene	1	U	1	0.2	1	U	1	0.2	NT				NT				1	U	1	0.2	1	U	1	0.2	1	U	1	0.2
Chloroethane	2	U	2	0.24	2	U	2	0.24	NT				NT				2	U	2	0.24	2	U	2	0.24	2	U	2	0.24
Chloroform	4.6		1	0.16	2.4		1	0.16	NT				NT				2.9		1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	2	U	2	0.14	0.42	J	2	0.14	NT				NT				2	U	2	0.14	2	U	2	0.14	2	U	2	0.14
Dibromochloromethane	0.2	J	1	0.19	1	U	1	0.19	NT				NT				1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Dichlorodifluoromethane	2	U	2	0.25	2	U	2	0.25	NT				NT				2	U	2	0.25	2	U	2	0.25	2	U	2	0.25
1,1-Dichloroethane	1	U	1	0.21	1	U	1	0.21	NT				NT				1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
1,2-Dichloroethane	1	U	1	0.16	1	U	1	0.16	NT				NT				1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
1,1-Dichloroethene	1	U	1	0.18	1	U	1	0.18	NT				NT				1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
cis-1,2-Dichloroethene	0.5	U	0.5	0.21	0.5	U	0.5	0.21	NT				NT				0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.21
trans-1,2-Dichloroethene	0.5	U	0.5	0.16	0.5	U	0.5	0.16	NT				NT				0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.16
1,2-Dichloropropane	1	U	1	0.15	1	U	1	0.15	NT				NT				1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
cis-1,3-Dichloropropene	1	U	1	0.12	1	U	1	0.12	NT				NT				1	U	1	0.12	1	U	1	0.12	1	U	1	0.12
trans-1,3-Dichloropropene	1	U	1	0.17	1	U	1	0.17	NT				NT				1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Ethyl benzene	1	U	1	0.19	1	U	1	0.19	NT				NT				1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
2-Hexanone	10	U	10	0.35	10	U	10	0.35	NT				NT				10	U	10	0.35	10	U	10	0.35	10	U	10	0.35
Methyl tert-Butyl ether	1	U	1	0.18	1	U	1	0.18	NT				NT				1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
4-Methyl-2-pentanone (MIBK)	5	U	5	0.32	5	U	5	0.32	NT				NT				5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	1	U	1	0.19	1	U	1	0.19	NT				NT				1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Styrene	1	U	1	0.13	1	U	1	0.13	NT				NT				1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
1,1,2,2-Tetrachloroethane	1	U	1	0.22	1	U	1	0.22	NT				NT				1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Tetrachloroethene	1	U	1	0.19	1	U	1	0.19	NT				NT				1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Toluene	1	U	1	0.17	1	U	1	0.17	NT				NT				1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
1,1,1-Trichloroethane	1	U	1	0.21	1	U	1	0.21	NT				NT				1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
1,1,2-Trichloroethane	1	U	1	0.22	1	U	1	0.22	NT				NT				1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
Trichloroethene	1	U	1	0.28	1	U	1	0.28	NT				NT				1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
Trichlorofluoromethane	2	U	2	0.16	2	U	2	0.16	NT				NT				2	U	2	0.16	2	U	2	0.16	2	U	2	0.16
1,1,2-Trichloro-1,2,2-trifluoroethane	1	U	1	0.26	1	U	1	0.26	NT				NT				1	U	1	0.26	1	U	1	0.26	1	U	1	0.26
Vinyl chloride	2	U	2	0.21	2	U	2	0.21	NT				NT				2	U	2	0.21	2	U	2	0.21	2	U	2	0.21
o-Xylene	NT				NT				NT				NT				NT				NT				NT			
Total Xylenes	1	U	1	0.44	1	U	1	0.44	NT				NT				1	U	1	0.44	1	U	1	0.44	1	U	1	0.44
1,3-Dinitrobenzene	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07
2,4-Dinitrotoluene	0.2	U	0.2	0.066	0.2	U	0.2	0.066	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,6-Dinitrotoluene	0.2	U	0.2	0.072	0.2	U	0.2	0.072	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08
2-amino-4,6-Dinitrotoluene	0.2	U	0.2	0.063	0.2	U	0.2	0.063	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.06
4-amino-2,6-Dinitrotoluene	0.2	U	0.2	0.088	0.2	U	0.2	0.088	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.09
HMX	0.5	U	0.5	0.061	0.5	U	0.5	0.061	0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.07
Nitrobenzene	0.2	U	0.2	0.072	0.2	U	0.2	0.072	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07
2-Nitrotoluene	0.2	U	0.2	0.12	0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2
3-Nitrotoluene	0.2	U	0.2	0.16	0.2	U	0.2	0.16	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1
4-Nitrotoluene	0.2	U	0.2	0.12	0.2	U	0.2	0.12	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2
RDX	0.5	U	0.5	0.053	0.5	U	0.5	0.053	0.5	U	0.5	0.1	0.5	U	0.5	0.1	0.5	U	0.5	0.1	0.5	U	0.5	0.1	0.5	U	0.5	0.1
Tetryl	0.2	U	0.2	0.078	0.2	U	0.2	0.078	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08
1,3,5-Trinitrobenzene	0.2	U	0.2	0.052	0.2	U	0.2	0.052	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08
2,4,6-Trinitrotoluene	0.2	U	0.2	0.051	0.2	U	0.2	0.051	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1

Table 4-8b
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Rinse Blanks (µg/L)

	Analytical Results																											
Sample ID:	SS032307R1				GW033007R1				GW061407R1				GW062007R1				GW062507R1				GW101507R1				SW101507R1			
Date Sampled:	3/23/2007				3/30/2007				6/14/2007				6/20/2007				6/25/2007				10/15/2007				10/15/2007			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																												
Acetone	0.75	J	10	0.74	10	U	10	0.74	10	U	10	1.1	10	U	10	1.1	10	U	10	1.1	10	U	10	1.1	10	U	10	1.1
Acetonitrile	20	U	20	1.5	20	U	20	1.5	20	U	20	3.5	20	U	20	3.5	20	U	20	3.5	20	U	20	3.5	20	U	20	3.5
Benzene	1	U	1	0.22	1	U	1	0.22	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
Bromodichloromethane	1	U	1	0.14	1	U	1	0.14	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
Bromoform	1	U	1	0.17	1	U	1	0.17	1	U	1	0.64	1	U	1	0.64	1	U	1	0.64	1	U	1	0.64	1	U	1	0.64
Bromomethane	2	U	2	0.36	2	U	2	0.36	2	U	2	0.41	2	U	2	0.41	2	U	2	0.41	2	U	2	0.41	2	U	2	0.41
2-Butanone	10	U	10	0.39	10	U	10	0.39	10	U	10	0.57	10	U	10	0.57	10	U	10	0.57	10	U	10	0.57	10	U	10	0.57
Carbon disulfide	1	U	1	0.28	1	U	1	0.28	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
Carbon tetrachloride	1	U	1	0.19	1	U	1	0.19	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
Chlorobenzene	1	U	1	0.2	1	U	1	0.2	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
Chloroethane	2	U	2	0.24	2	U	2	0.24	2	U	2	0.29	2	U	2	0.29	2	U	2	0.29	2	U	2	0.29	2	U	2	0.29
Chloroform	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16
Chloromethane	2	U	2	0.14	2	U	2	0.14	2	U	2	0.3	2	U	2	0.3	2	U	2	0.3	2	U	2	0.3	2	U	2	0.3
Dibromochloromethane	1	U	1	0.19	1	U	1	0.19	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
Dichlorodifluoromethane	2	U	2	0.25	2	U	2	0.25	2	U	2	0.31	2	U	2	0.31	2	U	2	0.31	2	U	2	0.31	2	U	2	0.31
1,1-Dichloroethane	1	U	1	0.21	1	U	1	0.21	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
1,2-Dichloroethane	1	U	1	0.16	1	U	1	0.16	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
1,1-Dichloroethene	1	U	1	0.18	1	U	1	0.18	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
cis-1,2-Dichloroethene	0.5	U	0.5	0.21	0.5	U	0.5	0.21	0.5	U	0.5	0.17	0.5	U	0.5	0.17	0.5	U	0.5	0.17	0.5	U	0.5	0.17	0.5	U	0.5	0.17
trans-1,2-Dichloroethene	0.5	U	0.5	0.16	0.5	U	0.5	0.16	0.5	U	0.5	0.19	0.5	U	0.5	0.19	0.5	U	0.5	0.19	0.5	U	0.5	0.19	0.5	U	0.5	0.19
1,2-Dichloropropane	1	U	1	0.15	1	U	1	0.15	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
cis-1,3-Dichloropropene	1	U	1	0.12	1	U	1	0.12	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14
trans-1,3-Dichloropropene	1	U	1	0.17	1	U	1	0.17	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19
Ethyl benzene	1	U	1	0.19	1	U	1	0.19	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
2-Hexanone	10	U	10	0.35	10	U	10	0.35	10	U	10	0.41	10	U	10	0.41	10	U	10	0.41	10	U	10	0.41	10	U	10	0.41
Methyl tert-Butyl ether	1	U	1	0.18	1	U	1	0.18	5	U	5	0.17	5	U	5	0.17	5	U	5	0.17	1	U	1	0.17	1	U	1	0.17
4-Methyl-2-pentanone (MIBK)	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32
Methylene chloride	1	U	1	0.19	1	U	1	0.19	1	U	1	0.33	1	U	1	0.33	0.33	J	1	0.33	1	U	1	0.33	1	U	1	0.33
Styrene	1	U	1	0.13	1	U	1	0.13	1	U	1	0.11	1	U	1	0.11	1	U	1	0.11	1	U	1	0.11	1	U	1	0.11
1,1,2,2-Tetrachloroethane	1	U	1	0.22	1	U	1	0.22	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
Tetrachloroethene	1	U	1	0.19	1	U	1	0.19	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29
Toluene	1	U	1	0.17	1	U	1	0.17	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13
1,1,1-Trichloroethane	1	U	1	0.21	1	U	1	0.21	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
1,1,2-Trichloroethane	1	U	1	0.22	1	U	1	0.22	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27
Trichloroethene	1	U	1	0.28	1	U	1	0.28	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Trichlorofluoromethane	2	U	2	0.16	2	U	2	0.16	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21
1,1,2-Trichloro-1,2,2-trifluoroethane	1	U	1	0.26	1	U	1	0.26	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	0.38	J	1	0.28	1	U	1	0.28
Vinyl chloride	2	U	2	0.21	2	U	2	0.21	2	U	2	0.22	2	U	2	0.22	2	U	2	0.22	2	U	2	0.22	2	U	2	0.22
o-Xylene	NT				NT				NT				NT				NT				NT				NT			
Total Xylenes	1	U	1	0.44	1	U	1	0.44	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
1,3-Dinitrobenzene	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.036	0.2	U	0.2	0.036
2,4-Dinitrotoluene	0.2	U	0.2	0.08	0.24		0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.062	2.5		0.2	0.062
2,6-Dinitrotoluene	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.051	0.44		0.2	0.051
2-amino-4,6-Dinitrotoluene	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.06	0.2	U	0.2	0.066	0.2	U	0.2	0.066
4-amino-2,6-Dinitrotoluene	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.09	0.2	U	0.2	0.065	0.2	U	0.2	0.065
HMX	0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.07	0.5	U	0.5	0.037	0.5	U	0.5	0.037
Nitrobenzene	0.2	U	0.2	0.07	3.5		0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.07	0.2	U	0.2	0.063	0.074	J	0.2	0.063
2-Nitrotoluene	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075	1.4		0.2	0.075
3-Nitrotoluene	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.042	0.15	J	0.2	0.042
4-Nitrotoluene	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.2	0.2	U	0.2	0.075	1.3		0.2	0.075
RDX	0.5	U	0.5	0.1	0.5	U	0.5	0.1	0.5	U	0.5	0.1	0.5	U	0.5	0.1	0.5	U	0.5	0.1	0.5	U	0.5	0.037	0.5	U	0.5	0.037
Tetryl	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.065	0.2	U	0.2	0.065
1,3,5-Trinitrobenzene	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.08	0.2	U	0.2	0.035	0.2	U	0.2	0.035
2,4,6-Trinitrotoluene	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.1	0.2	U	0.2	0.05	0.2	U	0.2	0.05

Table 4-8b
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Rinse Blanks (µg/L)

	Analytical Results																											
Sample ID:	GW101707R1				GW102207R1				GW102307R1				GW060908R1				GW061208R1				GW062308R1				SD062308R1			
Date Sampled:	10/17/2007				10/22/2007				10/23/2007				6/9/2008				6/12/2008				6/23/2008				6/23/2008			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																												
Acetone	10	U	10	1.1	1.7	J	10	1.1	10	U	10	1.1	5	U	5	0.77	5	U	5	0.77	5	U	5	0.77	NT			
Acetonitrile	20	U	20	3.5	20	U	20	3.5	20	U	20	3.5	NT				NT				NT				NT			
Benzene	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.059	1	U	1	0.059	1	U	1	0.059	NT			
Bromodichloromethane	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.031	1	U	1	0.031	1	U	1	0.031	NT			
Bromoform	1	U	1	0.64	1	U	1	0.64	1	U	1	0.64	1	U	1	0.1	1	U	1	0.1	1	U	1	0.1	NT			
Bromomethane	2	U	2	0.41	2	U	2	0.41	2	U	2	0.41	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29	NT			
2-Butanone	10	U	10	0.57	0.67	J	10	0.57	10	U	10	0.57	5	U	5	0.78	5	U	5	0.78	5	U	5	0.78	NT			
Carbon disulfide	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.045	1	U	1	0.045	1	U	1	0.045	NT			
Carbon tetrachloride	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.031	1	U	1	0.031	1	U	1	0.031	NT			
Chlorobenzene	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.047	1	U	1	0.047	1	U	1	0.047	NT			
Chloroethane	2	U	2	0.29	2	U	2	0.29	2	U	2	0.29	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	NT			
Chloroform	1	U	1	0.16	1	U	1	0.16	1	U	1	0.16	1	U	1	0.041	1	U	1	0.041	1	U	1	0.041	NT			
Chloromethane	2	U	2	0.3	2	U	2	0.3	2	U	2	0.3	1	U	1	0.11	1	U	1	0.11	1	U	1	0.11	NT			
Dibromochloromethane	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.035	1	U	1	0.035	1	U	1	0.035	NT			
Dichlorodifluoromethane	2	U	2	0.31	2	U	2	0.31	2	U	2	0.31	1	U	1	0.058	1	U	1	0.058	1	U	1	0.058	NT			
1,1-Dichloroethane	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.041	1	U	1	0.041	1	U	1	0.041	NT			
1,2-Dichloroethane	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.1	1	U	1	0.1	1	U	1	0.1	NT			
1,1-Dichloroethene	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.077	1	U	1	0.077	1	U	1	0.077	NT			
cis-1,2-Dichloroethene	0.5	U	0.5	0.17	0.5	U	0.5	0.17	0.5	U	0.5	0.17	1	U	1	0.065	1	U	1	0.065	1	U	1	0.065	NT			
trans-1,2-Dichloroethene	0.5	U	0.5	0.19	0.5	U	0.5	0.19	0.5	U	0.5	0.19	1	U	1	0.059	1	U	1	0.059	1	U	1	0.059	NT			
1,2-Dichloropropane	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.1	1	U	1	0.1	1	U	1	0.1	NT			
cis-1,3-Dichloropropene	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.049	1	U	1	0.049	1	U	1	0.049	NT			
trans-1,3-Dichloropropene	1	U	1	0.19	1	U	1	0.19	1	U	1	0.19	1	U	1	0.053	1	U	1	0.053	1	U	1	0.053	NT			
Ethyl benzene	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.038	1	U	1	0.038	1	U	1	0.038	NT			
2-Hexanone	10	U	10	0.41	10	U	10	0.41	10	U	10	0.41	5	U	5	0.29	5	U	5	0.29	5	U	5	0.29	NT			
Methyl tert-Butyl ether	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.036	1	U	1	0.036	1	U	1	0.036	NT			
4-Methyl-2-pentanone (MIBK)	5	U	5	0.32	5	U	5	0.32	5	U	5	0.32	5	U	5	0.29	5	U	5	0.29	5	U	5	0.29	NT			
Methylene chloride	1	U	1	0.33	1	U	1	0.33	0.55	J	1	0.33	1	U	1	0.12	1	U	1	0.12	1	U	1	0.12	NT			
Styrene	1	U	1	0.11	1	U	1	0.11	1	U	1	0.11	1	U	1	0.05	1	U	1	0.05	1	U	1	0.05	NT			
1,1,2,2-Tetrachloroethane	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.047	1	U	1	0.047	1	U	1	0.047	NT			
Tetrachloroethene	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29	1	U	1	0.063	1	U	1	0.063	1	U	1	0.063	NT			
Toluene	1	U	1	0.13	1	U	1	0.13	1	U	1	0.13	1	U	1	0.041	1	U	1	0.041	1	U	1	0.041	NT			
1,1,1-Trichloroethane	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.041	1	U	1	0.041	1	U	1	0.041	NT			
1,1,2-Trichloroethane	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27	1	U	1	0.072	1	U	1	0.072	1	U	1	0.072	NT			
Trichloroethene	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.058	1	U	1	0.058	1	U	1	0.058	NT			
Trichlorofluoromethane	2	U	2	0.21	2	U	2	0.21	2	U	2	0.21	1	U	1	0.067	1	U	1	0.067	1	U	1	0.067	NT			
1,1,2-Trichloro-1,2,2-trifluoroethane	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	NT				NT				NT				NT			
Vinyl chloride	2	U	2	0.22	2	U	2	0.22	2	U	2	0.22	1	U	1	0.062	1	U	1	0.062	1	U	1	0.062	NT			
o-Xylene	NT				NT				NT				1	U	1	0.06	1	U	1	0.06	1	U	1	0.06	NT			
Total Xylenes	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.097	1	U	1	0.097	1	U	1	0.097	NT			
1,3-Dinitrobenzene	0.2	U	0.2	0.036	0.2	U	0.2	0.036	0.2	U	0.2	0.036	0.25	U	0.25	0.04	NT				0.25	U	0.25	0.04	0.25	U	0.25	0.04
2,4-Dinitrotoluene	0.2	U	0.2	0.062	0.2	U	0.2	0.062	0.2	U	0.2	0.062	0.25	U	0.25	0.0097	NT				0.25	U	0.25	0.0097	0.25	U	0.25	0.0097
2,6-Dinitrotoluene	0.2	U	0.2	0.051	0.2	U	0.2	0.051	0.2	U	0.2	0.051	0.25	U	0.25	0.017	NT				0.25	U	0.25	0.017	0.25	U	0.25	0.017
2-amino-4,6-Dinitrotoluene	0.2	U	0.2	0.066	0.2	U	0.2	0.066	0.2	U	0.2	0.066	0.25	U	0.25	0.018	NT				0.25	U	0.25	0.018	0.25	U	0.25	0.018
4-amino-2,6-Dinitrotoluene	0.2	U	0.2	0.065	0.2	U	0.2	0.065	0.2	U	0.2	0.065	0.25	U	0.25	0.022	NT				0.25	U	0.25	0.022	0.25	U	0.25	0.022
HMX	0.5	U	0.5	0.037	0.5	U	0.5	0.037	0.5	U	0.5	0.037	0.25	U	0.25	0.018	NT				0.25	U	0.25	0.018	0.25	U	0.25	0.018
Nitrobenzene	0.2	U	0.2	0.063	0.2	U	0.2	0.063	0.2	U	0.2	0.063	0.25	U	0.25	0.04	NT				0.25	U	0.25	0.04	0.25	U	0.25	0.04
2-Nitrotoluene	0.2	U	0.2	0.075	0.2	U	0.2	0.075	0.2	U	0.2	0.075	0.25	U	0.25	0.017	NT				0.25	U	0.25	0.017	0.25	U	0.25	0.017
3-Nitrotoluene	0.2	U	0.2	0.042	0.2	U	0.2	0.042	0.2	U	0.2	0.042	0.25	U	0.25	0.017	NT				0.25	U	0.25	0.017	0.25	U	0.25	0.017
4-Nitrotoluene	0.2	U	0.2	0.075	0.2	U	0.2	0.075	0.2	U	0.2	0.075	0.25	U	0.25	0.026	NT				0.25	U	0.25	0.026	0.25	U	0.25	0.026
RDX	0.5	U	0.5	0.037	0.5	U	0.5	0.037	0.5	U	0.5	0.037	0.25	U	0.25	0.017	NT				0.25	U	0.25	0.017	0.25	U	0.25	0.017
Tetryl	0.2	U	0.2	0.065	0.2	U	0.2	0.065	0.2	U	0.2	0.065	0.25	U	0.25	0.04	NT				0.25	U	0.25	0.04	0.25	U	0.25	0.04
1,3,5-Trinitrobenzene	0.2	U	0.2	0.035	0.2	U	0.2	0.035	0.2	U	0.2	0.035	0.25	U	0.25	0.011	NT				0.25	U	0.25	0.011	0.25	U	0.25	0.011
2,4,6-Trinitrotoluene	0.2	U	0.2	0.05	0.2	U	0.2	0.05	0.2	U	0.2	0.05	0.25	U	0.25	0.012	NT				0.25	U	0.25	0.012	0.25	U	0.25	0.012

Table 4-8b
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Rinse Blanks (µg/L)

	Analytical Results																											
Sample ID:	SS062308R1				SW062408R1				GW070208R1				GW041910R1				GW042010R1				GW051010R1				GW051110R1			
Date Sampled:	6/23/2008				6/24/2008				7/2/2008				4/19/2010				4/20/2010				5/10/2010				5/11/2010			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles																												
Acetone	NT				5	U	5	0.77	5	U	5	0.77	10	U	10	1.8	56		10	1.8	10	U	10	1.8	10	U	10	1.8
Acetonitrile	NT				NT				NT				5	U	5	1.67	5	U	5	1.67	5	U	5	1.67	5	U	5	1.67
Benzene	NT				1	U	1	0.059	1	U	1	0.059	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14	1	U	1	0.14
Bromodichloromethane	NT				1	U	1	0.031	1	U	1	0.031	1	U	1	0.18	0.278	J	1	0.18	1	U	1	0.18	1	U	1	0.18
Bromoform	NT				1	U	1	0.1	1	U	1	0.1	1.5	U	1.5	0.5	1.5	U	1.5	0.5	1.5	U	1.5	0.5	1.5	U	1.5	0.5
Bromomethane	NT				1	U	1	0.29	1	U	1	0.29	2	U	2	0.32	2	U	2	0.32	2	U	2	0.32	2	U	2	0.32
2-Butanone	NT				5	U	5	0.78	5	U	5	0.78	5	U	5	1.6	5	U	5	1.6	5	U	5	1.6	5	U	5	1.6
Carbon disulfide	NT				1	U	1	0.045	1	U	1	0.045	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26
Carbon tetrachloride	NT				1	U	1	0.031	1	U	1	0.031	1	U	1	0.24	1	U	1	0.24	1	U	1	0.24	1	U	1	0.24
Chlorobenzene	NT				1	U	1	0.047	1	U	1	0.047	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21	1	U	1	0.21
Chloroethane	NT				1	U	1	0.15	1	U	1	0.15	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27
Chloroform	NT				1	U	1	0.041	1	U	1	0.041	1.21		1	0.23	1.82		1	0.23	1	U	1	0.23	1	U	1	0.23
Chloromethane	NT				1	U	1	0.11	0.91	J	1	0.11	1	U	1	0.36	1	U	1	0.36	1	U	1	0.36	1.23		1	0.36
Dibromochloromethane	NT				1	U	1	0.035	1	U	1	0.035	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18	1	U	1	0.18
Dichlorodifluoromethane	NT				1	U	1	0.058	1	U	1	0.058	2	U	2	0.26	2	U	2	0.26	2	U	2	0.26	2	U	2	0.26
1,1-Dichloroethane	NT				1	U	1	0.041	1	U	1	0.041	1	U	1	0.24	1	U	1	0.24	1	U	1	0.24	1	U	1	0.24
1,2-Dichloroethane	NT				1	U	1	0.1	1	U	1	0.1	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
1,1-Dichloroethene	NT				1	U	1	0.077	1	U	1	0.077	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28	1	U	1	0.28
cis-1,2-Dichloroethene	NT				1	U	1	0.065	1	U	1	0.065	1.5	U	1.5	0.45	1.5	U	1.5	0.45	1.5	U	1.5	0.45	1.5	U	1.5	0.45
trans-1,2-Dichloroethene	NT				1	U	1	0.059	1	U	1	0.059	1.5	U	1.5	0.53	1.5	U	1.5	0.53	1.5	U	1.5	0.53	1.5	U	1.5	0.53
1,2-Dichloropropane	NT				1	U	1	0.1	1	U	1	0.1	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27	1	U	1	0.27
cis-1,3-Dichloropropene	NT				1	U	1	0.049	1	U	1	0.049	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
trans-1,3-Dichloropropene	NT				1	U	1	0.053	1	U	1	0.053	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Ethyl benzene	NT				1	U	1	0.038	1	U	1	0.038	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15	1	U	1	0.15
2-Hexanone	NT				5	U	5	0.29	5	U	5	0.29	5	U	5	0.5	5	U	5	0.5	5	U	5	0.5	5	U	5	0.5
Methyl tert-Butyl ether	NT				1	U	1	0.036	1	U	1	0.036	1	U	1	0.25	1	U	1	0.25	NT				NT			
4-Methyl-2-pentanone (MIBK)	NT				5	U	5	0.29	5	U	5	0.29	5	U	5	0.5	5	U	5	0.5	5	U	5	0.5	5	U	5	0.5
Methylene chloride	NT				0.21	J	1	0.12	1	U	1	0.12	1	U	1	0.27	0.463	J	1	0.27	1	U	1	0.27	11.8		1	0.27
Styrene	NT				1	U	1	0.05	1	U	1	0.05	1	U	1	0.24	1	U	1	0.24	1	U	1	0.24	1	U	1	0.24
1,1,2,2-Tetrachloroethane	NT				1	U	1	0.047	1	U	1	0.047	1	U	1	0.23	1	U	1	0.23	1	U	1	0.23	1	U	1	0.23
Tetrachloroethene	NT				1	U	1	0.063	1	U	1	0.063	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17	1	U	1	0.17
Toluene	NT				1	U	1	0.041	1	U	1	0.041	0.272	J	1	0.19	0.284	J	1	0.19	1	U	1	0.19	0.391	J	1	0.19
1,1,1-Trichloroethane	NT				1	U	1	0.041	1	U	1	0.041	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29	1	U	1	0.29
1,1,2-Trichloroethane	NT				1	U	1	0.072	1	U	1	0.072	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26	1	U	1	0.26
Trichloroethene	NT				1	U	1	0.058	1	U	1	0.058	1	U	1	0.5	1	U	1	0.5	1	U	1	0.5	1	U	1	0.5
Trichlorofluoromethane	NT				1	U	1	0.067	1	U	1	0.067	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25	1	U	1	0.25
1,1,2-Trichloro-1,2,2-trifluoroethane	NT				NT				NT				5.79		1	0.33	1	U	1	0.33	1	U	1	0.33	1	U	1	0.33
Vinyl chloride	NT				1	U	1	0.062	1	U	1	0.062	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2	1	U	1	0.2
o-Xylene	NT				1	U	1	0.06	1	U	1	0.06	NT				NT				NT				NT			
Total Xylenes	NT				1	U	1	0.097	1	U	1	0.097	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22	1	U	1	0.22
1,3-Dinitrobenzene	0.25	U	0.25	0.04	0.25	U	0.25	0.04	0.25	U	0.25	0.04	NT				NT				NT				NT			
2,4-Dinitrotoluene	0.25	U	0.25	0.0097	0.25	U	0.25	0.0097	0.25	U	0.25	0.0097	NT				NT				NT				NT			
2,6-Dinitrotoluene	0.25	U	0.25	0.017	0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT				NT				NT			
2-amino-4,6-Dinitrotoluene	0.25	U	0.25	0.018	0.25	U	0.25	0.018	0.25	U	0.25	0.018	NT				NT				NT				NT			
4-amino-2,6-Dinitrotoluene	0.25	U	0.25	0.022	0.25	U	0.25	0.022	0.25	U	0.25	0.022	NT				NT				NT				NT			
HMX	0.25	U	0.25	0.018	0.25	U	0.25	0.018	0.25	U	0.25	0.018	NT				NT				NT				NT			
Nitrobenzene	0.25	U	0.25	0.04	0.25	U	0.25	0.04	0.25	U	0.25	0.04	NT				NT				NT				NT			
2-Nitrotoluene	0.25	U	0.25	0.017	0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT				NT				NT			
3-Nitrotoluene	0.25	U	0.25	0.017	0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT				NT				NT			
4-Nitrotoluene	0.25	U	0.25	0.026	0.25	U	0.25	0.026	0.25	U	0.25	0.026	NT				NT				NT				NT			
RDX	0.25	U	0.25	0.017	0.25	U	0.25	0.017	0.25	U	0.25	0.017	NT				NT				NT				NT			
Tetryl	0.25	U	0.25	0.04	0.25	U	0.25	0.04	0.25	U	0.25	0.04	NT				NT				NT				NT			
1,3,5-Trinitrobenzene	0.25	U	0.25	0.011	0.25	U	0.25	0.011	0.25	U	0.25	0.011	NT				NT				NT				NT			
2,4,6-Trinitrotoluene	0.25	U	0.25	0.012	0.25	U	0.25	0.012	0.25	U	0.25	0.012	NT				NT				NT				NT			

Table 4-8b
600 Area Groundwater Investigation
Summary of Chemicals Analyzed in Rinse Blanks (µg/L)

Sample ID:	Analytical Results											
Date Sampled:	GW051110R2 5/11/2010				GW012511R1 1/25/2011				GW020711R1 2/7/2011			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles												
Acetone	2.58	J	10	1.8	5	U	5	0.5	5	U	5	0.5
Acetonitrile	5	U	5	1.67	NT				NT			
Benzene	1	U	1	0.14	2.7		1	0.32	1	U	1	0.32
Bromodichloromethane	1	U	1	0.18	1	U	1	0.36	1	U	1	0.36
Bromoform	1.5	U	1.5	0.5	1	U	1	0.47	1	U	1	0.47
Bromomethane	2	U	2	0.32	1	U	1	0.2	1	U	1	0.2
2-Butanone	5	U	5	1.6	5	U	5	1.3	5	U	5	1.3
Carbon disulfide	1	U	1	0.26	1	U	1	0.2	1	U	1	0.2
Carbon tetrachloride	1	U	1	0.24	1	U	1	0.2	1	U	1	0.2
Chlorobenzene	1	U	1	0.21	1	U	1	0.49	1	U	1	0.49
Chloroethane	1	U	1	0.27	1	U	1	0.2	1	U	1	0.2
Chloroform	1	U	1	0.23	1.5		1	0.35	1	U	1	0.34
Chloromethane	0.559	J	1	0.36	1	U	1	0.2	1	U	1	0.2
Dibromochloromethane	1	U	1	0.18	1	U	1	0.2	1	U	1	0.2
Dichlorodifluoromethane	2	U	2	0.26	1	U	1	0.2	1	U	1	0.2
1,1-Dichloroethane	1	U	1	0.24	1	U	1	0.36	1	U	1	0.36
1,2-Dichloroethane	1	U	1	0.22	1	U	1	0.48	1	U	1	0.48
1,1-Dichloroethene	1	U	1	0.28	1	U	1	0.47	1	U	1	0.47
cis-1,2-Dichloroethene	1.5	U	1.5	0.45	1	U	1	0.35	1	U	1	0.35
trans-1,2-Dichloroethene	1.5	U	1.5	0.53	1	U	1	0.41	1	U	1	0.41
1,2-Dichloropropane	1	U	1	0.27	1	U	1	0.46	1	U	1	0.46
cis-1,3-Dichloropropene	1	U	1	0.15	1	U	1	0.31	1	U	1	0.31
trans-1,3-Dichloropropene	1	U	1	0.17	1	U	1	0.29	1	U	1	0.29
Ethyl benzene	1	U	1	0.15	1	U	1	0.2	1	U	1	0.2
2-Hexanone	5	U	5	0.5	5	U	5	1.9	5	U	5	1.9
Methyl tert-Butyl ether	NT				1	U	1	0.35	1	U	1	0.35
4-Methyl-2-pentanone (MIBK)	5	U	5	0.5	5	U	5	2.1	5	U	5	2.1
Methylene chloride	10.3		1	0.27	1	U	1	0.41	0.95	J	1	0.41
Styrene	1	U	1	0.24	1	U	1	0.36	1	U	1	0.36
1,1,2,2-Tetrachloroethane	1	U	1	0.23	1	U	1	0.31	1	U	1	0.31
Tetrachloroethene	1	U	1	0.17	1	U	1	0.27	1	U	1	0.27
Toluene	0.402	J	1	0.19	1	U	1	0.37	0.57	J	1	0.37
1,1,1-Trichloroethane	1	U	1	0.29	1	U	1	0.4	1	U	1	0.4
1,1,2-Trichloroethane	1	U	1	0.26	1	U	1	0.38	1	U	1	0.38
Trichloroethene	1	U	1	0.5	1	U	1	0.28	1	U	1	0.28
Trichlorofluoromethane	1	U	1	0.25	1	U	1	0.35	1	U	1	0.35
1,1,2-Trichloro-1,2,2-trifluoroethane	1	U	1	0.33	1	U	1	0.45	1	U	1	0.45
Vinyl chloride	1	U	1	0.2	1	U	1	0.34	1	U	1	0.34
o-Xylene	NT				1	U	1	0.43	1	U	1	0.43
Total Xylenes	0.409	J	1	0.22	2	U	2	0.95	2	U	2	0.95
1,3-Dinitrobenzene	NT				NT				NT			
2,4-Dinitrotoluene	NT				NT				NT			
2,6-Dinitrotoluene	NT				NT				NT			
2-amino-4,6-Dinitrotoluene	NT				NT				NT			
4-amino-2,6-Dinitrotoluene	NT				NT				NT			
HMX	NT				NT				NT			
Nitrobenzene	NT				NT				NT			
2-Nitrotoluene	NT				NT				NT			
3-Nitrotoluene	NT				NT				NT			
4-Nitrotoluene	NT				NT				NT			
RDX	NT				NT				NT			
Tetryl	NT				NT				NT			
1,3,5-Trinitrobenzene	NT				NT				NT			
2,4,6-Trinitrotoluene	NT				NT				NT			

NT = Not tested.
RL/EQL = Reporting Limit / Estimated Quantitation Limit
SQL = Sample Quantitation Limit

Q = Flags/Qualifiers (QA/QC):
J = Detect, value is an estimate of the concentration.
R = Rejected result, value should not be used for any purpose.

U = Non-detect, value is the detection limit.
(U) = Non-detect, chemical was detected in blank.

Rinnse Blank Analytical Results Specific to the Source Area Investigation

Sample ID	Analytical Results							
Date Sampled:	S062311R1 6/23/2011				TR052212R1 5/22/2012			
Chemical	Result	Q	RL/EQL	SQL	Result	Q	RL/EQL	SQL
Volatiles								
Acetone	NT				10	U	10	2.5
2-Butanone	NT				10	U	10	2.5
2-Chlorotoluene	NT				1	U	1	0.25
4-Chlorotoluene	NT				1	U	1	0.25
1,2-Dichlorobenzene	NT				1	U	1	0.25
cis-1,2-Dichloroethene	NT				1	U	1	0.25
p-isopropyltoluene	NT				1	U	1	0.25
4-Methyl-2-pentanone	NT				5	U	5	1.25
Naphthalene	NT				1	U	1	0.25
Tetrachloroethene	NT				1	U	1	0.25
Trichloroethene	NT				1	U	1	0.25
1,3,5-Trimethylbenzene	NT				1	U	1	0.25
1,2,4-Trimethylbenzene	NT				1	U	1	0.25
Explosives								
2-Nitrotoluene	0.299	U	0.299	0.0748	0.281	J	0.302	0.0755
RDX	0.299	U	0.299	0.0748	0.145	J	0.302	0.0755
Metals								
Aluminum	200	U	200	50	50	U	50	12.5
Arsenic	10	U	10	3	2.5	U	2.5	0.75
Barium	40	U	40	5	10	U	10	1.25
Beryllium	5	U	5	1	1.25	U	1.25	0.25
Cadmium	5	U	5	1	1.25	U	1.25	0.25
Calcium	5000	U	5000	1000	1250	U	1250	250
Chromium	10	U	10	2	2.5	U	2.5	0.5
Cobalt	12.5	U	12.5	5	3.12	U	3.12	1.25
Copper	10	U	10	4	2.5	U	2.5	1
Iron	100	U	100	30	25	U	25	7.5
Lead	3	U	3	1.5	0.75	U	0.75	0.375
Magnesium	5000	U	5000	1000	1250	U	1250	250
Manganese	15	U	15	3	3.75	U	3.75	0.75
Mercury	0.2	U	0.2	0.08	0.2	U	0.2	0.08
Molybdenum	20	U	20	5	NT			
Nickel	10	U	10	3	2.5	U	2.5	0.75
Potassium	5000	U	5000	200	1250	U	1250	250
Selenium	10	U	10	3	2.5	U	2.5	0.75
Sodium	5000	U	5000	200	902	J	1250	250
Vanadium	12.5	U	12.5	5	3.12	U	3.12	1.25
Zinc	20	U	20	5	5	U	5	1.25
Semivolatiles								
Benz(a)anthracene	4.63	U	4.63	1.16	4.67	U	4.67	1.17
Benzo(a)pyrene	4.63	U	4.63	1.16	4.67	U	4.67	1.17
Benzo(b)fluoranthene	4.63	U	4.63	1.16	4.67	U	4.67	1.17
Chrysene	4.63	U	4.63	1.16	4.67	U	4.67	1.17
Fluoranthene	4.63	U	4.63	1.16	4.67	U	4.67	1.17
Phenanthrene	4.63	U	4.63	1.16	4.67	U	4.67	1.17
Pyrene	4.63	U	4.63	1.16	4.67	U	4.67	1.17

Table 4-9
Results of Bioremediation Sampling

	Bioremediation Parameters															
Well	Dissolved Oxygen (meter), in mg/l	Dissolved Oxygen (Winkler method), in mg/l	Oxidation-Reduction Potential	Ammonia in mg/l	Nitrate, in mg/l	Sulfate, in mg/l	Sulfide, in mg/l	Iron (total), in mg/l	Iron (filtered), in mg/l	Total Ferrous Iron (calculated)	Manganese (total), in mg/l	Manganese (filtered), in mg/l	Total Mn^{+4} (calculated)	Ethane, in µg/L	Ethene, in µg/L	Methane, in µg/L
13MW-1	4.4	9.4	149.8	0.15	U	9	U	0.045J	U	0.045	0.01J	0.007J	0.003	U	U	U
13MW-4	0.21	0.6	(-)128.4	0.16	U	17.7	2.1	2.2	1.83	0.37	0.175	0.171	0.004	U	4.1	2
13MW-7	2.88	3.1	152.2	0.11	0.2	2.7	U	U	0.096	none	0.08	0.083	none	U	U	U
13MW-8	0.5	(-)	48.1	0.11J	0.21J	229	U	0.069 J	0.145	none	0.0002	0.0024	none	U	3.6	4.4
13MW-9	8.22	7.9	170.3	0.11J	0.068J	12.2	U	0.051J	U	0.051	0.113	0.116	none	U	U	U
13MW-10	7.12	7.8	(-)48.6	0.1J	0.33J	70.3	U	U	0.065J	none	0.0003J	0.0007J	none	U	U	U
13MW-11	10.25	10	197.5	0.077J	U	10.4	U	0.159	U	0.159	0.1	0.1	none	U	U	0.115
DM13-2	10.59	10.5	216.1	U	U	9	U	0.11	U	0.11	0.078	0.079	none	U	U	U
DM13-3	2.91	2.6	68.9	0.19J	0.1J	9.2	U	2.83	0.587	2.24	0.068	0.07	none	U	U	0.14

Table 4-10
Summary of MEC and MD Identified in June 2011 Test Pit/Trench Investigation

Description	Quantity	Test Pit/Trench Location	Comments
Munitions Debris			
Cartridge, Photflash: Practice, M121, Expended	1	TP-2, approximately 8 ft bgs	
M72 Rocket Launcher for 66mm Rocket (LAW), Empty - no sights	13	TP-2, approximately 10-12 ft bgs	3 sights were discovered, collected and tested by Picatinny Radiation Protection Office - not radiologically contaminated.
XM31 Anti Tank Land Mine, Expended	1	TP-2	Item recovered from within garbage can removed from TP-2
155mm Fragment (ogive)	1	TP-2	Item recovered from within garbage can removed from TP-2
Aircraft Flare, MK45, Expended	1	TR2*	
PD Fuze, Expended	1	TR2*	Photograph shows 2 pieces/components of fuze
BLU 3/B plate, CDU-10 canister cover	1 ea.	TR2*	
BLU 39/B Skitters, CN/CS Tear Gas, Inert	3	TR2*	
40mm Grenade Cartridge Cases, Expended	7	TR2*	
Electric Blasting Cap, Expended	1	TR2*	
Fuzes M48, M51, M81 Series, M557 Series, and M572	12	TR2	Several fuzes recovered folded into the side of a crushed drum
Munitions and Explosives of Concern			
CDU-10 (T-1)/B Canister with XM39E and XM44	1	TR2, East End, aproximately 4 ft bgs	MEC data sheet references approximately 680 XM40E5 and 48 XM44 mines per CDU-10/B.

Notes: No MD discovered in TP1

TR2 trench offset 8 ft to the south due to concentration of MD encountered at initial location. Locations noted with an asterix (TR2) refer to the location prior to the offset. Excavation of TR2 ceased upon encountering UXO.

Table 4-11
Summary of 600 Area Groundwater and Surface Water HHCOPCs

HHCOPCs by Media	Groundwater (maximum detected concentration in µg/L)	GW LOC in µg/L	Surface Water (maximum detected concentration in µg/L)	SW LOC in µg/L
2,4,6-Trinitrotoluene	X (0.30)	1.2		
2,4-Dinitrotoluene	X (0.15)	10		
cis-1,2-DCE	X (2)	70		
Acetonitrile	X (55)	120		
MTBE	X (140)	70		
Vinyl Chloride	X (0.24)	1		
RDX	X (1.1)	0.5	X (10)	0.5
PCE	X (2.2)	1		
TCE	X (170)	1	X (14)	1.09

Table 4-12
Summary of 600 Area Groundwater
Estimated Future Risks and Hazards

Receptor (Future)	Estimated Total Cancer Risk (RME)	Cancer Risk Driver(s) (contributing most to total risk)	Pathway Contributing Most to Cancer Risk
Industrial Research Worker	1.1E-5	TCE,PCE	Ingestion
Construction Excavation Worker	2.2E-8	None (CR < 1E-6)	--
Receptor (Future)	**Estimated Total Noncancer Hazard (RME)**	**Noncancer Hazard Driver (contributing most to total hazard)**	**Groundwater Pathway Contributing Most to Noncancer Hazard**
Industrial Research Worker	0.005	None (HI<1)	-
Construction Excavation Worker	0.0001	None (HI < 1)	--

Table 4-13
Summary of 600 Area Surface Water
Estimated Current and Future Risks and Hazards

Receptor (Future)	Estimated Total Cancer Risk (RME)	Cancer Risk Driver(s) (contributing most to total risk)	Pathway Contributing Most to Cancer Risk
Industrial Research Worker	1.1E-9	None (CR < 1E-6)	--
Receptor (Future)	**Estimated Total Noncancer Hazard (RME)**	**Noncancer Hazard Driver (contributing most to total hazard)**	**Groundwater Pathway Contributing Most to Noncancer Hazard**
Industrial Research Worker	0.000009	None (HI < 1)	--

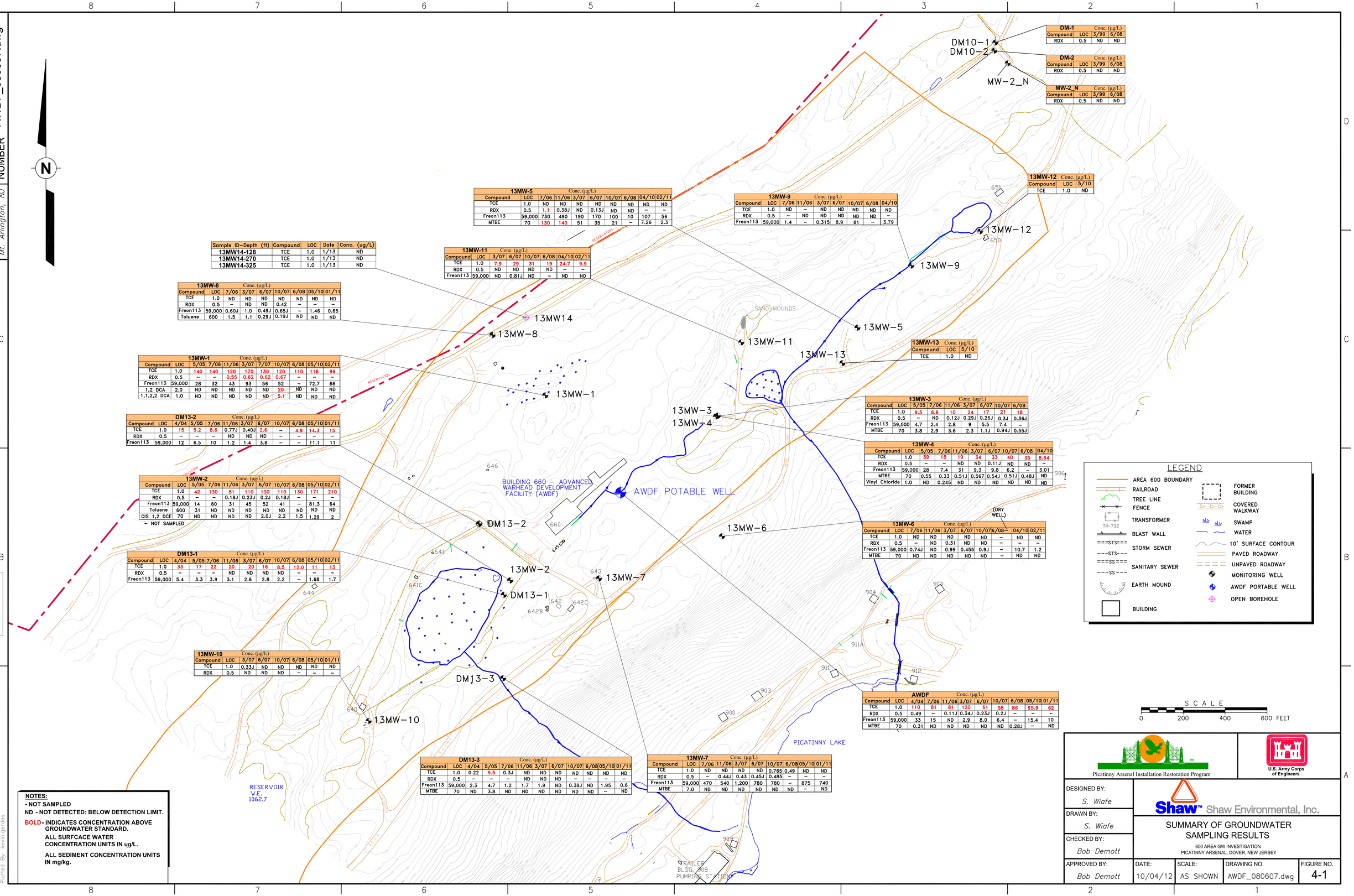
Table 4-14
Summary of 600 Area Groundwater Estimated Current and Future Risks and Hazards from Vapor Intrusion of VOC from *In-Situ* Groundwater

Receptor (Future)	Estimated Total Cancer Risk (RME)	Cancer Risk Driver(s) (contributing most to total risk)
Industrial Research Worker	6.3E-6	TCE
Receptor (Future)	**Estimated Total Noncancer Hazard (RME)**	**Noncancer Hazard Driver (contributing most to total hazard)**
Industrial Research	0.002	None (HI < 1)

Table 4-15
Summary of 600 Area Estimated Current and Future Risks and Hazards

Receptor (Future)	Estimated Total Cancer Risk (RME)	Cancer Risk Driver(s) (contributing most to total risk)	Pathway Contributing Most to Cancer Risk
Industrial Research Worker	1.7E-5	TCE	Ingestion and Inhalation
Receptor (Future)	**Estimated Total Noncancer Hazard (RME)**	**Noncancer Hazard Driver (contributing most to total hazard)**	**Groundwater Pathway Contributing Most to Noncancer Hazard**
Industrial Research Worker	0.007	None (HI<1)	-

OFFICE Mt. Arlington, NJ | DRAWING NUMBER AWDF_080607.dwg



DM-1	Conc. (µg/L)	
Compound	LOC	3/99	6/08
RDX	0.5	ND	ND

DM-2	Conc. (µg/L)		
Compound	LOC	3/99	6/08
RDX	0.5	ND	ND

MW-2_N	Conc. (µg/L)		
Compound	LOC	3/99	6/08
RDX	0.5	ND	ND

13MW-12	Conc. (µg/L)	
Compound	LOC	5/10
TCE	1.0	ND

13MW-5	Conc. (µg/L)								
Compound	LOC	7/06	11/06	3/07	6/07	10/07	6/08	04/10	02/11
TCE	1.0	ND	ND	ND	ND	ND	ND	ND	ND
RDX	0.5	1.1	0.38J	ND	0.13J	ND	ND	–	–
Freon113	59,000	730	490	190	170	100	10	107	56
MTBE	70	130	140	51	35	21	–	7.26	2.3

13MW-9	Conc. (µg/L)							
Compound	LOC	7/06	11/06	3/07	6/07	10/07	6/08	04/10
TCE	1.0	ND	–	ND	ND	ND	ND	ND
RDX	0.5	–	ND	ND	ND	ND	ND	–
Freon113	59,000	1.4	–	0.315	8.9	81	–	3.79

Sample ID-Depth (ft)	Compound	LOC	Date	Conc. (ug/L)
13MW14-128	TCE	1.0	1/13	ND
13MW14-270	TCE	1.0	1/13	ND
13MW14-325	TCE	1.0	1/13	ND

13MW-11	Conc. (µg/L)						
Compound	LOC	3/07	6/07	10/07	6/08	04/10	02/11
TCE	1.0	7.9	29	31	19	24.7	9.9
RDX	0.5	ND	ND	ND	ND	–	–
Freon113	59,000	ND	0.81J	ND	–	ND	ND

13MW-8	Conc. (µg/L)							
Compound	LOC	7/06	3/07	6/07	10/07	6/08	05/10	01/11
TCE	1.0	ND	ND	ND	ND	ND	ND	ND
RDX	0.5	–	ND	ND	0.42	–	–	–
Freon113	59,000	0.60J	1.0	0.49J	0.65J	–	1.46	0.65
Toluene	600	1.5	1.1	0.29J	0.19J	ND	ND	ND

13MW-13	Conc. (µg/L)	
Compound	LOC	5/10
TCE	1.0	ND

13MW-1	Conc. (µg/L)									
Compound	LOC	5/05	7/06	11/06	3/07	7/07	10/07	6/08	05/10	02/11
TCE	1.0	140	140	120	170	130	120	110	116	96
RDX	0.5	–	–	0.55	0.62	0.62	0.67	–	–	–
Freon113	59,000	28	32	43	93	56	52	–	72.7	66
1,2 DCA	2.0	ND	ND	ND	ND	ND	20	ND	ND	ND
1,1,2,2 DCA	1.0	ND	ND	ND	ND	ND	5.1	ND	ND	ND

13MW-3	Conc. (µg/L)							
Compound	LOC	5/05	7/06	11/06	3/07	6/07	10/07	6/08
TCE	1.0	9.5	6.6	10	24	17	21	18
RDX	0.5	–	ND	0.12J	0.29J	0.26J	0.3J	0.36J
Freon113	59,000	4.7	2.4	2.8	9	5.5	7.4	–
MTBE	70	3.8	2.9	3.6	2.3	1.1J	0.94J	0.55J

DM13-2	Conc. (µg/L)									
Compound	LOC	4/04	5/05	7/06	11/06	3/07	6/07	10/07	6/08	05/10	01/11
TCE	1.0	15	5.2	8.6	0.77J	0.40J	2.6	–	4.9	14.3	15
RDX	0.5	–	–	–	ND	ND	ND	–	–	–	–
Freon113	59,000	12	6.5	10	1.2	1.4	3.8	–	–	11.1	11

13MW-4	Conc. (µg/L)								
Compound	LOC	5/05	7/06	11/06	3/07	6/07	10/07	6/08	04/10
TCE	1.0	39	15	19	34	33	40	35	8.64
RDX	0.5	–	–	ND	ND	0.11J	ND	ND	–
Freon113	59,000	28	7.4	31	9.3	9.8	6.2	–	3.01
MTBE	70	0.55	0.33	0.51J	0.567	0.54J	0.51J	0.48J	ND
Vinyl Chloride	1.0	ND	0.245	ND	ND	ND	ND	ND	ND

13MW-2	Conc. (µg/L)									
Compound	LOC	5/05	7/06	11/06	3/07	6/07	10/07	6/08	05/10	02/11
TCE	1.0	42	130	81	110	130	110	130	171	210
RDX	0.5	–	–	0.18J	0.23J	0.2J	0.18J	–	–	–
Freon113	59,000	14	60	31	45	52	41	–	81.3	64
Toluene	600	31	ND	ND	ND	ND	ND	ND	ND	ND
CIS 1,2 DCE	70	ND	ND	ND	ND	2.0J	2.2	1.5	1.29	2

– NOT SAMPLED

13MW-6	Conc. (µg/L)							
Compound	LOC	7/06	11/06	3/07	6/07	10/07	6/08	04/10	02/11
TCE	1.0	ND	ND	ND	ND	ND	–	ND	ND
RDX	0.5	–	ND	0.31	ND	ND	–	–	–
Freon113	59,000	0.74J	ND	0.99	0.455	0.9J	–	10.7	1.2
MTBE	70	ND	ND	ND	ND	ND	–	ND	ND

DM13-1	Conc. (µg/L)									
Compound	LOC	4/04	5/05	7/06	11/06	3/07	6/07	10/07	6/08	05/10	02/11
TCE	1.0	33	17	22	20	20	16	8.5	12.0	11	13
RDX	0.5	–	–	–	ND	ND	ND	ND	–	–	–
Freon113	59,000	5.4	3.3	3.9	3.1	2.6	2.8	2.2	–	1.68	1.7

13MW-10	Conc. (µg/L)							
Compound	LOC	3/07	6/07	10/07	6/08	05/10	01/11
TCE	1.0	0.33J	ND	ND	ND	ND	ND
RDX	0.5	ND	ND	ND	–	–	–

AWDF	Conc. (µg/L)									
Compound	LOC	4/04	7/06	11/06	3/07	6/07	10/07	6/08	05/10	01/11
TCE	1.0	110	81	81	120	61	58	86	95.9	62
RDX	0.5	0.49	–	0.11J	0.34J	0.23J	0.2J	–	–	–
Freon113	59,000	33	15	ND	2.9	8.0	6.4	–	15.4	10
MTBE	70	0.31	ND	ND	ND	ND	ND	0.28J	–	ND

DM13-3	Conc. (µg/L)											
Compound	LOC	4/04	5/05	7/06	11/06	3/07	6/07	10/07	6/08	05/10	01/11
TCE	1.0	0.22	9.5	0.3J	ND	ND	ND	ND	ND	ND	ND
RDX	0.5	–	–	–	ND	ND	ND	–	–	–	–
Freon113	59,000	2.3	4.7	1.2	1.7	1.9	ND	0.38J	ND	1.95	0.6
MTBE	70	ND	3.8	ND	ND	ND	ND	ND	ND	–	ND

13MW-7	Conc. (µg/L)									
Compound	LOC	7/06	11/06	3/07	6/07	10/07	6/08	05/10	01/11
TCE	1.0	ND	ND	ND	ND	0.765	0.49	ND	ND
RDX	0.5	–	0.44J	0.43	0.45J	0.485	–	–	–
Freon113	59,000	470	540	1,200	780	780	–	875	740
MTBE	7.0	ND	ND	ND	ND	ND	ND	–	ND

NOTES:

- NOT SAMPLED

ND - NOT DETECTED: BELOW DETECTION LIMIT.

BOLD - INDICATES CONCENTRATION ABOVE GROUNDWATER STANDARD.

ALL SURFCACE WATER CONCENTRATION UNITS IN µg/L.

ALL SEDIMENT CONCENTRATION UNITS IN mg/kg.

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

DESIGNED BY: S. Wiafe	Shaw Environmental, Inc.
DRAWN BY: S. Wiafe	SUMMARY OF GROUNDWATER SAMPLING RESULTS 600 AREA GW INVESTIGATION PICATINNY ARSENAL, DOVER, NEW JERSEY
CHECKED BY: Bob Demott	

APPROVED BY:	DATE:	SCALE:	DRAWING NO.	FIGURE NO.
Bob Demott	10/04/12	AS SHOWN	AWDF_080607.dwg	4-1

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Plotted by: kevin.gerres

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Plot Date/Time: Apr 22, 2013 – 10:26am
Plotted By: andrius.yanavicius

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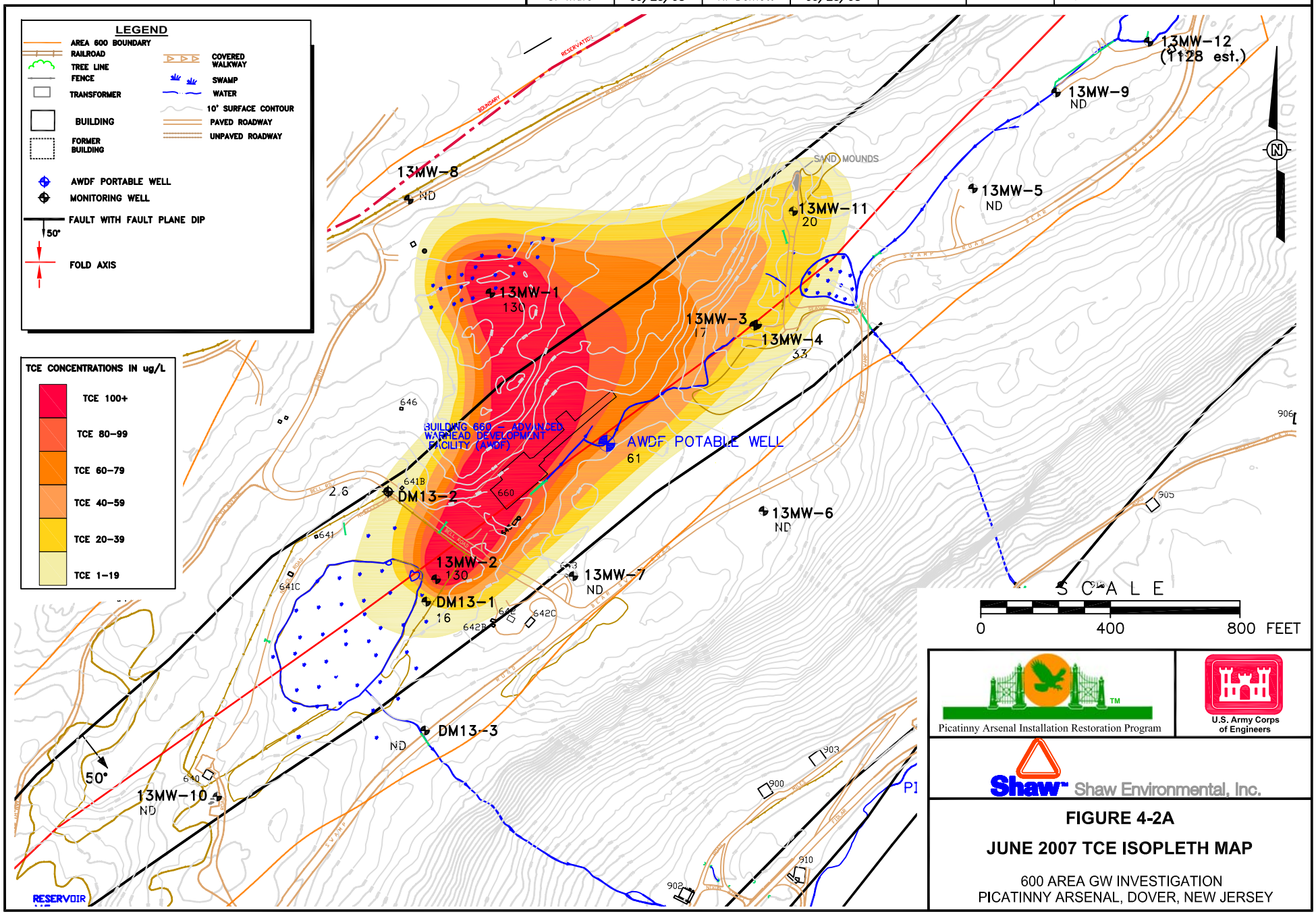
S. Wiafe	09/25/08	R. Demott	09/25/08	--	--		



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 4-2A

JUNE 2007 TCE ISOPLETH MAP

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

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Plot Date/Time: Apr 22, 2013 – 10:29am
Plotted By: andrius.yanavicius

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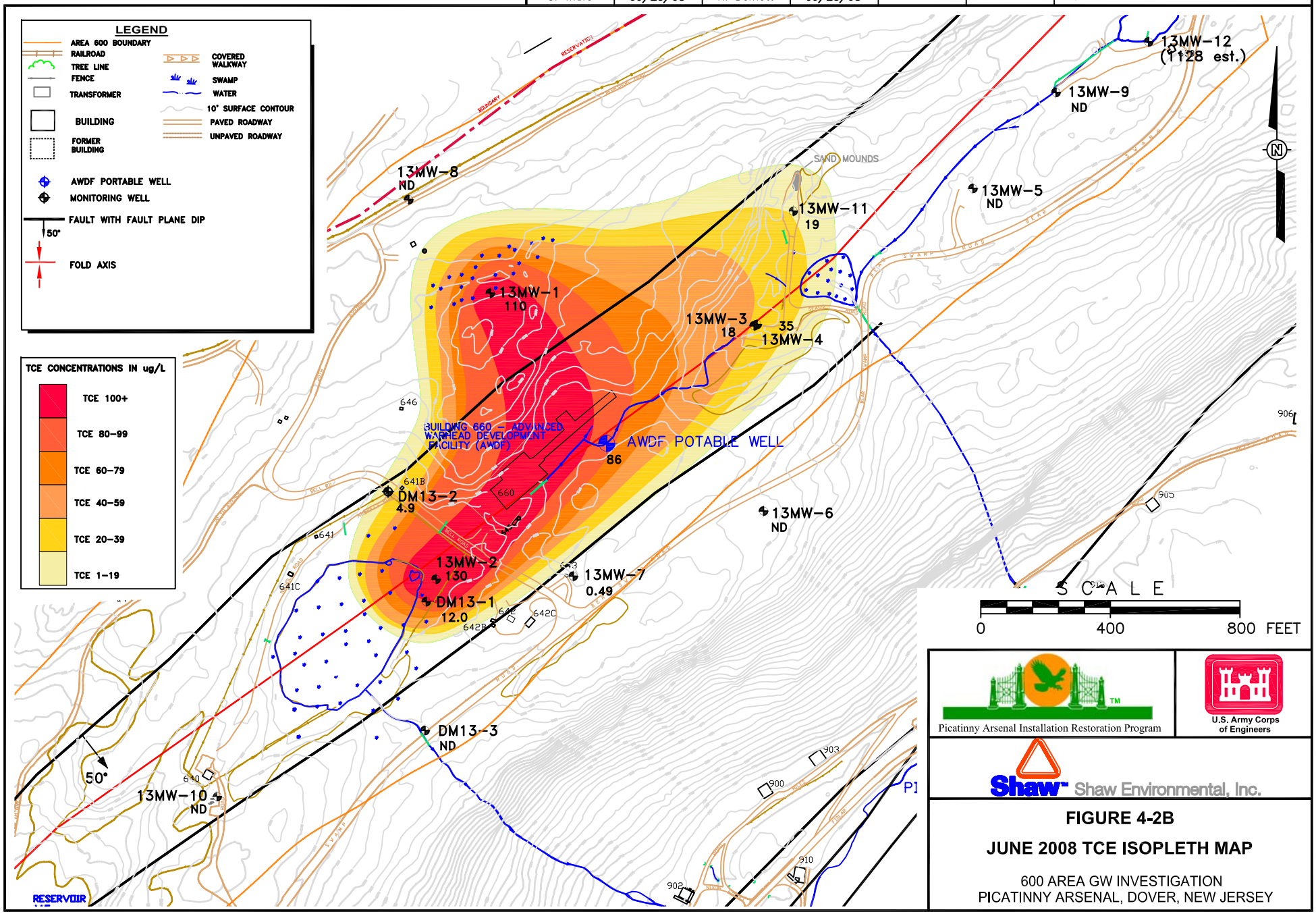
S. Wiafe	09/25/08	R. Demott	09/25/08	--	--		



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

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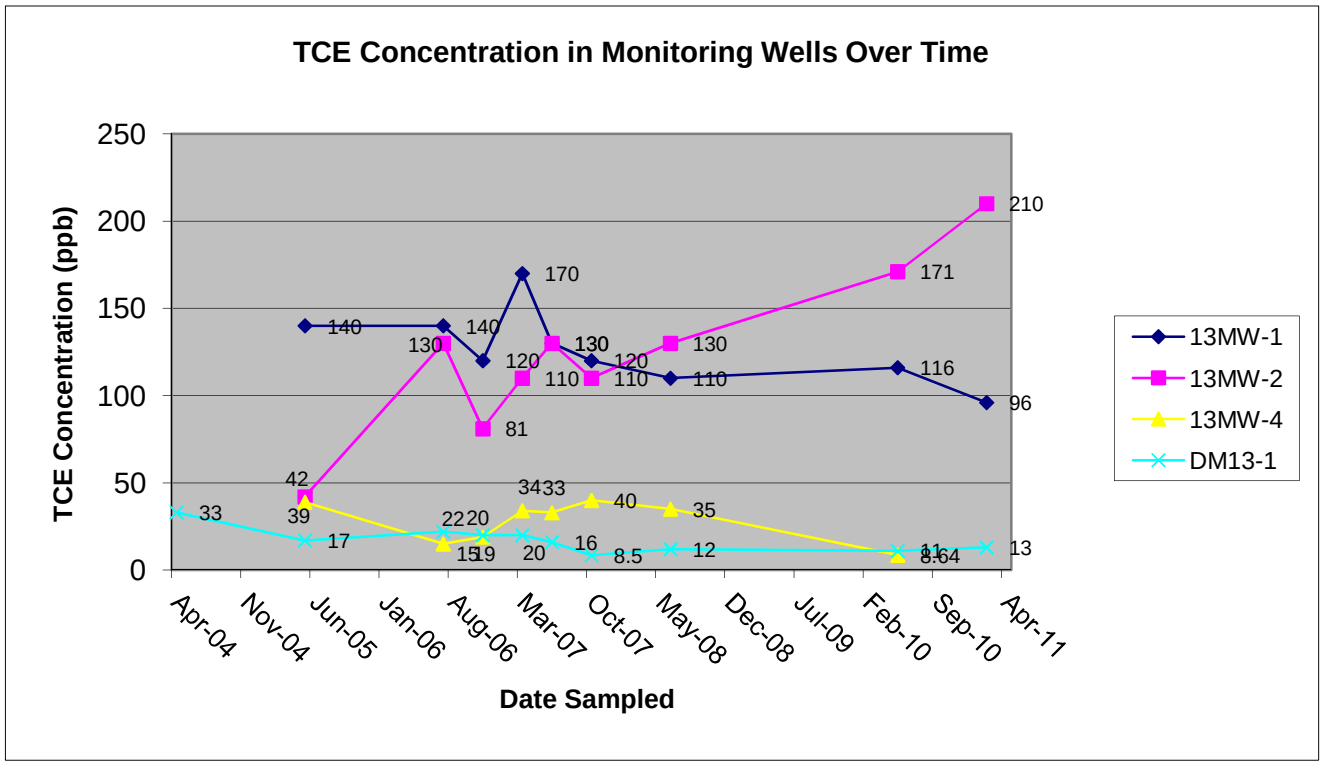
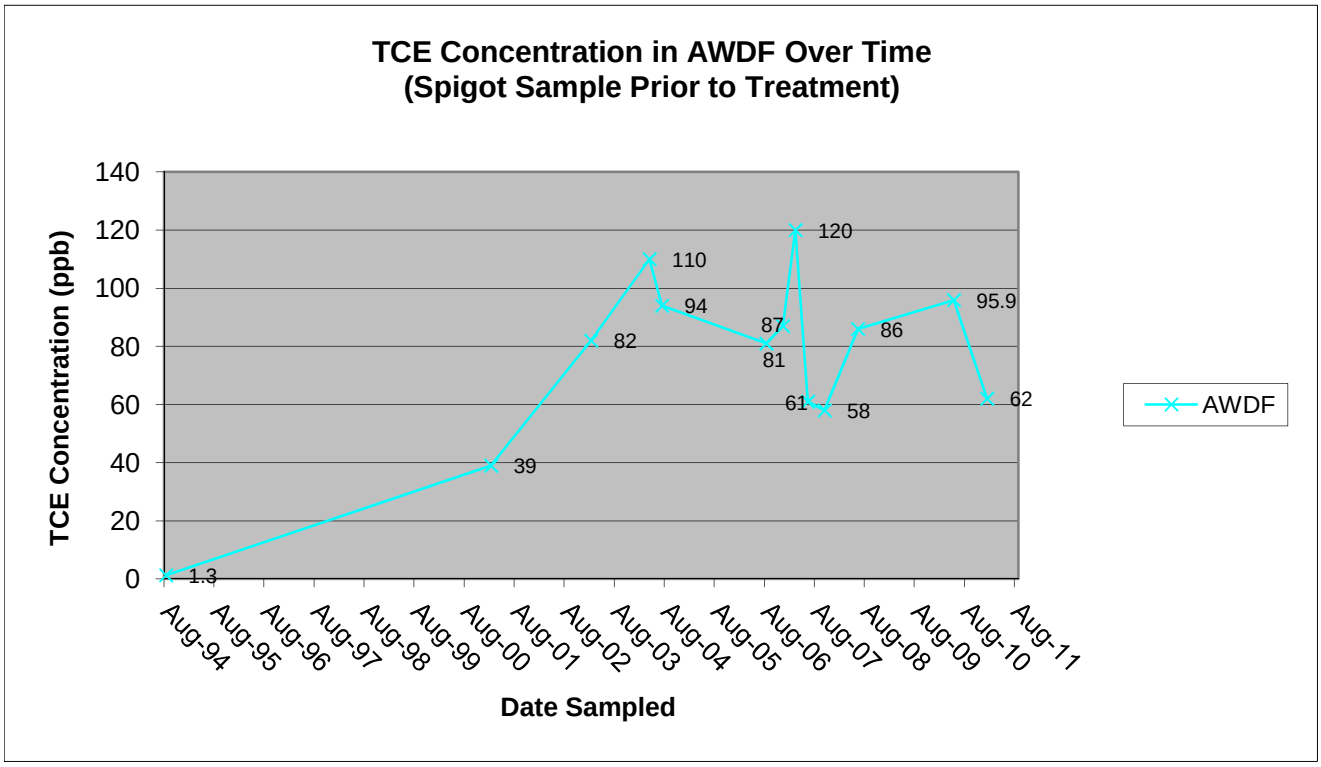
FIGURE 4-2B

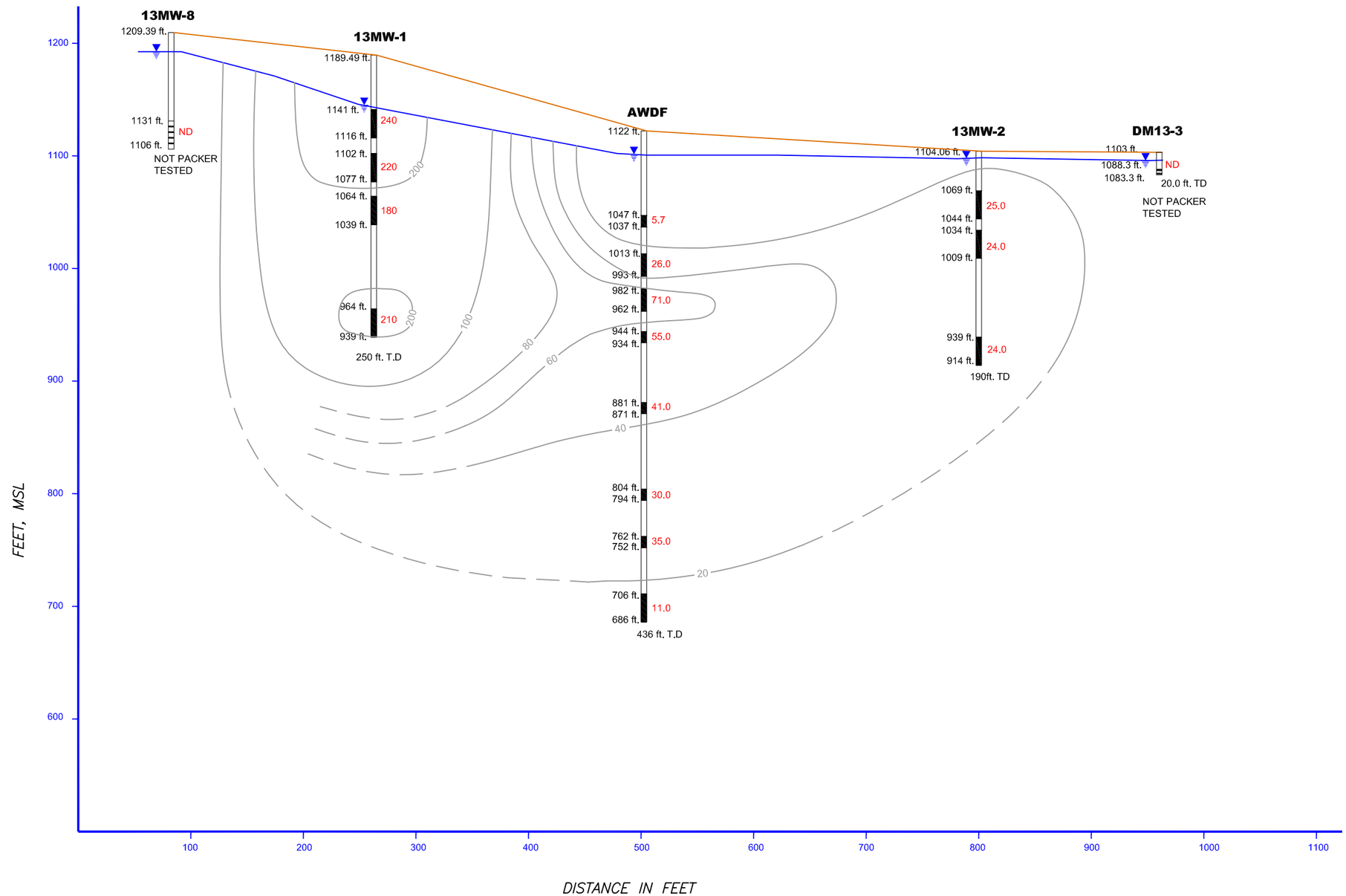
JUNE 2008 TCE ISOPLETH MAP

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

Figure 4-3
AWDF and Monitoring Well TCE Time-Concentration Data







LEGEND

13MW-8 — WELL ID

209.39 ft. — WATER TABLE

ND — PACKER TEST INTERVAL (in ft., bgs)

TCE CONCENTRATION (in ppb)

1131 ft.

1106 ft. — SCREEN INTERVAL

NOT PACKER TESTED

WATER TABLE

20 — TCE CONTAMINATION ISOPLETH

20 — DASHED WHERE INFERRED

NOTE:

PACKER TESTING AND SAMPLING WAS CONDUCTED OVER SEVERAL PERIODS AT EACH WELL.

PACKER TESTING AND SAMPLING WAS PERFORMED ON DIFFERENT DATES AT THE VARIOUS WELLS, WHICH MAY AFFECT THE ACCURACY OF THE CROSS-SECTIONS.

SCALE

0 100 200 FEET

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 4-4

VERTICAL DISTRIBUTION OF TCE IN PACKER TESTED WELLS

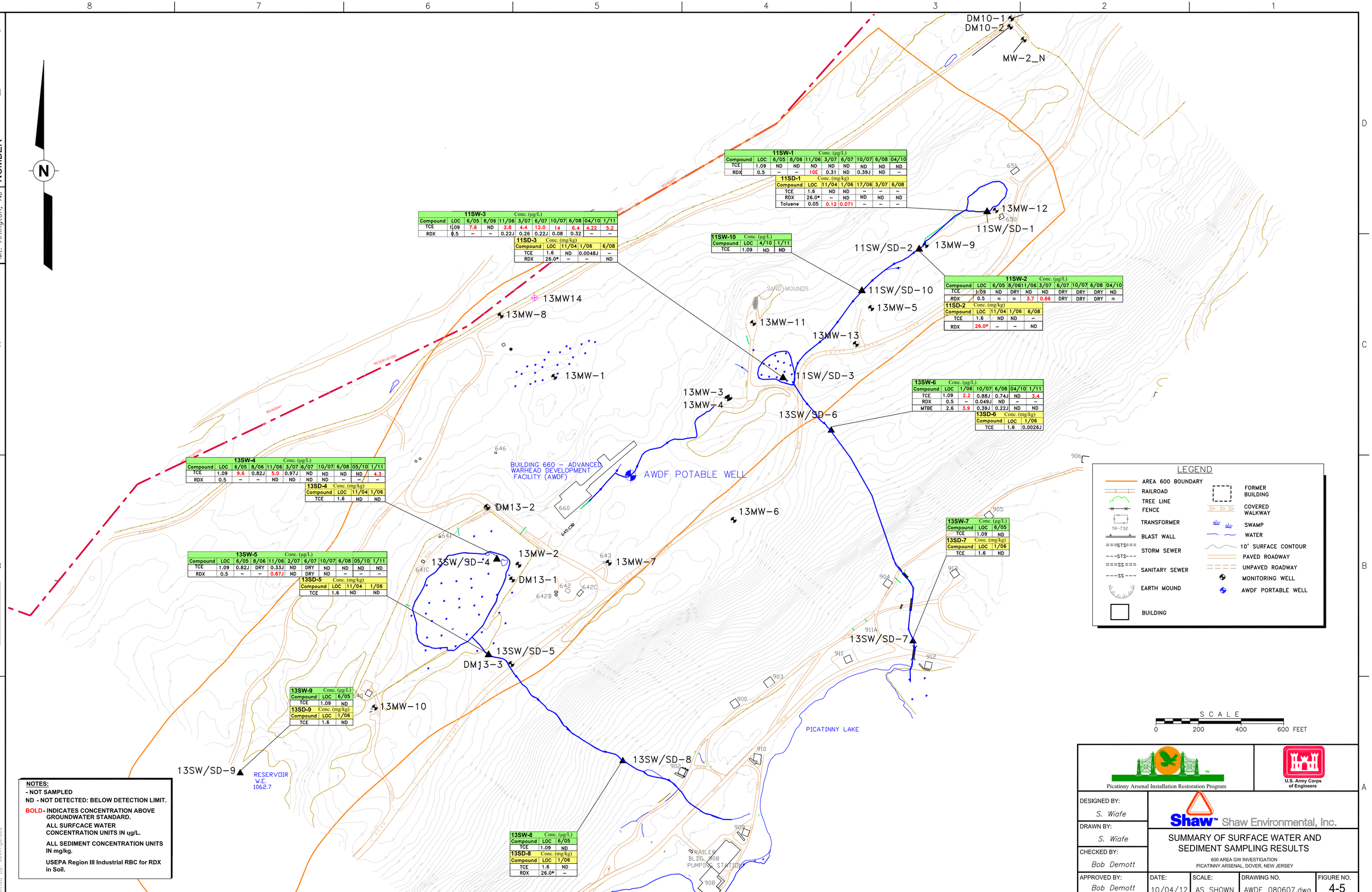
600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
S. Waite 08/13/07	B. Demott 08/13/07	-- --	GW-Xsect1e.dwg

File: N:\cad\CAD drawings\Picatinny\Area-N\GW-Xsect1e.dwg
Plot Date/Time: Jan 14, 2009 - 5:06pm
Plotted By: stephen.Waite

OFFICE Mt. Arlington, NJ

DRAWING NUMBER AWDF_080607.dwg



11SW-1 Conc. (µg/L)

Compound	LOC	6/05	8/06	11/06	3/07	6/07	10/07	6/08	04/10
TCE	1.09	ND	ND	ND	ND	ND	ND	ND	ND
RDX	0.5	–	–	10E	0.31	ND	0.39J	ND	–

11SD-1 Conc. (mg/kg)

Compound	LOC	11/04	1/06	17/06	3/07	6/08
TCE	1.6	ND	ND	–	–	–
RDX	26.0*	–	ND	ND	ND	ND
Toluene	0.05	0.12	0.071	–	–	–

11SW-3 Conc. (µg/L)

Compound	LOC	6/05	8/06	11/06	3/07	6/07	10/07	6/08	04/10	1/11
TCE	1.09	7.6	ND	2.8	4.4	12.0	14	6.4	4.22	5.2
RDX	0.5	–	–	0.22J	0.26	0.22J	0.08	0.32	–	–

11SD-3 Conc. (mg/kg)

Compound	LOC	11/04	1/06	6/08
TCE	1.6	ND	0.0048J	–
RDX	26.0*	–	–	ND

11SW-10 Conc. (µg/L)

Compound	LOC	4/10	1/11
TCE	1.09	ND	ND

11SW-2 Conc. (µg/L)

Compound	LOC	6/05	8/06	11/06	3/07	6/07	10/07	6/08	04/10
TCE	1.09	ND	DRY	ND	ND	DRY	DRY	DRY	ND
RDX	0.5	=	=	3.7	0.86	DRY	DRY	DRY	=

11SD-2 Conc. (mg/kg)

Compound	LOC	11/04	1/06	6/08
TCE	1.6	ND	ND	–
RDX	26.0*	–	–	ND

13SW-6 Conc. (µg/L)

Compound	LOC	1/06	10/07	6/08	04/10	1/11
TCE	1.09	2.2	0.88J	0.74J	ND	3.4
RDX	0.5	–	0.049J	ND	–	–
MTBE	2.6	3.9	0.39J	0.22J	ND	ND

13SD-6 Conc. (mg/kg)

Compound	LOC	1/06
TCE	1.6	0.0026J

13SW-4 Conc. (µg/L)

Compound	LOC	6/05	8/06	11/06	3/07	6/07	10/07	6/08	05/10	1/11
TCE	1.09	9.6	0.82J	5.0	0.97J	ND	ND	ND	ND	4.3
RDX	0.5	–	–	ND	ND	ND	ND	–	–	–

13SD-4 Conc. (mg/kg)

Compound	LOC	11/04	1/06
TCE	1.6	ND	ND

13SW-5 Conc. (µg/L)

Compound	LOC	6/05	8/06	11/06	2/07	6/07	10/07	6/08	05/10	1/11
TCE	1.09	0.82J	DRY	0.33J	ND	DRY	ND	ND	ND	ND
RDX	0.5	–	–	0.87J	ND	DRY	ND	–	–	–

13SD-5 Conc. (mg/kg)

Compound	LOC	11/04	1/06
TCE	1.6	ND	ND

13SW-7 Conc. (µg/L)

Compound	LOC	6/05
TCE	1.09	ND

13SD-7 Conc. (mg/kg)

Compound	LOC	1/06
TCE	1.6	ND

13SW-9 Conc. (µg/L)

Compound	LOC	6/05
TCE	1.09	ND

13SD-9 Conc. (mg/kg)

Compound	LOC	1/06
TCE	1.6	ND

13SW-8 Conc. (µg/L)

Compound	LOC	6/05
TCE	1.09	ND

13SD-8 Conc. (mg/kg)

Compound	LOC	1/06
TCE	1.6	ND
RDX	26.0*	–

NOTES:

- NOT SAMPLED

ND - NOT DETECTED: BELOW DETECTION LIMIT.

BOLD- INDICATES CONCENTRATION ABOVE GROUNDWATER STANDARD.

ALL SURFCACE WATER CONCENTRATION UNITS IN ug/L.

ALL SEDIMENT CONCENTRATION UNITS IN mg/kg.

USEPA Region III Industrial RBC for RDX in Soil.

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw™ Shaw Environmental, Inc.

DESIGNED BY: S. Wiafe	
DRAWN BY: S. Wiafe	
CHECKED BY: Bob Demott	
APPROVED BY: Bob Demott	

SUMMARY OF SURFACE WATER AND SEDIMENT SAMPLING RESULTS

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

DATE:	SCALE:	DRAWING NO.	FIGURE NO.
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Plotted By: kevin.gerdes

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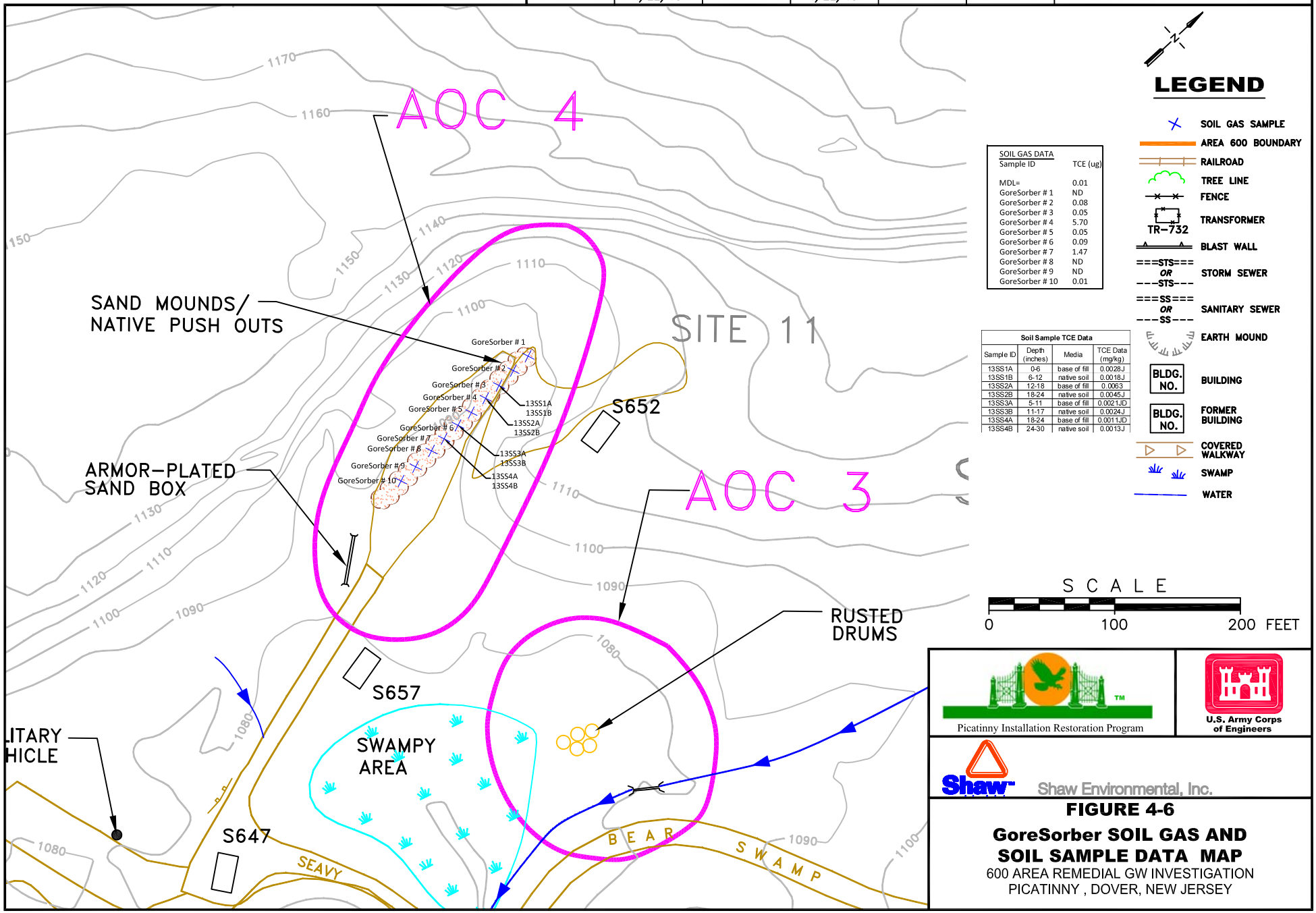
Plot Date/Time: Apr 23, 2013 - 8:18am
Plotted By: andrius.yanavicius

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	NAD032304.dwg
A. Yanavicius	4/22/13	K. Gerdes	4/22/13	--	--		



SOIL GAS DATA

Sample ID	TCE (ug)
MDL=	0.01
GoreSorber # 1	ND
GoreSorber # 2	0.08
GoreSorber # 3	0.05
GoreSorber # 4	5.70
GoreSorber # 5	0.05
GoreSorber # 6	0.09
GoreSorber # 7	1.47
GoreSorber # 8	ND
GoreSorber # 9	ND
GoreSorber # 10	0.01

Soil Sample TCE Data

Sample ID	Depth (inches)	Media	TCE Data (mg/kg)
13SS1A	0-6	base of fill	0.0028J
13SS1B	6-12	native soil	0.0018J
13SS2A	12-18	base of fill	0.0063
13SS2B	18-24	native soil	0.0045J
13SS3A	5-11	base of fill	0.0021JD
13SS3B	11-17	native soil	0.0024J
13SS4A	18-24	base of fill	0.0011JD
13SS4B	24-30	native soil	0.0013J

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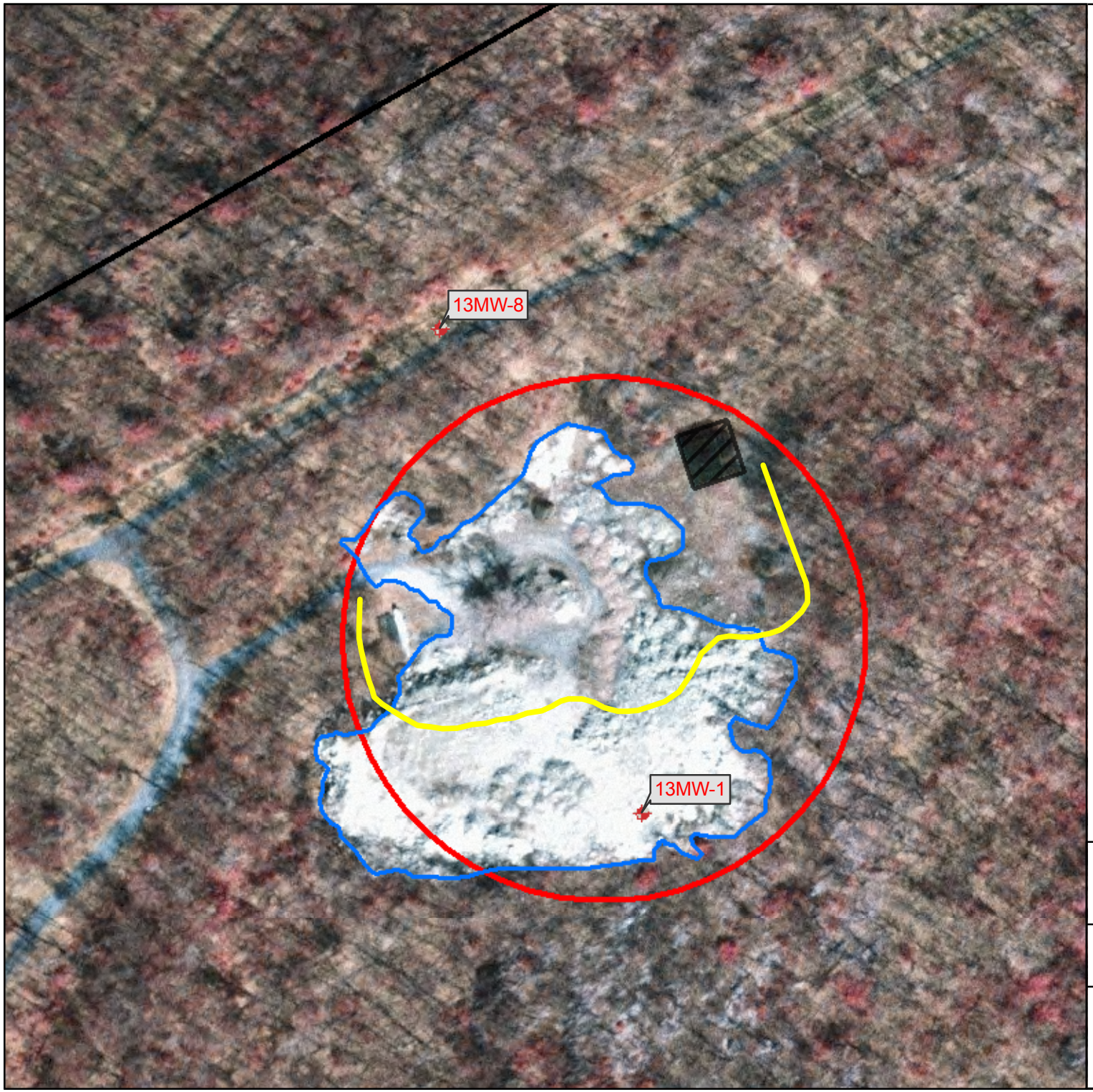
FIGURE 4-6

GoreSorber SOIL GAS AND SOIL SAMPLE DATA MAP

600 AREA REMEDIAL GW INVESTIGATION
PICATINNY , DOVER, NEW JERSEY



LEGEND

- Montoring Well
- Extent of Fill Material Deposited at Test Site in 1970s
- Burning Cage
- Extent of Fill Material and Rock Debris Deposited at Test Site in 1990s
- AOC 1 Boundary
- Arsenal Boundary

Notes: "Extent of Fill Material Used at Test Site Prior to Dumping Associated With the Construction of Building 660"was digitized based on historial aerial photo coverage, dated March 1991, obatined from TerraServer.

N

Scale:

0 50 100 Feet

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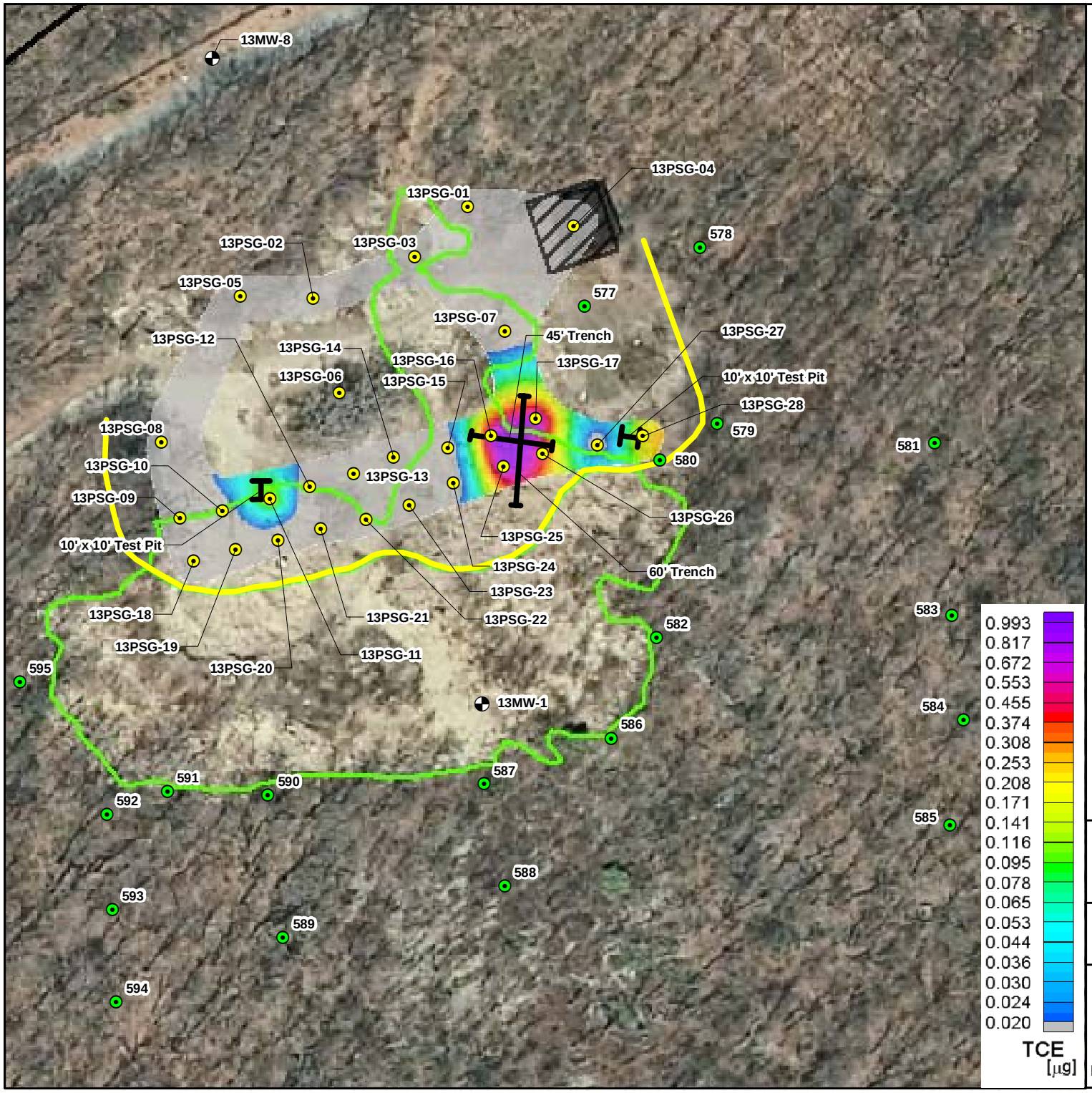
Shaw Environmental, Inc.

FIGURE 4-7

INTERPRETED AERIAL PHOTO OF AOC 1

PICATINNY ARSENAL
DOVER, NEW JERSEY

N:\GIS\Picatinny\Projects\600_area_site_12_10_ft_topo_aerial.mxd (1/4/2010 10:17:24 AM)



LEGEND

- Montoring Well
- 2004 Soil-Gas Sample Location
- 2010/2011 Soil-Gas Sample Location
- Extent of Fill Material Deposited at Test Site in 1970s
- Proposed Test Pit
- Burning Cage
- Extent of Fill Material and Rock Debris Deposited at Test Site in 1990s

N

Scale:

0 37.5 75 Feet

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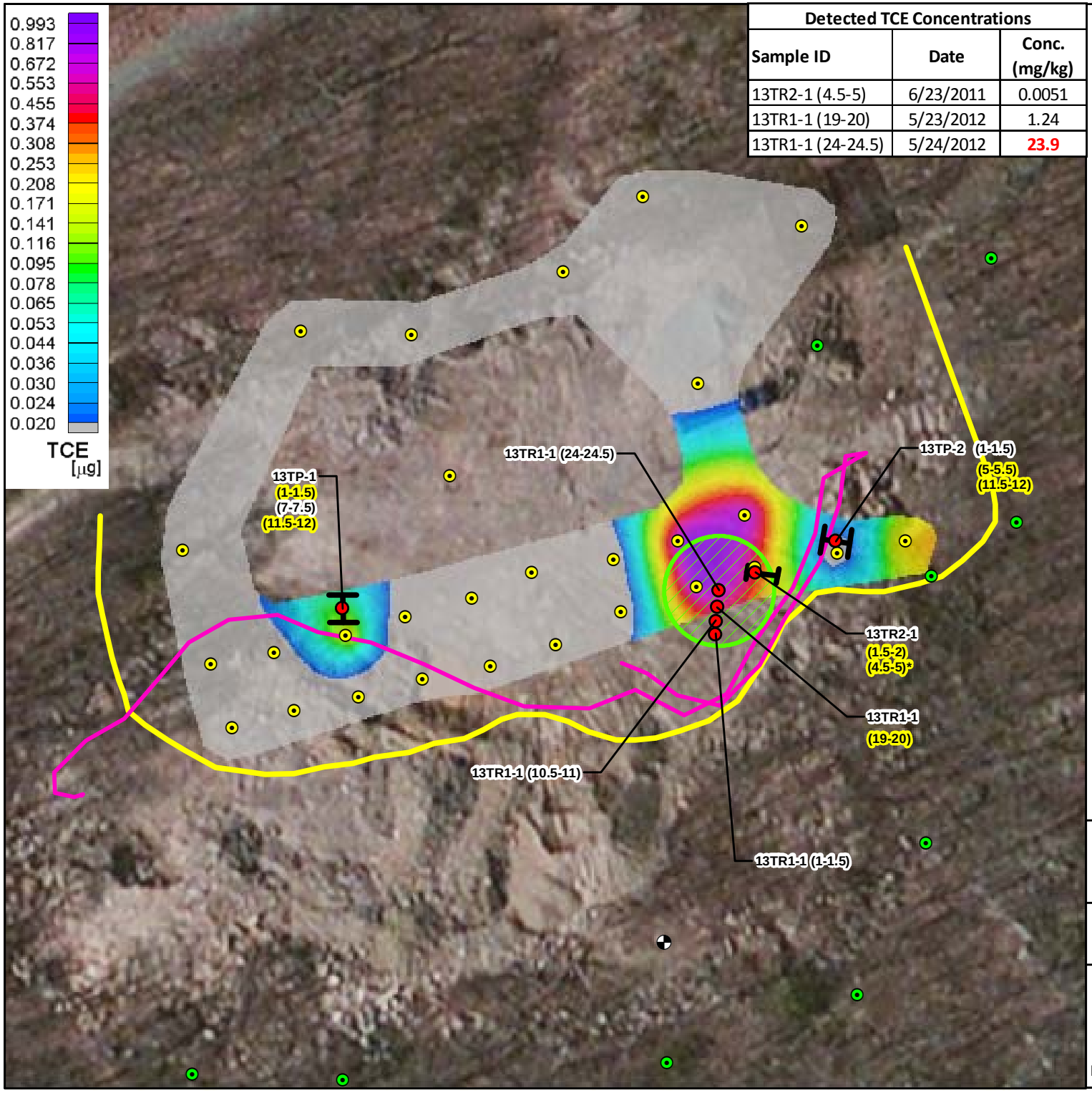
FIGURE 4-8

600 AREA SOURCE INVESTIGATION
PROPOSED TEST PIT LOCATIONS

PICATINNY ARSENAL, DOVER, NEW JERSEY

N:\GIS\Picatinny\GIS_Documents\Project_Maps\PTA_075_Fig4-8_Proposed_TP_Locations_600_Area_FS_Addendum_rpt.mxd (10/17/2012)



Detected TCE Concentrations		
Sample ID	Date	Conc. (mg/kg)
13TR2-1 (4.5-5)	6/23/2011	0.0051
13TR1-1 (19-20)	5/23/2012	1.24
13TR1-1 (24-24.5)	5/24/2012	23.9

LEGEND

- Test Pit or Trench Sample Location
- 2004 Soil-Gas Sample Location
- 2010/2011 Soil-Gas Sample Location
- Extent of Fill Material Deposited at Test Site in 1970s
- Extent of Large Gravel Piles During June 2011 Investigation
- 2011 Test Pit
- May 2012 Trench/Test Pit Excavation Area

Note:
1) Aerial photo source: Microsoft Bing map service.
2) Sample intervals are in feet.
3) 13TR2-1 (4.5-5)* - Two samples were collected from the same depth interval, on seperate dates, within approximately 2 feet, horizontally, of each other. The initial sample location addressed the location of a crushed drum. The 2nd sample location addressed the location of a gravel mine canister.
4) All test pit/trench samples were analyzed for VOCs. Highlighted sample intervals (i.e. 19-20) were also analyzed for Metals, Explosives, and SVOCs.

N

Scale:
0 25 50 Feet

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FIGURE 4-9
600 AREA SOURCE INVESTIGATION
TEST PIT SAMPLE LOCATIONS
AND RESULTS

PICATINNY ARSENAL, DOVER, NEW JERSEY

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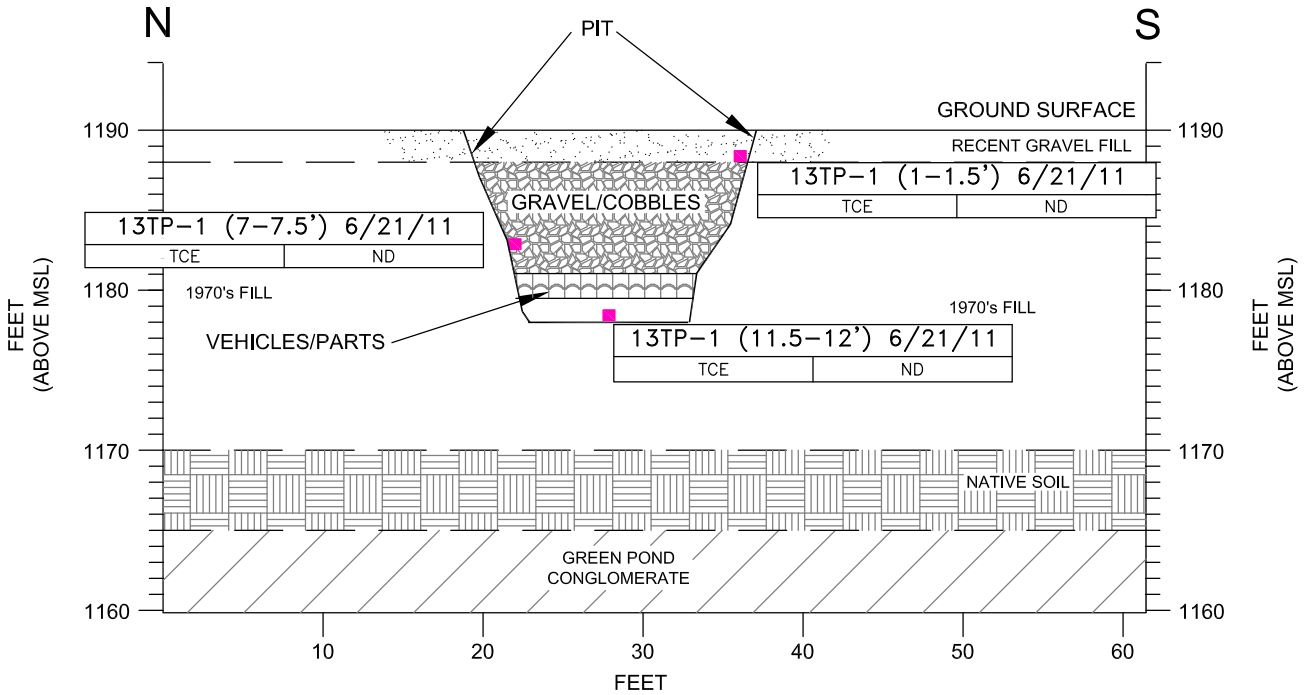
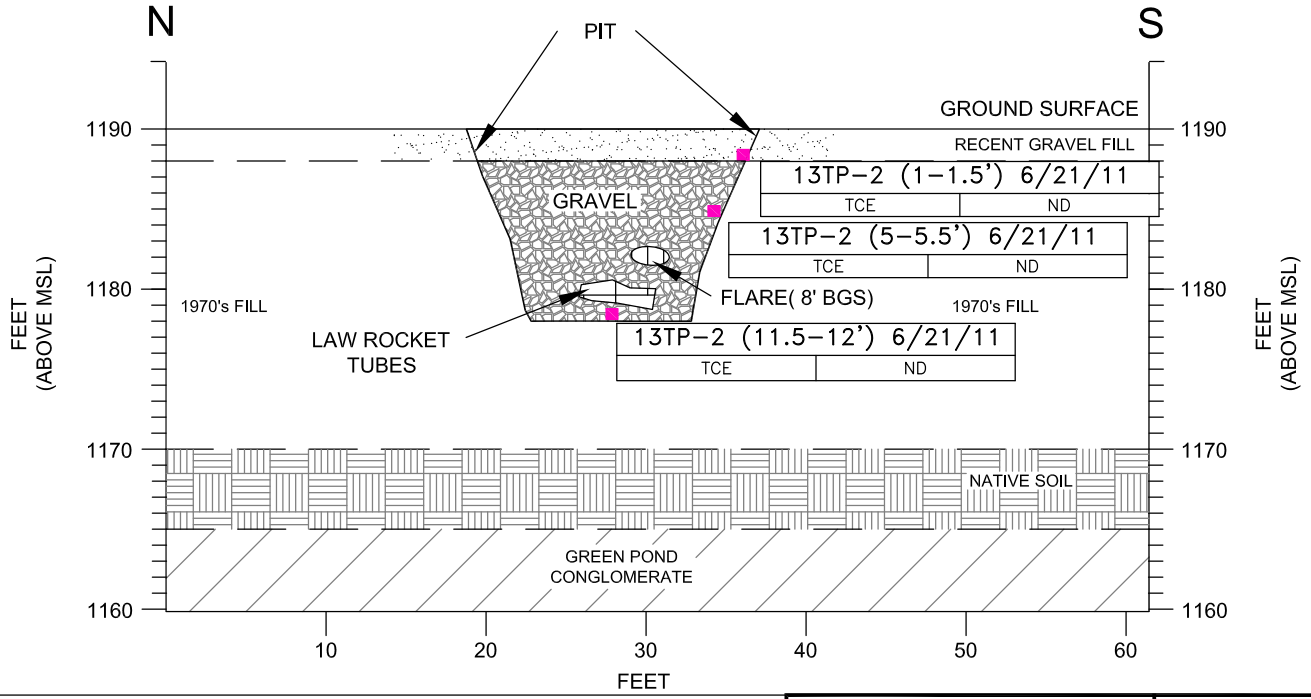
DRAWING NUMBER	APPROVED BY	CHECKED BY	DRAWN BY
117969-A1	-- K.G.	-- K.G.	-- A.Y.

600 AREA-SOURCE INVESTIGATION TEST PIT #1



600 AREA-SOURCE INVESTIGATION TEST PIT #2



SCALE

0 12 24 FEET

LEGEND:

■ SAMPLE LOCATION

TCE–TRICHLOROETHENE

PCE–TETRACHLOROETHENE

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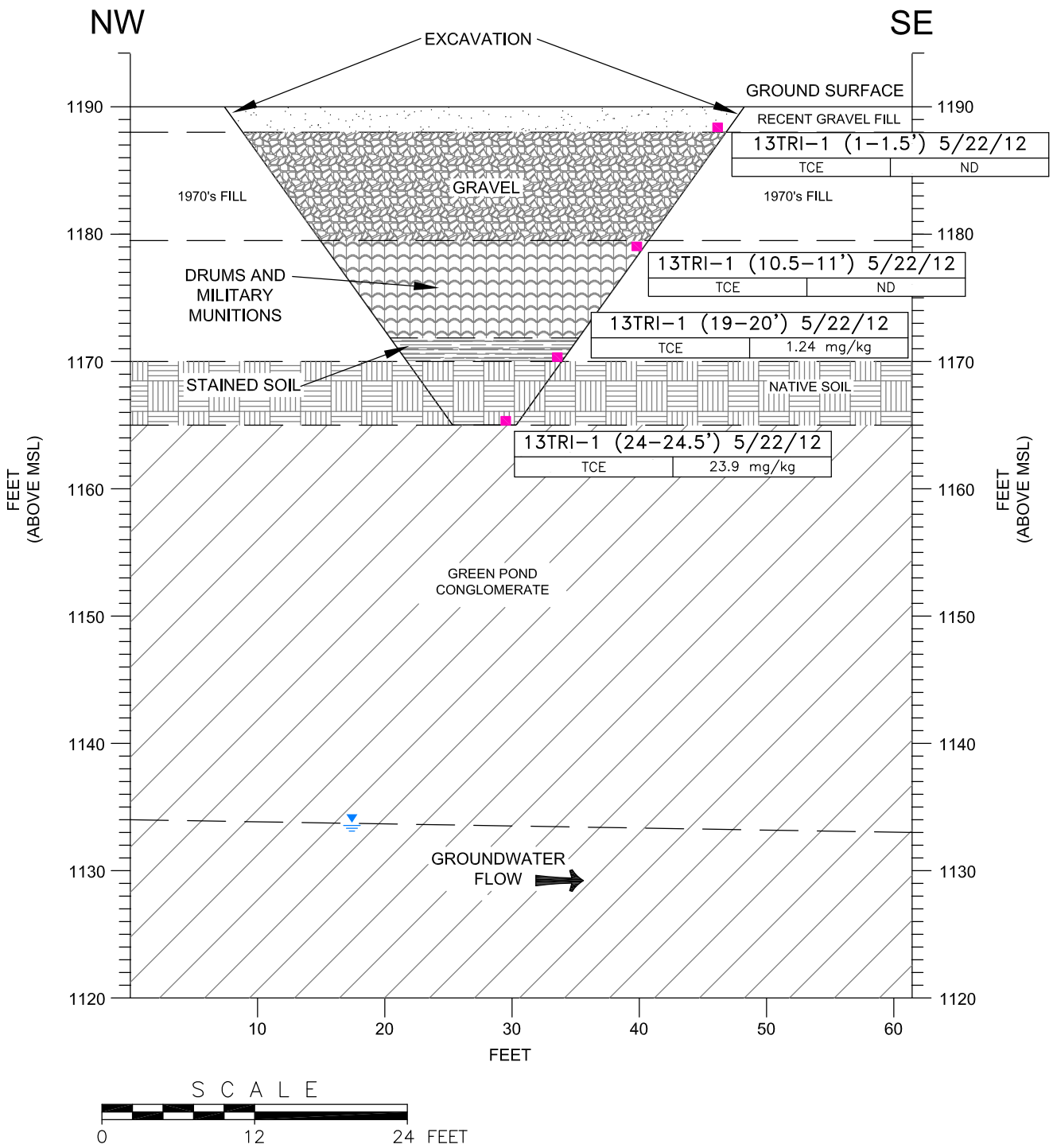
FIGURE 4-10

600 AREA-SOURCE INVESTIGATION TEST PITS #1 AND #2

PICATINNY ARSENAL, DOVER, NEW JERSEY

DRAWING NUMBER	117969-A1
APPROVED BY	K.G.
CHECKED BY	K.G.
DRAWN BY	A.Y.

600 AREA-SOURCE INVESTIGATION



LEGEND:

■ SAMPLE LOCATION

TCE–TRICHLOROETHENE

PCE–TETRACHLOROETHENE

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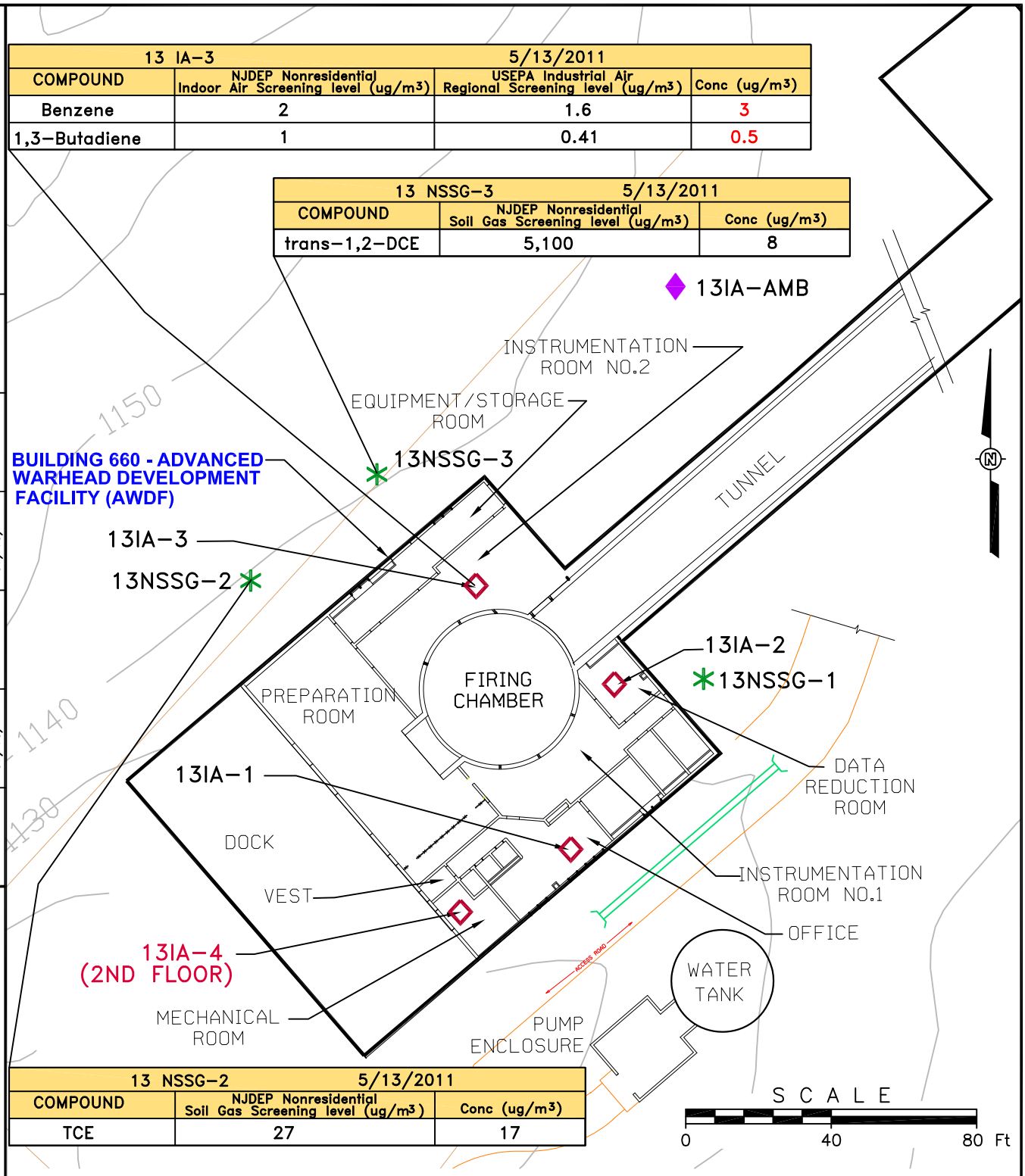
FIGURE 4-11

600 AREA-SOURCE INVESTIGATION, EXCAVATION RESULTS FOR INTENDED 60-FT TRENCH (TR1)

PICATINNY ARSENAL, DOVER, NEW JERSEY

13 IA-3	5/13/2011		
COMPOUND	NJDEP Nonresidential Indoor Air Screening level (ug/m3)	USEPA Industrial Air Regional Screening level (ug/m3)	Conc (ug/m3)
Benzene	2	1.6	3
1,3-Butadiene	1	0.41	0.5

13 NSSG-3	5/13/2011	
COMPOUND	NJDEP Nonresidential Soil Gas Screening level (ug/m3)	Conc (ug/m3)
trans-1,2-DCE	5,100	8



13 NSSG-2	5/13/2011	
COMPOUND	NJDEP Nonresidential Soil Gas Screening level (ug/m3)	Conc (ug/m3)
TCE	27	17

LEGEND

- RAILROAD
- TREE LINE
- FENCE
- TRANSFORMER
- BLAST WALL
- STORM SEWER
- SANITARY SEWER
- EARTH MOUND
- BUILDING
- AWDF PORTABLE WELL
- MONITORING WELL
- INDOOR AIR SAMPLE LOCATION
- NEAR SLAB SOIL GAS SAMPLE LOCATION
- AMBIENT SAMPLE LOCATION
- FORMER BUILDING
- COVERED WALKWAY
- SWAMP
- WATER
- 10' SURFACE CONTOUR
- PAVED ROADWAY
- UNPAVED ROADWAY

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FIGURE 4-12
VAPOR INTRUSION INVESTIGATION SAMPLING RESULTS

600 AREA SOURCE INVESTIGATION
PICATINNY ARSENAL, DOVER, NJ

DRAWING NUMBER AWDF_smp071011.dwg

DRAWN BY	S. Wiafe	07/15/11
CHECKED BY	K. Gerdes	07/15/11
APPROVED BY	--	--

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Plot Date/Time: Oct 16, 2012 - 6:20pm
Plotted By: kevin.gerdes

5.0 FATE AND TRANSPORT OF CONTAMINANTS

5.1 OVERVIEW

This fate and transport analysis was performed in 2008 in the initial draft FS. Subsequent to the initial regulatory review and approval of the FS, there was a request by the USEPA to complete a source investigation and vapor intrusion study. Planning and completion of the source investigation caused a delay in the finalization of this document. In order to continue monitoring the groundwater plume the Army collected additional rounds of data after 2008. This data was consistent with earlier data and in general showed decreasing trends. Based on this information the fate and transport analysis has not been updated with sampling data collected after 2008. The primary groundwater and surface water COPCs identified during the 600 Area groundwater sampling rounds include TCE and RDX based on the examination of the data set and comparison of the data to LOCs. The frequency of detection and maximum detected concentrations for groundwater and surface water are presented in **Tables 4-2** and **4-4**.

The physical and chemical properties of contaminants play a large role in determining their fate after release to the environment. Physical properties affecting fate and transport of contaminants include specific gravity, water solubility, vapor pressure, Henry's Law constant, organic carbon/water partition coefficient and the octanol/water partition coefficient (USEPA, 1998). Physical properties of the principle COPCs are presented in **Table 5-1** and are specifically addressed with physical processes in their respective transport sections.

Contaminant "fate" refers to the expected final state that an element, compound, or group of compounds will achieve following release to the environment. The fate processes for organic contaminants may include sorption, volatilization, hydrolysis, and abiotic and biotic degradation (USEPA, 1998). These fate processes dictate how contaminants will be transported in the environment. Contaminants can be transported with little attenuation or retardation due to these fate processes, or they can be delayed or transformed, so that little migration occurs.

Contaminant transport refers to the mechanisms and rates of migration of contaminants away from the source area. Migration pathways often include air, water, soil, and the interfaces between the phases of the contaminant (i.e., solid, liquid, or gas). Mechanisms controlling the movement of contaminants include advection, dispersion, diffusion, volatilization, and sorption (USEPA, 1998). These mechanisms are dictated by the physical and chemical nature of the environmental media and their interaction with the potential COCs. Water pathways include surface water, storm water runoff, groundwater, infiltration/percolation, and precipitation. The soil pathways include sediment and soil transported by erosion or by site activities such as construction and movement through the vadose zone as soil gas. Transport across an interface is primarily due to partitioning. The degree of partitioning will depend on the volatility, solubility, and sorptive capacity of the phases. The primary transport mechanism across the water-air and soil-air interfaces is volatilization and sorption, while transport across the soil-water interface is controlled by sorption/desorption and water solubility (USEPA, 2000).

Under the Army policy, every installation activity under the authorities of CERCLA is required to consider MNA as a remedial action alternative (U.S. Army, 1995 – DAIM-ED-R [200-1C] 12 Sep 1995). The Army defines NA as the reduction of contaminant concentrations in the environment through biological processes (aerobic and anaerobic biodegradation, plant and animal uptake), physical processes (advection, dispersion, dilution, diffusion, volatilization, sorption, and desorption), and chemical reactions (ion exchange, complexation, and abiotic transformation). MNA of 600 Area COPCs will be addressed in **Section 6.0**.

5.2 FATE AND TRANSPORT OF TCE

5.2.1 Degradation/Reduction Processes of TCE

Chlorinated solvents can be biodegraded in aerobic and anaerobic groundwater environments. In aerobic conditions, TCE can be cometabolized and degraded by methanotrophic and other bacteria in the presence of methane, propane, ethylene, toluene, or phenol (USEPA, 1998 and 2000). The aerobic degradation pathways for TCE are depicted on **Figure 5-1**. During oxidation of the primary substrates, these aerobes fortuitously oxidize or cometabolize the chlorinated substrate via enzymatic reactions. In

the presence of methane, propane, or ethylene, methanotrophic microbes release the enzyme monooxygenase to oxidize the subject primary substrate (USEPA 2000). Likewise, monooxygenase and dioxygenase enzymes can be released by the bacteria *Burkhoderia cepacia* and *Pseudomonas putida*, respectively, to oxidize a toluene substrate (Gao, 2010). The monooxygenase and dioxygenase enzymes are non-specific, and will cometabolize the secondary substrate (TCE for example). Common intermediate products of aerobic TCE degradation include choral hydrate and TCE epoxide. Potential degradation end products may vary depending on the specific enzyme, but would include CO_2, oxalate, glyoxylate, formate, and trichloroethanol (Gao, 2010).

Under anaerobic conditions, TCE can be reduced to form a sequence of progressively dechlorinated daughter products, including cis-1,2-DCE, VC, and ethene. The anaerobic degradation pathway for PCE/TCE is shown on **Figure 5-2**. These reactions are catalyzed by the *Dehalococcoides*, *Dehalobacter*, *Dehalospirillium* and other genera of bacteria, which produce specific reductive dehalogenase enzymes (i.e., TCE reductive dehalogenase). TCE is generally reduced to cis-1,2-DCE, but the trans isomer is also reported as a degradation product. Both cis- and trans-1,2-DCE are in turn reduced by a specific reductive dehalogenase to form VC (Gao, 2010).

Cis-1,2-DCE, VC, ethene, and ethane sampling data were evaluated during biodegradation sampling as potential anaerobic degradation products. Low concentrations of cis-1,2-DCE were detected in 8 of the 68 total groundwater samples, and ethene was detected in two of nine bioremediation samples. The infrequent detection of cis-1,2-DCE and ethene in TCE impacted wells indicates limited anaerobic degradation. The observed limited/incomplete degradation of TCE is consistent with the predicted slightly to moderately reducing redox conditions in the aquifer (see **Section 4.9**).

5.2.2 Transport of TCE

The important physical processes that may influence transport of TCE include dispersion/diffusion, advection, volatilization and sorption (USEPA 1998). Solute transport in a porous media is described by the advection-dispersion equation:

$$R\partial C/\partial t = D_x(\partial^2 C/\partial x^2) + v_x(\partial C/\partial x) - R\lambda C$$

In the above equation, C is the constituent concentration as a function of distance (x) and time (t), R is the constituent retardation factor, v_x is the groundwater velocity, D_x is the longitudinal dispersivity coefficient, and λ is the degradation rate constant. The term on the left-hand side of the equation represents the temporal change in concentration. The terms on the right side of the equation account for dispersion/diffusion, advection, and degradation, respectively. The remaining components of this equation, diffusion/dispersion and advection, are therefore assumed to be responsible for the majority of the temporal change in concentration of contaminants in the 600 Area aquifer(s). The significance of these processes can be predicted by evaluating measured site conditions and by considering the chemical properties of the contaminants.

Olsen and Davis (1990) provide convenient tables that generalize on the significance of value ranges for Henry's Law coefficients, K_d (distribution coefficient) and R (retardation factor) values. The effects of variation in these values are presented in **Table 5-2**. The Henry's Law constant for TCE is reported at 8.9 x 10^{-3} atm m^3/mol. This value indicates that TCE is quite volatile, and will readily move from the water to vapor phase. Passive soil gas investigations found low concentrations of TCE at AOCs 1 through 4. A calculated K_d value of 0.227 and R of 2.45 for TCE are based on published log K_{oc} values (2.10 for TCE) and fraction of organic carbon (f_{oc}) values (0.0018 for glacial till) and assumed bulk density and effective porosity values of 1.6 g/cm^3 and 0.25, respectively. These values indicate that TCE will have intermediate to relatively high mobility within the overburden saturated zone.

The effects of advection on dissolved TCE in the aquifer appear to be extensive. This is evidenced by the migration of the plume into the bedrock aquifer and wide lateral extent of the TCE plume from the AOC 1 source area in the 600 Area.

5.3 FATE AND TRANSPORT OF RDX

5.3.1 Degradation/Reduction Processes of RDX

Several studies have shown that RDX can be biotransformed and mineralized aerobically and anaerobically, particularly under sulfate-reducing and methanogenic environments, to simple compounds such as formaldehyde, methanol, nitrite, nitrous oxide, and ammonium ion. Aerobic biodegradation of RDX leads to the accumulation of the dead-end product 4-nitro-2,4-diazabutanal (Bhushan et al., 2003). The proposed pathway includes double denitration initiated by a cytochrome followed by spontaneous hydrolytic ring cleavage and decomposition to produce 4-nitro-2,4-diazabutanal (**Figure 5-3**).

Anaerobic biodegradation of RDX can follow a sequential reduction of RDX to nitroso derivatives including MNX, hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine (DNX), and hexahydro-1,3,5-trinitroso-1,3,5-triazine (TNX) (Gao, 2010) (**Figure 5-4**). These products are rarely observed in groundwater, but have been observed in laboratory microcosms (Pennington et al., 1999b; Price, Brannon, and Yost, 1998). MNX, DNX, and TNX derivatives are unstable under anaerobic conditions, and may further reduce to form smaller breakdown products including hydrazine; 1,1-dimethylhydrazine; 1,2-dimethylhydrazine; formaldehyde; and methanol (McCormick, 1981).

5.3.2 Transport of RDX

Physical, chemical, and environmental data for RDX was obtained from USACE Technical Report IRRP-96-1 (USACE 1996), and is summarized in **Table 5-1**. RDX has a water solubility of 45 mg/L, which indicates slight solubility in water. The vapor pressure for RDX is 4.03×10^{-9} millimeters mercury (mm Hg). The Henry's Law Constant for RDX is 1.96×10^{-11} atmospheres-cubic meters per mole (atm-m^3/mole). The vapor pressure along with the value for the Henry's Law Constant indicates that RDX will not volatilize to the atmosphere. The logarithm ($\log_{10}$) of the organic carbon/water partition coefficient (K_{oc}) is 2. This value indicates that RDX will not readily sorb to the organic fraction of soil and will tend to leach into groundwater or surface water runoff. This fact is further supported by the logarithm ($\log_{10}$) of the octanol/water partition coefficient (K_{ow}). The $\log_{10} K_{ow}$ for RDX is 0.86, which indicates that RDX will partition to the polar water phase instead of sorbing to soil. The distribution coefficient (Kd in liters per kilogram [L/kg]) and retardation coefficient (Rf) were calculated to predict the mobility of RDX in groundwater. The calculated Kd (0.18 L/Kg) and Rf (2.2) were based upon a $K_{oc} = 2$, $f_{oc} = 0.0018$ (for glacial till), bulk density of 1.6 grams per cubic meter (g/cm^3) and an effective porosity value of 0.25. The derived Kd and Rf values indicate that RDX would be mobile in groundwater.

Table 5-1
Physical Constants and Coefficients for Selected Organic Compounds

Physical/Chemical Property	Specific Gravity	Water Solubility (mg/L @ 20°C)	Vapor Pressure (mm Hg @ 20-25°C)	Henry's Law Constant (atm-m^3/mole @ 25°C)	Organic Carbon Partition Coefficient (log K_{OC})	Octanol/Water Partition Coefficient (log K_{OW})
What It Measures	Whether Pure Phase Compound Will Float or Sink	Propensity for a Compound to Dissolve in Water	Propensity for a Compound to Volatilize	Propensity for a Compound to Volatilize from an Aqueous Solution	Propensity for a Compound to Adsorb onto Organic Particles	Propensity for a Compound to Dissolve in a Solvent
Volatile Organic Compounds						
TCE	1.46	1000	-1.0	8.90E-03	2.10	2.29
Explosives						
RDX	1.82	4.50E+01	4.03E-09	1.96E-11	2.00	0.86

Table 5-2

Henry's Law Coefficients for Selected Organic Compounds

H (atm m^3/mol)	Phase	K_d	R	Mobility
$<5x10^{-5}$	Compound mostly in soil	>10	>100	Immobile
$>5x20^{-3}$	Compound mostly in air	2-10	40-100	Low Mobility
		0.5-2	9-20	Intermediate
		0.1-0.5	3-6	Mobile
		<0.1	1.4-2	Very Mobile

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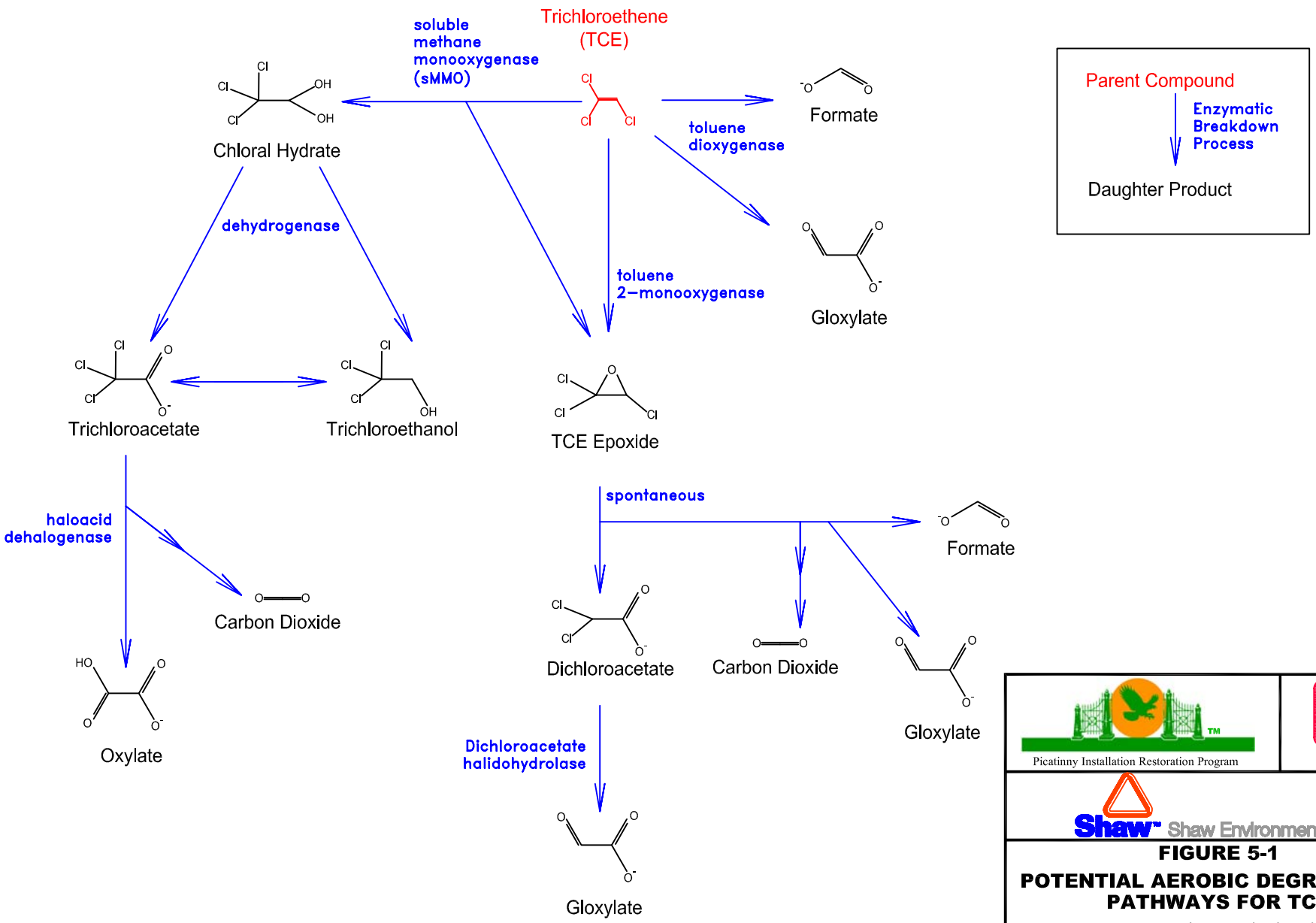


Picatinny Installation Restoration Program

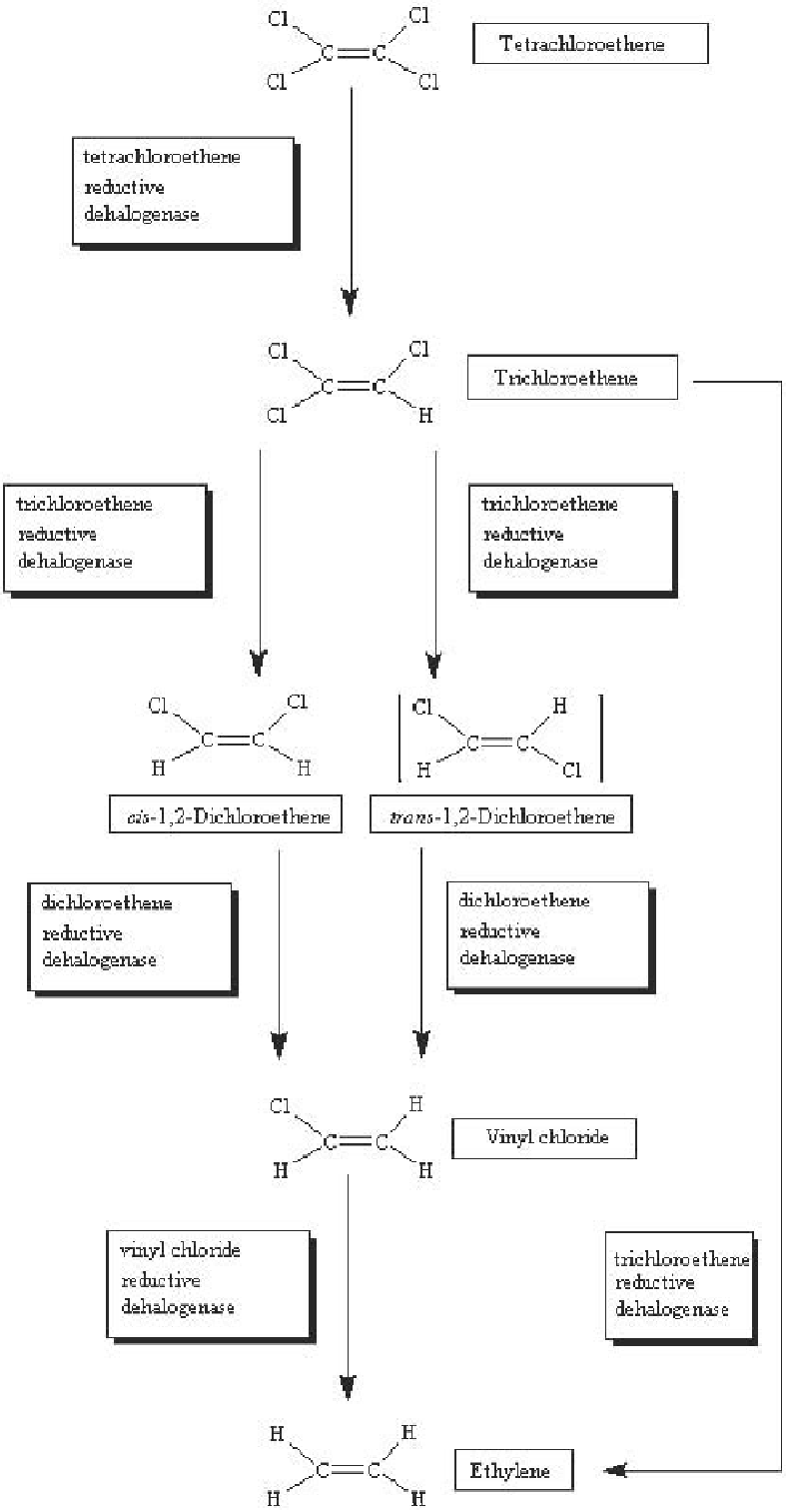
U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 5-1

POTENTIAL AEROBIC DEGRADATION PATHWAYS FOR TCE

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY



Source: University of Minnesota, Biocatalysis/Biodegradation Database

Picatinny Installation Restoration Program

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FIGURE 5-2

ANAEROBIC TETRACHLOROETHENE GRAPHICAL PATHWAY MAP

600 AREA GW INVESTIGATION
PICATINNY, DOVER, NEW JERSEY

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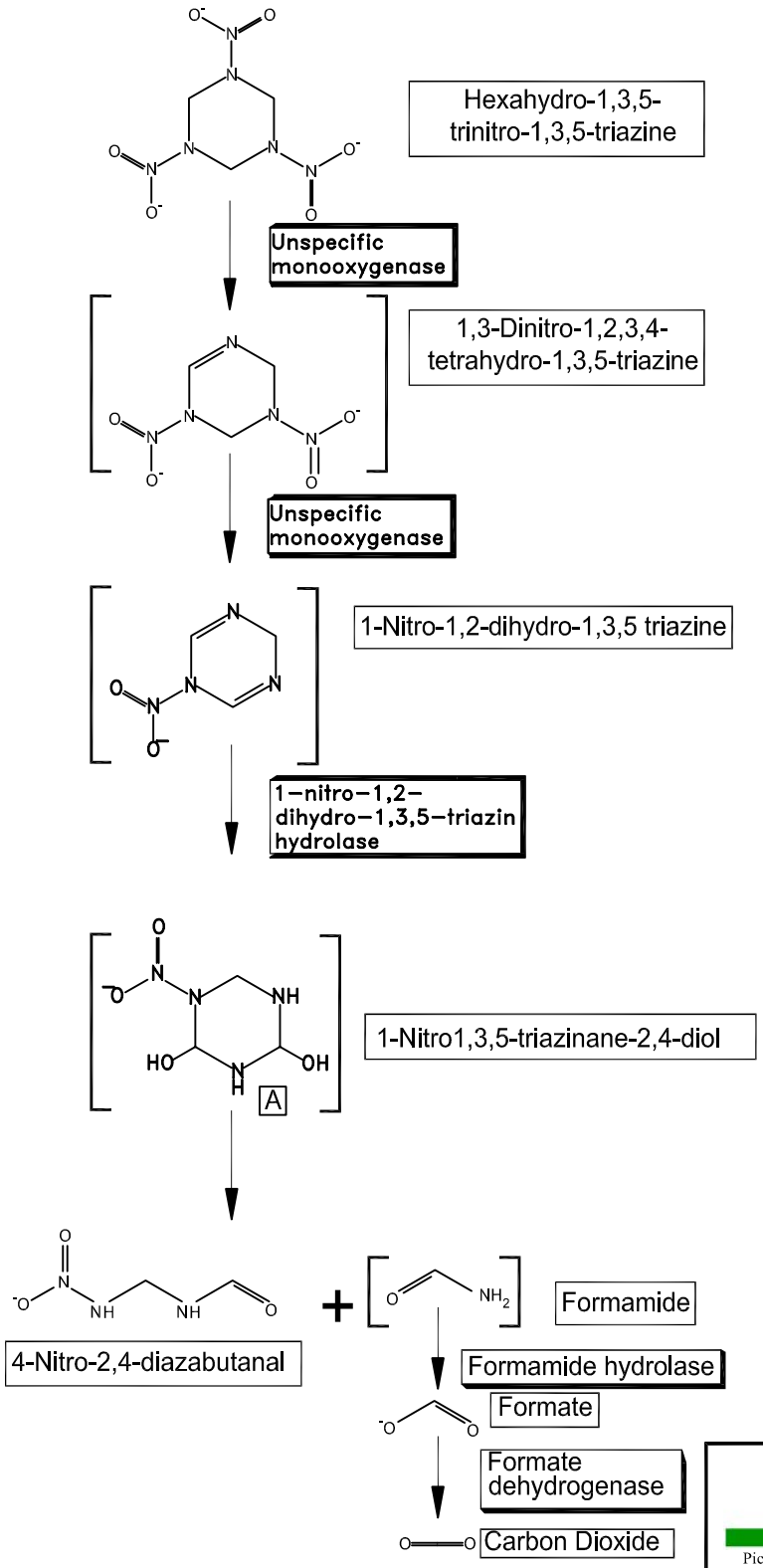

Source: University of Minnesota, Biocatalysis/Biodegradation Database

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 5-3

PROPOSED AEROBIC BIODEGRADATION PATHWAYS OF RDX BY HAWARI ET AL. (2003).

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	09/20/07	B. Demott	09/20/07	--	--	Sec_4B.dwg

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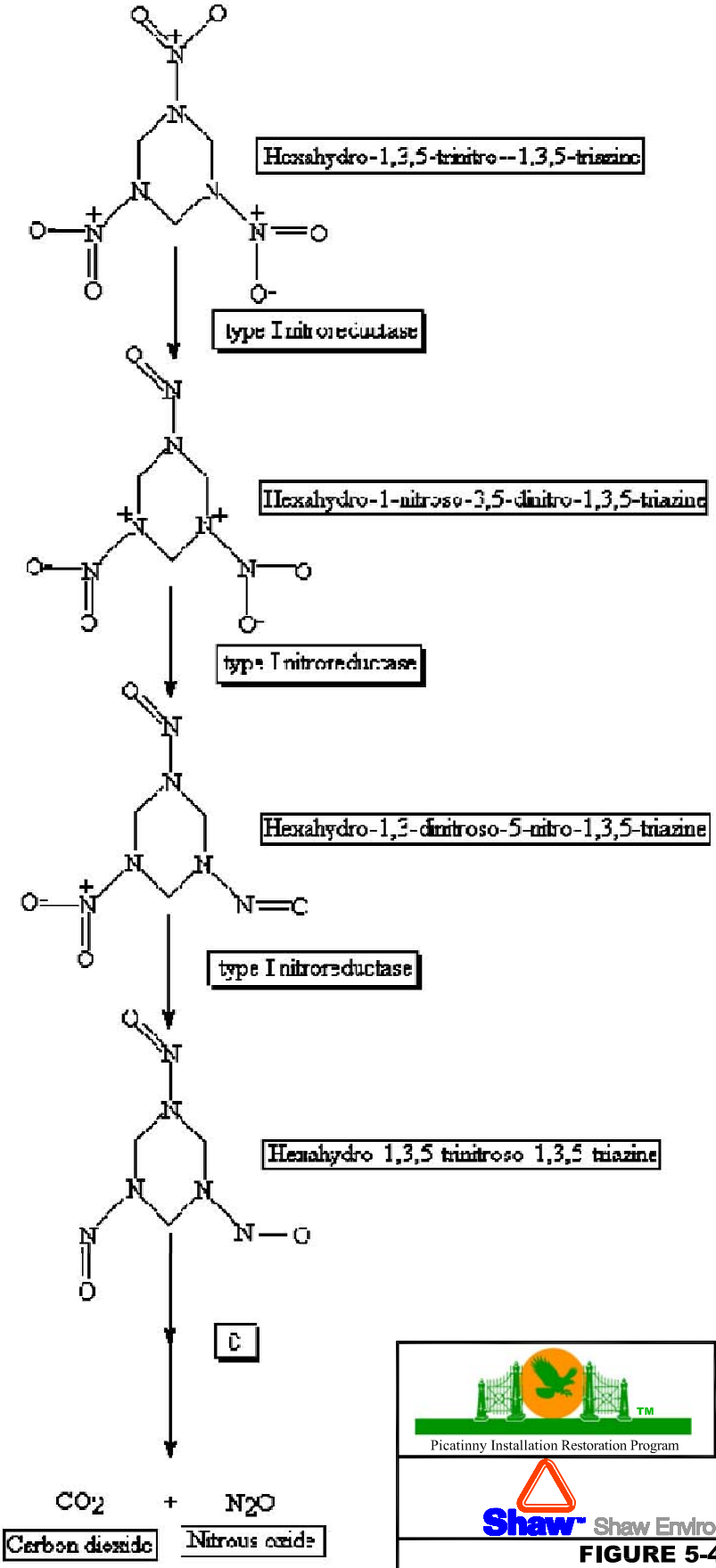

Source: University of Minnesota, Biocatalysis/Biodegradation Database

Picatinny Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 5-4

PROPOSED ANAEROBIC BIODEGRADATION PATHWAYS OF RDX BY HAWARI ET AL. (2003).

600 AREA GW INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
S. Wiafe	09/20/07	B. Demott	09/20/07	--	--	Sec_4B.dwg

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6.0 MNA ASSESSMENT OF GROUNDWATER

6.1 OVERVIEW OF THE MNA ASSESSMENT PROCESS

The purpose of this section is to present the MNA process and the investigation results of the MNA of TCE and RDX obtained in support of the FS for 600 Area groundwater. This section presents the results and discusses the potential efficacy of MNA for 600 Area Groundwater.. This MNA analysis was performed in 2008 in the initial draft FS. Subsequent to the initial regulatory review and approval of the FS, there was a request by the USEPA to complete a source investigation and vapor intrusion study. Planning and completion of the source investigation caused a delay in the finalization of this document. In order to continue monitoring the groundwater plume the Army collected additional rounds of data after 2008. This data was consistent with earlier data and in general showed decreasing trends. Based on this information the MNA analysis has not been updated with sampling data collected after 2008. Subsequent sections of this document discuss the implementation of MNA and its relationship to other remedial technologies. Under the Army policy, every installation activity under the authority of CERCLA is required to consider MNA as a remedial action alternative (U.S. Army, 1995 – DAIM-ED-R [200-1c] 12 Sep 1995). The Army defines NA as the reduction of contaminant concentrations in the environment through biological processes (aerobic and anaerobic biodegradation, plant and animal uptake), physical processes (advection, dispersion, dilution, diffusion, volatilization, sorption, and desorption), and chemical reactions (ion exchange, complexation, and abiotic transformation). NA involves the reduction of contaminant concentrations to environmentally benign levels through the mechanisms of fate and transport. MNA can be implemented as the sole remedy, or used as a polishing step following treatment or concurrent with an “active” remedy.

In general, the assessment of MNA for the chlorinated solvent plume at the 600 Area Sites follows the guidance in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (USEPA, 1998). To consider MNA as an RA, one must scientifically demonstrate that attenuation of site contaminants is occurring at rates sufficient to be protective of human health and the environment. Three lines of evidence can be used to support MNA. At a minimum, the investigator must obtain either the first two lines of evidence or the first and third lines of evidence. The lines of evidence are:

1. Historical groundwater and/or soil chemistry data may be used to demonstrate that a clear and meaningful trend of decreasing contaminant mass and/or concentration has been observed over time at appropriate monitoring or sampling points.
2. Hydrogeologic and geochemical modeling data can be used to demonstrate indirectly the type(s) of MNA processes active at the site and the rate at which such processes will reduce contaminant concentrations to required levels.
3. Data from field or microcosm studies (conducted in or with actual contaminated site media) may be used to directly demonstrate the occurrence of a particular MNA process at the site and its ability to degrade the COCs.

As described in the 1998 USEPA protocol, the assessment of MNA typically consists of a two step process, initial screening followed by a more detailed evaluation. Key steps for evaluating MNA include:

1. Review available site data and develop a preliminary conceptual model.
2. If sufficient data with appropriate quality exist, conduct a screening process.
3. If the preliminary screening results suggest that MNA may potentially occur, perform an additional site characterization.
4. Refine the conceptual model based on the site characterization data.
5. Perform analytical or numerical solute fate and transport models to estimate a site-specific MNA and biodegradation rate.
6. Identify potential receptors and exposure points and conduct an exposure pathways analysis.

7. Evaluate the need for supplemental source control measures. Additional source control may allow MNA to be a viable remedial option or decrease the time needed for natural processes to attain the RAOs.

6.2 ADEQUACY OF MNA DATA FOR TCE AND RDX IN GROUNDWATER

To support or repudiate the effectiveness of MNA as an appropriate remedial technology, MNA data were collected and assessed following the general approach advanced in the 1998 USEPA MNA Protocol (USEPA, 1998). A total of nine wells were sampled in March 2007 for bioremediation parameters, including TCE degradation products, redox parameters, and groundwater field parameters. The MNA degradation/daughter products representing complete dechlorination, redox analytes, and field parameters are listed in **Table 4-9**. Numerous peer-reviewed journal articles regarding TCE and RDX attenuation were used as technical guidance for data interpretation. TCE degradation product, electron acceptor data, and groundwater field parameter sampling results are evaluated in the following sections.

There are four general categories of data that can be used to assess the NA processes, including:

1. Parent and degradation/daughter products. Explosives can be degraded by aerobic (partially) and anaerobic process, resulting in defined degradation products. Chlorinated solvents are often destroyed by biochemical reactions that remove one chlorine atom from the "parent" or original solvent. When these breakdown products are detected in groundwater, it provides evidence that contaminant destruction is underway.
2. Concentration of electron donors. Explosives and chlorinated solvent attenuating microorganisms derive energy from redox reactions. During biodegradation, microorganisms utilize available nutrients and carbon sources for energy and cell reproduction by facilitating the transfer of electrons from donors to acceptors. This results in oxidation of the electron donor and reduction of the electron acceptor. Electron donors include natural organic carbon and petroleum hydrocarbons.
3. Concentration of terminal electron acceptors. Microorganisms will couple terminal electron accepting redox reactions that yield the greatest free energy. Therefore, certain electron acceptors will be utilized prior to others. For most groundwater systems, the order of redox reactions, from highest to lowest yielded energy, is aerobic respiration, denitrification, manganese reduction, iron reduction, sulfate reduction, and methanogenesis.
4. Groundwater quality parameters. Rapid microbial degradation of explosives and chlorinated solvents occurs only when the redox reactions are thermodynamically favorable. Water quality parameters such as pH, ORP, and alkalinity can provide information regarding the thermodynamic feasibility of anaerobic microbial degradation.

6.3 CONCENTRATION REDUCTION OF PARENT COMPOUNDS AND ACCUMULATION OF DEGRADATION/DAUGHTER PRODUCTS

The following data presentation includes all data sets collected through June 2008.

6.3.1 TCE Mass Concentration Trends and Accumulation of Daughter Products

Current and historical TCE sampling results were plotted for the AWDF well and monitoring wells 13MW-1, 13MW-2, 13MW-4, and DM13-1 to evaluate parent TCE compound concentration trends. Results are shown on **Figure 4-3**. As noted in **Section 4.2.1**, evaluation of the most recent sampling data (2004 to present) from source area and plume monitoring wells does not show a definitive concentration trend. TCE data varied significantly at key plume and source area wells over the six round sampling period, and overall concentrations may not have changed at these wells.

Cis-1,2-DCE, VC, ethane, and ethane sampling data were evaluated as potential TCE degradation products. Low concentrations of cis-1,2-DCE were detected in 8 of 68 total samples, with the corresponding detection of TCE in each sample. Trace concentrations of VC were also detected in 1 of 68 total samples. Ethene was detected in two wells during the March 2007 bioremediation sampling; however, ethane was not detected in any groundwater samples. The limited detection/distribution of cis-1,2-DCE, VC, and ethene at TCE impacted wells indicates very limited degradation. The observed

limited/incomplete degradation of TCE is consistent with the predicted slightly reducing redox conditions at most wells in the aquifer.

6.3.2 RDX Mass Concentration Trends

RDX sampling results were plotted for all wells on **Figure 4-1** to evaluate compound concentration trends. As noted in **Section 4.5.1**, the most recent sampling data (2004 to present) from source area and plume monitoring wells do not show a definitive concentration trend.

6.4 CONCENTRATION OF TERMINAL ELECTRON ACCEPTORS AND GROUNDWATER QUALITY PARAMETERS

Section 4.7 previously addressed the results of bioremediation sampling, and includes a detailed discussion about the concentration of terminal electron acceptors and groundwater quality parameters. **Section 4.7** is briefly summarized in the following sections.

6.4.1.1 Dissolved Oxygen

DO serves as the terminal electron acceptor for aerobic respiration. Aerobic degradation of organic compounds typically occurs with DO concentrations greater than 1.0 ppm, but has been reported as low as 0.5 ppm (USEPA, 1998). Six of eight wells show DO readings in excess of 1.0 µg/L, which is consistent with aerobic groundwater conditions.

6.4.1.2 Nitrogen Speciation Data

After DO has been depleted in groundwater, nitrate (NO_3^{2-}) can be used as the terminal electron acceptor for anaerobic biodegradation. Evaluation of the nitrogen NA data shows utilization/depletion of nitrate as an electron acceptor in seven of eight wells, with the corresponding accumulation of reduced ammonia. No nitrogen species were detected in the eighth well (13MW-7). This data, along with the findings of the ORP and DO data analysis, indicate slightly reduced conditions in seven of eight sampled NA wells.

6.4.1.3 Manganese Speciation Data

Under slightly reducing conditions, bacteria can use manganese in the minerals rhodochrosite, manganite and pyrolusite as electron acceptors. Manganese sampling results show utilization/depletion of Mn^{+4} in all wells, and accumulation of dissolved phase Mn^{+2}. This data is consistent with the nitrogen speciation data presented in the preceding section.

6.4.1.4 Iron Speciation Data

Ferric iron or particulate iron (Fe^{3+}) can be utilized as an electron acceptor upon depletion of oxygen, nitrate and Mn^{+4} in groundwater. Evaluation of the iron NA data shows utilization/depletion of ferric iron as an electron acceptor in three of six wells, with the corresponding accumulation of ferrous iron.

6.4.1.5 Sulfur Speciation Data

Once all of the ferric iron has been reduced, sulfate (SO_4^{2-}) can serve as the terminal electron acceptor for anaerobic biodegradation. Sulfide was detected in well 13MW-4 (2.1 µg/L), and may indicate the utilization/reduction of sulfate to sulfide at that location.

6.4.1.6 Methane

Once sulfate is depleted, CO_2 can act as an electron acceptor during anaerobic biodegradation, and is reduced to methane under strongly reducing (less than -240 mV) conditions. The detection of methane at well 13MW-4 is somewhat consistent with the low detected ORP readings (-128.4 mV) and indication of sulfate reduction in that sample.

6.4.1.7 Groundwater Quality Parameters

Redox potentials recorded during the March 2007 sampling round ranged from -128.4 mV to +216.1 mV, with the lowest ORP value reported at well 13MW-4. As shown in **Table 4-9**, the majority of measured ORP values fall within the slightly reduced category (>-100 mV to +250 mV), with well 13MW-4

categorized as 'reduced'. The ORP data is in agreement with the terminal electron acceptor data, which categorized seven of eight wells as slightly reduced. As noted in **Sections 5.2.1** and **5.3.1**, strongly reducing conditions (sulfate reduction) are required to anaerobically degrade TCE and RDX. The terminal electron acceptor and groundwater quality parameter data indicate that the 600 Area aquifer is insufficiently reduced to naturally degrade TCE and RDX.

6.5 PRINCIPLE MNA MECHANISMS IN AOC1 GROUNDWATER

As noted in **Section 4.2.1**, the plotted TCE plume is not considered stable since upgradient well 13MW-1 concentrations have declined in the last three sampling events. The downgradient well TCE concentrations and the extent of the plume have not changed during this period. TCE (and RDX) are leached into groundwater from impacted soils in AOC 1, and TCE is transported downgradient to the wetlands and mapped edge of the plume. The plume currently discharges into one wetland, where TCE is detected in surface water samples. The plume has not expanded since the onset of regular sampling in 2005, and MNA processes (and wetland TCE losses) are presumably in equilibrium with the input of TCE mass into the aquifer. There is only limited evidence of intrinsic TCE degradation in the aquifer (**Section 6.4**), which is consistent with the overall slightly reduced redox conditions found in 600 Area groundwater. Noting the exceptionally wide (sidegradient) extent of the TCE plume, the principle MNA mechanisms (for both TCE and RDX) are probably advection and dispersion, followed in importance by dilution (precipitation/seasonal wetland recharge), sorption to the aquifer matrix and volatilization. The amount of TCE mass loss via groundwater discharge to wetlands is not known, but is considered significant based on the concentration in surfaces water as well as the fact that the plume has not extended beyond the surface water features. The most recent data collected in 2010 and 2011 is consistent with and supports the conclusions reached in this section.

6.6 ESTIMATED MNA TIMEFRAMES FOR THE TCE GROUNDWATER PLUME

An important aspect of MNA is the length of time that contaminants will remain in groundwater at unacceptable levels. There are various methods used to estimate time to cleanup, each relying on a basic set of assumptions. In this case, the nature of the source is not well understood, and two conceptual source models were developed to predict plume characteristics and time to cleanup. The *Inactive Source Model* assumes an inactive or rapidly declining TCE source to the bedrock aquifer, and predicts time to cleanup based upon observed TCE concentration decreases in well(s). The *Soil Leaching Model* assumes an ongoing, but declining source of TCE to the bedrock aquifer over time, and estimates time to cleanup using predicted soil leaching rates. Each model and predicted time to cleanup is discussed in the following sections.

6.6.1 Source Area Conceptual Models

Inactive Source Model

Four rounds of groundwater TCE data collected at source area well 13MW-1 show steady concentration declines over a 15-month period. The decline is attributed to an inactive or rapidly declining source of TCE to the bedrock aquifer during that period. TCE concentrations have remained steady in downgradient plume monitoring wells during this period; however, these concentrations are also expected to decline over time with continued migration of TCE from the source area. Cleanup times were calculated from well 13MW-1 data using the time-dependant degradation rate constant method (USEPA, 2002a). In the degradation rate constant method, time and concentration data were plotted using Microsoft Excel®, and an exponential line was fitted through the points. The projected time to cleanup was determined by the 1.0 µg/L (TCE LOC) line intercept and a separate degradation rate calculation. Incorporating groundwater analytical results from the two most recent sampling rounds, the projected cleanup timeframe is 53 years, based upon the TCE attenuation rate observed at well 13MW-1. The calculation input and plot are provided in **Appendix N**.

The derived cleanup time should be applied with caution due to the relatively small data set from monitoring well 13MW-1, and absence of TCE concentration decreases in downgradient plume wells.

Declining Source (Soil Leaching) Model

In the absence of definitive groundwater data to determine time to cleanup, a more conservative soil leaching source model was run to estimate the "worst case" time to cleanup. For the purposes of this

model, the TCE source is presumed to be a thin layer of impacted soils or fill that is buried in or beneath blasted rock debris and other fill from the Building 660 site. Soil data collected during the 2012 source area investigation was used as the input data to this model. The source area is located in close proximity (within 100 ft, up/side gradient) relative to monitoring well 13MW-1. The low detected concentrations of TCE in source area groundwater (110 µg/L) suggest a small and/or diffuse source, which is expected to lose mass to groundwater via leaching. Site soil gas data supports the expectation that the source consists of a small area of soil contamination. If this conceptual model is correct, source area plume concentrations should continue to decline over time.

The model VLEACH was used to simulate leaching of the source area soils to determine a gross cleanup timeframe. Input assumptions include a 120 ft by 60 ft TCE impacted soil/fill source area of 5 ft thickness. Source soil TCE concentrations were assumed to be uniform throughout the TCE source area with a value equal to the maximum detected TCE concentration from the source area investigation (23.8 mg/kg). VLEACH model inputs and groundwater/soil time – concentration plots are provided in **Appendix N**. VLEACH simulation results indicate soil TCE concentrations will decline to the USEPA MCL-based soil screening level (applying a dilution attenuation factor of 20) in approximately 35 years.

6.6.2 Projected Cleanup Time

Projected cleanup times range from 35 to 53 years using the USEPA rate constant method and a VLEACH soil leaching model, respectively. The rate constant method derived cleanup time of 35 years is not used in the FS due to concerns about the relatively small data set at the source area well and absence of TCE concentration decreases in downgradient plume wells. However, as there is relatively good agreement between the two models, a gross cleanup time of 50 years is conservatively assumed for costing purposes.

Periodic groundwater sampling may be conducted in the 600 Area to monitor source and plume area TCE and RDX concentrations during the FS/PP and Record of Decision (ROD) review and approval process. Groundwater data would be evaluated for changes in TCE concentrations, and to delineate concentration trends if they develop.

7.0 REMEDIAL ACTION OBJECTIVES AND IDENTIFICATION OF ARARS

7.1 RAOS

Through the RI, it has been determined that a response action is necessary for PICA 58. A subsequent evaluation of potential ARARs identified the Safe Drinking Water Act (SDWA) Maximum Contaminant Level (MCLs) and the NJGWQS. As such, the response actions for groundwater will restore the groundwater to the more stringent of the two cleanup levels, MCLs or NJGWQS, thus restoring the groundwater to its beneficial use as a drinking water aquifer. The following RAOs were developed for PICA 58:

- To prevent human exposure to contaminated groundwater that would cause unacceptable risk over the duration of the response action.
- To achieve the more stringent of the MCLs or NJGWQS to restore groundwater to meet state Groundwater Quality Standards (GWQS) or risk-based cleanup goals for the identified COCs in a reasonable timeframe, thereby restoring groundwater to its beneficial use as a drinking water source.

7.2 ARARS

In July 2009, a resolution was reached between USEPA and the Army regarding differing approaches to addressing contaminated groundwater and surface water. This resolution is referred to as the “MidValley” dispute agreement. The resolution involved the recognition of the USEPA policy of returning groundwater to its beneficial use. The Army agreed to recognize promulgated groundwater criteria as ARARs even when sites have excess risk levels less than $1x10^{-4}$ for exposure to groundwater. Surface water was a secondary issue for which the Army agreed to monitor surface water but not recognize surface water criteria as ARARs without an unacceptable risk from surface water. Based on this resolution, a response action is necessary for 600 Area groundwater because concentrations of TCE in groundwater are greater than promulgate standards. The agreed upon approach developed as part of the MidValley resolution has been used in this document.

Based on the decision to take a response action for groundwater, an ARARs analysis was conducted in accordance with 40 CFR 300.400(g). ARARs that address 600 Area groundwater are identified in this section. Identification of ARARs is an integral part of the remediation process mandated under Section 121 (d) of CERCLA, as amended by SARA. ARARs are used to develop remedial action cleanup levels, determine the appropriate extent of site cleanup, and govern implementation and operation of the selected remedial action. The preamble of CERCLA states the purpose of the law is "to provide for liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive hazardous waste disposal sites." Remedial actions that “clean up” hazardous substances at CERLCA sites must comply with state and federal standards and criteria that are legally applicable to the substance, pollutant, or contaminant; or that are relevant and appropriate under the circumstances (42 U.S.C. 9621(d)(2)(A)). Furthermore, the more stringent ARAR identified may be applicable (40 CFR 300.5). "More stringent" also include those state laws or programs that have no federal counterpart as "they add to the Federal law requirements that are specific to the environmental conditions in the State" (USEPA, 1989). State requirements, however, must be adopted by formal means (i.e., promulgated) and applied universally throughout the state (i.e., not just to Superfund sites, but to all circumstances addressed in the requirement) (42 U.S.C. 9621(d)(2)(C)(iii)(I)).

7.2.1 ARAR Classification Requirements

In order to be classified as an ARAR, the NCP states that federal and/or state laws must meet one of the following two requirements: (1) applicability or (2) relevance and appropriateness. “Applicable” requirements are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site" (40 CFR 300.5). “Relevant and appropriate” requirements are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other

circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site" (40 CFR 300.5).

Once a federal or state law has been classified as applicable or relevant and appropriate, its requirements must be distinguished between substantive and administrative. “Substantive” requirements are “those requirements that pertain directly to actions or conditions in the environment.” “Administrative” requirements are “those mechanisms that facilitate the implementation of the substantive requirements of a statute or regulation.” Compliance with administrative requirements is not mandated for on-site actions (USEPA, 1988a). For example, CERCLA specifically exempts on-site actions from federal, state, and local permitting requirements (42 U.S.C. 9621(e)(1)).

In addition, the NCP identifies a third category, termed “information to be considered” (TBC). TBCs are guidelines or advisories that are issued by the federal or state government, but which are neither legally binding nor promulgated USEPA, 1988a). However, these guidelines may be used when they are necessary to ensure protection of public health and the environment (USEPA, 1988a). If ARARs do not address a particular circumstance at a CERCLA site, then TBCs can be used to establish remedial guidelines or targets. Even when TBCs are used, the requirements imposed on the remedy, including cost-effectiveness, still apply (55 Fed. Reg. 8745, March 8, 1990).

7.2.2 Types of ARARs

Selection of ARARs is dependent on the hazardous substances present at the site, site characteristics, the site location, and the actions selected to remediate the site. Thus, requirements may be chemical-, location-, or action-specific. These categories are not always mutually exclusive and there may be some conceptual overlapping.

Chemical-specific ARARs are generally health- or risk-based concentration (RBC) values set for specific hazardous substances or other contaminants potentially found in environmental media. Chemical-specific ARARs provide protective SCLs or a basis for calculating cleanup levels for chemicals of concern in the designated media. Chemical-specific ARARs are also used to determine treatment and disposal requirements for a particular remedial activity and to assess the effectiveness of an RA. In the event that a chemical has more than one ARAR, the most stringent is applied.

Location-specific ARARs are made up of restrictions or requirements for substances or activities based primarily on their specific physical location (USEPA, 1988a). An RA may be restricted or precluded based on federal, state, or facility siting laws that address things such as proximity to wetlands, flood plains, or man-made features (such as existing landfills, disposal areas, and local historic buildings). Location-specific ARARs provide a basis for assessing restrictions during the formulation and evaluation of potential site-specific remedies.

Action-specific ARARs are generally technology or activity-based requirements on actions taken with respect to cleanup of hazardous substances at a site. These requirements are triggered by the particular activities that are selected to accomplish a remedy. Thus, action-specific requirements do not in themselves determine the RA; rather, they indicate how a selected alternative must be achieved.

7.2.3 Chemical-Specific ARARs and TBC Guidance

Findings from the 600 Area Study have identified contaminated groundwater. Chemical-specific ARARs and TBCs for groundwater are developed for COPCs within this section.

Two jurisdictions, federal and state, can enact laws to protect human health and the environment. Localities (such as municipal governments) as well as facilities do not enact laws but usually govern by ordinances. CERCLA 121(d)(2)(A)(ii) discusses the consideration of environmental law or facility siting law; however, both are in the context of state laws which are more stringent. CERCLA, the mechanism under which remediation at this site is conducted, defines the role and importance of federal and state laws. Section 121 of CERCLA specifies that remedial actions for cleanup of hazardous substances must comply with requirements or standards under federal or more stringent state environmental laws that are applicable or relevant and appropriate to hazardous substances or particular circumstances at the site.

Chemical-specific ARARs for groundwater are highly dependent upon the use or potential use of the groundwater as a resource. The USEPA has a programmatic expectation at NPL sites that a

groundwater response action will return groundwater to its beneficial use within a reasonable period of time (USEPA, 1988a). Both the state and federal governments recognize the groundwater underlying the 600 Area as being Class IIA groundwater. The primary designated use of Class IIA groundwater is potable water and/or conversion of this groundwater through conventional water supply treatment, mixing, or other similar techniques to potable water, to the extent these uses are viable (New Jersey Administrative Code [NJAC] 7:9-6.5(c)). Class IIA secondary uses includes agricultural and industrial water.

The federal and state governments have promulgated standards, requirements, criteria, and/or limitations that are applicable or relevant and appropriate for 600 Area site groundwater. Federal ARARs have been promulgated in the SDWA, while the states ARARs have been promulgated in the New Jersey SDWA and the NJGWQS. These laws; any promulgated standard requirement, criteria, or limitation under the laws; and the ARAR status of standard requirement, criteria, or limitation are provided in **Table 7-1** and are discussed below.

In absence of federal or state-promulgated ARARs, TBC guidance can be used to provide a comprehensive list of comparison criteria. TBC guidance that will be used for the 600 Area FS are the federal lifetime drinking water Health Advisories (HA) and USEPA Region 3 RBCs. Federal lifetime drinking water HA are concentrations of chemicals in drinking water that are not expected to cause any adverse non-carcinogenic effects over a lifetime of exposure, with a margin of safety (USEPA, 1996). Region 3 RBCs combine toxicity factors with standard exposure scenarios to calculate chemical concentrations corresponding to fixed levels of risk – a Hazard Quotient of 1 or a lifetime cancer risk of 1E-6, whichever occurs at a lower concentration. These values have not been promulgated and will be considered only as TBC guidance in absence of ARAR values for a specific compound. The TBC criteria associated with each COPC along with promulgated criteria are presented in **Table 7-2**.

7.2.3.1 Federal Groundwater ARARs

The federal SDWA contains several lists of criteria including MCLs and maximum contaminant level goals (MCLGs). MCLs are enforceable standards that take into consideration human health effects, available treatment technologies, and costs of treatment. Generally, MCLGs are health-based criteria that are lower than the corresponding constituent's MCL criteria.

Pursuant to SDWA, MCLs are applicable "at the tap" for public water systems that have at least 15 service connections or that serve an average of at least 25 people daily for at least 60 days a year. The AWDF well has one connection and serves less than 10 people. MCLGs, though not enforceable under the SDWA, are specifically referenced within Section 121 of CERCLA. Section 121 specifically states that remedial actions shall attain MCLGs where such goals or criteria are relevant and appropriate. Section 121 goes on to state that in determining whether or not any water quality criteria under the SDWA is relevant and appropriate, designated or potential use of the groundwater must be considered. Because the designated use of Class IIA groundwater includes drinking water that will affect human health, MCLGs are ARARs. However, Section 300.430e(2)(i)(B) and (C) of the CFR states that MCLGs, established under the SDWA, which are set at levels above zero, shall be attained by remedial actions for ground or surface waters that are current or potential sources of drinking water. Therefore, only MCLs and non-zero MCLGs will be considered ARARs. The federal ARARs for each constituent detected that exceeded the LOC are presented in **Table 7-2**.

In addition, an HHRA was performed for the 600 Area groundwater. HHCOPCs identified in the risk assessment included 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, cis-1,2-DCE, acetonitrile, MTBE, RDX, PCE, TCE, and VC. The HHRA identified TCE as the primary risk driver.

7.2.3.2 State Groundwater ARARs

New Jersey has incorporated by reference the federal MCLs (NJAC 7:10-5.0 through 5.4). The New Jersey MCLs apply to public water systems and are identical to the SDWA MCLs except for more stringent MCLs for VOCs (NJAC 7:10-5.2(a)(4)). Like the federal MCLs, New Jersey MCLs are potentially relevant and appropriate for a Class II A water source.

Additionally, the state has promulgated GWQS (NJAC 7:9C). The purpose of GWQS are to protect groundwater quality through the establishment of constituent standards (NJAC 7:9C). GWQS

consist of two lists of criteria. The first list, referred to within this FS as "quality criteria," is generally composed of contaminant concentrations that are protective of human health and the environment. These values are health-based criteria that have been developed to protect public health without consideration of analytical feasibility, treatability, or cost. The second list is composed of PQLs. New Jersey PQLs are the lowest levels of a specified substance that can be reliably measured within specified limits of precision and accuracy during routine laboratory operations. The overall standard for any contaminant is the higher of that contaminant's quality criterion or PQL. GWQS are applicable for the development of groundwater protection standards pursuant to the National Pollutant Discharge Elimination System; groundwater cleanup standards and compliance levels beyond the boundaries of a contaminated site pursuant to applicable regulatory programs; and other requirements and regulatory actions applicable to discharges.

The New Jersey Technical Requirements for Site Remediation provide substantive cleanup levels or levels of control by requiring that remedial actions shall "comply with all applicable remediation standards in effect at the time the remedial action work plan is approved by the Department . . ." (NJAC 7:26E-6.1(b)(2)). "Applicable remediation standards" are defined to include the GWQS at NJAC 7:9C. These standards are promulgated and enforceable, thus qualify as ARARs.

In addition to the stated factors in the NCP to be evaluated in making the relevant and appropriate determination, USEPA has also stated an additional consideration in the relevant and appropriate determination: whether or not another requirement is available that more fully matches the circumstances at the site (CERCLA Compliance with Other Laws Manual, Draft Guidance, USEPA, Office of Solid Waste and Emergency Response [OSWER] Directive 9234.1-01, page 1-67, August 8, 1988; NCP Preamble, 55 FR 8666, 8754, March 8, 1990). The groundwater standards promulgated by New Jersey specifically address groundwater remediation. In addition, instead of the MCL, which applies to the level of drinking water at the tap by public water supplies, the state groundwater regulations have been promulgated to address the level of quality of groundwater in the aquifer. The New Jersey regulations have also taken into account the long-term issues with groundwater remediation by providing the mechanism of the CEA which is in place at PTA. Where a state has promulgated applicable groundwater requirements that directly address the groundwater or remediation of contaminated groundwater, and in the case of PTA where a state has promulgated applicable groundwater requirements that directly address the groundwater or remediation of contaminated groundwater, and in the case of PTA where such regulations (by use of the existing CEA) have been integrated into the groundwater remediation strategy, the existence of such regulations can be a basis to determine the MCLGs/MCLs as relevant but not appropriate. In this circumstance, the state groundwater regulations would more directly address the circumstances at the site rather than the MCLs that do not directly address the groundwater or incorporate any of the issues and barriers present at groundwater remediation sites. Therefore, the federal and state MCLs would not be relevant or appropriate to the site and thus, not ARAR. When an ARAR has been identified, there is no need to further evaluate TBCs. Thus, the chemical-specific ARAR for 600 Area groundwater has been focused on New Jersey groundwater quality criteria. To aid the review of this issue, **Table 7-2** provides the MCL, MCLG, New Jersey Maximum Contaminant Limit (NJMCL), NJGWQC, New Jersey Practical Quantitation Limit (NJPQL), Federal Drinking Water HA, and USEPA Region 3 RBC values for comparison.

7.2.4 Surface Water

No unacceptable human health or ecological risk has been identified associated with exposure to 600 Area surface water. Therefore, there are no chemical-specific surface water ARARs associated with the 600 Area. This approach is consistent with the resolution reached as part of the MidValley dispute resolution which is discussed in greater detail in Section 7.2. USEPA guidance (ARAR Q's & A's: Compliance with Federal Water Quality Criteria, page 3, USEPA, OSWER Publication 9234.2-09/FS, June 1990) requires all groundwater actions to be designed in such a way that they do not allow surface water exceedance due to the discharge of contaminated groundwater to surface water. It should be noted that attainment of the RAOs established for groundwater will prevent the discharge of contaminants in groundwater to surface water at concentrations above federal and state promulgated standards.

Federal and state promulgated standards exist for 600 Area surface water. Promulgated criteria for surface water are highly dependent upon the use or potential use of the surface water as a resource.

Accordingly, surface waters throughout the state of New Jersey have been assigned use designations. The small intermittent streams exiting each of the 600 Area wetlands flow into Picatinny Lake, which is classified as a Fresh Water 2 – Non-Trout (FW-NT) surface water (7:9B-1.15). The designated uses of FW2 surface waters as defined in NJAC 7:9B-1.12 (c) are as follows:

- Maintenance, migration, and propagation of the natural and established biota.
- Primary and secondary contact recreation.
- Industrial and agricultural water supply.
- Public potable water supply after such treatment as required by law or regulation.
- Any other reasonable uses.

The two 600 Area tributaries are in turn classified Fresh Water 2 – Trout Producing, Category 1 waters (FW-TP(C1)), reflecting the classification of the Green Pond Brook segment upstream from Picatinny Lake. The streams are designated category 1 (C1) because the ”waterway or water body of interest flows through or is entirely located within State parks, forests or fish and game lands, Federal wildlife refuges, or other special holdings”.

Federal criteria have been promulgated in the Clean Water Act (CWA) (42USC§9621(d)(2)(A)(ii)]) while the state criteria have been promulgated in the New Jersey SWQS (7:9B).

7.2.5 Location-Specific ARARs and TBC Guidance

Remedial action alternatives may be restricted or precluded by federal, state, and U.S. Army regulations based on their location within a site. Location-specific ARARs are designed to protect the local area from potentially damaging remedial actions. For example, altering habitat of an endangered species to construct a treatment facility may jeopardize the survivability of the species. The converse is also true; location-specific ARARs protect RAs from the environment. For example, locating a treatment facility within a flood plain without proper engineering precautions may result in structural damage during a flood. **Table 7-3** identifies the federal, state, and U.S. Army regulations that contain promulgated standards, requirements, criteria, or limitations that will be considered ARARs for this FS. Within the table, location-specific ARAR “requirements” are grouped by site characteristics that have been observed within the 600 study area or characteristics that are likely to be encountered in the study area. The promulgated standards and requirements and the impact each location-specific ARAR will have, if encountered, are also identified within **Table 7-3**.

7.2.5.1 Non-Applicable ARARs

The following location-specific ARARs were considered, but found to be not applicable or relevant and appropriate because these location-specific features are not present in or do not affect the 600 Area.:

- Faults
- Wilderness Areas
- Wildlife Resources and Refuges
- Scenic Rivers
- Farmlands
- Coastal Zones
- Flood Plains
- Endangered Species Act
- Fish and Wildlife Coordination Act

7.2.6 Action-Specific ARARs and TBC Guidance

Action-specific ARARs are promulgated state or federal laws that set controls or restrictions on activities related to the management of hazardous materials. Within **Section 9.0** of this FS, several RAs for the 600 study area are developed. Each of the RAs, except No Action, will require several "actions" to transpire in the course of successfully instituting the alternative and may be controlled or restricted by action-specific ARARs. Site activities associated with MEC removal (Alternatives 5 and 6) would include the transportation and disposal of MEC and MD and on-site soil-moving activities. The action-specific ARARs and TBCs are organized by the associated actions and presented in **Table 7-4**. ARARs listed in **Table 7-4** generally apply to RAs involving remediation of COCs through excavation and disposal, *in situ* treatment, MNA, and institutional controls (ICs).

By definition, ARARs pertain to on-site actions subject to promulgated state or federal laws. Legal requirements governing off-site actions, such as those pertaining to labeling and transportation of solid and/or hazardous waste do not qualify as ARARs; however, they are applicable requirements outside of the CERCLA ARARs process that must be met. Such requirements would be applicable to the transporter but would apply outside of the ARARs context. Off-site actions must comply with all applicable requirements. Such requirements would include:

- NJDEP – Division of Waste Management: NJAC 7:26 Subchapter 3, which requires that solid waste (investigation-derived waste) for off-site transportation, must obtain proper written approval from the state prior to transporting the waste. Once approved, the transporting vehicle has to be properly registered to handle the waste with appropriate placard.
- Resource Conservation and Recovery Act (RCRA) – Solid/Hazardous Waste Regulations: 40 CFR 262, Subparts A, B, C, and D and 40 CFR 263, Subparts A, B, and C; Directive #9330.2-07,49; and NJAC 7:26G-7 require vehicles transporting hazardous waste to be properly registered to handle and transport the waste to a regulated facility. In addition, waste must be properly packed and accompanied by proper emergency response spill procedures and manifests.
- U.S. Department of Transportation Hazardous Materials Transportation Regulations, 49 CFR 171-180 establishes classification, packaging, and labeling requirements for shipments of hazardous materials.

There are also several DoD directives that are to be considered when dealing with munitions. These include DoD 6055.9-STD, DoD Ammunition and Explosives Safety Standards (DoD, 2008a); DoD Directive 4140.62, Management and Disposition of Material Potentially Presenting an Explosive Hazard (DoD, 2008b); Engineer Manual (EM) 1110-1-4009, Military Munitions Response Actions (USACE, 2007); EM 385-1-97, Explosives Safety and Health Requirements (USACE, 2008); and Engineer Pamphlet (EP) 1110-1-18, Ordnance and Explosives Response (USACE, 2006).

Table 7-1
Chemical Specific Groundwater Criteria

Chemical	Laws/Regulations	Requirement(s)	ARAR or TBC?
See **Table 7-2** for specific chemicals	Safe Drinking Water Act (SDWA)--Maximum Contaminant Levels (MCLs), 40 CFR 141.60 through 141.62	MCLs have been promulgated and regulate contaminants in public drinking water.	ARAR
	New Jersey Safe Drinking Water Act--State MCLs, NJAC 7:10-5.0 through 5.4	MCLs have been promulgated by the state and regulate contaminants in public drinking water.	ARAR
	New Jersey Groundwater Quality Standards, NJAC 7:9C-1.5 through 1.9 and Table 1	Groundwater quality standards have been promulgated and regulate contaminants in groundwater.	ARAR
	SDWA--Maximum Contaminant Level Goals (MCLGs), 40CFR 141.50 through 141.51	Promulgated health-based criteria for drinking water sources.	ARAR
	EPA Office of Drinking Water Health Advisories	Non promulgated advisories that estimate risk due to consumption of contaminated drinking water/groundwater.	TBC
	EPA Region 3 Risk-Based Concentrations	Non-promulgated concentrations that estimate risk due to standard lifetime exposure scenarios.	TBC

Table 7-2
ARARs and Other Guidance to Be Considered for 600 Area Groundwater

Criteria Based Compounds of Potential Concern (CCOPC) and Human Health Compounds of Potential Concern (HHCOPC)	Promulgated Standards (µg/L)					Non-Promulgated Standards (µg/L)			
	Federal Drinking Water Standards (b)		New Jersey Drinking Water	New Jersey Groundwater (c)		Federal Drinking Water Health Advisories (b)	USEPA Region III Tap Water RBCs (d)		
Chemical	MCL	MCLG	NJMCL	Quality Criteria	NJPQL	HA	Non-carcinogen	Carcinogen 1x10-6	C/N
Volatiles									
Acetonitrile (HHCOPC)	---	---	---	---	---	---	120	---	N
cis-1,2-Dichloroethene (i) (HHCOPC)	70	70	---	70	1	70	55	---	N
Methyl tert-Butyl ether (CCOPC &HHCOPC)	---	---	70	70	1	---	---	2.6	C
Methlyne Chloride (CCOPC)	5	0	3	3	1	---	---	4.1	C
Tetrachloroethene (CCOPC & HHCOPC)	5	0	1	0.4	1	10	---	0.1	C
Trichloroethene (CCOPC & HHCOPC)	5	0	1	1	1	---	---	0.026	C
Vinyl chloride (HHCOPC)	2	0	---	0.08	1	---	---	0.015	C
Explosives									
2,4-Dinitrotoluene (z) (HHCOPC)	---	---	---	0.05	10	---	73	---	N
RDX (aq) (CCOPC & HHCOPC)	---	---	---	0.3	0.5	2	---	0.61	C
2,4,6-Trinitrotoluene (aq) (HHCOPC)	---	---	---	1.2	---	2	---	2	C

ARAR = Applicable or Relevant and Appropriate Requirement
C/N = Carcinogenic or noncarcinogenic according to USEPA (2003).
HA = Health Advisory
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
--- = No value available.
NJMCL = New Jersey Maximum Contaminant Level (2002)
PQL = Practical Quantitation Limit
TBC = To Be Considered
RBC = Risk Based Concentration

(b) USEPA Drinking Water Standards and Health Advisories (Winter 2004) Publication #EPA 822-R-04-005.
(c) NJDEP (2005).
(d) USEPA (2006). Residential exposure based on ingestion of tap water and inhalation while showering for 350 days. A hazard index of 1 was used for noncarcinogenic RBCs.
(i) The RBC value for 1,2-dichloroethene (total) was used.
(z) The value for 2,4-dinitrotoluene and 2,6-dinitrotoluene mixture was used for the QC and the PQL values.
(aq) The NJ Groundwater Quality Criteria values are Interim Specific Criterion

Table 7-3
Location-Specific ARARs and TBCs

Location	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
Wetlands	Clean Water Act Section 402 40 CFR 320.4 and pertinent substantive provisions of NJAC 7:7A (the Freshwater Wetlands Protection Act, P.L. 1987)	To the extent possible, action must be taken to avoid degradation or destruction of wetlands. Discharges for which there are practicable alternatives with less adverse impacts or those that would cause or contribute to significant degradation are prohibited. If adverse impacts are unavoidable, action must be taken to enhance, restore, or create alternative wetlands.	ARAR – Applicable to the substantive requirements if clearing or drilling activities encroach on wetlands or wetland transition zones. As shown on Figure 3-2, there are multiple wetland areas within the 600 Area Boundary (source Picatinny GIS database). Refer to Figure 3-2 for a presentation of wetland areas.

Table 7-4
Action-Specific ARARs and TBCs

Action	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
Generation of Hazardous Wastes and Solid Wastes	RCRA methods for identification and evaluation of solid and hazardous wastes - 40 CFR 262.11 - NJAC 7:26G-6.1 (incorporated by reference)	Specific requirements for identifying hazardous wastes and solid wastes. Requirement is substantive because it defines the levels to be utilized in determining whether or not a waste is a hazardous waste.	ARAR – Applicable to remedial alternatives utilizing in situ groundwater remediation and soil excavation, which may generate hazardous and solid waste. Generation of purge water, drill cuttings, contaminated soil, and other waste generated during remedial activity may be characterized as hazardous waste. Generation of scrap metal, soil or other IDW determined to be non-hazardous, and other waste generated during remedial activity may be characterized as solid waste.
Installation Of Wells	NJDEP Field Sampling Procedures Manual, August 2005	State guidance and general industry procedures for installation of extraction wells/monitoring wells are identified. Requirement is substantive because guidelines help ensure that groundwater samples collected from these wells are representative of groundwater in the aquifer	TBC – Guidelines for installation of monitoring and extraction wells which will be performed for all remedial alternatives with the exception of No Action.
	General Construction Requirements for all wells NJAC 7:9D-2.2 NJAC 7:9D-2.9, 2.10 and 3.1	Describes the construction specifications for the installation of wells. Describes the requirements for the abandonment of wells Requirement is substantive because it specifies the standard to which wells must be constructed and abandoned to ensure the protectiveness	ARAR – Applicable to groundwater injection wells and groundwater monitoring well installation and abandonment.

Table 7-4
Action-Specific ARARs and TBCs

Action	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
General Remediation and Institutional Controls	Technical Requirements for Site Remediation NJAC 7:26E-5.1(d)3	Specifies that remediation must not cause an uncontrolled discharge or transfer of contaminants to another media. Requirement is substantive because it specified a standard of control for onsite remedial action.	ARAR - Relevant and appropriate for on-site remediation activities. Relevant and appropriate for all remedial actions except No Action.
	NJAC 7:26E-5.1(e)	Requires that remediation must remove free product and residual product to the extent practicable, or contain free product and residual product when treatment or removal is not practicable. Prohibits monitored natural attenuation of residual product. Requirement is substantive because it provides a standard of control related to protectiveness of the onsite action.	ARAR - Although no free product or residual product has been identified at the site, this requirement is applicable in the event free product or residual product is identified during the response action.

Action	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
	Technical Requirements for Site Remediation NJAC 7:14A 7.5(c) 1 and 2	Requirements New Jersey Pollution Discharge Elimination System Permit-by-Rule for discharge to groundwater during remedial activities Specifies that the permit by rule is invalidated if the discharge is likely to contravene the ground water quality standards at N.J.A.C. 7:9C ; or The discharge may result in violation of the Surface Water Quality Standards at N.J.A.C. 7:9B Requirement is substantive because it specifies a level to ensure protectiveness of the onsite remedy.	ARAR – Relevant and appropriate to the substantive requirements for Permit-by-Rule for on-site remediation activities utilizing in situ groundwater treatment and groundwater monitoring well installation.
	Technical Requirements for Site Remediation NJAC 7:26E 1.5(h)(ii)	Excavated soil or drill cuttings may be returned to the original location provided neither free product nor residual product is present. Requirement is substantive because it provides a standard of control related to protectiveness of the onsite action.	ARAR – Applicable to drilling of monitoring wells and injection/recovery wells. Although no free product or residual product has been identified at the site, this requirement is applicable in the event free product or residual product is identified during the response action.

Action	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
	Technical Requirements for Site Remediation NJAC 7:26E 5.2 (b) through (f)	Specifies the requirements for using alternative fill from an onsite or offsite source for backfilling excavations. Specifies the requirements for utilizing clean fill for backfilling excavations. Requirement is substantive because it dictates levels for soil allowable to be utilized as backfill.	ARAR – Applicable to the excavation alternative which will utilize backfill.
Munitions and Explosives of Concern Removal	RCRA, Subpart M (Military Munitions Rule). 40 CFR 266.200 through 206	Relevant portions relate to the management of MEC that is recovered, including characterization as hazardous waste and requirements for treatment, storage, and transportation. The Rule provides for the storage and transportation of recovered military munitions in accordance with DoD Explosives Safety Board (DDESB) standards. New Jersey has adapted the Federal Military Munitions Rule. Therefore, munitions handling and disposal are addressed under the Federal Military Munitions Rule.	ARAR – Applicable to the management of MEC recovered during remedial action

Action	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
	DoD Directives, Manuals and Guidance: • DoD 6055.9-STD, DoD Ammunition and Explosives Safety Standards (DoD, 2008a); • DoD Directive 4140.62, Management and Disposition of Material Potentially Presenting an Explosive Hazard (DoD, 2008b); • Engineer Manual (EM) 1110-1-4009, Military Munitions Response Actions (USACE, 2007); • EM 385-1-97, Explosives Safety and Health Requirements (USACE, 2008); and • Engineer Pamphlet (EP) 1110-1-18, Ordnance and Explosives Response (USACE, 2006).	Substantive requirements for the investigation, handling, management and disposal of MEC.	TBC – Guidelines for the performance of MEC clearance and disposal
Discharge of Aqueous Waste to Surface Water	CWA Effluent Guidelines 40 CFR 401.12, 13, 15, 16, 17 40 CFR 122 and 125	Provides requirements for point source discharges of pollutants. Requirement is substantive because it specifies the level or standard of control for potential discharge of storm water resulting from remedial activities.	ARAR – Applicable for discharge of storm water that may result from on-site in situ and/or clearing activities and the discharge of treated wash water to the drainage ditch or wetlands. Provisions have been delegated to the State of New Jersey which has been authorized to administer and enforce the requirements (or more stringent requirements).
	New Jersey Water Pollution Control Act – New Jersey Pollutant Discharge Elimination System (NJPDES) (NJAC 7:14A- 6, 11, 12, 13, 14	Discharge of pollutants to surface water and groundwater from remediation sites is regulated via NJPDES requirements. Substantive requirements include effluent limitations, water quality based limitations, monitoring, and monitoring techniques.	ARAR – Applicable to the substantive requirements of the program for storm water and purge water discharges to surface water features.

Action	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
Stream/Wetland Encroachment	40 CFR 320.4 Flood Hazard Area Control (NJAC 7:13-1.1 et seq.) Freshwater Wetland Protection Act Rules (NJAC 7:7A-5.4 and 7:7A-4.3) All the regulations correlate with location specific requirements.	Provide requirements for the following activities: - Development or disturbances in floodplain and wetland area - Stream encroachment - Soil erosion and sediment control Requires minimum disturbance to freshwater wetlands, transition areas, and State open waters; and requires mitigation for disturbances of wetlands and open waters as a result of cleanup activities. Specifies location restrictions and protection of natural resources, public water supply intakes, threatened or endangered species habitat, historic places, vernal habitat; time period restrictions for waters with fishery resources; and applicability of stormwater management rules.	ARAR – Applicable to the substantive requirements of the regulation for remediation activities, including site clearance, drilling and excavation. Applicable to all remedies with the exception of No Action.
Groundwater Injection	New Jersey Water Pollution Control Act – New Jersey Pollutant Discharge Elimination System (NJPDES) (NJAC 7:14A-7 and 8)	Provides requirements for the discharge of wastes or other fluids (i.e., treated groundwater, treatment media) to groundwater as either a point or nonpoint discharge to groundwater to protect underground sources of groundwater/drinking water.	ARAR – Applicable if a treatment fluid is injected into groundwater. Requires a groundwater protection and monitoring program including engineering design, groundwater modeling, and long-term monitoring.

Action	Law/Regulation	Requirement of Law/Regulation	ARAR/TBC Status
Packaging, Labeling and Storage	RCRA Hazardous Waste Generation 40 CFR 262, Subpart C. NJAC 7:26G-6	Specifies requirements for hazardous waste Pre-Transport Requirements (packaging, labeling, marking).	ARAR – Potentially applicable to on-site requirements related to the off-site transportation of hazardous waste (off-site requirements are legally applicable but are not ARAR as they apply outside of the CERCLA process). Potentially applicable to in situ treatment alternatives which may generate hazardous waste.

8.0 IDENTIFICATION OF CONTAMINANTS OF CONCERN, SITE CLEANUP LEVELS, AND AREAS OF ATTAINMENT

This section describes the determination of COCs, SCLs, and AAs for groundwater within the 600 study area. Previous sections of this report have identified lists of potential COCs, as follows:

- Criteria-based contaminants of potential concern (CCOPCs) were identified by screening all monitoring well groundwater data against LOCs. Results of this screening process are included in **Section 4.2 and 4.7** and summarized in **Tables 4-1** and **4-2**.
- HHCOPCs were identified as potential risks in the HHRA. Results of the HHRA performed for 600 Area groundwater data are summarized in **Section 4.12**.

A COC is defined as a contaminant that poses significant human health and/or ecological risks at a particular site. The SCL is a level, determined based on the evaluation of ARARs and the potential risks posed to human health and ecological receptors, which is used to achieve the RAOs for a particular site. Lastly, an AA is defined as the area over which RAOs are to be obtained. Cleanup levels should be achieved throughout the AA.

COCs are addressed within this section for the media covered within this FS (i.e., groundwater). The starting point for the development of the list of COCs is the entire list of contaminants that were detected in samples collected from the 600 study area. These contaminants are listed in **Tables 4-2** and **4-4**. In these tables, the entire list of detected chemicals is presented along with a summary of detected concentrations and comparison with the appropriate LOC for the PTA Restoration Program. These lists of compounds were also screened using the results of the HHRA and, where available, chemical-specific ARARs. The constituents identified as a human health risk or those that exceed chemical-specific TBCs, are presented in **Table 7-2**.

8.1 GROUNDWATER

This section describes the process used in the identification of COCs, SCLs, and AAs in groundwater for the 600 Area region.

8.1.1 Groundwater COCs

This section identifies groundwater COC(s) in the 600 Area. The screening method used in this FS to determine the COC(s) is as follows:

1. Contaminants that exceed their corresponding LOCs are considered as CCOPCs. **Section 4.9** presents the comprehensive lists of CCOPCs developed for the 600 Area.
2. The list of COPCs was enhanced by the addition of all compounds which were identified as HHCOPCs. **Section 4.10** presents the comprehensive list of HHCOPCs developed for 600 Area groundwater.
3. The list of groundwater CCOPCs and HHCOPCs is then used in ARAR determinations. **Table 7-2** presents the determination of ARAR levels for the COPCs in the groundwater for the 600 Area.
4. If the maximum concentration of the COPC exceeds the ARAR level, the COPC is evaluated further.
5. The next step is to determine whether contaminant distribution is indicative of a contaminant plume. Contaminants that were sporadically detected and not confirmed in adjacent or subsequent samples were also eliminated via this criterion.
6. The final step is to screen the remaining compounds versus those that were identified as risk drivers as a result of the HHRA. All COPCs passing this step are considered as COCs.

Table 8-1 details the implementation of this refinement process that identifies TCE as the principle groundwater COC. It should also be noted that while RDX was screened out as a COC in this document, additional data and analysis of RDX in the 600 area was conducted in a separate investigation which further supports this decision. While all groundwater data for the 600 Area is included in this

document, the Army handled RDX as a separate issue. In order to determine the potential for a source of RDX to 600 area all groundwater data was analyzed, additional soil sampling was performed within Site 11 along with surface water/sediment data. The results of this investigation along with a recommendation for no further action were presented in the *Picatinny Arsenal Task Order 17 600 Area RDX Investigation Data Report* (Shaw, 2009). The NJDEP and USEPA approved the data report and agreed with this recommendation.

8.1.2 SCLs for Groundwater

The more stringent of the Federal MCL and NJDEP GWQS ARAR concentration for TCE will be used as an SCL within each AA. The plume will be addressed by the proposed remedy until such time that it is demonstrated through the use of an exit strategy that the RAOs have been met. The point of compliance for the groundwater SCL will be groundwater extracted from monitoring wells located within the AA. A groundwater SCL was identified only for contaminants that are considered as COCs. The applicable SCL for TCE is 1.0 µg/L.

8.1.3 Groundwater AAs

An AA is defined as the area over which RAOs are to be obtained. The AA was established by reviewing all site data and drawing a buffer around all cleanup criteria exceedances taking into account surface water discharge points. Cleanup levels should be achieved throughout the AA. The AA for groundwater is depicted on **Figure 8-1**. The only AA, AA1 addresses TCE in groundwater and surface water.

8.1.4 Restoration Timeframe

The restoration timeframe is the time required to lower COC concentrations to or below SCLs throughout each AA. The choice of a remedial technology often controls the duration of the restoration timeframe. For example, a technology that relies heavily upon rapid mass transfer, such as pump and treat, implemented within a clay aquifer would have an extensive restoration timeframe. Thus, factors that affect the choice of remedial technologies in turn affect the restoration timeframe.

Consequently, the following factors should be examined while evaluating remedial time constraints:

- Technical limits to extracting contaminants.
- Necessity of providing an alternative potable water supply.
- The potential use and value of the groundwater as a resource.
- The effectiveness and reliability of ICs.
- The ability to monitor and control contaminant movement.

The factors above were derived from USEPA guidance (USEPA, 1988a). The remainder of this section discusses each factor as it relates to 600 Area groundwater.

8.1.4.1 Technical Limits to Extracting Contaminants

Site characteristics that limit the technical practicability of technologies will impact the restoration timeframe. In the particular case of the contaminated groundwater within the 600 Area, the largest technical obstacles are related to extracting contaminants from the aquifer material. Contaminant extraction will be difficult since the contaminant mass resides within fractured bedrock. **Section 3.0** describes the physical characteristics of the groundwater aquifers in more detail.

8.1.4.2 Necessity of Providing an Alternative Potable Water Supply

Until recently, PTA extracted groundwater from the 600 Area for non-potable use in the AWDF. The AWDF non-potable water treatment system was capable of removing the TCE prior to distribution. Currently, the AWDF is off line and the 600 Area facilities have been connected to the base water supply. Additional information on the AWDF's non-potable supply is available within **Section 2.2.4**. Consequently, it is not necessary to provide an alternative non-potable water supply due to 600 Area

groundwater contamination. Therefore, the status of the potable water supply does not necessitate a rapid restoration timeframe.

8.1.4.3 The Potential Use and Value of the Groundwater as a Resource

The groundwater underlying part of the 600 Area is recognized by both the state and federal governments as being Class IIA. The primary designated use of Class IIA groundwater is "potable water and conversion (through conventional water supply treatment, mixing, or other similar technique) to potable water" (N.J.A.C. 7:9-6.5(c)). PTA currently utilizes this groundwater in a manner consistent with the definition of Class IIA groundwater; i.e., the use of groundwater is not impacted by the contaminant plumes because conventional water supply treatment renders the water suitable for use. Therefore, the status of the potential use and value of the groundwater as a resource does not necessitate a rapid restoration timeframe.

8.1.4.4 Elements of ICs

Sections of PTA have been continuously owned and operated by the U.S. military since 1880. The Army institutes and continuously enforces ICs within the facility. The IC system employed by the Army at PTA has six components. The components are:

- Site Clearance/Soil Management Procedures – Prior to all soil movement, the PTA Environmental Affairs Office must be notified and give approval.
- UXO Clearance Procedures- Intrusive activities will require a permit from the Picatinny Safety Office and will be subject to PTA UXO Safety requirement and review.
- Master Plan Regulations (Army Regulation 210-20) – Land use restrictions will be memorialized in the PTA Master Plan.
- PTA Geographic Information System (GIS) Database – The GIS will record site location, size, chemical analytical data (including COCs and LOCs). Furthermore the GIS will be used by the Environmental Affairs Office to administer the Site Clearance/Soil Management Procedures.
- PTA Base Access Restrictions (Security) – The Base is enclosed in a fence and entrances are guarded 24 hours per day. The site is enclosed within a restricted access area within PTA.
- PTA Safety Program – All contractors are required to attend safety training conducted by the PTA Safety Office.

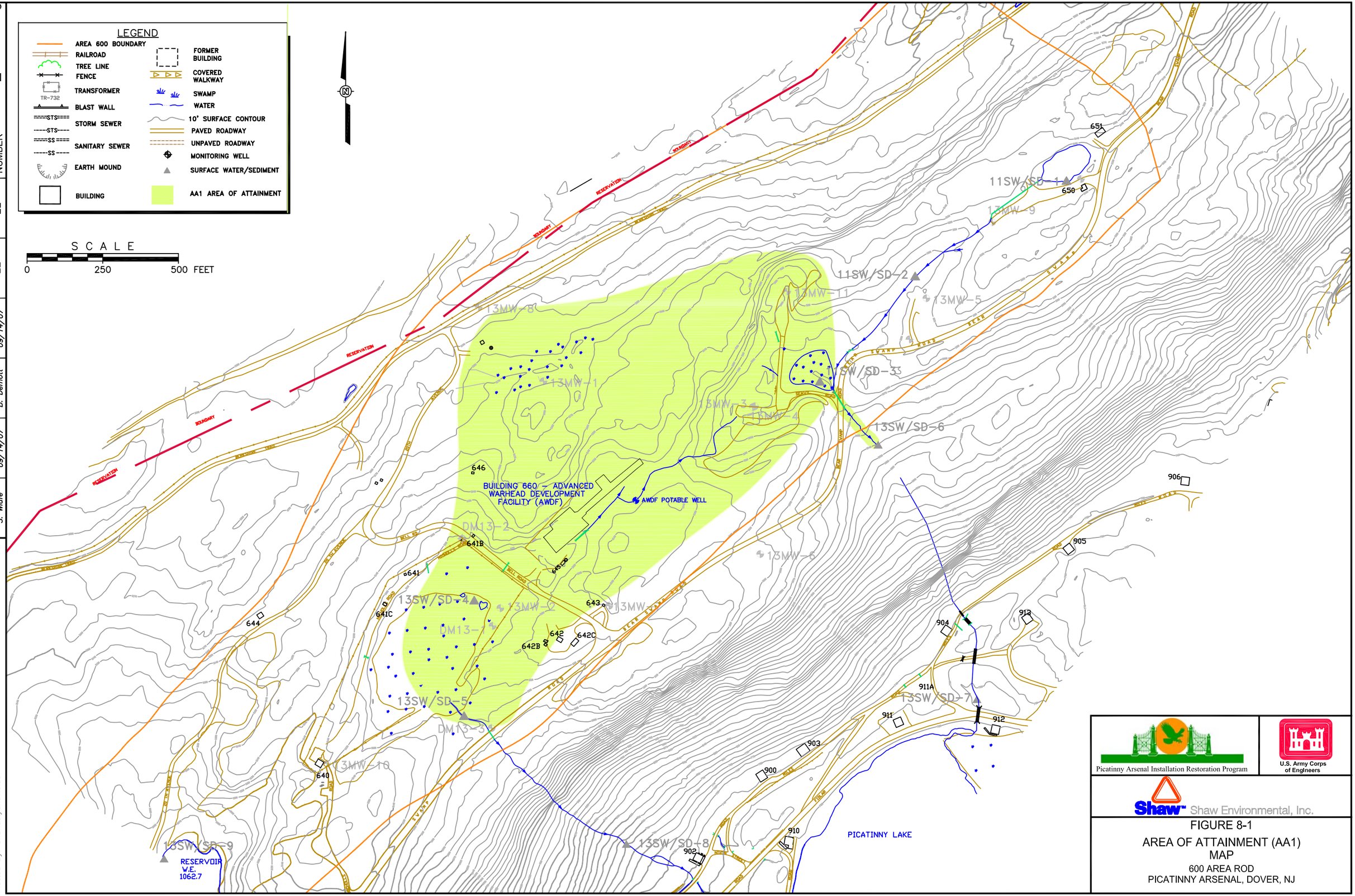
The NJDEP approved a CEA for all of PTA in 2002. The corresponding Well Restriction Area (WRA) covers all of PTA and therefore all of the 600 Area. Via the CEA, the state limits access to contaminated groundwater, thus adding an additional level of IC. The six elements of IC detailed above and the existing CEA are existing and constant. Therefore, the combination of these ICs does not necessitate a rapid restoration timeframe.

8.1.4.5 The Ability to Monitor and Control Contaminant Movement

The ability to monitor contaminant movement within the groundwater AA has been demonstrated during the many years of investigation (refer to **Sections 2.0** and **3.0**). Although the nature and extent of groundwater contaminants is well documented, surface water TCE concentrations are above promulgated criteria within the groundwater AA. **Section 4.7** contains a detailed discussion about the nature and extent of TCE surface water contamination. Therefore, the ability to control contaminant movement must be incorporated into any RA or the most rapid restoration timeframe technologically feasible would be appropriate.

Table 8-1
COC Groundwater Screening

Criteria Based Compounds of Potential Concern (CCOPC) and Human Health Compounds of Potential Concern (HHCOPC) (See Table 4-10)	Maximum Observed Concentration (µg/L)	ARAR (µg/L)	Frequency of ARAR Exceedances	COC Screening Criteria ("No" indicates elimination as a COC, only a "yes" will be evaluated by next criterion)			COC
	600 Study Area			Above ARAR?	Plume Distribution?	Risk Driver?[f]	
Volatiles							
Acetonitrile (HHCOPC)	55	120	0 / 91	No	No	No	
cis-1,2-Dichloroethene (HHCOPC)	2.2	70	0 / 124	No	No	No	
Methyl tert-Butyl ether (CCOPC & HHCOPC)	140	70	2 / 115	Yes	No	No	
Methylene chloride (CCOPC)	15	3	1 / 124	Yes	No	No	
Tetrachloroethene (CCOPC & HHCOPC)	2.2	1	1 / 124	Yes	No	No	
Trichloroethene (CCOPC & HHCOPC)	170	1	67 / 124	Yes	Yes	Yes	Yes
Vinyl chloride (HHCOPC)	0.24	1	0 / 124	No	No	No	
Explosives							
2,4-Dinitrotoluene (HHCOPC)	0.15	10	0 / 68	No	No	No	
RDX (CCOPC & HHCOPC)	1.1	0.5	4 / 68	Yes	No	No	
2,4,6-Trinitrotoluene (HHCOPC)	0.3	1.2	0 / 68	No	No	No	



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9.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES AND DEVELOPMENT OF REMEDIAL ALTERNATIVES

This section describes the identification and screening of applicable technologies and assembly of these technologies into RAs for the 600 Area. Since groundwater is the probable source of surface water contamination, surface water will be addressed in conjunction with groundwater in **Section 10.0**.

To identify applicable remedial technologies, it was assumed that any field proven technology or remedial process option that had successfully mitigated similar COCs in groundwater may also be suitable for remediating the contaminated media in the 600 Area. In addition to potentially applicable technologies, this section discusses technologies that are mandated for FS inclusion in the NCP, such as No Action, technologies that were requested for inclusion via regulatory comments, and MNA mandated by Army policy.

Discussions for each matrix include: identification of GRAs and technologies associated with the GRAs; a brief description of each technology; and an initial screening of technologies based on effectiveness, implementability, and cost. GRAs are broad classes of responses or remedial actions that can potentially achieve the RAOs. GRAs may encompass many remedial technologies and remedial technology process options. For example, *in situ* active restoration is a GRA, *in situ* biological treatment is a remedial technology, and methane sparging is a remedial technology process option. Technologies that pass the preliminary screening process are then used in the development of RAs at the end of this section.

After development of the RAs at the end of this section, a detailed analysis shall be conducted on the limited number of alternative that represent viable approaches to remedial action after evaluation in the screening stage. The detailed analysis consists of an assessment of individual alternatives against each of the nine evaluation criteria and a comparative analysis that focuses upon the relative performance of each alternative against those criteria. The nine criteria (40 CFR 300.430(e)(9)) are discussed in greater detail in Section 10.1.

In this FS, all RAs for the 600 Area would be implemented in conjunction with ICs, until SCLs are achieved.

9.1 IDENTIFICATION OF GRAs AND PRELIMINARY SCREENING OF GROUNDWATER REMEDIAL ACTION TECHNOLOGIES

This section presents the GRAs as well as the identification and preliminary screening of groundwater remedial action technologies. TCE is the only COC identified for groundwater. Surface water contamination is derived from TCE-contaminated groundwater. Both active and passive technologies are evaluated in the following sections.

9.1.1 General Response Actions

GRAs that would be potentially applicable for the groundwater AAs for the 600 Area are described below.

9.1.1.1 No Action

The NCP and CERCLA require the evaluation of a “No Action” alternative as a baseline for comparison with other RAs (40CFR 300.430(e)(6)). The “No Action” alternative does not involve remedial action; therefore, environmental media at the site, or emanating from the site, remain contaminated. For this reason, CERCLA, as amended, requires a review of site conditions every 5 years.

9.1.1.2 ICs

Land-use restrictions would prevent or limit the use of, and access to, the contamination at the site. These ICs could include property access restrictions, groundwater use restrictions, limitations on future construction activities, and/or deed restrictions. These restrictions can limit property usage or specify special considerations, such as required personal protective equipment (PPE) during future site clearing or construction activities. Land-use restrictions and development controls can also be an effective means of protecting public health, by decreasing risk of exposure to contamination at a site.

Another component of ICs is long-term monitoring (LTM) of chemical and biological parameters in groundwater, to ensure site conditions do not change or adversely affect human or ecological receptors.

9.1.1.3 MNA

"Monitored natural attenuation" technologies do not reduce the toxicity, mobility, or volume of contamination by engineered action. "Limited Action-MNA" technologies consist of ICs, LTM and site modeling, which reduce the potential for exposure of populations to contaminated media. MNA manages the naturally-occurring volatilization, adsorption to soil matrix, dispersion, abiotic transformation, and/or biodegradation of contaminants without engineering steps to enhance the process. It differs from the "No Action" alternative in that it requires comprehensive documentation of the attenuating processes along with extensive monitoring of groundwater chemical parameters. Furthermore, it requires that attenuation be "proven" by using site-specific data. MNA technologies are used to inform the public and to provide a database that allows for the evaluation of site changes over time.

9.1.1.4 *Ex Situ* Active Restoration

Ex Situ Active Restoration consists of groundwater extraction, treatment, and discharge technologies. The main advantage of *ex situ* treatment is that the treatment process is controlled and the effectiveness can be verified through monitoring of pre- and post-treatment samples. Groundwater extraction can also be an effective means to control contaminant migration through hydraulic control of the plume. *Ex Situ* Active Restoration is most effective for high contaminant concentrations in groundwater or when separate phase contaminants can be recovered. However, *ex situ* treatment requires potentially cost-intensive material-handling activities and the effectiveness can be limited by the desorption rates of contaminants adhering to aquifer soils.

9.1.1.5 *In Situ* Active Restoration

In Situ Active Restoration consists of technologies that remove or destroy contaminant mass without being brought to the surface, which usually results in significant cost savings. *In Situ* Active Restoration tends to be limited by the ability to distribute amendments uniformly across the plume. *In situ* treatment generally requires longer time periods to accomplish RAOs and has primarily been used to treat lower contaminant concentrations. Recent research focus on *in situ* technologies has led to the development of more rapid treatments capable of treating higher concentrations.

9.1.1.6 *Source Removal*

Source Removal involves the excavation of TCE impacted soil/fill in AOC 1, thereby eliminating the source of TCE to groundwater. Excavation is defined as the physical removal of solid material from the ground by mechanical means, and can be accomplished by digging up impacted material with a backhoe, excavator or other suitable equipment.

9.1.2 Identification and Screening of Remedial Action Technologies

The identification and screening process is performed in accordance with the CERCLA FS guidance document (USEPA, 1988a), as specified by the NCP (40 CFR Part 300). Identification of potentially applicable technologies is based primarily on technical feasibility using the following criteria:

- Compatibility with constituent characteristics.
- Compatibility with Picatinny/600 Area characteristics.
- Ability to achieve RAO – either alone or as a component of a treatment train.
- Development status – a technology must be developed to the point of field-scale demonstration so that information is available on performance, reliability, and cost.

Based on these criteria, some groundwater remedial action technologies were eliminated from further consideration. **Table 9-1** provides the list of groundwater remedial action technologies considered in the preliminary screening process for each GRA, along with brief descriptions of each technology. Information for this section was obtained from the Federal Remediation Technologies Roundtable (FRTR) web site (http://www.frtr.gov), the Naval Facility Engineering Service Environmental Restoration web site

(http://enviro.nfesc.navy.mil/erb/restoration), the Defense Environmental Network and Information Exchange (DENIX) web site (http://www.denix.osd.mil/denix/Public), technical journals, and vendors.

9.2 EVALUATION AND SCREENING OF PROCESS OPTIONS

9.2.1 Evaluation of Process Options

Process options within potential remedial technology types are evaluated based on three criteria; implementability, effectiveness, and cost.

9.2.1.1 Implementability

The evaluation of implementability focuses on: (1) technical feasibility; (2) availability; and, (3) administrative feasibility. Technical feasibility refers to the ability to build and reliably operate/maintain a technology; while, administrative feasibility refers to the ability to gain approval from regulators and other agencies and to obtain the necessary materials and skilled labor.

The NCP instructs that alternatives "that are technically or administratively infeasible or that would require equipment, specialists, or facilities that are not available within a reasonable period of time may be eliminated from further consideration" (40CFR300.430(e)(7)(ii)).

9.2.1.2 Effectiveness

The effectiveness criterion focused on the ability of a technology to:

- Reduce toxicity, mobility, or volume through treatment.
- Minimize residual risks.
- Afford long-term protection.
- Comply with ARARs.
- Minimize short-term impacts.
- Achieve protection within a reasonable timeframe.

The NCP instructs that "alternatives providing significantly less effectiveness than other, more promising alternatives may be eliminated. Alternatives that do not provide adequate protection of human health and the environment shall be eliminated from further consideration" (40CFR300.430(e)(7)(i)).

9.2.1.3 Cost

The evaluation of cost addresses direct and indirect capital costs and annual operation and maintenance (O&M) costs. When the information is available, the cost range is presented quantitatively. Otherwise, qualitative descriptions of low, moderate, and high are used. The cost ranges are based on a review of the literature, vendor quotations, and data prepared for other studies.

The NCP instructs that "costs that are grossly excessive compared to the overall effectiveness of alternatives may be considered as one of several factors used to eliminate alternatives. Alternatives providing effectiveness and implementability similar to that of another alternative by employing a similar method of treatment or engineering control, but at greater cost, may be eliminated" (40CFR300.430(e)(7)(iii)).

9.2.2 Preliminary Screening of Groundwater Process Options

Table 9-2 describes the preliminary screening process for the groundwater process options for the 600 Area. Based on this screening, the following process options were either retained or eliminated from further consideration:

Retained Technologies or Process Options	Eliminated Technologies or Process Options
No Action	Capping and other Impermeable Covers
	Pumping – Mass Removal
Institutional Restrictions	Air Stripping
Access/Land-Use Restrictions	Carbon Absorption

Retained Technologies or Process Options	Eliminated Technologies or Process Options
Public Education	UV Oxidation
Emergency Provisions	Bioreactor
LTM of Groundwater and Surface Water	Discharge to Surface Water
MNA	Aquifer Reinjection
Chemical Oxidation	Cometabolism
Zero-Valent Iron (ZVI) Injection	Soil Vapor Extraction
Accelerated Anaerobic Bioremediation	
Source Removal/Excavation	

9.2.3 Development of RAs

All treatment technologies and process options for groundwater that passed the preliminary screening criteria were then assembled into RAs. Alternatives can consist of a technology/process alone or several technology/processes in combination to address the 600 Area RAOs.

Table 9-1
General Response Actions, Identification and Screening of Remedial Action Technologies for Treatment of Groundwater

GRA	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING RESULTS
NO ACTION	Not Applicable	Not Applicable	"No Action" is not a category of technologies but provides a risk baseline to which all other alternatives may be compared. The NCP requires that "No Action" be included among the general response actions evaluated [40 CFR 300.43(e)(6)].	Retain
INSTITUTIONAL CONTROLS	Institutional Controls	Institutional Restrictions	Institutional restrictions involve controlling access to contaminated areas by implementing administrative policies. Administrative policies of interest include restricting future property uses within contaminated areas and restricting the installation of new drinking water wells. One such institutional restriction is the classification exemption area (CEA). The CEA is a state of New Jersey administrated designation of areas that are not potable due to contamination. The State exercises its authority by utilizing a statute that requires permits prior to the construction of any groundwater well. Thus, the drinking water well exposure pathway is administratively controlled by the State for those areas classified as a CEA.	Retain
		Access Restrictions	Access restrictions involve controlling access to contaminated areas by installing physical boundaries and/or signs.	Retain
		Public Education	An increased public awareness of the hazards present at the site would be achieved through public meetings, presentations at local schools, press releases, and posting of signs.	Retain
		Emergency Provisions	In the event of an unexpected deterioration of site conditions resulting in an increased threat to public health and the environment, emergency measures are outlined to allow prompt attention to the problem. Existing emergency provisions, if any, should be identified and updated.	Retain
	Long-Term Monitoring	Groundwater Monitoring	The primary objectives of long term monitoring include: (1) evaluation of long term behavior of the plume, (2) verify that exposure to contaminants and their breakdown products do not pose additional risks, and (3) assess when it is necessary to implement a contingent remedy.	Retain
MONITORED NATURAL ATTENUATION	Monitored Natural Attenuation	Natural Attenuation	Natural attenuation includes a variety of natural processes which work together to reduce the concentration of contaminants and their impact on the environment. Natural attenuation includes intrinsic bioremediation of contaminants, and reduction of contaminant concentrations through sorption/dispersion in the aquifer. Monitored Natural Attenuation or "MNA" is a formal and systemic approach of monitoring and measuring the rate at which the natural attenuation of contaminants occur, so as to demonstrate that RAOs are achieved.	Retain

Table 9-1
General Response Actions, Identification and Screening of Remedial Action Technologies for Treatment of Groundwater

GRA	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING RESULTS
BARRIERS	Impermeable/Low Permeability Barriers	Vertical Impermeable Barriers - Sheet piling, slurry wall and liner	Installation of vertical sheet piling, slurry walls or impermeable liners in the aquifer to prevent further migration of groundwater contaminants. Installation of sheet pile or a slurry wall is not practical in the overburden due to the potential for encountering MEC and boulders, and would not limit migration from the overburden soil to the bedrock aquifer. Installation of vertical barriers is not possible in the fractured granitic gneiss aquifer.	Do not retain
		Capping and other impermeable covers	Installation of an impermeable or low permeability cap (for example clay and/or concrete) or cover (liner) to prevent infiltration of rain and leaching of contaminated soils.	Retain
	Permeable Barriers	Drains, Interceptor Trenches	Drains and interceptor trenches are installed across the flow path of a contaminated plume to intercept shallow groundwater and prevent further migration. Water is then treated via an ex-situ technology. Drains and interceptor trenches could not be drilled within or directly downgradient of the source area because MEC avoidance could not be conducted. Drains or interceptor trenches installed downgradient of the source area would be of limited effectiveness because source area soil sits on top of bedrock and may be releasing TCE to the bedrock aquifer through fractures directly below the TCE contaminated soil.	Do not retain
		Permeable Reactive Barrier (PRB)	A PRB composed of zero valent iron filings or other material is installed across the flow path of a contaminated plume, allowing the water portion of the plume to passively move through while reacting/precipitating with chlorinated solvents and other contaminants. Installation of a PRB is not possible in the fractured granitic gneiss aquifer, where the TCE plume is located.	Do not retain
EX SITU ACTIVE RESTORATION	Extraction	Pumping/Extraction Wells for Mass Removal	Mass removal extraction wells consist of a series of pumping wells installed into highly contaminated areas of the plume to remove contaminated groundwater. Specifically, the well field configuration is optimized to remove groundwater from the highest contaminant concentration areas of the plume. The technology is most useful in formations with high transmissivity.	Retain
	Physical/Chemical Treatment	Air Stripping	Air stripping is a full-scale technology in which volatile organics are separated from groundwater by increasing the surface area of the contaminated water that is exposed to air. Types of aeration methods include packed towers, diffused aeration, tray aeration, and spray aeration. Air stripping involves the mass transfer of volatile contaminants from water to air. For groundwater remediation, this process is typically conducted in a packed tower or an aeration tank.	Retain

Table 9-1
General Response Actions, Identification and Screening of Remedial Action Technologies for Treatment of Groundwater

GRA	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING RESULTS
EX SITU ACTIVE RESTORATION (continued)	Physical/Chemical Treatment (continued)	Carbon Adsorption	Liquid phase carbon adsorption is a full-scale technology in which groundwater is pumped through a vessel or series of vessels containing granular activated carbon (GAC) to which dissolved contaminants adsorb. When the concentration of contaminants in the effluent from the bed exceeds a certain level, the carbon can be regenerated in place, removed and regenerated at an off-site facility, or discarded and replaced. Adsorption by activated carbon has a long history of use in treating municipal, industrial, and hazardous waste. Carbon adsorption is most efficient for removing organic compounds with a high boiling point, high molecular weight, and low solubility in water.	Retain
		UV Oxidation	UV oxidation is a destruction process that oxidizes organic, inorganics, and explosive constituents present in water by the addition of strong oxidizers and irradiation with UV light. The oxidation reaction is achieved through the synergistic action of UV light, in combination with ozone and or hydrogen peroxide. If complete mineralization is achieved, the final products of oxidation are CO_2, water, and salts. The main advantage of UV oxidation is that it is a destruction process, as opposed to air stripping or carbon adsorption, for which contaminants are extracted and concentrated in a separate phase. UV oxidation processes can be configured in batch or continuous flow modes, depending on the throughput under consideration.	Retain
		Zero-Valent Iron	This technology has been demonstrated to be capable of treating a wide range of contaminants, including halogenated organics and heavy metals.	Retain
	Biological Treatment	Bioreactor	Extracted groundwater is amended with nutrients, microbial cultures, and pH adjustment to facilitate biodegradation of contaminants. Granular activated carbon (GAC) is typically added as a microbial growth substrate. GAC provides a secondary benefit of adsorbing contaminants, limiting aqueous concentrations and potential toxicity to the microbes, and desorbing as aqueous concentrations are reduced though degradation.	Retain

Table 9-1
General Response Actions, Identification and Screening of Remedial Action Technologies for Treatment of Groundwater

GRA	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING RESULTS
EX SITU ACTIVE RESTORATION (continued)	Discharge	Surface Water	Treated groundwater is discharged into an on-site surface water channel.	Retain
		Reinjection	Treated groundwater is reinjected back to the aquifer through a series of reinjection wells.	Retain
		Publicly Owned Treatment Works	Discharge of treated or untreated water to a POTW facility. Pretreatment may be required if the untreated water has high content of heavy metals that could be toxic to the microorganisms used in the treatment system.	Retain
IN SITU ACTIVE RESTORATION	Physical and Chemical	Air Sparging and SVE	Air sparging is the process of injecting air into the saturated subsurface to remove contaminants. Air travels through the soil column and creates an *in situ* stripping mechanism in which the volatile contaminants partition from the solution phase into the vapor phase. The contaminated vapors travel upwards to the unsaturated zone where they can be extracted via SVE wells. Treatment of the contaminated vapors is then required. The water table depth (>50 feet bgs.) and tight fractured bedrock aquifer is not favorable for air sparging, due to the lack of aquifer/vadose zone permeability. Fracture communication between the saturated bedrock aquifer and bedrock/overburden vadose zone is expected to be variable, and poor where present. SVE would be limited to overburden glacial deposits and fill, which limits the area and depth of SVE treatment. Installation of either vertical or horizontal SVE wells in the source area is problematic due to buried MEC and large boulders/debris in the overburden fill. The primary biological degradation pathway is anaerobic. The aquifer is already oxygenated inhibiting the primary pathway. Increasing the level of oxygen will not improve the biological degradation pathway.	Do not retain
		Injection of Zero-Valent Iron (ZVI)	This technology has been demonstrated to be capable of treating a wide range of contaminants, including halogenated organics and heavy metals. ZVI may be dispersed into one or more aquifers as a nanoscale liquid suspension or through pneumatic fracturing followed by liquid atomized injection (LAI).	Retain
		Chemical Oxidation	In Situ Chemical Oxidation (ISCO) involves the addition of oxidizing agents, such as hydrogen peroxide, permanganate, ozone, or Fenton's reagent in order to facilitate direct oxidation of contaminants. Chemical oxidants are injected into the subsurface through injection wells.	Retain

Table 9-1
General Response Actions, Identification and Screening of Remedial Action Technologies for Treatment of Groundwater

GRA	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING RESULTS
IN SITU ACTIVE RESTORATION (continued)	Physical and Chemical (continued)	Steam Injection with Dual Phase Recovery	This alternative involves the injection of steam into the subsurface. This technology serves to remove contaminated groundwater via three mechanisms. First, steam displaces groundwater and causes a cold water flush. Second, steam that has condensed to warm water is also displaced by continued steam injection causing a warm water flush. Third, adsorbed or physically isolated VOCs are volatilized through heat imparted by the steam. Each flush of groundwater would have to be extracted and treated via a conventional pump and treat system. As the TCE source area is in unsaturated soil above the water table, the flushing mechanisms of steam treatment would be ineffective. Drilling steam injection/recovery wells within or immediately adjacent to the source area would be infeasible (while practicing MEC avoidance) because of the amount of metal and potential MEC.	Do not retain
	Biological	Cometabolism	Cometabolism is when microorganisms degrade contaminants without getting any benefits. This occurs by the activity of non specific enzymes which are generated during the degradation of another compound. Cometabolic processes can occur under a variety of electron accepting conditions, including aerobic and anaerobic. PCE and TCE can undergo cometabolic degradation under aerobic conditions in the presence of a co-substrate such as methane or propane. This technology was tested at Area D with limited success.	Retain
		Accelerated Anaerobic Bioremediation	This alternative stimulates the growth of microbial populations to consume available dissolved oxygen to generate anaerobic conditions, through the addition of an organic substrate (electron donor). Under anaerobic conditions, microbes utilize terminal electron accepting reactants that yield the greatest free energy. The depletion of electron receptors results in increasingly reducing conditions favorable to enhanced degradation of PCE and TCE.	Retain
Source Removal	Physical	Excavation	This alternative involves the physical removal TCE impacted soils/fill from the ground, performed mechanically with standard earthmoving equipment.	Retain
		SVE	SVE without air sparging is potentially applicable to the removal of the TCE source identified in the overburden soil. However, installation of traditional vertical SVE wells is impractical due to the vast amount of metallic debris and the potential to encounter MEC during drilling. An alternative would be to install horizontal SVE wells below the Munitions Waste Pit.	Retain

Table 9-2
Screening of Process Options

General Response Action/Technology	Effectiveness	Implementability	Relative Cost	Screening Result	Comments
A. NO ACTION	Does not achieve remedial action objectives.	Straightforward	None	Retained	The no action alternative must be fully evaluated according to 40 CFR 300.43(e)(6).
B. INSTITUTIONAL CONTROLS					
Institutional Restrictions	Institutional restrictions will help to reduce the potential for future exposure to groundwater, does not protect waters of the state.	Straightforward	Low capital, Low operation and maintenance (O&M)	Retained	Institutional controls have been implemented, and proven effective, at PTA and other DOD sites where risks and hazards have been identified as low and/or manageable. Institutional controls are retained for further evaluation.
Access/Land-Use Restriction	If properly enforced, land-use restrictions are an effective means of preventing exposure to contaminated media. Because the site is a controlled military base, access is already restricted to authorized personnel only.	Straightforward	Low capital, Low O&M	Retained	
Public Education	Public education will facilitate site remediation by keeping potentially affected individuals aware of site contamination and pending remedial actions.	Straightforward	Low capital, Low O&M	Retained	
Emergency Provisions	Outlining emergency measures allows for a prompt and organized response to threats to public health and the environment.	Straightforward	Low capital, Low O&M	Retained	
Long-Term Groundwater and Surface Water Monitoring (LTM)	Useful for documenting long term groundwater/surface water conditions and compliance; alone does not reduce risk.	Straightforward. Services and equipment available.	Low capital, Low O&M	Retained	
C. MONITORED NATURAL ATTENUATION	Effective for predicting, monitoring and measuring natural attenuation in groundwater and related reduction in risk. MNA cleanup timeframes can be lengthy.	Straightforward. Services and equipment available.	Low capital, Low O&M	Retained	

Table 9-2
Screening of Process Options

General Response Action/Technology	Effectiveness	Implementability	Relative Cost	Screening Result	Comments
D. CONTAINMENT					
Capping and other impermeable covers	Capping can prevent leaching of contaminated soil through infiltration of precipitation if soil is effectively isolated.	Straighforward. Services and equipment available.	Low capital, Low O&M	Not Retained	The contaminated soil is located on top of bedrock. Capping even the entire land fill could not provide assurance that perched groundwater flowing on top of the bedrock surface would not continue to slowly mobilized TCE for an extended period of time.
E. EX SITU ACTIVE RESTORATION					
Pumping - Mass Removal, Hydraulic Barrier, and Pulse Pumping	Groundwater extraction can be used to pump contaminated groundwater from multiple aquifers directly to on-site treatment facilities.	Straightforward. Services and equipment available.	Medium capital, Medium O&M	Not Retained	Groundwater extraction is not considered a cost effective technology due to the large number of extraction/monitoring wells required to control/monitor the fractured bedrock COC plume, low detected COC concentrations, and relatively high O&M costs. Groundwater extraction without source removal would not be effective since the source area is above the water table and would continue releasing TCE to the aquifer.
Air Stripping	Air stripping is a well demonstrated technology for the removal of VOCs in groundwater.	Straightforward for most organic compounds	Low to medium capital, Medium O&M	Not Retained	
Carbon Adsorption	Effective for removal of most VOCs and other organic compounds.	Straightforward	Medium capital, Medium O&M	Not Retained	
UV Oxidation	Demonstrated effective for the removal of most VOCs and other organic compounds. However, UV oxidation is considerably more complex and expensive in comparison to carbon adsorption and air stripping.	Straightforward	High capital, High O&M	Not Retained	Given the low contaminant concentrations in site groundwater UV oxidation is not a cost effective alternative.
Bioreactor	Effective for treatment of a wide range of organic contaminants including chlorinated solvents.	Straightforward	High capital, Low to medium O&M costs	Not Retained	

Table 9-2
Screening of Process Options

General Response Action/Technology	Effectiveness	Implementability	Relative Cost	Screening Result	Comments
Discharge to Surface Water	Discharge to a surface water body (GPB) is currently ongoing at PTA. An NPDES permit equivalent would be required.	Implementable when combined with appropriate treatment operations, strict surface water discharge standards.	Low capital, Low O&M	Not Retained	
Reinjection	Treated groundwater would be injected into the subsurface. An NPDES permit equivalent would be required.	Implementable when combined with appropriate treatment operations. Groundwater metals removal may be required to avoid injection well biofouling and clogging.	Medium capital and medium to high O&M due to potential well and formation plugging.	Not Retained	
F. IN SITU ACTIVE RESTORATION					
Chemical Oxidation	Chemical oxidation is an effective treatment and has been demonstrated to be effective for the rapid destruction of chlorinated solvents in groundwater	Straightforward. Services and equipment available	Medium to high capital, Low O&M	Retained	Remedial alternative to be implemented in conjunction with MNA as a polishing step.
ZVI Injection–Mass Removal	Effective treatment for removal of chlorinated solvents and degradation products in groundwater. Can be injected into aquifers as a liquid suspension or slurry.	Moderately complex to complex, requires batch testing and pilot study. Services and equipment available.	High capital, Low to medium O&M costs	Retained	Remedial alternative to be implemented in conjunction with MNA as a polishing step.
Cometabolism	Cometabolic processes can occur under a variety of electron accepting conditions, including aerobic and anaerobic. PCE and TCE can undergo cometabolic degradation under aerobic conditions in the presence of a co-substate such as methane or propane. This technology was tested at Area D with limited success.	Straightforward to moderately complex. May require pilot study to demonstrate effectiveness. Services and equipment available.	High capital, Low to medium O&M costs	Not Retained	Aerobic cometabolism does not produce consistent results when compared to other in situ technologies, and may require a pilot test to demonstate effectiveness in the field. Higher cost than other comparable in-situ technologies.
Accelerated Anaerobic Bioremediation	Enhanced anaerobic bioremediation is an effective treatment and has resulted in the mineralization of chlorinated solvents in groundwater.	Straightforward. Services and equipment available.	Medium to high capital, Low O&M	Retained	Remedial alternative to be implemented in conjunction with MNA as a polishing step.

Table 9-2
Screening of Process Options

General Response Action/Technology	Effectiveness	Implementability	Relative Cost	Screening Result	Comments
G. SOURCE REMOVAL					
Excavation	Physical removal of TCE impacted soils/fill would eliminate the source of groundwater contamination. Intrusive activity of this magnitude may be prohibitively expensive due to required UXO support and avoidance procedures.	Straightfoward. Services and equipment available	High capital, Low O&M costs	Retained	Remedial alternative to be implemented in conjunction with MNA as a polishing step.
Soil Vapor Extraction	Removal of the TCE source in soil through SVE would eliminate the source of groundwater contamination. Horizontal SVE wells feasible with available services and equipment; however, likely time and labor intensive due to logistics (thin 5-ft interval of native soil identified in TR1 not characterized throughout the site).	Complex. Traditional vertical SVE wells not feasible due to potential MEC.	High capital, Medium O&M costs	Not Retained	Installation of either vertical or horizontal SVE wells in the source area is problematic due to buried MEC and large boulders/debris in the overburden fill. Specifically, installation of vertical SVE wells would be infeasible (while practicing MEC avoidance) because of the amount of metal and potential MEC in and immediately adjacent to the source area. Horizontal well installation would likely requirea "trial and error" approach, with several wells attempted for each one completed. Lack of characterization of the native overburden soil is likely to greatly increase costs.

10.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The RA screening process described in **Section 9.0** generated the following remedial action alternatives to be considered in the detailed analysis:

TCE in Groundwater

- Alternative GW-1: No Action
- Alternative GW-2: MNA with ICs
- Alternative GW-3: *In Situ* Chemical Oxidation (ISCO) and MNA Polishing with ICs
- Alternative GW-4: *In Situ* Enhanced Anaerobic Bioremediation and MNA Polishing with ICs
- Alternative GW-5: TCE Source Material Removal and MNA Polishing with ICs
- Alternative GW-6: Total Landfill Removal and MNA Polishing with ICs

Alternatives GW-3, GW-4, GW-5, and GW-6 include an MNA component in order to treat the peripheral portions of the plume that will not be addressed by the active *in situ* treatment of groundwater or removal of source soil/fill material. All alternatives, with the exception of GW-1, include costs to implement ICs in conjunction with the active remedial actions.

10.1 RA SCREENING CRITERIA

Section 300.430(e) of the NCP lists nine criteria against which each RA must be assessed. The acceptability or performance of each alternative against the criteria is evaluated individually so that relative strengths and weaknesses may be identified. The detailed criteria are as follows:

1. Protection of human health and the environment.
2. Compliance with ARARs.
3. Long-term effectiveness and permanence.
4. Reduction of toxicity, mobility, or volume through treatment.
5. Short-term effectiveness.
6. Implementability.
7. Cost.
8. State acceptance.
9. Community acceptance.

The NCP (Section 300.430(f)(1)(i)(A)) states that the first two criteria, protection of human health and the environment and compliance with ARARs, are "threshold criteria" which must be met by the selected remedial action. In certain identified circumstances a waiver can be granted for specific ARARs under Section 121(d)(4) of CERCLA. Criteria three through seven are "primary balancing criteria," and the trade-offs within this group must be balanced. The preferred alternative will be the alternative that is protective of human health and the environment, is ARAR-compliant, and provides the best combination of primary balancing attributes. The final two criteria, state and community acceptance, are "modifying criteria," which are evaluated following the comment period on the RI/FS reports and the PP. The nine NCP criteria are described in further detail in the following sections and summarized on **Figure 10-1**. Only the first seven criteria are evaluated in this report. State and community acceptance will be evaluated in the ROD following the public comment period.

10.1.1 Overall Protection of Human Health and the Environment

This criterion involves an assessment based on a composite of factors addressed under other evaluation criteria, including long-term effectiveness, short-term effectiveness, and compliance with ARARs.

This criterion provides an evaluation of how the RA, as a whole, achieves RAOs and maintains protection of human health and the environment. A determination and declaration that this criterion will be met by the proposed remedial action must be made in the ROD; therefore, this is a threshold criterion, which must be met by the selected remedy. This criterion will be met if the risks associated with exposure of human and ecological receptors to contaminated media are eliminated, reduced, or controlled through treatment, engineering, or ICs, and if the remedial action is protective of human health and the environment.

10.1.2 Compliance with ARARs

This criterion assesses the compliance of an alternative with all contaminant-specific, action-specific, and location-specific ARARs. In the absence of ARARs, TBCs may also be taken into consideration as well as any other appropriate state or federal criteria, advisories, and guidance as they apply.

10.1.3 Long-Term Effectiveness and Permanence

This criterion examines the protection of human health and the environment after construction and implementation of the RA. This criterion addresses the long-term adequacy, reliability, and permanence of the RA.

10.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

This criterion examines the effectiveness of the RA in reducing the toxicity, mobility, and volume of contaminants through treatment. The statutory preference for remedial technologies that significantly and permanently reduce the toxicity, mobility, or volume of the waste is addressed by this criterion. The following factors will be considered:

1. The amount of hazardous materials that will be destroyed or treated.
2. The degree of expected reduction in toxicity, mobility, or volume.
3. The degree to which the treatment will be irreversible.
4. The type and quantity of treatment residuals that will remain following treatment.

10.1.5 Short-Term Effectiveness

The effects of the remedial action alternative from construction and implementation to completion of the remedial action alternative are addressed under this criterion. The following factors will be addressed:

- Protection of the community during the remedial action, including the effects of dust from excavation, transportation of contaminated materials, and air-quality impacts from on-site treatment.
- Protection of workers during the remedial action.
- Environmental impacts of the remedial action.
- Time required to achieve RAOs.

10.1.6 Implementability

This criterion considers the technical and administrative feasibility of each alternative, as well as availability of required resources. Factors considered in assessing this criterion include construction, operation, and maintenance of the RA; required approvals and permits from regulatory agencies; availability of required off-site treatment or disposal services; and availability of necessary equipment, materials, and personnel for implementation.

10.1.7 Cost

This criterion involves development and evaluation of the capital cost of construction, equipment, land, buildings, engineering services, and project administration, and O&M costs for labor, spare parts, materials, and administration. In addition, the present worth of each alternative is calculated using a

discount rate of 2.7 percent, based on the Office of Management and Budget Circular No. A-94, Appendix C, Revised December 2009 (valid for calendar year 2010 for projects with a duration of 20 years, or longer). Costs are then compared on a common, present-worth basis in terms of year 2010 dollars. The level of detail employed in developing these estimates is considered appropriate for making choices between alternatives, but the estimates are not intended for use in detailed budgetary planning.

10.1.8 State Acceptance

This criterion identifies the State's preferences or concerns about alternatives. State acceptance will be evaluated by providing this FS to the NJDEP for review. NJDEP comments or concerns will be addressed or reflected in the proposed plan provided to the public for comment.

10.1.9 Community Acceptance

This criterion identifies the community's preferences or concerns about alternatives. Community acceptance will be evaluated through communication with the Picatinny Arsenal Environmental Restoration Advisory Board and through the solicitation of comments to the pp for this action.

10.2 RA ANALYSIS FOR TCE IN GROUNDWATER

The following section provides a detailed description and analysis of each RA for TCE contamination in groundwater.

10.2.1 Detailed Analysis

Following is a detailed description of the RAs for TCE contamination in groundwater and analysis of each RA with respect to the NCP evaluation criteria.

10.2.2 Alternative GW-1: No Action

No additional actions would be undertaken at the site as part of this RA. According to the NCP, the level of treatment achieved must be compared to the required expenditures of time and materials as an integral portion of the remedy selection process. The No Action alternative is intended to serve as a baseline by which to compare the risk reduction effectiveness of other potential alternatives. In this alternative, no remedial actions would be performed. No efforts would be undertaken to contain, remove, monitor, or treat the TCE-contaminated groundwater at the site. The site would be left without any additional actions.

10.2.2.1 Overall Protection of Human Health and the Environment

Alternative GW-1 provides no control of exposure to the contaminated media and no reduction in risk to human health or the environment for the AA.

10.2.2.2 Compliance with ARARs

Since no remedial activities are associated with this alternative, chemical-specific ARARs for the groundwater would not be met. Action-specific and location-specific ARARs are not applicable since no remedial activities would be implemented.

10.2.2.3 Long-Term Effectiveness and Permanence

The "No Action" alternative does not provide any controls for reduction of exposure or long-term management measures. All current and potential future risks would remain the same under this alternative.

10.2.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative does not employ any treatment that would reduce the toxicity, mobility, or volume of COCs; therefore, it does not meet this detailed analysis criterion.

10.2.2.5 Short-Term Effectiveness

Implementation of this alternative does not pose any additional risks to the community, the workers, or the environment since there are no remedial activities associated with it.

10.2.2.6 Implementation

There are no implementability concerns posed by this option.

10.2.2.7 Cost

The total present worth cost and capital cost of Alternative GW-1 are estimated to be $0.00 since there would be no remedial action taken at the site.

10.2.3 Alternative GW-2: MNA with ICs

Alternative GW-2 would involve MNA for the contaminated groundwater within the AA. MNA is proposed as a standalone remedy, and is also proposed as a potential polishing step after implementation of active remedies GW-3 through GW-6. MNA monitoring would be used in conjunction with GW-3 and GW-4 upon completion of the proposed 3-year treatment and performance monitoring period, and continue until the TCE ARAR is achieved in groundwater. A 50-year monitoring period is assumed based upon the hypothetical leaching rate of TCE from source soils (see **Section 6.6**).

LTM would be conducted at selected wells and surface water sampling locations on a semiannual basis to year 10, annually to year 20, and once every 5 years to year 50. LTM would continue until the TCE ARAR is achieved in groundwater. Results of the first and subsequent five-year study will include a revised MNA timeframe for the remainder of the dissolved TCE plume.

In addition, Alternative GW-2 would involve continuous implementation of ICs, in particular restrictions on groundwater use. The long-term groundwater monitoring program would be used to determine whether subsequent actions would be required and determine if NA is progressing as anticipated.

An integral element of this alternative is a combination of MNA and ICs, which includes institutional and access restrictions, public education, emergency provisions, and LTM of the groundwater and surface water. No active treatment would be implemented to remove contaminants from the AA. Rather, monitoring of groundwater and surface water would provide data on the rate at which TCE is being attenuated. Therefore, ICs must be implemented until SCLs are met to minimize risk to potential receptors.

10.2.3.1 Description of Alternative

Alternative GW-2 would involve implementation of a long-term groundwater monitoring program and continuous implementation of ICs, in particular restrictions on groundwater use and no dig restrictions on the area of the Munitions Waste Pit.

Institutional Controls

The only objective for the implementation of ICs would be to safeguard human health. ICs would achieve this objective by restricting exposure to TCE in groundwater and subsurface soil, as well as potential MEC in the Munitions Waste Pit that results in an unacceptable risk to human health. As long as Picatinny is under military control, ICs and Land Use Controls (LUCs) would be in place. To ensure the implementation of these controls, Picatinny has developed a series of interlocking protective measures to safeguard human health and the environment. The eight elements are:

1. Site Clearance and Soil Management Procedures
2. UXO Clearance Procedures
3. Master Plan Regulations
4. Picatinny GIS Database
5. Picatinny Base Access Restrictions
6. Picatinny Safety Program
7. Army Military Construction Program
8. Picatinny Well Head Protection Program

LUCs, including restrictions on intrusive activities, would be recorded in the PTA GIS Database and Master Plan, and would be used by Picatinny's Safety Office and Environmental Affairs Office in the implementation of the Safety Program and Soil Management Procedures. The site lies within a fenced and guarded enclosure within Picatinny. Access to the enclosure requires specific permission beyond that required for general base access. Further, visitors to the site (located within an active range area) are required to register with Picatinny Range Control, where they are issued radios and GPS tracking devices. In addition, groundwater use restrictions and MNA would be implemented under Alternative GW-2:

Design and Permitting

Once an RA has been selected and the PP and ROD have been completed, a remedial design would be prepared. This would include, at a minimum, a site-specific work plan describing the remedial activities, QA/QC procedures, technical specifications, and a site health and safety plan. The design documents would be submitted for review and approval by the appropriate agencies prior to initiation of remedial activities.

The initial phase of the work would consist of the preparation of a site-specific health and safety plan. Because the remedial action would be conducted under CERCLA, the substantive requirements of the permits, and permitting agencies, would be followed in lieu of obtaining formal permits for required activities. The health and safety plan would outline the physical and chemical hazards associated with the work to be performed at the site and would serve as the instrument of control for ensuring the health and safety of personnel at the site.

Contractor and Material Procurement

Contractor and material procurement would include preparation of bid packages for the remedial activities, solicitation of bids, bid review, and contractor selection. Materials and equipment required to complete the remedial activities would be limited to the collection of MNA samples. As such, limited advanced material procurement would be required.

Groundwater Use Restrictions

Groundwater use restrictions would involve prohibitions of well installation/operation without well head protection and groundwater consumption or other beneficial uses, such as agricultural irrigation by extraction through wells or by other means. A facility-wide CEA is currently in place, in which the 600 Area groundwater is included. The CEA, which includes both unconsolidated and consolidated aquifers to a depth of 380 ft bgs, was approved by the NJDEP in November 2002. The CEA identifies contaminant concentrations within the CEA boundary (the property boundary of Picatinny) above Primary Drinking Water Standards; therefore, the CEA also serves as a WRA. The WRA functions as the IC by which potable use restriction can be affected.

Monitored Natural Attention

The primary objectives of the MNA program under Alternative GW-2 are to: (1) ensure that contaminant concentrations decrease as predicted; and, (2) assess when it is necessary to implement a contingent remedy.

Implementation of the MNA program under Alternative GW-2 would involve submittals of plans, field sampling activities, and reporting requirements. The submittal of plans would include the health and safety plan, the project work plan, the field sampling plan, the DQOs, and the QAPP that would detail elements, such as sampling locations, parameters, and frequency, as well as the exit strategy and the general evaluation criteria to evaluate the necessity of a contingent remedy. The reporting requirements would involve, at a minimum, submittal of the monitoring results and five-year review reports.

The project work plan would address all aspects of the program and direct the work to be performed. The field sampling plan would direct the technical requirements of the sampling program, including field sampling techniques, sampling locations, sampling frequency, proposed data use, sampling analytical programs, and use of site screening equipment. The QAPP would detail the requirements of the chemical analytical program (i.e., analytical methods), DQOs, data quality, and SOPs.

To address groundwater contamination, a total of eight monitoring wells (13MW-1, 13MW-2, 13MW-4, 13MW-6, 13MW-7, 13MW-8, 13MW-11, and DM13-3) in addition to the (now inactive) AWDF supply well would be included in the MNA sampling program. Eight monitoring wells have been assumed for costing purposes, based on an analysis of the data. However, the final number of wells will be established in the LTM plan. All groundwater samples would be analyzed for VOCs including TCE and their associated daughter products, and field parameters, such as DO, temperature, ORP, and pH. In addition, samples from monitoring wells 13MW-1, 13MW-8, and the AWDF well would be analyzed for explosive compounds. The wells selected for the MNA sampling program are shown in red type on **Figure 10-2**. In addition, surface water samples (labeled in blue) would be collected contemporaneously with each groundwater sampling event from two locations in the two marshlands into which groundwater apparently discharges and analyzed for TCL VOCs. The probable sample locations are displayed on **Figure 10-2**.

When the concentrations of COCs fall below the chemical-specific ARARs, groundwater monitoring would be continued for an additional 1 to 3 years to ensure that the new reduced concentrations are not the result of seasonal fluctuation. Each groundwater monitoring well would be maintained over the entire duration of 50 years and replaced as necessary to provide continuous service.

10.2.3.2 Evaluation of Screening Criteria

Overall Protection of Human Health and the Environment

Alternative GW-2 provides an adequate protection of the human health through the implementation of LUCs and groundwater ICs, primarily through groundwater use restrictions. MNA is expected to reduce contaminant concentrations in groundwater to within SCLs. Concentrations in surface water are likewise expected to be reduced below federal and state promulgated standards with NA of TCE in groundwater. The entirety of Picatinny Arsenal is within a Well Restriction Area as specified in a Classification Exception Area established by the NJDEP. The Classification Exception Area is updated biennially by the U.S. Army with a biennial certification sent to the NJDEP. As part of the biennial certification the U.S. Army reviews site use to ensure the remedy (including groundwater restrictions) is operating successfully. Additionally, this site remedy will be reviewed every five years by the USEPA as part of the CERCLA remedy.

Enforcement of ICs and LUCs identified in **Section 10.2.3.1** would prevent unauthorized site access or activities which could pose unacceptable risk to human health due to MEC or TCE in subsurface soil.

Compliance with ARARs

Compliance with ARARs for groundwater will be met at the end of the remedial action. Location-specific ARARs include wetland regulations within the clean water act. Compliance with these regulations will be complied with during well drilling and abandonment activities. Action-specific ARARs associated with groundwater sampling and analysis will be complied with during the remedial action. To be considered guidance for well drilling and abandonment can be easily complied with using industry standard practices. NJDEP regulation also dictates that drill cuttings can be returned to the site provided they do not contain free product or residual product. These regulations can be complied with through testing and proper disposal of cutting should they contain free or residual product.

Long-Term Effectiveness and Permanence

TCE concentrations will decrease over time through MNA. Long term effectiveness will be dictated by the success of ICs implemented under the RA. ICs include no dig restrictions, CEA with corresponding WRA, and groundwater use restrictions evaluated during the five-year review. Funding for the ICs will be programmed by the U.S. Army for the duration of the remedial action ensuring continuous implementation of ICs.

Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative does not employ any treatment that would reduce the toxicity, mobility, or volume of COCs in groundwater. However, the toxicity and volume of the TCE plume would be reduced over the anticipated 50 year time frame, during which ICs would effectively mitigate potential exposure.

Short-Term Effectiveness

Implementation of this alternative does not pose any additional risks to the community, the workers, or the environment since there are no active remedial actions. Potential risks to workers collecting samples in support of this RA would be mitigated through use of proper sampling techniques and PPE.

Implementation

There are no implementability concerns posed by this remedy. Picatinny has the administrative and financial capability to implement and maintain ICs, many of which are currently in place. The greatest obstacle to the implementation of Alternative GW-2 is acceptance by regulatory agencies.

Cost

The total present worth cost for Alternative GW-2 is approximately $680,235.73, including $60,000 in capital costs and $620,235.73 in O&M during the assumed 50-year monitoring timeframe. Detailed costs are provided in **Appendix P** of this volume.

10.2.4 Alternative GW-3: *In Situ* Chemical Oxidation and MNA Polishing with ICs

Alternative GW-3 would involve up to three periodic injections of a chemical oxidizer in six wells (three upgradient of the source area of the plume and three downgradient) for the *in situ* treatment of TCE concentrations in groundwater thereby decreasing contaminant discharge into downgradient well and wetland receptors. Due to the potential for encountering MEC during this remedial action, MEC construction support and MEC avoidance will be performed during the implementation of the RA. The upgradient wells would be completed in the overburden on top of the bedrock surface. Overburden injections would allow the oxidant to advectively migrate over the top of the bedrock surface through the source area. The three downgradient wells would be installed in the saturated zone of shallow bedrock just downgradient of the source. Sodium permanganate will rapidly oxidize TCE in groundwater at an approximate minimum concentration of 300 mg/L (permanganate), yielding carbon dioxide and water. Successful treatment will result in receptor TCE concentrations dropping below ARARs in an approximate eight-year period (See Alternative 3 modeling in **Appendix O**). Performance monitoring would be conducted at source injection wells and upgradient monitoring wells to evaluate the effectiveness of the remedy. Monitoring would be performed monthly for the first six months and quarterly thereafter until the last treatment. During this period, downgradient wells and surface water would be monitored on a semi-annual basis.

Active treatment in the form of ISCO would be conducted over a three-year period, followed by MNA polishing for the remainder of the TCE contaminated groundwater within the AA. Groundwater TCE concentrations are likely to rebound after active treatment in the source area, and later impact the downgradient receptors. TCE source soil concentrations are expected to leach and lose mass with time, with a consequent decrease in groundwater TCE concentrations. A 50-year monitoring period is assumed based upon the hypothetical leaching rate of TCE from source soils (see **Section 6.6**). After completion of ISCO performance monitoring, monitoring wells and surface water would continue to be monitored on a semiannual basis to year 10. Wells would then be sampled annually to year 20, and once every 5 years to year 50. Results of the first five-year study will include a revised MNA timeframe for the remainder of the dissolved TCE plume.

In addition, Alternative GW-3 would involve continuous implementation of ICs, in particular, restrictions on groundwater use. The long-term groundwater monitoring program for this area would be used to determine whether subsequent actions were required and determine if MNA is applicable following completion of the active groundwater treatment. Discussions of the MNA, IC, and LTM components of this alternative are presented under Alternative GW-2.

10.2.4.1 Description of Alternative

Alternative GW-3 would involve: (1) installation of six injection/monitoring wells; and (2) injection of approximately 6,700 pounds of sodium permanganate (applied in a 5 percent solution) to reduce COC concentrations *in situ*. Sodium (or potassium) permanganate is generally the preferred oxidizer for treatment of TCE. **Figure 10-3** shows the approximate treatment zone and proposed injection grid in

which Alternative GW-3 would be applied. This treatment zone covers an area of approximately 48,000 square ft and corresponds to the region that is suspected to be the source of the TCE plume. The permanganate solution would be pumped or gravity fed directly into each injection well, requiring approximately 22 days to complete. Three annual treatments are assumed to reduce concentrations to levels which would prevent TCE discharge into downgradient well and surface water receptors above applicable standards.

The first stage of this treatment would include a pilot test conducted upgradient of monitoring well 13MW-1, near the source area of the plume. Due to the location of the TCE source within a "Munitions Waste Pit," in which MEC was discovered during the source investigation; injection/monitoring wells will need to be installed outside of the boundaries of the landfill. The pilot study would utilize the six injection/monitoring wells installed for the pilot test, which would be used for the full-scale treatment as injection points. Selection of one well to use as the pilot injection well would be made based on observations made during installation, well yield, and number and distribution of producing fractures determined from borehole geophysics. Additional components of this alternative include groundwater monitoring, ICs, planning, permitting and reporting as presented under Alternatives GW-2.

Design and Permitting

Once an RA has been selected and the PP and ROD have been completed, a remedial design would be prepared. This would include, at a minimum, a site-specific work plan describing the remedial activities, QA/QC procedures, technical specifications, and a site health and safety plan. The design documents would be submitted for review and approval by the appropriate agencies prior to initiation of remedial activities.

The initial phase of the work would consist of the preparation of a site-specific health and safety plan. Because the remedial action would be conducted under CERCLA, the substantive requirements of the permits, and permitting agencies, would be followed in lieu of obtaining formal permits for required activities. The health and safety plan would outline the physical and chemical hazards associated with the work to be performed at the site and would serve as the instrument of control for ensuring the health and safety of personnel at the site.

Contractor and Material Procurement

Contractor and material procurement would include preparation of bid packages for the remedial activities, solicitation of bids, bid review, and contractor selection. Materials and equipment required to complete the remedial activities would also be selected and procured.

Mobilization and Demobilization

The first phase of this alternative would include mobilization of the required personnel, equipment, and facilities. It is anticipated that locations for injection wells can be selected from currently accessible areas or with limited site preparation. Following installation of the injection wells and initial round of substrate injections, all personnel, equipment, and materials would be demobilized, as subsequent treatment would be performed using the existing injection wells minimizing additional mobilization/demobilization.

10.2.4.2 Evaluation of Screening Criteria

Overall Protection of Human Health and the Environment

The treatment proposed under Alternative GW-3 should rapidly reduce TCE groundwater concentrations in the source area, and later reduce TCE concentrations in downgradient plume and receptor areas. However, downgradient TCE concentrations may rebound. Following the source zone treatment of the groundwater plume, MNA is expected to treat the remaining groundwater contamination to the SCL within a 50-year timeframe. Thus, the risk to human health and the environment would be minimized with this alternative and eventually eliminated. The protection of human health from the groundwater contamination in the bedrock aquifer would be further afforded through the implementation of ICs, particularly the groundwater use restrictions. The entirety of Picatinny Arsenal is within a Well Restriction Area as specified in a Classification Exception Area established by the NJDEP. The Classification Exception Area is updated biennially by the Army with a biennial certification sent to the

NJDEP. As part of the biennial certification the Army reviews site use to ensure the remedy (including groundwater restrictions) is operating successfully. Additionally, this site remedy will be reviewed every five years by the USEPA as part of the CERCLA remedy. Concentrations in surface water are expected to be reduced to below federal and state promulgated standards at the end of the 50-year period. Protection of field personnel using engineering controls and PPE is effective and reliable as this remedial technology has well established protocols.

Enforcement of ICs and LUCs identified in **Section 10.2.3.1** would prevent unauthorized site access or activities which could pose unacceptable risk to human health due to MEC or TCE in subsurface soil.

Compliance with ARARs

Although considered innovative, ISCO is a proven technology for the treatment of TCE contaminated groundwater. Chemical-specific ARARs will be met at the end of the remedial action. Alternative GW-3 would comply with all location- and action-specific ARARs. Location-specific ARARs include wetland regulations within the clean water act. Compliance with these regulations will be complied with during well drilling, ISCO injection and abandonment activities. Compliance with action-specific ARARs for activities related to the injection of permanganate can easily be met. To be considered guidance for well drilling and abandonment can be easily complied with using industry standard practices. Discharge to groundwater permit by rule regulations require that the remedial action not contravene NJDEP groundwater quality standards. These regulations can be complied with through thorough planning, dosage calculations and post injection monitoring. NJDEP regulation also dictates that drill cuttings can be returned to the site provided they do not contain free product or residual product. These regulations can be complied with through testing and proper disposal of cutting should they contain free or residual product.

Long-Term Effectiveness and Permanence

Upon completion of the ISCO treatment, the groundwater would exhibit rapid decreases in TCE concentrations within the treatment area. The long-term effectiveness of ISCO in the treatment zone is limited, however, by an active source area and expected rebound of TCE concentrations in groundwater. The effectiveness of this alternative is poor due to the large amount of buried metal, debris and MEC at the site. In order to be effective, permanganate must be in contact with the contaminated soil within the source area. The contaminated soil is comingled with or below MEC, MD, crushed drums and other debris. Therefore, injection wells would have to be placed upgradient of the source area, minimizing required contact. Long-term TCE groundwater concentrations are expected to decrease to ARARs in 50 years.

Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative is expected to provide effective reduction of toxicity, mobility, and volume of contamination. Implementation of Alternative GW-3 would result in the rapid destruction of TCE within the treatment zone reducing both toxicity and volume of TCE at the site. As a result, discharge of contaminated groundwater to downgradient receptors would be subsequently reduced by ISCO for a three or more year period after start of treatment. Without additional treatment, the volume of the TCE plume would likely rebound to a similar shape and extent with respect to current conditions. However, continued leaching of TCE from soil will reduce TCE concentrations in soil and corresponding migration to groundwater. Mobility will be reduced through the periodic treatments as TCE will be attenuated by advection and dispersion through the treatment zone, with gradual reduction of residual TCE concentration to ARARs by MNA over a 50-year period.

Short-Term Effectiveness

The short-term effectiveness of this alternative is good. There is a risk that site workers may be exposed to contaminated groundwater during the injections of permanganate. In addition, permanganate is a strong oxidizer; however, procurement and use of sodium permanganate solution (commercially available as a 40 percent solution) would reduce the hazards associated with the handling of permanganate (use of potassium permanganate in crystalline powder form can lead to potentially serious

inhalation hazard). Hazards would be minimized through the use of proper personal protection and field techniques. Use of PPE and engineering controls has been shown to be effective and reliable because this technology has well established protocols. There is also the potential that permanganate, or other oxidizer, could impact the environment if discharged to surface water. However, the oxidizer is expected to rapidly react with TCE in groundwater, resulting in the destruction of both compounds. Based on available site data, groundwater in the vicinity of the TCE source soil will take several years to reach, and discharge into the downgradient wetlands, yielding little possibility of discharging permanganate. Impacts that cannot be avoided should the alternative include increased vehicle traffic, increased water usage, and discharge of chemical oxidant to the aquifer.

Implementability

Although considered innovative, ISCO has been implemented widely for groundwater remediation in recent years. Technology implementation is contingent upon a successful pilot scale study. A potential issue could be obtaining the regulatory approval for ISCO; although, a formal permit from the NJDEP is not required for a CERCLA action. However, it has been documented that this technology is generally acceptable in the state of New Jersey. The implementability of this alternative is poor due to the large amount of buried metal debris and MEC at the site. ISCO is both technically and administratively feasible although complicated by the site conditions. Materials and equipment to implement the remedy are readily available.

Cost

The total estimated cost for Alternative GW-3 is $1,081,495.01, including $427,660.51 in capital costs and $653,834.50 in O&M costs. Detailed costs for Alternative GW-3 are provided in **Appendix P** of this volume.

10.2.5 Alternative GW-4: *In Situ* Enhanced Anaerobic Bioremediation and MNA Polishing with ICs

Alternative GW-4 would involve three periodic injections of an organic carbon substrate in the source area of the plume for the *in situ* treatment of TCE concentrations in groundwater, thereby decreasing contaminant discharge into downgradient well and surface water receptors. The treatment scenario was simulated using the model Biochlor, which found that treatment (see **Appendix O**) will result in surface water receptor TCE concentrations dropping below promulgated standards in an approximate four-year period. Performance monitoring would be conducted at source injection wells to evaluate the effectiveness of the remedy. Due to the potential for encountering MEC during this remedial action MEC construction support and MEC avoidance will be performed during the implementation of the RA. Monitoring will be performed monthly for the first six months and quarterly thereafter until the last treatment. During this period, downgradient monitoring wells and surface water would be monitored on a semi-annual basis.

Active treatment would be conducted over a three-year period, followed by MNA polishing for the remainder of the TCE contaminated groundwater within the AA. Groundwater TCE concentrations are likely to rebound after active treatment in the source area, and later impact the downgradient receptors. TCE source soil concentrations are expected to leach and lose mass with time, with a consequent decrease in groundwater TCE concentrations. A 50-year monitoring period is assumed based upon the hypothetical leaching rate of TCE from source soils (see **Section 6.6**). After completion of performance monitoring, monitoring wells and surface water would continue to be monitored on a semiannual basis to year 10. Wells would then be sampled annually to year 20, and once every 5 years to year 50. Results of the first five-year study will include a revised MNA timeframe for the remainder of the dissolved TCE plume.

In addition, Alternative GW-4 would involve continuous implementation of ICs, in particular, restrictions on groundwater use. The long-term groundwater monitoring program for this area would be used to determine whether subsequent actions were required and determine if MNA is applicable following completion of the active groundwater treatment. Discussions of the MNA, IC, and LTM components of this alternative are presented under Alternative GW-2.

Design and Permitting

Once an RA has been selected and the PP and ROD have been completed, a remedial design would be prepared. This would include, at a minimum, a site-specific work plan describing the remedial activities, QA/QC procedures, technical specifications, and a site health and safety plan. The design documents would be submitted for review and approval by the appropriate agencies prior to initiation of remedial activities.

The initial phase of the work would consist of the preparation of a site-specific health and safety plan. Because the remedial action would be conducted under CERCLA, the substantive requirements of the permits, and permitting agencies, would be followed in lieu of obtaining formal permits for required activities. The health and safety plan would outline the physical and chemical hazards associated with the work to be performed at the site and would serve as the instrument of control for ensuring the health and safety of personnel at the site.

Contractor and Material Procurement

This would include preparation of bid packages for the remedial activities, solicitation of bids, bid review, and contractor selection. Materials and equipment required to complete the remedial activities would also be selected and procured.

Mobilization and Demobilization

The first phase of this alternative would include mobilization of the required personnel, equipment, and facilities. It is anticipated that locations for injection wells can be selected from currently accessible areas or with limited site preparation. Following installation of the injection wells and initial round of substrate injections, all personnel, equipment and materials would be demobilized, as subsequent treatment would be performed using the existing injection wells minimizing additional mobilization/demobilization.

10.2.5.1 Description of Alternative

Alternative GW-4 would involve: (1) installation of six injection/monitoring wells; and (2) injection of sufficient carbon substrate to treat the suspected source area of the TCE plume. For the purpose of the cost estimate, it was assumed the substrate would be sodium lactate. Approximately 19,000 pounds of sodium lactate (applied in a 15 percent solution) would be required to reduce source area TCE concentrations *in situ*. The sodium lactate requirement is based on required mass to achieve a concentration of 500 mg/L within the targeted region. This concentration of sodium lactate will stimulate microbial growth which will deplete naturally-occurring electron receptors and drive the target area into increased reducing conditions (lower ORP) favorable to the sequential reductive dechlorination of TCE and its daughter products. **Figure 10-3** shows the approximate treatment zone and proposed injection grid in which Alternative GW-4 would be applied. This treatment zone covers an area of approximately 48,000 square ft and corresponds to the source of the TCE plume. Due to the location of the TCE source within a “Munitions Waste Pit,” in which MEC was discovered during the source area investigation, injection/monitoring wells will need to be installed outside of the boundaries of the landfill. The sodium lactate solution would be pumped or gravity fed directly into each injection well, requiring approximately eight days to complete. A total of three periodic treatments will be performed to reduce TCE groundwater concentrations in the source area and later to downgradient receptors.

The first stage of this treatment would include bench scale and pilot tests to ensure the efficacy of the RA and select the most effective carbon substrates. Bench scale studies would incorporate the evaluation of multiple carbon substrates and injectable nano-scale ZVI. A pilot test would then be conducted in the source area of the plume. The pilot study would utilize the six injection/monitoring wells installed for the pilot test, which would be used for the full-scale treatment as injection points. Selection of one well to use as the pilot injection well would be made based on observations made during installation, well yield, and number and distribution of producing fractures determined from borehole geophysics. The other components of this alternative include groundwater monitoring, ICs, planning, permitting, and reporting as presented under Alternative GW-2.

10.2.5.2 Evaluation of Screening Criteria

Overall Protection of Human Health and the Environment

The treatment proposed under Alternative GW-4 would rapidly reduce contaminant concentrations within the treatment area, and later reduce downgradient TCE concentrations at the downgradient well and wetland receptors. Following source zone treatment of the groundwater plume, MNA is expected to treat the remaining groundwater contamination to the TCE SCL within a 50-year period. MNA attenuation rates will be evaluated during the first and subsequent five-year reviews. Thus, the risk to human health and the environment would be minimized with this alternative and eventually eliminated. The protection of human health from the groundwater contamination in the bedrock aquifer would be further afforded through the implementation of ICs, particularly the groundwater use restrictions. The entirety of Picatinny Arsenal is within a Well Restriction Area as specified in a Classification Exception Area established by the NJDEP. The Classification Exception Area is updated biennially by the Army with a biennial certification sent to the NJDEP. As part of the biennial certification the Army reviews site use to ensure the remedy (including groundwater restrictions) is operating successfully. Additionally, this site remedy will be reviewed every five years by the USEPA as part of the CERCLA remedy. Concentrations in surface water are expected to be reduced to below federal and state promulgated standards within a 50-year period following remedy implementation.

Enforcement of ICs and LUCs identified in **Section 10.2.3.1** would prevent unauthorized site access or activities which could pose unacceptable risk to human health due to potential MEC or TCE in subsurface soil.

Compliance with ARARs

Enhanced anaerobic bioremediation is a proven technology for the treatment of TCE contaminated groundwater. Chemical-specific ARARs will be met at the end of the remedial action. Alternative GW-4 would comply with all location- and action-specific ARARs. Location-specific ARARs include wetland regulations within the clean water act. Compliance with these regulations will be complied with during well drilling, injection of electron donor and abandonment activities. Compliance with action-specific ARARs for activities related to the injection of electron donor can easily be met. To be considered guidance for well drilling and abandonment can be easily complied with using industry standard practices. Discharge to groundwater permit by rule regulations require that the remedial action not contravene NJDEP groundwater quality standards. These regulations can be complied with through thorough planning, dosage calculations and post injection monitoring. NJDEP regulation also dictates that drill cuttings can be returned to the site provided they do not contain free product or residual product. These regulations can be complied with through testing and proper disposal of cutting should they contain free or residual product.

Long-Term Effectiveness and Permanence

Upon completion of the organic substrate injections, the groundwater is expected to show rapid TCE concentration decreases within the treatment area. The long-term effectiveness of organic substrate injection in the treatment zone is limited, however, by an active source area and expected rebound of the TCE concentrations in groundwater. Long-term TCE groundwater concentrations are expected to decrease to ARARs in 50 years. The effectivness of this alternative is poor due to the large amount of buried metal, debris, and MEC at the site. In order to be effective, the electron donor must be in contact with the contaminated soil within the source area. The contaminated soil is comingled with or below MEC, MD, crushed drums and other debris. Therefore, injection wells would have to be placed upgradient of the source area, minimizing required contact.

Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative is expected to provide effective reduction of toxicity, mobility, and volume of contamination within the treatment zone by reduction of groundwater TCE concentrations. As a result of treatment, discharge of contaminated groundwater to downgradient receptors would be subsequently reduced for a three or more year period after treatments, with gradual reduction of residual TCE concentration by MNA over a 50-year period.

Short-Term Effectiveness

The short-term effectiveness of this alternative is good. There is a risk that site workers may be exposed to contaminated groundwater during the injections of the substrate. However, those hazards would be minimized through the use of proper personal protection and field techniques. There are not any special procedures or precautions for substrate injection, either from integrity and effectiveness, or a health and safety standpoint. In the short-term, implementation of Alternative GW-4 could result in the increase of potentially hazardous TCE daughter products. However, these would be subsequently degraded within the treatment zone, although bioaugmentation may be required (is costed) for mineralization of VC. Bioaugmentation has been demonstrated effectively where the indigenous microbial population is incapable of VC degradation. Bioaugmentation cultures are commercially available.

Implementability

Although considered innovative, enhanced anaerobic biodegradation has been implemented widely for groundwater remediation in recent years. Technology implementation is contingent upon successful bench and pilot scale studies. A potential issue could be obtaining regulatory approval for substrate injection; although, a formal permit from the NJDEP is not required for a CERCLA action. However, it has been documented that this technology is generally acceptable in the state of New Jersey. The implementability of this alternative is poor due to the large amount of buried metal debris and MEC at the site. Enhanced anaerobic bioremediation is both technically and administratively feasible although complicated by the site conditions. Materials and equipment to implement the remedy are readily available.

Cost

The total estimated cost for Alternative GW-4 is $1,203,064.81, including $469,863.67 in capital costs and $733,201.14 in O&M costs. Detailed costs for Alternative GW-4 are provided in **Appendix P** of this volume.

10.2.6 Alternative GW-5: TCE Source Material Removal and MNA Polishing with ICs

MNA is proposed in this alternative, as a polishing step after excavation of suspected TCE contaminated source soils, including confirmatory sampling of the limits of excavation. MNA monitoring would be used upon completion of the proposed source material removal, and continue until the TCE ARAR is achieved in groundwater. **Figure 10-4** shows the approximate location of the suspected source area to be excavated, as well as the extent of the required sidewall cutback. During intrusive activities, UXO personnel will be on-site to assess the site for MEC/MD. The remainder of MEC/MD associated with the site will be handled under the Inactive Munitions Waste Pit (PICA-0113-R-01) MMRP site. Following the excavation of TCE contaminated source soil, the excavation would be backfilled with clean fill to meet existing site contours.

A 10-year monitoring period is assumed based upon the results of USEPA Bioscreen simulations, which indicate NA would result in TCE groundwater concentrations below SCLs in approximately eight years, following TCE source removal. For the Bioscreen simulations, TCE was treated as a conservative solute without any degradation or transformation. The simulation was run, first, using the maximum observed source area groundwater concentration (in 13MW-1) and, second, using the calculated groundwater leachate concentration calculated from the maximum detected TCE soil concentration, from the source area investigation, using VLEACH. Both computations yielded an eight year timeframe to reach the TCE SCL. Following the proposed excavation, downgradient wells and surface water would be monitored on a semi-annual basis to year five. Wells would then be sampled annually to year 10. Results of the first and subsequent five-year study will include a revised MNA timeframe for the remainder of the dissolved TCE plume.

An integral element of this alternative is a combination of MNA and ICs, which includes institutional and access restrictions, public education, emergency provisions, as well as LTM of the groundwater and surface water. No active treatment would be implemented to remove contaminants from the impacted groundwater. Rather, monitoring of groundwater and surface water would verify that

contaminants are being attenuated. Therefore, ICs must be implemented until SCLs are met to minimize risk to potential receptors.

In addition, Alternative GW-5 would involve continuous implementation of ICs, in particular, restrictions on groundwater use. The long-term groundwater monitoring program for this area would be used to determine whether subsequent actions were required and determine if NA is progressing as anticipated following completion of the source remediation, if it is required. Discussions of the MNA, IC, and LTM components of this alternative are presented under Alternative GW-2.

10.2.6.1 Description of Alternative

Alternative GW-5 would involve the excavation, transport and disposal of approximately 1,334 cubic yards (CY) of TCE contaminated soil. In addition, an estimated 5,334 CY of clean overburden and 11,419 CY of sidewall cutback soils will need to be excavated and staged near the site in order to facilitate excavation of TCE contaminated soil. The clean overburden volume is based on the same area estimate of 120 ft by 60 ft, with a 20 ft thickness. The sidewall cutback volume was calculated based on a total excavation depth of 25 ft, and a sidewall slope of 1:2 (a worst-case scenario applicable to the fill material encountered at the site). During excavation, all soil will be assessed for MEC/MD. It is assumed that the majority of MEC/MD items will be located within the TCE contaminated soil and sidewall cutback soil from approximately 20 to 25 ft bgs. Assuming MEC/MD/OD items will account for approximately 30 percent of the material from 20 to 25 ft bgs, approximately 675 cubic yards of MEC/MD/other debris are anticipated at the site. The timeframe for completion of the excavation is approximately 16 weeks. The major elements are discussed in further detail below.

Design and Permitting

Once an RA has been selected and the PP and ROD have been completed, a remedial design would be prepared. This would include, at a minimum, a site-specific work plan describing the remedial activities, QA/QC procedures, technical specifications, a soil erosion and sedimentation control plan, and a site health and safety plan. The design documents would be submitted for review and approval by the appropriate agencies prior to initiation of remedial activities.

The initial phase of the work would consist of the preparation of a site-specific health and safety plan. Because the remedial action would be conducted under CERCLA, the substantive requirements of the permits, and permitting agencies, would be followed in lieu of obtaining formal permits for required activities. The health and safety plan would outline the physical and chemical hazards associated with the work to be performed at the site and would serve as the instrument of control for ensuring the health and safety of personnel at the site. The health and safety plan would also outline the air monitoring program that would be implemented during the excavation activities to ensure that a safe working environment is maintained. The health and safety plan will provide the action levels that will dictate the need for implementation of dust controls at the site.

Critical design elements and considerations would include work plan preparation, ESS, development of waste excavation and handling procedures, development of MEC/MD handling procedures, and design of erosion and sedimentation controls. Because this action would be performed under CERCLA, Picatinny is only required to file State and local permit equivalents. Permit equivalents will be filed for a storm water permit. Preparation of a Soil Erosion and Sedimentation Control Plan will also be required.

Contractor and Material Procurement

This would include preparation of bid packages for the remedial activities, solicitation of bids, bid review, and contractor selection. Materials and equipment required to complete the remedial activities would also be selected and procured.

Mobilization and Site Preparation

The first phase of this alternative would include mobilization of the required personnel, equipment, and facilities. Following mobilization, site preparation would occur. During the site preparation task, a small equipment decontamination area would be constructed to allow for the decontamination of equipment used on-site during construction activities. Liquids generated during

decontamination activities will be collected, sampled, analyzed, and disposed of at an appropriate permitted facility.

Material and waste staging areas would also be constructed during the site preparation phase to provide an area for storage of soils, MEC, MD, materials, and miscellaneous equipment used during site activities. A "clean" access road may also be required to allow trucks hauling clean backfill and waste materials to enter and exit without requiring decontamination.

Prior to the commencement of site clearing activities, the soil and sediment and erosion controls that are required to meet applicable local, state, and federal guidelines will be installed. These soil and sediment controls will be properly maintained during contaminated soil and sediment excavation, and will be removed once the disturbed areas have been restabilized. As required, the controls would consist of installation of silt fence, straw bale barriers, and diversion berms, as well as construction of a stabilized entrance through which vehicles will enter and exit the site. Erosion and sedimentation controls will be detailed in the site-specific Soil Erosion and Sedimentation Control Plan.

Contaminated Soil Excavation and Confirmatory Sampling

Contaminated soil would be excavated using an armored excavator with a minimum reach of 40 ft. All excavated soil to be transported to off-site landfills (RCRA Subtitle C or D) will be screened by a separate team of UXO technicians and certified as safe prior to being loaded into dump trucks and transported off-site. Additional details on MEC support are provided in the section below. Waste characterization samples would be collected and analyzed to ensure proper disposal. Standard dust control techniques would be used during the excavation activities to mitigate the potential for release of contaminated dust. Visual observations and confirmatory sampling will be used to determine the limits of the excavation.

Confirmatory samples will be collected for every 30 ft of each excavation sidewall and 900 square ft of each excavation bottom. Sample locations will be biased toward locations and depths of the highest expected contamination, utilizing an organic vapor analyzer and field indicators. Samples will be analyzed for VOCs. The excavation of contaminated soil will comply with the NJDEP Technical Requirements for Site Remediation set forth in NJAC 7:26E.

MEC Support

Based on the findings of the source area investigation and past site use MEC support will be required for intrusive activities. The purpose of MEC support is to reduce the potential for exposure to MEC and eliminate the potential for MEC to be transported off-site. All MEC support activities will be conducted in accordance with EP 75-1-2 (USACE, 2004) and DoD 6055.09-M. The type of MEC support required at the site will be dependent on the likelihood of encountering MEC/MD.

In areas where the MEC/MD is not likely (i.e., clean overburden), construction support activities will be required. This will consist of having two UXO technicians visually observe the excavation. Armoring and shielding will take place prior to excavation. Additional details on the armoring and shielding requirements will be provided in the ESS. Excavation will proceed in 6-inch lifts such that debris will be observed if present. A UXO team, will perform the construction support activities. Prior to non-intrusive activities (i.e., clearing, grubbing, and sampling), the UXO team will perform a visual survey of the site and identify any MEC/MD items. One UXO team member will be located to the rear and upwind of the excavation equipment and will visually observe excavation.

If debris is observed or once the excavation approach within 2 ft of where the debris is anticipated, the construction support process will be terminated and soil screening will commence. This will continue for the areas saturated with debris (i.e., vehicles, drums, MEC, MD, etc.). All material will be removed in 6-inch lifts. These soils will be visually inspected and all MEC/MD will be removed.

The debris will be separated into bins based on the type of debris. MD will be placed in a lockable container for further certification. MEC will be placed in a bin pending transport to the consolidation area for future disposal. Non-MD will be segregated into hazardous and non-hazardous waste bins for appropriate off-site disposal.

Exclusion zones (EZ) will have to be established, implemented and enforced during intrusive activities. The size of the EZ will be determined by the size and type of MEC expected at the site. EZ distances could potentially encompass on-post facilities, including roads and buildings, which could result in the restriction of some activities and workspace at Picatinny during implementation of this RA. Additional details on the EZ required for intrusive activities will be presented in the site-specific ESS.

MEC/MD Identification and Handling

UXO Technicians will make every effort to identify MEC through visual examination of items for markings and other identifying features such as shape, size, and external fittings. All MEC and MD identified at the site will be carefully cataloged and the location accurately recorded. Items will not be moved during the inspection/identification until the nature and condition of the item can be ascertained. The Senior UXO Specialist (SUXOS) and the UXO QC Specialist (UXOQCS) will agree on the positive identification and disposition of the item prior to implementing any disposal operations. All MEC disposal activities will be performed in accordance with EM-385-1-97 (USACE, 2008) and TM 60A-1-1-31 (Department of the Army, 2008) in addition to federal, state, and local regulations.

All MEC will be subjected to demolition procedures. Demolition will be conducted through blow-in-place (BIP) operations or consolidated shots. If an item is safe to move, the item may be relocated for disposal due to safety concerns or to consolidate shots. Prior to any detonation, a pre-established notification procedure will be initiated. As soon as it is determined that a detonation will be required, the SUXOS will initiate this procedure. The SUXOS will schedule the demolition to allow sufficient time to complete all notifications, approvals, and evacuations as required.

During demolition activities, the SUXOS will maintain overall control of the site. An EZ will be established around the demolition area according to the ESS. Only essential personnel and the UXO team will be allowed within the EZ once the demolition operations have begun. The UXOSO will ensure safe work practices are observed, and the UXO Team Leader will perform the necessary steps to safely dispose of the MEC item. Additional details on MEC demolition procedures will be provided in the site-specific work plan and ESS.

IDW Disposal

All recovered scrap metal (i.e., MD or other debris) will be removed from the site. The contractor will ensure that all recovered scrap metal is free of MEC through expert inspection by UXO Technicians. Because the MD recovered will ultimately be treated as solid waste and disposed off-site, it is imperative that procedures be established to preclude live ordnance from becoming intermingled with MD. MD inspection will be designed to ensure that all such material is 100 percent independently inspected and then 100 percent re-inspected as part of the certification and verification process. Additional details on MD management will be provided in the site-specific work plan.

Backfill and Restoration

The excavated areas would be backfilled as soon as practicable with clean fill from an approved off-post source and clean overburden and sidewall cutback soil. The excavated areas would be restored to the original contours. Run-off collection and retention would be considered during the design phase to comply with all location- and action-specific ARARs.

Site Cleanup and Demobilization

The final phase of the work would involve site cleanup and demobilization of all personnel, facilities, and equipment.

10.2.6.2 Evaluation of Screening Criteria

Overall Protection of Human Health and the Environment

Alternative GW-5 provides an adequate protection of the human health through removal of MEC/MD and TCE-contaminated soil in source zone excavation as well as the implementation of groundwater ICs, primarily through groundwater use restrictions. Following source zone excavation, MNA is expected to treat the remaining groundwater contamination to the TCE SCL within a 10-year period. The 10-year time period is based on the results of USEPA Bioscreen simulations which indicate NA

would result in TCE groundwater concentrations below SCLs in approximately eight years, following TCE source removal. Concentrations in surface water are likewise expected to be reduced below federal and state promulgated standards with NA of TCE in groundwater. MNA attenuation rates will be evaluated during the first and subsequent five-year reviews. Thus, the risk to human health and the environment would be minimized with this alternative and eventually eliminated. The protection of human health from the groundwater contamination in the bedrock aquifer would be further afforded through the implementation of ICs, particularly the groundwater use restrictions. The entirety of Picatinny Arsenal is within a Well Restriction Area as specified in a Classification Exception Area established by the NJDEP. The Classification Exception Area is updated biennially by the Army with a biennial certification sent to the NJDEP. As part of the biennial certification the Army reviews site use to ensure the remedy (including groundwater restrictions) is operating successfully. Additionally, this site remedy will be reviewed every five years by the USEPA as part of the CERCLA remedy. Concentrations in surface water are expected to be reduced to below federal and state promulgated standards within a 10-year period following remedy implementation.

Enforcement of ICs and LUCs identified in **Section 10.2.3.1** would prevent unauthorized site access or activities which could pose unacceptable risk to human health due to potential MEC remaining in the Munitions Waste Pit not addressed by Alternative GW-5.

Compliance with ARARs

Excavation and disposal is a proven technology for the treatment of TCE contaminated soil. Chemical-specific ARARs will be met at the end of the remedial action. Alternative GW-5 would comply with all location- and action-specific ARARs. Location-specific ARARs include wetland regulations within the clean water act. Compliance with these regulations will be complied with during well drilling, abandonment activities, excavation, MEC handling/disposal, and backfilling. Compliance with action-specific ARARs for activities related to the remedial alternative can easily be met. To be considered guidance for well drilling and abandonment can be easily complied with using industry standard practices. NJDEP regulation dictates that remediation must remove free or residual product to the extent practicable. In the event that free or residual product be identified this will be complied with through testing of the waste streams and post-excavation sampling. NJDEP regulation also dictates that drill cuttings and excavation spoils can be returned to the site provided they do not contain free product or residual product. These regulations can be complied with through testing and proper disposal of soil should it contain free or residual product in the case of this remedial alternative, all soil contaminated with TCE will be disposed of offsite. RCRA regulations related to the categorization, packing, labeling, shipping and disposal of waste will be followed through testing and examination of the waste streams. RCRA Military Munitions regulations which determine whether military munitions are solid or hazardous waste will be complied with through examination and testing of the military munitions items. NJDEP regulations dictate allowable levels in soil for alternative backfill from onsite or offsite sources. This regulation will be complied with through testing of fill prior to use. State and federal regulations regarding storm water control will be complied with through testing in the event a waste stream is generated.

Long-Term Effectiveness and Permanence

Upon completion of the excavation, the groundwater is expected to show a gradual TCE concentration decrease within AA1. The source material excavation will permanently remove contaminants from the site likely resulting in significantly reduced MNA time period to cleanup. Long-term TCE groundwater concentrations are expected to decrease to ARARs in 10 years.

Long term effectiveness will also be dictated by the success of ICs implemented under the RA until the TCE groundwater ARAR is achieved. ICs include the base-wide CEA with corresponding WRA, and groundwater use restrictions evaluated during the five-year review. Funding for the ICs will be programmed by the U.S. Army for the duration of the remedial action ensuring continuous implementation of ICs.

Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative is expected to effectively remove the volume of MEC/MD and migration of MEC (and MC, if any) within the source zone excavation footprint; thereby, reducing the MEC hazard at the site. In addition, this alternative is expected to remove the entire volume of the TCE source soil. Toxicity

and mobility of TCE in groundwater would be reduced through removal of the TCE source. However, the toxicity and volume of soil removed from the site would be transferred to the disposal facility rather than eliminated. This alternative does not employ any treatment that would directly reduce the toxicity, mobility, or volume of COCs in groundwater. However, as a result of excavation, a gradual reduction of residual TCE concentrations in groundwater by MNA is anticipated over a 10-year period.

Short-Term Effectiveness

The short-term effectiveness of this alternative is adequate. Excavation activities would result in significant material handling and some dust generation, posing a risk that site workers may be exposed to contaminated soil. Additional short-term risks include those posed by the short-term presence of an open excavation, increased vehicle and equipment traffic, and backfilling of the excavation. Increased vehicle traffic includes on-site activities as well as off-site traffic due the delivery of required equipment and materials, including clean backfill soil. However, the potential for exposure and/or physical injury would be minimized through the use of proper personal protection, good construction practices, and standard dust suppression techniques. In addition, there is the potential to encounter MEC during the excavation, posing additional risks to site workers and the community. All site workers will be properly trained in MEC procedures, thereby reducing their risk. During the excavation, appropriate MEC controls, such as evacuation of non-essential personnel, engineering controls during demolitions activities, etc., will be implemented. These controls will mitigate risk to the community. Construction and MEC safety protocols have been shown to be effective and reliable at mitigating the identified risks when properly implemented. There are no significant environmental impacts associated with this RA. Due to the site's location in an active range area, access restrictions and work delays are anticipated during munitions testing at the nearby ranges. However, all site activities included in this alternative can be completed despite these restrictions through the use of prior planning, continuous communication, and alternative work schedules.

Implementability

Alternative GW-5 is readily implementable. The greatest obstacle to the implementation of this RA is the potential discovery of MEC. The approach for handling MEC can be readily implemented and will not significantly delay field activities. Due to the site's location in an active range area, access restrictions and work delays are anticipated during munitions testing at the nearby ranges. Construction practices, materials, and equipment are standard and readily available. Armoring of the excavator requires relatively simple modifications. Several services/facilities are capable of transporting and disposing the TCE contaminated soil.

Cost

The total estimated cost for Alternative GW-5 is $1,661,678.98, including $1,411,844.81 in capital costs and $249,834.17 in O&M costs. Detailed costs for Alternative GW-5 are provided in **Appendix P** of this volume.

10.2.7 Alternative GW-6: Total Landfill Removal and MNA Polishing with ICs

MNA is proposed in this alternative, as a polishing step after excavation of the entire Inactive Munitions Waste Pit landfill, including suspected TCE contaminated source soils, and confirmatory sampling of the limits of excavation. The extent of the entire landfill has been based on the final delineation of the "Munitions Waste Pit," by Weston in the MMRP RI. MNA monitoring would be used upon completion of the proposed source material removal, and continue until the TCE ARAR is achieved in groundwater. **Figure 10-5** shows the approximate location of the total area to be excavated, as well as the extent of the required sidewall cutback. During intrusive activities, UXO personnel will be on-site to assess the site for MEC/MD. Following excavation of the landfill; the excavation would be backfilled with clean fill to meet existing site contours.

A 10-year monitoring period is assumed based upon the results of USEPA Bioscreen simulations that indicate NA would result in TCE groundwater concentrations below SCLs in approximately eight years, following TCE source removal. For the Bioscreen simulations, TCE was treated as a conservative solute without any degradation or transformation. The simulation was run, first, using the maximum observed source area groundwater concentration (in 13MW-1) and, second, using the calculated groundwater leachate concentration calculated from the maximum detected TCE soil concentration, from

the source area investigation, using VLEACH. Both computations yielded an eight year timeframe to reach the TCE SCL. Following the proposed excavation, downgradient wells and surface water would be monitored on a semi-annual basis to year five. Wells would then be sampled annually to year 10. Results of the first and subsequent five-year study will include a revised MNA timeframe for the remainder of the dissolved TCE plume.

An integral element of this alternative is a combination of MNA and ICs, which includes institutional and access restrictions, public education, emergency provisions, as well as LTM of the groundwater and surface water. No active treatment would be implemented to remove contaminants from the impacted groundwater. Rather, monitoring of groundwater and surface water would verify that contaminants are being attenuated. Therefore, ICs must be implemented until SCLs are met to minimize risk to potential receptors.

In addition, Alternative GW-6 would involve continuous implementation of ICs, in particular, restrictions on groundwater use. The long-term groundwater monitoring program for this area would be used to determine whether subsequent actions were required and determine if NA is progressing as anticipated following completion of the source remediation, if it is required. Discussions of the MNA, IC, and LTM components of this alternative are presented under Alternative GW-2.

10.2.7.1 Description of Alternative

Alternative GW-6 would involve the excavation of the entire Inactive Munitions Waste Pit landfill (approximately 9,723 CY), including transport and disposal of approximately 1,334 CY of TCE contaminated soil. In addition, an estimated 26,852 CY of clean overburden and sidewall cutback soils will need to be excavated and staged near the site in order to facilitate excavation of TCE contaminated soil. During excavation, all soil will be assessed for MEC/MD. It is assumed that the majority of MEC/MD items will be located within the landfill. Assuming MEC/MD/other debris items will account for approximately 30 percent of the landfill volume, approximately 2,917 cubic yards of MEC/MD/other debris are anticipated at the site. The timeframe for completion of the excavation is approximately 38 weeks. The major elements are discussed in further detail below.

Design and Permitting

Once an RA has been selected and the PP and ROD have been completed, a remedial design would be prepared. This would include, at a minimum, a site-specific work plan describing the remedial activities, QA/QC procedures, technical specifications, a soil erosion and sedimentation control plan, and a site health and safety plan. The design documents would be submitted for review and approval by the appropriate agencies prior to initiation of remedial activities.

The initial phase of the work would consist of preparation of a site-specific health and safety plan. Because the remedial action would be conducted under CERCLA, the substantive requirements of the permits, and permitting agencies, would be followed in lieu of obtaining formal permits for required activities. The health and safety plan would outline the physical and chemical hazards associated with the work to be performed at the site and would serve as the instrument of control for ensuring the health and safety of personnel at the site. The health and safety plan would also outline the air monitoring program that would be implemented during the excavation activities to ensure that a safe working environment is maintained. The health and safety plan will provide the action levels that will dictate the need for implementation of dust controls at the site.

Critical design elements and considerations would include work plan preparation, Explosive Siting Plan, development of waste excavation and handling procedures, development of MEC/MD handling procedures, and design of erosion and sedimentation controls. Because this action would be performed under CERCLA, Picatinny is only required to file State and local permit equivalents. Permit equivalents will be filed for a storm water permit. Preparation of a Soil Erosion and Sedimentation Control Plan will also be required.

Contractor and Material Procurement

This would include preparation of bid packages for the remedial activities, solicitation of bids, bid review, and contractor selection. Materials and equipment required to complete the remedial activities would also be selected and procured.

Mobilization and Site Preparation

The first phase of this alternative would include mobilization of the required personnel, equipment, and facilities. Following mobilization, site preparation would occur. During the site preparation task, a small equipment decontamination area would be constructed to allow for the decontamination of equipment used on-site during construction activities. Liquids generated during decontamination activities will be collected, sampled, analyzed, and disposed of at an appropriate permitted facility.

Material and waste staging areas would also be constructed during the site preparation phase to provide an area for storage of soils, MEC, MD, materials, and miscellaneous equipment used during site activities. A “clean” access road may also be required to allow trucks hauling clean backfill and waste materials to enter and exit without requiring decontamination.

Prior to the commencement of site clearing activities, the soil and sediment and erosion controls that are required to meet applicable local, state, and federal guidelines will be installed. These soil and sediment controls will be properly maintained during contaminated soil and sediment excavation, and will be removed once the disturbed areas have been restabilized. As required, the controls would consist of installation of silt fence, straw bale barriers, and diversion berms, as well as construction of a stabilized entrance through which vehicles will enter and exit the site. Erosion and sedimentation controls will be detailed in the site-specific Soil Erosion and Sedimentation Control Plan.

Contaminated Soil Excavation and Confirmatory Sampling

Contaminated soil would be excavated using an armored excavator with a minimum reach of 40 ft bgs. All excavated soil to be transported to off-site landfills (RCRA Subtitle C or D) will be screened by a separate team of UXO technicians and certified as safe prior to being loaded into dump trucks and transported off-site. Additional details on MEC support are provided in the section below. Waste characterization samples would be collected and analyzed to ensure proper disposal. Standard dust control techniques would be used during the excavation activities to mitigate the potential for release of contaminated dust. Visual observations and confirmatory sampling will be used to determine the limits of the excavation.

Confirmatory samples will be collected for every 30 ft of each excavation sidewall and 900 square ft of each excavation bottom. Sample locations will be biased toward locations and depths of the highest expected contamination, utilizing an organic vapor analyzer and field indicators. Samples will be analyzed for VOCs. The excavation of contaminated soil will comply with the NJDEP Technical Requirements for Site Remediation set forth in NJAC 7:26E.

MEC Support

Based on the findings of the source area investigation and past site use MEC support will be required for intrusive activities. The purpose of MEC support is to reduce the potential for exposure to MEC and eliminate the potential for MEC to be transported off-site. All MEC support activities will be conducted in accordance with EP 75-1-2 (USACE, 2004) and DoD 6055.09-M. The type of MEC support required at the site will be dependent on the likelihood of encountering MEC/MD.

In areas where the MEC/MD is not likely (i.e., clean overburden and cutback area), construction support activities will be required. This will consist of having two UXO technicians visually observe the excavation. Armoring and shielding will take place prior to excavation. Additional details on the armoring and shielding requirements will be provided in the ESS. Excavation will proceed in 6-inch lifts such that debris will be observed if present. A UXO team, consisting of UXO-qualified personnel, will perform the construction support activities. Prior to non-intrusive activities (i.e., clearing and grubbing and sampling), the UXO team will perform a visual survey of the site and identify any MEC/MD items. One UXO team member will be located to the rear and upwind of the excavation equipment and will visually observe excavation.

If debris is observed or once the excavation approach within 2 ft of where the debris is anticipated, the construction support process will be terminated and soil screening will commence. This will continue for the areas saturated with debris (i.e., vehicles, drums, MEC, MD, etc.). All material will be removed in 6-inch lifts. These soils will be visually inspected and all MEC/MD will be removed.

The debris will be separated into bins based on the type of debris. MD will be placed in a lockable container for further certification. MEC will be placed in a bin pending transport to the consolidation area for future disposal. Non-MD will be segregated into hazardous and non-hazardous waste bins for appropriate off-site disposal.

EZ will have to be established, implemented and enforced during intrusive activities. The size of the EZ will be determined by the size and type of MEC expected at the site. EZ distances could potentially encompass on-post facilities, including roads and buildings, which could result in the restriction of some activities and workspace at Picatinny during implementation of this RA. Additional details on the EZ required for intrusive activities will be presented in the site-specific ESS.

MEC/MD Identification and Handling

UXO Technicians will make every effort to identify MEC through visual examination of items for markings and other identifying features such as shape, size, and external fittings. All MEC and MD identified at the site will be carefully cataloged and the location accurately recorded. Items will not be moved during the inspection/identification until the nature and condition of the item can be ascertained. The SUXOS and the UXOQCS will agree on the positive identification and disposition of the item prior to implementing any disposal operations. All MEC disposal activities will be performed in accordance with EM-385-1-97 (USACE, 2008) and TM 60A-1-1-31 (Department of the Army, 2008) in addition to federal, state, and local regulations.

All MEC will be subjected to demolition procedures. Demolition will be conducted through BIP operations or consolidated shots. If an item is safe to move, the item may be relocated for disposal due to safety concerns or to consolidate shots. Prior to any detonation, a pre-established notification procedure will be initiated. As soon as it is determined that a detonation will be required, the SUXOS will initiate this procedure. The SUXOS will schedule the demolition to allow sufficient time to complete all notifications, approvals, and evacuations as required.

During demolition activities, the SUXOS will maintain overall control of the site. An EZ will be established around the demolition area according to the ESS. Only essential personnel and the UXO team will be allowed within the EZ once the demolition operations have begun. The UXOSO will ensure safe work practices are observed, and the UXO Team Leader will perform the necessary steps to safely dispose of the MEC item. Additional details on MEC demolition procedures will be provided in the site-specific work plan and ESS.

IDW Disposal

All recovered scrap metal (i.e., MD or other debris) will be removed from the site. The contractor will ensure that all recovered scrap metal is free of MEC through expert inspection by UXO Technicians. Because the MD recovered will ultimately be treated as solid waste and disposed off-site, it is imperative that procedures be established to preclude live ordnance from becoming intermingled with MD. MD inspection will be designed to ensure that all such material is 100 percent independently inspected and then 100 percent re-inspected as part of the certification and verification process. Additional details on MD management will be provided in the site-specific work plan.

Backfill and Restoration

The excavated areas would be backfilled as soon as practicable with clean fill from an approved off-post source and clean overburden and sidewall cutback soil. The excavated areas would be restored to the original contours. Run-off collection and retention would be considered during the design phase to comply with all location- and action-specific ARARs.

Site Cleanup and Demobilization

The final phase of the work would involve site cleanup and demobilization of all personnel, facilities, and equipment.

10.2.7.2 Evaluation of Screening Criteria

Overall Protection of Human Health and the Environment

Alternative GW-6 provides an adequate protection of the human health through removal of the landfill, which contains MEC/MD/other debris and TCE-contaminated soil, as well as the implementation of groundwater ICs, primarily through groundwater use restrictions. Following source zone excavation, MNA is expected to treat the remaining groundwater contamination to the TCE SCL within a 10-year period. The 10-year time period is based on the results of USEPA Bioscreen simulations which indicate NA would result in TCE groundwater concentrations below SCLs in approximately eight years, following TCE source removal. Concentrations in surface water are likewise expected to be reduced below federal and state promulgated standards with NA of TCE in groundwater. MNA attenuation rates will be evaluated during the first and subsequent five-year reviews. Thus, the risk to human health and the environment would be minimized with this alternative and eventually eliminated. The protection of human health from the groundwater contamination in the bedrock aquifer would be further afforded through the implementation of ICs, particularly the groundwater use restrictions. Concentrations in surface water are expected to be reduced to below federal and state promulgated standards within a 10-year period following remedy implementation. Alternative GW-6 has the added benefit of removing any risks associated with the Inactive Munitions Waste Pit MRS (which are not evaluated in this document).

Compliance with ARARs

Excavation and disposal is a proven technology for the treatment of TCE contaminated soil. Chemical-specific ARARs will be met at the end of the remedial action. Alternative GW-5 would comply with all location- and action-specific ARARs. Location-specific ARARs include wetland regulations within the clean water act. Compliance with these regulations will be complied with during well drilling, abandonment activities, excavation, MEC handling/disposal, and backfilling. Compliance with action-specific ARARs for activities related to the remedial alternative can easily be met. To be considered guidance for well drilling and abandonment can be easily complied with using industry standard practices. NJDEP regulation dictates that remediation must remove free or residual product to the extent practicable. In the event that free or residual product be identified this will be complied with through testing of the waste streams and post-excavation sampling. NJDEP regulation also dictates that drill cuttings and excavation spoils can be returned to the site provided they do not contain free product or residual product. These regulations can be complied with through testing and proper disposal of soil should it contain free or residual product in the case of this remedial alternative, all soil contaminated with TCE will be disposed of offsite. RCRA regulations related to the categorization, packing, labeling, shipping and disposal of waste will be followed through testing and examination of the waste streams. RCRA Military Munitions regulations which determine whether military munitions are solid or hazardous waste will be complied with through examination and testing of the military munitions items. NJDEP regulations dictate allowable levels in soil for alternative backfill from onsite or offsite sources. This regulation will be complied with through testing of fill prior to use. State and federal regulations regarding storm water control will be complied with through testing in the event a waste stream is generated.

Long-Term Effectiveness and Permanence

Upon completion of the excavation, the groundwater is expected to show a gradual TCE concentration decrease within AA1. The source material excavation will permanently remove contaminants from the site likely resulting in significantly reduced MNA time period to cleanup. Long-term TCE groundwater concentrations are expected to decrease to ARARs in 10 years.

Long term effectiveness will also be dictated by the success of ICs implemented under the RA until the TCE groundwater ARAR is achieved. ICs include the base-wide CEA with corresponding WRA, and groundwater use restrictions evaluated during the five-year review. Funding for the ICs will be programmed by the U.S. Army for the duration of the remedial action ensuring continuous implementation of ICs.

Reduction of Toxicity, Mobility, and Volume through Treatment

This alternative is expected to effectively remove the volume of MEC/MD and migration of MEC (and MC, if any) within the excavation footprint; thereby, reducing the MEC hazard at the site. In addition,

this alternative is expected to provide effective reduction of toxicity, mobility, and volume of contamination of environmental media within the potential source material. Toxicity, mobility, and volume would be removed from the site. However, the toxicity and volume removed from the site would be transferred to the disposal facility rather than eliminated. This alternative does not employ any treatment that would reduce the toxicity, mobility, or volume of COCs in groundwater. However, as a result of excavation, a gradual reduction of residual TCE concentrations in groundwater by MNA is anticipated over a 10-year period.

Short-Term Effectiveness

The short-term effectiveness of this alternative is adequate. Excavation activities would result in significant material handling and some dust generation, posing a risk that site workers may be exposed to contaminated soil. Additional short-term risks include those posed by the short-term presence of an open excavation, increased vehicle and equipment traffic, and backfilling of the excavation. Increased vehicle traffic includes on-site activities as well as off-site traffic due the delivery of required equipment and materials, including clean backfill soil. However, the potential for exposure and/or physical injury would be minimized through the use of proper personal protection, good construction practices, and standard dust suppression techniques. In addition, there is the potential to encounter MEC during the excavation posing additional risks to site workers and the community. All site workers will be properly trained in MEC procedures; thereby reducing their risk. During the excavation, appropriate MEC controls, such as evacuation of non-essential personnel, engineering controls during demolitions activities, etc., will be implemented. These controls will mitigate risk to the community. Construction and MEC safety protocols have been shown to be effective and reliable at mitigating the identified risks when properly implemented. There are no significant environmental impacts associated with this RA. Due to the site's location in an active range area, access restrictions and work delays are anticipated during munitions testing at the nearby ranges. However, all site activities included in this alternative can be completed despite these restrictions through the use of prior planning, continuous communication and alternative work schedules.

Implementability

Alternative GW-6 is readily implementable. The greatest obstacle to the implementation of this RA is the potential discovery of MEC. The for handling MEC can be readily implemented and will not significantly delay field activities. Due to the site's location in an active range area, access restrictions and work delays are anticipated during munitions testing at the nearby ranges. Construction practices, materials and equipment are standard and readily available. Armoring of the excavator requires relatively simple modifications. Several services/facilities are capable of transporting and disposing the TCE contaminated soil.

Cost

The total estimated cost for Alternative GW-6 is $2,610,027.62, including $2,360,193.45 in capital costs and $249,834.17 in O&M costs. Detailed costs for Alternative GW-6 are provided in **Appendix P** of this volume.

10.3 COMPARISON OF ALTERNATIVES FOR TCE IN GROUNDWATER

This section compares the RAs for groundwater according to the seven screening criteria. These comparisons are made so that the most appropriate alternative can be selected. Alternatives GW-2 through GW-6 rely on MNA and would provide comparable protection to human health through the continued implementation of ICs; primarily the groundwater use restrictions and because the 600 Area groundwater is no longer used to supply Building 660. Alternatives GW-3 and GW-4 provide protection to the environment because contaminant concentrations in the surface water would be reduced through treatment of upgradient groundwater. While Alternatives GW-3 through GW-6 all result in the reduction of TCE in surface water, due to the reliance of Alternatives GW-5 and GW-6 on MNA for the reduction of TCE concentrations in groundwater, the benefit to surface water is anticipated to lag that provided by Alternatives GW-3 and GW-4. However Alternatives GW-3 and GW-4 have the potential for TCE concentrations to rebound, thus, Alternatives GW-5 and GW-6 provide greater protection of the environment, as there is no anticipated rebound in TCE concentrations for these alternatives. Alternative GW-1 does not meet the threshold criterion for protection of human health and the environment. Action-specific and location-specific ARAR compliance would be satisfied by all alternatives.

Alternatives GW-5 and GW-6 provide the greatest long-term effectiveness, through removal of the TCE source in soil. Compared to other alternatives, Alternative GW-6 offers the greatest protection as only groundwater ICs would be required for a period of 10 years. Alternative GW-6 fully mitigates the risk of MEC from the Munitions Waste Pit. Alternative GW-5 offers the same level of protection for groundwater, but only partially mitigates the risk of MEC as the entire Munitions Waste Pit would not be addressed. Alternatives GW-3 and GW-4 provide greater long-term effectiveness than Alternative GW-2 through treatment of the groundwater source area and resulting reduction of downgradient groundwater and surface water TCE concentrations. The long-term effectiveness and permanence of these active groundwater treatment alternatives are compromised by an active source in AOC 1. TCE concentrations may rebound after treatment, and extend the follow-on monitoring period. Under Alternative GW-2, the residual risks in groundwater would remain unchanged. The adequacy and reliability of Alternatives GW-2, GW-3, and GW-4 exceeds that of Alternative GW-1 due to the groundwater and surface water monitoring program and monitoring and enforcement of ICs. Residual risks in ground water would also remain unchanged for Alternative GW-1. Alternatives GW-3 and GW-4 reduce contaminant concentrations, thereby reducing toxicity, mobility, and volume in groundwater through contaminant destruction.

Alternative GW-1 offers unchanged risk to the community; however, the RAOs, and thus the SCLs would not be achieved. Alternatives GW-2 through GW-6 involve continuous implementation of ICs, in particular, restrictions on groundwater use and implementation of a long-term groundwater monitoring program for contaminated groundwater. The greatest short-term risks are posed by Alternative GW-6, followed by Alternative GW-5. Alternative GW-6 has risk associated with its area of disturbance during the excavation and the potential for discovery of MEC. Alternative GW-5 has the second greatest short-term risk, as the risks are similar to Alternative GW-6 but the area of disturbance is smaller. However, the short term risk associated with Alternatives GW-5 and GW-6 are manageable through engineering controls. Elevated short-term risks to the community and construction workers would be experienced under the implementation of Alternatives GW-3 and GW-4 in comparison to Alternative GW-2; however, risks are considered manageable.

Alternatives GW-2, GW-3, GW-4, GW-5 and GW-6 are implementable; however, approvals from other agencies would be the most difficult for Alternative GW-1, as indicated from previous negotiations with NJDEP and USEPA. The implementability of Alternatives GW-3 and GW-4 would be slightly more involved as these technologies are considered innovative and are contingent on a successful bench and/or pilot studies. Literature review has shown that Alternatives GW-3 and GW-4 have been demonstrated successfully on the field scale for treatment of TCE-contaminated groundwater. However large amounts of buried metal and potential MEC on-site provide an additional challenge to implementing Alternatives GW-3 and GW-4, requiring modifications to the successful demonstrations of these technologies. The location of injection points must be installed outside the limits of the Munitions Waste Pit, reducing the effectiveness of these alternatives. Alternative GW-1 ($0) is the least costly option, followed by Alternatives GW-2 ($680,235.73). Alternative GW-3 ($1,081,495.01) is less expensive than Alternative GW-4 ($1,203,064.81). Alternative GW-6 involves the highest total cost ($2,791,911.60), including the greatest initial capital cost ($2,542,077.43), followed by Alternative GW-5 ($1,917,756.43 total, $1,667,922.26 capital).

Figure 10-1: Nine Criteria for Detailed Analysis of Remedial Alternatives

THRESHOLD CRITERIA

1 Overall Protection of Human Health and the Environment

- How the Alternative Provides Human Health and Environmental Protection

2 Compliance with ARARs (or justification of a Waiver)

- Compliance with Chemical-Specific ARARs
- Compliance with Location-Specific ARARs
- Compliance with Action-Specific ARARs
- Compliance with Other Criteria, Advisories, and Guidance (TBC Guidance)

PRIMARY BALANCING CRITERIA

3 Long-Term Effectiveness and Permanence

- Magnitude of Residual Risk
- Adequacy and Reliability of Controls

4 Reduction of Toxicity, Mobility, or Volume through Treatment

- Treatment Process used and Materials Treated
- Amount of Hazardous Materials Destroyed or Treated
- Degree of Expected Reductions in Toxicity, Mobility or Volume
- Degree to which Treatment is Irreversible
- Type and Quantity of Residuals Remaining after Treatment

5 Short-Term Effectiveness

- Protection of Community during Remedial Actions
- Protection of Workers during Remedial Actions
- Environmental Impacts
- Time Unit Remedial Action Objectives are Achieved

6 Implementability

- Ability to Construct and Operate the Technology
- Reliability of the Technology
- Ease of Undertaking Additional Remedial Actions, if necessary
- Ability to Monitor Effectiveness of Remedy
- Coordination with Other Agencies
- Availability of Off-Site Treatment, Storage and Disposal Services, and Capacity
- Availability of Necessary Equipment, Materials, and Specialists
- Availability of Prospective Technologies

7 Cost

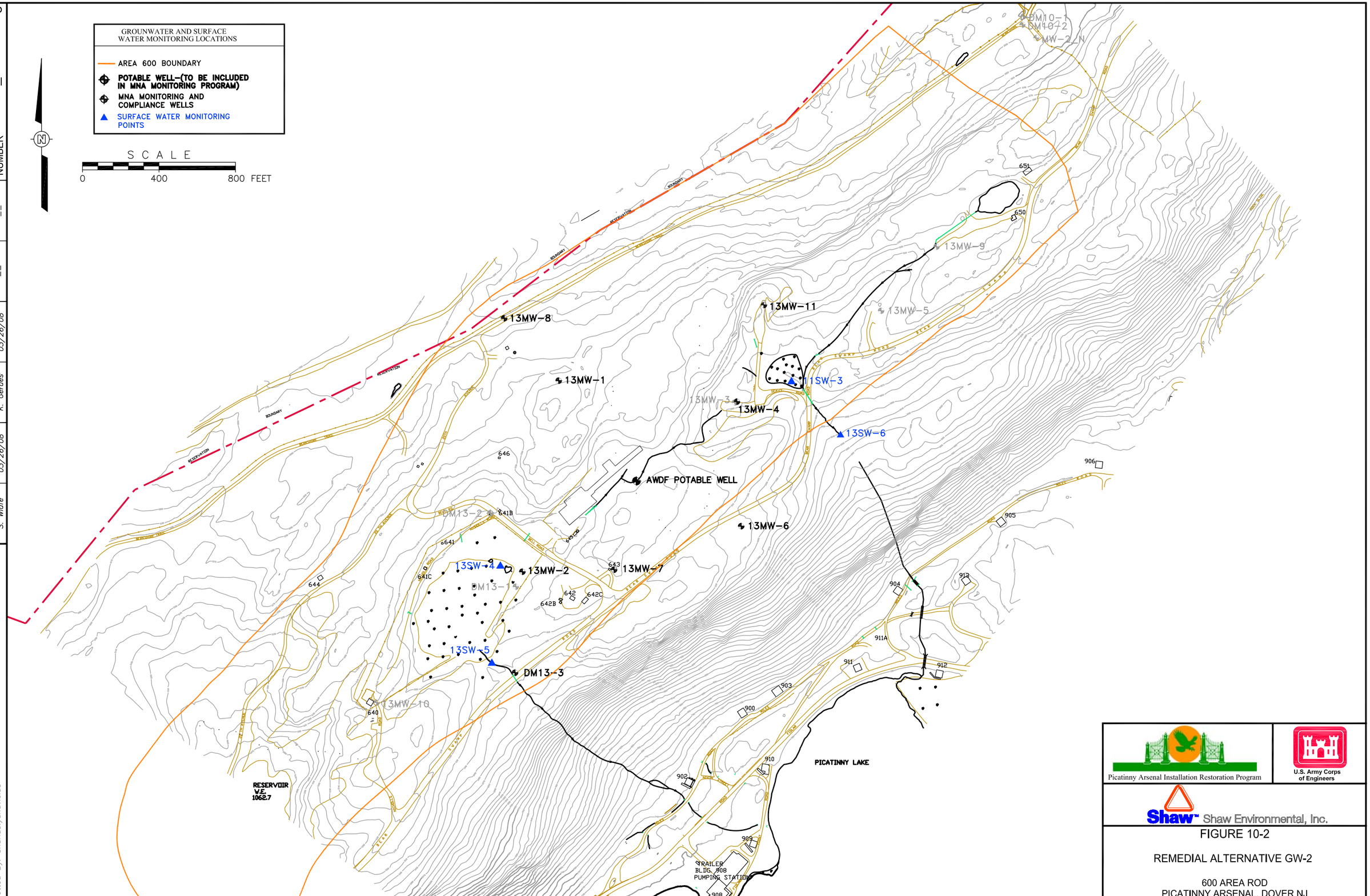
- Estimated Capital Costs
- Estimated Annual Operation and Maintenance Costs
- Estimated Present Worth Costs

MODIFYING CRITERIA[1]

8 State Acceptance

9 Community Acceptance

[1]These criteria are fully assessed following comment on the RI/FS Report and the Proposed Plan, and will be fully addressed in the ROD.



Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Environmental, Inc.

FIGURE 10-2

REMEDIAL ALTERNATIVE GW-2

600 AREA ROD
PICATINNY ARSENAL, DOVER NJ

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AWDF_091007.dwg	-- --	K. Gerdes 03/26/08	S. Wiafe 03/26/08

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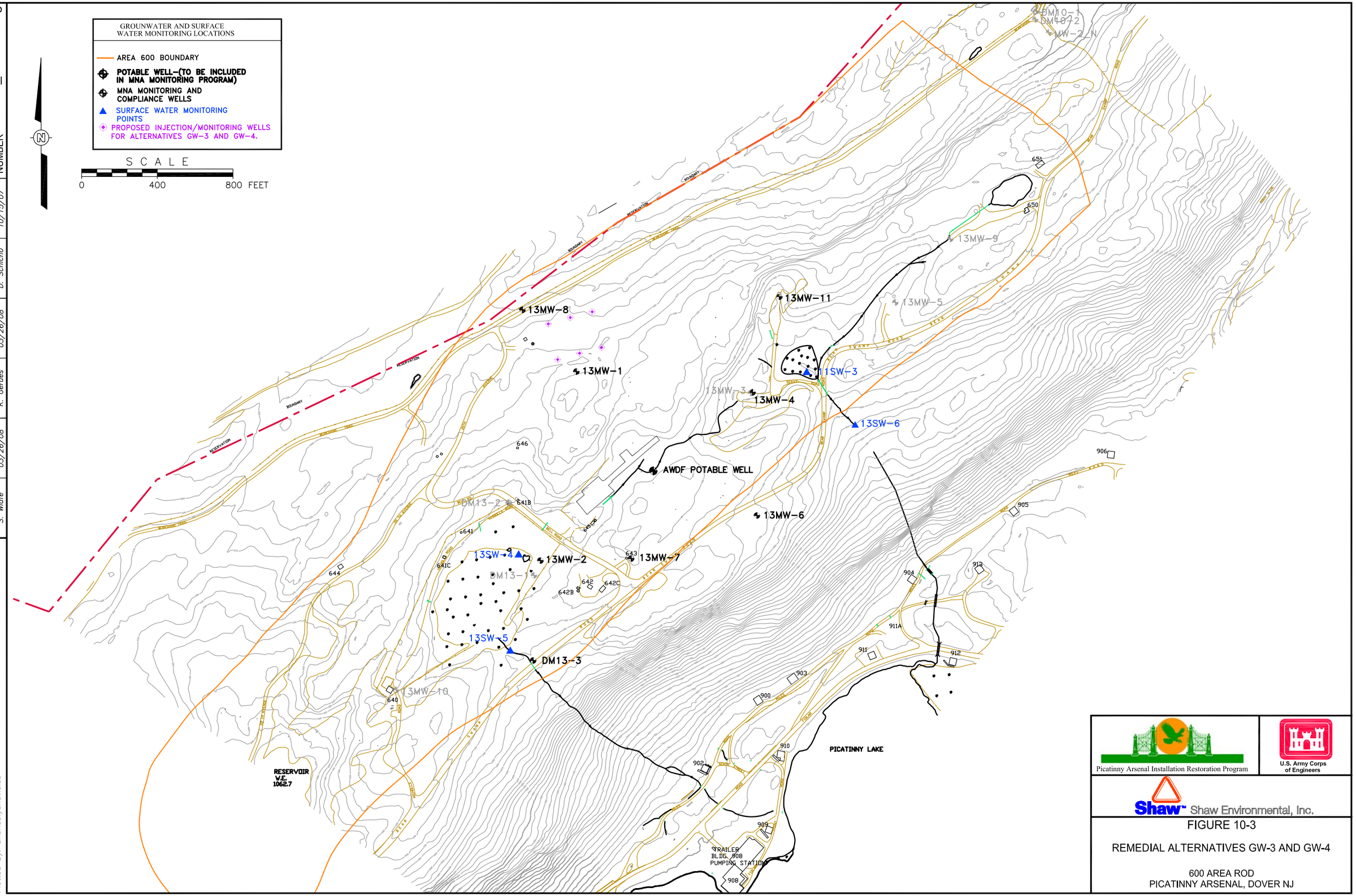

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S. Wiafe 03/26/08	K. Gerdes 03/26/08	D. Schicho 10/15/07	AWDF_091007.dwg

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

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FIGURE 10-3

REMEDIAL ALTERNATIVES GW-3 AND GW-4

600 AREA ROD
PICATINNY ARSENAL, DOVER NJ

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Plotted By: andrius.yanavicius

LEGEND

Montoring Well

Extent of Fill Material Deposited at Test Site in 1970s

Burning Cage

Proposed Remedial Alternatives

Excavation Area (60-120')

Cutback Area (160-200')

N

Scale:

0 30 60 Feet

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FIGURE 10-4

REMEDIAL ALTERNATIVE GW-5

PICATINNY ARSENAL, DOVER, NEW JERSEY

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LEGEND

Montoring Well

Extent of Fill Material Deposited at Test Site in 1970s

Burning Cage

Proposed Remedial Alternatives

Excavation Area *

Cutback Area (50' Buffer of Excavation Area)

Note:
* Excavation Area based on approximate location of waste pit identified by Weston (2012).

N

Scale:

0 30 60 Feet

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FIGURE 10-5

REMEDIAL ALTERNATIVE GW-6

PICATINNY ARSENAL, DOVER, NEW JERSEY

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600 AREA GROUNDWATER DATA REPORT/FS

APPENDIX P: Remedial Alternatives Cost Estimate

Final Document, Revision #2

Table ES-1 Summary of Group 1 Alternatives Analysis

Alternative	Description	Capital Cost	Discounted O&M	Total Present Worth
Groundwater				
GW-1	NO ACTION	**$0.00**	**$0.00**	**$0.00**
GW-2	MONITORED NATURAL ATTENUATION (MNA) WITH INSTITUTIONAL CONTROLS	**$60,000.00**	**$620,235.73**	**$680,235.73**
GW-3	IN SITU CHEMICAL OXIDATION (ISCO) AND MNA WITH ICs	**$427,660.51**	**$653,834.50**	**$1,081,495.01**
GW-4	IN SITU ENHANCED ANAEROBIC BIOREMEDIATION AND MNA WITH Ics	**$469,863.67**	**$733,201.14**	**$1,203,064.81**
GW-5	TCE SOURCE MATERIAL EXCAVATION AND MNA WITH ICs	**$1,411,844.81**	**$249,834.17**	**$1,661,678.98**
GW-6	TOTAL LANDFILL REMOVAL AND MNA POLISHING WITH ICs	**$2,360,193.45**	**$249,834.17**	**$2,610,027.62**

ALTERNATIVE GW-2

MONITORED NATURAL ATTENUATION (MNA) WITH INSTITUTIONAL CONTROLS (ICs)

Alternative GW-2 involves MNA and the maintenance and enforcement of ICs, in particular the restrictions of groundwater uses and long-term groundwater monitoring for all parameters that exceeded the SCLs. It is assumed that ICs and the long-term groundwater monitoring would be performed for 50 years. The anticipated length of MNA will be reevaluated following review of the groundwater sampling results, and reevaluation of site-specific attenuation rates.

CAPITAL COSTS

1.0 Institutional Controls/Planning

Land Use Restrictions: A site-specific Land Use Control Implementation Plan (LUCIP) will need to be written in order to place restrictions on activities that can be performed in areas of the plumes at the 600 Area Sites. These restrictions can be enforced through existing institutional controls and by restricting future land use. The land use restrictions will ensure that potential receptors are not exposed to contaminated groundwater from the 600 Area plumes.

Description	Unit Rate	Number of units	Cost
Paralegal	$150.00 /hr	80 hrs	$12,000.00
Lawyer	$200.00 /hr	80 hrs	$16,000.00
Total Cost For the Land Use Control Implementation Plan:			**$28,000.00**

2.0 Planning, Permitting and Reporting

Deliverables will include work plan, health and safety plan and a closure report. In addition, the substantive requirements for a Classification Exemption Area submittal will need to be made.

Description	Unit Rate	Number of Units	Cost
Permit equivalents	$2,000	Lump Sum	2,000.00
Work Plan	$5,000	Lump Sum	5,000.00
Health and Safety Plan	$5,000	Lump Sum	5,000.00
FSP, QAPP, and DQOs	$15,000	Lump Sum	15,000.00
Closeout Report (Draft, Draft Final, Final)	$5,000	Lump Sum	5,000.00
Total Cost for Reporting			**$32,000.00**

Summary of Institutional Control/Planning Costs

Description	Cost
Total Cost For Institutional Controls Plan Amendments:	$28,000.00
Total Cost For Planning, Permitting, and Reporting	$32,000.00
Total Capital Cost for Institutional Controls:	**$60,000.00**

OPERATION AND MAINTENANCE (O&M) COSTS

3.0 Long-Term Groundwater and Surface Water Monitoring

The long-term groundwater monitoring would be designed to evaluate the extent to which natural attenuation of the COCs is occurring, ensure that the plume characteristics are not changing in an unexpected manner, no new source areas are apparent, regulatory levels are being met, and the plume as a whole is acting as predicted.

The analytical program for the long-term groundwater monitoring program will consist of all of the contaminants of concern and daughter products in addition to dissolved oxygen, ORP, nitrate, iron (II), sulfate, and methane. These parameters ensure monitoring of the plume for regulatory compliance as wells as monitoring for changing geochemical and oxidation reduction state. All quality control sample analysis (field duplicates, rinse blanks, trip blanks) are assumed to be 20% of the total number of samples collection (20% of analytical costs).

ALTERNATIVE GW-2

MONITORED NATURAL ATTENUATION (MNA) WITH INSTITUTIONAL CONTROLS (ICs)

For each sampling event, the following unit costs and level of efforts (LOEs) will apply:

Field Sampler:	$50.00	/hr/person
Number of People:	2	people
Hours worked per day:	10	hrs
Anticipated time to collect GW samples per location:	3.0	hrs
Number of Wells to Sample for the long-term monitoring:	12	wells
Number of Surface Water Samples Collected Per Event:	5	locations
Anticipated time to collect SW samples per location:	1.5	hrs
Data Management cost per sampling event:	$3,000.00	per event

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	44 hrs	$4,350.00
Equipment (vehicle, pumps, water quality meter, etc.)	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (Including TCE, DCE, VC)	$116.00	21 samples	$2,436.00
alkalinity	$13.00	21 samples	$273.00
Iron (II)	$17.00	21 samples	$357.00
Sulfate	$17.00	21 samples	$357.00
Methane, Ethane, Ethene	$86.00	21 samples	$1,806.00
TOTAL CHEMICAL ANALYSIS COST:			**$5,229.00**
Data Management and Reporting cost	$3,000.00 per event	1 event	$3,000.00
Total Sampling and Reporting Costs per Sampling Event			**$13,179.00**

It is assumed that following the first 10 years of the LTM program that the total number of wells to be sampled would be reduced from 12 to 8.

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	32 hrs	$3,150.00
Equipment (vehicle, pumps, water quality	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (Including TCE, DCE, VC)	$116.00	16 samples	$1,856.00
alkalinity	$13.00	16 samples	$208.00
Iron (II)	$17.00	16 samples	$272.00
Sulfate	$17.00	16 samples	$272.00
Methane, Ethane, Ethene	$86.00	16 samples	$1,376.00
TOTAL CHEMICAL ANALYSIS COST:			**$3,984.00**
Data Management and Reporting cost	$3,000.00 per event	1 event	$3,000.00
Total Sampling and Reporting Costs per Sampling Event			**$10,734.00**

ALTERNATIVE GW-2

MONITORED NATURAL ATTENUATION (MNA) WITH INSTITUTIONAL CONTROLS (ICs)

DESCRIPTION OF COSTS PER PHASE ADJUSTED TO PRESENT VALUE

Description	Unit Rate	Number of units	Cost
Annual Cost for Semiannual Sampling Years 1-10	$13,179.00 /event	2 events	$26,358.00
Using a discount rate of 2.7%	**for a period of**	**10 years**	**$228,320.98**

Description	Unit Rate	Number of units	Cost
Annual Cost for Years 11-20 (annual sampling for 10 years)	$10,734.00 /event	1 events	$10,734.00
Using a discount rate of 2.7%	**for a period of**	**10 years**	**$71,234.52**

Description	Unit Rate	Number of units	Cost
Cost for Years 21-50 (sampled once every five years for 30 years)	$10,734.00 /event	1 events	$10,734.00
Using a discount rate of 2.7%	**for a period of**	**30 years**	**$24,333.18**

Total Discounted Sampling Cost:

Years 1-10	**$228,320.98**
Years 11-20	**$71,234.52**
Years 21-60	**$24,333.18**
Total	**$323,888.69**

4.0 Well Construction, Abandonment, and Maintenance

Since natural attenuation monitoring will occur over an anticipated period of 50 years, the groundwater monitoring wells will require maintenance to allow for accurate sampling of the aquifer. This will include inspections yearly with maintenance as needed.

Description	Unit Rate	Number of units	Discounted Cost
Well inspection and maintenance	$2,000.00 /year	50 years	$54,524.20
Future Well abandonment	$1,150.00 /well	23 wells	$6,980.77
Well Replacement			
Well replacement will be performed periodically as needed. For the purpose of this FS, the well replacement is assumed to occur every five years for the entire duration of the project. UXO support will be required for each well, assumed to take 2 days to complete.			
Well replacement	$10,000.00 / 5 year	50 years	$51,658.31
UXO Avoidance (2 person team)	$4,800.00 /5 year	50 years	$24,795.99
Total Discounted Well Construction, Abandonment, and Maintenance Cost			**$137,959.26**

Discount Rate = 2.7%

ALTERNATIVE GW-2

MONITORED NATURAL ATTENUATION (MNA) WITH INSTITUTIONAL CONTROLS (ICs)

5.0 5-Year Review

Five-year reviews will be performed to assess the effectiveness of the remedy. For the purpose of this FS, the duration for these activities is assumed to be 50 years.

Description	Unit Rate	Number of units	Cost
5-Year Review (including draft, draft final, and final reports)	$15,000	lump sum	$15,000.00
Using a discount rate of 2.7%	**for a period of**	**50 years**	**$77,487.46**

Discounted O&M Cost:

50-Year Sampling Cost	**$323,888.69**
Well Construction, Abandonment, and Maintenance	**$137,959.26**
5-Year Reviews	**$77,487.46**
Total	**$539,335.41**

TOTAL CAPITAL COST:		**$60,000.00**
DISCOUNTED O&M COST:		**$539,335.41**
Contingency of Scope:	**5%**	**$26,966.77**
Contingency of Bid:	**10%**	**$53,933.54**
TOTAL DISCOUNTED O&M COST:		**$620,235.73**
TOTAL PRESENT WORTH VALUE:		**$680,235.73**

ALTERNATIVE GW-3

IN SITU CHEMICAL OXIDATION (ISCO) AND MNA POLISHING WITH ICs

Alternative GW-3 would involve: 1) injection of a chemical oxidant (permanganate is generally the preferred oxidant for TCE remediation) within the source area of the contaminant concentrations, 2) monitored natural attenuation of the remainder of the TCE plume; and 3) maintenance and enforcement of ICs for as long as groundwater concentrations remain above SCLs. Under Alternative GW-3, TCE concentrations in the source area of the plume would be chemically degraded, thereby decreasing contaminant discharge into downgradient receptors to below ARAR levels. Performance monitoring of selected source area wells would be performed monthly for the first 6 months to be followed by quarterly monitoring until one year after the final permanganate injection. Monitoring of downgradient wells and surface water would be performed semiannually during the performance monitoring period. MNA polishing of residual groundwater TCE concentrations in the aquifer once active treatment (to protect downgradient receptors) is complete.

Following the perfomance monitoring period, long term monitoring would consist of both source area and downgradient wells and surface water sampled semiannually to year 10 (from implementation of the remedy), annually to year 20 , and once every 5 years to year 50.

GENERAL ASSUMPTIONS

1) The costs are adopted from R.S. Means 2007 Costworks - Site Work, previous work conducted by Shaw Environmental at PTA, and professional judgment.
2) The costs are adjusted with a location factor for Dover, New Jersey
3) The costs and duration of the construction activities are based on an 8-hour 5-day per week working schedule, unless otherwise noted.
4) Work is to be conducted under a safety level D condition. However, a general health and safety markup of **10%** will be used to account for modification of safety level condition.
5) A two person UXO team will be used for all clearing, grubbing, and ground instrusive activities.
6) Dimensions of the Areas of Concern:

AAs	GW Plume		Surface Area
	Area (SF)	Volume (Gal.)	Area (SF)*
AA_{1GW-1}	48,000	2,692,800	52,800

* Groundwater plume area multiplied by 1.1

CAPITAL COSTS

1.0 Institutional Controls/Planning

Land Use Restrictions: A site-specific Land Use Control Implementation Plan (LUCIP) will need to be written in order to place restrictions on activities that can be performed in areas of the groundwater plume. These restrictions can be enforced through existing institutional controls and by restricting future land use. The land use restrictions will ensure that potential receptors are not exposed to contaminated groundwater from the 600 Area plume.

Description	Unit Rate	Number of units	Cost
Paralegal	$150.00 /hr	80 hrs	$12,000.00
Lawyer	$200.00 /hr	80 hrs	$16,000.00
Total Cost For the Land Use Control Implementation Plan:			**$28,000.00**

2.0 Planning, Permitting and Reporting

Permit equivalents required for this alternative will include drilling for injection wells and any additional groundwater monitoring wells (including replacement wells which may be necessary during the timeframe of the project). Deliverables will include a work plan, design drawings and specifications, a health and safety plan and a closure report. In addition, the substantive requirements for a Classification Exemption Area submittal will need to be made.

ALTERNATIVE GW-3

IN SITU CHEMICAL OXIDATION (ISCO) AND MNA POLISHING WITH ICs

Description	Unit Rate	Number of Units	Cost
Permit equivalents	$2,000	Lump Sum	2,000.00
Design documents (drawings, specifications, design basis) - draft, draft final, and final	$15,000	Lump Sum	15,000.00
Pilot Tests (Oxidant Injections, ROI)	$30,000	Lump Sum	30,000.00
Work Plan	$10,000	Lump Sum	10,000.00
Health and Safety Plan	$5,000	Lump Sum	5,000.00
FSP, QAPP, and DQOs	$5,000	Lump Sum	5,000.00
Closeout Report (Draft, Draft Final, Final)	$15,000	Lump Sum	15,000.00
Total Cost for Reporting			**$82,000.00**

Summary of Institutional Control/Planning Costs

Description	Cost
Total Cost For Institutional Controls Plan Amendments:	$28,000.00
Total Cost For Planning, Permitting, and Reporting	$82,000.00
Total Cost for Institutional Controls:	**$110,000.00**

3.0 Site Preparations

3.1 Clearing

Negligible clearing will be required to allow drill rig access for the installation of injection wells.

3.2 Erosion Control (Silt Fence Construction and Maintenance):

Prior to start of work, silt fence will be erected along the perimeter of the work areas.
Silt fence will be maintained in an erect position and cleaned as required to ensure efficiency.

Required length of silt fence: 350 LF

Description	Cost Code	Unit Rate	Number of units	Duration (days)	Cost
Silt fencing, polypropylene, adverse conditions, 3' high	23705501100	$1.00 /lf	350 lf	1	$350.00
UXO Avoidance (2 person team)	Professional	$2,400.00 /day		1	$2,400.00
Additional H & S Markup of		**10%**			**$275.00**
Total Erosion Control Cost					**$3,025.00**

Estimated time required for Silt Fence Construction = 1 days

3.3 Layout and Construction Survey

The purpose of a layout/construction survey is to assure that the proper amount of cover materials are in place . The work will consist of

Assumptions:

1) Survey crew used to perform the construction layout survey will require a two person crew.

Description	Cost Code	Unit Rate	Number of units	Cost
Surveying Crew, 2 person survey	11077001100	$1,000.00 /day	5 days	$5,000.00
Total Cost for Survey Crew				**$5,000.00**
Total Surveying Cost with H & S Markup of		10%		**$5,500.00**

Estimated Number of days required = 5 days

ALTERNATIVE GW-3

IN SITU CHEMICAL OXIDATION (ISCO) AND MNA POLISHING WITH ICs

4.0 Injections of Permanganate and Construction of Monitoring Wells

Injections of permanganate would involve: (1) installation of 6 injection wells and 2 monitoring wells; and (2) injection of approximately
The initial stage would consist of installing approximately 8 wells, 6 injection wells and 2 monitoring wells, followed by a pilot test. UXO

Description	Unit Rate	Number of units	Cost
Well Installation			
Injection/Monitoring Well Installation	$10,000 /well	8 wells	$80,000.00
UXO Avoidance (2 person team) Professional Judgment	$2,400.00 /day	16 days	$38,400.00
Borehole Geophysics	$4,000 /well	8 wells	$32,000.00
Permanganate Injection			
Field Scientist	$460.00 /day	22 days	$10,120.00
Equipment (vehicle, poly tank, pump)	$1,000	lumpsum	$1,000.00
Sodium Permanganate	$2 /lb	6,700 lbs	$13,400.00
Total Cost for MW Installation and Lactate Injection			**$174,920.00**
Total Cost with H&S markup of:	**10%**		**$192,412.00**

Estimated construction time for the sodium lactate injections: 22 days

4.1 Performance Monitoring Following First Injection of Oxidizer

Performance monitoring for alternative GW-3 will consist of sampling selected source area monitoring wells. Samples will be collected

For each sampling event, the following unit costs and level of efforts (LOEs) will apply:

Field Sampler:	$50.00 /hr/person
Number of People:	2 people
Anticipated time to collect samples per location:	3.0 hrs
Number of Wells to Sample for performance monitoring:	3 wells

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	9 hrs	$900.00
Equipment (vehicle, pumps, water quality meter,	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (including TCE, DCE, VC)	$116.00	4 samples	$464.00
Methane, ethane, ethene	$86.00	4 samples	$344.00
Total Sampling and Analysis Cost per event			*$2,308.00*
TOTAL CHEMICAL ANALYSIS COST:	**$2,308.00 /month**	**6 months**	**$13,848.00**
Monitoring Report Cost	$3,000.00	lumpsum	$3,000.00
Total Performance Monitoring Cost			**$16,848.00**

ALTERNATIVE GW-3

IN SITU CHEMICAL OXIDATION (ISCO) AND MNA POLISHING WITH ICs

5.0 Mobilization/Demobilization

Mobilization and demobilization consists of providing and removing all required equipment and materials to and from the site. In

Mobilization is calculated as 10% of the direct capital costs, including site preparations and remedial system installations.

Mobilization/Demobilization	**10% of capital**	**$20,094**

6.0 Construction and Technical Oversight

Enhanced anaerobic degradation will require technical oversight during the planning and design stages and during the

Estimated total construction time frame:	Site preparations:	6	days
	Substrate Inject.	22	days
	Mob/Demob	2	days

Description	Unit Rate	Number of units	Cost
Data Review	$1,000.00	lump sum	$1,000.00
Site Visit and Meeting	$5,000.00	lump sum	$5,000.00
Field Engineer	$2,300.00 /week	6 weeks	$13,800.00
H&S Engineer	$3,500.00 /week	1.2 weeks	$4,200.00
Total Cost for Construction and Oversight			**$24,000.00**

All work associated with Remedial Alternative GW-3 to be done using local workforce.

SUMMARY OF CAPITAL COSTS:

1) Land Use Restrictions & Institutional Controls		**$28,000.00**
2) Permits and Reports Writing		**$82,000.00**
3) Site Preparation		**$8,525.00**
4) Installation of Injection Points and Sodium Permanganate Injection		**$209,260.00**
5) Mobilization/Demobilization		**$20,093.70**
6) Construction Oversight		**$24,000.00**
Contingency of Scope	**10%**	**$37,187.87**
Contingency of Bid	**5%**	**$18,593.94**
TOTAL CAPITAL COST		**$427,660.51**

ALTERNATIVE GW-3

IN SITU CHEMICAL OXIDATION (ISCO) AND MNA POLISHING WITH ICs

OPERATION AND MAINTENANCE COSTS

O&M activities required under this alternative would include additional permanganate injections as necessary to ensure contaminat

7.0 Additional Injections of Sodium Permanganate

Additional injections of permanganate would be performed as necessary to protect downgradient receptors. The objective of additional Injection of permanganate would be performed by site personnel, using the existing injection/monitoring wells and therefore would not

Description	Unit Rate	Number of units	Cost
Field Scientist (2)	$460.00 /day	22 days	$20,240.00
Equipment (vehicle, poly tank, pump)	$1,000	lumpsum	$1,000.00
Sodium Permanganate	$2 /lb	6,700 lbs	$13,400.00
Total Cost for Additional Lactate Injections			**$34,640.00**
Total Cost with H&S markup of:	**10%**		**$38,104.00**

Estimated construction time for the ISCO injections: 22 days

For the purpose of this cost estimate it is assumed that additional injections would be performed yearly for a period of three years.

Description	Unit Rate	Number of units	Cost
Annual Costs for Additional Permanganate Injections	$38,104.00 /event	1 events	$38,104.00
Using a discount rate of 2.7%	**for a period of**	**2 years**	**$73,229.06**

8.0 Long-Term Groundwater Monitoring

The long-term groundwater monitoring would be designed to monitor the RA performance and ensure that the plume characteristics are

The analytical program for the long-term groundwater monitoring program will consist of three parts:

- Source area monitoring following permanganate injections
- Downgradient monitoring during ISCO Injection period
- Long-term monitoring following completion of ISCO treatment

For each sampling event, the following unit costs and level of efforts (LOEs) will apply:

Field Sampler:	$50.00 /hr/person
Number of People:	2 people
Hours worked per day:	10 hrs
Anticipated time to collect samples per monitoring well:	3.0 hrs
Anticipated time to collect SW samples per location	1.5 hrs

Data Management/Monitoring Report per sampling event: $3,000.00 per event

8.1 Source Area Monitoring Following Additional Permanganate Injections

Number of Wells to Sample for performance monitoring program: 4 wells

ALTERNATIVE GW-3

IN SITU CHEMICAL OXIDATION (ISCO) AND MNA POLISHING WITH ICs

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	12 hrs	$1,200.00
Equipment (vehicle, pumps, water quality meter,	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (including TCE, DCE, VC)	$116.00	5 samples	$580.00
Methane, ethane, ethene	$86.00	5 samples	$430.00
TOTAL CHEMICAL ANALYSIS COST:			**$2,810.00**
Monitoring Report Cost	$3,000.00	lumpsum	$3,000.00
Total Source Area Monitoring Cost Per Event			**$5,810.00**

Description	Unit Rate	Number of units	Cost
Annual Cost for Quarterly Sampling Years 2-6 (5	$5,810.00 /event	4 events	$23,240.00
Using a discount rate of 2.7%	**for a period of**	**2 years**	**$43,488.91**

8.2 Downgradient Monitoring During the ISCO Injection Period

Number of Wells to Sample for downgradient monitoring: 11 wells
Number of surface water samples collected per event 5 locations

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	40.5 hrs	$4,050.00
Equipment (vehicle, pumps, water quality meter,	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (including TCE, DCE, VC, ethene)	$116.00	20 samples	$2,320.00
TOTAL CHEMICAL ANALYSIS COST:			**$2,320.00**
Monitoring Report Costs per Year	$3,000.00 per event	1 event	$3,000.00
Total Downgradient Sampling and Reporting Costs per Sampling Event			**$9,970.00**

Description	Unit Rate	Number of units	Cost
Annual Cost for Semiannual Sampling Years 1-3 (3	$9,970.00 /event	2 events	$19,940.00
Using a discount rate of 2.7%	**for a period of**	**3 years**	**$56,729.41**

8.3 Long-Term Monitoring Following Completion of ISCO Treatment
It is assumed that the total number of monitoring wells to be sampled for the LTM program would be reduced from the performance

Number of Wells to Sample for the long-term monitoring program: 9 wells
Number of surface water samples collected per event 5 locations

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	34.5 hrs	$3,450.00
Equipment (vehicle, pumps, water quality meter,	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (including TCE, DCE, VC, ethene)	$116.00	17 samples	$1,972.00
TOTAL CHEMICAL ANALYSIS COST:			**$1,972.00**
Monitoring Report Costs per Year	$3,000.00 per event	1 event	$3,000.00
Total Sampling and Reporting Costs per Sampling Event			**$9,022.00**

ALTERNATIVE GW-3

IN SITU CHEMICAL OXIDATION (ISCO) AND MNA POLISHING WITH ICs

DESCRIPTION OF COSTS PER PHASE

Description	Unit Rate	Number of units	Cost
Annual Cost for Semiannual Sampling Years 4-10	$9,022.00 /event	2 events	$18,044.00
Using a discount rate of 2.7%	**for a period of**	**7 years**	**$96,904.24**

Description	Unit Rate	Number of units	Cost
Annual Sampling Costs for Year 11-20 (10 years)	$9,022.00 /event	1 events	$9,022.00
Using a discount rate of 2.7%	**for a period of**	**10 years**	**$59,873.10**

Description	Unit Rate	Number of units	Cost
Sampling Costs for Years 21-50 (30 years,	$9,022.00 /event	1 events	$9,022.00
Using a discount rate of 2.7%	**for a period of**	**30 years**	**$20,452.21**

Total Discounted LTM Sampling Cost:

Years 1-6	**$100,218.32**
Years 7-10	**$96,904.24**
Years 11-20	**$59,873.10**
Years 21-60	**$20,452.21**
Total	**$277,447.87**

9.0 Well Abandonment, Replacement, and Maintenance

Since the long-term monitoring would occur over a period of 60 years, the groundwater monitoring wells will require maintenance to allow

Description	Unit Rate	Number of units	Cost
Well inspection and maintenance	$2,000.00 /year	50 years	$54,524.20
Future Well abandonment	$1,150.00 /well	31 wells	$9,408.87
Well Replacement			
Well replacement will be performed periodically as needed. For the purpose of this FS, the well replacement is assumed to occur			
Description	**Unit Rate**	**Number of units**	**Cost**
Well replacement	$10,000.00 / 5 year	50 years	$51,658.31
UXO Avoidance (2 person team)	$4,800.00 /5 year	50 years	$24,795.99
Total Well Abandonment, Replacement, and Maintenance Cost			**$140,387.36**

Discount Rate = 2.7%

10.0 5-Year Review

Five-year reviews will be performed to assess the effectiveness of the remedy. For the purpose of this FS, the duration for these

Description	Unit Rate	Number of units	Cost
5-Year Review (including draft, draft final, and final	$15,000	1 reviews	$15,000.00
Using a discount rate of 2.7%	**for a period of**	**50 years**	**$77,487.46**

Discounted O&M Cost:

7.0 Additional Injections of Permanganate	**$73,229.06**
8.0 Long Term Monitoring Program	**$277,447.87**
9.0 Well Abandonment, Replacement, and Maintenance	**$140,387.36**
10.0 5-Year Reviews	**$77,487.46**
Total	**$568,551.74**

ALTERNATIVE GW-3

IN SITU CHEMICAL OXIDATION (ISCO) AND MNA POLISHING WITH ICs

TOTAL CAPITAL COST:		**$427,660.51**
DISCOUNTED O&M COST:		**$568,551.74**
Contingency of Scope:	**10%**	**$56,855.17**
Contingency of Bid:	**5%**	**$28,427.59**
TOTAL DISCOUNTED O&M COST:		**$653,834.50**
TOTAL PRESENT WORTH VALUE:		**$1,081,495.01**

ALTERNATIVE GW-4

IN SITU ENHANCED ANAEROBIC BIOREMEDIATION AND MNA POLISHING WITH ICs

Alternative GW-4 would involve: 1) injection of a microbial growth substrate (for the purpose of this estimating costs it is assumed to be sodium lactate) within the source area of the contaminant concentrations, 2) bioaugmentation of dechlorinating microbial consortium (assumed to be SDC-9, comercially available from Shaw) 3) MNA of the remainder of the TCE plume; and 3) maintenance and enforcement of ICs for as long as groundwater concentrations remain above SCLs. Under Alternative GW-4, TCE concentrations in the source area of the plume would be reduced, thereby decreasing contaminant discharge into downgradient receptors to below ARAR levels. Performance monitoring of selected source area wells would be performed monthly for the first 6 months to be followed by quarterly monitoring until one year after the final substrate injection. Monitoring of downgradient wells and surface water would be performed semiannually during the performance monitoring period. MNA polishing of residual groundwater TCE and daughter product concentrations in the aquifer once active treatment (to protect downgradient receptors) is complete.

Following the performance monitoring period, LTM would consist of both source area and downgradient wells and surface water sampled semiannually to year 10 (from implementation of the remedy), annually to year 20, and once every 5 years to year 50.

Note: Injection of nano-scale zero-valent iron (ZVI) would be evaluated along with potential microbial growth substrates as part of the pilot study. Although abiotic, ZVI injection would involve nearly identical logistic requirements and result in reductive degradation of TCE (and its reductive daughter products). Sodium Lactate, the lowest cost (and most likely applied) substrate, is costed in this alternative.

GENERAL ASSUMPTIONS

1) The costs are adopted from R.S. Means 2007 Costworks - Site Work, previous work conducted by Shaw Environmental at PTA, and professional judgment.
2) The costs are adjusted with a location factor for Dover, New Jersey
3) The costs and duration of the construction activities are based on an 8-hour 5-day per week working schedule, unless otherwise noted.
4) Work is to be conducted under a safety level D condition. However, a general health and safety markup of **10%** will be used to account for modification of safety level condition.
5) A two person UXO team will be used for all clearing, grubbing, and ground instrusive activities.
6) Dimensions of the Areas of Concern:

AAs	GW Plume		Surface Area
	Area (SF)	Volume (Gal.)	Area (SF)*
AA_{1GW-1}	48,000	2,692,800	52,800

* Groundwater plume area multiplied by 1.1

CAPITAL COSTS

1.0 Institutional Controls/Planning

Land Use Restrictions: A site-specific Land Use Control Implementation Plan (LUCIP) will need to be written in order to place restrictions on activities that can be performed in areas of the groundwater plume. These restrictions can be enforced through existing institutional controls and by restricting future land use. The land use restrictions will ensure that potential receptors are not exposed to contaminated groundwater from the 600 Area plume.

Description	Unit Rate	Number of units	Cost
Paralegal	$150.00 /hr	80 hrs	$12,000.00
Lawyer	$200.00 /hr	80 hrs	$16,000.00
Total Cost For the Land Use Control Implementation Plan:			**$28,000.00**

2.0 Planning, Permitting and Reporting

Permit equivalents required for this alternative will include drilling replacement wells which may be necessary during the timeframe of the project. Deliverables will include a work plan, design drawings and specifications, a health and safety plan and a closure report. In addition, the substantive requirements for a Classification Exemption Area submittal will need to be made.

ALTERNATIVE GW-4

IN SITU ENHANCED ANAEROBIC BIOREMEDIATION AND MNA POLISHING WITH ICs

Description	Unit Rate	Number of Units	Cost
Permit equivalents	$2,000	Lump Sum	2,000.00
Design documents (drawings, specifications, design basis) - draft, draft final, and final	$15,000	Lump Sum	15,000.00
Pilot Tests (Substrate Injections, ROI)	$30,000	Lump Sum	30,000.00
Work Plan	$10,000	Lump Sum	10,000.00
Health and Safety Plan	$5,000	Lump Sum	5,000.00
FSP, QAPP, and DQOs	$5,000	Lump Sum	5,000.00
Closeout Report (Draft, Draft Final, Final)	$15,000	Lump Sum	15,000.00
Total Cost for Reporting			**$82,000.00**

Summary of Institutional Control/Planning Costs

Description	Cost
Total Cost For Institutional Controls Plan Amendments:	$28,000.00
Total Cost For Planning, Permitting, and Reporting	$82,000.00
Total Cost for Institutional Controls:	**$110,000.00**

3.0 Site Preparations

3.1 Clearing

Negligible clearing will be required to allow drill rig access for the installation of injection wells.

3.2 Erosion Control (Silt Fence Construction and Maintenance):

Prior to start of work, silt fence will be erected along the perimeter of the work areas.
Silt fence will be maintained in an erect position and cleaned as required to ensure efficiency.

Required length of silt fence: 350 LF

ALTERNATIVE GW-4

IN SITU ENHANCED ANAEROBIC BIOREMEDIATION AND MNA POLISHING WITH ICs

Description	Cost Code	Unit Rate	Number of units	Duration (days)	Cost
Silt fencing, polypropylene,	23705501100	$1.00 /lf	350 lf	1	$350.00
UXO Avoidance (2 person team)	Professional Judgment	$2,400.00 /day		1	$2,400.00
Additional H & S Markup of		**10%**			**$275.00**
Total Erosion Control Cost					**$3,025.00**

Estimated time required for Silt Fence Construction = 1 days

3.3 Layout and Construction Survey

The purpose of a layout/construction survey is to assure that the proper amount of cover materials are in place . The work will consist of furnishing, placing, and maintaining the construction layout controls (stakes) necessary.

Assumptions:
1) Survey crew used to perform the construction layout survey will require a two person crew.

Description	Cost Code	Unit Rate	Number of units	Cost
Surveying Crew, 2 person survey	11077001100	$1,000.00 /day	5 days	$5,000.00
Total Cost for Survey Crew				**$5,000.00**
Total Surveying Cost with H & S Markup of		10%		**$5,500.00**

Estimated Number of days required = 5 days

4.0 Injections of Sodium Lactate and Construction of Monitoring Wells

Injections of sodium lactate would involve: (1) installation of 6 injection points and (2) injection of approximately 19,000 lbs of sodium lactate (15% solution) and injection of 204 liters of dechlorinating consotium for bioaugmentation. Injection wells would be installed to a depth of up to 200 feet bgs to target the full plume thickness.

The initial stage would consist of installing approximately 8 wells, 6 injection wells and 2 monitoring wells, followed by a pilot test. UXO support would be required only for avoidance during the installation of IWs and MWs, the duration of which is assumed to be 2 days/well. Injection of sodium lactate would be performed by site personnel and therefore would not require subsequent mobilization. Sodium lactate requirement is based on required mass to achieve a concentration of 500 mg/L within the targeted region.

Description		Unit Rate	Number of units	Cost
Well Installation				
Injection Well Installation		$10,000 /well	8 wells	$80,000.00
UXO Avoidance (2 person team)	Professional Judgment	$2,400.00 /day	16 days	$38,400.00
Borehole Geophysics		$4,000 /well	8 wells	$32,000.00
Sodium Lactate Injection				
Field Scientist		$460.00 /day	8 days	$3,680.00
Equipment (vehicle, poly tank, pump)		$1,000	lumpsum	$1,000.00
Sodium Lactate (see attached)		$1 /lb	19,000 lbs	$19,000.00
Dechlorinating Consortium Demand for Bioaugmentation (see attached)		$170 /liter	204 liters	$34,680.00
Total Cost for MW Installation and Lactate Injection				**$208,760.00**
Total Cost with H&S markup of:		**10%**		**$229,636.00**

Estimated construction time for the sodium lactate injections: 8 days

ALTERNATIVE GW-4

IN SITU ENHANCED ANAEROBIC BIOREMEDIATION AND MNA POLISHING WITH ICs

4.1 Performance Monitoring Following Substrate Injection

Performance monitoring for alternative GW-4 will consist of sampling selected source area monitoring wells. Samples will be collected monthly for a period of 6-months and quarterly for the remainder of the year following injection. Samples will be analyzed for VOCs, TOC, nitrate alkalinity, soluble iron, methane, ethane, and ethene in addition to measured geochemical parameters measured during sampling. Quality control samples (field duplicates, rinse blanks, trip blanks) are assumed to be an additional 20% of the total number of samples collected.

For each sampling event, the following unit costs and level of efforts (LOEs) will apply:

Field Sampler:	$50.00	/hr/person
Number of People:	2	people
Anticipated time to collect samples per location:	3.0	hrs
Number of Wells to Sample for the long-term monitoring program:	3	wells

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	9 hrs	$900.00
Equipment (vehicle, pumps, water quality meter,	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (including TCE, DCE, VC)	$116.00	4 samples	$464.00
TOC	$26.00	4 samples	$104.00
alkalinity	$13.00	4 samples	$52.00
Iron (II)	$17.00	4 samples	$68.00
Sulfate	$17.00	4 samples	$68.00
Methane, ethane, ethene	$86.00	4 samples	$344.00
Total Sampling and Analysis Cost per event			*$2,600.00*
TOTAL CHEMICAL ANALYSIS COST:	**$2,600.00 /month**	**6 months**	**$15,600.00**
Monitoring Report Cost	$3,000.00	lumpsum	$3,000.00
Total Performance Monitoring Cost			**$18,600.00**

5.0 Mobilization/Demobilization

Mobilization and demobilization consists of providing and removing all required equipment and materials to and from the site. In addition, providing all required utilities is also included with mobilization.

Mobilization is calculated as 10% of the direct capital costs, including site preparations and remedial system installations.

Mobilization/Demobilization	**10% of capital**	**$23,816**

6.0 Construction and Technical Oversight

Enhanced anaerobic degradation will require technical oversight during the planning and design stages and during the implementation.

Estimated total construction time frame:	Site preparations:	6	days
	Substrate Inject.	8	days
	Mob/Demob	2	days

Description	Unit Rate	Number of units	Cost
Data Review	$1,000.00	lump sum	$1,000.00
Site Visit and Meeting	$5,000.00	lump sum	$5,000.00
Field Engineer	$2,300.00 /week	4 weeks	$9,200.00
H&S Engineer	$3,500.00 /week	0.8 weeks	$2,800.00
Total Cost for Construction and Oversight			**$18,000.00**

ALTERNATIVE GW-4

IN SITU ENHANCED ANAEROBIC BIOREMEDIATION AND MNA POLISHING WITH ICs

All work associated with Remedial Alternative GW-4 to be done using local workforce.

SUMMARY OF CAPITAL COSTS:

1) Land Use Restrictions & Institutional Controls		**$28,000.00**
2) Permits and Reports Writing		**$82,000.00**
3) Site Preparation		**$8,525.00**
4) Installation of Injection Points and Sodium Lactate Injection		**$248,236.00**
5) Mobilization/Demobilization		**$23,816.10**
6) Construction Oversight		**$18,000.00**
Contingency of Scope	**10%**	**$40,857.71**
Contingency of Bid	**5%**	**$20,428.86**
TOTAL CAPITAL COST		**$469,863.67**

OPERATION AND MAINTENANCE COSTS

O&M activities required under this alternative would include additional substrate injections as necessary to ensure contaminat concentrations do not rebound to the extent which continues to impact downgradient receptors, and long-term monitoring of groundwater to measure the performance of the remediation.

7.0 Additional Injections of Sodium Lactate

Additional injections of sodium lactate (or other microbial growth substrate) would be performed as necessary to protect downgradient receptors. The objective of additional injections is to prevent a rebound in contaminant concentrations to above the modeled concentation demonstarted to be protective of downgradient receptors.

Injection of sodium lactate would be performed by site personnel, using the existing injection/monitoring wells and therefore would not require subsequent driller mobilization. Sodium lactate requirement is based on required mass to achieve a concentration of 500 mg/L within the targeted region, although the final substrate quantity would be adjusted based on the results of previous injections and pilot testing.

Description	Unit Rate	Number of units	Cost
Field Scientist (2)	$460.00 /day	8 days	$7,360.00
Equipment (vehicle, poly tank, pump)	$1,000	lumpsum	$1,000.00
Sodium Lactate	$1 /lb	19,000 lbs	$19,000.00
Dechlorinating Consortium Demand for Bioaugmentation (see attached)	$170 /liter	204 liters	$34,680.00
Total Cost for MW Installation and Lactate Injection			**$62,040.00**
Total Cost with H&S markup of:	**10%**		**$68,244.00**

Estimated construction time for the sodium lactate injections: 8 days

For the purpose of this cost estimate it is assumed that additional injections would be performed yearly for a period of five years.

Description	Unit Rate	Number of units	Cost
Annual Costs for Additional Lactate Injections	$68,244.00 /event	1 events	$68,244.00
Using a discount rate of 2.7%	**for a period of**	**2 years**	**$131,152.73**

8.0 Long-Term Groundwater Monitoring

The long-term groundwater monitoring would be designed to monitor the RA performance and ensure that the plume characteristics are not changing, no new source areas are apparent, regulatory levels are being met, and the plume as a whole is acting as predicted. Quality control samples (field duplicates, rinse blanks, trip blanks) are assumed to be an additional 20% of the total numbers of samples collected.

The analytical program for long term monitoring will consist of 3 parts:

- Source area monitoring following substrate injections
- Downgradient monitoring during substrate injection period
- Long-term monitoring following completion of treatment

ALTERNATIVE GW-4

IN SITU ENHANCED ANAEROBIC BIOREMEDIATION AND MNA POLISHING WITH ICs

For each sampling event, the following unit costs and level of efforts (LOEs) will apply:

Field Sampler:	$50.00	/hr/person
Number of People:	2	people
Hours worked per day:	10	hrs
Anticipated time to collect samples per monitoring well:	3.0	hrs
Anticipated time to collect SW samples per location	1.5	hrs
Monitoring Report per sampling event:	$3,000.00	per event

8.1 Source Area Monitoring Following Additional Substrate Injections:

Number of wells to sample for performance monitoring program: 3 wells

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	9 hrs	$900.00
Equipment (vehicle, pumps, water quality meter,	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (including TCE, DCE, VC, ethene)	$116.00	4 samples	$464.00
TOC	$26.00	4 samples	$104.00
alkalinity	$13.00	4 samples	$52.00
Iron (II)	$17.00	4 samples	$68.00
Sulfate	$17.00	4 samples	$68.00
Methane, ethane, ethene	$86.00	4 samples	$344.00
TOTAL CHEMICAL ANALYSIS COST:			**$2,600.00**
Monitoring Report Costs	$3,000.00 per event	1 event	$3,000.00
Total Source Area Monitoring Cost Per Event			**$7,100.00**

Description	Unit Rate	Number of units	Cost
Annual Cost for Quarterly Sampling Years 2-6 (5 years)	$7,100.00 /event	4 events	$28,400.00
Using a discount rate of 2.7%	**for a period of**	**2 years**	**$54,579.71**

8.2 Downgradient Monitoring During the Sodium Lactate Injection Period

Number of wells to sample for performance monitoring program: 11 wells
Number of surface water samples collected per event: 5 locations

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	40.5 hrs	$4,050.00
Equipment (vehicle, pumps, water quality meter,	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (including TCE, DCE, VC, ethene)	$116.00	20 samples	$2,320.00
TOTAL CHEMICAL ANALYSIS COST:			**$2,320.00**
Monitoring Report Costs	$3,000.00 per event	1 event	$3,000.00
Total Source Area Monitoring Cost Per Event			**$9,970.00**

Description	Unit Rate	Number of units	Cost
Annual Cost for Semiannual Sampling Years 1-3 (3 years)	$9,970.00 /event	2 events	$19,940.00
Using a discount rate of 2.7%	**for a period of**	**3 years**	**$56,729.41**

ALTERNATIVE GW-4

IN SITU ENHANCED ANAEROBIC BIOREMEDIATION AND MNA POLISHING WITH ICs

8.3 Long-Term Monitoring Following Lactate Treatment

It is assumed that the total number of monitoring wells to be sampled for the LTM program would be reduced from the performance monitoring sampling. Two of the 4 source area monitoring wells (those with the highest historic concentrations) would be selected as representative of the source area, and an additional 4 wells would be eliminated from the downgradient wells.

Number of wells to sample for performance monitoring program:	9 wells
Number of surface water samples collected per event:	5 locations

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	34.5 hrs	$3,450.00
Equipment (vehicle, pumps, water quality meter,	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (including TCE, DCE, VC, ethene)	$116.00	17 samples	$1,972.00
TOTAL CHEMICAL ANALYSIS COST:			**$1,972.00**
Monitoring Report Costs	$3,000.00 per event	1 event	$3,000.00
Total Source Area Monitoring Cost Per Event			**$9,022.00**

DESCRIPTION OF COSTS PER PHASE

Description	Unit Rate	Number of units	Cost
Annual Costs for Semiannual Sampling Years 4-10 (4 years)	$9,022.00 /event	2 events	$18,044.00
Using a discount rate of 2.7%	**for a period of**	**7 years**	**$96,904.24**

Description	Unit Rate	Number of units	Cost
Annual Costs for Annual Sampling Years 11-20 (10 years)	$9,022.00 /event	1 events	$9,022.00
Using a discount rate of 2.7%	**for a period of**	**10 years**	**$59,873.10**

Description	Unit Rate	Number of units	Cost
Sampling Costs for Year 21-50 (30 years, sampled once every five years)	$9,022.00 /event	1 events	$9,022.00
Using a discount rate of 2.7%	**for a period of**	**30 years**	**$20,452.21**

Total Discounted Sampling Cost:

Years 1-6	**$111,309.12**
Years 7-10	**$96,904.24**
Years 11-20	**$59,873.10**
Years 21-60	**$20,452.21**
Total	**$288,538.66**

ALTERNATIVE GW-4

IN SITU ENHANCED ANAEROBIC BIOREMEDIATION AND MNA POLISHING WITH ICs

9.0 Well Abandonment, Replacement, and Maintenance

Since the long-term monitoring would occur over a period of 50 years, the groundwater monitoring wells will require maintenance to allow for accurate sampling of the aquifer. This will include inspections yearly with maintenance as needed.

Description	Unit Rate	Number of units	Cost
Well inspection and maintenance	$2,000.00 /year	50 years	$54,524.20
Future Well abandonment	$1,150.00 /well	31 wells	$9,408.87
Well Replacement			
Well replacement will be performed periodically as needed. For the purpose of this FS, the well replacement is assumed to occur every five years for the entire duration of the project. UXO support will be required for each well, assumed to take 2 days to complete.			
Description	**Unit Rate**	**Number of units**	**Cost**
Well replacement	$10,000.00 / 5 year	50 years	$51,658.31
UXO Avoidance (2 person team)	$4,800.00 /5 year	50 years	$24,795.99
Total Well Abandonment, Replacement, and Maintenance Cost			**$140,387.36**

Discount Rate = 2.7%

10.0 5-Year Review

Five-year reviews will be performed to assess the effectiveness of the remedy. For the purpose of this FS, the duration for these activities is assumed to be 50 years.

Description	Unit Rate	Number of units	Cost
5-Year Review (including draft, draft final, and final reports)	$15,000	1 reviews	$15,000.00
Using a discount rate of 2.7%	**for a period of**	**50 years**	**$77,487.46**

Discounted O&M Cost:

7.0 Additional Injections of Sodium Lactate	**$131,152.73**
8.0 Long Term Monitoring Program	**$288,538.66**
9.0 Well Abandonment, Replacement, and Maintenance	**$140,387.36**
10.0 5-Year Reviews	**$77,487.46**
Total	**$637,566.21**

TOTAL CAPITAL COST:		**$469,863.67**
DISCOUNTED O&M COST:		**$637,566.21**
Contingency of Scope:	**10%**	**$63,756.62**
Contingency of Bid:	**5%**	**$31,878.31**
TOTAL DISCOUNTED O&M COST:		**$733,201.14**
TOTAL PRESENT WORTH VALUE:		**$1,203,064.81**

ALTERNATIVE GW-5

SOURCE MATERIAL EXCAVATION AND MNA WITH ICs

Alternative GW-5 involves excavation of the assumed source of the plume in the soil overburden; LTM; and the maintenance and enforcement of ICs, in particular the restrictions of groundwater uses and long-term groundwater monitoring for all parameters that exceeded the SCLs. It is assumed that ICs and the long-term groundwater monitoring would be performed for 10 years. The anticipated length of LTM will be reevaluated following review of the groundwater sampling results, and evaluation of site-specific attenuation rates.

GENERAL ASSUMPTIONS

1) The costs are adopted from R.S. Means 2007 Costworks - Site Work, previous work conducted by Shaw Environmental at PTA, and professional judgment.
2) The costs are adjusted with a location factor for Dover, New Jersey

3) The costs and duration of the construction activities are based on an 8-hour 5-day per week working schedule, unless otherwise noted.
4) Work is to be conducted under a safety level D condition. However, a general health and safety markup of **10%** will be used to account for modification of safety level condition.

5) For activities requiring construction support, the team will consist of: 1 truck driver, 2 laborers, 1 Tech 3,1 Tech 2, and 2 Operators (Tech 2).

6) For activities requiring MEC screening, the team will consist of: 1 truck driver, 2 laborers, SUXOS, UXOSO/QCS, 1 Tech 3, 2 Tech 2, 2 Tech 2, and 3 Operators (Tech 2).

7) The source area is assumed to be located under 20' of clean overburden, with an area 60' x 120' and a thickness of 5'. Total excavated volume: 18,087 CY. Volume of source area (60' x 120' x5'): 1334 CY, volume of clean overburden (60'x120'x20'): 5334 CY, volume of excavation sidewall cutback (1:2 slope): 11,419 CY

CAPITAL COSTS

1.0 Institutional Controls/Planning

Land Use Restrictions: A site-specific Land Use Control Implementation Plan (LUCIP) will need to be written in order to place restrictions on activities that can be performed in areas of the plumes at the 600 Area Sites. These restrictions can be enforced through existing institutional controls and by restricting future land use. The land use restrictions will ensure that potential receptors are not exposed to contaminated groundwater from the 600 Area plumes.

Description	Unit Rate	Number of units	Cost
Paralegal	$150.00 /hr	80 hrs	$12,000.00
Lawyer	$200.00 /hr	80 hrs	$16,000.00
Total Cost For the Land Use Control Implementation Plan:			**$28,000.00**

2.0 Planning, Permitting and Reporting

Deliverables will include work plan, health and safety plan and a closure report. In addition, the substantive requirements for a Classification Exemption Area submittal will need to be made.

Description	Unit Rate	Number of Units	Cost
Permit equivalents	$2,000	Lump Sum	2,000.00
Design documents (drawings, specifications, design basis) - draft, draft final, and final	$15,000	Lump Sum	15,000.00
Work Plan	$10,000	Lump Sum	10,000.00
Explosive Safety Submission	$15,000	Lump Sum	15,000.00
Health and Safety Plan	$5,000	Lump Sum	5,000.00
FSP, QAPP, and DQOs	$5,000	Lump Sum	5,000.00
Closeout Report (Draft, Draft Final, Final)	$15,000	Lump Sum	15,000.00
Total Cost for Reporting			**$67,000.00**

ALTERNATIVE GW-5

SOURCE MATERIAL EXCAVATION AND MNA WITH ICs

Summary of Institutional Control/Planning Costs

Description	Cost
Total Cost For Institutional Controls Plan Amendments:	$28,000.00
Total Cost For Planning, Permitting, and Reporting	$67,000.00
Total Capital Cost for Institutional Controls:	**$95,000.00**

3.0 Site Preparation

3.1 Erosion Control

Prior to start of work, silt fence will be erected along the perimeter of the work areas. In addition to the assumed 60' x 120' source area, a 1:2 slope will be required for side wall stabilization. For an overall depth of 25' bgs, the resulting cutback is 50', yeilding a 160' x 220' work area.
Silt fence will be maintained in an erect position and cleaned as required to ensure efficiency.

Required length of silt fence (110% of work area perimeter): 836 LF

Description	Cost Code	Unit Rate	Number of units	Duration	Cost
Silt fencing, polypropylene,	23705501100	$1.00 /lf	836 lf	1	$836.00
MEC Support (2 person team)	Professional Judgment	$1,322.00 /day		1	$1,322.00
Additional H & S Markup of		**10%**			**$215.80**
Total Erosion Control Cost					**$2,373.80**

Estimated time required for Silt Fence Construction = 1 days

3.2 Layout and Construction Survey

The purpose of a layout/construction survey is to assure that the proper amount of cover materials are in place . The work will consist of furnishing, placing, and maintaining the construction layout controls (stakes) necessary.

Assumptions:
1) Survey crew used to perform the construction layout survey will require a two person crew.

Description	Cost Code	Unit Rate	Number of units	Cost
Surveying Crew, 2 person survey	11077001100	$1,000.00 /day	5 days	$5,000.00
Total Cost for Survey Crew				**$5,000.00**
Total Surveying Cost with H & S Markup of		10%		**$5,500.00**

Estimated Number of days required = 5 days

3.3 Site Setup

Equipment necessary prior to start of fieldwork. Assume 2 magazines and 1 remote firing device required during excavation.

Description	Cost Code	Unit Rate	Number of units	Duration	Cost
Office Trailer	Professional	$7,500.00	Lump Sum		$7,500.00
Explosives Storage Magazine	Professional	$600.00	Lump Sum		$600.00
RFD Remote Firing Device	Professional	$3.00	Lump Sum		$3.00
Additional H & S Markup of		**10%**			**$810.30**
Total Vehicle and Personnel Decon Area Cost					**$8,913.30**

3.4 Vehicle and Personnel Decontamination Area

The decontamination facility will be constructed using a geomembrane liner to contain liquids generated during the decontamination activities. The liner will be placed directly on the dround surface. Sand will be used to smooth the existing terrain.

Description	Cost Code	Unit Rate	Number of units	Duration (days)	Cost
Material and Installation costs for Decon Pad	Professional Judgment	$7,500.00	Lump Sum		$7,500.00
Additional H & S Markup of		**10%**			**$750.00**
Total Vehicle and Personnel Decon Area Cost					**$8,250.00**

Estimated time required for Decon Area Construction = 2 days

ALTERNATIVE GW-5

SOURCE MATERIAL EXCAVATION AND MNA WITH ICs

4.0 Excavation and Disposal of Source Material

4.1 Excavation of Material Requiring Construction Support

Assumptions:

Soil will be excavated using an excavator that will load directly into end dump trucks or staging area. The excavation rate and unit cost have been selected based on Shaw experience and professional judgment to account for difficult terrain, site accessibility, and anticipated MEC clearance activities. In areas where the MEC/MD is not likely (i.e., clean overburden), construction support activities will be required. This will consist of having two UXO technicians visually observing the excavation. Excavation will proceed in six inch lifts such that debris will be observed if present. One UXO team member will be located to the rear and upwind of the excavation equipment and will visually observe excavation. Assume 5,334 CY of clean overburden and 10,505 CY of cutback soil require construction support. Assume 700 CY/day during construction support activities.

Clean overburden and sidewall cutback spoils will be staged and used as backfill following confirmation sampling.

Volume of source area requiring construction support:	0	CY
Volume of clean overburden requiring construction support:	5334	CY
Volume of excavation sidewall cutback requiring construction support:	10505	CY
Total excavated volume requiring construction support:	15839	CY

Description	Cost Code	Unit Rate		Duration			Cost
Extended Reach Excavator with Thumb	Professional Judgment	$600.00	/day	23	days		$13,576.29
Front End Loader	Professional Judgment	$120.00	/day	23	days		$2,715.26
Dump Truck	Professional Judgment	$120.00	/day	23	days		$2,715.26
Diesel Fuel Tank, 500 gallon	Professional Judgment	$100.00	/day	23	days		$2,262.71
Office Trailer	Professional Judgment	$20.00	/day	23	days		$452.54
Construction Support Team	Professional Judgment	$4,447.00	/day	23	days		$100,622.90
Additional H & S Markup of		**10%**					**$12,234.50**
Total Cost for Source Material Excavation							**$134,579.46**

Estimated time required for Excavation = 23 days

4.2 Excavation of Material Requiring Screening of Excavated Soil for MEC/MD

Assumptions:

TCE contaminated soil will require screening for MEC/MD and certification as safe prior to disposal. In addition, 914 CY of the excavated cutback will also require screening to remove MEC/MD. It is assumed that the screening process will involve laying out soil to be screened in 6-inch lifts and visually inspected (aided by the use of a Schonstedt) by a team of UXO Technicians. MEC/MD screening will take place simultaneously with the excavation. Assume 150 CY/day during construction support activities.

Volume of source area:	1334	CY
Volume of overburden expected to contain MEC/MD:	0	CY
Volume of excavation sidewall cutback expected to contain MEC/MD:	914	CY
Total excavated volume requiring MEC/MD screening:	2248	CY

Description	Cost Code	Unit Rate		Duration			Cost
Extended Reach Excavator with Thumb	Professional Judgment	$600.00	/day	15	days		$8,992.00
Dozer	Professional Judgment	$85.00	/day	15	days		$1,273.87
Front End Loader	Professional Judgment	$120.00	/day	15	days		$1,798.40
Dump Truck	Professional Judgment	$120.00	/day	15	days		$1,798.40
Diesel Fuel Tank, 500 gallon	Professional Judgment	$100.00	/day	15	days		$1,498.67
Office Trailer	Professional Judgment	$20.00	/day	15	days		$299.73
MEC Support Team	Professional Judgment	$8,373.00	/day	15	days		$125,483.36
Additional H & S Markup of		**10%**					**$14,114.44**
Total Cost for MEC/MD screening							**$155,258.87**

Estimated time required for Excavation = 15 days

ALTERNATIVE GW-5

SOURCE MATERIAL EXCAVATION AND MNA WITH ICs

4.3 MEC Destruction

Assumptions:

Since a subsurface investigation has not been performed over the entire excavation area, the number of MEC items anticipated remains unknown. Assume 1 BIP per 20 CY of MEC/MD/OD

Description	Unit Rate	Number of units	Cost
Explosives	$65.00 /BIP	34 BIPS	$2,210.00
Total Cost for MEC Destruction			**$2,210.00**
Total Cost with H & S Markup of	**10%**		**$2,431.00**

4.4 Transportation and Off-Site Disposal of Contaminated Soil

Note: Based on previous investigations, it is assumed that the TCE-contaminated soil will have to be disposed as hazardous.

Subtitle C Landfill with transportation:			$200.00	/ton
Estimated unit weight of contaminated soil:			1.5	ton/CY
Tonnage of contaminated soil, including	30%	swelling factor:	2,602	ton

Description	Unit Rate	Number of units	Cost
Transportation and Disposal	$200.00 /ton	2,602 tons	$520,400.00
Total Cost for Transportation and Off-Site Disposal			**$520,400.00**
Total Cost with H & S Markup of	**10%**		**$572,440.00**

4.5 Transportation and Off-Site Disposal of Non-Hazardous Debris

Note: Based on previous investigations, it is assumed that the majority of MD/OD identified will be non-hazardous and will be recycled at no cost to contractor. Assume 675 CY of scrap metal.

Subtitle D Landfill with transportation:	$0.00	/ton
Estimated volume of non-hazardous waste:	675	CY
Estimated unit weight of non-hazardous waste:	0.375	ton/CY
Tonnage of non-hazardous waste:	254	ton

Description	Unit Rate	Number of units	Cost
Transportation and Disposal	$0.00 /ton	254 tons	$0.00
Total Cost for Transportation and Off-Site Disposal			**$0.00**
Total Cost with H & S Markup of	**10%**		**$0.00**

4.6 Confirmation Sampling, Soil Profiling for Disposal, and Decon Water Profiling

Waste Characterization Samples:	0
1 sample for 1st 100cy + 1ea per add'l 200cy	
Post excavation samples (1 sample per 30 ft of sidewall and 1 sample per 900 sf of excavation bottom)	10
Decon water:	1
Total Number of Samples:	11

Note: Hazardous waste characterization sampling required under RCRA for disposal includes: TCLP VOCs, TCLP SVOCs, TCLP pesticides/herbicides, TCLP metals, reactivity, corrosivity, and ignitability.

Description	Unit Rate	Number of units	Cost
Post Excavation Sampling Analysis (VOCs only)	$116.00 /sample	10 samples	$1,160.00
Decon Water Waste Characterization	$730.00 /sample	1 samples	$730.00
Hazardous Waste Characterization	$1,040.00 /sample	0 samples	$0.00
Total Cost for Confirmatio/Profiling Sampling			**$1,890.00**
Total Cost with H & S Markup of	**10%**		**$2,079.00**

ALTERNATIVE GW-5

SOURCE MATERIAL EXCAVATION AND MNA WITH ICs

4.7 Site Restoration

Site Restoration activities include backfilling the area with clean overburden, sidewall cutback spoils and certified clean fill; compaction; and slope stabilization.

Estimated volume of certified clean fill required:	1,334 CY
Including 30% swelling factor	1,734 CY
Total backfill volume:	18,087 CY

Description	Cost Code	Unit Rate	Number of units	Duration (days)	Cost
Backfill, structural, 200 H.P., 150" haul, common earth	Professional Judgment	$2.00 /CY	18,087 CY	16.5	$36,174.00
Certified Clean Fill (delivered)		$15.00 /CY	1,734 CY		$26,013.00
Compaction, riding, sheepsfoot or wobbly whl rlr, 12" lifts, 4 passes	Professional Judgment	$0.55 /CY	18,087 CY	7.3	$9,947.85
Total Cost for Site Restoration					**$72,134.85**
Total Cost with H & S Markup of		**10%**			**$79,348.34**

Estimated time required for Site Restoration: 24 days

5.0 Mobilization / Demobilization

Mobilization and demobilization consists of providing and removing all required equipment and materials to and from the site. In addition, providing all required utilities is also included with mobilization.

Mobilization is calculated as 10% of the direct capital costs, including site preparations and remedial system installations.

Mobilization/Demobilization	**10% of capital**	**$97,117**

6.0 Construction and Technical Oversight

Field construction oversight will be required for the duration of the project. The duration of the project will include time to construct and remove support facilities (i.e. decon pad, erosion controls), excavation, and site restoration. An H&S Engineer is estimated to provide additional oversight at a rate of 1 day/wk. Due to the site location in an active range area, an additional 10% is applied to the work duration to account for anticipated work restrictions and delays. A similar cost is applied to UXO support for Characterization Sampling, Site Prep, and Excavation; however as base UXO support costs have already been applied in the preceding sections, only the additional 10% is applied here.

Estimated total construction time frame:

Site preparations:	8	days
Excavation/Restoration:	62	days
Mob/Demob:	2	days
Duration (including 10% standby):	79	days

Description	Unit Rate	Number of units		Cost
Data Review	$1,000.00	lump sum		$1,000.00
Site Visit and Meeting	$5,000.00	lump sum		$5,000.00
Field Engineer	$2,300.00 /week	16	weeks	$36,800.00
H&S Engineer	$3,500.00 /week	3.2	weeks	$11,200.00
UXO Support (work restriction and delays due to work in active range area)	$132.20 /day	79	days	$10,443.80
Total Cost for Construction and Oversight				**$64,400.00**

ALTERNATIVE GW-5

SOURCE MATERIAL EXCAVATION AND MNA WITH ICs

All work associated with Remedial Alternative GW-5 to be done using local workforce.

SUMMARY OF CAPITAL COSTS:

1) Institutional Controls/Planning		**$28,000.00**
2) Planning, Permiting and Reporting		**$67,000.00**
3) Site Preparation		**$25,037.10**
4) Excavation of Source Material		**$946,136.66**
5) Mobilization/Demobilization		**$97,117.38**
6) Construction and Technical Oversight		**$64,400.00**
Contingency of Scope	**10%**	**$122,769.11**
Contingency of Bid	**5%**	**$61,384.56**
TOTAL CAPITAL COST		**$1,411,844.81**

OPERATION AND MAINTENANCE (O&M) COSTS

7.0 Long-Term Groundwater and Surface Water Monitoring

The long-term groundwater monitoring would be designed to ensure that the plume characteristics are not changing in an unexpected manor, no new source areas are apparent, regulatory levels are being met, and the plume as a whole is acting as predicted.

The analytical program for the long-term groundwater monitoring program will consist of all of the contaminants of concern in addition to field parameters including dissolved oxygen, pH, Conductivity, Temperature, Turbidity, and ORP. These parameters ensure monitoring of the plume for regulatory compliance as wells as monitoring for changing geochemical and oxidation reduction state. All quality control sample analysis (field duplicates, rinse blanks, trip blanks) are assumed to be 20% of the total number of samples collection (20% of analytical costs).

For each sampling event, the following unit costs and level of efforts (LOEs) will apply:

Field Sampler:	$50.00	/hr/person
Number of People:	2	people
Hours worked per day:	10	hrs
Anticipated time to collect GW samples per location:	3.0	hrs
Number of Wells to Sample for the long-term monitoring:	12	wells
Number of Surface Water Samples Collected Per Event:	5	locations
Anticipated time to collect SW samples per location:	1.5	hrs
Data Management cost per sampling event:	$3,000.00	per event

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	44 hrs	$4,350.00
Equipment (vehicle, pumps, water quality meter, etc.)	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (Including TCE, DCE, VC)	$116.00	21 samples	$2,436.00
TOTAL CHEMICAL ANALYSIS COST:			**$2,436.00**
Data Management and Reporting cost	$3,000.00 per event	1 event	$3,000.00
Total Sampling and Reporting Costs per Sampling Event			**$10,386.00**

ALTERNATIVE GW-5

SOURCE MATERIAL EXCAVATION AND MNA WITH ICs

It is assumed that following the first 5 years of the LTM program that the total number of wells to be sampled would be reduced from 12 to 8.

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	32 hrs	$3,150.00
Equipment (vehicle, pumps, water quality meter,	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (Including TCE, DCE, VC)	$116.00	16 samples	$1,856.00
TOTAL CHEMICAL ANALYSIS COST:			**$1,856.00**
Data Management and Reporting cost	$3,000.00 per event	1 event	$3,000.00
Total Sampling and Reporting Costs per Sampling Event			**$8,606.00**

DESCRIPTION OF COSTS PER PHASE ADJUSTED TO PRESENT VALUE

Description	Unit Rate	Number of units	Cost
Annual Cost for Semiannual Sampling Years 1-5	$10,386.00 /event	2 events	$20,772.00
Using a discount rate of 2.7%	**for a period of**	**5 years**	**$95,950.05**

Description	Unit Rate	Number of units	Cost
Annual Cost for Years 6-10 (annual sampling for 5 years)	$8,606.00 /event	1 events	$8,606.00
Using a discount rate of 2.7%	**for a period of**	**5 years**	**$34,794.93**

Total Discounted Sampling Cost:

Years 1-5	**$95,950.05**
Years 6-10	**$34,794.93**
Total	**$130,744.98**

8.0 Well Construction, Abandonment, and Maintenance

Since LTM will occur over an anticipated period of 10 years, the groundwater monitoring wells will require maintenance to allow for accurate sampling of the aquifer. This will include inspections yearly with maintenance as needed.

Description	Unit Rate	Number of units	Discounted Cost
Well inspection and maintenance	$2,000.00 /year	10 years	$17,324.61
Future Well abandonment	$1,150.00 /well	23 wells	$20,263.82
Well Replacement			
Well replacement will be performed periodically as needed. For the purpose of this FS, the well replacement is assumed to occur every 5 years for the entire duration of the project.			
Description	**Unit Rate**	**Number of units**	**Discounted Cost**
Well replacement	$10,000.00 / 5 year	10 years	$16,413.99
UXO Avoidance (2 person team)	$4,800.00 /5 year	10 years	$7,878.72
Total Discounted Well Construction, Abandonment, and Maintenance Cost			**$61,881.13**

Discount Rate = 2.7%

ALTERNATIVE GW-5

SOURCE MATERIAL EXCAVATION AND MNA WITH ICs

9.0 5-Year Review

Five-year reviews will be performed to assess the effectiveness of the remedy. For the purpose of this FS, the duration for these activities is assumed to be 10 years.

Description		Unit Rate	Number of units	Cost
5-Year Review (including draft, draft final, and final reports)		$15,000	lump sum	$15,000.00
Using a discount rate of	**2.7%**	**for a period of**	**10 years**	**$24,620.99**

Discounted O&M Cost:

20-Year Sampling Cost	**$130,744.98**
Well Construction, Abandonment, and Maintenance	**$61,881.13**
5-Year Reviews	**$24,620.99**
Total	**$217,247.11**

TOTAL CAPITAL COST:		**$1,411,844.81**
DISCOUNTED O&M COST:		**$217,247.11**
Contingency of Scope:	**5%**	**$10,862.36**
Contingency of Bid:	**10%**	**$21,724.71**
TOTAL DISCOUNTED O&M COST:		**$249,834.17**
TOTAL PRESENT WORTH VALUE:		**$1,661,678.98**

ALTERNATIVE GW-6

TOTAL LANDFILL REMOVAL AND MNA POLISHING WITH ICs

Alternative GW-6 involves excavation of the entire Munitions Waste Pit as defined from the MMRP RI (Weston), including the assumed source of the plume in the soil overburden; LTM; and the maintenance and enforcement of ICs, in particular the restrictions of groundwater uses and long-term groundwater monitoring for all parameters that exceeded the SCLs. It is assumed that ICs and the long-term groundwater monitoring would be performed for 10 years. The anticipated length of LTM will be reevaluated following review of the groundwater sampling results, and evaluation of site-specific attenuation rates.

GENERAL ASSUMPTIONS

1) The costs are adopted from R.S. Means 2007 Costworks - Site Work, previous work conducted by Shaw Environmental at PTA, and professional judgment.
2) The costs are adjusted with a location factor for Dover, New Jersey
3) The costs and duration of the construction activities are based on an 8-hour 5-day per week working schedule, unless otherwise noted.
4) Work is to be conducted under a safety level D condition. However, a general health and safety markup of **10%** will be used to account for modification of safety level condition.
5) For activities requiring construction support, the team will consist of: 1 truck driver, 2 laborers, 1 Tech 3,1 Tech 2, and 2 Operators (Tech 2).
6) For activities requiring MEC screening, the team will consist of: 1 truck driver, 2 laborers, SUXOS, UXOSO/QCS, 1 Tech 3, 2 Tech 2, 2 Tech 2, and 3 Operators (Tech 2).
7) Preliminary estimate of the entire waste pit area is approximately 10,500 SF with a total depth of approximately 25 ft bgs. Volume of landfill: 9,723 CY, Volume of clean overburden and cutback: 26,852 CY

CAPITAL COSTS

1.0 Institutional Controls/Planning

Land Use Restrictions: A site-specific Land Use Control Implementation Plan (LUCIP) will need to be written in order to place restrictions on activities that can be performed in areas of the plumes at the 600 Area Sites. These restrictions can be enforced through existing institutional controls and by restricting future land use. The land use restrictions will ensure that potential receptors are not exposed to contaminated groundwater from the 600 Area plumes.

Description	Unit Rate	Number of units	Cost
Paralegal	$150.00 /hr	80 hrs	$12,000.00
Lawyer	$200.00 /hr	80 hrs	$16,000.00
Total Cost For the Land Use Control Implementation Plan:			**$28,000.00**

2.0 Planning, Permitting and Reporting

Deliverables will include work plan, health and safety plan and a closure report. In addition, the substantive requirements for a Classification Exemption Area submittal will need to be made.

Description	Unit Rate	Number of Units	Cost
Permit equivalents	$2,000	Lump Sum	2,000.00
Design documents (drawings, specifications, design basis) - draft, draft final, and final	$15,000	Lump Sum	15,000.00
Work Plan	$10,000	Lump Sum	10,000.00
Explosive Safety Submission	$15,000	Lump Sum	15,000.00
Health and Safety Plan	$5,000	Lump Sum	5,000.00
FSP, QAPP, and DQOs	$5,000	Lump Sum	5,000.00
Closeout Report (Draft, Draft Final, Final)	$15,000	Lump Sum	15,000.00
Total Cost for Reporting			**$67,000.00**

ALTERNATIVE GW-6

TOTAL LANDFILL REMOVAL AND MNA POLISHING WITH ICs

Summary of Institutional Control/Planning Costs

Description	Cost
Total Cost For Institutional Controls Plan Amendments:	$28,000.00
Total Cost For Planning, Permitting, and Reporting	$67,000.00
Total Capital Cost for Institutional Controls:	**$95,000.00**

3.0 Site Preparation

3.1 Erosion Control

Prior to start of work, silt fence will be erected along the perimeter of the work areas. In addition to the assumed 60' x 120' source area, a 1:2 slope will be required for side wall stabilization. For an overall depth of 25' bgs, the resulting cutback is 50', yeilding a 160' x 220' work area.
Silt fence will be maintained in an erect position and cleaned as required to ensure efficiency.

Required length of silt fence (110% of work area perimeter): 1,276 LF

Description	Cost Code	Unit Rate	Number of units	Duration	Cost
Silt fencing, polypropylene,	23705501100	$1.00 /lf	1,276 lf	2	$1,276.00
MEC Support (2 person team)	Professional Judgment	$1,322.00 /day		2	$2,644.00
Additional H & S Markup of		**10%**			**$392.00**
Total Erosion Control Cost					**$4,312.00**

Estimated time required for Silt Fence Construction = 2 days

3.2 Layout and Construction Survey

The purpose of a layout/construction survey is to assure that the proper amount of cover materials are in place . The work will consist of furnishing, placing, and maintaining the construction layout controls (stakes) necessary.

Assumptions:
1) Survey crew used to perform the construction layout survey will require a two person crew.

Description	Cost Code	Unit Rate	Number of units	Cost
Surveying Crew, 2 person survey	11077001100	$1,000.00 /day	5 days	$5,000.00
Total Cost for Survey Crew				**$5,000.00**
Total Surveying Cost with H & S Markup of		10%		**$5,500.00**

Estimated Number of days required = 5 days

3.3 Site Setup

Equipment necessary prior to start of fieldwork. Assume 2 magazines and 1 remote firing device required during excavation.

Description	Cost Code	Unit Rate	Number of units	Duration	Cost
Office Trailer	Professional Judgment	$7,500.00	Lump Sum		$7,500.00
Explosives Storage Magazine	Professional Judgment	$600.00	Lump Sum		$600.00
RFD Remote Firing Device	Professional Judgment	$3.00	Lump Sum		$3.00
Additional H & S Markup of		**10%**			**$810.30**
Total Vehicle and Personnel Decon Area Cost					**$8,913.30**

3.4 Vehicle and Personnel Decontamination Area

The decontamination facility will be constructed using a geomembrane liner to contain liquids generated during the decontamination activities. The liner will be placed directly on the dround surface. Sand will be used to smooth the existing terrain.

Description	Cost Code	Unit Rate	Number of units	Duration (days)	Cost
Material and Installation costs for Decon Pad	Professional Judgment	$7,500.00	Lump Sum		$7,500.00
Additional H & S Markup of		**10%**			**$750.00**
Total Vehicle and Personnel Decon Area Cost					**$8,250.00**

Estimated time required for Decon Area Construction = 2 days

ALTERNATIVE GW-6

TOTAL LANDFILL REMOVAL AND MNA POLISHING WITH ICs

4.0 Excavation and Disposal of Source Material

4.1 Excavation of Material Requiring Construction Support

Assumptions:

Soil will be excavated using an excavator that will load directly into end dump trucks or staging area. The excavation rate and unit cost have been selected based on Shaw experience and professional judgment to account for difficult terrain, site accessibility, and anticipated MEC clearance activities. In areas where the MEC/MD is not likely (i.e., clean overburden and sidewall cutback), construction support activities will be required. This will consist of having two UXO technicians visually observing the excavation. Excavation will proceed in six inch lifts such that debris will be observed if present. One UXO team member will be located to the rear and upwind of the excavation equipment and will visually observe excavation. Assume 26,852 CY of clean overburden and sidewall cutback soil require construction support. Assume 700 CY/day during construction support activities.
Clean overburden and sidewall cutback spoils will be staged and used as backfill following confirmation sampling.
Total excavated volume requiring construction support: 26852 CY

Description	Cost Code	Unit Rate		Duration			Cost
Extended Reach Excavator with Thumb	Professional Judgment	$600.00	/day	38	days		$23,016.00
Front End Loader	Professional Judgment	$120.00	/day	38	days		$4,603.20
Dump Truck	Professional Judgment	$120.00	/day	38	days		$4,603.20
Diesel Fuel Tank, 500 gallon	Professional Judgment	$100.00	/day	38	days		$3,836.00
Office Trailer	Professional Judgment	$20.00	/day	38	days		$767.20
Construction Support Team	Professional Judgment	$4,447.00	/day	38	days		$170,586.92
Additional H & S Markup of		**10%**					**$20,741.25**
Total Cost for Source Material Excavation							**$228,153.77**

Estimated time required for Excavation = 38 days

4.2 Excavation of Material Requiring Screening of Excavated Soil for MEC/MD

Assumptions:

Excavation of the entire Inactive Munitions Waste Pit landfill (approximately 9,723 CY), including transport and disposal of approximately 1,334 cubic yards (CY) of TCE contaminated soil will require screening for MEC/MD and certification as safe prior to disposal. It is assumed that the screening process will involve laying out soil to be screened in 6-inch lifts and visually inspected (aided by the use of a Schonstedt) by a team of UXO Technicians. MEC/MD screening will take place simultaneously with the excavation. Assume 150 CY/day during construction support activities.

Total excavated volume requiring MEC/MD screening: 9723 CY

Description	Cost Code	Unit Rate		Duration			Cost
Extended Reach Excavator with	Professional	$600.00	/day	65	days		$38,892.00
Dozer	Professional	$85.00	/day	65	days		$5,509.70
Front End Loader	Professional	$120.00	/day	65	days		$7,778.40
Dump Truck	Professional	$120.00	/day	65	days		$7,778.40
Diesel Fuel Tank, 500 gallon	Professional	$100.00	/day	65	days		$6,482.00
Office Trailer	Professional Judgment	$20.00	/day	65	days		$1,296.40
MEC Support Team	Professional Judgment	$8,373.00	/day	65	days		$542,737.86
Additional H & S Markup of		**10%**					**$61,047.48**
Total Cost for MEC/MD screening							**$671,522.24**

Estimated time required for Excavation = 65 days

ALTERNATIVE GW-6

TOTAL LANDFILL REMOVAL AND MNA POLISHING WITH ICs

4.3 MEC Destruction

Assumptions:

Since a subsurface investigation has not been performed over the entire excavation area, the number of MEC items anticipated remains unknown. Assume 1 BIP per 20 CY of MEC/MD/OD

Description	Unit Rate	Number of units	Cost
Explosives	$65.00 /BIP	146 BIPS	$9,490.00
Additional H & S Markup of	**10%**		**$949.00**
Total Cost for MEC Destruction			**$10,439.00**

4.4 Transportation and Off-Site Disposal of Contaminated Soil

Note: Based on previous investigations, it is assumed that the TCE contaminated soil will have to be disposed as hazardous.

Subtitle C Landfill with transportation:			$200.00	/ton
Estimated unit weight of contaminated soil:			1.5	ton/CY
Tonnage of Subtitle C soil, including	30%	swelling factor:	2,602	ton

Description	Unit Rate	Number of units	Cost
Transportation and Disposal	$200.00 /ton	2,602 tons	$520,400.00
Additional H & S Markup of	**10%**		**$52,040.00**
Total Cost for MEC/MD screening			**$572,440.00**

4.5 Transportation and Off-Site Disposal of Non-Hazardous Debris

Note: Based on previous investigations, it is assumed that the majority of MD/OD identified will be non-hazardous and will be recycled at no cost to contractor. Assume 2917 CY of scrap metal.

Subtitle D Landfill with transportation:	$0.00	/ton
Estimated volume of non-hazardous waste:	2917	CY
Estimated unit weight of non-hazardous waste:	0.375	ton/CY
Tonnage of non-hazardous waste:	1,094	ton

Description	Unit Rate	Number of units	Cost
Transportation and Disposal	$0.00 /ton	1,094 tons	$0.00
Total Cost for Transportation and Off-Site Disposal			**$0.00**
Total Cost with H & S Markup of	**10%**		**$0.00**

4.6 Confirmation Sampling, Soil Profiling for Disposal, and Decon Water Profiling

Waste Characterization Samples:	10
1 sample for 1st 100cy + 1ea per add'l 200cy	
Post excavation samples (1 sample per 30 ft of sidewall and 1 sample per 900 sf of excavation bottom)	10
Decon water:	1
Total Number of Samples:	21

Note: Hazardous waste characterization sampling required under RCRA for disposal includes: TCLP VOCs, TCLP SVOCs, TCLP pesticides/herbicides, TCLP metals, reactivity, corrosivity, and ignitability.

Description	Unit Rate	Number of units	Cost
Post Excavation Sampling Analysis (VOCs only)	$116.00 /sample	10 samples	$1,160.00
Decon Water Waste Characterization	$730.00 /sample	1 samples	$730.00
Hazardous Waste Characterization	$1,040.00 /sample	10 samples	$10,400.00
Total Cost for Confirmatio/Profiling Sampling			**$12,290.00**
Total Cost with H & S Markup of	**10%**		**$13,519.00**

ALTERNATIVE GW-6

TOTAL LANDFILL REMOVAL AND MNA POLISHING WITH ICs

4.7 Site Restoration

Site Restoration activities include backfilling the area with clean overburden, sidewall cutback spoils and certified clean fill; compaction; and slope stabilization.

Estimated volume of certified clean fill required:	1,334 CY
Including 30% swelling factor	1,734 CY
Total backfill volume:	36,575 CY

Description	Cost Code	Unit Rate	Number of units	Duration (days)	Cost
Backfill, structural, 200 H.P., 150" haul, common earth	Professional Judgment	$2.00 /CY	36,575 CY	33.3	$73,150.00
Certified Clean Fill (delivered)		$15.00 /CY	1,734 CY		$26,013.00
Compaction, riding, sheepsfoot or wobbly whl rlr, 12" lifts, 4 passes	Professional Judgment	$0.55 /CY	36,575 CY	14.7	$20,116.25
Total Cost for Site Restoration					**$119,279.25**
Total Cost with H & S Markup of		**10%**			**$131,207.18**

Estimated time required for Site Restoration: 48 days

5.0 Mobilization / Demobilization

Mobilization and demobilization consists of providing and removing all required equipment and materials to and from the site. In addition, providing all required utilities is also included with mobilization.

Mobilization is calculated as 10% of the direct capital costs, including site preparations and remedial system installations.

Mobilization/Demobilization	**10% of capital**	**$165,426**

6.0 Construction and Technical Oversight

Field construction oversight will be required for the duration of the project. The duration of the project will include time to construct and remove support facilities (i.e. decon pad, erosion controls), excavation, and site restoration. An H&S Engineer is estimated to provide additional oversight at a rate of 1 day/wk. Due to the site location in an active range area, an additional 10% is applied to the work duration to account for anticipated work restrictions and delays. A similar cost is applied to UXO support for Characterization Sampling, Site Prep, and Excavation; however as base UXO support costs have already been applied in the preceding sections, only the additional 10% is applied here.

Estimated total construction time frame:

Site preparations:	9	days
Excavation/Restoration:	151	days
Mob/Demob:	2	days
Duration (including 10% standby):	179	days

Description	Unit Rate	Number of units		Cost
Data Review	$1,000.00	lump sum		$1,000.00
Site Visit and Meeting	$5,000.00	lump sum		$5,000.00
Field Engineer	$2,300.00 /week	36	weeks	$82,800.00
H&S Engineer	$3,500.00 /week	7.2	weeks	$25,200.00
UXO Support (work restriction and delays due to work in active range area)	$132.20 /day	179	days	$23,663.80
Total Cost for Construction and Oversight				**$137,660.00**

ALTERNATIVE GW-6

TOTAL LANDFILL REMOVAL AND MNA POLISHING WITH ICs

All work associated with Remedial Alternative GW-5 to be done using local workforce.

SUMMARY OF CAPITAL COSTS:

1) Institutional Controls/Planning		**$28,000.00**
2) Planning, Permiting and Reporting		**$67,000.00**
3) Site Preparation		**$26,975.30**
4) Excavation of Source Material		**$1,627,281.18**
5) Mobilization/Demobilization		**$165,425.65**
6) Construction and Technical Oversight		**$137,660.00**
Contingency of Scope	**10%**	**$205,234.21**
Contingency of Bid	**5%**	**$102,617.11**
TOTAL CAPITAL COST		**$2,360,193.45**

OPERATION AND MAINTENANCE (O&M) COSTS

7.0 Long-Term Groundwater and Surface Water Monitoring

The long-term groundwater monitoring would be designed to ensure that the plume characteristics are not changing in an unexpected manor, no new source areas are apparent, regulatory levels are being met, and the plume as a whole is acting as predicted.

The analytical program for the long-term groundwater monitoring program will consist of all of the contaminants of concern in addition to field parameters including dissolved oxygen, pH, Conductivity, Temperature, Turbidity, and ORP. These parameters ensure monitoring of the plume for regulatory compliance as wells as monitoring for changing geochemical and oxidation reduction state. All quality control sample analysis (field duplicates, rinse blanks, trip blanks) are assumed to be 20% of the total number of samples collection (20% of analytical costs).

For each sampling event, the following unit costs and level of efforts (LOEs) will apply:

Field Sampler:	$50.00	/hr/person
Number of People:	2	people
Hours worked per day:	10	hrs
Anticipated time to collect GW samples per location:	3.0	hrs
Number of Wells to Sample for the long-term monitoring:	12	wells
Number of Surface Water Samples Collected Per Event:	5	locations
Anticipated time to collect SW samples per location:	1.5	hrs
Data Management cost per sampling event:	$3,000.00	per event

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	44 hrs	$4,350.00
Equipment (vehicle, pumps, water quality meter, etc.)	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (Including TCE, DCE, VC)	$116.00	21 samples	$2,436.00
TOTAL CHEMICAL ANALYSIS COST:			**$2,436.00**
Data Management and Reporting cost	$3,000.00 per event	1 event	$3,000.00
Total Sampling and Reporting Costs per Sampling Event			**$10,386.00**

ALTERNATIVE GW-6

TOTAL LANDFILL REMOVAL AND MNA POLISHING WITH ICs

It is assumed that following the first 5 years of the LTM program that the total number of wells to be sampled would be reduced from 12 to 8.

Description	Unit Rate	Number of units	Cost
COSTS PER SAMPLING EVENT			
Labor for chemical sampling	$50.00 /hr/person	32 hrs	$3,150.00
Equipment (vehicle, pumps, water quality meter,	$600.00 /event	1 event	$600.00
Chemical Analysis Cost			
VOCs (Including TCE, DCE, VC)	$116.00	16 samples	$1,856.00
TOTAL CHEMICAL ANALYSIS COST:			**$1,856.00**
Data Management and Reporting cost	$3,000.00 per event	1 event	$3,000.00
Total Sampling and Reporting Costs per Sampling Event			**$8,606.00**

DESCRIPTION OF COSTS PER PHASE ADJUSTED TO PRESENT VALUE

Description	Unit Rate	Number of units	Cost
Annual Cost for Semiannual Sampling Years 1-5	$10,386.00 /event	2 events	$20,772.00
Using a discount rate of 2.7%	**for a period of**	**5 years**	**$95,950.05**

Description	Unit Rate	Number of units	Cost
Annual Cost for Years 6-10 (annual sampling for 5 years)	$8,606.00 /event	1 events	$8,606.00
Using a discount rate of 2.7%	**for a period of**	**5 years**	**$34,794.93**

Total Discounted Sampling Cost:

Years 1-5	**$95,950.05**
Years 6-10	**$34,794.93**
Total	**$130,744.98**

8.0 Well Construction, Abandonment, and Maintenance

Since LTM will occur over an anticipated period of 10 years, the groundwater monitoring wells will require maintenance to allow for accurate sampling of the aquifer. This will include inspections yearly with maintenance as needed.

Description	Unit Rate	Number of units	Discounted Cost
Well inspection and maintenance	$2,000.00 /year	10 years	$17,324.61
Future Well abandonment	$1,150.00 /well	23 wells	$20,263.82
Well Replacement			
Well replacement will be performed periodically as needed. For the purpose of this FS, the well replacement is assumed to occur every 5 years for the entire duration of the project.			
Description	**Unit Rate**	**Number of units**	**Discounted Cost**
Well replacement	$10,000.00 / 5 year	10 years	$16,413.99
UXO Avoidance (2 person team)	$4,800.00 /5 year	10 years	$7,878.72
Total Discounted Well Construction, Abandonment, and Maintenance Cost			**$61,881.13**

Discount Rate = 2.7%

ALTERNATIVE GW-6

TOTAL LANDFILL REMOVAL AND MNA POLISHING WITH ICs

9.0 5-Year Review

Five-year reviews will be performed to assess the effectiveness of the remedy. For the purpose of this FS, the duration for these activities is assumed to be 10 years.

Description	Unit Rate	Number of units	Cost
5-Year Review (including draft, draft final, and final reports)	$15,000	lump sum	$15,000.00
Using a discount rate of 2.7%	**for a period of**	**10 years**	**$24,620.99**

Discounted O&M Cost:

20-Year Sampling Cost	**$130,744.98**
Well Construction, Abandonment, and Maintenance	**$61,881.13**
5-Year Reviews	**$24,620.99**
Total	**$217,247.11**

TOTAL CAPITAL COST:		**$2,360,193.45**
DISCOUNTED O&M COST:		**$217,247.11**
Contingency of Scope:	**5%**	**$10,862.36**
Contingency of Bid:	**10%**	**$21,724.71**
TOTAL DISCOUNTED O&M COST:		**$249,834.17**
TOTAL PRESENT WORTH VALUE:		**$2,610,027.62**