RECORD OF DECISION AMENDMENT

NORTH PENN AREA 5 SUPERFUND SITE
Operable Unit 1
Montgomery County, Pennsylvania

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION III, PHILADELPHIA, PENNSYLVANIA
July 2016

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TABLE OF CONTENTS

I. DECLARATION

NORTH PENN AREA 5
SUPERFUND SITE
Operable Unit 1

Montgomery County, Pennsylvania

RECORD OF DECISION AMENDMENT
NORTH PENN AREA 5
SUPERFUND SITE
Operable Unit 1

DECLARATION

Site Name and Location

North Penn Area 5 Superfund Site (Operable Unit 1)
Montgomery County, Pennsylvania
Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number: PAD980692693

Statement of Basis and Purpose

This Record of Decision Amendment (ROD Amendment) presents the Selected Remedy for Operable Unit 1 (OU1) at the North Penn Area 5 (North Penn 5 or NP5) Superfund Site (Site) located in Montgomery County, Pennsylvania (See Figure 1 in Section V), which was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, 42 U.S.C. § 9601 et seq., and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This ROD Amendment explains the factual and legal basis for amending the selected remedial action for OU1 at the Site. The information considered or relied upon in making this decision is contained in the Administrative Record supporting the ROD Amendment for Operable Unit 1 of the Site.

The Pennsylvania Department of Environment Protection (PADEP) has indicated that it does not object to the Selected Remedy in a letter dated March 8, 2016.

Assessment of the Site

Pursuant to duly delegated authority, I hereby determine, pursuant to Section 106 of CERCLA, 42 U.S.C. § 9606, that the response action selected in this ROD Amendment is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Description of the Selected Remedy

The Site includes several areas in the vicinity of Colmar, Pennsylvania where groundwater is contaminated with trichloroethylene (TCE) and other volatile organic compounds (VOCs). Based on the results of the remedial investigation (RI), which identified three plumes of groundwater contamination, EPA divided the Site into three operable units (OUs) based on the primary areas of contamination for purposes of

performing the cleanup. See Figure 2 for the approximate locations of each of the three OUs.

On June 25, 2004, the United States Environmental Protection Agency (EPA) issued a ROD (hereinafter, 2004 ROD) selecting a response action for the OU1 and OU3 portions of the Site. In the 2004 ROD, EPA selected in-situ chemical oxidation and extraction and treatment of groundwater for containment as the remedy for both OU1 and OU3[1]. It also required further evaluation of copper and cadmium contamination in OU1 sediment near the former BAE facility located at 305 Richardson Road (hereinafter, "Former BAE Facility").

On September 7, 2011, EPA issued an interim ROD for OU2 which selected enhanced in-situ bioaugmentation and Institutional Controls (ICs) to address VOC contamination in the overburden groundwater.

Based on information it has collected and reviewed since the issuance of the 2004 ROD, EPA has determined that the selected remedy for OU1 needs to be changed to ensure that it achieves cleanup levels to meet Maximum Contaminant Levels (MCLs) as described below. Sampling undertaken as part of the in-situ chemical oxidation remedial design did not identify source area(s) contributing to current contamination in the OU1 plume, but rather showed the presence of a diffuse plume. In-situ chemical oxidation is most efficient when the oxidant is applied to a source area, not a diffuse plume. The in-situ chemical oxidation remedy without an identified source area is unlikely to achieve cleanup levels at OU1. Therefore, EPA has selected a new groundwater remedy as outlined below, although EPA has retained in-situ chemical oxidation as a contingent remedy in the event that a source area is identified during future site work (e.g., as the result of pre-design investigations, or during the implementation of the selected optimized extraction and treatment remedy). In addition, EPA has also selected enhanced bioremediation as a contingent remedy in the event that the Groundwater Extraction and Treatment System has been optimized to the satisfaction of EPA in consultation with PADEP and contaminant concentrations become asymptotic approaching MCLs. Prior to implementation of bioremediation, a pilot study will be undertaken in order to demonstrate whether bioremediation will be effective in achieving cleanup levels. In the event that a contingent remedy is triggered based on Site conditions, EPA would issue an Explanation of Significant Differences (ESD) in accordance with 42 U.S.C. § 9617(c) and so inform the public as required by the NCP, 40 C.F.R. § 350.435(c).

As required by the 2004 ROD, EPA conducted further risk evaluation of copper and cadmium present in sediments at OU1 and proposed removal of the impacted sediment in the 2014 Proposed Plan. However, EPA received public comment indicating sediment removal was unnecessary. In response to public comment, EPA conducted a Site inspection in 2014 to observe existing conditions. EPA has determined that, although copper and cadmium present in sediment in 1998 could have posed risk to ecological

[1] The components of the remedy selected for OU1 and OU3 are described in detail in the 2004 ROD and the components of the interim remedy selected for OU2 are described in detail in the 2011 ROD, which are both available in the Administrative Record supporting this ROD Amendment.

receptors based on 1998 ecological conditions at the Site, conditions observed by EPA in 2014 indicate that sediment accumulation and exposure to ecological receptors is spatially limited. The sediment samples from 1998 are no longer representative, and the bioavailability of any residual contamination has likely been sufficiently reduced by the presence of organic material in areas of sediment deposition in the existing wetland. Therefore, EPA has concluded that copper and cadmium do not pose unacceptable risk to ecological receptors under the current Site ecological conditions.

This ROD Amendment selects Optimized Groundwater Extraction and Treatment and Institutional Controls with Contingent Treatment (Selected Remedy) to address groundwater contamination at OU1. The major components of the Selected Remedy, which are described in detail in Section 12.2 (Description of the Selected Remedy and Performance Standards), are:

1. Design and implementation of an optimized groundwater extraction and treatment system, using an iterative approach;

2. Extraction of contaminated groundwater to achieve aquifer restoration;

3. Treatment of contaminated groundwater followed by discharge to surface water or a local publically owned treatment works;

4. Monitoring groundwater and testing of the extraction system to ensure effectiveness of the remedy;

5. Implementation of in-situ treatment(s) in the event certain contingencies occur; and

6. Implementation of institutional controls to protect the integrity of the remedy and to prevent exposure to site-related contamination.

The estimated cost of the Selected Remedy is $7,859,000.

Statutory Determinations

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions to the maximum extent practicable.

The Selected Remedy satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

Because the Selected Remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted

exposure, a statutory review will be conducted within five years after the initiation of the remedial action, pursuant to CERCLA Section 121(c) and the NCP, 40 C.F.R. § 300.430(f)(5)(iii)(C), in order to ensure the remedy is, or will be, protective of human health and the environment. The first five-year review will be conducted within five years of the initiation of remedial action at the Site and will continue every five years thereafter until OU1 conditions allow for unlimited use of and unrestricted exposure to groundwater.

ROD Data Certification Checklist

The following information is included in the Decision Summary of this ROD Amendment. Additional information can be found in the Administrative Record supporting this ROD Amendment.

ROD DATA CERTIFICATION CHECKLIST	
Information	Location/Page Number
Chemicals of concern	Section 7.0, Page 16; Table 1
Risk represented by the chemicals of concern	Section 7.1, Page 18; Table 2
Cleanup levels for chemicals of concern	Section 8.0, Page 23; Table 3
How source materials constituting principal threats are addressed	Section 11.0, Page 43
Current and reasonably anticipated future land use and potential future beneficial uses of groundwater	Section 6.0, Page 16
Potential future groundwater use that will be available at the Site as a result of the Selected Remedy	Section 12.4, Page 53
Estimated remedy cost	Section 12.3, Pages 51-53; Table 6
Key factors that led to selecting the remedy	Section 12.1, Pages 44-45

Dominique Lueckenhoff, Acting Director
Hazardous Site Cleanup Division
EPA Region III

JUL 12 2016
Date

II. DECISION SUMMARY

NORTH PENN AREA 5 SUPERFUND SITE
OPERABLE UNIT 1

COLMAR, MONTGOMERY COUNTY,
PENNSYLVANIA

1.0 SITE NAME, LOCATION AND DESCRIPTION

The North Penn Area 5 (North Penn 5 or NP5) Superfund Site (Site) is located in the vicinity of Colmar, Pennsylvania. The majority of the Site is located in the eastern part of Montgomery County, with a portion of the Site extending into Bucks County. The Site encompasses an area of approximately five square miles with Richardson Road to the southeast, Bethlehem Pike (Route 309) to the west, Trewigtown Road to the northwest, and Schoolhouse Road to the east (See Figure 1).

The Site is in an area comprised generally of commercial and industrial businesses, residences, undeveloped woodland properties, parkland, and farmland (Figure 3). Census data from 2010 indicate approximately 1,200 people live in Colmar, PA. Historically, two municipal water suppliers, North Penn Water Authority (NPWA) and North Wales Water Authority (NWWA), have utilized water-supply wells in the vicinity of the Site. In addition, at least one resident in the vicinity of the Site continues to use a private well as a source of drinking water.

The Site is one of five sites within the NPWA service district in Montgomery and Bucks Counties added to the National Priorities List (NPL) in March 1989. The NPL includes sites where known releases or threats of release of hazardous substances, pollutants or contaminants present the most significant potential threat to human health and the environment. The North Penn Area 5 Site was first identified in 1979 after volatile organic compounds (VOCs) were detected in the groundwater extracted at NPWA supply well NP-21, which was later taken out of service and is expected to be sold and properly abandoned in the future.

The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number for the Site is PAD980692693. EPA is the lead agency for the Site activities and the Pennsylvania Department of Environmental Protection (PADEP) is the support agency.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Investigations by NPWA, PADEP (formerly known as the Pennsylvania Department of Environmental Resources, or PADER) and EPA identified several potential sources of groundwater contamination in the Colmar area. In October 1990, EPA sent letters to a number of parties informing them of their potential liability at the Site. In July 1997, EPA sent special notice letters to several Potentially Responsible Parties (PRPs) offering them the opportunity to perform a site-wide remedial investigation (RI) and feasibility study (FS). When negotiations proved unsuccessful, EPA initiated a Fund-lead RI/FS.

Initial field investigations to characterize Site conditions, determine the nature and extent of contamination, and assess risks to human health and the environment began in April 1998 and were completed in June 2002. EPA issued the draft RI/FS Report in July 2002 (July 2002 RI/FS). The July 2002 RI/FS Report consists of three volumes, one of which contains the “Supplemental RI” which presents information gathered beginning in March

2002. EPA conducted additional field investigations and issued a subsequent supplemental report, identified as the Remedial Investigation Report – Supplement II, in September 2003 (September 2003 Supplemental RI) (The July 2002 RI/FS and September 2003 Supplemental RI are hereinafter collective referred to as the "RI"). Investigations undertaken during the RI and September 2003 Supplemental RI included identification of existing groundwater wells and installation of additional groundwater monitoring wells at 31 locations across the Site. The approximate well locations are shown in Figure 4. EPA collected groundwater samples and conducted aquifer pump tests to better understand the regional groundwater flow patterns and their influence on the movement of the contamination. These investigations also included sampling soil in suspected source areas and sampling surface water and sediments in nearby streams.

The RI identified three primary areas of contaminated groundwater which have been identified as Operable Unit (OU) 1 (OU1), OU2, and OU3. The approximate locations of each of the three OUs are shown in Figure 2. This ROD Amendment pertains only to OU1; however, a brief description of each OU and associated activities conducted is provided below.

2.1 Operable Unit 1

Based on the data collected during the RI, the apparent source of the OU1 groundwater contamination plume appeared to be the Former BAE facility located at 305 Richardson Road in Colmar, Pennsylvania (305 Richardson Road), although portions of the plume extended to adjacent properties (Figure 3). The 67-acre property at 305 Richardson Road has consisted of an electronics manufacturing and testing facility which includes several buildings. Operations at this location, which began in 1953, included the manufacturing of communications equipment. From 1953 until 2008, the facility was owned and operated by BAE, formerly known as Marconi Aerospace Electronic Systems, Inc., Tracor Aerospace Systems, Inc. and American Electronics Laboratory (AEL). In 1995 Tracor Aerospace Systems bought AEL, and in 1999, the facility became BAE. In February 2008, the 305 Richardson Road facility and the property on which it is located were purchased by Sensor and Antenna Systems, Lansdale, Inc.

Beginning in 1979, under the supervision of PADER, AEL conducted sampling of soil, groundwater, and surface water at numerous locations on the facility property. This investigation found that soils and groundwater in an area surrounding an underground storage tank (UST) that had been used to store spent solvents were contaminated with trichloroethylene[2] (TCE), which is a VOC. TCE is a common component of many chemical solvents and degreasers. As a result, AEL removed the UST that contained TCE and excavated and treated the surrounding soils via aeration to reduce soil and groundwater TCE concentrations. The treated soils were returned to the area from which they were excavated (Environmental Alliance 2010). In addition, BAE has indicated to EPA that AEL also excavated and removed six 55-gallon drums and two 1-gallon containers of unknown contents from an area approximately 800 feet to the northwest of the former solvent tank. BAE has indicated to EPA that no soil contamination was

[2] Note that tricholorethene is synonymous with trichloroethylene.

identified during post-excavation sampling conducted in 1981 at the time of removal of the UST, drums, and containers. The area was later sampled as part of the RI and no soil contamination was identified at that time.

In April 1981, AEL began pumping water from certain overburden (A-series) wells into a tank for batch treatment with aeration and carbon adsorption. AEL subsequently installed a recovery well (formerly well A-10) in 1983 (Recovery Well), and in April 1986, AEL initiated a pump and treat program using that well in an effort to address TCE contamination. Groundwater was pumped from the well, treated with an air stripper, and then discharged to an on-site tributary of the West Branch Neshaminy Creek under a National Pollution Discharge Elimination System (NPDES) permit. In December 2004, BAE attempted to optimize the extraction system by converting two existing monitoring wells, RW-1 and RI-20S, into extraction wells. In August 2010, BAE ceased the operation of these pumping and air stripping activities (Environmental Alliance monthly report, 2010).

EPA evaluated the nature and extent of contamination at the Site between 1997 and 2003. The findings of the investigation are documented in the July 2002 RI/FS Report and the September 2003 Supplemental RI report. These reports are summarized below and are contained in full in the Administrative Record. In addition to the VOC groundwater contamination identified at the Site, elevated levels of copper and cadmium were found in sediment samples taken from a 1,600-foot section of a tributary in the vicinity of the Former BAE Facility.

Contamination has been detected in both the overburden groundwater (i.e., groundwater in the soil and unconsolidated material overlying the bedrock aquifer) and in the underlying bedrock aquifer. Based on historic sampling results, the groundwater contamination appeared to originate from the former BAE underground solvent tank area and extended to adjacent residential and commercial properties located west of the facility (Figures 5 and 6). Based on an Optimization Review (HGL, February 2015) (hereinafter, "Optimization Review") of the data and the conceptual site model as presented in the Optimization Review, a secondary diffusive source of TCE contamination is likely present in the subsurface (hereinafter referred to as "Secondary Source" or "Secondary Source Areas"). The Optimization Review stated that, "[t]his secondary diffusion source is not a principal threat waste such as a drum, unsaturated soil contamination, or non-aqueous phase liquid (NAPL); rather, it is likely high concentration dissolved TCE that is present in low permeability zones beneath the water table that is slowly diffusing into the more transmissive bedrock fractures that are sampled using existing monitoring wells." Optimization Review at 2-2. The Optimization Review also states that, "the contaminants 1,1,1-trichloroethane (1,1,1-TCA) and 1,1-dichloroethene (1,1-DCE) are also present [in data historically] in some OU1 monitoring wells above the MCL but do not have the same spatial distribution as TCE. . . . The relative absence of 1,1-DCE in monitoring wells near the known TCE source (former UST) but presence in other OU1 monitoring wells suggests the presence of another source of chlorinated solvents other than the former waste solvent UST." Optimization Review at 2-2. Since 1,1-DCE is a dehydrochlorination product of 1,1,1-

TCA, it is possible that any such unidentified source could contain or could have contained 1,1,1-TCA.

Properties in the vicinity of OU1 are connected to the public water supply and no longer utilize private drinking water supply wells.

In June 2004, EPA issued a ROD for OU1 and OU3 (2004 ROD). The 2004 ROD selected in-situ chemical oxidation with containment pump and treat as the remedial action for both OU1 and OU3. The 2004 ROD identified a section of the southwest tributary on the BAE property where elevated levels of copper and cadmium were detected in some sample locations. See Section 5.5 "Nature and Extent of Contamination of OU1" below. As part of the remedy selected in the 2004 ROD, the 1,600 foot long section of the tributary would be evaluated to delineate the extent of elevated inorganic detections and to evaluate the need for remediation of that section of the tributary. 2004 ROD at page 48.

In December 2006, in accordance with CERCLA Sections 104, 106, and 122(a), BAE and EPA entered into a Settlement Agreement and Administrative Order on Consent (Docket Number CERC-03-2007-0034DC) (AOC) to conduct a pre-design investigation to further define the extent of the OU1 groundwater plume to aid in the design and facilitate the implementation of the remedy for OU1. BAE summarized these investigations in a Pre-Design Investigation Report (PDI), dated January 8, 2009. The PDI described activities conducted by BAE including the installation and sampling of new monitoring wells at 10 locations on the Former BAE Facility and geophysical and hydraulic testing to refine the understanding of the hydrogeologic conditions and contaminant transport mechanisms at OU1. At that time, BAE also conducted activities to better evaluate chemical, physical, and biological treatment alternatives, including enhanced in-situ chemical oxidation, which was selected as part of the remedy for OU1 in the 2004 ROD. These activities included additional sampling and analyses to further characterize the groundwater geochemistry at OU1. In addition, BAE conducted a pilot test to evaluate the possible use of soil vapor extraction (SVE) and/or dual-phase extraction, which combines SVE and groundwater extraction and treatment technologies, to address the contamination at OU1.

The sampling and analysis undertaken during the PDI did not identify a groundwater contamination source area which is necessary for the efficient application of in-situ chemical oxidation. In-situ chemical oxidation, as an efficient remedial technology, requires application of the oxidant to the source area, not a diffuse plume. EPA determined based on the results of the PDI, that it would re-assess whether the remedial action selected for OU1 in the 2004 ROD could successfully clean up the Site in a reasonable timeframe, and, therefore, EPA conducted a Focused Feasibility Study (FFS) to re-evaluate the remedial alternatives for OU1 groundwater (October 2011 FFS).

In 2014, EPA performed an evaluation of contaminant concentrations in sediment to determine background conditions in order to assess ecological risk posed by Site-related contamination. The data from the RI was used in this evaluation. Comparison of

contaminants in sediment against background levels indicated that copper and cadmium were present in sediment at levels exceeding the background concentrations and the ecological screening levels.

In August 2014, EPA issued a Proposed Remedial Action Plan (2014 PRAP) for public comment which presented a revised preferred remedial alternative for OU1 based upon the data summarized in the PDI, the 2014 monitoring data, and EPA's evaluation of sediment. The 2014 PRAP identified Optimized Groundwater Extraction and Treatment with Institutional Controls (ICs) as the preferred alternative for groundwater and removal and off-site treatment or disposal as the preferred alternative for contaminated sediment.

Additional information regarding site conditions at OU1 is provided in Section 5 (Site Characteristics) of this ROD Amendment.

2.2 Operable Unit 2

The facility at 92 County Line Road in Colmar which was formerly operated by Stabilus, Inc. (Former Stablius Facility) is the apparent source of the OU2 groundwater contamination plume although portions of the plume extend to adjacent properties. It is possible that this plume has been impacted by other unidentified sources on properties adjacent to the former Stabilus property. The former Stabilus property is 11 acres and includes a building, a covered storage pad and a large paved parking lot (Former Stabilus Property). From 1979 to 1998, Stabilus, Inc. (formerly Stabilus/Gas Spring Company) manufactured gas springs used in hinged doors and windows at the Former Stabilus Facility. From 1953 to 1979, approximately 4 acres of the Former Stabilus Property was owned by AEL. Constantia Colmar Group, formerly part of H&N Packaging, Inc., has owned the Former Stabilus Property since 1999, where it manufactures packaging materials at the Former Stabilus Facility.

Sampling conducted as part of the RI confirmed that TCE and other VOCs are present in the groundwater at the Former Stabilus Facility. Contamination has been detected in both the overburden groundwater and in the underlying bedrock aquifer. As discussed in the 2011 ROD, the general groundwater flow direction at the Former Stabilus Facility is to the north; however, there are also localized flow gradients causing flow to the southwest. Based on the sampling conducted during the RI, the OU2 plume appears to have two lobes. One lobe extends from the Former Stabilus Facility to properties located to the north, while the other lobe of the plume extends from the Former Stabilus Facility to the adjacent property containing the Former BAE Facility to the southwest (Figure 2).

Properties in the vicinity of the northern lobe of the plume include a commercial facility owned and operated by KEMA-Powertest, Inc. (KEMA-Powertest), as well as residential properties, parkland, and farmland. The KEMA-Powertest facility consists of two buildings on an 11-acre parcel located on the property at 4379 County Line Road. Historically, KEMA-Powertest conducted electrical equipment testing at the facility.

In July 2002, EPA issued a PRAP for all three OUs at the Site. The PRAP recommended the selection of in-situ chemical oxidation with containment pump and treat. However, because, among other things, EPA received a large number of comments on the proposed remedy for OU2, it delayed the issuance of the ROD for OU2. EPA issued a PRAP for an interim action at OU2 in September 2008 and the ROD for OU2 for interim action in September 2011 (OU2 ROD). EPA selected enhanced in-situ bioaugmentation in the OU2 ROD to address VOC contamination in the overburden groundwater. Work to implement the remedy selected in the OU2 ROD is currently being performed by Stabilus pursuant to a Unilateral Administrative Order (UAO) for Remedial Design/Remedial Action (RD/RA) (Docket Number CERCLA-03-2012-0205DC).

As part of the remedial design for implementation of the OU2 ROD, Stabilus conducted sampling to further delineate VOC contamination in the overburden groundwater. Analysis of the sample taken directly to the rear of the former Stabilus Building revealed TCE concentrations of greater than 7,000 micrograms/liter ("µg/l"). This level of TCE in groundwater within 100 feet of a building indicates that vapor intrusion (VI) may be occurring and may present an unacceptable risk to workers inside. Because there may be a threat to public health or welfare or the environment, a removal action to assess VI was determined to be appropriate to abate, minimize, stabilize, mitigate, or eliminate the release or threat of release of hazardous substances at or from the Site. This initial assessment was performed in the winter of 2014-2015 and additional monitoring is required under an AOC entered between Stabilus, Constantia Colmar, and EPA (Docket Number. CERC-03-2014-0060AC).

2.3 Operable Unit 3

Groundwater contamination at OU3 is located in the vicinity of Advance Lane and Enterprise Lane in Colmar, Pennsylvania (See Figure 2). In 1998, as part of the RI, EPA conducted sampling of water-supply wells in the area east of Bethlehem Pike (Route 309). The sampling results indicated that TCE and other VOCs were present in water-supply wells and monitoring wells at several commercial facilities located on Advance Lane, Enterprise Lane, and Bethlehem Pike. In 2000, EPA connected four commercial facilities with TCE-contaminated water-supply wells to public water. In 2002, EPA conducted sampling of water-supply wells in the area west of Bethlehem Pike and no Site-related contaminants were detected. The 2004 ROD selected in-situ chemical oxidation with containment pump and treat as the remedial action for both OU1 and OU3. Since EPA did not identify any PRPs in connection with OU3, EPA is funding and performing OU3 activities.

In April 2007, EPA conducted sampling of residential and commercial supply wells in the vicinity of Trewigtown Road and north and upgradient of the known area of groundwater contamination for OU3. Although trace levels of organic and inorganic compounds were detected in certain water samples, the results suggest that the contamination is not related to the OU3 plume. In addition, none of the constituents were reported at levels that exceeded risk-based concentrations for residential drinking water. At that time, EPA also installed four new monitoring wells in the area of Advance

Lane in an attempt to identify the source of contaminated groundwater and to aid in further defining the extent of the groundwater plume associated with OU3. The recent sampling results from new and existing monitoring wells indicate that TCE levels have decreased.

In 2013, EPA began conducting a field pilot test as part of the remedial design. The purpose of the pilot test was to evaluate the effectiveness of selected in-situ chemical oxidation with containment pump and treat as as selected in the 2004 ROD at OU3. To date, the pilot test includes, among other things, the installation of monitoring wells to improve plume delineation, performance of aquifer tests, injection of chemical oxidants, and monitoring the groundwater. The results of the field pilot test will aid the design of the final cleanup remedy for OU3. The pilot study is ongoing.

3.0 COMMUNITY PARTICIPATION

General information on the North Penn Area 5 Site can be found at EPA's website: https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0301452.

The 2002 RI/FS, September 2003 Supplemental RI, 2004 ROD for OU1 and OU3, 2009 PDI for OU1, 2011 ROD for OU2, 2014 PRAP for OU1, and other Site-related documents in the Administrative Record file supporting this ROD Amendment have been made available to the public at several locations. Copies of the Administrative Record file are located in the information repository at the EPA Region III offices in Philadelphia, Pennsylvania, and online at http://www.epa.gov/arweb. The file can also be reviewed near the Site at either of the following locations:

Lansdale Public Library
301 Vine Street
Lansdale, PA 19446
(215) 855-3228

Montgomery Township Municipal Building
1001 Stump Road
Montgomeryville, PA 18963
(215) 393-6900

The notice of availability of the Administrative Record and EPA's PRAP for OU1 was published in *The Reporter* on August 18, 2014. In addition, EPA posted online and distributed fact sheets summarizing EPA's PRAP for OU1 to local residences and businesses in August 2014.

From August 18, 2014, to October 17, 2014, EPA held a 60-day public comment period to accept public comments on the remedial alternatives presented in the PRAP and the other documents contained within the Administrative Record for the Site. The public comment period was originally scheduled to occur from August 18, 2014, to September 17, 2014. However, EPA received a request to extend the comment period and subsequently extended the comment period to October 17, 2014.

On September 4, 2014, EPA held a public meeting at the Montgomery Township Municipal Building at 1001 Stump Road, Montgomeryville, Pennsylvania to discuss the PRAP and accept comments. A transcript of this meeting is included in the

Administrative Record for the Site. A summary of significant comments received during the public comment period and EPA's responses to these comments are included in the Responsiveness Summary, which is Section III of this ROD Amendment.

The actions discussed above fulfill the public notification requirements of Sections 113(k)(2)(B) and 117(a) of CERCLA, 42 U.S.C. §§ 9613(k)(2)(B) and 9617(a), and the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR § 300.430(f)(3).

4.0 SCOPE AND ROLE

This remedial action will be a final action for OU1 at the Site. The remedy selected herein will control and treat VOC contamination in groundwater and establish ICs to protect the integrity of the remedy and to prevent exposure to site-related contamination until such time that cleanup levels are met. Current information does not indicate a need to assess the VI pathway at OU1. However, if additional information obtained during design or cleanup indicates a potential VI pathway, an assessment will be performed at that time. If VI is determined to pose an unacceptable risk, it will be addressed in a separate action.

OU1 is one of three operable units at the North Penn Area 5 NPL site. Groundwater at OU2 is being addressed pursuant to the September 2011 OU2 ROD for Interim Action. Groundwater at OU3 is currently being addressed pursuant to the 2004 ROD.

5.0 SITE CHARACTERISTICS

5.1 Topography

The topography tends to slope gently from the northwest and southeast portions of the Site toward the West Branch of the Neshaminy Creek. Large portions of the Site are relatively flat from grading associated with construction or agriculture. Some steep slopes are located immediately adjacent to streams, tributaries, and property-line ditches.

5.2 Surface Water

The major surface water bodies in the vicinity of the Site include the West Branch of the Neshaminy Creek, and its Western and Eastern tributaries. In addition, the South Central Tributary and North Central Tributary merge and flow into the Western Tributary of Neshaminy Creek. See Figure 1.

5.3 Geology

The Site is in the Triassic Lowlands section of the Piedmont Physiographic Province. The Site is underlain by sedimentary rocks of the Brunswick Formation (lower beds) and the Lockatong Formation of the Newark Supergroup. The lower beds of the Brunswick Formation consist of red to reddish-brown and gray to greenish-gray mudstones and clay

and mud shales. The bedding is irregular and wavy. The Brunswick Formation rocks are thin-bedded and evenly-bedded shale and siltstone that are medium to dark gray and olive to greenish-gray. The Lockatong Formation consists of thick, medium to dark gray, calcareous shale interbedded with thin beds of gray to black shale and siltstone, with lenses of limestone with traces of pyrite; overlain by massive gray to red siltstone.

The Site's subsurface consists of an overburden layer on top of fractured bedrock. The overburden layer is comprised of soil and unconsolidated weathered bedrock and consists of silt, clay, and some sand, and becomes progressively harder with depth. The overburden layer is generally thin and discontinuous across the Site (usually less than 10 to 20 feet thick), although in some areas, near drainage features, it can be 20 to 40 feet thick. Across the Site, the overburden is predominantly dry, but is wet at its base during seasonally wetter periods. However, thicker sections of overburden may contain a saturated layer year round.

The depth to fractured bedrock across the Site ranges from 3 to 45 feet, with a median depth of 10 feet. The bedrock has little primary permeability, but contains a variety of fractures, including bedding-plane partings and high-angle fractures that allow groundwater to flow through the subsurface both vertically and horizontally. Most of the water-bearing fractures are located within the upper 80 to 100 feet of the surface. The frequency of fractures generally decreases with depth.

5.4 Hydrogeology

Groundwater at the Site originates from infiltration of local precipitation, moves through vertical and horizontal fractures in the shale and siltstone, discharges to streams, and can be drawn by pumping wells. Groundwater in the Brunswick and Lockatong Formations may be under confined and unconfined conditions. Groundwater levels fluctuate with variations in both pumping and seasonal recharge. Groundwater is found within the overburden and in the bedrock aquifer.

The localized overburden is predominantly dry, but contains groundwater at its base above the bedrock during wetter periods. Thicker sections of overburden, such as that in the vicinity of the Former BAE Facility and the former Stabilus Facility, contain a saturated thickness of approximately 3 to 10 feet year round. The depth to groundwater in this overburden unit is approximately 4 to 10 feet below grade. The groundwater flow direction in the overburden unit is locally variable. Water from the overburden unit drains locally to the streams in some areas and also leaks downward to the fractured bedrock aquifers.

The shallow portion of the bedrock aquifer consists of the fractured bedrock zone underlying the overburden layer to a depth of approximately 90 to 100 feet below the surface. The depth to groundwater in this aquifer varies from 10 to 30 feet below grade. Groundwater flow directions in this aquifer are influenced by the regional setting. Groundwater in this portion of the aquifer generally flows in a direction similar to topographic gradient which tends to be toward the West Branch Neshaminy Creek and its tributaries. Groundwater flow north of the West Branch Neshaminy Creek is generally

southeasterly, and groundwater flow south of the creek is generally northwesterly. Groundwater in this portion of the aquifer eventually discharges to the surface streams or provides recharge to the deeper aquifer system.

The deep portion of the bedrock aquifer consists of the fractured bedrock zone greater than 100 feet below the surface and extending to an approximate maximum depth of 500 feet. The geology and hydrogeology of the deeper portion of the bedrock aquifer is similar to the shallow portion of the bedrock aquifer (including groundwater flow directions), but the deeper zone generally has fewer water-bearing fractures. However, these fractures can also yield higher volumes of groundwater. The deep portion of the bedrock aquifer is used as a regional water-supply source. In addition, BAE's former water-supply well[3] (approximately 300 feet deep) and the NPWA's former municipal well NP-21 (approximately 500 feet deep) obtained water from the deeper portion of the bedrock aquifer at the Site. In portions of the Site, the wells installed in the deeper portion of the aquifer are artesian (i.e., they flow out at the surface).

The vertical groundwater flow direction and gradient across the Site is highly variable. While some areas exhibit a downward flow gradient such that groundwater flows from the shallow portion of the bedrock aquifer downward into the deeper zones, other areas exhibit an upward flow gradient.

5.5 Nature and Extent of Contamination of OU1

Groundwater

In 1979, TCE was detected in NPWA supply well NP-21 (See Figures 3 and 4). The operations of AEL (which became BAE) at the Former BAE Facility used TCE. After BAE, the facility was owned and operated by Sensor and Antenna Systems and is currently owned and operated by Cobham Advanced Electronic Solutions Inc. ("Cobham"). The Former BAE Facility was determined by EPA to be a potential source of TCE contamination after TCE was detected in soil and groundwater at an underground storage tank (UST) there. Site investigations have shown that TCE contamination is present in the shallow bedrock aquifer within the top 80 feet of rock at OU1.

The approximate extent of the VOC contamination plume in the shallow bedrock is shown in Figures[4] 5 and 6. As shown in Figure 5, based upon the data generated August 2014 sampling event, TCE and 1,1-DCE exceed their respective Maximum Contaminant Levels promulgated by EPA pursuant to the Safe Drinking Water Act, 42 U.S.C. §§ 300g-1 et seq., and codified at 40 C.F.R. Part 141 (MCLs).

[3] Note this well was used for the facility's water supply and not pumped as part of the historic pumping for contamination from the UST area.

[4] The contamination depicted on Figure 5 was generated using groundwater analytical data from BAE's August 2014 groundwater sampling event. The contamination depicted on Figure 6 was generated using groundwater analytical data from June/July 2008 sampling performed during the PDI and August 2009 sampling.

The approximate extent of the VOC contamination plume in the deeper bedrock (wells RI-20D, PW-7A, PW-7B, RW-2, RW-3, NP-21 and NP-87) is shown in Figure 7[5]. Figure 7 demonstrates that the contaminant levels detected in these deeper bedrock wells do not exceed MCLs.

In 1980, AEL installed 18 A-series shallow monitoring wells ranging in depth from 9 to 24 feet, 16 W-series intermediate monitoring wells ranging in depth from 28 to 52 feet, and 4 RW-series deep monitoring wells ranging in depth from 70 to 210 feet (Earthtech, 1993). In 1980, groundwater samples collected from these 38 wells on the Former BAE facility showed TCE contamination ranging from 5.2 to 70,700 µg/L. In 1981, after the UST removal, samples from the same wells showed TCE contamination ranging from 0.1 to 2,254 µg/L, indicating that the UST was a likely source of VOCs.

AEL began pumping water from certain overburden (A-series) wells into a tank for batch treatment with aeration and carbon adsorption in April 1981. The location of A-series wells is shown in Figures 3, 5, and 6. From 1986 to 2010, AEL, and then BAE, used the Recovery Well (Figures 3, 5, and 6) to pump groundwater contamination prior to treatment by air stripping. The Recovery Well draws water from 4 to 104 feet below ground surface (bgs), intersecting both the shallow bedrock zone and the upper portion of the deep bedrock zone. From December 2004 to August 2010, BAE pumped groundwater from the Recovery Well, and well RW-1 and well RI-20S and treated the recovered groundwater using an air stripper to remove VOCs.

EPA's RI activities, performed between 1997 and 2003, included surveying and sampling of pre-existing wells that could be located, installation and sampling of new monitoring wells (27 locations with 51 monitoring points in the original RI and 4 locations in the September 2003 Supplemental RI), measurements of water level, and aquifer pump testing. Approximate well locations associated with EPA's RI activities are identified on Figure 4. EPA collected groundwater samples and conducted aquifer pump tests to better understand the regional groundwater flow patterns and their influence on the movement of the contamination. The following information was collected during the RI regarding the OU1 plume in the vicinity of the former BAE facility:

- In the overburden aquifer, concentrations of TCE ranged from 12 µg/l in well A-8 to greater than 1,000 µg/l in well A-12, with median concentrations ranging from 20 to 50 µg/l. The 1,000 µg/l analytical result in well A-12 may be an outlier, but the information is included as part of the Site history.

- In the shallow bedrock aquifer, concentrations of TCE ranged from less than 1 µg/l in several wells located west of the former BAE facility (W-10, W-12 and W-14) to 320 µg/l in RI-20S, with other shallow bedrock wells in the vicinity of the main plant ranging from 150 µg/l (W-1) to 270 µg/l (RW-1).

[5] The contamination depicted on Figure 7 was generated using groundwater analytical data from June/July 2008 sampling performed during the PDI. Where the contour lines are dashed on the figures, BAE has inferred the plume extent, which has not been confirmed by sampling and analysis.

- In the deep bedrock aquifer, concentrations of TCE ranged from 1 µg/l (NP-87) to 6 µg/l (RI-20D).

- A wide variety of inorganics were detected in the OU1 groundwater, although no statistical difference was observed between upgradient and downgradient location data. There were only limited random detections of inorganics in certain wells.

BAE's PDI activities, performed from 2006 to 2009, included installation of 10 new groundwater monitoring wells in various locations (PW-1 through PW-10) complete with borings and corings (Figures 6 and 7). Packer testing was completed on nine of these borings and three existing wells (RW-1, RW-2, and RW-3), with a total of 47 individual zones tested at depths up to approximately 300 feet bgs. Five of these locations had cluster wells installed (two wells per location). The focus of the drilling activity was concentrated on the upper 60 to 70 feet of the groundwater system, with certain wells targeting depths up to 281 feet. The shallow depth focus (less than 70 feet) was based on the depths at which historic impacts were observed in the vicinity of the spillage/overfills surrounding the former UST (PW-I through PW-5). Additional boring locations (PW-6 through PW-9) were selected to refine the delineation of contamination remaining in OU1 (in conjunction with the existing monitoring well network) in relation to geologic structure. The borings were installed down dip and downgradient of the former UST area to investigate whether contamination from the former UST had migrated into the deep aquifer.

The PDI did not identify any source material or any discrete source areas in the subsurface of OU1, i.e., the presence of pure-phase contamination such as Dense Non-Aqueous Phase Liquid (DNAPL) in the groundwater, or any TCE-contaminated soils above PADEP's direct contact or soil-to-groundwater standards. The PDI identified a diffuse TCE groundwater contamination plume in the shallow bedrock aquifer, with a maximum concentration of 220 µg/l in shallow bedrock well RI-20S.

In 2009, on BAE's own initiative and without consultation with EPA on design or EPA's concurrence on the effort, BAE completed the installation, surveying, and sampling of four property boundary observation wells (PW-11 through PW-14). The depths of those wells ranged from a top open interval of 13 to 19 feet bgs to a bottom depth of 80 feet bgs and were located near the western property line of the former BAE facility property (Figures 5 and 6). PW-11 was positioned between wells PW-8 and MW-5, samples from PW-11 had TCE concentrations of approximately 100 µg/l. Groundwater samples taken from PW-12 and PW-13 showed TCE concentrations slightly exceeding the 5 µg/l Maximum Contaminant Limit (MCL) with a maximum concentration of 9 µg/l at each well. Samples taken from PW-14 were not found to have TCE concentrations in excess of the MCL.

Since these wells did not undergo geophysical or packer testing, specific water-bearing fractures were not targeted in well construction. Therefore, well sample results taken from the wells represent an average of contaminant concentrations across all fractures intersecting each individual well rather than allowing various fractures and/or fracture

zones within a borehole to be isolated and contaminated groundwater from those intervals to be sampled without mixing with groundwater from other portions of the borehole. Furthermore, samples drawn from these four wells are of limited utility to determine the extent of contamination since the results represent a flow-weighted average contamination concentration from multiple water-bearing fractures of various concentrations, some of which could be significantly higher or lower than the reported sampling results.

In August 2010, on BAE's own initiative, BAE ceased pumping (Environmental Alliance monthly report, 2010) and instead began to implement a voluntary Monitored Natural Attenuation (MNA) Pilot. Since then, BAE has submitted annual MNA reports to EPA ("MNA report"). The Third Annual MNA report, dated April 1, 2014, and the Fourth Annual MNA report, dated October 15, 2014, are included in the Administrative Record since EPA considered these reports in drafting the PRAP, in performing a January 2015 streamlined human health risk assessment (SHHRA), and in selecting the remedy in this ROD Amendment.

The Fourth Annual MNA report, documenting BAE's voluntary pilot, presented various information, including the following:

- Figure 5 presents data from sampling conducted in 2014 demonstrating TCE (a high value of 150 µg/L) and 1,1 DCE (a high value of 130 µg/L) contamination at levels that exceed MCLs.
- Figure 8 states, "capture zones [are] inferred based on groundwater elevation contours and assuming isotropic conditions" during the operation of BAE's historic pumping.
- Figure 9 shows groundwater elevations without pumping.

As the second bullet above states, BAE inferred capture zones assuming isotropic conditions, a theoretical state in which groundwater would flow equally in all directions. However, fractured bedrock, such as the geology at OU1, does not exhibit isotropic conditions, but rather preferential pathways based upon the aperture, orientation, and interconnectedness of individual fractures in the bedrock. Therefore, the capture zones presented in BAE's MNA report are based upon a condition that does not exist at OU1.

EPA performed a third-party optimization review of BAE's historic pumping titled "Treatment System Optimization Review for North Penn 5, OU1 Site" (Optimization Review). The Optimization Review concluded that, "despite nearly 30 years of pump and treat operation, sufficient operational data is [sic] not available to evaluate system effectiveness, improve the understanding of secondary diffusion source [herein referred to as a "Secondary Source"], or identify the source of the 1,1-DCE" and that pumping for contaminant control can improve aquifer conditions outside of any source area. The full Optimization Review is included in the AR supporting this Selected Remedy.

Soil, Sediment, and Surface Water

In June 1980, AEL ceased the use of, emptied the contents of, and removed the UST which was believed to historically have been used to store waste solvents. During the same period, AEL completed a soil investigation of the UST area. AEL found that soils collected from the immediate vicinity of the UST contained TCE concentrations ranging from 150 to 4,950 µg/kg. These findings were consistent with the conclusion that the UST was associated with surface spills of solvents because the highest concentrations of TCE were reported to be in the upper two feet of soil. In 1982, AEL excavated approximately 210 cubic yards of soil that exceeded 100 µg/kg of TCE from the vicinity of the former UST. The soil was treated with aeration to promote TCE volatilization and was returned to the area from which it had been excavated.

EPA's 2002 RI included the sampling of soil in both the former UST area and additional suspected source areas and the sampling of surface water and sediments in nearby streams. When EPA sampled soil during the RI, no VOCs were detected. Also, surface water samples indicated limited low-level detections and J-qualified[6] detections of VOCs and semi-volatile organic compounds (SVOCs). BAE's 2009 PDI did not sample these media.

In the RI, limited metals contamination was detected in the South Central Tributary channel (See Figure 1 for the location of the South Central Tributary). In May 1998, a single round of sediment sampling was conducted at 26 stations (Figure 10) for full Target Compound List/Target Analyte List **(**TCL/TAL) analytical parameters, total organic carbon, and grain size. Sediment samples were co-located with surface water samples at all locations except locations 24 and 25, which had no surface water present at the time of sampling. These sediment samples contained a wide variety of low concentration polycyclic aromatic hydrocarbons (PAHs), pesticides, and heavy metals. No statistical difference was present between the upstream and downstream station data for most analytes. Notable exceptions were copper and cadmium, which were detected at stations SD13, SD14, and SD15 in the South Central Tributary channel downstream from the former BAE facility (Figure 10). Specifically, copper was detected at a maximum of 764 mg/kg and cadmium was detected at a maximum of 10.9 mg/kg. EPA's 2012 evaluation of copper and cadmium in sediment samples taken at stations SD1, SD11, SD12, SD16, SD19, and SD23, which are locations unlikely to be affected by site activities, indicated that the average background level for copper in sediment was 19.45 mg/kg and was 0.42 mg/kg for cadmium, respectively. The EPA Region 3 Biological Technical Assistance Group (BTAG) Freshwater Sediment Screening Benchmarks screening levels for copper and cadmium in sediment are 31.6 mg/kg and 0.99 mg/kg, respectively. In addition, EPA proposed the less stringent of the background and ecological baseline screening levels as the sediment cleanup levels as outlined in the 2014 PRAP.

[6] "J qualified" results indicate that the analyte of interest was detected but that the reported values may not be accurate or precise.

6.0 CURRENT AND POTENTIAL FUTURE LAND USES AT OU1

The Site is comprised of commercial and industrial businesses, residences, undeveloped woodland properties, parkland, and farmland. Census data from 2010 indicate approximately 1,200 people live in Colmar, PA. The Site is located above a Class II-A aquifer that provides potable water for the surrounding area. Historically, two municipal water suppliers, NPWA and NWWA, have utilized water-supply wells in the vicinity of the Site. In addition, although no one utilizes groundwater directly impacted by OU1 at present, residents in the vicinity of the Site utilize private wells as a source of drinking water.

A number of separate properties are impacted by contamination at OU1. First, the present Cobham facility (the former BAE facility at 305 Richardson Road) is an electronics manufacturing and testing facility. A portion of this property contains woodland to the West and South. In addition, an adjacent property to the southwest is currently undergoing redevelopment for residential purposes. The new residents will utilize municipal water as their source of drinking water. In addition, the newly constructed homes are expected to have VI mitigation measures in place. Additional residential areas also are located to the south and east of 305 Richardson Road and businesses are located to the north. Finally, the NPWA owns land to the southwest of 305 Richardson Road at which it historically operated its commercial wells NP-21 and NP-87 although NPWA may transfer ownership of that land in the near future for potential residential development. The future use of properties affected by contamination at OU1 is expected to remain consistent with the existing use, i.e., a mix of commercial business and residential use.

7.0 SUMMARY OF OU1 SITE RISKS

As part of the 2002 RI, EPA conducted a risk assessment to identify potential risks to human health and the environment that could result from exposure to the hazardous substances associated with the Site. The risk assessment provides the basis for taking action and identifies the contaminants, media, and exposure pathways that need to be addressed by the remedial action at the Site. The risk assessment evaluated the potential risks from exposure to contamination found in site media (soil, sediment, surface water and groundwater) both site-wide and at each OU investigated during the RI. The risk assessment concluded that Site media at OU1, OU2 and OU3 pose an unacceptable risk to human health, with groundwater being the primary medium of concern at the Site.

The response action selected in this ROD Amendment is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. A detailed discussion of the human health baseline risk assessment (BLRA) and screening level ecological risk assessment (SLERA) for the Site is included in Appendices M and N to the July 2002 RI/FS Report and is summarized in the 2004 ROD and in this section of the ROD Amendment.

The NCP establishes a range of acceptable cancer risk for Superfund sites from one in ten thousand to one in one million additional cancer cases, expressed in scientific notation as 1E-04 to 1E-06, over a lifetime exposure to site-related contaminants. In comparison, the chance of a person developing cancer from other causes (e.g., smoking or excess sun exposure) has been estimated to be as high as one in three.

Additionally, chemicals that are ingested, inhaled or absorbed through the skin may present non-cancer risks to different organs of the human body. The non-carcinogenic risks, or toxic effects, are expressed as a Hazard Quotient calculated for the effect of each Chemical of Potential Concern (COPC) on each target human organ; the cumulative risk is expressed as a Hazard Index (HI). If an HI is less than one (1.0), then exposure to site conditions is not expected to result in adverse effects during a lifetime or part of a lifetime. The NCP establishes an HI exceeding one (1.0) as an unacceptable non-carcinogenic risk.

Contaminants of concern (COCs) are determined by identifying COPCs and performing a site-specific risk analysis for each COPC and each pathway to identify current or potential future risk. To determine whether risk posed by COPCs is unacceptable to human health, EPA calculates whether the risk exceeds EPA's acceptable risk level of 1E-04 to 1E-06 for carcinogens or exceeds an HI of 1 for non-carcinogens, in accordance with the NCP at 40 C.F.R. § 300.430(e)(2)(i)(A). Table 1 lists the COCs identified at OU1 based on the BLRA and SLERA across multiple exposure pathways.

Table 1
Contaminants of Concern from the 2004 ROD

	Groundwater[1]	Sediment[2]
1,2 – Dichloroethane*[3]	X	
1,1 – Dichloroethene*	X	
Tetrachloroethene*	X	
Trichloroethene*	X	
Cadmium		X
Copper		X

[1] Human health risk assessment
[2] Ecological risk assessment
[3] 1,2-DCA was reported at non-detectable levels 11/2013, 2/2014, 5/2014 and 8/2014 monitoring data. The inclusion of 1,2-DCA as a COC may have been a transcription error in previous reports. Instead, 1,2-dichloroethene (1,2-DCE) may have been present in groundwater in excess of health-based concentrations or MCLs; if so, this compound should have been captured as a COC at the Site. Note that 1,2-DCE is an anaerobic degradation product of TCE; 1,2-DCA, on the other hand, is not. A cleanup level for 1,2- DCE is required as part of this remedy because it is an anaerobic degradation product of TCE.
* Classified as a Volatile Organic Compound (VOC)

7.1 Summary of OU1 Human Health Risk Assessment

The results of three rounds of sampling, conducted from 1998 to 2000 as part of the RI, were evaluated by EPA in the BLRA to determine the potential effects of exposure to contaminated media at the Site. The results of this BLRA are documented in Appendix M of the 2002 RI and the 2004 ROD and were summarized in the 2014 PRAP for purposes of public comment.

EPA received a comment during the public comment period stating that the BLRA was "not correctly performed using current available data and methodology" (EA, 2014, p. 117). In response to this comment, EPA performed a streamlined human health risk assessment (SHHRA) for OU1 groundwater using the most recent sampling data as provided by BAE in the Fourth Annual Report of the Monitored Natural Attenuation Pilot Study, dated October 15, 2014. The January 2015 conclusions of the SHHRA are consistent with the conclusions of the 2002 BLRA and provide an independent basis for taking action to protect public health or welfare from actual or threatened releases of hazardous substances into the environment. The SHHRA, dated January 23, 2015, is contained in the Administrative Record for the Site. The findings of the SHHRA, as summarized in greater detail in Table 2, are as follows:

- Reasonable Maximum Exposure (RME) calculations for TCE demonstrated unacceptable risks, both cancer (2.8E-04) and non-cancer (child HI = 24, adult HI = 21), under a residential exposure scenario due to TCE in groundwater. Further, TCE (up to 170 µg/L) was consistently observed in groundwater in excess of its MCL (5 µg/L).

- Exposure to 1,1-DCE did not exceed acceptable risk levels under any exposure scenario; however, detected concentrations in on-site groundwater (up to 130 µg/L) were substantially greater than the MCL (7 µg/L) for this compound.

- Tetrachloroethene[7] (PCE) was observed in approximately one third of groundwater samples at trace concentrations (up to 4 µg/L). See Figure 5. This compound did not contribute significantly to cumulative risk posed by groundwater at OU1, and was detected at concentrations marginally below its MCL (5 µg/L).

With one exception (as described in the fourth bullet, below), EPA's SHHRA, in which EPA evaluated the groundwater data from samples taken in November 2013, February 2014, May 2014, and August 2014 for North Penn 5 OU1, supports the conclusions of the 2002 BLRA. The SHHRA identified COCs in groundwater at OU1 as set forth below:

- TCE in groundwater continues to exceed its MCL and to pose unacceptable risk to human health. This compound is still a COC at OU1.

[7] Note that tetrachloroethene is synonymous with tetrachloroethylene and perchloroethylene.

- 1,1-DCE has been consistently observed in groundwater at OU1 in excess of its MCL. This compound remains a COC at the Site.

- PCE in groundwater at OU1 neither poses an unacceptable risk nor exceeds its MCL. However, observed concentrations (up to 4 µg/L) in groundwater are very close to the MCL (5 µg/L). These concentrations could fluctuate for a variety of reasons, including changes in the groundwater environment, pumping modifications in other wells, temporal fluctuations, or errors in sampling or analysis. For these reasons, and because PCE is a historical site-related contaminant, PCE is retained as a COC.

- 1,2-DCA was reported at a non-detectable level in every sample reviewed for EPA's SHHRA. This compound does not appear to be present in groundwater at OU1. It is possible that the inclusion of 1,2-DCA as a COC was a transcription error in previous reports. Instead, 1,2-dichloroethene (1,2-DCE) may have been present in groundwater in excess of health-based concentrations or MCLs; if so, this compound should have been captured as a COC at OU1. Note that 1,2-DCE is an anaerobic degradation product of TCE; 1,2-DCA is not.

- In addition to the chlorinated compounds listed above, all degradation products of TCE should be identified as COCs in groundwater at the Site because these breakdown products could pose an unacceptable risk during cleanup if concentrations rise. These degradation products are 1,2-DCE (typically expressed as cis-1,2-dichloroethene and trans-1,2-dichloroethene), and vinyl chloride.

Table 2
Summary of Risks from the
Streamlined Human Health Risk Assessment
RME Risks – Residential Exposure Scenario

COC	Maximum Detected Concentration (µg/L)	Exposure Point Concentration (µg/L)	Cancer Risk (child + adult)	Non-Cancer HI (child)	Non-Cancer HI (adult)	MCL (µg/L)
1,2-DCA	Nd	Na	na	na	na	5
1,1-DCE	**130**	**39.3**	na***	0.14	0.12	7
PCE	4	1.3	1.2E-07	0.03	0.03	5
TCE	**170**	**67.9**	2.8E-04	24	21	5

nd = not detected
na = not applicable

Values in **bold** print indicate an exceedance of an MCL and/or risk threshold.
*** 1,1-DCE is categorized as a possible human carcinogen; however, no carcinogenic criteria have been developed from which to calculate risk.

7.2 Summary of OU1 Ecological Risk Assessment

A SLERA was performed based on sampling conducted in 1998 as part of the 2002 RI. The SLERA describes existing habitats and ecological receptor species that have been noted or are expected to be present at the Site, and evaluates the potential risks associated with the exposure of the biota to surface water, sediment, and surface soil COPCs. EPA uses an eight-step process, including numerous scientific/management decision points, for evaluating potential risks to potential ecological receptors such as small mammals, birds, and plants. The SLERA is intended to allow a rapid determination as to whether the Site either poses no unacceptable ecological risks or to identify which contaminants and exposure pathways require further evaluation. Using conservative assumptions about potential ecological risks, it is determined that if no risks are estimated during the screening level evaluation, the ecological risk assessment process stops with the SLERA. If ecological risks are indicated by the SLERA, EPA may proceed to a more comprehensive baseline ecological risk assessment (BERA) to further refine and better evaluate the site-specific ecological risk.

The outcome of the SLERA undertaken as part of the RI is described in Section 7.2 of the 2004 ROD and reported in detail in Appendix N of the 2002 RI/FS report. The SLERA found that levels of copper and cadmium in sediment collected in the 1998 sampling event at stations SD13, SD14, and SD15 (Figure 10) in the South Central Tributary channel downstream from the former BAE facility exceeded ecological screening levels. However, the SLERA concluded that "no further ecological investigations are recommended for sediment…"

EPA's 2004 ROD indicated that that further analysis was necessary. In the 2004 ROD, EPA required further evaluation of copper and cadmium contamination in sediment in a 1,600-foot section of the South Central Tributary on and adjacent to the 305 Richardson Road property.

In 2012, EPA calculated background levels of copper and cadmium, relying on the data collected in 1998 and presented in the 2002 RI. This 2012 evaluation of copper and cadmium in sediment samples indicated that the average background level for copper in sediment was 19.45 mg/kg and was 0.42 mg/kg for cadmium, respectively. The EPA Region 3 BTAG Freshwater Sediment Screening Benchmarks screening levels for copper and cadmium in sediment are 31.6 mg/kg and 0.99 mg/kg, respectively. Since the levels of cadmium and copper detected in sediment exceeded ecological baseline screening during the SLERA and background levels, as determined by the 2012 evaluation, both cadmium and copper were listed as COCs in the 2014 PRAP. In addition, EPA proposed the less stringent of the background and ecological baseline screening levels as the sediment cleanup levels as outlined in the 2014 PRAP.

7.2.1 Identification of Ecological Contaminants of Concern at OU1

EPA Region 3 BTAG Freshwater Sediment Screening Benchmarks screening levels were compared against on-site concentrations detected at the Site as the initial step to identify contaminants that may pose an ecological risk and require more evaluation. Sediments sampled in 1998 and located in the South Central Tributary Channel downstream of the former BAE facility contained concentrations of copper (a maximum of 764 µg/kg) and cadmium (a maximum of 10.9 µg/kg), which were higher than the BTAG screening values of 31.6 µg/kg and 0.99 µg/kg, respectively, and so, copper and cadmium were identified as ecological COCs.

7.2.2 OU1 Ecological Exposure Assessment

The South Central Tributary is a tributary to the West Branch Neshaminy Creek and runs along the southwestern side of the former BAE facility parking lot. See Figure 1. The stream joins with the North Central Tributary approximately 1,200 feet downstream of the former BAE facility parking lot; within approximately 25 feet downstream of the confluence, the stream formed by the two tributaries passes under railroad tracks via a culvert.

After the South Central Tributary flows past the former BAE facility parking lot (Figure 3), it enters a wetland complex dominated by mature trees with relatively little sub-canopy species. EPA believes that the hydrology of the wetlands is dictated by more than the stream and is complex and likely is seasonably variable. During a Site visit in December 2014, an EPA ecologist noted a drainage channel leading to a small forested wetland complex with a braided stream as opposed to a single stream channel as was described in the 1998 RI. Refer to *Memorandum* to Ms. Sharon Fang, U.S. EPA, from Mr.Bruce Pluta, U.S. EPA, re: December 16, 2014, Ecological Site Inspection, Operable Unit 1, 6/18/15. SEMS document number 2199388.

7.2.3 OU1 Ecological Effects Assessment

The 2002 SLERA determined that maximum concentrations of copper and cadmium from a limited number of sample locations exceeded ecological screening levels and posed a potential ecological risk to birds and the benthic community.

7.2.4 OU1 Ecological Risk Characterization

In 2002, EPA undertook a further evaluation of the copper and cadmium contamination in the 2004 ROD by analyzing the 1998 sediment contamination data from the 2002 RI/FS and performing an evaluation of the background concentrations based on the 1998 data. EPA concluded that the copper and cadmium in sediments of the South Central Tributary exceeded site background levels and ecological screening levels. Background calculations using 1998 data are in the Administrative Record.

As described in the SLERA portion of the RI/FS report, the elevated levels posed a potential ecological risk to birds at this Site; however, the 2002 RI/FS concludes that

cadmium and copper "appear to be related to other potential sources of contamination." The data presented in the SLERA demonstrated potential risk based on a limited number of samples.

In response to public comment[8] on the PRAP, EPA performed the 2014 Ecological Site Inspection of the South Central Tributary. During the 2014 Ecological Site Inspection, EPA observed a forested wetland with a braided stream and it was evident that the single sampling event performed in 1998 during the RI was no longer representative of current Site conditions. Areas of sediment accumulation observed during the 2014 inspection were spatially limited and could not be correlated to the reported sample locations that contained elevated cadmium and copper levels in 1998. Based on the apparent dynamics of the wetland system observed during EPA's 2014 Ecological Site Inspection, EPA's report of the 2014 Site inspection (June, 2015) concludes that the sediment samples from 1998 are no longer representative of current Site conditions, and the bioavailability of any residual contamination is likely sufficiently reduced due the levels of carbon present in the existing wetland.

Based on apparent changes to the sediment deposition over the years since the 1998 sampling event, and likely reduced bioavailability to avian receptors of the metals due to the organics present in depositional areas based on the 2014 Ecological Site Inspection, EPA has determined that copper and cadmium detected in sediment in 1998 do not pose a risk to ecological receptors.

7.3 Basis For Change

In the 2004 ROD, EPA selected in-situ chemical oxidation and extraction and treatment of groundwater for containment as the remedy for both OU1 and OU3. It also required further evaluation of copper and cadmium contamination in OU1 sediment near the former BAE facility.

Based on information collected and reviewed since the issuance of the 2004 ROD, the selected remedy was not implemented and EPA has determined that the selected remedy for OU1 needs to be changed to ensure that it achieves cleanup levels to meet MCLs. Sampling undertaken as part of the in-situ chemical oxidation remedial design did not identify a source area of groundwater contamination, but rather showed the presence of a diffuse plume. The in-situ chemical oxidation remedy without an identified source area is unlikely to achieve cleanup levels at OU1. Therefore, EPA has selected a new groundwater remedy as outlined below, although EPA has retained in-situ chemical oxidation as a contingent remedy in the event that a source area is identified during future site work (e.g., as the result of pre-design investigations, or during the implementation of the selected optimized extraction and treatment remedy). In addition, EPA has also selected enhanced bioremediation as a contingent remedy in the event that the Groundwater Extraction and Treatment System has been optimized to the satisfaction of

[8] EA Comment 16 was that EPA has not established a proper record for the remedy selected for the sediments. EA Comment 17 was that the justification in the 2014 PRAP that the sediment remedy is required to protect birds is not warranted.

EPA in consultation with PADEP and contaminant concentrations become asymptotic approaching MCLs. Prior to the implementation of bioremediation, a pilot study will be undertaken in order to demonstrate whether bioremediation will be effective in achieving cleanup levels. In the event that a contingent remedy is triggered based on Site conditions, EPA would issue an ESD and so inform the public as required by the NCP, 40 C.F.R. § 350.435(c).

Although not a change from the 2004 ROD, EPA has evaluated copper and cadmium in sediments at OU1 and has determined that copper and cadmium do not pose an unacceptable risk to ecological receptors under current Site conditions.

8.0 OU1 REMEDIAL ACTION OBJECTIVES

The Remedial Action Objective (RAO), which was established for groundwater at OU1 in the 2004 ROD, is renewed here:

- Restore the groundwater quality in the overburden and the fractured bedrock and reduce the concentration of contaminants of concern in the aquifer to their respective MCLs or below (Table 3).

The COCs identified for groundwater, listed in Table 1, are present at OU1 at concentrations exceeding their respective MCLs. In order to address the unacceptable risks at OU1 and protect human health and the environment, cleanup levels have been developed for the groundwater COCs and are presented in Table 3. Table 3 also includes cleanup up levels for chemicals that are produced by degradation of the COCs and which could increase in concentration during the remedial process.

Table 3
Cleanup Levels for Groundwater

Contaminant of Concern (COC)	Cleanup Level/ MCL (µg/L)
1,1 – Dichloroethene	7
Tetrachloroethlyene	5
Trichloroethlyene	5
cis-1,2 – Dichloroethene*	70
trans-1,2 – Dichloroethene*	100
Vinyl Chloride*	2

MCL= Maximum Contaminant Level pursuant to the Safe Drinking Water Act
µg/L=micrograms per liter
*These chemicals were not detected at levels posing unacceptable risk. However, they are breakdown products of chemicals present and could present an unacceptable risk during cleanup.

In addition, based on conclusions of the January 2015 SHHRA, EPA is adding the following RAO for OU1:

- Prevent contact (direct and inhalation) with contaminated groundwater and associated vapor above levels that are acceptable for human receptors under existing use and/or likely use exposure scenarios.

According to EPA's *Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy*, issued November 1986, the bedrock aquifer underlying the Site is classified as a Class II-A aquifer that provides potable water for the surrounding area. The RAOs address risk posed to future residential users of the groundwater and to protect from potential risk posed by inhalation of vapors.

9.0 SUMMARY OF OU1 REMEDIAL ALTERNATIVES

EPA evaluated alternatives, described below, to determine the cleanup method that would best address the groundwater contamination at OU1. EPA is selecting Alternative GW2, Optimized Groundwater Extraction and Treatment and Institutional Controls and Contingent Treatment, as described in more detail in Sections 9.2 and 12.0 of this ROD Amendment.

In December 2006, in accordance with CERCLA Sections 104, 106, and 122(a), BAE and EPA entered into an AOC to conduct a pre-design investigation to further define the extent of the OU1 groundwater plume to aid in the design and facilitate the implementation of the remedy selected in the 2004 ROD for OU1. BAE summarized these investigations in the PDI. The PDI described activities conducted by BAE including the installation and sampling of new monitoring wells at ten locations on the former BAE facility and geophysical and hydraulic testing to refine the understanding of the hydrogeologic conditions and contaminant transport mechanisms at OU1. At that time, BAE also conducted activities to better evaluate chemical, physical and biological treatment alternatives, including enhanced in-situ chemical oxidation, which was selected as part of the remedy for OU1 in the 2004 ROD. These activities included additional sampling and analyses to further characterize the groundwater geochemistry at OU1. In addition, BAE conducted a pilot test to evaluate the possible use of soil vapor extraction (SVE) and/or dual-phase extraction, which combines SVE and groundwater extraction and treatment technologies to address the contamination at OU1.

The sampling undertaken during the PDI did not identify a groundwater contamination source area, the presence of which supported the prior selection of in-situ chemical oxidation in the original ROD remedy. In-situ chemical oxidation is most efficient when the oxidant is applied to the source area, not a diffuse plume. Therefore, the remedy in the 2004 ROD will be unlikely to achieve cleanup objectives unless source area(s) are identified. In addition, BAE conducted a pilot test to evaluate the possible use of soil vapor extraction (SVE) and/or dual-phase extraction, which combines SVE and groundwater extraction and treatment technologies. Both technologies proved unlikely to meet cleanup goals.

Based on the results of the PDI, EPA reassessed the remedial action selected for OU1 in the 2004 ROD and decided that the 2004 remedy was unlikely to achieve the cleanup RAO set forth in the 2004 ROD. Therefore, EPA undertook the October 2011 FFS, which re-evaluated the remedial alternatives for OU1. The October 2011 FFS identified and evaluated a range of remedial alternatives to address VOC groundwater contamination at the Site. For the purpose of comparing the new proposed alternatives to the original selected remedy, GW3a and GW3b represent a remedial approach similar to the original remedy that EPA is proposing to amend. GW3a and GW3b include different in-situ technologies that were considered in the FFS in light of EPA's determination that the original remedy, in-situ treatment using chemical oxidation, would be inefficient in achieving the remedial objective.

After considering comments submitted during the comment period for the 2014 PRAP, EPA made modifications to the proposed remedy. Such modifications are described at length in Section 14.0 of this ROD Amendment (Documentation of Significant Changes).

9.1 Common Elements and Distinguishing Features

Many of the alternatives include common components. For the groundwater alternatives, each requires monitoring and ICs, except for the "No Action Alternative."

9.1.1 Common Element - Monitoring

With the exception of "No Action," each groundwater alternative requires a monitoring network to define a treatment area and to determine remedy effectiveness. In order to ensure the contaminated fractures are pumped and monitored, individual boreholes should be geophysically logged, packer tested, and chemically tested before completion of the wells. Existing bedrock monitoring wells may be utilized if they have been geophysically logged, packer tested, and chemically tested. The final number, location, and design of any new wells are expected to be determined during design.

In addition, with the exception of "No Action," each groundwater alternative includes monitoring to evaluate the effectiveness of the remedy in reducing VOCs in the groundwater. The components of the monitoring program will be defined during the remedial design stage. EPA assumed that the monitoring program will include a minimum of 30 wells sampled for VOCs semi-annually for 30 years for cost-estimation purposes only.

9.1.2 Common Element – Institutional Controls (ICs)

For all the groundwater alternatives except for the "No Action" alternative, ICs (legal and administrative controls and informational devices) would be implemented to protect the integrity of the Selected Remedy and to prevent exposure to site-related contamination until such time that cleanup levels are met. The types of ICs employed would include activity and use restrictions enacted through proprietary (e.g., easements, covenants) and/or governmental (e.g., zoning) controls to prevent use of the property that would

damage the components of the remedy or that would pose an unacceptable risk to receptors (i.e., by residential use). ICs shall include restrictions on installation of shallow aquifer drinking water wells and groundwater within the plume footprint exceeding cleanup levels. Advisories, public education activities, and deed notices could also be employed to warn potential receptors about the contaminated groundwater until cleanup levels are achieved. EPA will coordinate these efforts with PADEP and the Montgomery County Health Department (MCHD). An Institutional Control Implementation and Assurance Plan (ICIAP) will be developed for OU1 during the design of the selected remedy to ensure appropriate controls are drafted, implemented and monitored.

Also, EPA is required by Section 121(c) of CERCLA, 42 U.S.C. § 9621(c), and 40 CFR § 300.430(f)(4)(ii) to review the Site at least every five years after the initiation of a remedial action until cleanup levels are met if a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure (Five-Year Review). If COC levels do not allow for unlimited use and unrestricted exposure, then a Five-Year Review will be performed at least every five years.

9.2 Description of OU1 Remedial Alternatives

This section describes the remedial alternatives that EPA considered for amending the remedy for OU1. EPA's Selected Alternative is GW2, Optimized Groundwater Extraction and Treatment and Institutional Controls and Contingent Treatment. The alternatives evaluated are:

Groundwater Alternatives

GW1 No Action
GW2 Optimized Groundwater Extraction and Treatment and Institutional Controls and Contingent Treatment
GW3a In-Situ Treatment and Institutional Controls – Bioremediation
GW3b In-Situ Treatment and Institutional Controls – Zero Valent Iron
GW4 Monitored Natural Attenuation and Institutional Controls

CERCLA Section 121, 42 U.S.C. § 9621, requires that the alternative chosen to clean up a contaminated site meet several criteria. The Selected Remedy must protect human health and the environment and meet the requirements of environmental regulations. Permanent solutions to contamination problems, which reduce the volume, toxicity, or mobility of contaminants, should be developed wherever possible. Emphasis is also placed on treating the wastes at the site, whenever possible, and on applying innovative technologies to clean up the contaminants.

Each groundwater alternative, each alternative requires monitoring as described in Section 9.1.1 above and ICs as described in Section 9.1.2 above, except for the "No Action Alternative."

ALTERNATIVE GW1: No Action

Estimated Capital Cost: $0

Estimated Annual O&M Cost: $0

Estimated Total Present Worth Cost: $0

The No Action alternative is required to be considered by the NCP to provide a baseline for comparison with other alternatives. Under this alternative, no further action would be implemented and the current status of the groundwater contamination would remain unchanged. Under Alternative GW1, no remedial technologies would be used to reduce contaminant mobility, toxicity, or volume.

ALTERNATIVE GW2: Optimized Groundwater Extraction and Treatment and Institutional Controls and Contingent Treatment

Estimated Capital Cost: $3,055,150

Estimated Annual O&M Cost: $339,100

Estimated Total Present Worth Cost: $7,859,000

Alternative GW2 consists of extracting contaminated groundwater and air stripping the extracted groundwater to remove contamination before discharging the treated groundwater to a local publically owned treatment works or surface water. Extraction and treatment of groundwater can be accomplished in a phased approach to expand and optimize BAE's historic pumping and treatment with air stripping. BAE operated an air stripper at the Site from 1986 to 2010.

In addition, Alternative GW2 provides for in-situ chemical oxidation as a contingent remedy in the event that a source area is identified during future site work (e.g., as the result of pre-design investigations, or during the implementation of the selected optimized extraction and treatment remedy). In addition, Alternative GW2 provides for bioremediation as a contingent remedy in the event that the Groundwater Extraction and Treatment System has been optimized to the satisfaction of EPA in consultation with PADEP and contaminant concentrations become asymptotic approaching MCLs. Prior to the implementation of bioremediation, a pilot study would be undertaken in order to demonstrate whether bioremediation will be effective in achieving cleanup levels. In the event that a contingent remedy is triggered based on Site conditions, EPA would issue an ESD and so inform the public as required by the NCP, 40 C.F.R. § 350.435(c).

According to the Optimization Review, one or more source areas have not been identified and present data demonstrate a diffuse plume. Therefore, EPA has determined that in-situ chemical oxidation alone would not be efficient and thus has amended the OU1 remedy accordingly.

In addition, previous investigations (EA, 2010) have determined that most of the groundwater pumped from the Recovery Well during historic pumping was drawn from depths below 80 feet bgs. The PDI found that contaminants were present in the shallow bedrock aquifer above 80 feet bgs, and that no contaminant was above its MCL in the deeper bedrock aquifer below 80 feet bgs (Figures 5, 6, and 7) in the vicinity of the former UST. For effective implementation of this alternative, the Recovery Well should be plugged and abandoned to eliminate the hydraulic connection between shallow and deep bedrock. The installation of several properly designed extraction wells, the number and location of which is to be determined during the design of the optimized groundwater extraction and treatment system, is necessary to target the contamination in the shallow bedrock aquifer. The time and cost for construction of GW2 are likely to be reduced because portions of the historic pumping and treatment system are already in place. Figure 3 shows the location of the existing air stripper.

Performance tests would be conducted on all existing and new extraction wells to optimize extraction flow rates and to determine each well's capture zone to ensure all areas of the plume exceeding cleanup levels are being extracted and treated. Installation, operation, and monitoring of an optimized extraction and treatment system would be phased as part of an iterative process to ensure that the appropriate number of wells are installed to extract the contaminated groundwater and to ensure that contaminated groundwater is captured throughout the plume. The specific number and locations of wells would be determined as part of the remedial design. For present cost-estimation purposes, the first phase would include: 1) closure of the Recovery Well; 2) installation of a replacement extraction well and three additional new extraction wells; 3) the operation of the replacement extraction well, the three additional extraction wells, and existing wells RW-1 and RI-20S; and 4) monitoring the optimized groundwater extraction and treatment system.

Once the pumping has produced steady-state conditions (i.e. groundwater contaminant levels that remain constant), the second phase of this alternative would begin with an assessment of the ability of the system to capture the plume and whether additional extraction wells are necessary to effectively capture the plume. For purposes of this cost estimate, EPA presumes that installation of four additional extraction wells ultimately would be necessary in the second phase of the groundwater remedy implementation.

Extracted groundwater would be treated using the existing treatment system, which was an air stripper located in the area of monitoring wells A-17 and A-18 (See Figure 3). Air stripping involves the physical removal of volatile contaminants by exposure to air. Contaminated groundwater flows by gravity through a packed tower air stripper. A blower supplies air through the tower where the contaminants are converted from the liquid phase to vapor phase and are stripped from the groundwater. Off-gas treatment after air stripping, which could include vapor-phase granular activated carbon or oxidation, will be determined during design. The existing treatment system may need to be modified to accommodate a pumping rate of approximately 50 gallons per minute (gpm) as a result of an increased number of operating extraction wells. Treated water would be discharged to either the Hatfield Township Municipal Authority Wastewater

Treatment Plant or to an on-site tributary of the Neshaminy Creek, which will also be determined during design. For the purposes of costing, the FFS assumed the use of the existing air stripper and discharge to the on-site tributary of the Neshaminy Creek.

Monitoring groundwater (See Section 9.1.1) and the implementation of appropriate ICs (See Section 9.1.2) as determined during the design would ensure that the remedy is effective and protective of human health and the environment.

ALTERNATIVE GW3: In-Situ Treatment and Institutional Controls

	GW3a	*GW3b*
Estimated Capital Cost:	*$10,491,880*	*$4,929,155*
Estimated Annual O&M Cost:	*$117,000*	*$137,000*
Estimated Total Present Worth Cost:	*$11,050,000*	*$5,511,000*

Alternative GW3 is in-situ treatment of groundwater contamination coupled with ICs and long-term groundwater monitoring. In-situ treatment consists of the injection of amendments into the aquifer in order to stimulate degradation processes. Long-term groundwater monitoring and ICs would be required to accompany all in-situ treatment until cleanup levels are achieved. Alternative GW3 represents an updated version of the original remedy that was selected in the 2004 ROD. The updated technologies identified have not been tested at the Site and are considered as alternatives to better compare the proposed alternatives to the original remedy which included in-situ chemical oxidation.

The two technologies most likely to be effectively implemented across the entire plume, which were considered in the FFS, are enhanced bioremediation (EAB), referred to as GW3a, and injection of micro-scale zero valent iron (ZVI) and food-grade organic carbon (combined biological/chemical reduction), referred to as GW3b. The FFS did not evaluate chemical oxidation as a stand-alone alternative because data evaluated during the PDI indicated chemical oxidation would not be able to be efficiently implemented across the entire plume. On the other hand, EAB and ZVI amendments have a longer retention time in the aquifer than chemical oxidation amendments and could be applied to a diffuse plume. Additional detail on the delivery mechanics of amendments into the subsurface and assumptions made for EAB and ZVI can be found in Section 3.3.3 of the FFS.

Even though in Alternative GW3a, EAB would stimulate anaerobic biotic degradation processes and in Alternative GW3b, ZVI would stimulate abiotic degradation processes, both in-situ treatment methods would be implemented in the same manner by injecting different amendments into the subsurface. For both GW3a and GW3b in-situ treatment methods, an amendment would be injected into the ground via injection points that are optimally placed throughout OU1. The subsurface at the Site is fractured bedrock which, by nature, does not have uniform flow and displays different properties in different directions (such that it is anisotropic and heterogeneous). FFS, at 3-4. Water in a

fractured bedrock system flows at different rates and in different directions, and, therefore, amendments may not reach contamination that is distant from injection points. FFS, at 3-4. In addition, there is uncertainty that the amendments can adequately contact the contaminants in this complicated fractured bedrock aquifer. Groundwater flow rates and directions can vary drastically over several feet. Therefore, predicting injection deliveries would be very complex and the uncertainty in these predictions is high. To reduce this uncertainty, a three-dimensional model may be developed during remedial design. FFS, at 3-4. In addition, while assumptions have been made regarding the achievable radius of influence of the in-situ technologies, the actual distribution of the injected substances would need to be evaluated in both a treatability and a pilot study. The installation would likely be required to proceed in phases. During the first phase, a series of wells would be used to inject the amendment. The results of the first phase would be used to help guide subsequent phases, as they are expected to demonstrate the effectiveness of the remedy and the need, if any, for additional extraction wells.

It is estimated that active bioremediation could take place in the aquifer for up to 6 years and then the OU1 groundwater plume would be monitored for the remainder of the evaluation period (10 years). An extensive monitoring well network, as detailed in the FFS, would be required to implement and to track the progress of the remedy. Monitoring conditions both inside the plume and along the edges of the plume would be necessary in order to ensure injected substances and contamination do not migrate outside the plume area.

Monitoring groundwater (See Section 9.1.1) and the implementation of appropriate ICs (See Section 9.1.2) as determined during the design would ensure that the remedy is effective and protective of human health and the environment.

For the purposes of costing, it is presumed that Alternative GW3a (EAB) would use Edible Oil Substrate (EOS™) as the injected amendment at the Site; however, a different amendment or amendments could be selected during the remedial design based on the results of treatability and pilot testing. For estimation purposes, EOS™ would be injected via approximately 26 injection wells throughout the treatment zone (based on the expected radius of influence), so as to not adversely affect the wells monitoring the injection process. In addition, for costing purposes, it is presumed that a bioaugmentation injection would occur at one-third of the well locations approximately 3 months after the initial EOS™ injection is completed and that an additional full-scale injection event would take place approximately 18 months after the first injection is completed. Monitoring of chlorinated VOCs, ethene, ethane, methane, sulfate, iron, alkalinity, total organic carbon, and water quality parameters (dissolved oxygen, conductivity, temperature, oxidation reduction potential, and pH) would be performed for 10 years following the final injections. For costing purposes, quarterly sampling is assumed through a full year after completion of the second (and assumed final) injection event, with the frequency reduced to twice a year thereafter.

For Alternative GW3b (ZVI) water would be injected under pressure to increase the radius of influence for the injected amendments into the aquifer. For cost estimation

purposes, these injection points would be installed on 120-foot centers in the contaminated area and in two lines of wells with wells in each line spaced approximately 120 feet apart in the remainder of the plume. This configuration of fracturing points would enhance ZVI distribution by enhancing a network of preferential flow paths around the injection point. For costing purposes, GW3b assumes a one-time injection event and quarterly sampling through a full year with the frequency reduced to twice a year thereafter. For the ZVI option, it is assumed that no further ZVI injections or follow-up injections of biological amendments would be required after the initial introduction of ZVI via the hydraulic fractures. Quarterly sampling is assumed for the first year, with the frequency reduced to twice a year thereafter. Monitoring would continue at a reduced number of wells for 10 years. The installation of up to 17 new monitoring wells, to be included in the group of 30 wells to be monitored, is anticipated for the ZVI option.

ALTERNATIVE GW4: Monitored Natural Attenuation (MNA) and Institutional Controls

Estimated Capital Cost: $1,139,000

Estimated Annual O&M Cost: $345,000

Estimated Total Present Worth Cost: $2,021,000

Under Alternative GW4, extensive monitoring would be performed in order to demonstrate that contaminated groundwater is being naturally reduced to cleanup levels at OU1. No active action would be taken to clean contaminated groundwater. If, after a specified period of monitoring, groundwater contaminant levels are not decreasing, there is an increase in more toxic breakdown products, or contamination is migrating further from source area(s) as a result of natural processes, a different remedy would need to be selected and implemented.

EPA Directive Number 9200.4-17P, "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites" (1999) (hereinafter, "MNA Directive"), outlines those site-specific conditions necessary for the use of MNA. EPA has noted in its MNA Directive: "In general, the level of Site characterization necessary to support a comprehensive evaluation of MNA is more detailed than that needed to support active remediation." MNA Directive at page 13. EPA's MNA Directive states that, for MNA, "Site characterization should include collecting data to define in three spatial dimensions over time the nature and distribution of contaminants of concern and contaminant sources as well as potential impacts on receptors." (MNA Directive, at page 14).

EPA expects that source control measures will be evaluated for all sites under consideration for any proposed MNA remedy (MNA Directive, at page 2). Second, EPA expects that sites where the contaminant plumes are no longer increasing in extent, or are shrinking, would be the most appropriate candidates for MNA remedies. MNA should not be used where such an approach would result in plume migration. (MNA Directive, at page 18).

Assuming these expectations are met, to determine the potential efficacy of MNA as a remedial alternative, an evaluation of three lines of evidence is necessary. The first line of evidence utilizes historical groundwater data to demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring points (MNA Directive, at page 16). The second and third lines of evidence are based on hydrogeologic and geochemical data that can be used to demonstrate through field or microcosm studies the particular types of natural attenuation processes active at the site, the rate at which such processes will reduce contaminant concentrations to required levels, and the ability of those processes to degrade site contaminants of concern.

With respect to OU1, given the complex geologic conditions and the existing data available, the accuracy of such projections is uncertain. To help address the uncertainty, a clear definition of the plume's migration and a MNA pilot study would be required in order to provide information to better project the effectiveness of natural attenuation mechanisms at field scale under non-pumping conditions. Extensive groundwater monitoring upgradient, throughout, and downgradient of the plume would also be necessary. While a pilot study would need to be conducted for a sufficient period of time to observe meaningful trends (i.e., several years), decision points and contingency plans would need to be specified so that any unexpected increase in contaminant concentrations could be quickly addressed.

A successful completion of a pilot study and performance monitoring would be necessary to ensure that the remedy is protective and that natural processes are sufficiently reducing contamination levels. The primary parameters to be monitored would be VOCs, geochemical indicators of transformation processes (e.g., oxidation-reduction potential, dissolved oxygen, pH, nitrate, iron (II), sulfate, methane, ethane, ethene), and hydrogeologic parameters (e.g., elevation of groundwater in monitoring wells and piezometers, local rates and schedules of any irrigation that may be occurring, local precipitation data, and pumping rates and schedules for nearby wells). Several years of monitoring data are typically necessary to estimate site variability and expected rates of change in groundwater flow, contaminant concentrations, and geochemistry. (See MNA Directive, at page 15 ("Once site characterization data have been collected and a conceptual model developed, the next step is to evaluate the potential efficacy of MNA as a remedial alternative. This involves collection of site-specific data sufficient to estimate with an acceptable level of confidence both the rate of attenuation processes and the anticipated time required to achieve remediation objectives.") For costing purposes, a monitoring network similar to those described for GW2 and GW3 would be necessary (an estimated 30 wells monitored semi-annually for VOCs, geochemical indicators, and hydrogeologic parameters for a period of 30 years). Once monitoring activities provide the data to characterize the groundwater and evaluate performance, monitoring frequency may be revised if the remedy progresses at an acceptable rate. Increases and decreases in monitoring frequency may occur over the life of the remedy based on changes in site conditions or other factors such as the adequacy or inadequacy of resulting data sets. If groundwater contaminant levels are not decreasing as a result of natural processes after a

specified period of monitoring, an active action then would be needed to remediate contaminated groundwater.

Monitoring groundwater (See Section 9.1.1) and the implementation of appropriate ICs (See Section 9.1.2) as determined during the design would ensure that the remedy is effective and protective of human health and the environment.

10.0 EVALUATION OF ALTERNATIVES

The remedial alternatives described above were evaluated in detail to determine which would best meet the requirements of CERCLA and the NCP, and achieve the RAOs identified in Section 8.0 of this ROD. In accordance with the NCP, EPA evaluates the remedial alternatives against the nine criteria set forth at 40 C.F.R. § 300.430(e)(9)(iii). The first two criteria are ***threshold criteria***: (1) overall protection of human health and the environment and (2) compliance with applicable or relevant and appropriate requirements ("ARARs"). The Selected Remedy must meet both of these threshold criteria, except when an ARAR waiver is invoked. No ARAR has been waived for the action selected in this ROD Amendment. The next five criteria are the ***primary balancing criteria***: (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility or volume through treatment; (5) short-term effectiveness; (6) implementability; and (7) cost. The remaining two criteria are ***modifying criteria*** and are taken into account after public comment is received on the PRAP: (8) state and (9) community acceptance (Table 4).

The following discussion summarizes the evaluation of each of the remedial alternatives[9] developed for OU1 against the nine evaluation criteria.

[9] With respect to the two contingent remedies that are part of GW2, in-situ chemical oxidation was evaluated and selected in the 2004 ROD as being appropriate for application to source areas and has been retained as a contingent remedy. In addition, bioremediation was screened as a standalone remedial option in the FFS as GW3a. While GW3a alone was not selected, EPA considered bioremediation against the nine criteria and has determined that it may be appropriate in the event that the contingency set forth in GW2 arise.

Table 4: Evaluation Criteria

Threshold Criteria	*Primary Balancing Criteria*	*Modifying Criteria*
Overall protection of human health and the environment - Addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or ICs.	**Long-term effectiveness and permanence** - Addresses expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met.	**State/Support Agency Acceptance** - Indicates whether the support agency concurs with or has comments on the preferred alternative.
Compliance with applicable or relevant and appropriate requirements (ARARs) - Addresses whether a remedy will meet all of the requirements of other Federal and State environmental statutes, regulations, and other requirements that are pertinent to the Site, and/or justifies a waiver.	**Reduction of toxicity, mobility, or volume through treatment** - Addresses the anticipated performance of the treatment technologies a remedy may employ.	**Community Acceptance** - Summarizes the public's general response to the alternatives described in the Proposed Plan and Remedial Investigation/ Feasibility Study Report. The specific responses to public comments are addressed in the Responsiveness Summary section of the Record of Decision.
	Short-term effectiveness - Addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup levels are achieved.	
	Implementability - Addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option	
	Cost - Includes estimated capital and operation and maintenance costs, compared as present worth costs.	

10.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether a remedy provides adequate protection of human health and the environment and analyzes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or ICs.

In Alternative GW1, under future land use scenarios, receptors could be exposed to groundwater contaminated with COCs or contaminated groundwater could migrate, which could pose a risk to humans using groundwater. Without the implementation of any actions such as remediation, ICs, or groundwater monitoring, GW1 fails to provide any protection of human health and the environment.

Alternative GW2 would recover and treat dissolved VOC concentrations in the groundwater, thereby reducing VOC contamination to levels that restore the aquifer to beneficial use, preventing migration, and limiting potential exposure to humans and the environment. Pumping would also serve to prevent contamination from further migration. ICs would protect human health by restricting the use of and access to contaminated groundwater until cleanup levels are achieved. The removal and treatment of contaminated groundwater, coupled with ICs, and implementation of contingent in-situ remedies if triggered by Site conditions, would eliminate unacceptable risk posed by groundwater conditions at OU1, providing protection of human health and the environment.

Alternatives GW3a and GW3b would result in the biodegradation/abiotic degradation of VOCs in groundwater in-situ, thereby reducing concentrations of VOCs in the groundwater. Reducing the level of contamination in the groundwater, coupled with ICs, would eliminate unacceptable risk posed by groundwater conditions at OU1, providing protection of human health and the environment.

Alternative GW4 would be protective of human health and the environment in the short term because ICs and periodic monitoring would prevent exposure to groundwater presenting an unacceptable risk. However, in the long term, the existing data fail to support that GW4 would achieve the RAOs and restore the aquifer to beneficial use at OU1 within a reasonable time, as required by the NCP. Letter Report to Ms. Sharon Fang, U.S. EPA, from Ms. Mistry Kauffman, HGL, re: Estimate of Clean-Up time frame with MNA Remedy, 4/21/16. P. 2217958. Therefore, in the long term, GW4 would rely on ICs to ensure protection of human health and the environment. Also, in Alternative GW4, under future land use scenarios, receptors could be exposed to groundwater contaminated with COCs if contaminated groundwater migrated beyond the area subject to ICs, which could pose a risk to humans using groundwater.

The present data provide no evidence suggesting that the potential long-term risk associated with VOC-contaminated groundwater at OU1 could be addressed through natural attenuation of contaminant levels to below MCLs. Available site data do not support a finding of the basic predicates for MNA, nor that any one of the three lines of

evidence have been met based on current information with respect to OU1 groundwater contamination. In the event that monitoring data or other evidence collected in the future demonstrates that MNA could adequately address long term risk associated with TCE and other groundwater contaminants at OU1, EPA may consider a change in the selected remedy at that time.

Without active remediation, it is expected that groundwater contamination would remain near current levels, not meet cleanup levels, and could continue to migrate within the aquifer. Further, the NCP establishes a preference for selection of active remedies where practicable. See 40 C.F.R. § 300.430(a)(1)(iii)(D).

GW1 (the No Action Alternative) and GW4 (the MNA Alternative) fail to meet this threshold criterion of protectiveness. The remaining groundwater remedies (GW2 and GW3) meet the threshold criterion for Overall Protection of Human Health and the Environment. Implementation of ICs would provide interim protection of human health and the environment for alternatives GW2 and GW3 until cleanup levels are met.

10.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA, 42 U.S.C. § 9621(d), and the NCP at 40 C.F.R. § 300.430(f)(1)(ii)(B), require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards of control, and other substantive environmental protection requirements, criteria or limitations promulgated under Federal law, or, if more stringent, under State law, which are collectively referred to as "ARARs," unless such ARARs are waived under Section 121(d)(4) of CERCLA, 42 U.S.C. § 9621(d)(4), and the NCP at 40 C.F.R. § 300.430(f)(1)(ii)(C). ARARs identified for the Selected Remedy are presented in Section 13.2, below.

"Applicable" requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations promulgated under Federal environmental or State environmental or facility-siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Only those State standards that are identified by a State in a timely manner and that are more stringent than Federal requirements may be applicable.

"Relevant and appropriate" requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or 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. Only those State standards that are identified by a State in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

The primary ARAR associated with groundwater is the applicable MCL promulgated pursuant to the Safe Drinking Water Act as implemented by 40 C.F.R. Part 141. GW2 and GW3 would each be designed to comply with ARARs. Both GW2 and GW3 would reduce contaminant levels in groundwater to meet chemical-specific ARARs. Under GW3, it is possible that existing contaminants could produce more toxic daughter products. These alternatives include monitoring for such daughter products (e.g., vinyl chloride) and their respective cleanup levels to ensure protectiveness. GW2 is most likely to treat contaminants and any daughter products, as well as any other comingled VOC contamination, to meet ARARs because it involves actively pumping and treating any such contamination. GW2 controls groundwater flow and removes the contaminants. In addition, if certain contingencies are triggered, GW2 would continue to control groundwater flow while the contingent remedy is implemented via a delivery system which is necessary for the in-situ treatment to come into contact with subsurface contamination. In contrast, GW3 alone relies solely on a delivery system to come into contact with the contamination in the subsurface.

For GW2's treatment, one of the following two ARARs would be necessary depending on the treatment method decided during design. If treated groundwater is discharged to the South Central Tributary, groundwater will be discharged in accordance with applicable substantive requirements of an NPDES permit. If treated groundwater is sent to a local Publically Owned Treatment Works (POTW), groundwater will meet all applicable NPDES pretreatment requirements established by the local POTW, where it would be treated with aerobic biological treatment.

In the event that either of the contingent remedies set forth in GW2 were triggered based on future site data, implementation would have to meet appropriate ARARs, including the underground injection control (UIC) requirements specifically.

Based on present evidence, EPA has determined that GW4 will not achieve chemical-specific ARARs. The data from the "Fourth Annual Report, Monitored Natural Attenuation Study" shows the lack of the contaminant concentration decreases at several wells (such as MW-5, PW-10, RI-20S, and RW-1) and the contaminant concentration increases at PW-9B since pumping was discontinued in 2010. Without active remediation, EPA expects that groundwater contamination would remain at or near current levels, would likely continue to migrate downgradient, and the remedy would not meet cleanup levels in a timely manner, if at all. Because GW4 will fail to meet ARARs and, therefore, does not meet the threshold criterion, it has been eliminated from further analysis. In the event that monitoring data or other evidence collected in the future demonstrates that MNA could adequately address long term risk associated with TCE and other groundwater contaminants at OU1, EPA may consider a change in the selected remedy at that time.

The remaining groundwater (GW2 and GW3) alternatives meet the threshold criterion for compliance with ARARs and are retained for further analysis. GW4 has been eliminated from further analysis because it fails to meet the compliance with ARARs threshold criterion.

10.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time once the cleanup levels have been met.

GW2 would provide a moderate degree of long-term effectiveness and permanence by permanently removing contamination from the groundwater aquifer by actively extracting contaminated groundwater from the aquifer and treating the contaminants using an air stripper. Air stripping permanently removes the contamination from the groundwater media. In addition, in the event that information about Site conditions cause contingencies to be triggered, in-situ chemical oxidation and/or bioremediation would also foster long-term effectiveness and permanence by treating contamination in place similar to GW3 below.

GW3 also would provide a moderate degree of long-term effectiveness and permanence by permanently reducing VOC concentrations in groundwater within the active treatment zone and the enhanced biotic and/or abiotic degradation processes. In addition, by-products generated during anaerobic fermentation, such as methane, could enhance aerobic natural attenuation processes, such as aerobic co-metabolism, i.e., the simultaneous degradation of compounds, in the downgradient dissolved plume. Once a robust microbial community is established by injecting natural and/or augmented bacteria, enhanced degradation processes could remain effective over the long term through ongoing in-situ degradation of VOCs. However, for both Alternatives GW3a (EAB option) and GW3b (ZVI option), follow-up injections of amendments may be required to establish the desired reactions. Additionally, without an identified and delineated contamination source area in the aquifer, the efficiency of the application of an in-situ remediation to a diffuse contamination plume is highly uncertain. Moreover, the long-term success of the ZVI option in the field is also uncertain because many of the case studies from other sites that were evaluated are mostly in pilot phase and were conducted in types of aquifers other than the fractured bedrock found at this Site.

10.4 Reduction of Toxicity, Mobility or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

GW2 is preferable over GW3 with respect to this balancing criterion because GW2 directly reduces the toxicity, mobility, and volume of groundwater contamination by extracting and treating contaminated groundwater. If triggered, implementation of either GW2 contingent in-situ remedy has the potential to increase mobility and toxicity of contaminants. However, the optimized groundwater extraction and treatment system will have been and still be in place. The contingent remedies could be utilized in conjunction with the optimized extraction and treatment system which, after reducing contaminant levels, could also be utilized to control mobility.

By comparison, GW3 could reduce contaminant toxicity and volume by lowering VOC concentrations in groundwater. However, GW3 could increase toxicity through the generation of daughter products as a result of remediation or if degradation stalls prior to completion. In addition, GW3 also could to increase mobility of contaminants because of the injection of amendments into the aquifer. Implementing GW3 without the added prior application of and ongoing containment provided by an optimized extraction and treatment system could lead to an increase in toxicity and mobility.

10.5 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed from the construction and implementation period until the achievement of cleanup levels.

Alternative GW2 could take 30 years or longer to achieve the RAO of restoring the groundwater aquifer to its beneficial use by reducing COCs to MCLs. The contingent remedies described herein are designed to be implemented in the place of or in conjunction with, as applicable, the Optimized Extraction and Treatment system with the goal of reducing the time to achieve that RAO. Although the timeframe for GW3 completion is expected to be less than that of GW2, the potential to generate degradation products and for the migration of groundwater contamination to nearby residents makes GW3 more risky to the community than GW2. Therefore, GW3 is less effective in the short-term than GW2.

GW2 would provide a moderate to high level of short-term risk to the community and to site workers due to increased traffic and site noise during well installation. These risks could be partially mitigated through site control and traffic control measures. Additionally, the risks to remediation workers associated with direct contact with contaminated materials would be mitigated through the use of personal protective equipment (PPE) and standard health and safety practices.

GW3 would also provide a moderate to high level of short-term risk to the community and site workers. The installation of GW3 could be completed within six months of site mobilization. GW3 could take up to 16 years to achieve protectiveness if assumptions about the number of injections are correct. Amendment injection is anticipated to occur in two rounds, so the risks to workers and the public (vapors at wells, onsite physical hazards, and traffic) would be present twice within this period of time. Potential for short-term risks to the community and to site workers would be mitigated through site control and traffic control measures. The risks to remediation workers associated with direct contact with contaminated materials would be mitigated through the use of PPE and standard health and safety practices.

GW2 would require significantly more energy than GW3. However, energy-efficient equipment could be used for these alternatives to minimize energy consumption and alternative fuels could be used to minimize greenhouse gas emissions. In addition, renewable energy sources, such as solar panels, could be used for GW2 to help power the

treatment or auxiliary systems. For both GW2 and GW3, ICs would afford short-term protection to the community until cleanup levels are met.

10.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as the availability of services and materials, administrative feasibility, and coordination with other governmental entities may also be considered.

GW2 is preferable over GW3 with respect to this balancing criterion. The implementability of GW3 is highly uncertain because amendments may not contact the contamination in the complicated fractured bedrock aquifer based on current site data. Without contaminant source identification, the implementability of GW3 is even less certain. Further, widespread injections could cause the contamination to become mobile, which could make implementation of GW3 more challenging because the contaminated groundwater could become a moving target for the second injection of amendment. GW2 is technically and administratively implementable using readily available conventional construction equipment and portions of the existing wells and treatment system at the Site. Although the implementability uncertainties of GW3 could occur if a contingent in-situ remedy of GW2 is triggered, the likelihood of an implementability problem is lower because those remedies are only triggered by site conditions (e.g., the identification of a source area or asymptotic contaminant levels above cleanup levels) would maximize their success.

Extraction and treatment technology, GW2, is well-established and readily implementable at OU1 because the remedy would be able to use the portions of the existing network of wells and portions of the existing treatment system. Without contaminant source identification, GW2 will provide capture zones for contamination to treat and limit mobility, which aids implementability in a setting where full source identification has not occurred. Operation of the extraction and treatment system may aid in identifying Secondary Source material such that additional or alternative remedial measures such as in-situ treatment may be viable in the future. Therefore, GW2 has provided for contingent remedies to utilize such measures, which are also well-established and readily implementable. In addition, the existing treatment system (air stripper and appurtenances such as piping, and previously used monitoring wells) at OU1 may be able to be re-used if GW2 were implemented. Additional wells, well vaults, and underground piping and electrical lines could be installed using standard drilling and construction equipment.

GW3 would be technically and administratively implementable; however, application of in-situ remediation without first identifying the location of sources of contamination and complete delineation of a plume can be highly uncertain and a round of injections on a small-scale would be required prior to full-scale implementation. A robust monitoring network would be required. Injection into the aquifer can also cause contamination to become more mobile and can cause daughter products to be formed during in-situ degradation which could require additional remedial action.

GW3a is relatively standard technology, and EPA is aware of several contractors that have experience with successful implementation. Treatment of VOCs in groundwater with in-situ enhanced bioremediation using commercially-available bacterial cultures is a proven technology. However, as noted in the description of GW3 above, a groundwater model, treatability study, and pilot study would be needed to facilitate the proper application of the technology. Without a completed pilot study, there is uncertainty surrounding the ability to effectively implement GW3a alone and its ability to restore the aquifer to beneficial reuse.

For GW3b, no significant construction issues are expected to be encountered, although vendor availability for both increasing the amendment's radius of influence under pressure and procuring the ZVI material may be limited, thereby making this alternative less implementable than the others. Also, similar to GW3a, injection in the center of the plume may push contamination outward if a fracture intersects another fracture which has the substantial capability to transmit water. Again like GW3a, additional injections could be necessary, depending on the effectiveness of the first round of injections.

10.7 Costs

Cost is the final balancing criterion that EPA considers in evaluating remedial alternatives. EPA compares the estimated capital and annual Operation and Maintenance (O&M) costs, as well as present worth cost of each alternative. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50% to -30%.

In order to best compare the varying costs of the alternatives, a present worth analysis was performed. This analysis includes the present worth of annual O&M costs with a discount rate of 7% over the project life (estimated to be 10 years for comparison purposes) and the one-time capital costs and one-time cost of the additional investigations. The cost for each alternative is presented in Table 5.

After considering all comments submitted during the comment period for the PRAP, EPA made certain modifications to the selected remedy as documented in Section 14.0 below. These modifications impacted the final cost estimate for GW2; the cost presented for GW2 in Table 5 is the revised cost estimate and not the cost considered in the 2014 PRAP and the 2011 FFS. The detailed cost estimate of the Selected Remedy is presented in Section 12.3.

Table 5
Costs of Evaluated Alternatives

Alternative	Capital	Annual O&M	Present Worth
GW2 Optimized Groundwater Extraction and Treatment and Institutional Controls and Contingent Treatment[10]	$3,055,550	$441,000	$7,859,000
GW3a In-Situ Treatment and Institutional Controls – Bio	$10,491,880	$117,000	$11,050,000
GW3b In-Situ Treatment and Institutional Controls – ZVI	$4,929,155	$137,000	$5,511,000

10.8 State Acceptance

The Commonwealth of Pennsylvania has indicated that it does not object to the Selected Remedy in a letter dated March 8, 2016.

10.9 Community Acceptance

From August 18, 2014, to October 17, 2014, EPA held a 60-day public comment period to accept public comments on the remedial alternatives presented in the 2014 PRAP and the other documents contained within the Administrative Record. The public comment period was originally scheduled from August 18, 2014, to September 17, 2014. However, EPA received a request to extend the comment period. As a result, the comment period was extended to October 17, 2014.

The notice of availability of the 2014 PRAP and the documents in the Administrative Record for the PRAP were published in *The Reporter* on August 18, 2014. In addition, EPA distributed fact sheets summarizing EPA's preferred remedial alternative for OU1 to local residences and businesses within an approximately 0.25-mile radius of OU1 in August 2014.

[10] The costs associated with the contingent remedies have not been included because the conditions precedent to such actions may not occur and the scope of any such remedies will depend on future data about Site conditions.

On September 4, 2014, EPA held a public meeting at the Montgomery Township Municipal Building at 1001 Stump Road, Montgomeryville, Pennsylvania to discuss the PRAP and accept comments. A transcript of this meeting is included in the Administrative Record supporting this ROD Amendment.

EPA received extensive comments on the 2014 PRAP, primarily from the parties responsible for the cleanup. Many of the comments suggested that remedial action is not needed at the Site. A summary of significant comments received during the public comment period and EPA's responses are included in the Responsiveness Summary, which is a part of this Record of Decision.

11.0 PRINCIPAL THREAT WASTE

EPA characterizes waste on-site as either principal threat waste or low-level threat waste. The concept of principal threat waste and low-level threat waste, as developed by EPA in the NCP, is applied on a site-specific basis when characterizing source material. "Source material" is defined in 40 C.F.R. § 300.430(a)(1)(iii)(A) as material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, to surface water, to air, or that act as a source for direct exposure. Principal threat wastes are those source materials considered to be highly toxic or highly mobile, which would present a significant risk to human health or the environment should exposure occur. Contaminated groundwater is generally not considered to be source material.

The 2004 ROD for OU1 and OU3 indicated that, based on the levels found in the overburden and fractured bedrock, groundwater, and any associated soils contamination, TCE, 1,1-DCE and 1,2-DCA were principal threat wastes at the Site. However, EPA has since determined that contaminated groundwater and/or soil at OU1 are not considered to be principal threat wastes because the contaminants present in those media at OU1 do not constitute source material. As such, EPA determined that investigations conducted, to date, have not identified principal threat wastes associated with the OU1 portion of the Site.

12.0 SELECTED REMEDY

Following review and consideration of the information in the Administrative Record supporting this ROD Amendment, the requirements of CERCLA and the NCP, and public comments, EPA has selected Alternative GW2 (Optimized Groundwater Extraction and Treatment and Institutional Controls and Contingent Treatment), as the Selected Remedy for OU1 of the North Penn Area 5 Superfund Site. The Selected Remedy for OU1 addresses groundwater contamination to allow beneficial use of the aquifer.

12.1 Summary of the Rationale for the Selected Remedy

EPA's Selected Remedy for OU1 meets the threshold criteria of overall protection of human health and the environment and compliance with ARARs. Based on the information currently available, EPA has determined that Alternative GW2 (Optimized Groundwater Extraction and Treatment and Institutional Controls and Contingent Treatment) provides the best balance of advantages and disadvantages among the alternatives with respect to the balancing criteria. Specifically, EPA's Selected Remedy:

1. will be protective of both human health and the environment;

2. will meet Federal and State ARARs;

3. will minimize migration of contaminants in the aquifer and restore groundwater quality;

4. will directly reduce toxicity and volume of groundwater contaminants through treatment;

5. can be easily implemented;

6. will be effective in the short-term and long-term; and

7. is the most cost effective of the alternatives that provide overall protection to human health and the environment.

EPA selects GW2 (Optimized Groundwater Extraction and Treatment and Institutional Controls and Contingent Treatment) because it directly removes VOCs dissolved in the groundwater and treats contamination prior to discharge. The extraction of contaminated groundwater will reduce risk at the Site and will ensure that contamination does not migrate further in the aquifer. GW2 will reduce contaminant levels in groundwater, and ARARs will be reached in a reasonable timeframe. GW2 promotes long-term effectiveness and permanence because contaminated groundwater will be removed and treated, thereby reducing toxicity and volume through treatment. Even though it may take 30 years or longer to achieve the cleanup levels, time for construction of the remedy would be reduced because portions of the necessary groundwater extraction and treatment system are in place and can be re-used. Performance tests will ensure that extraction flow rates are optimized and will determine capture zones for each extraction well so that all areas of the plume are treated. The optimized extraction and treatment system can be constructed in phases as part of an iterative approach so that the appropriate number of wells required to capture contaminated groundwater are installed.

During the remedial action, a monitoring network will be utilized to define the migration of the plume. In addition, optimizing GW2 could lead to the identification of additional source areas, and any such source areas may be evaluated for alternative remedial measures such as removal or in-situ treatment, which could reduce the overall timeframe for the operation of GW2. Also during the implementation of GW2, monitoring data or

other evidence could be generated to demonstrate that MNA could adequately address long term risk associated with TCE and other groundwater contaminants at OU1. With this technical data or other evidence, EPA could amend the selected remedy at that time. ICs would be implemented to protect the integrity of the Selected Remedy and to prevent exposure to site-related contamination until such time that cleanup levels are met.

Even though the cost of GW2 is higher than the cost of GW3b, GW2 is preferred because of its short-term effectiveness and since the reduction of toxicity, mobility, and volume are more certain when compared to both GW3a and GW3b. The GW3 in-situ treatment options could result in increased contaminant mobility and plume migration, and also could result in the production of degradation products that could be more toxic than TCE. Also, the ultimate success of the GW3 options is hindered significantly because a contamination source area has not been identified, and, more generally, it may be difficult for the amendments to contact the contaminants in the complicated fractured bedrock aquifer.

GW2 is easier to implement compared to the in-situ alternatives, GW3a and GW3b. GW2 will reduce toxicity, mobility, and the volume of groundwater contamination through treatment and is technically and administratively implementable using readily available conventional construction equipment. GW2 will hydraulically control the contaminated groundwater plume while restoring the aquifer. Extraction and treatment technology is well established and readily implementable at OU1 and the iterative implementation of GW2 has the potential to identify the location of any secondary sources.

Based on present information as set forth in the Administrative Record supporting this ROD Amendment, EPA has determined that it is necessary to amend the original remedy, in-situ chemical oxidation with extraction and treatment, identified in the 2004 ROD by selecting Optimized Groundwater Extraction and Treatment and Institutional Controls as the Selected Remedy.

EPA expects the Selected Remedy for groundwater to satisfy the statutory requirements of Section 121 of CERCLA, 42 U.S.C. § 9621, because it will 1) be protective of human health and the environment; 2) comply with ARARs; 3) be cost-effective; 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) satisfy the preference for treatment as a principal element.

12.2 Description of the Selected Remedy and Performance Standards

Based on the comparison of the nine criteria, EPA's selected alternative for OU1 is GW2- Optimized Groundwater Extraction and Treatment and Institutional Controls and Contingent Treatment. The estimated Total Present Worth Cost of EPA's selected alternative is $7,859,000. The major components of the Selected Remedy include:

1. Design and implementation of an optimized groundwater extraction and treatment system, using an iterative approach;

2. Extract contaminated groundwater to achieve aquifer restoration;

3. Treatment of contaminated groundwater followed by discharge to surface water or a local publically owned treatment works;

4. Performance monitoring and groundwater extraction system testing;

5. Implementation of in-situ treatment(s) in the event certain contingencies occur; and

6. Implement ICs to protect the integrity of the remedy and to prevent exposure to site-related contamination until such time that cleanup levels are met.

The Selected Remedy shall comply with all applicable or relevant and appropriate requirements (ARARs) contained in Section 13.2.

12.2.1 Design and implement an optimized groundwater extraction and treatment system, using an iterative approach

Design, installation, and operation of the optimized extraction and treatment system would be completed in phases as part of an iterative approach to ensure that the lowest appropriate number of wells required are installed to capture the contaminated groundwater.

Performance Standards for Constructing an Optimized Groundwater Extraction and Treatment System

The following performance standards will apply with respect to constructing the optimized extraction system:

1. The conceptual site model will be updated using Site data. A conceptual site model will provide a basis to guide and support future data collection efforts to assess effectiveness of the remedy based upon operation and monitoring data.

2. The existing network of wells and extraction system will be designed and optimized based on the updated conceptual site model and sampling data. The performance standards for the remedy will ensure that the groundwater extraction system will establish hydraulic control and restore the aquifer within a reasonable timeframe.

3. Wells determined by EPA to no longer be necessary will be abandoned in accordance with State requirements. EPA anticipates that the Recovery Well will be abandoned for the reasons discussed earlier; however, the actual wells to be abandoned will be determined during the design.

4. New wells will be installed and/or existing wells will be modified to monitor the horizontal and vertical extent of groundwater contamination. EPA anticipates that a new extraction well in the vicinity of the former Recovery Well will be installed, using geophysical analysis and packer testing to target contaminated fracture(s). Also, since wells PW-11, PW-12, PW-13 and PW-14 are open boreholes, geophysical analysis and packer testing will be conducted in order to evaluate whether each well is constructed to properly intersect contaminated fractures. The final number, location, and construction details of the extraction and monitoring wells will be determined during the design.

5. New extraction wells will be installed and/or existing extraction wells will be modified, as necessary, in order to capture groundwater contaminated above MCLs. Performance tests will be conducted on all extraction wells to ensure that extraction flow rates are optimized and capture zones for each extraction well are identified so that all areas of groundwater contamination above cleanup levels are targeted for extraction and treatment. The first iteration is expected to include the proper closure of the Recovery Well and the installation of a replacement extraction well in its vicinity to target the Recovery Well's intended capture zone. The number, location, and construction details of the initial set of extraction wells will be determined during the design.

6. Engineering controls and safety measures will be taken to prevent inhalation of and direct contact with contaminated groundwater above levels that are acceptable for human receptors.

12.2.2 Extract contaminated groundwater to achieve aquifer restoration

The Selected Remedy will prevent the migration of contaminated groundwater while reducing the volume of contaminated materials in groundwater in order to restore groundwater to beneficial use. Groundwater from within the plume shall be pumped to maintain hydraulic containment, and be collected and treated as necessary to achieve the following performance standards.

Design and iterative monitoring data will determine actual pumping locations and pumping rates in order to optimize groundwater extraction.

Performance Standards for Extracting Contaminated Groundwater

The following performance standards will apply with respect to extracting contaminated groundwater:

1. Groundwater quality in the overburden and the fractured bedrock will be restored such that contamination in the aquifer will be reduced to drinking water MCLs pursuant to the Safe Drinking Water Act (Table 3) by extracting contaminated groundwater based upon locations and rates determined during design.

2. Pumping rates and static water levels will be monitored to assure that hydraulic control over the contaminant plume above cleanup levels is established and then maintained. The nature of this monitoring will be determined during design.

3. The extraction of contaminated groundwater will be adjusted as necessary based upon ongoing performance tests, monitoring, and capture zone analysis in order to ensure that applicable cleanup levels will be met (Table 3).

4. The groundwater collection system will be operated and maintained until the groundwater cleanup levels set forth in Table 3 have been achieved. The system shall continue to operate until the MCLs are attained throughout the plume consistent with *Recommended Approach for Evaluating Completion of Groundwater Restoration Remedial Actions at a Groundwater Monitoring Well*, OSWER 9283.1-44 (August 2014). EPA, in consultation with PADEP, will determine when these conditions have been met.

5. Engineering controls and safety measures will be taken to prevent inhalation of and direct contact with VOCs above levels that are acceptable for human receptors.

12.2.3 Treat and discharge groundwater to surface water or a local publically owned treatment works

Contaminated groundwater shall be treated, if necessary, and lawfully discharged to surface water or a local POTW.

Performance Standards for Treating and Discharging Groundwater

The following performance standards will apply with respect to the treatment and discharge of groundwater:

1. If groundwater is discharged to the South Central Tributary, groundwater will be discharged in accordance with applicable substantive requirements of a NPDES permit.

2. If groundwater is sent to a local POTW, groundwater will meet all applicable NPDES pretreatment requirements established by the local POTW (where it would be treated with aerobic biological treatment). All such activities shall be coordinated with the POTW to ensure the discharge can be accepted by the POTW.

3. If the Selected Remedy is designed to discharge to the POTW, piping to the sanitary sewer tie-in shall be properly inspected and maintained in order to ensure the wastewater is being treated at the POTW.

4. In the event that the groundwater cannot meet NPDES requirements for discharge into the South Central Tributary or the POTW's pretreatment requirements,

additional measures, such as treatment, will be taken in order to meet either the substantive requirements of a NPDES permit for discharge or the POTW's pretreatment requirements.

5. In the event that additional treatment is required to treat groundwater prior to discharge, the Annual Extraction and Treatment Evaluation Reports required under Section 12.2.2, shall contain data and any other information sufficient to allow EPA to determine whether or not the groundwater treatment system(s) is in compliance with this ROD Amendment and, in particular, whether performance standards are achieved and maintained.

12.2.4 Performance monitoring and groundwater extraction system testing

Monitoring wells will be installed in sufficient numbers and at locations to evaluate the performance of the remedy. Existing monitoring wells may be utilized where appropriate. Sampling and analysis of the monitoring well network will be conducted, as necessary, to document contaminant levels before and during the operation of the optimized groundwater extraction system. Monitoring shall be conducted to evaluate the effectiveness of the remedy in reducing VOCs in the groundwater and meeting performance standards.

Performance Standards for Performance Monitoring

The following performance standards will apply with respect to performance monitoring:

1. Groundwater elevations will be monitored and groundwater samples will be collected and analyzed to determine levels of site-related contaminants. The monitoring program shall compare the groundwater quality to the cleanup levels identified in Table 3. The specific locations and frequency of sampling shall be determined in the remedial design. EPA, in consultation with PADEP, may modify the monitoring requirements, as necessary.

2. As part of an iterative process and based on monitoring data, new wells may be installed and/or existing wells may be modified in order to conduct necessary monitoring of the groundwater. The number, location, and construction details of the monitoring wells will be determined during optimization and should be implemented upon EPA's review and approval.

3. The extraction and treatment system will be evaluated to determine whether it is necessary to make modifications in order to optimize performance. The specifics and schedule of this evaluation should be determined and performed upon EPA's review and approval.

4. Monitoring reports will be submitted to EPA annually and will include sufficient detail to allow EPA to determine whether or not the groundwater extraction system is operating optimally and whether the performance standards have been achieved and are being maintained. Each annual monitoring report should present

and interpret the monitoring data, extraction and treatment system data, include an updated capture zone analysis, and propose system modifications in order to optimize the system as necessary. These reports will ensure effectiveness of the remedy.

5. Any well(s) determined by EPA to no longer be necessary will be abandoned or closed in accordance with applicable State requirements for well abandonment.

12.2.5 Implement ICs

ICs will be implemented to protect the integrity of the Selected Remedy and to prevent exposure to site-related contamination until such time that cleanup levels are met. EPA expects that it will be necessary to restrict the installation of water supply wells on all parcels impacted by contamination associated with OU1 by implementing ICs, such as covenants, orders, local ordinances, or agreements with the property owners. EPA will coordinate these efforts with PADEP and the MCHD. The Institutional Controls Implementation and Assurance Plan (or "ICIAP") will be developed during the design to ensure appropriate controls are drafted, implemented, and monitored at OU1 until groundwater cleanup levels are met.

Performance Standards for Institutional Controls

The following performance standards will apply with respect to institutional controls on all properties with contaminated groundwater until groundwater cleanup levels are met:

1. ICs will be drafted, implemented, and monitored in order to maintain and protect the integrity of the engineered remedy including, but not limited to, any monitoring wells and injections wells.

2. ICs will prohibit human exposure to groundwater that exceeds site cleanup levels and contact with contaminated groundwater via ingestion, vapor inhalation, or dermal contact.

12.2.6 Implement Contingent Remedies if Site Conditions Warrant

In addition to the optimized extraction and treatment remedy above, EPA has retained in-situ chemical oxidation as a contingent remedy in the event that a source area is identified during future site work (e.g., as the result of pre-design investigations, or during the implementation of the selected optimized extraction and treatment remedy). In addition, EPA has also selected enhanced bioremediation as a contingent remedy in the event that the Groundwater Extraction and Treatment System has been optimized to the satisfaction of EPA in consultation with PADEP and contaminant concentrations become asymptotic approaching MCLs. Prior to implementation of bioremediation, a pilot study will be undertaken in order to demonstrate whether bioremediation will be effective in achieving cleanup levels.

Performance Standards for Contingent Remedies

In the event that the contingencies triggering either in-situ treatment or bioaugmentation remedies arise, EPA will issue an ESD which will describe the relevant performance standards and so inform the public as required by the NCP, 40 C.F.R. § 350.435(c).

12.3 Summary of the Estimated Remedy Costs

The estimated total Present Worth cost of the Selected Remedy is $7,859,000. Cost estimate summary tables for the Selected Remedy are included in Table 6.

Table 6
Cost of the Selected Remedy

Item	Quantity	Units	Unit Cost	Capital Cost	O&M Cost	
					Annual	Present Worth
Mobilization	1	ls	$100,000	$100,000		
Extraction System:						
Installation of New Extraction Wells	8	well	$13,750	$110,000		
(6 in extraction well - 80 ft deep with 15 ft screen)						
Vaults	8	vault	$5,600	$44,800		
Piping	1800	lf	$49	$88,200		
Pumps	8	pump	$4,000	$32,000		
Wellhead plumbing and electrical connection	1	ls	$443,000	$443,000		
Review system & determine if it has adequate capacity	120	hr	$200	$24,000		
Install monitoring wells (assume 6 new wells needed)	6	well	$4,500	$27,000		
Properly close Recovery Well	1	well	$8,000	$8,000		
Institutional Controls						
Public Education						
Community Interviews/Open House	1	ls	$38,000	$38,000		
Preparation of Fact Sheets, Pamphlets, Handouts, etc	1	ls	$20,000	$20,000		
Deed Restrictions						
Legal research, coordination with government officials	1	ls	$90,000	$90,000		
Health and Safety	1	ls	$50,000	$50,000		
Subtotal (1)				$1,075,000		
Confirmation Sampling						
(a) Develop Sampling Plan	1	ls	$15,000	$15,000		
(b) Groundwater sampling (semiannual)	2	event	$35,000		$70,000	$868,633
mple Collection ($20K) + Analysis $500/sample for 30 samples						
Subtotal (2)				$15,000	$70,000	$868,633
O&M:						
Operating cost for air stripper						
assume 50 gpm treatment system (26.3 million gallons/yr)	26,300	1,000 gal	$7		$184,100	$2,284,504
Major repair (1 per year, as a percent of system cost)	1	ls	$15,000		$15,000	$186,136
Subtotal (3)					$199,100	$2,470,640
Site Restoration	1	ls	$80,000	$80,000		
Subtotal (4)				$80,000		
Reporting:						
Review data and prepare annual reports	1	ls	20,000		$20,000	$248,181
5-Year Review (every 5 years for 30 years)	1	ls	50,000		$50,000	$107,900
Remedial Action Report	1	ls	$45,000	$45,000		
Redo NPDES Permit with new design	160	hr	$200	$32,000		
Subtotal (4)				$77,000	$70,000	$356,081
CONSTRUCTION SUBTOTAL				$1,247,000		
Contractor Submittals, H&S, and Construction QA/QC	10% of Construction Subtotal			$124,700		
Contractor Overhead	15% of Construction Subtotal			$187,050		
Contractor Profit	10% of Construction Subtotal			$124,700		
Contingency	40% of Construction Subtotal			$498,800		
CONSTRUCTION TOTAL				$2,182,250		
Project Management	10% of Construction Total			$218,225		
Engineering	15% of Construction Total			$327,338		
Services During Construction	15% of Construction Total			$327,338		
TOTAL CAPITAL COSTS				$3,055,150		
OPERATION & MAINTENANCE SUBTOTAL					$339,100	$3,695,354
O&M Project Management and Support	5% of O&M Subtotal				$16,955	$184,768
O&M Contingency	25% of O&M Subtotal				$84,775	$923,838
TOTAL ESTIMATED COSTS				$3,055,000	$441,000	$4,804,000
NET PRESENT WORTH				$7,859,000		

The information in the cost-estimate summary tables is based on the best available information regarding the anticipated scope of the selected response action. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. The costs associated with the contingent remedies have not been included because the conditions precedent to such actions may not occur and the scope of any such remedies will depend on future data about Site conditions. The cost of any contingent remedies as set forth in GW2 will be described in the associated ESD(s) and so inform the public as required by the NCP, 40 C.F.R. § 350.435(c).

Minor changes to the cost estimate may be documented by EPA in the form of a memorandum in the Administrative Record. Changes that are significant, but not fundamental, may be documented in an Explanation of Significant Differences. Any fundamental changes would be documented in a subsequent ROD amendment.

12.4 Expected Outcomes of the Selected Remedy

The Selected Remedy will be a final action for OU1 and is expected to reduce risks associated with exposure to contaminated groundwater and to restore the groundwater aquifer. ICs will prevent exposure to contaminated groundwater until final groundwater cleanup levels are met and monitoring will be conducted to ensure that the groundwater cleanup levels are achieved.

Any minor, significant, or fundamental change will be appropriately documented.

13.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121, 42 U.S.C. § 9621, and the NCP, selected remedies must protect human health and the environment, comply with ARARs (unless a statutory waiver is justified), be cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy for OU1 of the North Penn Area 5 Superfund Site meets these statutory requirements and preferences.

13.1 Protection of Human Health and the Environment

The Selected Remedy will protect human health and the environment through the treatment of VOC contaminated groundwater in OU1 groundwater by Optimized Groundwater Extraction and Treatment and ICs. The Selected Remedy is expected to

reduce contaminant levels in groundwater to MCLs. The Selected Remedy includes groundwater monitoring to evaluate its effectiveness in achieving groundwater cleanup levels.

The Selected Remedy requires ICs to protect the integrity of the remedy and prevent exposure to contaminated groundwater and, as such, is expected to be protective of human health and the environment in the short term. ICs are expected to provide adequate protection from contaminated groundwater until cleanup levels are met.

13.2 Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy will attain all applicable or relevant and appropriate requirements, which are identified as performance standards in Section 12.2 and specified in Table 7 below. ARARs are generally divided into three categories: chemical-specific, action-specific, and location-specific. Chemical-specific ARARs provide standards for acceptable or permissible contaminant concentrations in soil, air, and water. Action-specific ARARs are technology- or activity-based requirements, while location-specific ARARs govern activities in critical environments such as floodplains, wetlands, endangered species habitats, or historically significant areas. The following sections provide a summary of Federal and State ARARs identified for this Site.

Chemical-Specific

National Primary Drinking Water Standards, 40 C.F.R. §§ 141.50, 141.51, 141.61, 141.62, were promulgated pursuant to the requirements of the Safe Drinking Water Act, 42 U.S.C. §§ 300f through 300j, to set standards for potable water supplies. The primary standards include Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs), which are enforceable standards for specific contaminants. The MCLs as set forth in Table 3 are relevant and appropriate to the cleanup of groundwater pumped at OU1.

Action-Specific

Pretreatment Standards for Discharges to POTWs, 40 C.F.R. § 403.5(a)(1), (b), and (d), prohibit the introduction of certain pollutants into a POTW, including those which will cause Pass Through or Interference. These regulations are applicable to the groundwater portion of the selected remedy should the treated groundwater be discharged to a POTW.

National Pollution Discharge Elimination System (NPDES) Regulations, 25 Pa. Code §§ 92a.11; 92a.12(a)-(b); 92a.41(a)(4), (5)(incorporating 40 C.F.R. § 122.41(d), (e)); 92a.41(c); 92.44 (incorporating 40 C.F.R § 122.44(a)(1), (b)(1)(first sentence), (d), (e), (i)(1), and (k)); 92a.45 (incorporating 40 C.F.R. § 122.45(a), (b)(2)(i), (c), (e), and (f)); 92a.48(a)(1) and 92a.61(d), (e), and (i), set forth requirements governing discharges of pollutants into waters of the United States. These regulations are applicable to remedial activities that involve discharge of treated groundwater to surface water.

The Pennsylvania Water Well Drillers License Act, 32 P.S. §§ 645.1-645.13, provides provisions related to well abandonment and closure. These provisions are applicable to any remedial activities that involve the abandonment or closure of a well.

EPA-authorized Pennsylvania Hazardous Waste Management Regulations, 25 Pa. Code § 264a.1, which incorporates by reference federal regulations at 40 C.F.R. § 264.554(d), (e), (f), (g), (h), (j), and (k), establishes requirements for the storage of remediation waste in temporary staging piles. These regulations are relevant and appropriate to any excavation activities undertaken as part of the Selected Remedy.

Fugitive Air Emissions, 25 PA Code §§ 123.1-123.2, regulations establish the fugitive dust regulation for particulate matter. These regulations are applicable if fugitive air emissions are generated during well construction activities.

National Emissions Standards for Hazardous Air Pollutants, 25 PA Code §§ 124.1-124.3; 40 C.F.R. Parts 61 and 63, regulations establish the hazardous air pollutant discharge regulations. These regulations, including 40 C.F.R. § 63 Subpart GGGGG, are applicable with respect to air stripping activities.

Construction, Modification, Reactivation, and Operation of Sources, 25 PA Code §§ 127.1 et seq., regulations establish requirements for the use of best available technology on new air pollutant emissions sources. These regulations are applicable with respect to any well construction activities as well as any treatment alternative that would result in the emission of site contaminants to the air.

Underground Injection Control (UIC) Program, 40 C.F.R. §§ 141.1(g), 141.11, 141.12(a), 144.82, 146.6, 146.10(c), regulations are applicable to the installation of injection wells for purposes of in-situ treatment and bioaugmentation. The UIC regulations define and establish five classes of injection wells. Generally, Class V wells are shallow discharge or disposal wells, storm water or agricultural drainage systems, or other devices that are used to release fluids into or above an underground source of drinking water. In Pennsylvania, EPA Region III has primacy in matters involving UIC and PADEP defers to EPA implementation of the UIC program. Each contingent remedy alternative is expected to comply with these requirements.

Table 7 Summary of Applicable or Relevant and Appropriate Requirements (ARARs)

ARAR OR TBC	LEGAL CITATION	MEDIUM	CLASSIFICATION	SUMMARY OF REQUIREMENT	FURTHER DETAIL REGARDING ARARS IN THE CONTEXT OF THE REMEDY
Chemical Specific					
National Primary Drinking Water Standards, Maximum Contaminant Levels (MCLs)	40 C.F.R. §§ 141.50-.51, 141.61-.62.	Groundwater	Relevant and Appropriate	MCLs are enforceable standards for public drinking water supply systems. However, under the circumstances of this site, MCLs are relevant and appropriate to establishing groundwater cleanup levels.	The groundwater will meet these requirements and additional risk-based performance standards for those contaminants set forth in Table 3.
Action Specific					
Federal Pretreatment Standards for Discharges to POTW	40 C.F.R. § 403.5	Groundwater	Relevant and Appropriate	Establishes prohibitions on the introduction of certain pollutants into publicly owned treatment works.	Water sent to the POTW as a result of remedial activities at the Site will meet these standards.
National Pollution Discharge Elimination System (NPDES) Regulations	25 Pa. Code §§ 92a.11; 92a.12; 92a.41; 92.44; 92a.45; 92a.48 and 92a.61	Groundwater	Relevant and Appropriate	Establishes prohibitions on the introduction of certain pollutants into waters of the United States.	Water discharged in the South Central Tributary as a result of remedial activities at the Site will meet these standards.
Pennsylvania Water Well Drillers License Act	32 P.S. §§ 645.1-645.13	Groundwater	Relevant and Appropriate	Provides provisions related to well abandonment and closure	Remedial activities that involve the abandonment or closure of a well.
Pennsylvania Hazardous Waste Management Regulations	25 Pa. Code § 264a.1, which, as set forth therein, incorporates Federal regulations at 40 C.F.R. Part 264.554(d), (e), (f), (g), (h), (j) and (k)	Groundwater	Relevant and Appropriate	Regulates storage of remediation waste.	Any waste generated as a result of remedial activities will meet these standards.
Fugitive Air Emissions	25 Pa. Code § 123.1 - 123.2 40 C.F.R. § 50.6 - 50.7	Air	Applicable	Establishes the fugitive dust regulation for particulate matter.	Any construction activities will comply with the substantive requirements of these regulations.

National Emissions Standards for Hazardous Air Pollutants	25 Pa. Code §§ 124.1 – 124.3 40 C.F.R. Parts 61 and 63, including 40 C.F.R. § 63 Subpart GGGGG	Air	Applicable	Establishes the hazardous air pollutant emissions regulation.	Any construction activities as well as any treatment alternative that would result in the emission of Site contaminants to the air will meet these standards.
Construction, Modification, Reactivation, and Operation of Sources	25 Pa. Code §§ 127.1 et seq.	Air	Applicable	Establishes requirements for the use of best available technology on new air pollutant emissions sources.	Any construction activities as well as any treatment alternative that would result in the emission of site contaminants to the air will comply with the substantive requirements of these regulations.
Underground Injection Control Program	40 C.F.R. §§ 144.1(g), 144.11, 144.12(a), 144.82, 146.6, 146.7, 146.8, 146.10(c)	Groundwater	Applicable	Establishes classes of injection wells and requirements for those wells pursuant to the Underground Injection Control Program	The regulations apply to the installation of injection wells with respect to the contingent remedies. The contingent remedies, if triggered, will comply with these regulations.
Location Specific					
Federal regulations governing groundwater withdrawals in the Delaware River Basin	18 C.F.R. §§ 430.7, 430.9, 430.13(i)(3)(i), 430.15(b)	Groundwater	Applicable	Governs the withdrawal of water from the Delaware River Basin, where the Site is located.	Wells utilized to undertake groundwater withdrawals at the Site will meet these standards.
Delaware River Basin Commission Standards	18 C.F.R. § 410.1 (language set forth in 1991 MOA)	Groundwater	Applicable	Governs operation of groundwater wells withdrawing water from the Delaware River Basin where Site is located.	Wells utilized to undertake groundwater withdrawals at the Site will meet these standards.

Location-Specific

Groundwater Withdrawal Regulations, 18 C.F.R. §§ 430.7, 430.9, 430.13(i)(3)(i), 430.15(b)(1) and (2), govern the withdrawal of water from the Delaware River Basin. These regulations require groundwater withdrawals to meet certain standards to limit the impact on the Delaware River Basin and are applicable to the groundwater portion of the Selected Remedy.

Delaware River Basin Commission (DRBC), The DRBC has established standards governing the extraction of groundwater from the Delaware River Basin. Pursuant to a Memorandum of Agreement with DRBC, EPA has agreed to acknowledge the following requirements as ARARs.

A. Proposed water withdrawal well(s) shall be equipped with readily accessible capped port(s) and drop pipe(s) so that water levels may be measured under all conditions;

B. Water withdrawal wells shall be metered with an automatic continuous recording device that measures to within five percent of actual flow. Note: a record of daily withdrawals shall be maintained and monthly totals shall be reported to DRBC;

C. If the construction, monitoring, or any other data or information demonstrates that the operation of the water withdrawal well or surface water intake significantly affects or interferes with any domestic or other existing wells, an alternate supply of water or other mitigating measures shall be provided;

D. The operation of a water withdrawal project shall not cause long-term progressive lowering of groundwater levels, permanent loss of storage capacity or substantial impact on low flows of perennial streams.

These standards are incorporated as federal standards through 18 C.F.R. § 410.1, and are relevant and appropriate to groundwater remediation to be undertaken at the Site under the Selected Remedy.

13.3 Cost Effectiveness

In EPA's judgment, the Selected Remedy is the most cost-effective when compared to the overall effectiveness of this alternative against other alternatives. In making this determination, the following definition from the NCP was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." 40 C.F.R. § 300.430(f)(1)(ii)(D). EPA evaluated the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated using the balancing criteria. Three of the five balancing criteria in combination (reduction in

toxicity, mobility and volume through treatment; short-term effectiveness; and implementability) were more favorable to GW2. Therefore, overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of the Selected Remedy was determined to be proportional to its costs and, therefore, EPA has determined it is the most cost effective remedial option. The Selected Remedy is most cost effective pursuant to 40 C.F.R. § 300.430(f)(1)(ii)(D).

13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The Selected Remedy utilizes long-term solutions and treatment technologies to the maximum extent practicable by extracting and treating VOCs from groundwater. The Selected Remedy will not pose unacceptable short-term risks or cause cross-media impacts. In addition, it provides a permanent solution and prevents further migration of contaminants in the aquifer. Of the alternatives that are protective of human health and the environment and that comply with ARARs, EPA has determined that the Selected Remedy best balances trade-offs in terms of the five balancing criteria (long term effectiveness and permanence, reduction of toxicity, mobility or volume of contaminants through treatment, short-term effectiveness, implementability, and cost), while also considering State and community acceptance.

13.5 Preference for Treatment as a Principal Element

The Selected Remedy for groundwater meets the statutory preference for treatment as a principal element, since it treats the groundwater present at the Site.

13.6 Five-Year Review Requirements

The Selected Remedy will not leave hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. However, since the Selected Remedy is a long-term groundwater extraction and treatment will require five or more years to complete, EPA expects to undertake five year reviews as a matter of policy. The first five-year review will be conducted within five years of the initiation of remedial action taken at the Site and will continue every five years thereafter until hazardous substances, pollutants, or contaminants no longer remain on site at levels that do not allow for unlimited use and unrestricted exposure.

14.0 DOCUMENTATION OF SIGNIFICANT CHANGES

Upon considering all comments on the PRAP submitted during the comment period, EPA made significant changes to the remedy selected in this ROD Amendment. As discussed below, these changes impact the final cost of the selected remedy.

The first change to the Selected Remedy relates to the ability to retrofit and optimize the historic pumping of the Recovery Well at OU1. The PRAP included in the preferred alternative that the Recovery Well would be retrofitted and optimized. During the public comment period, it was noted that the Recovery Well is a screened well and not an open

borehole as discussed in the PRAP. The screen in the Recovery Well makes retrofitting infeasible. Therefore, the Recovery Well should be properly closed and a new extraction well should be installed using geophysical analysis and packer testing to target the contaminated fracture(s). The cost of properly closing the Recovery Well is estimated at $8,000. The cost of installing an extraction well to replace the Recovery Well in the first phase of optimizing the extraction system is absorbed by assuming that one of the four extraction wells installed at that time will replace the Recovery Well. Thus, $8,000 was added into the cost estimate for the Selected Remedy.

The second change to the Selected Remedy relates to sediment in the South Central Tributary. The PRAP proposed the excavation and off-site disposal for contaminated sediment. In response to public comment on the PRAP, EPA performed the 2014 Ecological Site Inspection of the South Central Tributary, which revealed significant changes in the ecosystem since the sediment samples were taken 16 years earlier. Based on the 2014 Ecological Site Inspection, EPA has determined that current conditions do not trigger an ecological risk. This change has led to the removal of ARARs pertaining to sediment and a reduction of $131,600 in the Selected Remedy's cost estimate. The revised ARARs are listed in Section 13.2. The revised cost estimate for the Selected Remedy is included in Section 12.3.

The third change is that, based on samples analyzed during the SHHRA, in which 1,2-DCA was not detected, that compound was eliminated from risk calculations and is no longer considered to be a COC at OU1. In contrast, 1,2-DCE, as noted in Table 3 as cis-1,2-DCE and trans-1,2-DCE, is now included as a COC because it is a degradation product of TCE. EPA notes that while 1,2-DCE has not been detected at levels posing an unacceptable risk, it is a breakdown product of TCE and could present an unacceptable risk later during the cleanup.

The fourth change relates to the screening of alternatives for Threshold Criteria – Overall protection of human health and the environment in the PRAP. As stated in the PRAP, MNA (GW4) met the criteria based upon short-term protectiveness of human health and the environment. However, based upon the data available to date, MNA is not expected to meet both the threshold criteria Overall Protection of Human Health and the Environment or Compliance with ARARs in the long term. As stated in Section 10.1 above, "in the long term, the existing data fail to support that GW4 would achieve the RAOs and restore the aquifer to beneficial use at OU1 within a reasonable time frame, as required by the NCP." In the long term, GW4 would rely on ICs to ensure protection of human health and the environment and would be unlikely to restore groundwater to cleanup levels. In Alternative GW4, under future land use scenarios, receptors could be exposed to contaminated groundwater, which could migrate beyond the area of ICs. This scenario could pose a risk to humans using groundwater.

The fifth change relates to the inclusion of 1,1,1-TCA as a COC in the 2014 PRAP. In preparing this ROD Amendment, the EPA toxicologist reviewed the analytical data for North Penn 5 (Former BAE Facility). In the 1980s and 1990s, 1,1,1-TCA was observed in several wells, at varying concentrations. During these early sampling years, the MCL (200 µg/L) for this compound was exceeded in only two wells during a single sampling

round (up to 464 µg/L in April 1982). Since 2010, 1,1,1-TCA has not been detected in either of these wells. More recent sampling rounds (post-2000) revealed a maximum 1,1,1-TCA concentration of 112 µg/L in RI-20S (2002). 1,1,1-TCA continues to be detected in this well, but at much lower concentrations (approximately 11 or 12 µg/L). None of the observed concentrations of 1,1,1-TCA throughout the sampling history at this Site poses an unacceptable risk.

1,1-DCE and 1,1-DCA are both breakdown products of 1,1,1-TCA. As expected, there appears to be a strong positive correlation between wells with hits of 1,1,1-TCA and observations of 1,1-DCE and 1,1-DCA. 1,1,1-TCA is likely the source of 1,1-DCE in groundwater at the site. However, although 1,1-DCE is a COC at the site (due to MCL exceedances), 1,1,1-TCA has not exceeded its MCL since 1982 and it does not present an unacceptable risk under a residential exposure scenario. Therefore, this ROD Amendment does not list 1,1,1-TCA as a COC for this site.

The sixth change relates to the inclusion of contingent remedies with respect to GW2. In order to promote flexibility and cost effectiveness, EPA has retained in-situ chemical oxidation as a contingent remedy in the event that a source area is identified during future site work (e.g., as the result of pre-design investigations, or during the implementation of the selected optimized extraction and treatment remedy). In addition, EPA has also selected enhanced bioremediation as a contingent remedy in the event that the Groundwater Extraction and Treatment System has been optimized to the satisfaction of EPA in consultation with PADEP and contaminant concentrations become asymptotic approaching MCLs. Prior to implementation of bioremediation, a pilot study will be undertaken in order to demonstrate whether bioremediation will be effective in achieving cleanup levels. In the event that a contingent remedy is triggered based on Site conditions, EPA would issue an ESD and so inform the public as required by the NCP, 40 C.F.R. § 350.435(c).

15.0 CONCLUSION

Based on the Administrative Record, EPA hereby has selected the Selected Remedy GW2 Optimized Groundwater Extraction and Treatment and Institutional Controls and Contingent Treatment as supported herein and in the Responsiveness Summary.

III. RESPONSIVENESS SUMMARY

NORTH PENN AREA 5 SUPERFUND SITE
OPERABLE UNIT 1
MONTGOMERY TOWNSHIP, MONTGOMERY COUNTY, PENNSYLVANIA

1. INTRODUCTION

This Responsiveness Summary provides a summary of significant public comments regarding the North Penn Area 5 Superfund Site (the Site, or the NP5 Site) Operable Unit 1 (OU1) Proposed Plan (2014 PRAP) and provides the U.S. Environmental Protection Agency's (EPA) responses to those comments. After reviewing and considering all public comments received during the public comment period, EPA has selected a remedial action in order to address contamination at OU1.

The Proposed Plan and documentation supporting the Proposed Plan were made available to the public in the Administrative Record for the OU1 at http://loggerhead.epa.gov/arweb. In the Proposed Plan, EPA provided notice to the public that the Administrative Record could also be viewed at the following locations:

Lansdale Public Library
301 Vine Street
Lansdale, PA 19446
(215) 855-3228

Montgomery Township Municipal Building
1001 Stump Road
Montgomeryville, PA 18936
(215) 393-6900

Administrative Records Room
US EPA Region 3
1650 Arch Street
Philadelphia, PA 19103
(215) 814-3157 (please call for an appointment)

EPA issued a public notice of availability and brief description of the Proposed Plan in *The Reporter*, a Bucks County newspaper, on August 18, 2014, which described the duration of the public comment period, the date of the public meeting, and the availability of the Proposed Plan and the Administrative Record. In addition, EPA sent a fact sheet summarizing the Agency's preferred remedial alternative for OU1 of the Site to residents near the Site in August 2014. The 30-day comment period began on August 18, 2014 and, after a request for an extension was granted by EPA, ended on October 17, 2014.

EPA conducted a public meeting in Montgomeryville, Pennsylvania to inform local officials, interested citizens, and other stakeholders about EPA's proposed cleanup plan and supporting analysis and information, and the Superfund process, to respond to questions, and to receive comments on the Proposed Plan. The public meeting was held by EPA on September 4, 2014 at the Montgomery Township Building, 1001 Stump Road, Montgomeryville, PA 18936. A transcript of the public meeting has been included in the Administrative Record supporting the ROD Amendment.

This Responsiveness Summary provides a summary of significant comments and new relevant information received during the public comment period and EPA's responses. Section 2.0, below, includes a summary of general comments raised during the comment period and EPA's responses, including those discussed at the September 4, 2014 public meeting. In Section 2.0, the comments have been grouped into the following categories:

- Whether Any Cleanup is Necessary
- Whether the Action Proposed in the 2014 PRAP is Arbitrary and Capricious and Otherwise Not in Accordance with Applicable Law.
- Whether the Cleanup Will Spread Existing Contamination
- Impact of Remedy Construction on Air Quality
- Funding the Remedy

Section 3.0, below, includes EPA's response to all other specific comments received during the public comment period. The original text of the comments can be found in the Administrative Record.

Comments of Blank Rome LLP on behalf of BAE Systems & Cobham Regarding the Proposed Plan for Record of Decision Amendment, North Penn 5 Superfund Site Operable Unit 1, Colmar, Pennsylvania, August 2014, dated 8/14. SEMS document number 2217892.

Letter to Ms. Sharon Fang, U.S. EPA, from Mr. Derek Tomlinson, Geosyntec consultants (Geosyntec), re: Technical comments on Proposed Plan for Record of Decision Amendment, Operable Unit 1, 10/17/14. SEMS document number 2217884.

Report: Comments on the Proposed Plan for Record of Decision Amendment (PRAP) for the North Penn 5 Superfund Site, Operable Unit 1 (NP5 OU1), Colmar, Pennsylvania, August 2014, prepared by Environmental Alliance, Inc., 10/17/14. SEMS document number 2199389.

2.0 GENERAL COMMENTS

2.1 Whether Any Cleanup is Necessary

2.1.1 *Comment:* A commenter requested EPA to withdraw the 2014 PRAP and select a No Further Action Remedy.

EPA Response: The National Contingency Plan (NCP), 40 C.F.R. Part 300, is the set of regulations that govern the selection and implementation of response actions at a Superfund site. The NCP requires that the remedy selected by EPA be based upon the nine criteria set forth at 40 C.F.R. § 300.430(e)(9)(iii). The first two criteria are threshold criteria: (1) overall protection of human health and the environment and (2) compliance with applicable or relevant and appropriate requirements (ARARs). The selected remedy must meet both of these threshold criteria, except when an ARAR waiver is invoked under 40 C.F.R. § 300.430(f)(1)(ii)(C), which is not the case here. In Section 10.0 of the ROD Amendment for OU1 of the North Penn 5 Superfund Site, EPA has determined, based on present Site information, that a No Action Remedy does not meet these threshold criteria and, therefore, cannot be selected.

2.1.2 *Comment:* A commenter requested EPA to withdraw the Site from the National Priorities List (NPL).

EPA Response: According to Section 300.425(e)(1) of the NCP, sites may be deleted from the NPL where no further response action is appropriate. 40 C.F.R. § 300.425(e)(1). In addition, before removing a site from the NPL, EPA must consult with the state and consider whether: (i) Responsible parties or other persons have implemented all appropriate response actions required; (ii) All appropriate Fund-financed response under Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. § 9601, et seq., (CERCLA) has been implemented, and no further response action by responsible parties is appropriate; or (iii) The remedial investigation has shown that the release poses no significant threat to public health or the environment and, therefore, taking remedial measures is not appropriate.

To date, cleanup response actions at the Site have been performed under the direction of the Pennsylvania Department of Environmental Resources (PADER), now the Pennsylvania Department of Environmental Protection (PADEP). EPA has determined, upon consideration of the remedial investigation (RI), that the release at OU1 poses a significant threat to public health and the environment and thus does not meet the criterion of 40 C.F.R. § 300.425(e)(1)(iii), and that the responsible parties or other persons have not yet implemented all appropriate response actions as required by 40 C.F.R. § 300.425(e)(1)(i). Moreover, contamination at OU1 remains above maximum contaminant levels (MCLs) and all cleanup or response actions necessary to address the contamination have not yet been performed under the NCP as necessary pursuant to 40 C.F.R. § 300.425(e)(1)(ii). The 2004 ROD and 2014 PRAP document EPA's evaluation of possible remedial actions to address this contamination pursuant to the NCP. EPA is unable to delete the Site from the NPL until all remedial actions, including the action selected in this OU1 ROD Amendment, are performed as required by the NCP. 40 C.F.R. § 300.425(e)(1)(i) and (iii).

2.1.3 *Comment:* A commenter cited to other EPA Superfund RODs where EPA determined that no further remedial action was appropriate, citing the same contaminants and same geology, and comments that no further remedial action should be undertaken at OU1.

EPA Response: The 2014 PRAP was written relying on site-specific information in accordance with the NCP. See 40 C.F.R. § 300.430(a)(1): "The purpose of the remedy selection process is to implement remedies that eliminate, reduce, or control risks to human health and the environment. Remedial actions are to be implemented as soon as site data and information make it possible to do so." While other site histories, contaminants, concentrations, and geologic formation may be similar, each site is unique. For purpose of this Responsiveness Summary, EPA reviewed the remedial decisions referenced by the commenter and provides a response based on the circumstances of the sites; see response to EA comment 19 under Section 3.0, below; see also *Memorandum to File*, from Ms. Sharon Fang, U.S. EPA, re: Consideration of 17 sites referenced by EA in comment 19 with respect to the North Penn Area 5 Superfund Site Operable Unit 1, 3/16/16. SEMS document number 2217882.

2.1.4 *Comment:* A commenter indicated that there is no significant threat to public health or environment.

EPA Response: The NCP contains an expectation that usable ground waters be returned to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site. 40 C.F.R. § 300.430(a)(1)(iii)(F). EPA has determined that the remedy selected in the ROD Amendment can practicably return OU1 groundwater to its beneficial use within a timeframe that is reasonable given the particular circumstances of OU1 as required by the NCP.

During the 2002 Remedial Investigation (RI), EPA performed a risk assessment, which EPA has relied on to select the remedy in the ROD Amendment. Based on this risk assessment, EPA determined that there was a risk to public health associated with groundwater contamination. Moreover, after issuing the 2014 PRAP, and in response to this public comment, EPA performed a streamlined human health risk assessment (SHHRA) using 2014 monitoring data provided to EPA by Environmental Alliance on behalf of BAE Systems. EPA's 2015 SHHRA confirmed that the potential for unacceptable risk continues to be posed to human health by groundwater at OU1 of the Site. Data from the SHHRA are presented in the ROD Amendment Section 7.1, and the SHHRA is in the Administrative Record for the Site. While the groundwater directly beneath the former BAE facility is not being used currently, the aquifer does provide drinking water to area residents, and the groundwater beneath the former BAE facility is usable groundwater that shall be returned to its beneficial reuse in accordance with the NCP at 40 C.F.R. § 300.430(a)(1)(iii)(F).

The 2003 U.S Geological Survey (USGS) Study, "Aquifer Tests and Simulation of Ground-water flow in Triassic Sedimentary Rocks near Colmar, Bucks and Montgomery Counties, Pennsylvania," showed a hydraulic connection between pumping at North Penn Water Authority (NPWA) wells NP-21/NP-87 and the groundwater at OU1. The report states, "Outside of the immediate area of well NP–87, the greatest drawdowns (7-12 ft) were observed near the BAE Systems facility in wells A–10, BAE Systems supply well, and RW–3. The drawdown confirms

the existence of a good hydraulic connection between NP–87 and wells completed within the deepest part of the geologic units penetrated by the pumped well." NPWA well NP-21, the contamination of which supported the listing of this Site on the NPL, is currently not operational. If NP-21 or NP-87 were to be brought back on line, the risk to human health would be significant.

Although the optimized extraction and treatment remedy could take 30 years or longer to achieve the OU1 Remedial Action Objective (RAO) of restoring the groundwater aquifer to its beneficial reuse by achieving MCLs for Contaminants of Concern (COCs), it is nonetheless a practicable remedy given the conditions at OU1.

2.1.5 *Comment:* A commenter stated that PADEP would concur with a No Action approach since it is consistent with cleanups under Pennsylvania's Act 2.

EPA Response: The North Penn Area 5 Site is not a voluntary cleanup site under PADEP's oversight pursuant to Pennsylvania's Land Recycling and Environmental Remediation Standards Act (often called "Act 2"). Once a site has been listed on the NPL, it is subject to the requirements of CERCLA and the NCP. As discussed earlier, No Action at OU1 does not meet the threshold criteria set forth in 40 C.F.R. § 300.430(e)(9)(iii).

2.1.6 *Comment:* A commenter stated that EPA has deleted sites from the NPL with groundwater contamination present.

EPA Response: EPA may propose an NPL site for deletion when all appropriate response actions under CERCLA, other than operation, maintenance, and five-year reviews, have been completed or when the RI shows that the release poses no significant risk to public health or the environment. See 40 C.F.R. § 300.425(e)(1). To ensure public involvement, EPA must publish a Notice of Intent to Delete in the Federal Register, soliciting public comment for at least 30 days, and must publish a notice of availability of the Notice of Intent to Delete in a major newspaper near the site. After consideration of public comments, and only with the concurrence of the state where the site is located, EPA may delete a site from the NPL. EPA must respond to public comment on the proposed deletion and place the response in the public record. EPA may not delete the Site from the NPL until the requirements of 40 C.F.R. § 300.425(e) are met. Moreover, a site's deletion does not preclude future actions under Superfund. See 40 C.F.R. § 300.425(e)(3),

As discussed earlier, no cleanup or response actions have been performed under CERCLA at the NP5 Site for OU1. EPA's 2002 RI and 2015 SHHRA both determined that site conditions at OU1 pose significant risk to public health. Thus, EPA cannot delete the Site from the NPL.

2.1.7 *Comment:* A commenter suggested referring the Site to PADEP to oversee site closure consistent with CERCLA and other applicable federal and state laws.

EPA Response: Pursuant to CERCLA Section 105(h), 42 U.S.C. § 9605(h), EPA may defer a site to a state voluntary cleanup program only before listing the site on the NPL. As mentioned above, once a site is listed on the NPL, it must be addressed in accordance with the NCP. The

North Penn Area 5 Site is not an Act 2 Site, nor is it PADEP's responsibility to oversee site cleanup consistent with CERCLA. As EPA is selecting optimized extraction and treatment to address OU1 groundwater contamination, site closure is not relevant at this time.

2.2 Whether the Action Proposed in the 2014 PRAP is Arbitrary and Capricious and Otherwise Not in Accordance with Applicable Law.

Comment: A commenter stated that EPA's risk is grossly overstated when no one is currently using the groundwater.

EPA Response: As mentioned in Section 2.1 above, the EPA's 2015 SHHRA, which assessed risk posed by groundwater at the Site based on 2014 monitoring data provided to EPA by Environmental Alliance on behalf of BAE Systems, confirms that the potential for unacceptable risk to public health exists from exposure to contaminated groundwater at OU1.

While the OU1 groundwater is not being used currently, the aquifer is classified as a drinking water aquifer and is expected to be restored pursuant to the NCP. 40 C.F.R. § 300.430(a)(1)(iii)(F).

Comment: A commenter indicated that EPA's statement in the PRAP "…based on three decades of historic groundwater monitoring, contaminant levels are not decreasing…" is incorrect. Between 1980 and 2014, TCE concentrations in the well closest to the TCE release in OU1 (i.e. monitoring well W-1) decreased by more than 99.9%.

EPA Response: The comment takes the PRAP language out of context. See EPA's response to EA Comment 15 under Specific Comments, below.

2.3 Whether the Cleanup Will Spread Existing Contamination

Comment: Commenters expressed concerns that EPA would create more problems by extracting the contamination while conducting cleanup actions than it would if it left the contamination alone. Specifically, the commenters expressed concern that the cleanup would expose area residents to contamination at the Site if there were to be a release from the optimized groundwater extraction and treatment system.

EPA Response: The selected groundwater remedy, Optimized Groundwater Extraction and Treatment and Institutional Controls, is a common method used to clean up contaminated groundwater; the technology and procedures have been tested and are well-established. EPA will ensure that the remedy is designed to prevent releases of contamination into the environment. EPA will also ensure that when the remedy is constructed, appropriate monitoring is conducted and that that secondary containment is in place so contamination is not released into the environment. Based on the available current information, EPA has no reason to believe that construction, operation, and maintenance of the remedy will spread contamination at or from the Site.

2.4 Impact of Remedy Construction on Air Quality

Comment: Commenters asked whether volatile organic compounds ("VOCs") would be released during construction and operation of the remedy, how EPA would determine whether VOCs were being released, and what the Agency would do to protect public health and the environment from any releases.

EPA Response: EPA is required to prevent emissions from leaving the Site during construction of the remedy. The Agency will ensure that the design of the remedy will include specific plans and actions to be undertaken during construction to monitor for VOCs and other contaminants in the air, and specify actions that may be taken should VOCs be detected. Maintaining air quality while cleanup activities are occurring is an ongoing priority and contingency actions will be required in the event of a release of VOCs, which will be detailed in the final design. Additionally, if the public is interested in reviewing the results of air monitoring at OU1, EPA will make them available.

2.5 Funding the Remedy

Comment: Commenters asked a number of questions about how the cleanup will be funded.

EPA Response: Consistent with its "Enforcement First" Policy (Suarez, John Peter and Horinko, Marianne Lamont, *Enforcement First for Remedial Actions at Superfund Sites*, Sept. 2002) (hereinafter, "Enforcement First Policy"), EPA intends that potentially responsible parties ("PRPs") conduct remedial actions whenever possible. If a Region cannot negotiate a timely settlement with PRPs to perform the remedial action at a site, the Enforcement First policy indicates that the Region should issue Unilateral Administrative Orders to all appropriate parties to compel cleanup expeditiously before a Region proceeds with a Fund-financed remedial action. Enforcement First Policy, at page 2.

3. RESPONSES TO SPECIFIC COMMENTS

This section provides responses to specific comments received during the comment period. To the extent that comments received during the public meeting have been responded to in the discussion of general comments in Section 2.0, above, they are not repeated here.

3.1.1 Environmental Alliance (EA) Comment 1: "The 2014 PRAP's reason for the need to amend the 2004 ROD misstates the actual history of the site."

EPA Response: EPA carefully considered all comments, including this comment, and in response EPA took steps as follows which resulted in the confirmation that a remedial action is warranted at the Site:

A. EA cites the particular data point A-12 as being the "genesis of the decision to even consider remedies to treat a source in the overburden/shallow aquifer." The NCP provides that remedial action is triggered by site-specific risk. 40 C.F.R. § 300.430(a)(1) EPA relied upon the risk assessment performed during the 2002 RI as the basis for the

preferred alternative in the 2014 PRAP. After issuance of the 2014 PRAP and in response to a comment by Environmental Alliance for BAE Systems, as noted in Section 2.1 above, EPA performed the 2015 SHHRA using the most recent groundwater monitoring data, which had been provided to EPA in 2014 by Environmental Alliance for BAE Systems. The 2015 SHHRA confirms that unacceptable risk is still posed by groundwater contamination at OU1. Thus, the data presented in the ROD Amendment Section 7.1, and the 2015 SHHRA (which is included in the Administrative Record) reaffirm the need for remedial action at the Site.

B. EPA's 2002 RI/FS and 2003 RI Supplement were relied upon by EPA as a basis for the remedy selected in the 2004 ROD. However, more recent data regarding the Site conditions have become available upon which EPA has relied to select the remedy in the ROD Amendment, including but not limited to, the 2009 pre-design investigation (PDI) report, monitoring data associated with the PDI report, and additional monitoring data collected after the PDI report. The Administrative Record supporting the ROD Amendment contains information supporting EPA's decision to select Optimized Groundwater Extraction and Treatment and Institutional Controls at OU1.

C. EPA has identified operable units for administration of investigation and remedial tasks at the Site based on the size and complexity of the Site and to allow for a phased remedial response. See 40 C.F.R. § 300.430(a)(1)(ii)(A) ("Sites should generally be remediated in operable units when early actions are necessary or appropriate to achieve significant risk reduction quickly, when phased analysis and response is necessary or appropriate given the size or complexity of the site, or to expedite the total site cleanup."). As is recounted in Section 2.0 of the ROD Amendment (Site History), "The [2011 OU2] interim ROD selected enhanced in-situ bioaugmentation to address VOC contamination in the overburden groundwater. Work to implement the remedy selected in the 2011 ROD for OU2 is currently underway." The OU1 ROD Amendment selects a remedy to address contamination at OU1 in light of the 2009 PDI and more recent OU1 Site data. As mentioned above, no cleanup or response actions have been performed under CERCLA at the NP5 Site for OU1.

D. EA's Comment 1 also states that with respect to the PDI the "focus of the PDI was to investigate for DNAPL in deep bedrock, not to address whether it was necessary to perform an in situ oxidation remedy for overburden/shallow aquifer." This comment by EA misconstrues the purpose of the PDI, which was, as set forth in the Administrative Order on Consent (Docket No. CERC-03-2007-0034-DC (December 12, 2006)) (AOC), to broadly "aid in the design, and facilitate the implementation of the remedy" for OU1. At the time, neither EPA nor BAE knew that contamination was isolated to the overburden/shallow aquifer and that there would not be DNAPL present. Therefore, in order to identify a groundwater contaminant source area for the purpose of applying in-situ oxidation, an investigation scope was mutually agreed upon and implemented under the AOC. The PDI ultimately did not identify a groundwater contamination source area. In-situ chemical oxidation typically works most efficiently when the oxidant is applied to the source area, not a diffuse plume. The lack of an identified source area, as set forth in

the PDI, indicates that the in-situ chemical oxidation remedy for OU1 is unlikely to achieve cleanup levels and EPA has determined that the 2004 ROD must be amended.

In addition, the remedy selected in the 2004 ROD included "extraction wells to capture any migration of contaminants from the BAE property and prevent migration beyond the BAE property." EPA notes that the 2004 remedy still calls for pumping to prevent migration, which is consistent with the remedy selected in the ROD Amendment.

3.1.2 EA Comment 2: "The 2014 PRAP represents a material increase in the response actions proposed for OU1, even though EPA now acknowledges that the nature and extent of contamination is less severe than was considered in the 2004 ROD."

EPA Response: The 2014 PRAP restated the RAO set forth in the 2004 ROD, which was, and in the ROD Amendment is, to "restore the groundwater quality in the overburden and the fractured bedrock and to reduce the concentration of contamination in the aquifer to EPA Maximum Contaminant Levels (MCLs) or below for drinking water pursuant to the Safe Drinking Water Act." The preferred alternative presented in the 2014 PRAP and selected in the ROD Amendment is consistent with this RAO, just as the remedy selected in the 2004 ROD was consistent with this RAO.

The sampling undertaken as part of the PDI did not identify any groundwater contamination source areas, which is necessary for the successful application of in-situ chemical oxidation, the remedy selected in the 2004 ROD. In-situ chemical oxidation typically works most efficiently when the oxidant is applied to the source area, not a diffuse plume. Therefore, the in-situ chemical oxidation remedy for OU1 is unlikely to achieve cleanup objectives and EPA is amending the 2004 ROD to select a remedy that is likely to achieve the RAO. As discussed above, recent data continue to demonstrate that Site conditions pose an unacceptable risk and that must be addressed at OU1.

Of the viable alternatives that will remediate OU1 groundwater to MCLs, optimized extraction and treatment can address the contamination with more certainty than the other alternatives, given the current Site data. In addition, in order to promote flexibility, EPA has retained in-situ chemical oxidation as a contingent remedy in the event that a source area is identified during future site work (e.g., as the result of pre-design investigations, or during the implementation of the selected optimized extraction and treatment remedy). In addition, EPA has also selected enhanced bioremediation as a contingent remedy in the event that the Groundwater Extraction and Treatment System has been optimized to the satisfaction of EPA in consultation with PADEP and contaminant concentrations become asymptotic approaching MCLs. Prior to implementation of bioremediation, a pilot study will be undertaken in order to demonstrate whether bioremediation will be effective in achieving cleanup levels. These contingent remedies are intended to streamline the process based on future site conditions.

In addition, pursuant to the NCP, EPA has considered cost as one of the criteria in selecting the remedy. 40 C.F.R. § 300.430(e)(9)(iii)(7). Based upon EPA's analysis presented in the ROD Amendment, Section 12.0 (Selected Remedy), the optimized extraction and treatment remedy is

the most effective alternative that satisfies the threshold criterion of overall protection to human health and the environment, as required by 40 C.F.R. § 300.430(e)(9). In addition, it is likely that the contingent remedies discussed above may reduce the overall cost and time necessary to reach cleanup levels.

3.1.3 EA Comment 3: "There are no existing human receptors to OU1 Groundwater."

EPA Response: The NCP sets forth the expectation that groundwater be restored to its beneficial use for current and future potential receptors. The aquifer underlying the Site consists of a Class II-A aquifer, which provides potable water for the surrounding area. Therefore, the beneficial use for the groundwater at OU1 is drinking water. NPWA water supply wells NP-21 and NP-87 were used for drinking water but were shut down after NP-21 was impacted by contamination from OU1. The Safe Drinking Water Act established MCLs for drinking water, which are an applicable or relevant and appropriate requirement for groundwater at the Site under CERCLA; therefore, the NCP sets forth the expectation that the OU1 groundwater meet MCLs.

EPA relied upon the conclusions of the risk assessment performed during the 2002 RI to identify a preferred alternative. While there is no current use of the contaminated groundwater within OU1, there are residents that currently use the aquifer for drinking water purposes. NPWA well NP-21, which led to the listing of this Site, is currently not operational. However, in the past, the NPWA has contacted EPA to request use of this well. The risk to public health would be significant if NP-21 were to be reinstated as a drinking water supply well. In addition, at present, EPA is not aware of any binding restrictions that would ensure that NP-21 could not be used as a source of drinking water by the NPWA on an emergency or regular basis.

In addition, there could be potential vapor intrusion concerns for structures above or within 100 feet of NP5 OU1. Current information does not indicate a need to assess the vapor intrusion pathway at OU1. However, if additional information obtained during design or cleanup indicates a potential vapor intrusion pathway, an assessment will be performed at that time. If vapor intrusion is determined to pose an unacceptable risk, it will be addressed in a separate action.

3.1.4 EA Comment 4: "The continued 2014 PRAP reference that the shallow groundwater in OU1 contains TCE at a concentration of 1,200 µg/l is not a fair representation of the conditions in OU1."

EPA Response: EPA recognizes that the 1,200 µg/l data point is an outlier in the extensive data values reported for this particular well. EPA acknowledges the variation in the TCE concentrations at the Site in the ROD Amendment Section 5.5: "In the overburden aquifer, concentrations of TCE ranged from 12 µg/l in well A-8 to greater than 1,000 µg/l in well A-12 with median concentrations ranging from 20 to 50 µg/l. The 1,000 µg/l analytical result in well A-12 may be an outlier, however, the information is included as part of the Site history."

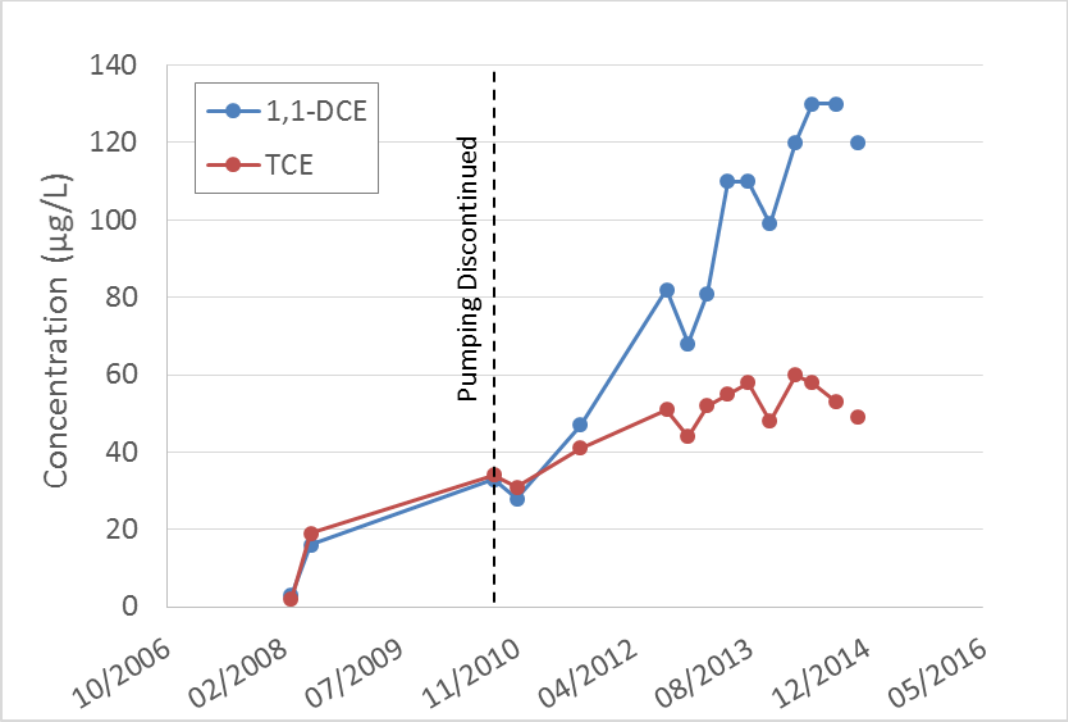
3.1.5 EA Comment 5: "The mass removal rate of the former pump and treat system was already maximized and demonstrates the limited effectiveness of this remedial option."

EPA Response: BAE's historic pumping has not been operational since August 2010 and, prior to that time, was not optimally designed for mass removal and source control. Hydraulic testing conducted by Environmental Alliance during the PDI demonstrated that some of the most contaminated wells at OU1 had a weak hydraulic connection with the extraction wells associated with historic pumping. For example, as part of the PDI, wells RW-1 and the Recovery Well were re-started in March 2008, but showed little or no hydraulic response in well PW-10A.

Additionally, the absence of a change in contaminant levels at MW-5 due to the start of increased remedy pumping in 2004 and the discontinuation of all remedy pumping in 2010, indicates that contaminant mass was migrating around or past extraction well capture zones toward MW-5. If the system had been designed to effectively capture the contaminant mass, the system mass removal rate would likely have been higher and contaminant concentrations at MW-5 would have similarly decreased.

In contrast to well MW-5, contaminant concentrations at PW-9B increased when groundwater pumping was discontinued in 2010. RS Figure 1 (below) shows the TCE and 1,1-DCE concentrations at PW-9B from February 2008 until December 2014. When pumping was discontinued, concentrations of TCE and 1,1-DCE increased at PW-9B, which suggests that groundwater extraction, if effectively designed, can reduce plume concentrations and facilitate restoration of the aquifer. It is not clear, based on the available data, which extraction well most impacted the concentrations at PW-9B, but the system restart test suggests that, of the three extraction wells, RI-20S likely has the strongest hydraulic connection with PW-9B. RI-20S generally operated at less than 1 gallon per minute (gpm) from 2004 through September 2009 and only increased to an average of 3 gpm in 2010 before being shut down in August 2010. PW-9B was first sampled in 2008 and sampling was limited between 2008 and 2010.

RS Figure 1. 1,1-DCE and TCE Concentrations Trends at PW-9B



Additionally, Figure 19 in the Environmental Alliance, *Fourth Monitored Natural Attenuation Report* (2014) (Fourth MNA Report) states, "Capture Zones inferred based on groundwater elevation contours and assuming isotropic conditions." Isotropic, which means that pumping can be expected to influence groundwater equally in all directions, is a faulty assumption in fractured bedrock, which is known to be anisotropic, meaning that preferential pathways through fractures within the bedrock are present. An effectively designed groundwater extraction system would ensure that the capture zones cover all contaminated areas above cleanup levels. The three capture zones identified in the Fourth MNA Report did not provide for complete capture of contaminated groundwater. Specifically, capture was not achieved at certain wells at which data indicate exceedances of MCLs, specifically FOX MW-5, FOX MW-2, W-17, PW-11, PW-8A, PW-8B, W-14, and PW-12. An effectively designed extraction and treatment system would ensure that the capture zones target all contaminated groundwater above cleanup levels.

The 2014 PRAP identified as the preferred alternative, and this ROD Amendment selects, an optimized groundwater extraction and treatment system that will retrofit and install extraction wells to target and capture groundwater where contamination exceeds MCLs. Performance tests will be conducted to ensure that extraction flow rates are optimized and to determine capture zones for each extraction well to ensure all areas of the plume are being treated. In addition, construction and operation of the optimized extraction and treatment system can be phased in through an iterative process to ensure that the appropriate number of wells necessary are installed and that full capture is achieved.

In addition, in EA Comment 5, EA argues that groundwater quality data from the site monitoring wells demonstrates the lack of benefit that pumping groundwater has on achieving remedial action goals in a reasonable timeframe. (p. 23). EA states:

> As documented in the January 26, 2010 *Evaluation of Monitored Natural Attenuation For Operable Unit 1 (OU1) Of the North Penn Area 5 Superfund Site* report, the rate of decline in TCE concentration in well W-1 over the life of pumping from Recovery well (-0.0055 ug/l per day), which is 12 feet away from the Recovery Well, was less than the rate of decline in concentration from a well outside the capture zone of Recovery Well (RW-1, -0.0095 ug/l per day). Thus, the pump and treat system did not provide a measureable increase in the rate of groundwater quality improvement. EA Comment 5, at page 23.

The data at OU1 suggest that the historic pumping wells were poorly connected to the portion of the aquifer with the highest contaminant concentrations. Therefore, historic pumping was ineffective in achieving MCLs throughout the plume. Thus, there can be no determination of the adequacy of the benefit of historic pumping toward the objective of restoring the aquifer to MCLs in those areas of the plume that were not accessed by historic pumping operations. In contrast, an optimized extraction and treatment system would target capture of the entire plume exceeding MCLs.

With respect to the remark about the rate of decline of concentration, it is unclear whether this comparison is meaningful because the wells are not screened over the same portion of the aquifer. The Recovery Well is screened from 4 to 104 feet and RW-1 is screened from 9 to 40 feet.

3.1.6 EA Comment 6: "EPA has acknowledged the limited benefit of Pump and Treat Remedies."

EPA Response: Groundwater remediation is a component of more than 90 percent of active Superfund sites, and achieving groundwater remedial action objectives (RAOs) can take years or even decades. See *Superfund Remedy Report*, 14th Edition. EPA 542-R-13-016 (2013).

In 2014, EPA issued the *Groundwater Remedy Completion Strategy*, OSWER Directive 9200.2-144 (2014) (GRCS). The GRCS was developed by an EPA workgroup to help focus resources toward the efficient and effective completion of groundwater remedies to ensure protection of human health and the environment. The GRCS recommends a step-wise planning and decision-making process for evaluating the design and operation of ongoing groundwater cleanup remedies and evaluating the progress toward attaining site-specific RAOs and associated cleanup levels in a reasonable timeframe. Assessment of the effectiveness of groundwater remediation in accordance with EPA's GRCS should generally be undertaken at CERCLA sites with active and/or passive groundwater restoration remedies. The historic pumping activities at NP5 OU1 were not performed under CERCLA, and the pumping operation was not designed nor operated to achieve mass removal or to remediate contaminated groundwater exceeding ARARs. Optimized extraction and treatment systems often provide data on potential source area(s) and the distribution and reduction of contamination throughout the plume, which allows for the ongoing evaluation of the effectiveness of the remedy.

To understand a site and to develop and evaluate a remedy completion strategy, it is important to have an accurate and up to date conceptual site model (CSM), which accounts for current site and remedy characteristics. EPA, *Environmental Cleanup Best Management Practices: Effective Use of the Life Cycle Conceptual Site Model*. EPA 542-F-11-011 (2011). The site's CSM should be regularly re-evaluated and updated based on more recent data collection and more refined site knowledge. Understanding site-specific conditions related to groundwater contamination fate and transport is typically a dynamic process and usually evolves as cleanup actions are implemented. The reevaluation and updating of the CSM may help resolve any potential uncertainties regarding the remedy's effectiveness and may help to identify key data gaps. The NP5 OU1 CSM should be updated regularly during design, and thereafter as additional monitoring data become available, through a dynamic and iterative process.

The study by the National Academies of Science, *Managing the Nation's Complex Contaminated Sites* (2012) (NAS Study), suggested among other things, the use of transition analyses to decide when to change active groundwater cleanups to long-term management. EPA has reviewed the NAS Study and has considered several of its recommendations. The NAS Study continues the dialogue about how to improve and advance groundwater remediation approaches. Before the NAS Study was released, EPA had already begun the process of

evaluating and updating Superfund groundwater policy. For example, EPA incorporates into the GRCS the following concepts that are also included in the NAS Study:

- Planning ahead to ensure that data collection will support decision making,
- Recognizing that timely evaluation of monitoring data is key to determining if a remedy is working effectively, and
- Considering an approach consistent with an adaptive management approach including remedy optimization opportunities and remedy modifications based upon evaluation of monitoring results.

BAE pumped the Recovery Well from 1986 to 2010 and began pumping two additional monitoring wells from 2004 to 2010. To date, BAE's historic pumping activities have been ineffective at meeting MCLs and at controlling plume migration. For some wells, such as PW-1, the inability of historic pumping to meet MCLs may be due to matrix diffusion. However, for PW-9B, PW-10A, RI-20S, PW-11, MW-5, and other wells, the failure to reach MCLs appears to be due to an ineffective design, which led to the incomplete capture of contaminants.

An effectively-designed extraction and treatment system can address contaminants to meet MCLs in a groundwater plume. EPA's analysis of alternatives concluded that injection remedies are unlikely to be effective because no source area has been identified at OU1, and BAE's MNA study did not indicate that the contamination is attenuating naturally. Thus, EPA has selected Optimized Groundwater Extraction and Treatment and Institutional Controls in the ROD Amendment because, in relevant part, it directly removes VOCs dissolved in the groundwater and treats the contamination prior to discharge. ICs will protect human health by restricting the use of and access to contaminated groundwater until groundwater is cleaned up. The selected remedy meets the threshold criteria set forth in the NCP, 40 C.F.R. § 300.430(e)(9)(iii)(A) and (B), and best balance the criteria in the NCP, 40 C.F.R. § 300.430(e)(9)(iii)(C) through (I), as discussed in ROD Amendment Section 12.1.

As described in Section 2.1 herein, the NCP at 40 C.F.R. § 300.430(a)(1)(iii)(F) sets forth the expectation that groundwater be restored to its beneficial use, contrary to the comment, which states that requiring extraction and treatment for groundwater "to which humans have no present exposure is not reasonable." (EA Comment 6 at page 27.) In the case of NP5 OU1, the beneficial use of the aquifer is for drinking water.

3.1.7 EA Comment 7: "The technical literature provides the basis for why the restoration times for groundwater in fractured bedrock are long, regardless of the remedial technology used."

EPA Response: The summary for Comment 7 states the physical limitations of the aquifer will prevent any substantial improvement to groundwater beyond natural attenuation. The data at OU1 suggest that the historic pumping wells were poorly connected to the portion of the aquifer with the highest concentrations of contamination. Therefore pumping system activities to date have been ineffective due to the system design limitations and, once an extraction and treatment system is optimized, the specific factors influencing the longevity of the plume will be determined based on the data gathered.

The summary for Comment 7 also states further containment is no longer necessary as the plume is no longer expanding or increasing in concentrations at the center or at its perimeter. Data presented in Fourth MNA Report do not support this statement. For example, concentrations at PW-9B, RI-20S, and RW-1 have increased since remedy pumping was discontinued in 2010. In addition, the migratory path of the plume is unclear; therefore these conclusions made regarding plume migration are unsupported by the data.

As discussed in the literature, diffusion-limited remedial processes may result in long restoration time frames, particularly for source areas or where contaminant concentrations were very high for long periods of time. Restoration of groundwater to MCLs in areas outside of a source zone can occur in a timelier manner than in the source or near-source areas, as long as there is effective source control. This concept could apply to groundwater in the vicinity of wells in or near the former UST source area where concentrations of TCE were over 5,000 µg/L. However, generally speaking, downgradient of any source area, where concentrations were lower, the amount of contaminant mass diffusing into bedrock primary pore space generally would be lower, therefore reducing the amount of contaminant mass and mass flux that would able to diffuse back into bedrock fractures.

The extent of the area impacted with high concentrations (for example, above 5,000 µg/L) at NP5 OU1 has never been fully delineated. While historical groundwater contaminant data showed that these relatively high levels have been observed as far away from the former UST area as A-11, which is more than 100 feet (ft) from the former UST, the extent of these high concentrations was not delineated. It is also important to note that the monitoring data for NP5 OU1 presented in the Fourth MNA Report suggest that an additional, unidentified source of contamination may be present at OU1. In summary, present information suggests that the lack of progress toward aquifer restoration in the diffuse plume through the operation of historic pumping is due to (1) inefficient system design, (2) a lack of appropriate performance monitoring data, and (3) the likely presence of an additional unidentified secondary source area. Therefore, the period of time over which non-optimized historic pumping has operated is not indicative of whether or not an optimized extraction and treatment system will restore the aquifer over a reasonable amount of time.

For the first 18 years of historic pumping, groundwater was extracted from the Recovery Well, which was screened from 4 ft below ground surface (bgs) to 104 ft bgs. However, data collected from PW-1 and PW-5, which are in the vicinity of the Recovery Well, during packer testing in 2008, demonstrate that contamination in that area is primarily limited to approximately 10 ft to 50 ft bgs. EPA believes that TCE concentrations at deeper intervals as observed in PW-1 and PW-5, were biased by contamination from the shallower intervals. The Recovery Well therefore pumped mostly clean water from deeper intervals. For most of this 18-year period, the only significantly impacted bedrock monitoring wells were W-1 and RW-1, which were likely within the Former UST Source Area or near the Former UST Source Area. With the exception of RI-20S, which was installed in 1998, there were no contaminated bedrock wells downgradient of the Former UST Source Area or RW-1 to demonstrate concentration decreases and to help delineate the source area or areas near those areas.

Extraction was initiated at RW-1 and RI-20S in 2004, but no bedrock monitoring wells were installed to evaluate their performance. MW-5 was the only well available, but this single downgradient well was not sufficient to comprehensively evaluate historic pumping performance in this complex setting. Data from MW-5 demonstrated poor performance of the extraction system with respect to migration control. Monitoring well installation and hydraulic testing during the PDI provided information about hydraulic connections or lack of hydraulic connections between extraction wells and monitoring wells, offering some explanation as to the reason for poor system performance. However, this information was not used as a basis to improve system design. Groundwater monitoring was limited between 2008 and 2010, and pumping was discontinued in 2010.

MW-5, RI-20S, PW-10A and other wells continue to have elevated concentrations of TCE and 1,1-DCE. As shown in RS Figure 1 (above), concentrations at PW-9B have increased since 2010, suggesting that pumping had reduced concentrations at that area. Unfortunately, PW-9B and other recently installed bedrock monitoring wells were not installed earlier, which, through sampling, would have allowed for the identification of concentrations trends during pumping.

Finally, 1,1-DCE is generally not present or is present at very low concentrations (3 µg/L or less) in the area near the former UST. Rather, the highest 1,1-DCE concentrations are at PW-9B, PW-10A, and RI-20S which are not near the former UST area, which suggests a different, unidentified source of 1,1-DCE. The co-location of elevated TCE concentrations with the 1,1-DCE suggests that this unidentified source could also likely to be a source of TCE. TCE from this unidentified source could be the primary contributor to persistent TCE concentrations that are observed in many OU1 monitoring wells.

3.1.8 EA Comment 8: "EPA has accepted the realities of the conclusions in the literature and applied these concepts to sites with the same contaminants in the same bedrock as at NP5 OU1."

EPA Response: EPA Region 3 has consistently implemented extraction and treatment systems at sites with contaminated groundwater in fractured rock. The efficacy of the individual systems at sites is based on many factors, including but not limited to, the physiochemical properties of the individual chemicals, the effectiveness of source characterization and control, plume delineation, hydrogeologic controls, and site access. Past experience demonstrates that the appropriateness of using extraction and treatment technology is based on site-specific conditions.

The comment references the 2012 ROD for OU3 of the Cornell Dubilier Site (CDE OU3) in New Jersey, which addresses TCE contamination in fractured Triassic sedimentary rock similar to NP5 OU1. The CDE OU3 ROD waives certain applicable or relevant and appropriate requirements (ARARSs) due to technical impracticability and selects monitoring and institutional controls rather than other remedial approaches. One of the remedial approaches considered at the CDE OU3 site included source control with an extraction and treatment system with the goal of restoring the aquifer downgradient of the source control area. Two areas for source control were considered: areas where groundwater contamination exceeds 25,000 µg/L and areas where groundwater exceeds 2,500 µg/L. Modeling conducted during the CDE Remedial Investigation demonstrated that controlling either of these areas would not appreciably improve groundwater quality downgradient of the control area.

There are several key differences to consider between the site conditions at CDE OU3 and NP5 OU1. See *Memorandum to File*, from Ms. Sharon Fang, U.S. EPA, re: Consideration of 17 sites referenced by EA in comment 19 with respect to the North Penn Area 5 Superfund Site Operable Unit 1, 3/16/16. SEMS document number 2217882, and *Letter* to Ms. Sharon Fang, U.S. EPA, from Ms. Misty Kauffman, HGL, re: Technical Assistance for Response to Comment #19, Comments on PRAP for OU1, dated October 17, 2014, 3/31/16. *P. 2199397.*
for more information. EPA notes here the following differences which are of particular note in response to this Comment 8:

- Groundwater concentrations at NP5 OU1 are significantly lower than those at CDE OU3. Generally speaking, original contaminant concentrations are directly proportional to the amount of contaminant that diffuses into the rock matrix, and the contaminant mass in the rock matrix directly influences the magnitude and longevity of future groundwater contaminant concentrations. Therefore, the lower concentrations at NP5 OU1 provide a substantially higher chance of reaching MCLs than the higher concentration conditions at CDE OU3.
- The NP5 OU1 data suggest that there may be another unidentified source of contamination causing the 1,1-DCE and TCE concentrations at several monitoring wells. Treating or controlling this source has the potential to substantially reduce concentrations downgradient of the source and allow for timely restoration of the dissolved plume.
- The NP5 OU1 data suggest that historic pumping wells were poorly connected to the portion of the aquifer with the highest contaminant concentrations and, as a result, historic pumping to date has been ineffective. Therefore, past effectiveness of the historic pumping cannot form the basis to conclude that meeting MCLs at downgradient wells is technically impractical.

In conclusion, the site conditions and remedial options presented by NP5 OU1 are not the same as those present in CDE OU3. CDE OU3 should not serve as a paradigm to remediate NP5 OU1.

3.1.9 EA Comment 9: "The 2014 PRAP does not consider the negative impacts of the P&T Remedy."

EPA Response: EA comments that EPA should select a remedy that is just as protective as extraction and treatment but would use less energy; the comment proposes MNA as an alternative remedy. In Section 10.1 of the ROD Amendment, EPA explains why MNA is not protective of human health and the environment as a remedy at OU1. The NCP requires that the remedy selected by EPA be based upon the nine criteria set forth at 40 C.F.R. § 300.430(e)(9)(iii).

In EPA's *Superfund Green Remediation Strategy*, OSRE and OSRETI (2010) (SGRS), EPA recognizes "that much can be done to conserve natural resources, minimize waste generation, and reduce energy consumption, consequently improving environmental performance of Superfund activities while fulfilling our mission to protect human health and the environment." SGRS, at i. Consistent with the Superfund Green Remediation Strategy, EPA encourages the

PRPs to consider methods to perform the selected remedy in a manner that reduces the environmental impacts of the remedy. For example, if the PRPs exercise sufficient control over the OU1 property for purposes of implementing the remedy, they could utilize a form of renewable energy such as solar panels. In the alternative, the PRPs could consider purchasing green electricity or credits. EPA's expectation is that these potential actions will be considered during the remedial design and remedial work plan for the remedy at OU1 as selected in the ROD Amendment.

3.1.10 EA Comment 10: "There are lines of evidence to support the use of MNA at OU1."

EPA Response: As noted in EPA's technical document, *Use of Monitored Natural Attenuation at Superfund, RCRA Correction Action, and Underground Storage Tank Sites*, OSWER Directive 9200.4-17P (1999) (hereinafter, "MNA Directive"), there are several expectations with respect to the selection of MNA as a remedy. EPA noted in its MNA Directive: "In general, the level of site characterization necessary to support a comprehensive evaluation of MNA is more detailed than that needed to support active remediation." MNA Directive, at page 13. EPA's MNA Directive states that, for MNA, "Site characterization should include collecting data to define (in three spatial dimensions over time) the nature and distribution of contaminants of concern and contaminant sources as well as potential impacts on receptors." MNA Directive, at page 14.

EPA received numerous comments during the public comment period in response to the 2014 PRAP regarding historic pumping. To ensure that it would provide a comprehensive response to the public, EPA performed a third party optimization review of BAE's historic pumping entitled, "Treatment System Optimization Review for North Penn 5, OU1 Site," February 2015 (hereinafter, "Optimization Review"). The Optimization Review states, "OU1 data interpretation and depiction in recent documents does not fully consider the three-dimensionality of the OU1 site." Optimization Review, at page 4-1. EPA expects that source control measures will be evaluated for all sites under consideration for any proposed remedy (MNA Directive, at page 2). With respect to OU1, present data support the possibility that a secondary source of contamination is present. Second, EPA expects that sites where the contaminant plumes are no longer increasing in extent, or are shrinking, would be the most appropriate candidates for MNA remedies (MNA Directive, at page 18). MNA should not be used where such an approach would result in plume migration. (MNA Directive, at page 18). As presented in Section 10.1 of the ROD Amendment, and based on the October 2014 Fourth MNA Report, OU1 data indicate increasing concentrations and that the plume boundaries have not yet been adequately delineated for purposes of evaluating plume stability. Third, when relying on natural attenuation processes for site remediation, EPA expresses a clear preference for those processes that degrade or destroy contaminants. (MNA Directive, at page 3.) In response to a request by EPA Region 3, EPA's Office of Research and Development (ORD), Groundwater Technical Support Center, reviewed comments submitted to EPA by EA on behalf of BAE Systems during the public comment period, BAE's Fourth MNA Report, and other documents. In a memorandum to EPA Region 3 dated March 5, 2015, ORD confirmed, "[t]he available data do not appear to indicate the presence of biogeochemical conditions that would readily support extensive and rapid destruction of the contaminants." *Memorandum from David S. Burden, Ph.D., Director,*

Groundwater Technical Support Center, ORD to Sharon Fang, RPM, EPA Region 3, at page 3 (March 5, 2015).

EPA does not believe that present evidence demonstrates that the three expectations of the MNA Directive are met at NP5 OU1. Even if the site conditions did meet those expectations, to determine the potential efficacy of MNA as a remedial alternative, EPA has also evaluated the three lines of evidence as follows: MNA Directive, at page 16.

First, the MNA Directive states that historical groundwater data should statistically demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring or sampling points. MNA Directive at page 16. Although contaminant concentrations in several wells have declined substantially since initial sampling in the 1980s, contaminant concentrations at several locations persist at levels more than an order of magnitude above MCLs and are not further declining. For example, concentrations of 1,1-DCE and TCE at MW-5 and PW-10A have not shown a decreasing trend. At PW-9B, RI-20S, and RW-1, concentrations have increased since pumping was discontinued in 2010. The concentration increases at RI-20S and RW-1 are likely because these wells were operating extraction wells. Post-pumping concentrations at these two wells are similar to pre-pumping concentrations. The increases at PW-9B, however, are likely the result of contamination that is no longer being captured by pumping (which indicates that pumping was partially effective at remediating groundwater contamination in the direction of PW-9B). Therefore, in addition to the presence of contaminants in concentrations that are not decreasing at some wells, contaminant concentrations are actually increasing in at least one monitoring well. OU1 data indicate that contaminant concentrations are increasing and that the plume boundaries have not yet been adequately delineated for purposes of evaluating plume stability. The migratory path of contamination is not defined in some directions, including west of MW-5 and northwest of PW-9B. Given the lack of the contaminant concentration decreases at several wells (such as MW-5, PW-10, RI-20S, and RW-1), the increase of contaminant concentrations at PW-9B, and the lack of a defined migratory pathway, the first line of evidence to support MNA has demonstrably not been met.

The second and third lines of evidence are based on hydrogeologic and geochemical data that can be used to demonstrate through field or microcosm studies the particular types of natural attenuation processes active at the site, the rate at which such processes will reduce contaminant concentrations to required levels, and the ability of those processes to degrade site COCs. EA Comment 10 cites to EPA's Interim MNA Directive, EPA, *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, OSWER Directive 9200.4-17 (1997), to support its position that MNA is an appropriate remedy if any one of the three lines of evidence is present. However, 1999 MNA Directive, which superseded the 1997 Interim Directive in 1999, expressly prefers MNA as a remedy when both MNA processes degrade or destroy contaminants and when site conditions indicate that contamination is not migrating. EA's comment 10 indicates that the plume at NP5 OU1 "is stable and appears to be decreasing." (EA comment at page 42.) The 1999 MNA Directive states that "sites where the contaminant plumes are no longer increasing in extent, or are shrinking, would be the most appropriate candidates for MNA remedies." (1999 MNA Directive at page 18). However, based on its review of the 2014 Fourth MNA Report, EPA finds that concentrations are in fact increasing in well 9B, which is located at the edge of the presently-

identified plume, an indication that the plume is moving and not shrinking. Moreover, the plume could be migrating in areas where complete delineation has not yet taken place. EA's Comment 10 does not argue that MNA processes are present that degrade or destroy contaminants, and from the data of 2014 Fourth MNA Report, EPA concludes that such conditions are not present in groundwater at NP5 OU1.

3.1.11 EA Comment 11: "EPA does not acknowledge that an MNA pilot study has been on going at the Site."

EPA Response: EA's Comment 11 quotes the 2014 PRAP's description of the Alternative GW4, MNA, which included the requirement to undertake a pilot study and performance monitoring, if the alternative were selected in the ROD. The description of the MNA alternative in the PRAP should not be interpreted as EPA's failure to acknowledge that BAE has collected data from August 2010 to the present under its voluntary pilot study. In fact, EPA has included documentation regarding BAE's pilot study in the Administrative Record and relies on the monitoring data presented therein as part of the basis for the preferred alternative presented in the 2014 PRAP and selected in the ROD Amendment.

In 2010, on BAE's own initiative, BAE ceased pumping and instead began to implement a voluntary MNA pilot study. BAE, however, has not collected data for all the parameters that EPA would typically collect and analyze to evaluate the effectiveness of a MNA remedy. Some of these parameters are listed in Section 9.2 of the 2014 PRAP, and include VOCs, geochemical indicators of transformation processes (e.g., oxidation-reduction potential, dissolved oxygen, pH, nitrate, iron (II), sulfate, methane, ethane, ethene), and hydrogeologic parameters.

Further, in its Fourth MNA Report, BAE concludes that contamination is decreasing; however, EPA finds that the conclusion is inconsistent with the data presented in the report. In fact, data demonstrate that contamination levels at certain monitoring points are steady and even increasing. Refer to EPA responses to EA Comments 10, 12 and 15, which provide details for specific wells where this is the case.

3.1.12 EA Comment 12: "EPA has not demonstrated that the P&T remedy selected in the 2014 PRAP provides any material benefit over a natural attenuation remedy."

EPA Response: The comment incorrectly states that "the groundwater plume has been demonstrated to be stable or decreasing- therefore, P&T is not necessary to control plume migration." Based on the review of data from BAE's Fourth MNA Report, OU1 groundwater contamination is not decreasing throughout the plume. As described in greater detail in EPA's response to EA Comment 15, below, contamination at specific wells is steady or increasing. In addition to chemical oxidation, the remedy selected in the 2004 ROD also included "extraction wells to capture any migration of contaminants from the BAE property and prevent migration beyond the BAE property." Since the source area(s) contributing to current contamination in the OU1 plume has not been identified and the requirement has not been modified by this ROD Amendment, pumping to prevent migration continues to be a component of the selected remedy for OU1.

At EPA's request, HydroGeoLogic, Inc. conducted a third-party optimization review of the investigation and remedial activities undertaken at NP5 OU1. The Optimization Review presents the analysis of the groundwater data generated during historic pumping at OU1 and the conceptual site model, and concludes that "there is likely a secondary source, the plume is not currently delineated to the extent to select MNA, and contamination likely continues to migrate." EPA's evaluation of the remedial alternatives determined that the preferred alternative in the 2014 PRAP, Optimized Groundwater Extraction and Treatment and Institutional Controls (GW2), is the best alternative to mitigate contaminant migration and promote aquifer restoration within a reasonable timeframe. EPA's response to Comment 10, above, and Section 10.1 of the ROD Amendment presents the reasons why EPA has concluded that MNA is not an appropriate remedy for NP5 OU1. In the event that monitoring data or other evidence collected in the future demonstrates that site conditions necessary to trigger the in-situ contingent remedies are present, EPA will document the application of those remedies at that time. In addition, if monitoring data or other evidence collected in the future demonstrates that MNA could adequately address long term risk associated with groundwater contaminants at OU1, EPA may consider a change in the selected remedy at that time.

3.1.13 EA Comment 13: "EPA has no basis to dismiss the "Utility" of the data from wells PW-11, PW-12, PW-13, & PW-14."

EPA Response: The accuracy and utility of information derived from PW-11, PW-12, PW-13, and PW-14 could be significantly improved with packer testing, which allows various fractures and/or fracture zones within a borehole to be isolated and contaminated groundwater from those intervals to be sampled without mixing with groundwater from other portions of the borehole. Since these wells did not undergo geophysical or packer testing, specific water-bearing fractures were not targeted in well construction. Therefore, well sample results taken from the wells represent an average of contaminant concentrations across all fractures intersecting each individual well. Furthermore, samples drawn from these four wells are of limited utility to determine the extent of contamination since the results represent a flow-weighted average contamination concentration from multiple water-bearing fractures of various concentrations, some of which could be significantly higher or lower than the reported sampling results.

For example, data from PW-11 confirm that TCE and 1,1-DCE are present in this location at concentrations of at least 50 µg/L and 40 µg/L, respectively. However, the concentrations detected at PW-11 and these other wells could be diluted by relatively cleaner groundwater. These wells are comprised of open boreholes with an open interval from approximately 20 ft bgs to 80 ft bgs, and groundwater samples from PW-11 have been taken from across the entire span at one time. There is an upward gradient at other wells near PW-11, such as PW-10A/B and PW-8A/B, and contaminant concentrations are lower in deeper water in those wells. As a result, the concentrations in PW-11 across a narrower interval (perhaps 20 ft bgs to 50 ft bgs) might be significantly higher if isolated through packer testing.

EA Comment 13 refers to packer testing conducted at other PW-series wells. The packer testing at PW-1 and PW-5 suggests contamination is higher in shallower depth intervals. Although contamination was present in the deeper-isolated intervals of those wells, the packer testing demonstrated hydraulic communication between those isolated deeper intervals and the

shallower intervals, indicating that shallow contamination was drawn down during sampling. Sampling of some PW well clusters also provides evidence of contaminant stratification. For example, the contaminant concentrations in PW-10A are approximately an order of magnitude higher than in its deeper counterpart, PW-10B. By contrast, contaminant concentrations at PW-9A are significantly lower than the contaminant concentrations at its deeper counterpart, PW-9B. Contaminant concentrations at other PW clusters (PW-6A/B, PW-7A/B, and PW-8A/B) are generally similar across the shallower and deeper intervals but are significantly lower than the concentrations detected at PW-11. Packer testing PW-11 through PW-14 and possibly converting these open boreholes into screened monitoring wells may improve the understanding of hydraulic connections between fractures and improve future performance monitoring data.

EA comment 13 also points out an error in the 2014 PRAP, in which EPA stated that the depth of wells PW-11 through PW-14 range from 13 to 19 feet bgs. EPA notes that this discrepancy was due to a clerical error and did not reflect EPA's understanding of those wells at any time. The top of the borehole for each of the wells is located at a depth of 13 to 19 feet bgs. EPA agrees with the commenter that the depth of the wells is 80 feet. The ROD Amendment has been updated to correct this.

3.1.14 EA Comment 14: "EPA's suggestion to raise the bottom of the Recovery Well to 80 feet is inconsistent with its construction."

EPA Response: The proposed plan discusses raising the open interval of the Recovery Well to 80 feet to draw groundwater from the more contaminated shallow aquifer. However, after consideration of the comment, EPA believes that installation of a new, shallower recovery well in the Former-UST area would be more appropriate, rather than raising the bottom of the Recovery Well, for the reasons indicated in EA's Comment 14. That is, the Recovery Well boring log indicates that it is a PVC-cased well with pea gravel between the casing and native material. Grouting the well would not necessarily eliminate the hydraulic connection that is likely present in the pea gravel.

Since it is not feasible to reconstruct the current Recovery Well, the ROD Amendment states that "the removal of groundwater COCs would be more efficient by closing the Recovery Well and installing a properly designed extraction well to target the contaminated, shallow bedrock aquifer" in the vicinity of the former Recovery Well.

Additional geophysical analysis to determine the proper well specifications is necessary before installing a new well to replace the Recovery Well. The appropriate total depth of a new well to target contaminated groundwater may be shallower than 80 ft bgs.

In addition, EA argues that the continued ineffectiveness of utilizing P&T as a remedy for OU1 going forward is documented by the historic data from well W-1. EA Comment, p. 48. EA further states that from "the data discussed above and presented in other reports, it is clear that the effect of pumping at Recovery Well on surrounding groundwater quality has been maximized, lingering concentrations reflect the diffusion limitations of the bedrock, and these limitations cannot be overcome by any optimizing of the Recovery Well, or any other well." EA Comment, p. 48.

As discussed earlier, the data at OU1 suggest that the historic pumping wells were poorly connected to the portion of the aquifer with the highest contaminant concentrations. Therefore, historic pumping was ineffective in achieving EPA's remedial action goals throughout the plume. Thus, the comment that continued ineffectiveness of utilizing P&T as a remedy is without basis until those areas of the plume that were not captured by historic pumping operations are addressed by an appropriately designed extraction and treatment system that would target capture of the entire plume exceeding MCLs.

The Recovery Well should be plugged and abandoned to eliminate the hydraulic connection between shallow and deep bedrock. Replacement of a well in this location will be determined during the design of the optimized extraction and treatment system.

3.1.15 EA Comment 15: "The 2014 PRAP's suggestion that contaminant levels are not decreasing is not supported by the record or data for the Site."

EPA Response: The EA comment takes the PRAP language out of context. The statement in the PRAP, "*Based on three decades of historic groundwater monitoring, contaminant levels are not decreasing, it is expected that groundwater contamination would remain at current levels and not meet cleanup levels. . .*" was made in connection with screening the MNA remedy to achieve chemical-specific ARARs.

The data shows that the past activities, notably the UST removal and soil excavation activities, reduced groundwater concentrations in the Former UST Source Area by more than 80 percent.

Based on review of the data contained in BAE's Fourth MNA Report, TCE and 1,1-DCE contamination persists at concentrations greater than 100 µg/L in the OU1 plume. This indicates that BAE's voluntary historic pumping may not have been properly designed to target contaminated fractures and provide adequate capture of the plume. In addition, there could likely be a secondary diffusive source of TCE contamination remaining in the subsurface and an additional, as of yet unidentified, source of 1,1-DCE and likely TCE, that is causing persistent groundwater contamination. Review of hydraulic testing data suggests multiple contaminant migration pathways that were not previously identified in the CSM. These pathways might be hydraulically isolated from each other which could result in a pumping system that is not appropriately configured to control additional contaminant sources.

Since historic pumping was discontinued in 2010, contaminant trends do not indicate that groundwater will decrease to MCLs. Please refer to RS Figure 1, above, which shows a clear trend of increasing concentrations at well PW-9B. At wells MW-5 and PW-10A, concentrations have varied during the monitoring period, but overall have remained about the same since 2003 and 2008, respectively.

Also, Comment 15 seeks to cite natural attenuation processes at work in well W-4 in the vicinity of OU2. EA refers to its Figure 5 to demonstrate that TCE concentrations increased and then subsequently decreased after 2003. No data is provided to support EA's position that natural

attenuation caused this decrease. The current monitoring network is not adequate to determine whether the change in TCE concentrations in W-4 was simply due to plume migration.

3.1.16 EA Comment 16: "EPA has not established a proper record for the remedy selected for the sediments (SD2)."

EPA Response: In response to public comment, EPA conducted a Site inspection in 2014 to observe existing conditions. EPA has determined that, although copper and cadmium present in sediment in 1998 could have posed risk to ecological receptors based on 1998 ecological conditions at the Site, conditions observed by EPA in 2014 indicate that sediment accumulation and exposure to ecological receptors is spatially limited. The sediment samples from 1998 are no longer representative and the bioavailability of any residual contamination has likely been sufficiently reduced by the presence of organic material in areas of sediment deposition in the existing wetland. Therefore, EPA has concluded that copper and cadmium do not pose unacceptable risk to ecological receptors under the current Site ecological conditions. EPA is no longer proposing a remedial action for this media.

3.1.17 EA Comment 17: "The justification in the 2014 PRAP that the sediment remedy is required to protect birds is not warranted."

EPA Response: As described above, EPA has concluded that copper and cadmium do not pose unacceptable risk to ecological receptors under the current Site ecological conditions.

3.1.18 EA Comment 18: "EPA is not requiring any remedial actions for the HTMA property that the Ecological Risk Assessment identified as presenting an ecologic risk."

EPA Response: The 2004 ROD for OU1 and OU3 states, "As part of this remedy, additional investigation and evaluation of the former ash disposal area should be performed to delineate the extent of elevated contaminants and to evaluate the possible remediation for that section of the facility." The HTMA property is part of OU3, not OU1. EPA is currently in the design phase for OU3.

3.1.19 EA Comment 19: "EPA has discretion in the remedies selected at Superfund sites. This includes remedies that involve treating Principal Threats and not providing active treatment of the diffuse groundwater plume, remedies that only require Natural Attenuation, and remedies that acknowledge that it is technically impractical to achieve MCLs (or combinations of these remedies)." Seventeen specific Superfund sites are cited in this comment.[1]

[1]EPA notes that one commenter stated that "[i]f EPA does not agree that a No Further Action alternative is appropriate for OU-1, we respectfully request the right to supplement the Administrative Record to submit a list and summary of other sites around the United States where EPA has not required remediation of all groundwater contamination to achieve MCLs." In addition to considering voluminous comments received during the public comment period, including over 52,000 pages from the commenter, EPA has continued to consider in good faith and include in the Administrative Record comments received by the commenter after the close of the comment period until the date of the issuance of the ROD to ensure that the remedy is selected based on the Administrative Record as a whole, including the most recent information submitted to EPA.

The commenter requests that, based on the particular remedy selected for OU-1, EPA accept further documents to the Administrative Record after the ROD is signed. Pursuant to 40 C.F.R. § 300.815(d), "[d]ocuments generated or received after

EPA Response: EPA is bound by CERCLA, as amended, and the NCP. Remedies at other sites, including the 17 sites referred to by the commenter, were selected by EPA by evaluating an array of remedial alternatives against the NCP criteria. 40 C.F.R. § 300.430(e)(9)(iii). Each site has its own history, site-specific data, and unique conditions and considerations. Therefore, although EPA considers remedies selected at other sites, EPA is required to evaluate alternatives against the criteria in the NCP, See 40 C.F.R. § 300.430(f) and 40 C.F.R. § 300.430(e)(9)(iii), based on the specific conditions presented at each Superfund site. Throughout various comments, including in reference to specific sites in Comment 19, the commenter references the application of institutional controls and groundwater monitoring at sites with contaminated groundwater. Pursuant to the NCP at 40 C.F.R. § 300.430(a)(1)(iii)(D), EPA relies on the use of institutional controls to supplement engineering controls to prevent current and future potential exposure until groundwater remedies reach cleanup levels. Groundwater monitoring is an integral part of ensuring the effectiveness and protectiveness of groundwater remedial actions. The selected groundwater remedy in the NP5 OU1 ROD Amendment incorporates institutional controls and monitoring appropriately with engineering controls and treatment in accordance with the NCP.

To date, no cleanup has been implemented under CERCLA at OU1. Since groundwater contamination continues to pose a risk at the Site (See ROD Amendment, Section 7.0), EPA must select and implement a remedy by evaluating remedial action alternatives against the nine criteria in the NCP at 40 C.F.R. § 300.430(e)(9)(iii).

EPA has considered the 17 sites referenced by the commenter and disagrees with the Commenter's assertion that the decisions made in the past with respect to those 17 sites dictate any specific course of action at NP5 OU1, such as the selection of natural attenuation or a finding of technical impracticability to meet MCLs. Every site has its own data and unique circumstances that are considered when selecting a remedy. The 17 sites referenced by the commenter differ from NP5 OU1 for a variety of significant reasons including, but not limited to:

1. Differences in the specific contaminants present;
2. Differences in the level of data with respect to plume morphology, size, and temporal behavior;
3. Differences in adequacy of data with respect to source areas;
4. Differences in regulatory regime under which response activities have occurred;

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the record of decision is signed shall be added to the administrative record file only as provided in § 300.825." In turn, 40 C.F.R. § 300.825 provides several circumstances under which EPA may or should include documents in the Administrative Record after the ROD is signed, as follows:

(a) If documents submitted pertain to a portion of the response action that is not addressed by the ROD or if the documents pertain to a supplemental decision such as an Explanation of Differences or a post-ROD response action modification. Neither circumstance is the current procedural situation at OU-1.

(b) If EPA holds a public comment period after the ROD is signed to solicit public opinion, in which case comments shall be limited to the issues for which EPA has requested additional comment. EPA does not foresee holding a post-ROD public comment period for OU-1 at this time.

(c) If post-ROD comments are submitted that "contain significant information not contained elsewhere in the administrative record file which could not have been submitted during the public comment period and which substantially support the need to significantly alter the response action." EPA welcomes submission of information regarding site conditions that could not have been submitted during the public comment period and which substantially support the need to significantly alter the response action.

5. Differences in geologic conditions such as unconsolidated material versus fractured rock material, and, within fractured rock, the frequency, aperture size, distribution and interconnectedness of fractures at each specific site location;
6. Differences in hydrology;
7. Differences in contaminant mobility;
8. Differences in the presence of matrix diffusion;
9. Differences in the evidence with respect to biological and abiotic attenuation processes and the rate at which such processes are occurring; and/or
10. Differences in viability of remedial options based on site specific conditions.

For additional information on EPA's analysis, see:

Memorandum to File, from Ms. Sharon Fang, U.S. EPA, re: Consideration of 17 sites referenced by EA in comment 19 with respect to the North Penn Area 5 Superfund Site Operable Unit 1, 3/16/16. SEMS document number 2217882, and

Letter to Ms. Sharon Fang, U.S. EPA, from Ms. Misty Kauffman, HGL, re: Technical Assistance for Response to Comment #19, Comments on PRAP for OU1, dated October 17, 2014, 3/31/16. P. 2199397.

3.1.20 EA Comment 20: The conditions at NP5 OU1 are consistent with sites that are routinely closed in Pennsylvania pursuant to Act 2.

EPA Response: EPA is bound by CERCLA and the NCP. See EPA's response under Section 2.1.7 and 2.1.7 in this Responsiveness Summary, above, which explains EPA's obligations under CERCLA and the NCP.

3.1.21 Geosyntec Comment: Geosyntec asserts that the CSM for the NP5 site should be updated along the following lines:

1. Groundwater flow direction;
2. Surface topography and surface water flow;
3. Overburden-Bedrock interface topography;
4. Bedrock structure and upward vertical groundwater gradients; and
5. Origins and historic uses of contaminants of concern.

EPA Response: EPA agrees that the CSM is an iterative and dynamic model. EPA will incorporate appropriate data into a revised CSM. Response to each of the five topics is discussed below:

1. Groundwater Flow Direction
   Aquifer testing conducted during the RI by EPA and during the PDI by BAE Systems provides information about hydraulic connections between various wells and possible preferential pathways for contaminant migration. In addition, water levels collected at multiple depth intervals within bedrock provide information to more accurately represent the three-dimensional aspects of groundwater flow at this Site. Water quality data also provide information related to historical groundwater flow direction. To date, aquifer testing, water

level, and water quality data from OU1 suggest that the OU1 plume migrates to the west or west-northwest as suggested by interpreted potentiometric surface maps (under pumping and non-pumping conditions). In addition, this information does not suggest flow in the direction of the dipping bedding planes toward the Stabilus facility as suggested by Geosyntec.

Geosyntec Figure 3 does not incorporate or appear to consider important information. For example, the water levels posted in Figure 3 do not include measurements from the following wells: RI-20S, RI-20D, PW-1, PW-2, PW-4, PW-5, PW-7A, PW-7B, PW-10A, and PW-10B. In addition, only one water level each from PW-6A/B, PW-8A/B, and PW-9A/B are posted on the figure and were used to develop the potentiometric surface map. The use of water levels from the A and B intervals is also inconsistent. Water levels vary significantly with depth and need to be considered when evaluating groundwater flow direction.

With regard to Geosyntec Figure 4, there is insufficient information to conclude that groundwater from the Former UST Source Area reaches the bedrock trough in OU2. There is a strong downward gradient from overburden into bedrock in OU1, and the presence of an OU1 plume in bedrock demonstrates that contaminated groundwater moved downward into the bedrock. The groundwater elevation contours in overburden presented on Figure 4 also may not accurately represent groundwater flow in the vicinity of the bedrock trough. The contours indicate a northwesterly flow direction; however, there is insufficient information depicted on both sides of the trough to determine if flow actually converges into the trough from multiple directions. If this is the case, there is a generally decreasing hydraulic gradient from the Stabilus facility (288.83 ft above mean sea level (amsl) at TW01/SB01) to the southwest toward TW09/SB09 (286.04 ft amsl). This CSM of converging flow with a southwesterly groundwater flow direction would be generally consistent with the TCE plume depicted as emanating from the Stabilus facility in Geosyntec Figure 11.

2. Surface Topography and Surface Water Flow
   Information to date, including water quality data, topography, and surface drainage, suggests surface flow from the known extent of the NP5 OU1 former-UST source area is to the west and west-northwest, which is south of the bedrock trough and south of the trajectory suggested by Geosyntec. However, there may be another, yet unidentified chlorinated solvent source that may also be contributing to the NP5 OU1 plume. Further characterization of the NP5 OU1 plume is expected to provide additional insight to the extent of contamination migrating from OU1.

3. Overburden-Bedrock Interface Topography
   As depicted on Geosyntec Figure 7, the bedrock surface slopes to the west (toward RW-1) in the immediate vicinity of the Former UST Source Area. This slope in the bedrock surface generally agrees with historical groundwater overburden groundwater flow direction and with the historical extent of elevated OU1 TCE concentrations. Based on the available information, overburden groundwater generally follows the bedrock surface and infiltrates into fractured bedrock; however, the data to date suggest that overburden groundwater flow in OU1 may have been controlled by a more localized bedrock trough than those indicated in Figure 7 by Geosyntec. Further characterization of the extent of the remaining contamination

in the known OU1 source area would clarify the impact of a bedrock trough on contaminant movement as well as the presence of other potential source areas of the OU1 plume.

4. Bedrock Structure and Upward Vertical Groundwater Gradients

   There is insufficient evidence for a DNAPL release from OU1 that would have migrated significantly beyond the immediate area of the Former UST Source Area. Contaminant concentrations in OU1 decreased by orders of magnitude when the UST was removed in 1980 and contaminated soil was addressed in 1982. Had DNAPL extended beyond the immediate Former UST Source Area, OU1 concentrations would likely continue to be significantly higher than the currently detected maximum TCE concentrations of approximately 150 µg/L.

   The conceptual description of upward groundwater flow from bedrock to overburden in OU1 or OU2 is not supported by the data presented in Geosyntec's Figures 3 and 4. Using the overburden well locations RI-23, RI-24, RI-25, RI-28, RI-29, RI-30, and RI-31 (which are distributed throughout OU2), there is a downward gradient from overburden to bedrock in all locations. Therefore, contamination in OU2 overburden likely originated in the overburden rather than in bedrock.

5. Origins and Historic Uses of Contaminants of Concern

   Please see the responses to EPA's response to Geosyntec's comment numbered 1 through 4 above, which discuss groundwater flow in fractured bedrock, the role of the bedrock/overburden interface, and potential sources.

   The results of the compound-specific isotope analysis (CSIA) performed during the OU2 Pre-Design Investigation (PDI) did indicate two distinct vintages of TCE in OU2 overburden groundwater. Without identification of the source for the second vintage of TCE, conclusions drawn in the Geosyntec comment cannot be supported. The second vintage of TCE is unlikely to be from the known OU1 source area. However, the second vintage of TCE could possibly be from another unidentified OU1 source or another unidentified source within OU2. Thus, the CSIA data neither support nor invalidate the transport mechanisms discussed in Geosyntec's comment.

IV. FIGURES

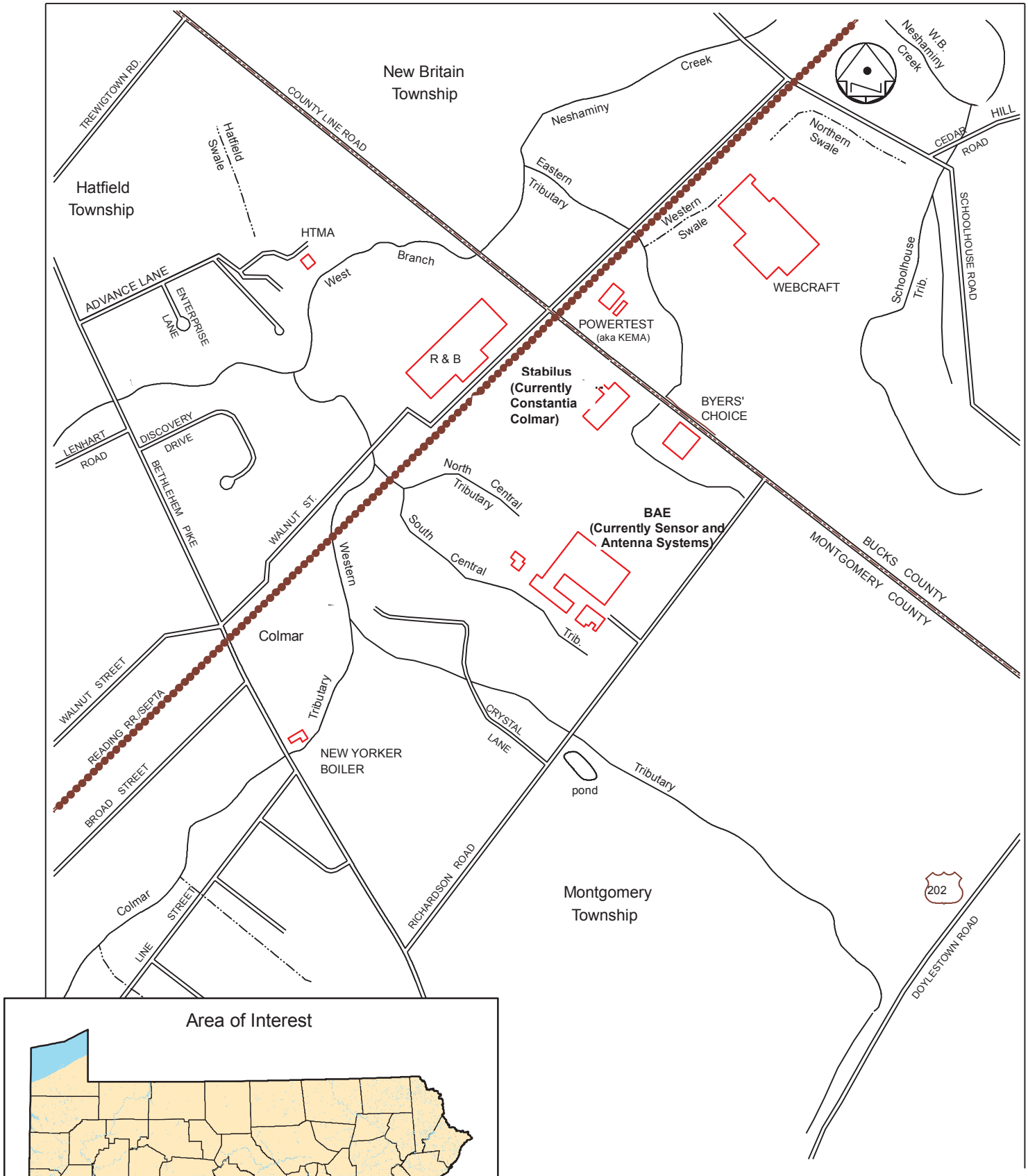


Figure 1
General Site Location Map
North Penn Area 5

EPA R3 GIS Team 9/2/2008 Bob Walker VIS 111 Map 3464

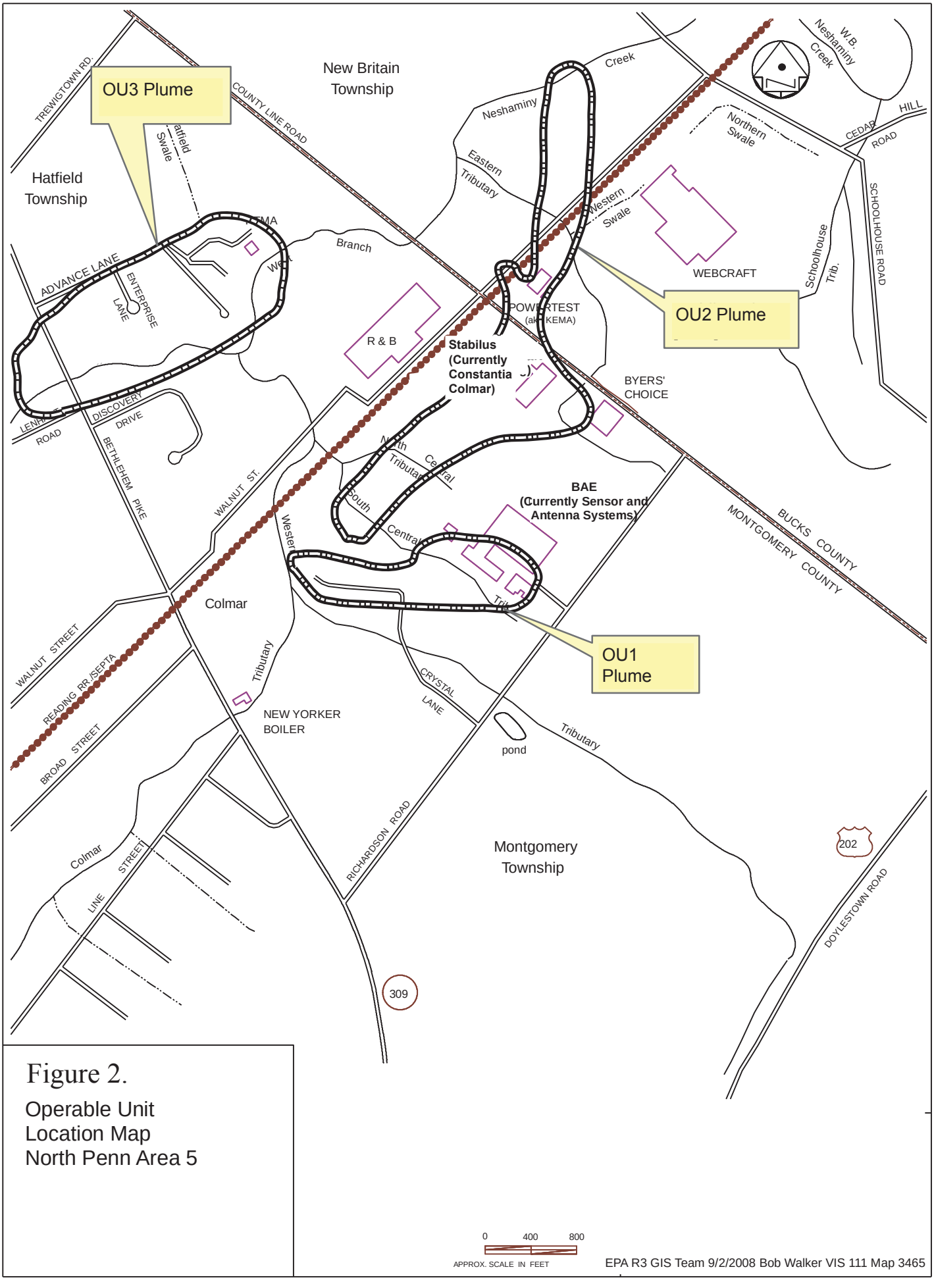


Figure 2.

Operable Unit
Location Map
North Penn Area 5

EPA R3 GIS Team 9/2/2008 Bob Walker VIS 111 Map 3465

11/08/13 9:54:22 AM • G:\EAI Projects\Won-PCG Projects\1863-Colmar\1863-Maps\1863_OU1 Base 4-12.mxd

Legend

- Monitoring Well
- Test Pit
- Abandoned Well
- Unlocated Well
- Property Line
- Swale
- Stream/Tributary
- Site Road

0 150 300 Feet

Sources:
Aerial photograph from The National Map, March, 2010
Modified based on PASDA Aerial Image
Base Map from Synergy Environmental, Inc.
Base Map from Metz Engineers Survey
Mean bedding, low-angle fracture, and high-angle fracture strike and dip from downhole OTV survey (ARM GEOPHYSICS, Feb. 2007)

Environmental Alliance, Inc.
5341 Limestone Road, Wilmington, DE 19808
Phone: (302) 234-4400 - Fax: (302)234-1535

NORTH PENN AREA 5 SUPERFUND SITE
BUCKS AND MONTGOMERY COUNTIES, PA
OU-1 (BAE)

OU-1 Area Map

DESIGNED BY:	DRAWN BY:	UPDATED BY:	FIGURE NO.:
JSE	SKJ	--	3.
APPROVED BY:	PROJECT NO.: 1863	DATE: 04/17/2012	

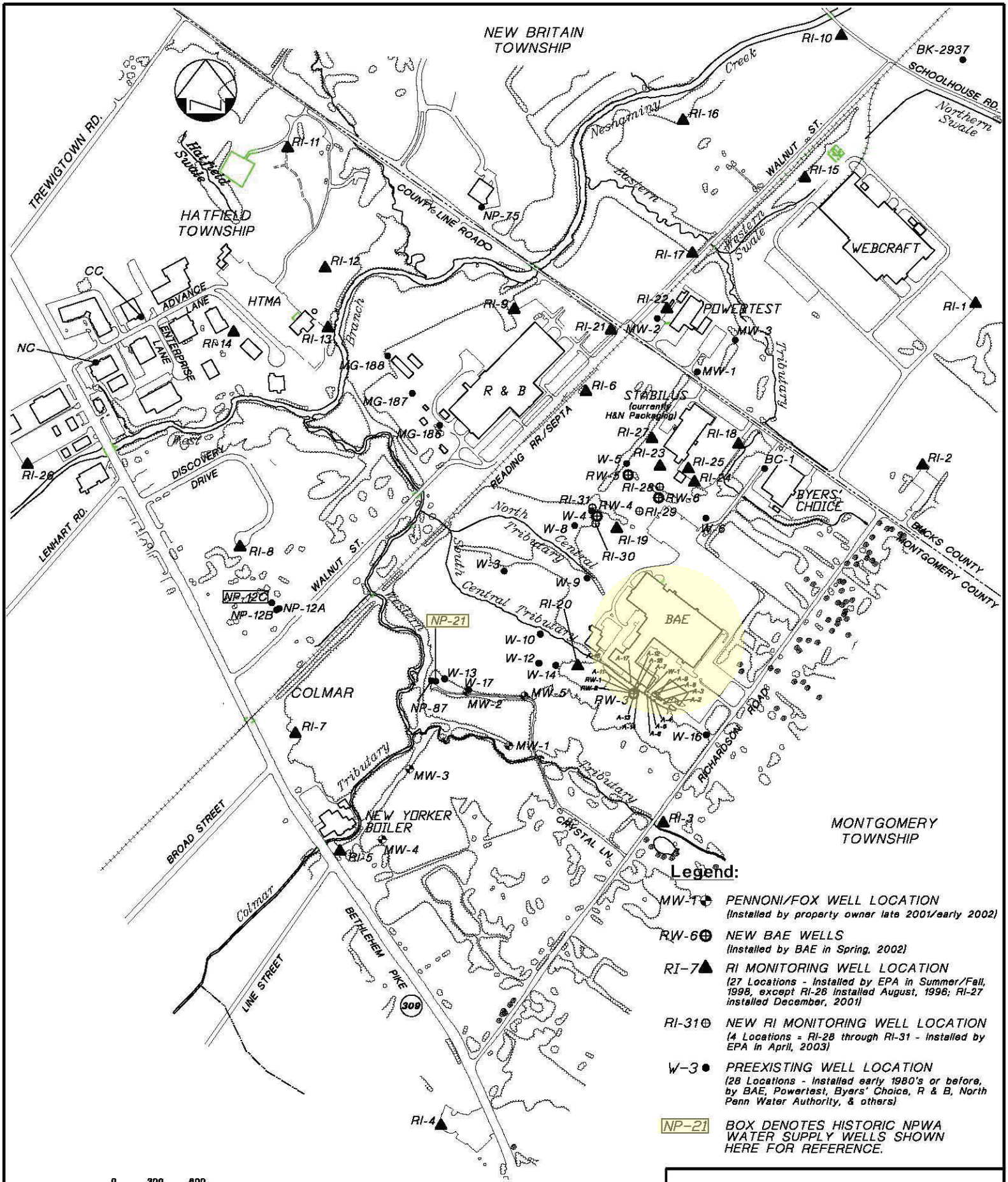


Figure 4.

Monitoring Well Location Map

North Penn Area 5

Colmar, Pennsylvania

Notes:
ND = Not detected
NS = Not Sampled
J = Estimated value
Duplicate sample results shown in parenthesis

Analytes:
1,1,1 TCA = 1,1,1 Trichloroethane
1,1 DCA = 1,1 Dichloroethane
1,1 DCE = 1,1 Dichloroethene
CIS-1,2-DCE = cis-1,2-Dichloroethene
PCE = Tetrachloroethene
TCE = Trichloroethene
VC = Vinyl Chloride

W-10
ND

South Central Tributary

RI-20S
1,1,1 TCA: 11
1,1 DCA: 3
1,1 DCE: 87
CIS-1,2-DCE: 5
PCE: 4
TCE: 150
VC: 0.066

RI-20D
1,1,1 TCA: 0.8 J
1,1 DCE: 1
CIS-1,2-DCE: 0.7 J
TCE: 3

PW-9B
1,1,1 TCA: 4
1,1 DCA: 2
1,1 DCE: 130
CIS-1,2-DCE: 17
TCE: 53
VC: 0.092 (0.084)

PW-9A
1,1 DCA: 0.5 J
1,1 DCE: 24
CIS-1,2-DCE: 3
TCE: 18
VC: 0.043 J

LOADING DOCK

Production Well

FORMER SYSTEMS
BLDG 5 ACTORY

W-14
1,1,1 TCA: 11
1,1 DCE: 9
TCE: 6

W-12
ND

PW-8A
1,1,1 TCA: 6
1,1 DCE: 5
TCE: 9

PW-10A
1,1,1 TCA: 4
1,1 DCA: 6
1,1 DCE: 49
CIS-1,2-DCE: 4
PCE: 2
TCE: 120
VC: 0.089

PW-6A
1,1 DCA: 2
1,1 DCE: 10
CIS-1,2-DCE: 3
TCE: 13

PW-6B
TCE: 5

PW-5
1,1,1 TCA: 0.6 J
1,1 DCE: 0.5 J
CIS-1,2-DCE: 1
TCE: 18

PW-4
CIS-1,2-DCE: 2
TCE: 15

RECOVERY WELL
CIS-1,2-DCE: 2
TCE: 43

PW-1
1,1,1 TCA: 0.9 J (0.9 J)
1,1 DCE: 0.7 J (0.7 J)
CIS-1,2-DCE: 3 (3)
PCE: 0.6 J (0.5 J)
TCE: 35 (35)

PW-7A
TCE: 5

PW-7B
TCE: 4

PW-10B
1,1 DCE: 0.6 J
CIS-1,2-DCE: 0.6 J
TCE: 11

W-1
CIS-1,2-DCE: 11
TCE: 37
VC: 0.012 J

PW-11
1,1,1 TCA: 6
1,1 DCA: 1
1,1 DCE: 41
CIS-1,2-DCE: 2
PCE: 0.9 J
TCE: 61
VC: 0.038 J

PW-8B
1,1,1 TCA: 1
1,1 DCE: 3
CIS-1,2-DCE: 1
TCE: 13

PW-12
1,1,1 TCA: 2
1,1 DCE: 2
CIS-1,2-DCE: 1
TCE: 13

RW-1
1,1,1 TCA: 3
1,1 DCE: 2
CIS-1,2-DCE: 3
PCE: 1
TCE: 79
VC: 0.040 J

RW-2
ND

RW-3
ND

PW-2
1,1,1 TCA: 9
1,1 DCE: 3
CIS-1,2-DCE: 4
PCE: 3
TCE: 93

PW-13
1,1,1 TCA: 2
1,1 DCE: 2
CIS-1,2-DCE: 4
PCE: 2
TCE: 22

PW-3
1,1,1 TCA: 1
1,1 DCE: 0.6 J
CIS-1,2-DCE: 1
PCE: 2
TCE: 30

PW-14
CIS-1,2-DCE: 0.8 J
PCE: 1
TCE: 15

W-16
PCE: 0.6 J (0.5 J)

NP-21
NS

NP-87
NS

W-13
1,1,1 TCA: 2 (2)
1,1 DCE: 1 (1 J)
TCE: 0.6 J (0.7 J)

W-17
1,1,1 TCA: 6
1,1 DCE: 4
TCE: 4

FOX MW-2
1,1,1 TCA: 7
1,1 DCE: 12
CIS-1,2-DCE: 0.6 J
TCE: 14

FOX MW-5
1,1,1 TCA: 11
1,1 DCA: 0.6 J
1,1 DCE: 19
CIS-1,2-DCE: 2
PCE: 2
TCE: 93

FOX MW-1
ND

MEAN CONJUGATE JOINTS [STR 300°, DIP 82° NE]
MEAN MASTER JOINTS [STR 040°, DIP 83° SE]
MEAN BEDDING [STR 060°, DIP 11° NW]
MEAN LOW ANGLE FRACTURES [STR 082°, DIP 12° NW]

Location ID	Open Interval/Screen Top (ft)*	Open Interval/Screen Bottom (ft)*
FOX MW-1	9	50
FOX MW-2	9	50
FOX MW-5	9	50
PW-1	11	60
PW-2	12	60
PW-3	12	60
PW-4	12	61
PW-5	11	70
PW-6A	18	52
PW-6B	66	86
PW-7A	90	110
PW-7B	124	144
PW-8A	18	46
PW-8B	60	100
PW-9A	10	48
PW-9B	62	85
PW-10A	19	50
PW-10B	64	84
PW-11	13	80

Location ID	Open Interval/Screen Top (ft)*	Open Interval/Screen Bottom (ft)*
PW-12	13	80
PW-13	19	80
PW-14	18	80
Recovery Well	4	104
RI-20S	70	80
RI-20D	100	110
RW-1	23	70
RW-2	80	150
RW-3	150	210
W-1	9	40
W-10	12	34
W-12	7	40
W-13	10	44
W-14	6	36
W-16	9	47
W-17	6	44
NP-21	103	476
NP-87	50	500

*Reported depths below ground surface
Intervals for non-PW wells as reported in USGS WRIR 03-4159 (Risser & Bird)
Shallow bedrock wells = open interval ≤80 ft
Deeper bedrock wells = open interval ≥80 ft
Shaded wells are the deeper bedrock wells

MEAN BEDDING, LOW-ANGLE FRACTURE, & HIGH-ANGLE FRACTURE STRIKE & DIP FROM DOWNHOLE OTV SURVEY (ARM GEOPHYSICS, FEB. 2007)

ALL CONCENTRATIONS REPORTED IN MICROGRAMS PER LITER (µg/L).

GROUNDWATER RECOVERY SYSTEM (PUMPING WELLS: RECOVERY WELL, RI-20S & RW-1) INACTIVE DURING DATA COLLECTION.

Legend
Monitoring Well
Test Pit
Abandoned Well
Unlocated Well
Stream/Tributary
Site Road
Property Line
Swale

0 130 260
Feet

Source: Modified from PASDA Aerial Image
Base Map from Synergy Environmental, Inc.
Base Map from Metz Engineers Survey

At or above MCL

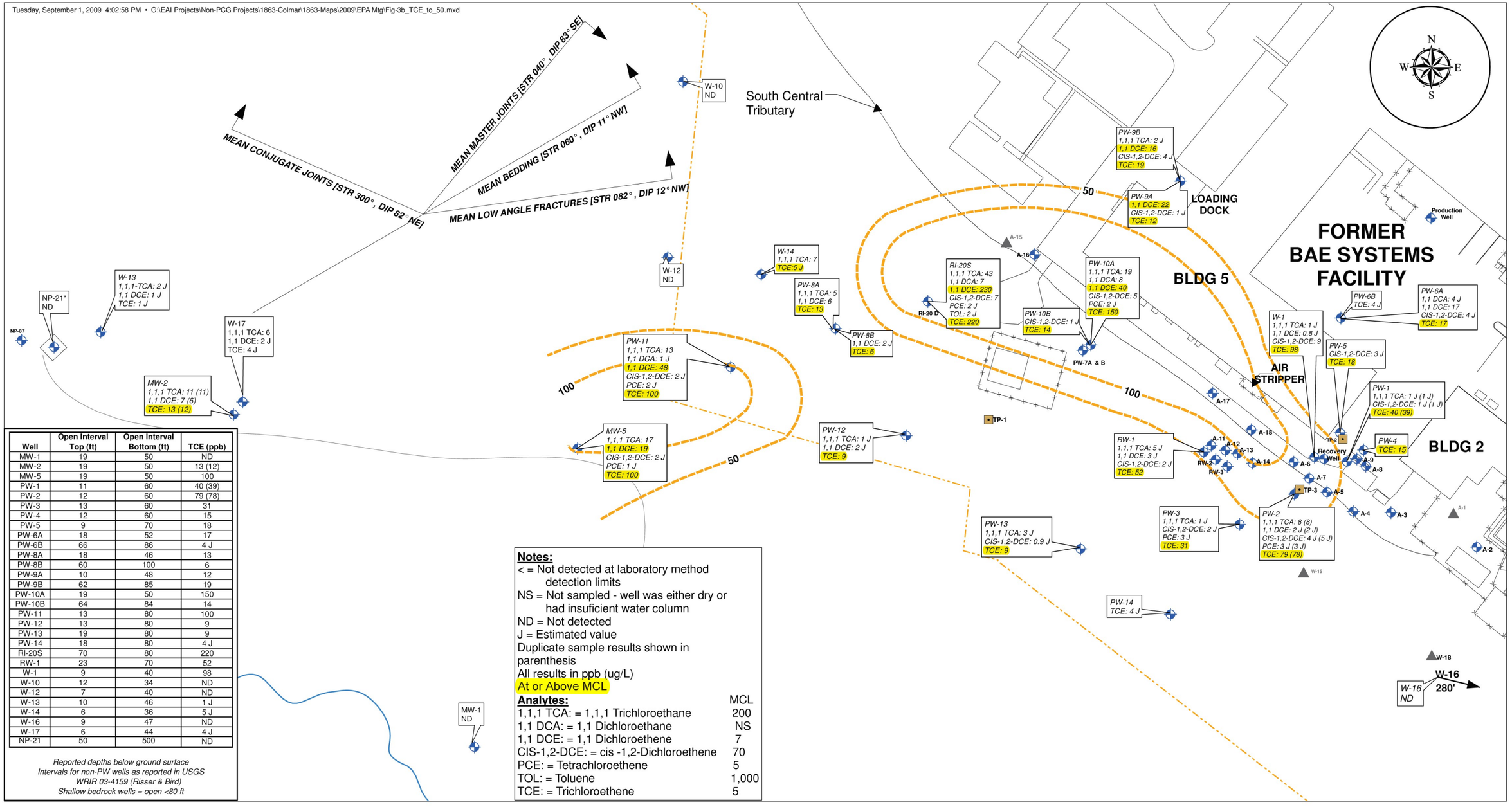
Approximate Location of Former UST

Environmental Alliance, Inc.
5341 Limestone Road, Wilmington, DE 19808
Phone: (302) 234-4400 - Fax: (302)234-1535

NORTH PENN AREA 5 SUPERFUND SITE
BUCKS & MONTGOMERY COUNTIES, PA
OU-1 (BAE)

Groundwater VOCs - Bedrock Wells
August 2014 (Post-P&T System Deactivation)
Groundwater Sampling Event

DESIGNED BY:	DRAWN BY:	UPDATED BY:	FIGURE NO.:
CPT	SKJ	---	5.
APPROVED BY:	PROJECT NO.:	DATE:	
	1863	10/13/2014	



Well	Open Interval Top (ft)	Open Interval Bottom (ft)	TCE (ppb)
MW-1	19	50	ND
MW-2	19	50	13 (12)
MW-5	19	50	100
PW-1	11	60	40 (39)
PW-2	12	60	79 (78)
PW-3	13	60	31
PW-4	12	60	15
PW-5	9	70	18
PW-6A	18	52	17
PW-6B	66	86	4 J
PW-8A	18	46	13
PW-8B	60	100	6
PW-9A	10	48	12
PW-9B	62	85	19
PW-10A	19	50	150
PW-10B	64	84	14
PW-11	13	80	100
PW-12	13	80	9
PW-13	19	80	9
PW-14	18	80	4 J
RI-20S	70	80	220
RW-1	23	70	52
W-1	9	40	98
W-10	12	34	ND
W-12	7	40	ND
W-13	10	46	1 J
W-14	6	36	5 J
W-16	9	47	ND
W-17	6	44	4 J
NP-21	50	500	ND

Reported depths below ground surface
Intervals for non-PW wells as reported in USGS WRIR 03-4159 (Risser & Bird)
Shallow bedrock wells = open <80 ft

Notes:
< = Not detected at laboratory method detection limits
NS = Not sampled - well was either dry or had insuficient water column
ND = Not detected
J = Estimated value
Duplicate sample results shown in parenthesis
All results in ppb (ug/L)
At or Above MCL

Analytes:	MCL
1,1,1 TCA: = 1,1,1 Trichloroethane	200
1,1 DCA: = 1,1 Dichloroethane	NS
1,1 DCE: = 1,1 Dichloroethene	7
CIS-1,2-DCE: = cis -1,2-Dichloroethene	70
PCE: = Tetrachloroethene	5
TOL: = Toluene	1,000
TCE: = Trichloroethene	5

MEAN BEDDING, LOW-ANGLE FRACTURE, & HIGH-ANGLE FRACTURE STRIKE & DIP FROM DOWNHOLE OTV SURVEY (ARM GEOPHYSICS, FEB. 2007)

AREA INSIDE CONTOUR LINES:
5 PPB CONTOUR = 325,596.3 SQFT

GROUNDWATER RECOVERY SYSTEM (PUMPING WELLS: RECOVERY WELL, RI-20S & RW-1) OFF DURING DATA COLLECTION AT ALL WELLS EXCEPT FOR NP-21

PW-11 THROUGH PW-14 AND MW-5 WERE SAMPLED IN AUGUST 2009. ALL OTHER WELLS WERE SAMPLED IN JUNE/JULY 2008.

Legend
- * TCE Plume
- Monitoring Well
- Unlocated Well
- Test Pit
- Stream/Tributary
- Site Road
- Property Line

Scale:
0 85 170 Feet
1:1,310

Sources:
Modified from PASDA Aerial Image
Base Map from Synergy Environmental, Inc.
Base Map from Metz Engineers Survey

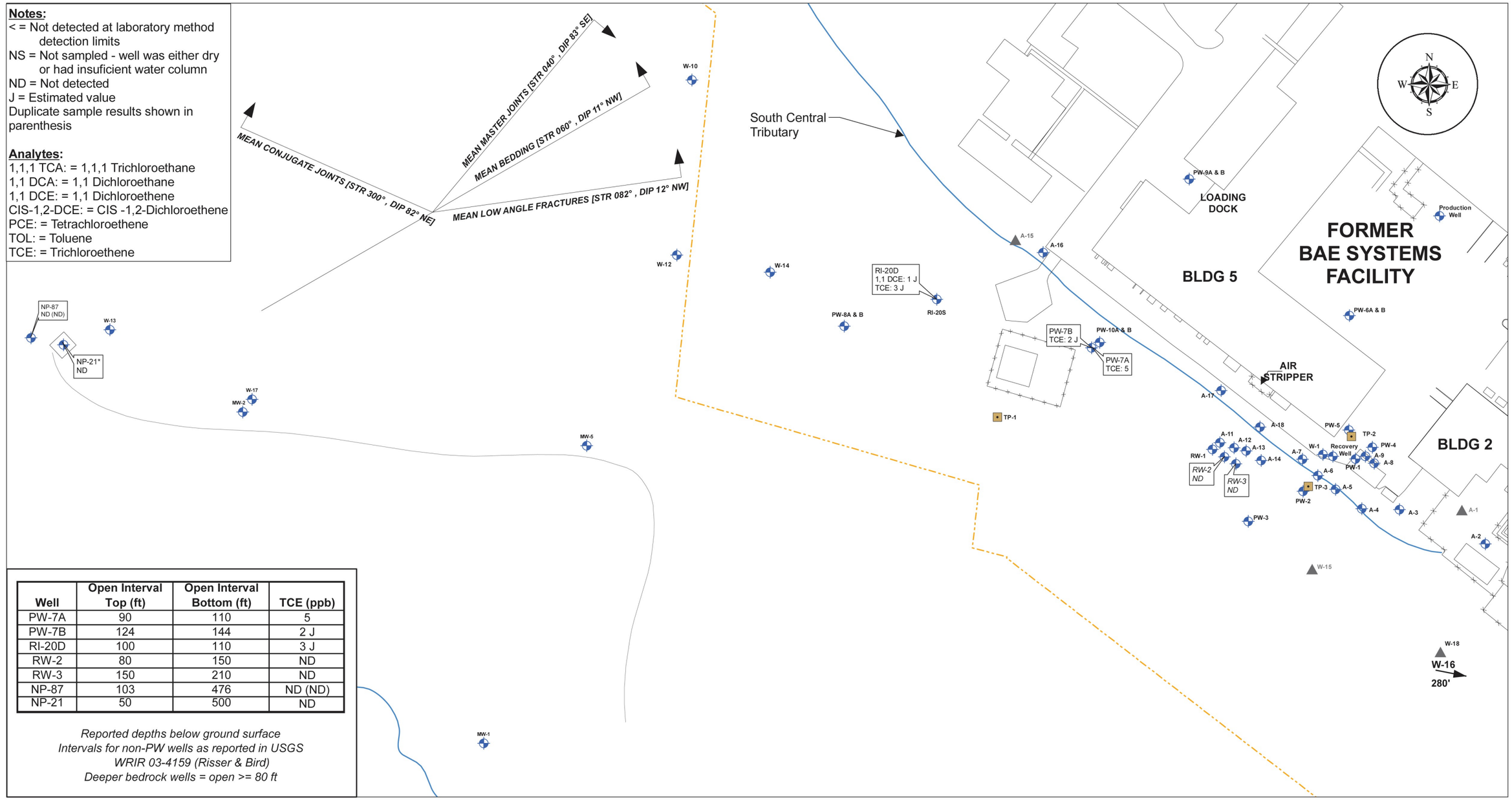
Environmental Alliance, Inc.
660 Yorklyn Road - Hockessin, DE 19707
Phone: (302) 234-4400 - Fax: (302) 234-1535

NORTH PENN AREA 5 SUPERFUND SITE
BUCKS & MONTGOMERY COUNTIES, PA
OU-1 (BAE)

Figure 6. Extent of TCE in Shallow Bedrock Groundwater June/July 2008 & August 2009 Groundwater Data

Notes:
< = Not detected at laboratory method detection limits
NS = Not sampled - well was either dry or had insuficient water column
ND = Not detected
J = Estimated value
Duplicate sample results shown in parenthesis

Analytes:
1,1,1 TCA: = 1,1,1 Trichloroethane
1,1 DCA: = 1,1 Dichloroethane
1,1 DCE: = 1,1 Dichloroethene
CIS-1,2-DCE: = CIS -1,2-Dichloroethene
PCE: = Tetrachloroethene
TOL: = Toluene
TCE: = Trichloroethene



Well	Open Interval Top (ft)	Open Interval Bottom (ft)	TCE (ppb)
PW-7A	90	110	5
PW-7B	124	144	2 J
RI-20D	100	110	3 J
RW-2	80	150	ND
RW-3	150	210	ND
NP-87	103	476	ND (ND)
NP-21	50	500	ND

Reported depths below ground surface
Intervals for non-PW wells as reported in USGS WRIR 03-4159 (Risser & Bird)
Deeper bedrock wells = open >= 80 ft

MEAN BEDDING, LOW-ANGLE FRACTURE, & HIGH-ANGLE FRACTURE STRIKE & DIP FROM DOWNHOLE OTV SURVEY (ARM GEOPHYSICS, FEB. 2007)

ALL RESULTS IN ppb

*** NP-21 OPEN FROM 50 FEET TO 500 FEET**

GROUNDWATER RECOVERY SYSTEM (PUMPING WELLS: RECOVERY WELL, RI-20S & RW-1) OFF DURING DATA COLLECTION AT ALL WELLS EXCEPT FOR NP-21 & NP-87

SYSTEM OFF FROM JUNE 6 THROUGH JUNE 20, 2008.

Legend
Monitoring Well
Unlocated Well
Test Pit
Stream/Tributary
Site Road
Property Line

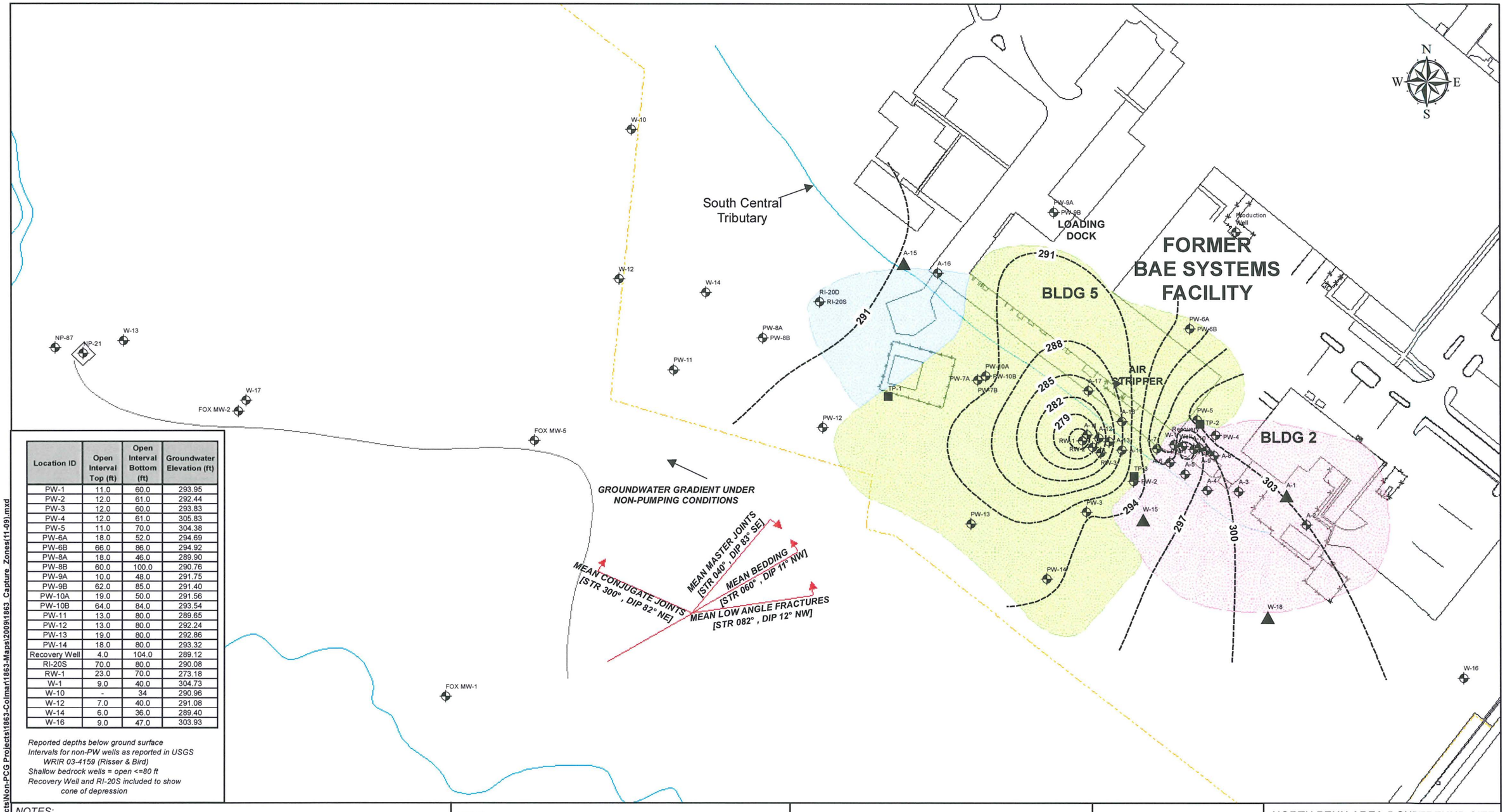
Scale:
0 85 170 Feet
1:1,300

Sources:
Modified from PASDA Aerial Image
Base Map from Synergy Environmental, Inc.
Base Map from Metz Engineers Survey

Environmental Alliance, Inc.
660 Yorklyn Road - Hockessin, DE 19707
Phone: (302) 234-4400 - Fax: (302) 234-1535

NORTH PENN AREA 5 SUPERFUND SITE
BUCKS & MONTGOMERY COUNTIES, PA
OU-1 (BAE)

Figure 7. Groundwater VOCs Deeper Bedrock Wells June/July 2008 Groundwater Sampling Event



Location ID	Open Interval Top (ft)	Open Interval Bottom (ft)	Groundwater Elevation (ft)
PW-1	11.0	60.0	293.95
PW-2	12.0	61.0	292.44
PW-3	12.0	60.0	293.83
PW-4	12.0	61.0	305.83
PW-5	11.0	70.0	304.38
PW-6A	18.0	52.0	294.69
PW-6B	66.0	86.0	294.92
PW-8A	18.0	46.0	289.90
PW-8B	60.0	100.0	290.76
PW-9A	10.0	48.0	291.75
PW-9B	62.0	85.0	291.40
PW-10A	19.0	50.0	291.56
PW-10B	64.0	84.0	293.54
PW-11	13.0	80.0	289.65
PW-12	13.0	80.0	292.24
PW-13	19.0	80.0	292.86
PW-14	18.0	80.0	293.32
Recovery Well	4.0	104.0	289.12
RI-20S	70.0	80.0	290.08
RW-1	23.0	70.0	273.18
W-1	9.0	40.0	304.73
W-10	-	34	290.96
W-12	7.0	40.0	291.08
W-14	6.0	36.0	289.40
W-16	9.0	47.0	303.93

Reported depths below ground surface
Intervals for non-PW wells as reported in USGS WRIR 03-4159 (Risser & Bird)
Shallow bedrock wells = open <=80 ft
Recovery Well and RI-20S included to show cone of depression

NOTES:
- Mean Bedding, Low-Angle Fracture, & High-Angle Fracture Strike & Dip from Downhole OTV Survey (ARM GEOPHYSICS, FEB. 2007)
- Capture zones inferred based on groundwater elevation contours and assuming isotropic conditions.
- Groundwater recovery system (Pumping wells: Recovery Well, RI-20S & RW-1) active during data collection.
- Due to low average pumping rate (~0.8 gpm), Cone-of-Depression around RI-20S is not apparent. Inferred capture zone for RI-20S based on groundwater elevation contours and other inferred capture zones.
- Wells PW-11 through PW-14 installed in August 2009.

Legend
- Monitoring Well
- Test Pit
- Abandoned Well
- Unlocated Well
- Groundwater Elevation Contour (ft)
- Stream/Tributary
- Site Road
- Property Line
- Swale
- Interpreted Capture Zone for RI-20S
- Interpreted Capture Zone for RW-1
- Interpreted Capture Zone for Recovery Well

0 130 260
Feet

Source: Modified from PASDA Aerial Image
Base Map from Synergy Environmental, Inc.
Base Map from Metz Engineers Survey

Environmental Alliance, Inc.
5341 Limestone Road, Wilmington, DE 19808
Phone: (302) 234-4400 - Fax: (302)234-1535

NORTH PENN AREA 5 SUPERFUND SITE
BUCKS & MONTGOMERY COUNTIES, PA
OU-1 (BAE)

Interpreted Capture Zones
November 23, 2009 Pumping Conditions

DESIGNED BY:	DRAWN BY:	UPDATED BY:	FIGURE NO.:
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APPROVED BY:	PROJECT NO.: 1863	DATE: 03/31/14	

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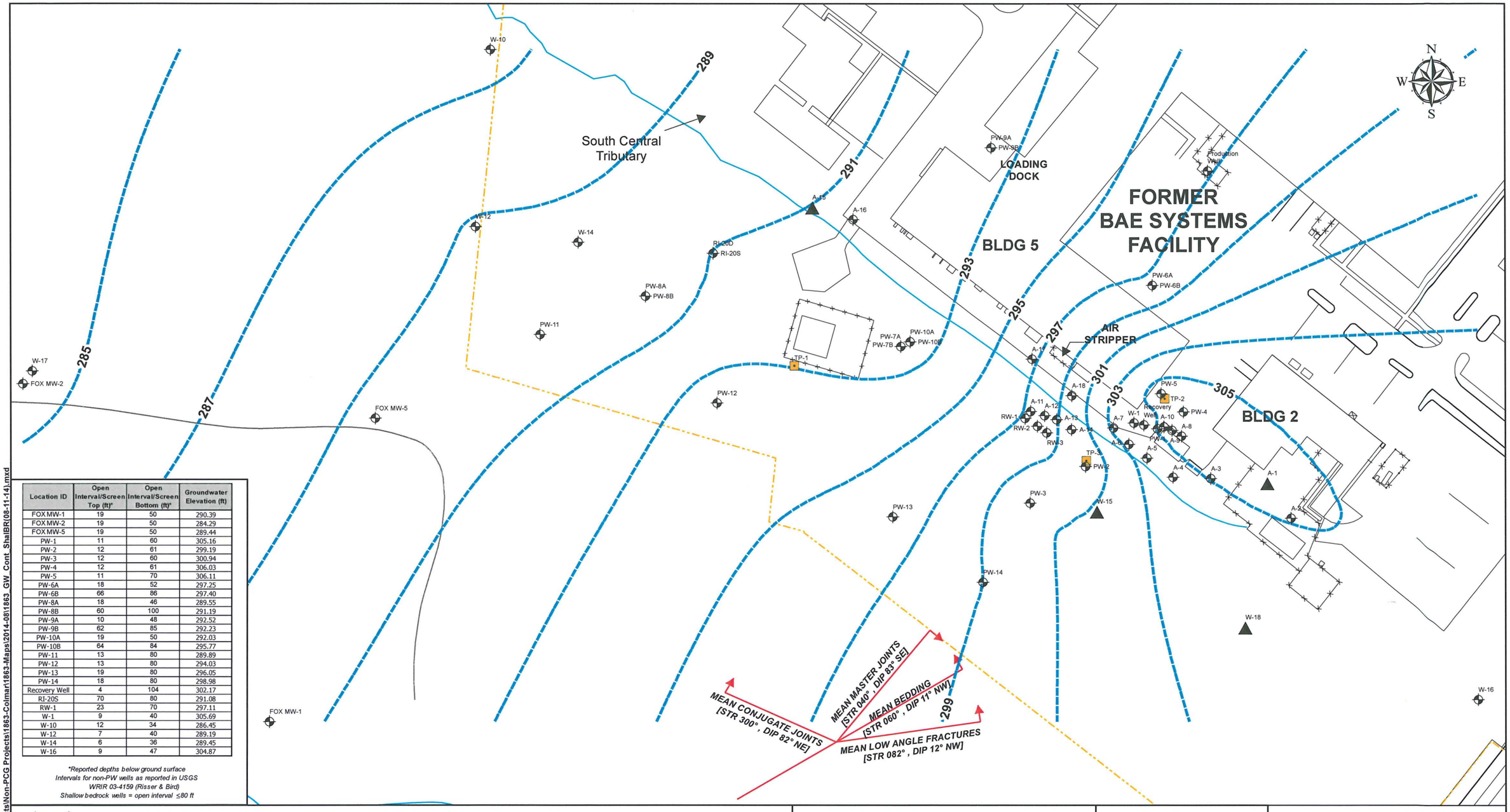

Location ID	Open Interval/Screen Top (ft)*	Open Interval/Screen Bottom (ft)*	Groundwater Elevation (ft)
FOX MW-1	19	50	290.39
FOX MW-2	19	50	284.29
FOX MW-5	19	50	289.44
PW-1	11	60	305.16
PW-2	12	61	299.19
PW-3	12	60	300.94
PW-4	12	61	306.03
PW-5	11	70	306.11
PW-6A	18	52	297.25
PW-6B	66	86	297.40
PW-8A	18	46	289.55
PW-8B	60	100	291.19
PW-9A	10	48	292.52
PW-9B	62	85	292.23
PW-10A	19	50	292.03
PW-10B	64	84	295.77
PW-11	13	80	289.89
PW-12	13	80	294.03
PW-13	19	80	296.05
PW-14	18	80	298.98
Recovery Well	4	104	302.17
RI-20S	70	80	291.08
RW-1	23	70	297.11
W-1	9	40	305.69
W-10	12	34	286.45
W-12	7	40	289.19
W-14	6	36	289.45
W-16	9	47	304.87

**Reported depths below ground surface*
Intervals for non-PW wells as reported in USGS WRIR 03-4159 (Risser & Bird)
Shallow bedrock wells = open interval ≤80 ft

Legend

- Monitoring Well
- Test Pit
- Abandoned Well
- Unlocated Well
- Groundwater Contour (ft)
- Property Line
- Swale
- Stream/Tributary
- Site Road

Contours created by Surfer 11 using the Kriging method.

0 110 220 Feet

Sources:
Modified based on PASDA Aerial Image
Base Map from Synergy Environmental, Inc.
Base Map from Metz Engineers Survey
Mean bedding, low-angle fracture, and high-angle fracture strike and dip from downhole OTV survey (ARM GEOPHYSICS, Feb. 2007)

Environmental Alliance, Inc.
5341 Limestone Road, Wilmington, DE 19808
Phone: (302) 234-4400 - Fax: (302)234-1535

NORTH PENN AREA 5 SUPERFUND SITE
BUCKS AND MONTGOMERY COUNTIES, PA
OU-1 (BAE)

Groundwater Gradient Map
For Shallow Bedrock Wells
August 2014 (Post-P&T System Deactivation)

DESIGNED BY:	DRAWN BY:	UPDATED BY:	FIGURE NO.:
CPT	SKJ	---	9.
APPROVED BY:	PROJECT NO.:	DATE:	
	1863	10/13/2014	

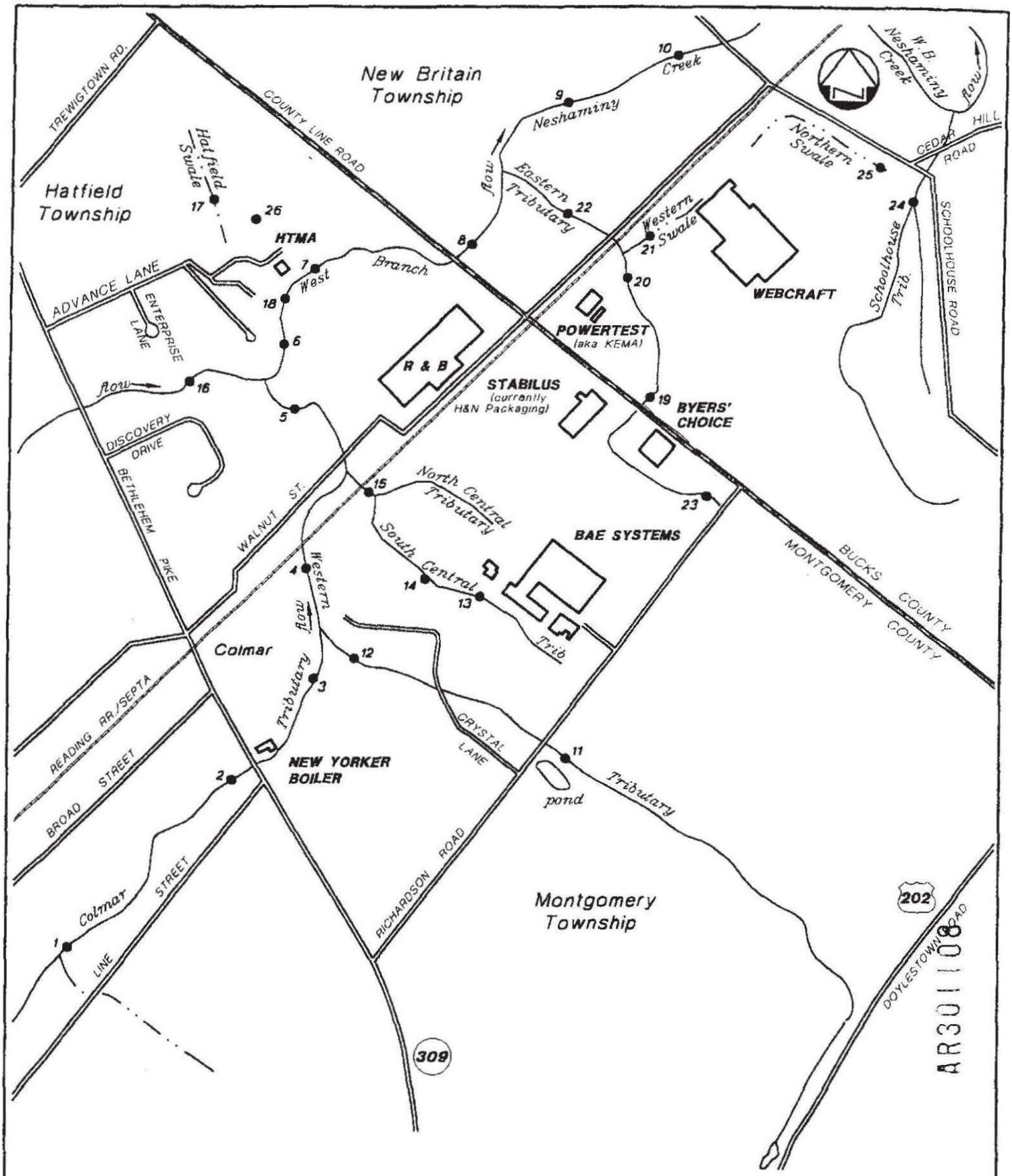

Figure 10.
North Penn Area 5 Superfund Site
Sediment Sampling Locations 1998