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NAS WILLOW GROVE
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IMPLEMENTATION PLAN
FOR

Pilot Studies and Field Demonstration Testing of Bioaugmentation Remediation for Groundwater Contaminated with Chlorinated VOCs
Site 05 – Former Fire Training Area
NAS JRB Willow Grove
Willow Grove, Pennsylvania

Submitted by:
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April 24, 2007

Submitted to:

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Mid Atlantic Division
9742 Maryland Avenue
Norfolk, VA 23511-3095

In Support of:

CONTRACT NUMBER N62467-04-D-0055
"CLEAN" IV Contract Task Order No. 0411

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1.0 INTRODUCTION

This implementation plan has been prepared for Contract Task Order (CTO) 411, under the Comprehensive Long-Term Environmental Action Navy (CLEAN IV) Contract No. N62467-04-D-0055. Pursuant to the CTO, Tetra Tech NUS Inc. (Tetra Tech) will execute the scope of work for performing the Pilot Studies and Field Demonstration Testing of Bioaugmentation Remediation for Groundwater Contaminated with Chlorinated VOCs for Site 5, the former fire training area, at the NAS JRB Willow Grove, in Willow Grove, Montgomery County, Pennsylvania.

1.1 IMPLEMENTATION PLAN ORGANIZATION

This Implementation Plan consists of the following five sections:

- Section 1.0 - Introduction
- Section 2.0 - Project Staffing
- Section 3.0 - Scope of Work
- Section 4.0 - Budget
- Section 5.0 - Schedule and Deliverables

Section 1.0 is this introduction and Section 2.0 provides a description of the management approach and key personnel. Section 3.0 contains a description of the tasks for the project scope of work. Section 4.0 contains the cost spreadsheets. A schedule for the project and list of deliverables is provided in Section 5.0.

2.0 PROJECT STAFFING

2.1 MANAGEMENT APPROACH

Tetra Tech NUS (Tetra Tech) will be the lead technical firm for this CTO. The project work will be managed from the Philadelphia (King of Prussia) office and staffed from the Philadelphia and Pittsburgh offices. The Tetra Tech project manager will be responsible for the day-to-day management of this assignment and will track performance of the scope of work in accordance with the approved budget and schedule. He will be responsible for communicating pertinent decisions and developments to project participants and will be the primary liaison with the Navy Remedial Project Manager (RPM). Tetra Tech program management staff are responsible for overseeing all technical and administrative activities for individual projects.

CLEAN program planning documents, including the Contract Management Plan, provide overall direction for the execution of projects under CLEAN. These plans require technical review of all deliverables, routine project reviews, established responsibilities, and other standard guidelines.

2.2 KEY PROJECT PERSONNEL

Program management staff that are involved with the overall performance of CLEAN CTOs include:

- John Trepanowski - Program Manager (610) 491-9688
- Garth Glenn- Deputy Program Manager (757) 461-3926
- Meg Price – Lead Contract Specialist at (610) 491-9688
- Kelly Carper - Quality Assurance Manager (412) 921-7273
- Matt Soltis - Health and Safety Manager (412) 921-8912

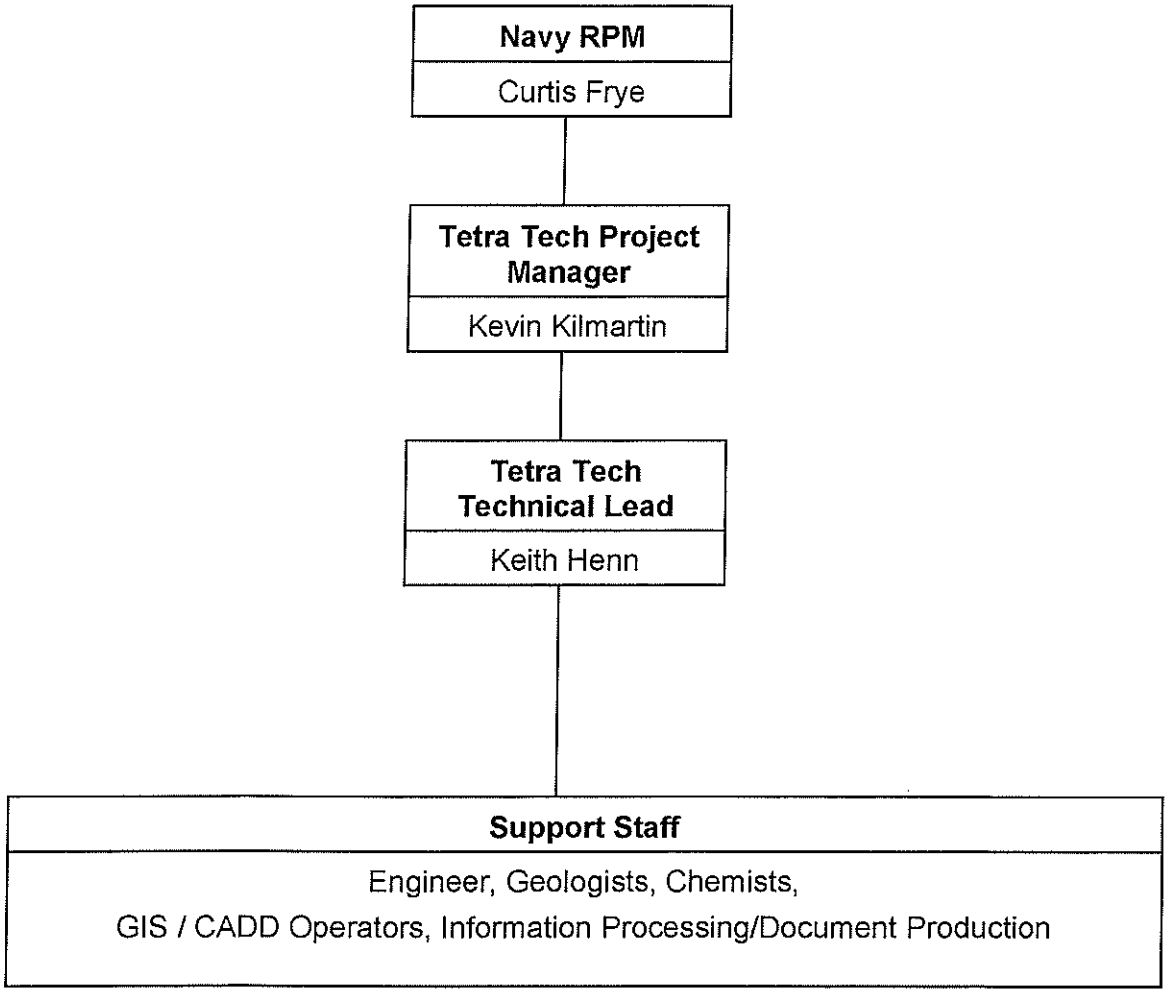
Mr. Kevin Kilmartin, PG, will serve as Project Manager for this CTO and will manage the work on a day-to-day basis. Mr. Kilmartin will ensure that all project objectives are met by tasking support staff and subcontractors and monitoring progress of those tasks to assure timely delivery and technical content. Mr. Kilmartin has served as a project geologist at the NAS JRB Willow Grove under previous CTOs since 1995. A copy of his resume is attached. Kevin Kilmartin may be reached by phone at (610) 491-9688, and electronic mail at kevin.kilmartin@ttnus.com.

Supporting Mr. Kilmartin will be Mr. Keith Henn, PG. Mr. Henn is a senior geologist with extensive experience in the planning, execution, and interpretation of bioremediation projects, and is the Tetra Tech Remediation Group Manager. Mr. Henn and his staff have planned and executed numerous bioremediation projects for the Navy under the EFD South CLEAN contract. A copy of Mr. Henn's resume is attached.

Also supporting this project will be Tetra Tech staff of chemists, geologists, and engineers with experience in bioremediation projects and/or previous site investigations at NAS JRB Willow Grove.

FIGURE 2-1

PROJECT ORGANIZATION CHART



3.0 SCOPE OF WORK

The scope of work proposed herein reflects the work requirements presented in the Statement of Work (SOW) dated March 26, 2007.

The objective of this Contract Task Order (CTO) is to implement the pilot study and field demonstration testing of bioaugmentation remediation for groundwater contaminated with chlorinated VOCs at Site 5 (the former fire training area) at NAS JRB Willow Grove, in Willow Grove, Pennsylvania. Site 5 is located near the southern end of the Navy's property, west of the runways and south of Taxiway Juliet, and covers an irregularly shaped area of approximately 1.25 acres. Fire training operations included storage and burning of flammable liquid wastes generated in the period from 1942 through 1975. For decision making purposes under CERCLA, the Site 5 groundwater has been designated Operable Unit 2.

The principal contaminants associated with Site 5 groundwater are volatile organic compounds (VOCs) historically disposed or spilled near the site's former drum storage area. At the monitoring well cluster located near or at the source area (05MW01), the highest concentrations of VOCs occur in the shallow groundwater (near the water table) and decrease with increasing depth. Multiple VOCs, including trichloroethene (TCE), tetrachloroethene (PCE), benzene, 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethene (1,1-DCE), and 1,2-dichlorethene (1,2-DCE) were detected at concentrations above reference criteria at this location, with most exceedances occurring in the shallow zone. Below the shallow zone at this location and at other locations throughout the site, only TCE and 1,1-DCE still exceed reference criteria, but at concentrations much less than detected in the shallow zone at the source area.

The Navy completed a draft feasibility study (FS) for Site 5, OU 2, in 2004 (Tetra Tech NUS, October 2004) that included a remedial alternative of in-situ enhanced biological anaerobic reductive dehalogenation treatment and natural attenuation (NA) to promote remediation of the groundwater impacted by VOCs. This implementation plan contains the technical scope of work and associated costs to perform a pilot test (including treatability testing) to evaluate and prove the applicability of the bioaugmentation strategy, as well as provide the data to aid in the design and installation of a full-scale extraction and/or injection system at the site, and select operational parameters for the full-scale system.

The SOW provided for the installation of 2 injection wells and 2 extraction wells near the source area (05MW01) for this pilot test, but directed that the existing Site 5 monitoring wells should be used to monitor and evaluate the progress of the pilot test. Based upon our review of the site's hydrogeologic data (in particular, the observed hydraulic gradients and the assumed hydraulic conductivity) relative to the bioremediation technology, Tetra Tech has concluded that it is likely that the radius of influence of the test (within which effects will be most readily observed within the timeframe of the pilot test) is likely to be less than the distance to the closest downgradient monitoring wells. Therefore, we have included the costs for installing 7 additional observation wells (4 shallow and 3 intermediate) which will permit the sampling and analysis of groundwater at various locations and depths within the zone of influence of the pilot test. The Navy has concurred with this approach in revised statement of work dated April 18, 2007, and verbally directed Tetra Tech to add these wells to the SOW. At the Navy's verbal direction, Tetra Tech has also added labor and subcontractor costs associated with the geophysical borehole logging of each new well.

Subsequent to the Tetra Tech receipt of this SOW, the Navy directed Tetra Tech to add the installation of 12 soil borings and the submittal of 24 soil samples to the SOW. This soil investigation will be performed in the vicinity of the identified source area, to determine if the soils are a continuing and significant source of contamination to the groundwater, and whether a remedial action is merited for these soils.

In addition to work plan development and subsequent data validation, interpretation, and reporting of results, the implementation of the pilot test will chronologically include the following field elements:

- Installation of additional observation wells

- Performance of a short-term aquifer pumping test
- Sampling of wells for treatability study analyses
- Installation of injection and extraction wells
- Construction and installation of the treatment trailer
- One round of baseline sampling of observation wells
- Application of the bioremediation compounds and recirculation (with O&M) for 12 months
- Perform 6 rounds of sampling (4 quarters during circulation, 2 quarters post-circulation)

TtNUS notes that currently the NASJRB inner security fence runs directly through the source area at 05MW01 (in fact, the wells from that cluster occur on both sides of the fence). By the nature of its location, this fence will present severe logistical difficulties throughout the field operations of this CTO, and access to the area immediately inside the fence will likely be required for extended periods.

3.1 TASK 1 - PROJECT MANAGEMENT

Scope
Under this task, the day-to-day management of the CTO will be performed. This will include communications with the RPM and activity representatives, tracking financial expenditures and scheduled deliverables, direction of personnel between multiple offices and different work groups, maintenance of documentation of all communications and decisions and assistance for MIDLANT with the coordination of other parties involved.

Assumptions
- Monthly reporting requirements in accordance with the CLEAN contract are covered under this subtask.
- This task also includes technical closeout activities at the end of the project.
- The project is expected to be active for a 29 -month period, excluding project closeout activities.

Deliverables
There are no formal deliverables associated with this subtask.

3.2 Task 2 –TREATABILITY TESTING (BENCH OR LABORATORY SCALE)

Treatability testing will be conducted to evaluate the effectiveness of the candidate bioaugmentation mechanisms and remediation processes that are being considered for the site. The results of the treatability testing will be used to determine the conditions under which degradation products are produced, the rates of degradation, and the paths of degradation. This testing is expected to identify the naturally-occurring organisms (if present) that will be stimulated for field- and potentially full-scale in-situ treatment schemes for the VOCs in groundwater. Data from the treatability testing will be used to identify the parameters to be used for the field-scale testing and implementation.

3.2.1 Subtask 2.1 – Prepare Internal Draft Work Plan for Treatability Testing

Scope of Work
Under this subtask, Tetra Tech will prepare an internal draft version of the work plan for performing the treatability testing. This version of the work plan will be for Navy review only. The Navy will provide written comments, but written responses will not be required. The specific tasks to be addressed by this work plan include:

- Installation of additional observation wells
- Performance of a short-term aquifer pumping test
- Acquisition of selected groundwater samples for the treatability test

- Performance of the treatability test
- Report of results that will include the presentation, interpretation and analysis of all data, and its impact and meaning relative to the subsequent performance of the field-scale test.
- Installation of soil borings in the source area, with soil sampling and analytical testing

In addition, this subtask includes the preparation of a Health and Safety Plan (HASP). The HASP will address all activities associated with the treatability and pilot study including all field activities, sampling and operation and maintenance activities. It is assumed that the HASP will be prepared for Tetra tech and its subcontractors use only and will not require Navy review and approval.

Deliverables
The internal draft work plan will be delivered to the Navy in both hard copy and electronic (pdf) format.

The HASP will be prepared fore Tetra Tech use. A copy will be provided to the Navy if required.

3.2.2 Subtask 2.2 – Draft Work Plan for Treatability Testing

Scope:
Under this subtask, Tetra Tech will prepare a draft version of the work plan that is revised in response to the Navy comments on the internal draft of the work plan. The draft work plan will address the same work elements addressed by the internal draft work plan (Subtask 2.1). The draft work plan will be distributed to the Navy, EPA, and PADEP for regulatory review and comment. Written responses to the regulatory comments will be required. Tetra Tech will initially draft the responses for Navy review, and then finalize the responses upon the revision and acceptance of the comments by the Navy.

Deliverables
The draft work plan will be distributed to the Navy, EPA, and PADEP in hard copy within a 3-ring binder.

3.2.3 Subtask 2.3 – Final Work Plan for Treatability Testing

Scope:
Under this subtask, Tetra Tech will prepare a final version of the work plan that is revised in response to regulatory comments on the draft work plan. The final work plan will address the same work elements addressed by the internal draft work plan (Subtask 2.1).

Assumptions:
- Extra copies of the report will be required for the administrative record, and possibly for interested RAB members.

Deliverables
The final work plan will be distributed to EPA and PADEP in hard copy within a 3-ring binder, and to the Navy in both hard copy and electronic (pdf) format.

3.2.4 Subtask 2.4 – Obtain Samples and Hydraulic Data

Scope:
Under this subtask, Tetra Tech will obtain the groundwater samples to evaluate by the treatability test, and determine the hydraulic conductivity of the aquifer. These data are required to optimize the planning and performance of the subsequent field-scale test, to ensure that the test successfully evaluates the efficacy of this remedial alternative through the collection of the most pertinent technical data. In addition, soil samples will be obtained to evaluate the nature and extent of soil contamination remaining in the source area, to assist in evaluating whether any further source reduction should be considered as part of the remedial action. This subtask consists of the following components:

- Collection of groundwater samples from selected wells for the treatability test

Groundwater samples will be collected from a maximum of 5 monitoring wells and submitted to a fixed-base laboratory for bench-scale treatability testing.

Assumptions:

- The 5 monitoring wells will be sampled over a 2-day period.
- Purged groundwater will be disposed through a local sewer to the NASJRB WWTP.

Deliverables
There are no deliverables for this subtask.

3.2.5 Subtask 2.5 – Perform Bench-Scale Treatability Testing

Scope:
Under this subtask, Tetra Tech will submit the groundwater samples to a subcontracted, fixed-base laboratory to perform the treatability tests. The high concentrations of 1,1,1-TCA at the source area are a specific concern for this site. The 1,1,1-TCA has the potential to interfere with the effectiveness of the selected biological agent (Dehalococcoides, or DHC) that is most effective for the chlorinated ethenes.

Assumptions:

- The laboratory bench-scale testing will be performed over a 2-month period.

3.2.6 Subtask 2.6 – Internal Draft Report of Results for Bench-Scale Treatability Testing

Scope of Work
Under this subtask, Tetra Tech will prepare an internal draft version of the results of the bench-scale tests. This version of the report will be for Navy review only. The Navy will provide written comments, but written responses will not be required. Specific components of this report will include:

- The results of the bench-scale testing submitted as a letter report by the laboratory.
- The presentation of the data and interpretation of the aquifer pumping test.
- Geologic and geophysical boring logs and monitoring well construction details.
- The presentation of the validated soil data for VOCs.
- A comprehensive discussion of the overall results, and their significance to the planning of the subsequent field-scale test, including recommendations for the configuration of the injection and extraction wells and the proposed format and strategy for the field-scale test.

Deliverables
The internal draft work plan will be delivered to the Navy in both hard copy and electronic (pdf) format.

3.2.7 Subtask 2.7 – Draft Report of Results for Bench-Scale Treatability Testing

Scope:
Under this subtask, Tetra Tech will prepare a draft version of the report of results that is revised in response to the Navy comments on the internal draft of the report. The draft report will address the same work elements addressed by the internal draft report (Subtask 2.6). The draft report will be distributed to the Navy, EPA, and

PADEP for regulatory review and comment. Written responses to the regulatory comments will be required. Tetra Tech will initially draft the responses for Navy review, and then finalize the responses upon the revision and acceptance of the comments by the Navy.

Deliverables
The draft report will be distributed to the Navy, EPA, and PADEP in hard copy within a 3-ring binder.

3.2.8 Subtask 2.8 – Final Report of Results for Bench-Scale Treatability Testing

Scope:
Under this subtask, Tetra Tech will prepare a final version of the report of results that is revised in response to regulatory comments on the draft report. The final report will address the same work elements addressed by the internal draft report (Subtask 2.6).

Assumptions:
- Extra copies of the report will be required for the administrative record, and possibly for interested RAB members.

Deliverables
The final report will be distributed to EPA and PADEP in hard copy within a 3-ring binder, and to the Navy in both hard copy and electronic (pdf) format.

3.3 Task 3 –PILOT FIELD-SCALE TESTING

Pilot field-scale testing will be used to evaluate or prove the applicability of the bioaugmentation strategy to this site, as well as provide data to aid in the design and installation of a full-scale extraction and/or injection system at the site, and select the operational parameters for that full-scale system.

3.3.1 Subtask 3.1 – Prepare Internal Draft Work Plan for Pilot Test

Scope of Work
Under this subtask, Tetra Tech will prepare an internal draft version of the work plan for performing the pilot test. This version of the work plan will be for Navy review only. The Navy will provide written comments, but written responses will not be required. The specific tasks to be addressed by this work plan include:

- Installation of additional observation wells
- Installation of injection and extraction wells
- The installation of the delivery system
- Descriptions of the materials to be injected, including the estimated schedule, volumes, and rates
- Sampling and Analysis Plan, including strategy, parameters, well locations, schedule, QA/QC strategy, and proposed data validation strategy.
- Report of results that will include the presentation, interpretation and analysis of all data, and its impact and meaning relative to the subsequent performance of the field-scale test.

Deliverables
The internal draft work plan will be delivered to the Navy in both hard copy and electronic (pdf) format.

3.3.2 Subtask 3.2 – Draft Work Plan for Pilot Test

Scope:
Under this subtask, Tetra Tech will prepare a draft version of the work plan that is revised in response to the Navy comments on the internal draft of the work plan. The draft work plan will address the same work elements addressed by the internal draft work plan (Subtask 3.1). The draft work plan will be distributed to

the Navy, EPA, and PADEP for regulatory review and comment. Written responses to the regulatory comments will be required. Tetra Tech will initially draft the responses for Navy review, and then finalize the responses upon the revision and acceptance of the comments by the Navy.

Deliverables
The draft work plan will be distributed to the Navy, EPA, and PADEP in hard copy within a 3-ring binder.

3.3.3 Subtask 3.3 – Final Work Plan for Pilot Test

Scope:
Under this subtask, Tetra Tech will prepare a final version of the work plan that is revised in response to regulatory comments on the draft work plan. The final work plan will address the same work elements addressed by the internal draft work plan (Subtask 3.1).

Assumptions:
- Extra copies of the report will be required for the administrative record, and possibly for interested RAB members.

Deliverables
The final work plan will be distributed to EPA and PADEP in hard copy within a 3-ring binder, and to the Navy in both hard copy and electronic (pdf) format.

3.3.4 Subtask 3.4 – Procure Surveyor Services for New Wells

Scope:
Under this subtask, Tetra Tech will procure a surveyor to survey the horizontal locations and vertical elevations of the new wells installed during this project. The wells will be tied into an existing site benchmark.

Assumptions:
- The wells will be surveyed during one field day, at the conclusion of all installation activities. The Navy will provide access through the inner security fence.

Deliverables
No separate deliverable is required for this subtask. The surveying results will be presented in the report of results for the pilot test.

3.3.5 Subtask 3.5 – Provide Services Required for the Pilot Test

Subtask 3.5.1 Install 2 Injection Wells, 2 Extraction Wells, and Remaining 2 Monitoring Wells

Scope:
Under this subtask, Tetra Tech will prepare the site for the pilot test. Under this subtask, Tetra Tech will install the final 2 monitoring wells, 2 injection wells, and 2 extraction wells for the recirculation system.

Assumptions:
- 1 additional shallow monitoring well (70 feet deep) and 1 additional intermediate monitoring well (150 feet deep) will be installed. (NOTE THAT THE LABOR AND SUBCONTRACTOR COSTS FOR INSTALLING THESE WELLS ARE INCLUDED UNDER SUBTASK 3.12).
- The monitoring wells will be constructed with 2-inch-diameter PVC.
- 2 injection wells and 2 extraction wells will be installed. The wells will be approximately 100 feet deep.
- The injection and extraction wells will be constructed with 4-inch-diameter PVC.
- Drill cuttings will be containerized and disposed off-site as IDW.

- Aqueous IDW will be disposed through a local sewer to the NASJRB WWTP.
- NAS JRB will clear the subsurface utilities, and will provide access through the inner security fence.
- The water transfer lines for the injection/extraction system will be buried to prevent system freezing during cold weather.

Deliverables
No deliverable is required for this subtask.

3.3.6 Subtask 3.6 – System Construction and Start-Up

Scope:
Under this subtask, Tetra Tech will deliver the system trailer to the site and perform the initial injection of biological materials, including sodium lactate, sodium bicarbonate, nutrients, and the microbial innoculum (DHC), into the aquifer.

Assumptions:
- A trailer-mounted unit containing all injection piping, amendment containers, values, piping, and meters will be constructed off site and transported to the site for hookup.
- The trailer mounted unit will be customized/built-out specifically for this project. The piping, pump, tank, valve and other project-specific requirements will be determined based on the Bench Scale testing and will be defined in the Pilot Test Work Plan. For the purpose of this proposal, the costs associated with purchasing and customizing the trailer unit have been included. A build/buy/lease evaluation and determination will be made when the specific needs are defined. The cost proposal does not include costs associated with developing and maintaining a Government property control system, which, if required, would not be charged to this CTO.
- An electrical subcontractor will be used for the wiring of the system to a power source. It is assumed that an electrical line will be extended approximately 250 feet from a local source, and that this line will be buried to prevent interferences with base operations. It is possible that the trench may need to pass beneath the inner security fence, requiring the temporary removal of the fence.
- Start-up of the system will commence immediately after system installation.

Deliverables
No deliverable is required for this subtask.

3.3.7 Subtask 3.7 – System Operation

Scope:
This subtask includes the operation and maintenance of the pilot test system.

Assumptions:
- The system will continue to recirculate the biological materials for a period of 12 months.
- Amendments will be added as needed.
- Site operation visits will be conducted two times per week during the first month of operation and one time per week during months 2 through 12. The first month of O&M will use experienced system operators from the Pittsburgh office, who will also train the local (Philadelphia) staff. The local staff will assume the O&M activities in the second month of operation, through the total extent of the project.
- Periodic water level measurements will be taken from all wells within the project area, and pressure transducers will be installed in selected wells.
- During site visits, the operation of the system will be verified, field parameters will be recorded, and chemical tanks will be refilled.

Deliverables
No deliverable is required for this subtask.

3.3.8 Subtask 3.8 – Recirculation for One Year - Monitoring and Sampling

Scope:
This subtask includes the periodic sampling and analysis of groundwater samples that are required to evaluate the progress and effectiveness of the pilot test.

Assumptions:
- A total of 7 sampling rounds will be conducted, including one baseline round immediately prior to the initial injection (Round 1), The system will continue to recirculate the biological materials for a period of 12 months.
- Amendments will be added as needed.
- Site operation visits will be conducted two times per week during the first month of operation and one time per week during months 2 through 12. The first month of O&M will use experienced system operators from the Pittsburgh office, who will also train the local (Philadelphia) staff. The local staff will assume the O&M activities in the second month of operation, through the total extent of the project.
- Periodic water level measurements will be taken from all wells within the project area, and pressure transducers will be installed in selected wells.
- During site visits, the operation of the system will be verified, field parameters will be recorded, and chemical tanks will be refilled.
- A total of 20 wells will be sampled each round (an estimated 10 shallow wells and 10 intermediate wells). The samples will be obtained through the low-flow sampling procedure. An average of 4 wells per day will be sampled, resulting in a 1-week sampling effort for the entire round.
- The typical sampling day will consist of an 11-hour day (including travel) for a 2-person team. Additional time is included in this subtask for mobilization and demobilization efforts for each round.
- The analytical strategy will include:
  - All 20 wells will be sampled for VOCs for Rounds 1, 3, 5, and 7.
  - 10 selected wells will be sampled for VOCs for all 7 rounds.
  - 7 wells will be sampled for MNA/geochemistry for all 7 rounds.
  - 4 wells will be sampled for molecular biological tools (MBT)/molecular analysis for 4 rounds (Rounds 1, 2, 4, and 7).
- All analyses will be performed under a laboratory turnaround-time of 30 days.
- All laboratory data will be validated using the Navy and EPA Region 3 guidelines for data validation.

Deliverables
No deliverable is required for this subtask.

3.3.9 Subtask 3.9 – Internal Draft Report of Results for Pilot Test

Scope of Work
Under this subtask, Tetra Tech will prepare an internal draft version of the results of the pilot tests. This version of the report will be for Navy review only. The Navy will provide written comments, but written responses will not be required. Specific components of this report will include:

- A detailed summary of the system operation, including the agents injected, dates injected, volume of materials injected.
- The presentation and interpretation of the complete set of analytical data.
- Geologic boring logs and well construction details for the monitoring, injection, and extraction wells.
- A comprehensive discussion of the overall results, and an evaluation of the efficacy of anaerobic reductive dechlorination (ARD) at this site.

Deliverables
The internal draft work plan will be delivered to the Navy in both hard copy and electronic (pdf) format.

3.3.10 Subtask 3.10 – Draft Report of Results for Pilot Test

Scope:
Under this subtask, Tetra Tech will prepare a draft version of the report of results for the pilot test that is revised in response to the Navy comments on the internal draft of the report. The draft report will address the same work elements addressed by the internal draft report (Subtask 3.9). The draft report will be distributed to the Navy, EPA, and PADEP for regulatory review and comment. Written responses to the regulatory comments will be required. Tetra Tech will initially draft the responses for Navy review, and then finalize the responses upon the revision and acceptance of the comments by the Navy.

Deliverables
The draft report will be distributed to the Navy, EPA, and PADEP in hard copy within a 3-ring binder.

3.3.11 Subtask 3.11 – Final Report of Results for Pilot Test

Scope:
Under this subtask, Tetra Tech will prepare a final version of the report of results for the pilot test that is revised in response to regulatory comments on the draft report. The final report will address the same work elements addressed by the internal draft report (Subtask 3.9).

Assumptions:
- Extra copies of the report will be required for the administrative record, and possibly for interested RAB members.

Deliverables
The final report will be distributed to EPA and PADEP in hard copy within a 3-ring binder, and to the Navy in both hard copy and electronic (pdf) format.

3.3.12 Subtask 3.12 – Installation of Observation Wells

Under this subtask, Tetra Tech will

- Installation of 7 monitoring wells

Tetra Tech recommends the installation of additional monitoring wells because our review of the site data indicate that the zone of influence of the pilot test (or the zone with the most relevant or pertinent results) is not likely to extend as far as the closest current monitoring well cluster. Tetra Tech recommends that 7 additional wells be installed, with 5 wells installed during the initial field mobilization, and 2 wells subsequently installed during the installation of the injection and extraction wells (Subtask 3.5), which will occur after the data obtained through this subtask are evaluated.

Assumptions:

- 3 shallow wells (70 feet deep) and 2 intermediate wells (150 feet deep) will be installed during this first mobilization. (NOTE THAT THE LABOR AND SUBCONTRACTOR COSTS FOR INSTALLING THE TWO ADDITIONAL MONITORING WELLS DURING THE SECOND MOBILIZATION ARE ALSO INCLUDED IN THIS SUBTASK).
- The wells will be constructed with 2-inch-diameter PVC.
- Drill cuttings will be containerized and disposed off-site as IDW.
- Aqueous IDW will be disposed through a local sewer to the NASJRB WWTP.
- NAS JRB will clear the site for subsurface utilities.

- Performance of a short-term (24-hour) aquifer pumping test

A short-term (24-hour) pumping test will be performed to obtain the hydraulic data required for the design of the field-scale pilot test. Specifically, the hydraulic conductivity (K) of the aquifer will be obtained to determine the local groundwater flow velocity and to help determine the volume (and rate) of the biochemicals to be added. In addition, the test may indicate preferred directions of drawdown, or preferred avenues of groundwater flow. All of these data are required to design the most optimal field-scale test that will lead to the collection of the most relevant data.

Assumptions:

- The pumped groundwater will be disposed through a local sewer to the NASJRB WWTP.
- Transducers will be placed in a maximum of 5 monitoring wells.
- Access to wells (including several inside the security fence) will be available over an approximately 30-consecutive-hour period.
- If no meaningful trends or drawdown are observed after 24 hours, Tetra Tech will contact the Navy regarding the possibility of extending the test.

3.3.13 Subtask 3.13 – Perform Geophysical Borehole Logging in all New Boreholes

Scope:
Under this subtask, Tetra Tech will procure a subcontractor to perform geophysical borehole logging of ALL new site boreholes, including the boreholes for the initial 5 monitoring wells installed during the first field mobilization.

Assumptions:
- The borehole logging will be performed during 2 field mobilizations. The first mobilization will be for the logging of the 5 initial monitoring well boreholes (a 2-day field effort). The second mobilization will be for the logging of the final 2 monitoring well boreholes, the 2 extraction well boreholes, and the 2 injection well boreholes (a 3-day field effort).
- A Tetra Tech geologist will perform field oversight of the logging program.
- The geophysical logs to be run include a caliper log, natural gamma log, formation resistivity log, fluid temperature and resistance log, and vertical flow log (thermal pulse). Video logs (television surveys) will not be performed.
- Drill cuttings will be containerized and disposed off-site as IDW.
- Aqueous IDW (formation water produced during the performance of the vertical flow logs) will be disposed through a local sewer to the NASJRB WWTP.

3.3.14 – Matches 3.8.

3.3.15 Subtask 3.15 – Soil Boring Sampling

Under this subtask, Tetra Tech

- Installation of 12 soil borings and collection of surface and subsurface soil samples

A total of 12 soil borings will be drilled in the vicinity of the source area (near well cluster 05MW01) in order to further delineate the nature and extent of the soil contamination that has been detected in this area. The exceedances of soil-to-groundwater screening criteria suggest that the soil may be a continuing source of the groundwater plume.

Assumptions:

- The 12 soil borings will be drilled with a DPT ("Geoprobe") rig over a 2-day period.

- The DPT work will be done by the same drilling subcontractor installing the wells. A separate procurement will not be required.
- A total of 24 samples (including 2 field duplicates) will be submitted to a laboratory for VOC analysis.
- The analytical data will be validated using Navy and EPA Region 3 guidelines for data validation.

Deliverables

There are no deliverables for this subtask.

Table 3-1
NAS JRB WILLOW GROVE Site 05 Bioaugmentation Pilot Test

Media	Analyses[1]	Field Samples	Field Duplicates (1 per 10 field samples)	Rinsate Blanks[2]	Trip Blanks[3]	Source Blanks[4]	Total Quantity[5]
Soil	TCL VOCs w/percent moisture	22	2	0	2	0	26
Groundwater	TCL VOCs	150	15	8	35	1	209
	Total Organic Carbon	49	0	0	0	0	49
	Select Inorganics	49	0	0	0	0	49
	Dissolved Sulfide	49	0	0	0	0	49
	Anions	49	0	0	0	0	49
	PCR/Enzymes	16	0	0	0	0	16
	Metabolic acids	49	0	0	0	0	49
	Dissolved Gasses	49	0	0	0	0	49

Notes:

(1) TCL= Target Compound List
VOCs= Volatile Organic Compounds

(2) One rinsate blank per type of tool or sampling procedure used, such as a stainless steel trowel or bowl. If pre-cleaned, dedicated, or disposable equipment are used, such as plastic scoopulas or scoops, one rinsate blank will be collected as a "batch blank" per type of equipment used.

(3) One trip blank will be included in every discrete shipping container (i.e. cooler) that transports a sample for determination of volatile organics.

(4) Source water blanks will be generated at a rate of one per lot of decontamination water source (e.g. deionized ultra-filtered (DIUF), potable water, and water in driller's storage tank) brought on site.

4.0 PROJECT BUDGET

The estimated cost for Tetra Tech to perform the scope of work for the tasks described in Section 3 is presented on Tables 4-1 through 4-6. The total project cost is shown on Table 4-1. This cost includes all labor, overhead, travel, other direct costs (ODCs), G&A, subcontracts and fee. Tetra Tech hourly estimates by classification and task are shown on Table 4-2. Other direct costs are summarized on Table 4-3 and travel and living expenses are summarized on Table 4-4. Subcontractor costs are provided on Table 4-5 and field equipment costs are provided on Tables 4-6.

The estimated budget assumes that all work will be performed as described in the scope of work presented in Section 3.0 and within the project schedule presented in Section 5.0.

Labor rates used for this estimate are the base hourly rates specified in the CLEAN contract. Actual hourly salaries of Tetra Tech staff may vary from these rates but will not go above the not-to-exceed rates specified in the contract without the prior written consent of the government. Overhead, G&A, and fee rates used are those specified in the contract.

5.0 PROJECT SCHEDULE

The proposed key field event and deliverables schedule is shown below. Attached as Figure 5-1 is a Gantt chart depiction of the schedule. The milestone dates are presented as weeks from Notice to Proceed.

Summary of Deliverables

Schedule Item	Proposed Completion Date (Weeks, Notice to Proceed)
Notice to Proceed	May 1, 2007
Submit Internal Draft Work Plan for Bench Test	May 15, 2007
Submit Draft Work Plan for Bench Test	May 29, 2007
Submit Final Work Plan for Bench Test	June 25, 2007
Install Soil Borings and Phase I Monitoring Wells	July 10 - July 23, 2007
Perform Bench Test	July 24 - September 10, 2007
Submit Internal Draft Report of Results for Bench Test	September 24, 2007
Submit Draft Report of Results for Bench Test	October 8, 2007
Submit Final Report of Results for Bench Test	October 24, 2007
Submit Internal Draft Work Plan for Pilot Test	November 7, 2007
Submit Draft Work Plan for Pilot Test	November 21, 2007
Submit Final Work Plan for Pilot Test	December 18, 2007
Install Injection/Extraction Wells and Phase II Monitoring Wells	January 9 – January 15, 2008
Begin Pilot Test - Inject Bio Agents	January 16, 2008
System Operation & Monthly Monitoring and Sampling	
Submit Internal Draft Report of Results for Pilot Test	September 15, 2009
Submit Draft Report of Results for Pilot Test	September 29, 2009
Submit Final Report of Results for Pilot Test	October 23, 2009

Please enter the following information	
Description of Project (e.g., Remedial Investigation)	Pilot Study for Site 5 Bioaugmetatior
Location of Project (e.g., Naval Surface Warfare Center, Dahlgren	NASJRB Willow Grove
Continued Description of Location (e.g., Bedford, Massachusetts	Willow Grove, Pennsylvania
CTO No.	411
Indicate if this is an Implementation Plan or a Cost Impact Letter (if a CIL, please indicate the number as well, i.e. Cost Impact Letter No. 2)	Implementation Plan

For items a through g, please enter 1 if the notation is applicable to your project; if it is not applicable, please enter a 0 (zero). Items h through j are unused.	a	CIL		0
	b	IMPLEMENTATION PLAN		1
	c	DPM		1
	d	DPM = G. Glenn		1
		PM		
	e	P5		1
	f	P4		1
	g	P3		1
	h			0
	i			
	j			0
For item k, FOR AN IMPLEMENTATION PLAN, please indicate the CTO start and end dates, from the date the IP (not the start-up) is funded to the date of the final deliverable; FOR A CIL, indicate the additional weeks the project will be active due to the CIL (from the end date of the last proposal to the new end date).	k	Starting Date		5/1/2007
	k	Ending Date		10/23/2009
The number of total weeks the proposed work will be active or the additional weeks added by the CIL are automatically calculated, based on the item k input.		Weeks Active		129
The number of total months the proposed work will be active or the additional months added by the CIL are automatically calculated, based on the item k input.		Months Active		29
For item l, please indicate by number (1 or 2) the type of proposal funding you received	l	Small (1): Large (2)		0
For item m, please indicate the number of NEW subcontractors (other than BOA Laboratories) that will be required under this Implementation Plan or CIL.	m	# NEW SUBS		0
		(NOT MSA LABS)		
For item n, FOR AN IMPLEMENTATION PLAN, please indicate how many of each type of sub there will be working on the project and the number of weeks each subcontractor will be active. FOR A CIL, please indicate the additional time for each new or previous sub.	n		No. of Subs.	No. of Wks.
		Analytical (NOT MSA)	0	0
		Surveyor	1	1
		Drilling	1	0
		Electrical	1	0
		IDW	1	0
		Other	1	0
For item o, please indicate how many MSA labs will be working on the project and the combined number of weeks the MSA subcontractor(s) will be active on the project for an Implementation Plan; or additional weeks for a CIL.	o	MSA	1	0

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DATE:	24-Apr-07	RATES:	P5	$51.82
CONTRACT:	N62467-04-D-0055		P4	$39.78
FIRM:	TETRA TECH NUS, INC.		P3	$32.53
TITLE:	Pilot Study for Site 5 Bioaugmetatior		P2	$26.40
LOCATION:	NASJRB Willow Grove		P1	$22.08
	Willow Grove, Pennsylvania		S3	$19.88
CTO NO.:	411		S2	$18.72
	Implementation Plan		S1	$16.05

TABLE 4-1: TETRA TECH NUS, INC. SUMMARY OF COST

TETRA TECH NUS, INC. ELEMENT OF COST		
LABOR		
Direct Labor (Table 4-3)		98,451
DIRECT LABOR BURDEN at 123.11%		121,203
Subtotal Labor and Direct Labor Burden		219,654
OTHER DIRECT COSTS		
Travel (Table 4-5)		12,747
Other ODCs (Tables 4-4, and 4-7)		80,940
Subtotal ODCs		93,687
G & A AT 10.46% on ODCs		9,800
SUBTOTAL OF ALL COSTS		323,141
AWARD FEE BASE		323,141
AWARD FEE AT 10.0%		32,314
TOTAL ESTIMATED TETRA TECH NUS, INC. COST AND FEE		355,455
SUBCONTRACTOR ELEMENT OF COST		
SUBCONTRACTORS (Table 4-6)		208,671
Analytical	77,121	
Surveying	1,800	
Drilling	96,225	
IDW Mgmt.	16,275	
Electrical	7,500	
Geophysics	9,750	
SUBCONTRACT HANDLING FEE 1.43%		2,984
SUBTOTAL OF ALL COSTS		211,655
AWARD FEE BASE		211,655
AWARD FEE AT 10.0%		21,165
TOTAL ESTIMATED SUBCONTRACTOR COST AND FEE		232,820
TOTAL COMBINED COST		534,796
TOTAL COMBINED FEE		53,480
COMBINED COST AND FEE		588,276

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TABLE 4-3 - DIRECT LABOR SUMMARY (Level of Effort)

CONTRACT NO.:	**N62467-04-D-0055**
CTO NO.:	**411**
FIRM:	**TETRA TECH NUS, INC.**
TITLE:	**Pilot Study for Site 5 Bioaugmetation**
LOCATION:	**NASJRB Willow Grove**
	Willow Grove, Pennsylvania
	Implementation Plan

Task #	Task Description	Senior Review P5	Project Manager P3	Senior Geologist P4	Staff Engineer P3	Jr. Engineer/ Geologist P2	Sr. Geol/ H&S P3	Staff Geologist P1	Staff Chemist P2	Sr. Chemist P4	Staff Procurement S3	Cost Schedule Specialist P1	Sr. Support Equip Mgr P1	Sr. CADD P1	Support Adm. S2	TOTAL
1	Project Management		280.00									58.00			35.00	373.00
2	Treatability Testing															0.00
2.1	Work Plan internal draft			43.00	40.00	6.00	52.00		35.00					6.00		182.00
2.2	Work Plan Draft			8.00	2.00	2.00	1.00		5.00					2.00		20.00
2.3	Work Plan Final			10.00	4.00	4.00	1.00		2.00					2.00		23.00
2.4	Obtain Samples and Data					22.00		22.00	4.00				4.00			52.00
2.5	Bench or laboratory Testing			4.00					10.00							14.00
2.6	Report of Results internal draft			30.00	7.00			4.00								41.00
2.7	Report of Results Draft			8.00	12.00			2.00								22.00
2.8	Report of Results Final			4.00	4.00			2.00								10.00
3	Pilot Test															0.00
3.1	Work Plan internal draft			100.00	25.00		12.00	25.00	12.00					6.00		180.00
3.2	Work Plan Draft			10.00	5.00		1.00	5.00	4.00					2.00		27.00
3.3	Work Plan Final			20.00	7.00		1.00							2.00		30.00
3.4	Procure Surveyor							1.00								1.00
3.5	Pilot Test															0.00
3.5.1	Install Injection/Extraction Wells			8.00	8.00	53.00		54.00								123.00
3.6	System Construction & Start-Up			40.00	40.00	132.00		40.00								252.00
3.7	System Operation			40.00	280.00	80.00		80.00								480.00
3.8	Monitoring & Sampling			12.00	12.00	409.00		409.00	50.00	12.00			8.00			912.00
3.9	Report of Results internal draft			110.00	50.00			35.00						10.00		205.00
3.1	Report of Results Draft			24.00	14.00			6.00						2.00		46.00
3.11	Report of Results Final			45.00	16.00			8.00						8.00		77.00
3.12	Installation of Observataion Wells			9.00		82.00	8.00	82.00					4.00		4.00	189.00
3.13	Geophysical Borehole Logging			4.00			4.00	55.00								63.00
3.14	see 3.8 - Navy 3.14															0.00
3.15	Install Soil Borings					12.00		13.00	8.00	2.00			4.00			39.00
4	Meetings															0.00
4.1	Participate in 2 Meetings		16.00	24.00												40.00
																0.00
																0.00
																0.00
																0.00
																0.00
																0.00
																0.00
																0.00
																0.00
Total Hours		0.00	296.00	553.00	526.00	802.00	80.00	843.00	130.00	14.00	0.00	58.00	20.00	40.00	39.00	3,401.00
Labor Rates		$51.82	$32.53	$39.78	$32.53	$26.40	$32.53	$22.08	$26.40	$39.78	$19.88	$22.08	$22.08	$22.08	$18.72	
Direct Labor Cost		$0.00	$9,628.88	$21,998.34	$17,110.78	$21,172.80	$2,602.40	$18,613.44	$3,432.00	$556.92	$0.00	$1,280.64	$441.60	$883.20	$730.08	$98,451.08

TOTAL DIRECT LABOR: $98,451.08

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TABLE 4-4 - OTHER DIRECT COSTS SUMMARY

CONTRACT NO.: N62467-04-D-0055
CTO NO.: 411
FIRM: TETRA TECH NUS, INC.
TITLE: Pilot Study for Site 5 Bioaugmetation
LOCATION: NASJRB Willow Grove
Willow Grove, Pennsylvania
Implementation Plan

TASK #	TASK DESCRIPTION	Computer Usage $1.77 Unit	each hour Cost	All Copies $0.07 Unit	each copy Cost	Report Binding Matls $5.00 each Unit	Cost	Communications $6.00 Unit	each call Cost	Postage & Shipping $7.59 Unit	5 lb pkg Cost	Postage & Shipping $81.70 Unit	60# cooler Cost	** Technical Closeout	Total
1.00	Project Management	373.00	$660.21		$0.00		$0.00		$0.00		$0.00		$0.00	$217.96	$878.17
2.00	Treatability Testing	0.00	$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00
2.10	Work Plan internal draft	182.00	$322.14	3000	$210.00		$0.00		$0.00		$0.00		$0.00		$532.14
2.20	Work Plan Draft	20.00	$35.40	1600	$112.00	10	$50.00		$0.00	4	$30.36		$0.00		$227.76
2.30	Work Plan Final	23.00	$40.71	1600	$112.00	15	$75.00		$0.00	6	$45.54		$0.00		$273.25
2.40	Obtain Samples and Data	52.00	$92.04	100	$7.00		$0.00		$0.00		$0.00		$0.00		$99.04
2.50	Bench or laboratory Testing	14.00	$24.78	100	$7.00		$0.00		$0.00		$0.00	10	$817.00		$848.78
2.60	Report of Results internal draft	41.00	$72.57	2000	$140.00		$0.00		$0.00		$0.00		$0.00		$212.57
2.70	Report of Results Draft	22.00	$38.94	1600	$112.00	10	$50.00		$0.00	4	$30.36		$0.00		$231.30
2.80	Report of Results Final	10.00	$17.70	1600	$112.00	10	$50.00		$0.00	4	$30.36		$0.00		$210.06
3.00	Pilot Test	0.00	$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00
3.10	Work Plan internal draft	180.00	$318.60	4000	$280.00		$0.00		$0.00		$0.00		$0.00		$598.60
3.20	Work Plan Draft	27.00	$47.79	3000	$210.00	10	$50.00		$0.00	4	$30.36		$0.00		$338.15
3.30	Work Plan Final	30.00	$53.10	3000	$210.00	15	$75.00		$0.00	6	$45.54		$0.00		$383.64
3.40	Procure Surveyor	1.00	$1.77		$0.00		$0.00		$0.00		$0.00		$0.00		$1.77
3.50	Pilot Test	0.00	$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00
3.5.1	Install Injection/Extraction Wells	123.00	$217.71		$0.00		$0.00		$0.00		$0.00		$0.00		$217.71
3.60	System Construction & Start-Up	252.00	$446.04	500	$35.00		$0.00		$0.00		$0.00		$0.00		$481.04
3.70	System Operation	480.00	$849.60	500	$35.00		$0.00		$0.00		$0.00		$0.00		$884.60
3.80	Monitoring & Sampling	912.00	$1,614.24	500	$35.00		$0.00		$0.00		$0.00	60	$4,902.00		$6,551.24
3.90	Report of Results internal draft	205.00	$362.85	4000	$280.00	10	$50.00		$0.00	4	$30.36		$0.00		$723.21
3.10	Report of Results Draft	46.00	$81.42	3000	$210.00	10	$50.00		$0.00	4	$30.36		$0.00		$371.78
3.11	Report of Results Final	77.00	$136.29	3000	$210.00	15	$75.00		$0.00	6	$45.54		$0.00		$466.83
3.12	Installation of Observataion Wells	189.00	$334.53	100	$7.00		$0.00		$0.00		$0.00		$0.00		$341.53
3.13	Geophysical Borehole Logging	63.00	$111.51		$0.00		$0.00		$0.00		$0.00		$0.00		$111.51
3.14	see 3.8 - Navy 3.14	0.00	$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00
3.15	Install Soil Borings	39.00	$69.03	100	$7.00		$0.00	2	$12.00		$0.00	4	$326.80		$414.83
4.00	Meetings	0.00	$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00
4.10	Participate in 2 Meetings	40.00	$70.80	60	$4.20		$0.00	2	$12.00		$0.00		$0.00		$87.00
		0.00	$0.00		$0.00		$0.00		$0.00		$0.00		$0.00		$0.00
TOTAL		3401	$6,019.77	33360	$2,335.20	105	$525.00	4	$24.00	42	$318.78	74	$6,045.80	$217.96	$15,486.51

TOTAL OTHER DIRECT COSTS: $15,486.51

Technical Closeout
500 copies at $.07 $35.00
8 boxes at $5.87 $46.96
UPS shipping at $17 ea $136.00

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TABLE 4-5 - OTHER DIRECT COSTS SUMMARY - TRAVEL

CONTRACT NO.: N62467-04-D-0055
CTO NO.: 411
FIRM: TETRA TECH NUS, INC.
TITLE: Pilot Study for Site 5 Bioaugmetatior
LOCATION: NASJRB Willow Grove
Willow Grove, Pennsylvania
Implementation Plan

TASK #	TASK DESCRIPTION	No. of People	No. of Trips	No. of Days	Airfare @ $/Person 200	Lodging w/tax @ $/day 158.7	Meals/Incids @ $/day 65	Car Rental @ $/day $75	Parking @ $/day $9	Tolls @ $/trip $3	Mileage @ $0.485/mil (calculate)	Total
					$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
3.12	Install Observataion Wells	1	11	1	$0.00	$0.00	$0.00	$0.00	$0.00	$33.00	$0.00	$33.00
3.12	Aquifer Pumping Test	2	3	1	$0.00	$0.00	$0.00	$0.00	$0.00	$9.00	$0.00	$9.00
2.40	Sample Selected Wells	2	2	1	$0.00	$0.00	$0.00	$0.00	$0.00	$6.00	$0.00	$6.00
3.15	Install Soil Borings	1	2	1	$0.00	$0.00	$0.00	$0.00	$0.00	$6.00	$0.00	$6.00
3.5.1	Install Injection Wells	1	9	1	$0.00	$0.00	$0.00	$0.00	$0.00	$27.00	$0.00	$27.00
3.13	Geophysical Logging	1	5	1	$0.00	$0.00	$0.00	$0.00	$0.00	$15.00	$0.00	$15.00
					$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
3.60	System Construction & Start-Up	1	4	5	$800.00	$2,539.20	$1,170.00	$1,500.00	$180.00	$0.00	$0.00	$6,189.20
	(Pitts to Phila to Pitts)				$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
3.7	System Operation	1	4	4	$800.00	$1,904.40	$910.00	$1,200.00	$144.00	$0.00	$0.00	$4,958.40
	(Pitts to Phila to Pitts)				$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
3.70	System Operation	1	50	1	$0.00	$0.00	$0.00	$0.00	$0.00	$150.00	$0.00	$150.00
3.80	Monitoring and Sampling	2	35	1	$0.00	$0.00	$0.00	$0.00	$0.00	$105.00	$0.00	$105.00
4.1	Participate in 2 Meetings	1	2	2	$400.00	$317.40	$195.00	$300.00	$36.00	$0.00	$0.00	$1,248.40
	(Pitts to Phila to Pitts)				$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
					$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
					$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
					$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
					$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
					$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
					$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
					$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
					$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
					$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
					$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
TOTAL					$2,000.00	$4,761.00	$2,275.00	$3,000.00	$360.00	$351.00	$0.00	$12,747.00

Local travel: Tolls ($3/trip) only expense. Cargo van and gas covered elsewhere.

TOTAL TRAVEL EXPENSES: $12,747.00

"Use or disclosure of data contained on this sheet is subject to the restriction on the title page of the CTO Implementation Plan."

TABLE 4-6 - SUBCONTRACTOR COST SUMMARY
CONTRACT NO.: N62467-04-D-0055
CTO NO.: 411
FIRM: TETRA TECH NUS, INC.
TITLE: Pilot Study for Site 5 Bioaugmetation
LOCATION: NASJRB Willow Grove
Willow Grove, Pennsylvania
Implementation Plan

TASK	Analytical	Surveying	Drilling	IDW Mgmt.	Electrical	Geophysics (attached)	TOTAL
	$77,121.00	$1,800.00	$96,225.00	$16,275.00	$7,500.00	$9,750.00	$208,671.00
TOTAL	**$77,121.00**	**$1,800.00**	**$96,225.00**	**$16,275.00**	**$7,500.00**	**$9,750.00**	**$208,671.00**

TOTAL SUBCONTRACTOR COSTS: $208,671.00

Analytical Estimate	Quantity	Unit	Unit Price	Total
3.8 TCL VOCs (aq)	209	sample	$110.00	$22,990.00
2.4.2 TCL VOCs (soil)	24	sample	$165.00	$3,960.00
2.4.2 TCL VOCs (aq)	2	sample	$110.00	$220.00
3.8 TOC	49	sample	$25.00	$1,225.00
3.8 Select Inorganics	49	sample	$30.00	$1,470.00
3.8 Dissolved Sulfide	49	sample	$25.00	$1,225.00
3.8 Anions	49	sample	$75.00	$3,675.00
3.8 PCR/Enzymes	16	sample	$650.00	$10,400.00
3.8 Metabolic acids	49	sample	$100.00	$4,900.00
3.8 Dissolved Gasses	49	sample	$144.00	$7,056.00
3.8 Bench Testing	1	LS	$20,000.00	$20,000.00
TOTAL	546			$77,121.00

Drilling Estimate	Quantity	Unit	Unit Price	Total
2.4.1 Mob and Demob	1	LS	$3,000.00	$3,000.00
2.4.1 Surface Casings	140	ft	$30.00	$4,200.00
2.4.1 Air Rotary 6-inch	730	ft	$30.00	$21,900.00
2.4.1 Install Well 2" PVC	750	ft	$20.00	$15,000.00
2.4.1 Well Completions	7	eacj	$250.00	$1,750.00
2.4.1 Well Development	28	hours	$225.00	$6,300.00
2.4.2 Daily Rate DPT	2	day	$1,600.00	$3,200.00
2.4.2 DPT materials	1	LS	$600.00	$600.00
3.5.1 Mob and Demob	1	LS	$1,500.00	$1,500.00
3.5.1 Surface Casings	160	ft	$30.00	$4,800.00
3.5.1 Air Rotary 8-inch	400	ft	$35.00	$14,000.00
3.5.1 Install Well 4" PVC	415	ft	$25.00	$10,375.00
3.5.1 Well Completions	4	eacj	$250.00	$1,000.00
3.5.1 Well Development	16	hours	$225.00	$3,600.00
3.5.1 Trenching/Plumbing	1	LS	$5,000.00	$5,000.00
TOTAL				$96,225.00

Surveying Estimate	Quantity	Unit	Unit Price	Total
Survey New Wells	1	LS	$1,800.00	$1,800.00
				$0.00
				$0.00
TOTAL				$1,800.00

IDW Mgmt. Estimate	Quantity	Unit	Unit Price	Total
Container spotting/pickup	3	container	$1,900.00	$5,700.00
Container rental	9	week	$175.00	$1,575.00
IDW characterization	3	sample	$400.00	$1,200.00
Non-haz disposal	120	ton	$65.00	$7,800.00
TOTAL				$16,275.00

Electrical	Quantity	Unit	Unit Price	Total
Power to Source Area	1	LS	$7,500.00	$7,500.00
				$0.00
				$0.00
TOTAL				$7,500.00

Geophysics	Quantity	Unit	Unit Price	Total
Mobilization	2	LS	$1,000.00	$2,000.00
Borehole Logging	5	day	$1,250.00	$6,250.00
Report	2	LS	$750.00	$1,500.00
TOTAL				$9,750.00

"Use or disclosure of data contained on this sheet is subject to the restriction on the title page of the CTO Implementation I

TABLE 4-7 - EXPENDABLE SUPPLIES/EQUIPMENT USAGE COST SUMMARY

CONTRACT NO.: N62467-04-D-0055
CTO NO.: 411
FIRM: TETRA TECH NUS, INC.
TITLE: Pilot Study for Site 5 Bioaugmetation
LOCATION: NASJRB Willow Grove
Willow Grove, Pennsylvania
Implementation Plan

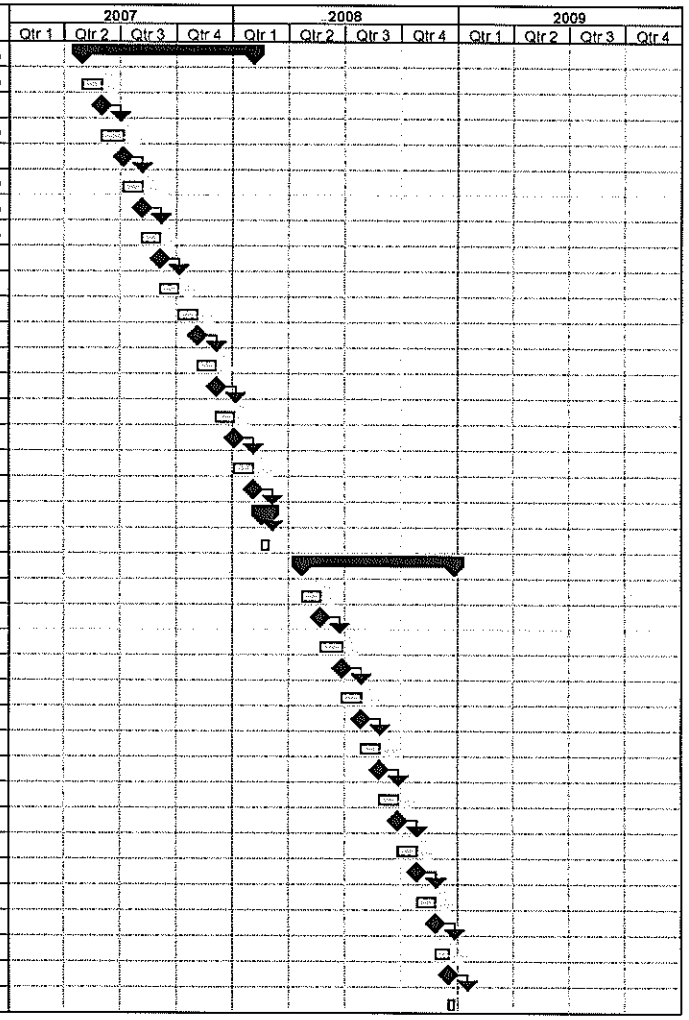
Expendable Supplies	Quantity		Unit Rate/Price	Total
Aluminum Foil		roll	$2.10	$0.00
Bubble Wrap	10	roll	$16.99	$169.90
Strapping Tape	16	roll	$2.13	$34.08
Duct Tape	16	roll	$3.43	$54.88
Clear Tape	16	roll	$2.38	$38.08
Paper Towels	20	roll	$1.25	$25.00
Garbage Bags (large)	24	box	$4.23	$101.52
Ziplock Bags (small)	30	box	$2.11	$63.30
Ziplock Bags (large)	40	box	$2.11	$84.40
Liquinox (gallon)	4	each	$28.16	$112.64
Bulldog Boots	20	pair	$9.90	$198.00
Cotton Work Gloves	40	pair	$0.70	$28.00
Tape Measure (300 ft)	1	each	$74.29	$74.29
Nitrile Gloves	20	pair	$1.19	$23.80
Surgeons Gloves	20	box	$9.68	$193.60
Tyvek Overalls	40	each	$4.07	$162.80
Wooden Stakes	2	bundle	$8.15	$16.30
Spray Paint	10	can	$3.97	$39.70
PID Span Gas	4	cylinder	$37.10	$148.40
Decontamination Tub	6	each	$12.00	$72.00
Decon Scrub Brush	4	each	$4.30	$17.20
Plastic Drop Cloth	16	roll	$4.24	$67.84
DI water (gallon)	16	each	$16.18	$258.88
First Aid Supplies	1	each	$150.00	$150.00
Isopropanol (5 liter)	1	each	$32.00	$32.00
Wash Bottles	6	each	$17.55	$105.30
5-Gallon Bucket	6	each	$4.00	$24.00
Ice	120	bag	$1.60	$192.00
Mixing Bowls		each	$3.00	$0.00
Teflon Tubing (50 ft)	5	each	$82.00	$410.00
Surgical Tubing (50 ft)	2	each	$60.56	$121.12
SS Trowels		each	$4.20	$0.00
Fuel for Van	650	gal	$2.90	$1,885.00
Hach Alakalinity AL-DT kit	6	each	$158.00	$948.00
Hach Ferrous Iron IR-18C Kit	8	each	$44.90	$359.20
Hach Manganese MN-5 Kit	6	each	$89.95	$539.70
Hach Nitrate N1-12 Kit	6	each	$80.00	$480.00
Hach Hydrogen Sulfide HS-C Kit	20	each	$34.10	$682.00
Chemetrics CO2 Kits (H/M/L)	12	each	$28.00	$336.00
Chemetrics DO Kits (H/L)	16	each	$45.10	$721.60
Chemetrics Sulfide Kits (H/L)	6	each	$52.80	$316.80
Sodium bicarbonate	48	50 lb bag	$12.00	$576.00
Sodium lactate	12	275 kg bag	$649.00	$7,788.00
Nutrients (B12, phosphorous)	1	LS	$300.00	$300.00
DHC	20	liters	$300.00	$6,000.00
Total Trailer Construction Costs	1	LS	$16,000.00	$16,000.00
				$0.00
				$0.00
		TOTAL		$39,951.33

Equipment - Third Party Rental	Quantity		Duration		Unit Rate/Price	Total
Water qual meter Horiba U22	1	each	15	week	$212.00	$3,180.00
PID Photovac 2020	1	each	15	week	$159.00	$2,385.00
Peristaltic Pump ISCO 150	1	each	11	week	$53.00	$583.00
Water level indicator (M-scope)	1	each	50	week	$31.80	$1,590.00
Heron Dipper T		each		week	$31.80	$0.00
Submersible pump Grundfos Redi-flo	1	each	58	week	$182.32	$10,574.56
Cargo Van	1	each	13	week	$375.00	$4,875.00
Air Sampler		units		week		$0.00
Rental Truck		each		week	$350.00	$0.00
Data Loggers and Transducers	3	each	5	week	$125.00	$1,875.00
Turbidity Meter	1	each	8	week	$40.00	$320.00
Hach Colorimeter	1	each	3	week	$40.00	$120.00
						$0.00
		TOTAL				$25,502.56

Total Table 4-7 $65,453.89

CTO 407 SCHEDULE

Task	Plan Begin	Act. Begin	Plan End	Act. End	% Comp.
STP PDI WORK PLAN	5/1/07	NA	2/4/08	NA	0%
Prepare Internal Draft WP	5/1/07	NA	6/1/07	NA	0%
Submit Internal Draft WP	***6/1/07***	***NA***	***6/1/07***	***NA***	***0%***
Prepare Draft WP	6/1/07	NA	7/6/07	NA	0%
Submit Draft WP	***7/6/07***	***NA***	***7/6/07***	***NA***	***0%***
Regulatory Review	7/6/07	NA	8/6/07	NA	0%
Receive Regulatory Comments	8/6/07	NA	8/6/07	NA	0%
Prepare Response To Comments	8/6/07	NA	9/5/07	NA	0%
Submit Response to Comments	***9/5/07***	***NA***	***9/5/07***	***NA***	***0%***
Regulatory Review of Comments	9/5/07	NA	10/5/07	NA	0%
Prepare Draft Final Work Plan	10/5/07	NA	11/5/07	NA	0%
Submit Draft Final Work Plan	***11/5/07***	***NA***	***11/5/07***	***NA***	***0%***
Regulatory Review	11/5/07	NA	12/5/07	NA	0%
Receive Regulatory Comments	12/5/07	NA	12/5/07	NA	0%
Prepare Response To Comments	12/5/07	NA	1/4/08	NA	0%
Submit Response to Comments	***1/4/08***	***NA***	***1/4/08***	***NA***	***0%***
Prepare Final Work Plan	1/4/08	NA	2/4/08	NA	0%
Submit Final Work Plan	***2/4/08***	***NA***	***2/4/08***	***NA***	***0%***
STP PDI FIELD WORK	2/18/08	NA	2/29/08	NA	0%
Field Work	2/18/08	NA	2/29/08	NA	0%
STP PDI REPORT	4/23/08	NA	12/26/08	NA	0%
Prepare Internal Draft Report	4/23/08	NA	5/23/08	NA	0%
Submit Internal Draft Report	***5/23/08***	***NA***	***5/23/08***	***NA***	***0%***
Prepare Draft Report	5/23/08	NA	6/27/08	NA	0%
Submit Draft Report	***6/27/08***	***NA***	***6/27/08***	***NA***	***0%***
Regulatory Review	6/27/08	NA	7/28/08	NA	0%
Receive Regulatory Comments	7/28/08	NA	7/28/08	NA	0%
Prepare Response To Comments	7/28/08	NA	8/27/08	NA	0%
Submit Response to Comments	***8/27/08***	***NA***	***8/27/08***	***NA***	***0%***
Regulatory Review of Comments	8/27/08	NA	9/26/08	NA	0%
Receive Regulatory Comments	9/26/08	NA	9/26/08	NA	0%
Prepare Draft Final Report	9/26/08	NA	10/27/08	NA	0%
Submit Draft Final Report	***10/27/08***	***NA***	***10/27/08***	***NA***	***0%***
Regulatory Review	10/27/08	NA	11/26/08	NA	0%
Receive Regulatory Comments	11/26/08	NA	11/26/08	NA	0%
Prepare Response To Comments	11/26/08	NA	12/17/08	NA	0%
Submit Response to Comments	***12/17/08***	***NA***	***12/17/08***	***NA***	***0%***
Prepare Final Report	12/17/08	NA	12/26/08	NA	0%



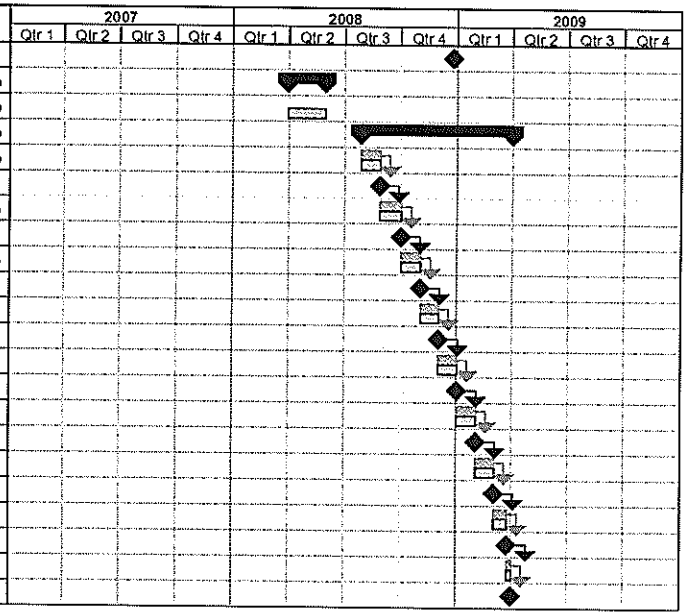
05/10/07

Critical Path Item - Anticipated Progress
Critical Path Item - Actual Progress
Noncritical Path Item - Anticipated Item
Noncritical Path Item - Actual Progress
Schedule

Schedule Milestone
Anticipated Milestone
Actual Milestone
Summary
External Milestone

CTO 407 SCHEDULE

Task	Plan Begin	Act. Begin	Plan End	Act. End	% Comp.
Submit Final Report	***12/26/08***	***NA***	***12/26/08***	***NA***	***0%***
WGL PDI FIELD WORK	3/31/08	NA	5/30/08	NA	0%
Field Work	3/31/08	NA	5/30/08	NA	0%
WGL PDI REPORT	7/28/08	NA	4/1/09	NA	0%
Prepare Internal Draft Report	7/28/08	NA	8/28/08	NA	0%
Submit Internal Draft Report	***8/28/08***	***NA***	***8/28/08***	***NA***	***0%***
Prepare Draft Report	8/28/08	NA	10/2/08	NA	0%
Submit Draft Report	***10/2/08***	***NA***	***10/2/08***	***NA***	***0%***
Regulatory Review	10/2/08	NA	11/3/08	NA	0%
Receive Regulatory Comments	11/3/08	NA	11/3/08	NA	0%
Prepare Response To Comments	11/3/08	NA	12/3/08	NA	0%
Submit Response to Comments	***12/3/08***	***NA***	***12/3/08***	***NA***	***0%***
Regulatory Review of Comments	12/3/08	NA	1/2/09	NA	0%
Receive Regulatory Response to Comments	1/2/09	NA	1/2/09	NA	0%
Prepare Draft Final Report	1/2/09	NA	2/2/09	NA	0%
Submit Draft Final Report	***2/2/09***	***NA***	***2/2/09***	***NA***	***0%***
Regulatory Review	2/2/09	NA	3/4/09	NA	0%
Receive Regulatory Comments	3/4/09	NA	3/4/09	NA	0%
Prepare Response To Comments	3/4/09	NA	3/25/09	NA	0%
Submit Response to Comments	***3/25/09***	***NA***	***3/25/09***	***NA***	***0%***
Prepare Final Report	3/25/09	NA	4/1/09	NA	0%
Submit Final Report	***4/1/09***	***NA***	***4/1/09***	***NA***	***0%***



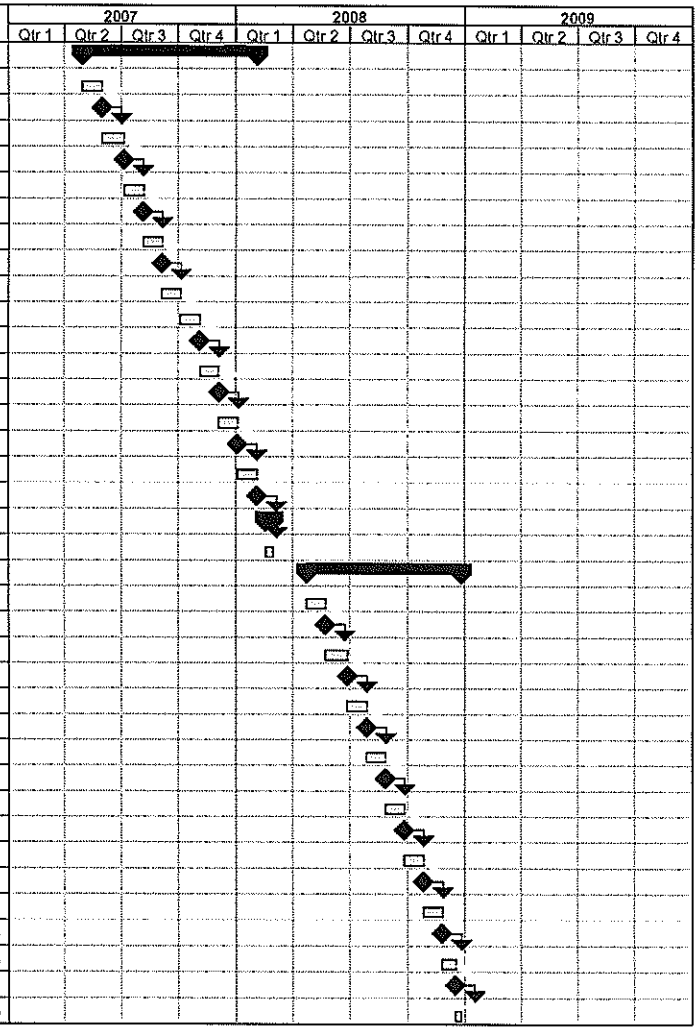
05/10/07

Critical Path Item - Anticipated Progress
Critical Path Item - Actual Progress
Noncritical Path Item - Anticipated Item
Noncritical Path Item - Actual Progress
Schedule

Schedule Milestone
Anticipated Milestone
Actual Milestone
Summary
External Milestone

CTO 407 SCHEDULE

Task	Plan Begin	Act. Begin	Plan End	Act. End	% Comp.
STP PDI WORK PLAN	5/1/07	NA	2/4/08	NA	0%
Prepare Internal Draft WP	5/1/07	NA	6/1/07	NA	0%
Submit Internal Draft WP	***6/1/07***	***NA***	***6/1/07***	***NA***	***0%***
Prepare Draft WP	6/1/07	NA	7/6/07	NA	0%
Submit Draft WP	***7/6/07***	***NA***	***7/6/07***	***NA***	***0%***
Regulatory Review	7/6/07	NA	8/6/07	NA	0%
Receive Regulatory Comments	8/6/07	NA	8/6/07	NA	0%
Prepare Response To Comments	8/6/07	NA	9/5/07	NA	0%
Submit Response to Comments	***9/5/07***	***NA***	***9/5/07***	***NA***	***0%***
Regulatory Review of Comments	9/5/07	NA	10/5/07	NA	0%
Prepare Draft Final Work Plan	10/5/07	NA	11/5/07	NA	0%
Submit Draft Final Work Plan	***11/5/07***	***NA***	***11/5/07***	***NA***	***0%***
Regulatory Review	11/5/07	NA	12/5/07	NA	0%
Receive Regulatory Comments	12/5/07	NA	12/5/07	NA	0%
Prepare Response To Comments	12/5/07	NA	1/4/08	NA	0%
Submit Response to Comments	***1/4/08***	***NA***	***1/4/08***	***NA***	***0%***
Prepare Final Work Plan	1/4/08	NA	2/4/08	NA	0%
Submit Final Work Plan	***2/4/08***	***NA***	***2/4/08***	***NA***	***0%***
STP PDI FIELD WORK	2/18/08	NA	2/29/08	NA	0%
Field Work	2/18/08	NA	2/29/08	NA	0%
STP PDI REPORT	4/23/08	NA	12/26/08	NA	0%
Prepare Internal Draft Report	4/23/08	NA	5/23/08	NA	0%
Submit Internal Draft Report	***5/23/08***	***NA***	***5/23/08***	***NA***	***0%***
Prepare Draft Report	5/23/08	NA	6/27/08	NA	0%
Submit Draft Report	***6/27/08***	***NA***	***6/27/08***	***NA***	***0%***
Regulatory Review	6/27/08	NA	7/28/08	NA	0%
Receive Regulatory Comments	7/28/08	NA	7/28/08	NA	0%
Prepare Response To Comments	7/28/08	NA	8/27/08	NA	0%
Submit Response to Comments	***8/27/08***	***NA***	***8/27/08***	***NA***	***0%***
Regulatory Review of Comments	8/27/08	NA	9/26/08	NA	0%
Receive Regulatory Comments	9/26/08	NA	9/26/08	NA	0%
Prepare Draft Final Report	9/26/08	NA	10/27/08	NA	0%
Submit Draft Final Report	***10/27/08***	***NA***	***10/27/08***	***NA***	***0%***
Regulatory Review	10/27/08	NA	11/26/08	NA	0%
Receive Regulatory Comments	11/26/08	NA	11/26/08	NA	0%
Prepare Response To Comments	11/26/08	NA	12/17/08	NA	0%
Submit Response to Comments	***12/17/08***	***NA***	***12/17/08***	***NA***	***0%***
Prepare Final Report	12/17/08	NA	12/26/08	NA	0%



05/10/07

Critical Path Item - Anticipated Progress
Critical Path Item - Actual Progress
Noncritical Path Item - Anticipated Item
Noncritical Path Item - Actual Progress
Schedule

Schedule Milestone
Anticipated Milestone
Actual Milestone
Summary
External Milestone

KEVIN CHARLES KILMARTIN PG, CPG

HYDROGEOLOGIST

KING OF PRUSSIA, PENNSYLVANIA

EDUCATION: MS, Geology, Louisiana State University, 1981
BS, Geology, Rider College, 1977

CERTIFICATIONS/ REGISTRATIONS: Registered Professional Geologist, 1994, Pennsylvania
Registered Professional Geologist, 1996, Virginia
Certified Professional Geologist, 1991, American Institute of Professional Geologists

TRAINING: 40-Hour HAZWOPER Training, 29 CFR 1910.120 OSHA, 1989
8-Hour Refresher 29 CFR 1910.120 OSHA Refresher, annually, 2006
8-Hour Supervisory Training, 29 CFR 1910.120 OSHA, 1990
FEMA IS-00200. ICS for Single Resources and Initial Action Incidents. June, 2006.

EXPERIENCE SUMMARY:

Mr. Kilmartin has 26 years of professional experience, including 17 years of experience in hazardous waste site investigation activities. He is the Lead Professional of the Geology and Field Services Department and is experienced in the technical and management oversight of projects, budget control, scheduling of projects, allocation of work, and interaction with regulatory personnel. Mr. Kilmartin served as a project hydrogeologist or project manager for many hazardous waste site investigations performed under CERCLA and RCRA hazardous waste remediation contracts. He has extensive experience in a wide variety of hydrogeological environments with the design, execution, and interpretation of investigative field techniques such as monitoring well installation, aquifer testing, soil borings, soil gas surveys, surface geophysics, borehole geophysics, and vapor intrusion investigations. He has extensive experience in remedial actions, and has designed groundwater remediation networks (including groundwater extraction and in-situ chemical reaction) for sites located in diverse hydrogeological environments. He is experienced in the Operations and Maintenance (O&M) monitoring and evaluation of groundwater remediation systems, and has participated in several system optimization projects. Mr. Kilmartin has experience in litigation support and served as an expert witness in a civil lawsuit tried in federal court, and has extensive experience in supporting clients at public meetings and presentations.

PROJECT EXPERIENCE

Project Hydrogeologist, U.S. Navy/CLEAN; Willow Grove NASJRB, Remedial Investigation and Feasibility Study; U.S. Navy; Montgomery County, Pennsylvania; Spring 1996 to present. Serves as a project hydrogeologist for a multi-phase RI/FS being performed under CERCLA at a military facility in Pennsylvania. Responsible for the drafting of certain project documents, including the work plan, and responsible for the scoping, design, and implementation of the field investigation and the analysis and interpretation of the investigation-generated data. To date, the multi-phase field program has consisted of surface water and sediment sampling, a soil boring and sampling program, test pits, the installation of more than

25 monitoring wells, and long-term aquifer monitoring and testing. Responsible for the hydrogeological information within multiple RI and FS documents, and for presenting these results to the public at Restoration Advisory Board (RAB) meetings. Designed and interpreted the results of a long-term aquifer study that concluded that the Navy was not responsible for the contamination in their base supply wells, which supported a No Further Action (NFA) Record of Decision for one of the CERCLA sites, and led EPA to reopen their investigation of off-site sources.

Project Manager and Project Hydrogeologist; Willow Grove NASJRB, UST Investigation; U.S. Navy; Montgomery County, Pennsylvania; Spring 1993. Procured and supervised subcontractors for precision tank testing for an UST RI. Responsible for developing and writing the project work plan addressing the delineation of contamination resulting from past UST leakage. The assignment was completed on-time and under budget.

Assistant Project Manager/Project Hydrogeologist; Warminster NAWC, Remedial Investigation/Feasibility Study; U.S. Navy; Bucks County, Pennsylvania; Fall 1991 to Fall 1999. Served as assistant Project Manager and Project Hydrogeologist for a multi-phase RI/FS being performed under CERCLA at a DOD Research and Development facility in Pennsylvania. This site occurs in a hydrogeologically complex area and involves eight separate waste sites scattered over a large geographic area. Off-site receptors have been impacted, resulting in a time-critical removal action. Community involvement was very high due to the off-site impacts and the imminent closure and transfer of the base property to the community. As the assistant project manager, assisted the project manager in all phases of site management duties. Responsible for the drafting and completion of certain project documents, including the work plan and the quality assurance project plan. Responsible for the scheduling and execution of all field activities and helped in the coordination of effort of all involved parties, including the Navy, EPA, Pennsylvania Department of Environmental Protection, the United States Geological Survey, community task forces, and local and regional government officials. As a project hydrogeologist, duties included the design and execution of the field investigation program and the analysis and interpretation of the investigation-generated data. The field program included a geophysical survey, a soil-gas sampling program, a soil-boring and sampling program, test pits, the installation of more than 50 on-site and off-site monitoring wells, and the performance of aquifer testing.

Project Manager/Hydrogeologist; Crossley Farm Superfund Site, Remedial Investigation and Feasibility Study, EPA Region 3; Berks County, Pennsylvania; October 1995 to February 2002. Managed and provided technical input for all site-related activities for an RI/FS performed under CERCLA at a TCE dense non-aqueous phase liquid (DNAPL) site. Worked closely with EPA technical and management personnel to develop and budget a fast-tracked focused feasibility study to address nearby contaminated residential wells, many of which were above removal action levels. Responsibilities also included the planning, design, and interpretation of all site characterization studies, including source investigation, groundwater plume delineation, and potential remedial alternatives. Studies included a soil gas survey, surface and borehole geophysical surveys, test pitting, soil borings, surface water and sediment sampling, the installation of onsite and offsite monitoring wells, residential well sampling, and aquifer testing. The source investigation delineated an area of buried drums, which led to an emergency removal action. Worked closely with EPA technical personnel to ensure that all

intrusive activities were developed and performed consistent with regulatory guidelines for potential DNAPL sites.

Project Hydrogeologist; Crossley Farm Superfund Site, Remedial Design and Remedial Action for Operable Unit-2; EPA Region 3; Berks County, Pennsylvania; Spring 2003 to Fall 2006. Designed the extraction well network and recharge well network for a groundwater remediation system for a chlorinated solvent plume in a fractured crystalline bedrock aquifer. Performed an aquifer recharge test to determine the suitability of recharge wells at the site. Contributed to the design, execution, and interpretation of an In-Situ Chemical Oxidation (ISCO) treatability study to evaluate the potential application of this technology to contaminant mass reduction at the source area. Designed and interpreted an innovative stream recharge investigation using passive diffusion bag (PDB) samplers buried in a local stream that has been significantly impacted by the site. The site contains a considerable volume of TCE DNAPL and dissolved TCE concentrations as great as 1,300 ppm.

Project Manager/Hydrogeologist; Crossley Farm Superfund Site, Remedial Design and Remedial Action for Operable Unit-1; EPA Region 3; Berks County, Pennsylvania; Fall 1997 to Fall 2006. Managed and provided technical support for an RD and RA conducted for an interim remedy requiring the installation of more than 50 water treatment systems on residential private wells due to a large plume of contaminated groundwater. Responsibilities included overseeing and contributing to the design of the treatment systems that were customized to the diverse hydrogeochemical conditions encountered within the work area, managing the procurement of a subcontractor to perform the installation and O&M activities, and monitoring the results to assure the continued safe operation of the units. Assisted in the performance of a vapor intrusion investigation designed to assess the impact of the plume on the residential air quality.

Project Hydrogeologist; Safety Light Corporation Superfund Site, Remedial Investigation; EPA Region 3; Columbia County, Pennsylvania; Winter 2004 to present. Planned remedial investigation activities for a site contaminated with radioactive wastes. Multiple media have been affected, including surface and subsurface soils, groundwater, and surface water. Interpreted borehole geophysical logs to determine the zones to be monitored through the installation of multiport ("WestBay") sampling systems.

Project Geologist; Bally Groundwater Superfund Site, Remedial Action Oversight; EPA Region 3; Berks County, Pennsylvania; Fall 2003 to Fall 2006. Reviewed PRP plans for the installation of a new public water supply well. Reviewed PRP plans for the performance of a long-term aquifer pumping test designed to assure that the new supply well would not be impacted by the site's groundwater contamination, provided field oversight of the test, and reviewed and commented on the PRP data interpretations.

Project Hydrogeologist; NASA Wallops Island Facility, Remedial Investigation Activities at Multiple Sites; U.S. Navy; Wallops Island, Virginia; Fall 2002 to Present. Planned, designed, and provided the technical oversight and data interpretation for remedial investigation activities for multiple sites at the NASA base. Activities included soil borings, surface and subsurface soil sampling, monitoring well installation and rehabilitation of old wells, and groundwater sampling. Analyzed and interpreted a time-series collection of hydraulic head measurements to determine the tidal effects of groundwater flow at a barrier island location.

Project Manager/Hydrogeologist; DeRewal Superfund Site; U.S. Army Corps of Engineers; Hunterdon County, New Jersey; Spring 2003 to present. Managed and provided technical support for a hydrogeologic investigation to obtain data required for a subsequent remedial action. Installed multiple soil borings and monitoring wells to refine the delineation of the source area and the extent of the groundwater plume. Designed, performed, and interpreted two aquifer pumping tests in a technically difficult environment (adjacent to a recharge boundary) to determine the optimal groundwater extraction network and pumping rates. Planning an in-situ chemical oxidation pilot test that is designed to significantly reduce or eliminate the residual source.

Project Manager/Hydrogeologist; Lang Superfund Site; U.S. Army Corps of Engineers; Burlington County, New Jersey; Winter 2003 to Present. Managed and provided technical support for two fast-tracked subsurface soil investigation designed to support subsequent removal (excavation) actions. Drilled and sampled more than 150 soil borings using direct-push technology (DPT), with analytical turnaround times as rapid as same-day service. Installed a temporary microwell network to delineate the extent of residual contamination, and installed a permanent monitoring well network as part of site closure activities to document the effectiveness of the remedial action. Used the USACE Automated Data Review (ADR) software to handle and manipulate the voluminous analytical data generated by the project, and to assemble the required Electronic Data Deliverables (EDDs).

Project Manager/Hydrogeologist; Tranguch Emergency Response Site; U.S. Army Corps of Engineers; Luzerne County, Pennsylvania; Spring 2000 to Spring 2003. Managed and provided technical support for an emergency action conducted in response to a gasoline spill emanating from multiple leaking USTs at several retail facilities. The technical delineation of the spill (through the installation of soil borings, temporary wells, and permanent monitoring wells) was very difficult due to the presence of an underlying, abandoned and partially flooded coal mine; fuel product and vapors were also transported through a damaged storm and sanitary sewer system. Performed a structural analysis of the sewer system, leading to the retrofitting-in-place or actual replacement of extended segments of the sewers. Managed a microgravity survey that confirmed the existence and delineated the extent of multiple mine shafts that were acting as conduits for vapor migration. Conducted and analyzed the data from a long-term hydraulic head investigation that delineated the effects of the utility trenches on the local groundwater flow system.

Project Hydrogeologist; Former Ametek Facility, Remedial Investigation and Feasibility Study; EPA Region 3; Montgomery County, Pennsylvania; Summer 2000 to Fall 2006. Provided technical oversight of PRP-led field work to ensure conformance to the work plan and to CERCLA and EPA Region 3 guidelines, and conducted the technical review of PRP-generated documents. Reviewed periodic operating data from the site's groundwater remediation system.

Project Hydrogeologist; CryoChem Superfund Site, Remedial Action; EPA Region 3; Berks County, Pennsylvania; Spring 2005 to Fall 2006. Provides technical oversight for an operating groundwater remediation system. Designed a borehole geophysical program and contributed to the construction of a groundwater model intended to optimize the system performance.

Hydrogeologist; Valmont TCE Superfund Site, Remedial Investigation and Feasibility Study; EPA Region 3; Luzerne County, Pennsylvania; Summer 2000 to present. Reviewed and interpreted hydrogeological data to delineate the extent of the chlorinated solvent plume and to determine the effects of the local structural influence (complex folding, faulting, and fracturing) on the geometry and migration patterns of the plume.

Hydrogeologist; NWS Earle; Technical Memorandum for OU-3; U.S. Navy; Monmouth County, New Jersey. Spring 2003. Reviewed and reinterpreted the historical hydrogeological data at Site 26. Contributed to a technical memorandum that successfully petitioned the New Jersey Department of Environmental Protection to allow the Navy to incorporate the management of the site into an existing Classification Exception Area (CEA).

Task Manager/Project Hydrogeologist; Keystone Sanitation Landfill Remedial Investigation for Operable Unit-2; EPA Region 3; Adams County, Pennsylvania; Spring 1995 to December 1999. Planned and designed the field investigation program for an RI/FS performed under CERCLA to address Operable Unit 2 (OU-2) (off-site) contamination and the interpretation and presentation of the acquired data. Activities included a soil gas sampling program, borehole geophysics, and the installation and sampling of 12 monitoring wells. Community involvement is very high at this site. Worked closely with EPA personnel to serve as a technical liaison between EPA, government officials, and several very active community task forces. Assisted EPA through the technical contribution of portions of the ROD and Responsiveness Summary.

Project Hydrogeologist; Keystone Sanitation Landfill Remedial Action Oversight; EPA Region 3; Adams County, Pennsylvania; Summer 2005 to Fall 2006. Providing technical comment and support to EPA's Five-Year Review of the remedial action for groundwater by reviewing and interpreting the considerable volume of hydrogeological and geochemical data generated by the PRPs since the startup of the remediation system. Identified multiple data gaps (including incomplete hydraulic capture) that resulted in the performance of additional action by the PRPs to assure the protectiveness of the remedial system.

Field Operations Leader/Project Hydrogeologist; Grumman Aerospace Facility Remedial Investigation and Feasibility Study; U.S. Navy; Nassau County, New York; Summer 1991 to Summer 1995. As project hydrogeologist and field operations leader for a multi-phase RI/FS at an active joint DOD/industrial site in New York, responsibilities included supervision of a soil gas survey and soil-boring program, the installation of more than 30 on-site and off-site temporary monitoring wells, and the installation of more than 30 on-site and off-site permanent monitoring wells. Responsible for conducting and analyzing both short-term and long-term pumping tests and for the interpretation of all field-generated hydrogeological data. Assisted in the development and interpretation of a local groundwater model. Served as company liaison between subcontractors and military and industrial personnel and worked with representatives of the other potentially responsible parties (PRPs), including the co-tenant and an adjoining NPL site to ensure that the investigations were performed in an overall consistent manner. Worked closely with the local community to keep them informed and comfortable with the considerable amount of field work conducted within the residential neighborhood located adjacent to the site.

Project Hydrogeologist; Retail Service Station Site Investigation; Confidential Client; New Hanover County, North Carolina; Summer 1995 to Fall 1997. Collected and interpreted the

hydrogeological data at a leaking Underground Storage Tank (UST) site impacting a major, regional multi-aquifer system in the North Carolina Coastal plain. Numerous supply wells were affected. The hydrocarbon plume was successfully delineated and the hydrogeological regime was defined using a combination of temporary well points and permanent monitoring wells, which led to a fast-tracked corrective action. The investigation was conducted under severe time constraints imposed by state regulators; all deadlines were met. Subsequently provided litigation support to the client and was accepted as an expert witness by the federal court in a civil lawsuit resulting from the hydrocarbon release.

Project Hydrogeologist; Retail Service Station Site Investigation; Confidential Client; Indiana; Spring 1999 to Summer 1999. Reviewed project documents and provided technical support and assistance to a service station facing a state lawsuit designed to recover costs from an emergency response action.

Project Manager and Project Hydrogeologist; Crater Resources Site Remedial Investigation, Feasibility Study, Remedial Design, and Remedial Action; EPA Region 3; Montgomery County, Pennsylvania; Fall 1997 to present. Provides management (RI/FS) and technical oversight (all phases) of PRP-led field work to ensure conformance to the work plan and to CERCLA and EPA Region 3 guidelines, and the technical review of PRP-generated documents. Managed and provided technical assistance to a large and complex risk assessment conducted under EPA's new risk assessment guidelines (RAGS). The risk assessment was fast-tracked and conducted under severe time constraints due to pending property transfers and building development at the site.

Project Hydrogeologist; AIW Frank Site Remedial Investigation/Feasibility Study, Remedial Design, and Remedial Action; EPA Region 3, Chester County, Pennsylvania; Fall 1997 to Spring 2006. Planned and designed a pre-design hydrogeologic investigation, which included the drilling of additional (post-RI) boreholes, surficial (seismic reflection and refraction) and borehole geophysical logging, monitoring well installation, extraction well installation, and aquifer testing. Conducted a first-year review and optimization study for the groundwater treatment system to improve the overall efficiency of the system by recommending the abandonment of underperforming extraction wells, the installation of several replacement wells, and the adjustment of the pumping rates and schedules in other wells. Interprets data collected during semiannual monitoring events to evaluate the efficiency of the operating extraction system. Participated in an EPA-sponsored optimization study designed to assure the most efficient operation of the remedial system.

Project Hydrogeologist; Butz Landfill Remedial Action; EPA Region 3, Monroe County, Pennsylvania; Winter 2004 to present. Interprets data collected during semiannual monitoring events to evaluate the performance and efficiency of the operating extraction system. Participated in the hydraulic fracturing of selected extraction wells to increase their radius of influence and to improve the efficiency of the extraction system.

Project Hydrogeologist; Multiple Sites; Preliminary Assessments and Site Investigations; EPA Region 3; Pennsylvania, Maryland, Delaware, Virginia, and West Virginia; Fall 1989

to Spring 1991. Served as a project hydrogeologist under the ARCS III and FIT III contracts. Specific duties under these contracts included the following:

- Responsible for the pre-remedial geological and hydrogeological evaluation of potentially hazardous CERCLA and RCRA sites. Wrote over 100 technical report sections for EPA on site-specific and regional hydrogeology for preliminary assessment, site investigations, and expanded site inspections (ESIs). These reports included the geological interpretation of local and regional structures, stratigraphy, lithology, soils, and groundwater characteristics of aquifers and the influence of each upon the local and regional hydrogeological regime.

- Under the ESI program, prepared work plans and performed field work to acquire additional data at sites considered for inclusion on the NPL. The sites were located in a variety of hydrogeological settings throughout Region 3. Representative sites included a joint federal/state ESI at an inactive landfill in Virginia. Responsibilities included the design, execution, and interpretation of a geophysical survey to define the extent of the fill, the procurement of a drilling subcontractor, and the supervision of the installation of both shallow and deep (500 feet) monitoring wells in the overburden and the fractured bedrock.

- Responsible for the HRS evaluation of over 20 sites being considered for inclusion on the NPL. The hydrogeological evaluation of the sites for EPA included defining local and regional aquifers and determining the degree of aquifer interconnection, the extent of known and potential soil, surface water, and groundwater contamination, and known and potential human and wetland targets.

- Provided oversight for EPA of PRP-led field work to ensure conformance with appropriate CERCLA guidelines and regulations.

- Provided technical review of third-party reports for EPA.

CHRONOLOGICAL WORK HISTORY:

Hydrogeologist and Project Manager; Tetra Tech NUS, Inc.; King of Prussia, Pennsylvania; October 1989 to present.

Geologist; Exxon Company USA; Houston, Texas; November 1980 to October 1989. Served as an exploration geologist searching for hydrocarbon reserves in the offshore Gulf of Mexico region. Major assignments were as a biostratigrapher and as a regional geologist and stratigrapher. As a biostratigrapher, examined drill cuttings from wells to identify the age, lithology, and paleoenvironments of the subsurface sediments, and integrated these data with borehole geophysical logs and seismic data to correlate prospective intervals through the subsurface. As a regional geologist and stratigrapher, was part of a team responsible for integrating paleontological, borehole geophysical, seismic, and gravity/magnetic data into a comprehensive sequence-stratigraphic interpretation of the very deep water (frontier) areas of the Gulf of Mexico. Few wells had been drilled in this area, so the interpretations relied greatly on the team's ability to make sound geological conclusions based on very limited data. This work subsequently led to the discovery of numerous economical hydrocarbon reserves.

PROFESSIONAL AFFILIATIONS:
National Ground Water Association

American Institute of Professional Geologists

KEITH W. HENN, P.G.
REMEDIATION GROUP MANAGER
PITTSBURGH, PENNSYLVANIA

EDUCATION: M.S., Hydrogeology, Wright State University, 1996
B.S., Geology, University of Pittsburgh at Johnstown, 1993

CERTIFICATIONS/ REGISTRATIONS: Professional Geologist – Pennsylvania (#PG-003767-E, 2000);
Professional Geologist – South Carolina (#2242, 2000)
Professional Geologist – Florida (#PG-0002133, 2000)
Professional Geologist – Illinois (196-001091, 2003)
Professional Geologist – Texas (#5451, 2003)

TRAINING: OSHA 1910.120 40-Hour HAZWOPER Training; June 1996
OSHA 1910.120 8-Hour Annual Refresher Training; annual updates
OSHA 1910.120 8-Hour Supervisory Training; June 1998;annual updates
Ohio Voluntary Action Program Certified Professional Initial Training 2006

AWARDS:

Technical Achievement Award, FY2005, presented by Tetra Tech, Inc "In Recognition of Innovative Technical Excellence." (Annually presented to individual or group from 7,600+ employees).

EXPERIENCE SUMMARY:

Mr. Henn has more than 14 years of professional experience in technical and project management in hydrogeology, site investigation, remediation, and groundwater flow and transport modeling. Specific strengths within these areas include natural attenuation evaluation, geochemistry, and emerging technology evaluation and implementation. For example, Mr. Henn is recognized as a national expert in the use of nanoscale zero valent iron for in situ remediation of chlorinated solvent contamination. Mr. Henn is proficient in technical writing and verbal communication. He has used these skills on behalf of clients as a central participant in technical negotiations, public meetings, and litigation support. Mr. Henn has also given numerous seminar and technical training presentations both at industry conferences, technical meetings, and for Tetra Tech, Inc nationwide "Brown Bag University" technology transfer sessions. Finally, Mr, Henn is the Director of Tetra Tech's Remediation Strategies Team (Tt RST), a nation-wide network of remediation experts.

PROJECT EXPERIENCE:

Lead Program Hydrogeologist, Department of the Navy, EFD South, Naval Facilities Engineering Command, Comprehensive Long-Term Environmental Action Navy (CLEAN) Program; Multiple Facilities; Multiple EPA Regions; $250 MM (CLEAN III) and $125 MM CLEAN IV), July 2000 to present. Mr. Henn is responsible for maintaining technical standards for all aspects of geology/hydrogeology, site investigation planning and practices (e.g., monitoring well installation, data quality objectives, groundwater modeling, etc), and remediation design and implementation for the program. In this role, Mr. Henn maintains an active knowledge of the more

than 340 contract task orders and ensures that all of the projects follow and comply with the defined intra-company, client, and regulatory technical standards and policies. Mr. Henn develops and coordinates the implementation of technical guidelines related to all geology/hydrogeology and natural attenuation related aspects of the contract. Mr. Henn is responsible for developing, implementing and distributing information on innovative and cost-saving methodologies and strategies. Some of the investigative technologies implemented include the use of Membrane Interface Probe (MIP), passive diffusion bag (PDB) and HydraSleeve™ groundwater samplers, borehole flowmeters (heat-pulse and colloidal borescope), prepacked micro-wells, multi-channel wells, and development of a mobile laboratory system for explosive residues. Some of the remediation approaches include selection and implementation of conventional bioremediation [(Oxygen and Hydrogen Releasing Compound® (ORC/HRC)], alternative bioremediation approaches {e.g., alternative substrate [chit-in, direct oxygen, hydrogen and propane gas delivery using the in situ Submerged Oxygen Curtain (iSOC™)]}, cometabolism, biosparging, amendment delivery mechanisms (e.g., hydraulic/pneumatic fracturing), abiotic destruction/adsorption of contaminants (e.g., permeable reactive/adsorptive wall technologies and micro/nanoscale iron particle injection), and chemical and thermal destruction technologies. Many of these have been demonstrated with significant time and cost savings. Mr. Henn is also leader of the Field Operation Leader (FOL) Discussion Group, a nation-wide network of professionals responsible for the expansion, growth, and coordination of FOLs and field work. Cliff Casey (Technical Support Branch, 2004) stated that a recent ESTCP proposal submittal spearheaded by Mr. Henn "was outstanding (and)...was TtNUS' best effort yet."

Task Order Manager (Project Manager)/ Remediation Specialist; In Situ Remediation; NAS Jacksonville; U.S. Navy, EFD South CLEAN; Jacksonville, Florida, December 2001 to October 2006. Prepared the proposal and work plan (including objectives, design, rationale, and approach) for injection of bimetallic nanoscale particles (BNP) to promote in situ abiotic degradation of chlorinated solvents. BNPs are nanometer (10^{-9} m) or bacteria-sized particles of zero valent iron (ZVI or Fe^0) with a trace noble metal catalyst [palladium (Pd)] and other coatings used to destroy contaminants. This ongoing study includes the supplemental site characterization, bench scale testing (batch and column treatability studies), and field scale implementation. The study is evaluating BNP for remediation of an estimated source of up to 125 pounds of PCE, TCE, DCE, etc. present as DNAPL and dissolved phase. Rapid and complete dehalogenation results are between 65 and 99 percent in the field. The project was funded by the competitive NAVFAC YO817 program designed to demonstrate/validate innovative technologies. Dr. Dan Waddill (Navy RPM, 2003) noted that "Keith brings top notch technical expertise to this project. As always, Keith is great to work with and could not be more responsive to project needs." The client consistently rates this project within the top 4 award fee ratings out of 145+ total projects. This project was selected as a success story for submittal in the FY05 Five-year Restoration Report to Congress.

Technical Expert - Remediation Specialist; In Situ Remediation; Vint Hill Farms Station; U.S. Army Corp of Engineers; Warrenton, Virginia, August 2006 to November 2006. Spearheaded the winning proposal, technical approach, and work plan to implement a performance based remediation contract including building demolition, hotspot soil/groundwater remediation, removal/ replacement of monitoring wells, performance monitoring of groundwater,

and site restoration. In situ soil mixing with a combination of ZVI and clay was selected to treat chlorinated ethenes, ethanes, and methanes to treat the overburden soil and groundwater.

Remediation Specialist; In Situ Anerobic Remediation and Remediation Planning; Industrial Client, Maryland; August 2004 to present. Prepared remedial goals, remediation plan, and designed/implemented 3 pilot-scale studies for comparison and selection of remedial technologies for full scale implementation. The pilot scale technologies included (1) nanoscale zero valent iron (ZVI) injection; (2) sodium lactate injection coupled with bioaugmentation; and, (3) emulsified soy-based oil coupled with bioaugmentation. This study is one of the first where aquifer buffering was performed in combination with bioaugmentation. Results of the pilot studies demonstrated up to 92% reductions (from starting concentrations of up to 33 mg/L TCE and 120 mg/L DCE) coupled with an increase of up to 40 times innocuous byproducts (e.g., ethane and ethane). Modifications to the original remedial approach are being evaluated to address 1,4-dioxane (up to 1.2 mg/L) recently discovered in the subsurface. Remedial goals for full scale remediation (up to $16.7 million) were prepared and presented to the Head of Remediation of this Fortune 100 client.

Remediation Specialist; Remediation Planning; Industrial Client, Maryland; January 2005 to present. Remedial goals for full scale remediation and associated implementation costs (up to $14.9 million) were prepared and presented to the client for remediation requiring clean closure for Brownfield redevelopment. The technical approach and costs were verified by two third party reviewers. Results of the remedial investigation data suggesting CVOCs (up to 5 ppm), BTEX (up to 0.5 mg/L), and 1,4-dioxane (up to 0.12 mg/L) are present at the low permeability site. In situ bioremediation, ZVI, chemical oxidation, and ex situ treatment were evaluated and selected.

Co-Principle Investigator; Application of Nucleic Acid-Based Tools; DoD Environmental Security Technology Certification Program (ESTCP); Project # CU-0518; January 2005 to October 2006. Mr. Henn co-prepared the proposal, demo plan and implementation of a comprehensive nucleic acid-based (i.e., bio-marker) toolkit which evaluates and assesses dechlorinating bacteria [*Dehalococcoides (Dhc)* and specific target genes such as *tceA*, *bvcA*, and *vcrA*] testing in field applications. This unique demonstration and validation (Dem/Val) project applies the results to support sites where MNA is being evaluated; predict sites where biostimulation will be successful; and identify sites where bioaugmentation is required. This is the first Navy Environmental Broad Agency Announcement (BAA) proposal granted to Tetra Tech NUS, Inc.

Remediation Specialist; In Situ Remediation Bench Study and Remediation Planning; NAS Jacksonville, Florida; May 2005 to Present. Led the technical team on development and analysis of a bench scale treatability study for treatment of chlorinated pesticides and volatile organic compounds. Technologies evaluated included (1) nanoscale zero valent iron (ZVI); (2) electron-donor enhanced micro scale zero valent iron (ZVI), (3) sodium lactate, (4) emulsified soy-based oil, and (4) numerous chemical oxidants.

Technical Expert; EPA Hdq; OSRTI/TIFSD; July 2005 to October 2006. Senior expertise provided to the EPA to assist in the development of programmatic DNAPL remediation strategy.

Participated in planning discussions with EPA Office of Superfund Remediation and Technology Innovation (OSRTI) and Technology Innovation and Field Services (TIFSD) Division Directors and Branch Chief and mining information from Cost & Performance Reports to capture an understanding of the work that has been done on DNAPL source cleanup.

Project Manager, Remediation for Aircraft Components Manufacturer, Cleveland, Ohio. Mr. Henn was the project manager of a multi-area remediation project for a confidential defense client headquartered in California. Mr. Henn was responsible for developing and implementing project scope, budgets, and schedule and for communicating with the client's and current site owner's legal and project management teams. This project involved multiple soil source areas that have been remediated under Ohio VAP and Ohio BUSTR programs. Groundwater impacted by CVOCs, petroleum hydrocarbons, and metals are currently being contained by a pump and treatment system. This remedial approach is currently being optimized including refinement of the current system as well as evaluation of alternative approaches.

Project Hydrogeologist; Optimization Study; OU-1 Landfill; NAS Pensacola; U.S. Navy, EFD South CLEAN; Pensacola, Florida, July 2003 to Present. Completed an optimization study shutting down a pump and treat system by re-evaluating the applicability of vague and in appropriate remedial action goals previously established. The study also optimized a MNA program to better quantify contaminant reduction via numerous chemical, physical and biological attenuation mechanisms. Mike Singletary (Navy Technical Support Branch, 2004) noted that "I am very pleased with (the report). You guys did a very thorough review of the existing site data and researched and presented common-sense regulatory and technical alternatives to improve remedy performance.

Remediation Specialist; MNA at Numerous DOD and Industrial Sites; July 2000 to Present. Performed evaluations or peer-reviews of natural attenuation studies at over seventy-five different sites. Sites included contamination including petroleum hydrocarbons (e.g., BTEX, PAHs), fuel oxygenates (MTBE), chlorinated solvents (e.g., PCE, TCE, TCA, etc.), explosives (e.g. TNT, RDX, HMX, etc.) and other contaminants. Many evaluations included analytical models such as Bioscreen and Natural Attenuation Software (NAS) have been utilized successfully. In addition to the collection of conventional MNA and geochemistry analysis, advanced geochemistry (e.g., bio-available iron), advanced microbial (e.g., *Dhc* and target gene detection using RTm qPCR, DGGE, and PLFA) and isotopic (e.g, compound specific isotopic) analyses has been selected and evaluated.

Remediation Specialist; In Situ Anerobic Bioremediation Pilot Study using HRC®; Three Locations; Jan. 2002 to Present. Prepared the completion reports for 2 pilot-scale injections and provided oversight and direction on a third study using HRC®. At NSWC Indian Head, biostimulation successfully degraded TCE by as much as 98 percent, coupled with DCE decreases and ethene and ethane generation. At NAS Key West, FL biostimulation successfully reduced source concentrations by over 50%.

Remediation Specialist, Air Sparge/Soil Vapor Extraction (AS/SVE) and MNA Remediation; NRL Orlando, U.S. Navy, EFD South CLEAN; Orlando, FL, May 2002 to Present. Co-designed and assisted in the implementation of an air sparging/vapor extraction

(AS/VE) system for the removal of chlorinated organic contamination. The design included the placement of the AS/SVE wells as part of an optimization study to foster the complete removal of contaminants for project closeout. Data from the AS/SVE system and monitored natural attenuation (MNA) data were evaluated to determine the influence on downgradient contamination. Use of the AS/SVE in combination with in situ cometabolic biostimulation and bioaugmentation is being evaluated for future implementation.

Project Manager/Remediation Specialist; FS for Chromium Remediation; Former J&S Chrome Site, California EPA Department of Toxic Substances Control (DTCS); September-October 2005. Managed and spearheaded the selection of remedial technologies. The maximum concentration of chromium VI in subsurface soil is 200 mg/kg (to 80 feet bgs) and in groundwater is 166,000 μg/L (shallow aquifer). Report was prepared under an accelerated schedule and was prepared on time and under budget. The remedy selected included a permeable reactive barrier (PRB) using zero valent iron (ZVI) to reduce chromium in the groundwater to chromium III, and subsequently precipitate the chromium III, as it passes through the barrier. The barrier would be installed via directional fracturing from a depth of 65 to 102 feet bgs.

Remediation Specialist; FS for CVOCs; Pier A West, Port of Long Beach, Long Beach, CA; August 2005 to Present. Senior technical direction and support provided to select remediation technologies viable for in situ treatment of chlorinated solvents at three sites. Total chlorinated VOCs in groundwater (e.g., TCE, VC, 1,1,2-TCA, 1,2-DCA) at concentrations up to 618 mg/L suggest the presence of DNAPL at, at least one of these sites. A treatment train of technologies included a combination of in situ bioremediation/bioaugmentation, chemical oxidation, and multiphase extraction. This report is currently under review by the client for implementation.

Remediation Specialist; Numerous In Situ Aerobic Bioremediation Studies using ORC®; and PermeOx®, Numerous DOD and industrial Sites; Jan. 2002 to present. Prepared completion reports at 4 NAS Pensacola, FL (ORC®) sites, one site at NAS Pensacola (PermeOx®), and one site at NAS Key West, FL (ORC®) demonstrating that biostimulation using these compounds successfully degraded BTEX, naphthalene, 1- and -2 methylnapthene.

Remediation Specialist; In Situ Aerobic Bioremediation Pilot Studies using iSOC™; Numerous locations, EFD South CLEAN; May 2001 to Present. Prepared and assisted in the work plan, design, and completion reports for pilot-scale studies at 3 sites (NAS Cecil Field, FL, NAS Pensacola, FL, and MCRD Parris Island, SC) using iSOC™. These studies demonstrated that biostimulation successfully degraded BTEX, naphthalene, 1- and -2 methylnapthene. Implementation of iSOC™ at NAS Pensacola resulted in a no-further action.

Remediation Specialist; In Situ Chemical Oxidation and Anerobic Bioremediation Pilot Study; NAS Dallas, TX; EFD South CLEAN; September Jan. 2001 to Present. Prepared the work plan, design, procurement, oversaw the implementation, and the reporting for a pilot-scale study at ASA-5 coupling hydraulic fracturing with chemical oxidation (Fenton's and Permanganate) followed by planned biostimulation using emulsified vegetable oil. This study demonstrated that delivery of remedial reagents is critical for in situ remediation of CVOCs.

Remediation Specialist; In Situ Pilot Study Using Zero Valent Iron; NIROP NAS Dallas, TX; EFD South CLEAN; May 2005 to Present. Led a team of professionals on a technology screening and pilot study implementation to treat low level CVOCs (less than 300 ug/L) in a low permeability matrix at Site 21. Based upon a review of technologies, implementation of micro zero valent iron (ZVI) particle injection via fracturing techniques was selected to promote in situ abiotic degradation of the contaminants.

Remediation Specialist; In Situ Anerobic Bioremediation Pilot Study using Chit-in; NIROP NAS Dallas, TX; EFD South CLEAN; May 2003 to October 2005. Prepared the work plan to stimulate biostimulation of CVOCs using hydraulic fracturing and chit-in in the subsurface. This work was not implemented by the client for reasons unrelated to this project.

Senior Hydrogeologist; Forensic and Natural Attenuation Analyses; Industrial Client, Florida; January 2005 to October 2005. Designed a plan to identify off-site contaminant source(s) that may be contributing to contamination present on a client site. A step-wise approach including use of historical records, geochemistry and natural attenuation data, and evaluation of additional characterization data was used. Proposed use of isotopic analysis to determine contaminant(s) "fingerprint" analysis has not yet been performed due to adjustment in client decision making process.

Remediation Specialist/Project Hydrogeologist; In Situ Anerobic Bioremediation Pilot Study using Emulsified Oil; NIROP Fridley, MN; EFD South CLEAN; Jan. 2002 to October 2006. Assisted in the planning and data review of a pilot study using emulsified soy-based oil for remediation of CVOCs by another contractor. Data showed that delivery and distribution of the oil was critical in the outcome of the study.

Remediation Specialist; In Situ Permable Adsorptive Wall using Activated Alumina; NTC Orlando, FL, EFD South CLEAN; June 2002 to December 2004. Provided project direction, data characterization, modeling, design, and data review of a permeable reactive wall using activated alumina to prohibit the migration of arsenic into an adjacent lake. This passive remedy was selected in a parcel of property soon to be transferred and developed as a residential community. The wall was installed using a one-pass trencher.

Remediation Specialist / Project Hydrogeologist; Corrective Action Plan (CAP); Former Fuel Farm; United States Coast Guard, Support Center Elizabeth City, North Carolina; December 2001 to Nov. 2004. Spearheaded the proposal/ work plan and performed the field work and report preparation for supplemental field investigation and CAP. Field work included the use of ground penetrating radar (GPR) and resistivity, MIP, and soil and groundwater sampling to investigate a JP-4/JP-5 LNAPL and a dissolved plume greater than 200,000 gallons encompassing a 3 acre site. The CAP evaluated alternative remedial options including multiphase extraction (bioslurping), bioventing, exsitu soil treatment (biopiles, and low temperature thermal desorption), and continuation of a natural attenuation plan. Designed and prepared a work plan to evaluate a mobile bioslurping/bioventing unit for LNAPL extraction.

Project Hydrogeologist; NIROP Fridley; EFD South CLEAN; Fridley, Minnesota; November 1997 to October 2006. Performed several investigations and management and optimization of a

long-term monitoring and pump and treat operation (including numerous extraction wells having a pumping rate of 675 gpm). Investigations included determining the extent of chlorinated solvents (dissolved and potential DNAPLs). Designed and implemented work plans including subcontractor procurement, soil boring and monitoring well placement up to 170 feet deep, and long term groundwater sampling strategies. Responsibilities also include technical hydrogeological interpretation of a complex glacial drift and bedrock aquifer system and its interaction with the adjacent Mississippi River. Conducted assessments of extent and migration of dissolved contaminants (e.g., long-term data evaluation, trend analysis, plume delineation, etc.), evaluation of the effectiveness of the active pump and treat system for plume containment (e.g., mass flux calculations, analytical/numerical capture zone analysis), and optimization studies for long term monitoring (LTM), long term process optimization (LTO), and in-situ remedy selection and evaluation. Mr. Henn plays a lead role in summarizing these interpretations in multiple reports and representing the client in technical meetings between the federal and state regulatory agencies. Received a letter of accommodation from the EPA Region V Tier II Partnering Alliance "acknowledging your accomplishments which through much hard work, sacrifice, and long hours....have culminated in moving environmental restoration forward at NIROP Fridley". Demonstrated cost avoidance of over $300,000 with the implemention of the optimization recommendations while achieving better remedial results.

Senior Technical Specialist/Project Hydrogeologist; RCRA Closure Soil and Groundwater Assessment Plan; Industrial Client, Ohio; September 2002 to October 2004. Spearheaded and prepared a RCRA work plan that was accepted by the state agency with few comments after they essentially rejected the previous plan from another consultant. The Ohio EPA regulator complemented Mr. Henn and the other TtNUS project team member's effort by saying "...Quality work on the front end always makes our turn-around-time quicker and relations with the consultants better. Thanks!"

Task Order Manager/Project Geologist; Basewide Background Soil Investigation, NSWC Crane; Navy, EFD South CLEAN; Crane, Indiana; September 1998 to September 2001. Prepared the proposal, work plan and the final report. The WP/QAPP were developed using the U.S. EPA Data Quality Objective process. Data were evaluated using statistical tests. Data sets are being used by others to evaluate potential contamination at 33 SWMUs over the 100 sq. mile facility. Received written commendation from Bill Gates (2001) saying, "The TOM and the technical support staff did a great job...", and from U.S. EPA (2000) saying that the "Work Plan and QAPP have been very well planned." Later the EPA (2001) wrote that, "(they) would like to commend the Navy for it's efforts," and verbally stating that they would use the report as a "guide" or "model" for conducting background investigations at other sites. This project saved the Navy an estimated $250,000 by combining repetitive background efforts from many sites into one project.

Project Manager/Project Hydrogeologist; Baseline Characterization Study, NOVA Chemicals, Inc.; Belpre Ohio, and Joliet, Illinois; June 1999 to August 2001. Prepared the proposal, work plan, and final reports to evaluate the presence of contamination at chemical facilities. Responsibilities included developing and meeting the schedule, scope, and budget, and formulation of project objectives, sampling design, rationale, and approach. Mr. Henn prepared multiple site specific work plans, master work plan, and quality assurance project plan for six sites (these two

sites, 2 other domestic sites, and 2 European sites). BJ Stephan (client) wrote that, "Belpre is very pleased with how the project has been run, excellent job... (it) was the most efficient and best run external job that they have ever had." Upon completion of the project, Brigitte Goudreau (on site client manager) wrote if "I ever need remediation work, you (Keith) will be the first person I call".

Project Hydrogeologist/Field Operations Leader; NAWC Indianapolis; Navy, EFD South CLEAN; Indianapolis, Indiana; May 1997 to January 2001. Performed the RI and FS for this base realignment and closure (BRAC) site. The investigation included determining the extent of VOC SVOC, PCB, and metals in various media. Created and implemented work plans including multi-media sampling, hydrogeological evaluation, plume delineation, remediation assessment, RI report generation, and formal project presentations to the Base Closure Team (BCT) and the Restoration Advisory Board (RAB). Responsibilities included implementation of soil boring/monitoring well installation, soil, groundwater, surface water, sediment, samples, synoptic water-level measurements, and aquifer tests. Evaluated remedial approaches including chemical oxidation (modified Fenton's Reagent), and excavation for an Engineering Evaluation/Cost Analysis (EE/CA) and other remedies for a site wide FS.

Field Hydrogeologist; Baseline Characterization Study, NOVA Chemicals, Inc.; Ribecourt France; November 1999 to December 1999. Performed tasks including soil/groundwater sampling and installation of monitoring wells. Soil sampling was performed using 'window' and 'ackerman' samplers and cable tool drilling. Coordinated a multi-national subcontractor team.

Task Hydrogeologist; International Staple Manufacturing Corporation, Butler, PA, PADEP: ACT II; Phase II Site Assessment, September 1996 through February 1997. Installation of soil borings/monitoring wells and groundwater sampling at a manufacturing facility under PADEP ACT II regulations. Responsibilities included subcontractor procurement, Work Plan preparation, all aspects of the field investigative activities, and report preparation.

Task Hydrogeologist; Beazer East, Inc., Cabot Carbon/Koppers Superfund Site, Gainesville, FL; U.S.; Groundwater Flow Modeling, January 1997 through May 1997. Evaluated the performance of a pump-and-treat system consisting of 13 extraction wells to ensure the capture of groundwater contaminants (BTEX, chromium, arsenic, and naphthalene) on site. Tasks involved analysis of capture zones generated using FLOWPATH model simulations.

Field Geologist; Cooper Power Industries, Inc., Canonsburg, PA; U.S.; PCB Evaluation and Inspection of Remediation System, June 1993 to August 1993. Delineated the extent of a LNAPL (mineral oils and transformer fluids containing PCBs) plume. Thickness of LNAPL was measured up to six-feet thick. Inspected the installation of a groundwater interceptor trench and GAC adsorption treatment system to remediate the site.

Groundwater Modeling Specialist/ Hydrogeologist; Navy, EFD South CLEAN; NSWC Dahlgren, VA; May 1997 to May 1998. Performed field activities at an ordnance burial area, rocket motor pit/ordinance burn structure, and OB/OD area. Field work included installation of borings/ wells in a UXO laden and tidally influenced coastal wetlands. Created a groundwater flow (MODFLOW), particle tracking (MODPATH), and solute fate and transport (MT3D) models

simulating the migration of 10 metals. The model was used to simulate a cap, slurry wall, interceptor trench, and downgradient leach control options for a remedial design.

Groundwater Modeling Specialist; EWAN Property Site, OU 2; Shamong Township, NJ; Modeling Report for Remedial Design, February 1997 to May 1997. Created and utilized MODFLOW and MODPATH models to optimize the pumping rates of seven extraction wells to achieve hydraulic control and re-injection of the treated effluent water into surrounding wetlands.

Groundwater Modeling Specialist; Wright-Patterson Air Force Base; Dayton, OH; Groundwater Flow and Contaminant Fate/Transport Modeling, April 1995 to June 1996. Conceptualized and designed a groundwater flow (MODFLOW) and solute fate and transport (MT3D) models simulating groundwater and PCE and TCE migration over 4.5 sq. mile area. Indicator geostatistics were used to establish 3D spatial distribution of aquitard and aquifer facies and hydraulic conductivity in the buried glacial valley aquifer. The model was used to optimize pumping rates of seven wells that best contained and extracted the PCE and TCE.

Modeling Specialist; Industrial Client; Long Branch, NJ; Modeling for Litigation Support, Jan. 1997 to Feb. 1997. Created and implemented a groundwater flow and contaminant transport model for litigation support. Favorable results supported the client's defense.

Groundwater Modeling Specialist; Beazer East, Inc.; Beardstown, IL; Pump and Treatment Evaluation, October 1996 to March 1997. Implemented the use of WinFlow, an analytical flow/contaminant transport model for remedial design. The model was used to determine the optimal pumping strategy of four extraction wells to capture pentachlorophenol (PCP).

Geographic Information System/Database Specialist: PPG Industries, Inc.; Moorestown, NJ; GIS Information Update. Maintained GIS/database (GIS/Key software) including well information, analytical results and graphics.

Engineering Geologist; USX, South Taylor Landfill; West Mifflin, PA; Closure of Hazardous and Residual Waste Landfills, June 1993 to April 1994. Supervised placement of controlled fill and performed field tests (e.g., nuclear moisture/densimeter tests, vane shear slope stability tests, plasticity indexes, and proctor tests) for the construction and closure of one hazardous and two residual waste cells (containing BOP, fly ash, and other steel by-products).

Engineering Geologist; Pennsylvania Department of Transportation; Numerous Highway and Bridge Design Projects, August 1993 to May 1994. Supervised drilling 250+ geotechnical and environmental test borings and report preparation for numerous highway and bridge construction projects (e.g., Mon-Fayette Highway, Fayette Co., PA; Lackawanna Valley Industrial Highway, Lackawanna Co., PA; and Myersdale Highway Bypass, Somerset Co., PA.

Engineering Geologist; Constitution Bridge; Clinton County, PA; Geological Engineering and Soils Reconnaissance Report, March 1994 to June 1994. Completed a Geological Engineering and Soils Reconnaissance Report for a 1,200-foot, eight-span, reinforced concrete arch bridge. Received written commendation from the PennDOT District Materials/Geotechnical Engineer for a "thorough and complete report".

CHRONOLOGICAL WORK HISTORY:

Remediation Group Manager; Tetra Tech NUS, Inc.; Pittsburgh, PA; February 2007 to present.

Lead Program Hydrogeologist, Navy CLEAN III/IV; Tetra Tech NUS, Inc.; Pittsburgh, PA; July 2000 to 2006.

Senior Hydrogeologist; Tetra Tech NUS, Inc.; Pittsburgh, PA; April 1999 to July 2000.

Associate Hydrogeologist; Tetra Tech NUS, Inc.; Pittsburgh, PA; May 1997 to April 1999.

Assistant Geoscientist; McLaren/Hart Environmental Engineering Corporation; Pittsburgh, PA; July 1996 to April 1997. Mr. Henn performed investigation and remediation design projects involving groundwater flow and contaminant modeling, soil and groundwater sampling and monitoring, and GIS/database development. Head of the McLaren/Hart Modeling Group, a nation-wide network of modelers, responsible for the growth of the firm's modeling capabilities.

Head Tutor; Center for Ground Water Management, Wright State Univ., Dayton, Ohio; June 1994 to June 1996. Instructed students in graduate-level Interactive Remote Instructional System® (IRIS®) courses titled *Ground Water Flow Modeling* and *Ground Water Hydrology*. Created the IRIS® course titled *Soil and Ground Water Contamination*.

Engineering Geologist; GeoMechanics, Inc.; Elizabeth, Pennsylvania; May 1993 to June 1994. Mr. Henn was the resident geotechnical advisor for the installation of engineered fill for residual/hazardous landfill construction/closure and subbase for roads, buildings, and other structures. He supervised drilling, sampling, and coring geotechnical borings and performed geotechnical tests for Pennsylvania Department of Transportation (DOT) roads, bridges, and private-sector structures. Mr. Henn prepared and completed Geological Engineering and Soils Reconnaissance Reports and Geotechnical Foundation Structure Reports including technical evaluation of subsurface geotechnical parameters for construction.

Hydrogeology Intern; Pennsylvania Department of Environmental Protection; Elizabeth, Pittsburgh, Pennsylvania; May 1993 to August 1993. Mr. Henn reviewed and oversaw site investigation and remediation projects.

PROFESSIONAL AFFILIATIONS:

National Groundwater Association (NGWA)
Society of American Military Engineers (SAME)
Interstate Technology Regulatory Council (ITRC) Bioremediation DNAPL Workgroup
ITRC Diffusion Sampler Workgroup

PRESENTATIONS/PUBLICATIONS (chronological order):

Henn, K. W., 1996, "Evaluation of pumping strategies for capturing aqueous tetrachloroethylene and trichloroethylene at Wright-Patterson Air Force Base, Dayton, Ohio," master's thesis, Wright State University, Department of Geological Sciences, Dayton, Ohio.

Henn, K. W., 2000, "Multiple Techniques to Assess the Influences of a Heterogeneous Porous Medium on a Multiple Well Capture Zone," Proceedings for GSA Annual Meeting and Exposition, Abstracts with Programs, Vol. 32, No. 7.

Kendrick, A. and K. Henn, 2001, "Successes and Limitations of Accelerating In Situ Bioremediation Using ORC in a Fractured Bedrock Aquifer", Proceedings for the Seventh In Situ and On-Site Bioremediation Symposium, Battelle, San Diego California, June 4-7, 2001.

Henn, K. W., T. Johnston, B. Lewis, 2001, "Generation of Facility-Wide Soil Background Values – A Case Study," 17th Annual International Conference on Contaminated Soils, Sediments, and Water Abstract Book, University of Massachusetts at Amherst, October 22-25, 2001

Henn, K. W., and K. Kendrick, 2001, "Use of Passive Diffusion Bag (PDB) Samplers – Advantages, Limitations, and Important Considerations," 17th Annual Inter. Conference on Contaminated Soils, Sediments, and Water, Univ. of Mass. at Amherst, Oct. 22-25, 2001

Tillman, N., K. Henn, W. Lacourse, M. Maughon, and T. Johnston, 2002, "Development of a Field Analytical Platform for Energetic Residues in Soil and Water," 18th Annual Inter. Conf. on Contaminated Soils, Sediments, and Water, Univ. of Mass. at Amherst, Oct. 21-24, 2002.

Arnseth, R, K. Henn, D. Waddill, and W. Zhang, 2002, "Nanoparticle Iron for Source Area Treatment," 18th Annual International Conference on Contaminated Soils, Sediments, and Water Abstract Book, Univ. of Massachusetts at Amherst, October 21-24, 2002.

McRee, E., Bryan, K. Henn, and J. Sanders, 2003 "Bioremediation of Trans/Cis-1,2-Dichloroethene, and Benzene Plumes," Seventh In Situ and On-Site Bioremediation Symposium, Battelle, Orlando, FL; June 2-5, 2003.

Henn, K. 2003, Remediation of Chlorinated VOCs with Nanoscale Zero Valent Iron, Navy/Marine IRP Partnering Program, Tier I/Tier II Joint Meeting, December 3-4, 2003 (invited speaker).

Jordan, T., G. S. Baker, K. Henn, and J. P. Messier, 2004, Case Study: Using Amplitude Variation with Offset (AVO) and Normalized Residual Polarization (NRP) Analysis of Ground Penetrating Radar Data to Differentiate a NAPL Release from Stratigraphic Changes, Journal of Applied Geophysics, Elsevier, Amsterdam, Vol 56, pp 41-58.

Henn, K, G. Walker, M. Perry, and B. Glover, 2004, Direct Oxygen Injection for Aerobic Respiration of Petroleum Hydrocarbons, Fourth Inter. Conf. on Remediation of Chlorinated & Recalcitrant Compounds Sym., Battelle, Monterey, CA; May 24-27, 2004.

Waddill, D., K. Henn, M. Halil, 2004, In Situ Nano Iron Source Remediation: Site Investigation

and Project Design, Fourth Inter. Conference on Remediation of Chlorinated & Recalcitrant Compounds Symposium, Battelle, Monterey, CA; May 24-27.

Henn, K. and D. Waddill. 2004, Implementation of a Pilot In Situ Nano Iron Source Remediation Fourth Inter. Conference on Remediation of Chlorinated and Recalcitrant Compounds Symposium, Battelle, Monterey, CA; May 24-27.

Henn, K., Y.Sun and W.Zhang, D.Waddill., 2004, Feasibility of In Situ Nano Scale Iron Remediation – From Lab to Field, Fourth Inter. Conference on Remediation of Chlorinated and Recalcitrant Compounds Sym., Battelle, Monterey, CA; May 24-27.

Henn, K. and D. Waddill. 2005, Biological Degradation Stimulated by a Nanoscale Iron Injection, Eighth In Situ and On-Site Bioremediation Symposium, Battelle, Baltimore, MD; June 6-9, 2005.

Jordan, T., G. S. Baker, K. Henn, and J. P. Messier, 2005, Using Normalized Residual Polarization (NRP) Analysis of Ground Penetrating Radar Data to Detect Jet Propellant in Soils, AAPG Eastern Section Meeting, Morgantown West Virginia, September 18-20, 2005.

Henn, K. 2005, Implementation of Nanoscale Zero Valent Iron for In Situ Source Remediation – From the Lab to the Field, US EPA Workshop on Nanotechnology for Site Remediation, Washington, DC. October 20 – 21 (invited speaker).

Lebrón, C., E. Petrovskis, F. Löffler, C. Casey, K. Henn, 2005, Application of Nucleic Acid-Based Tools for Monitoring MNA, Biostimulation, and Bioaugmentation at Chlorinated Solvent Sites, 2005 SERDP & ESTCP Partners in Environmental Technology Technical Symposium & Workshop, November 29-December 1, 2005.

Henn, K. W. and D. W. Waddill, 2006, Utilization of Nanoscale Zero Valent Iron for Source Remediation - A Case Study, Remediation Journal, Volume 16, Issue 2, pages 57-77.

Henn, K.W., 2006, Bioaugmentation v. Nanoscale Iron Source Treatment – The Tortoise and the Hare, U.S. Air Force 2006 Environmental Training Symposium, Pittsburgh, PA.

Henn, K.W., 2006, Optimization – It's needed throughout the entire project life cycle, U.S. Air Force 2006 Environmental Training Symposium, Pittsburgh, PA.

Henn, K.W., and M. T. Perry, 2006, How can we learn from BRAC '95: Case Studies Documenting Transfer from DoD Owned Properties to Private Sector Ownership and Use, Joint Services Environmental Management (JSEM) Conference and Expo., Denver, CO.

Henn, K.W. R. Adams. K. Grim, S. Reed, 2006, Treatment of Chlorinated Solvents in a Tight Matrix: A Treatment Train Full of Lessons Learned, Fifth Inter. Conference on Remediation of Chlorinated and Recalcitrant Compounds Sym., Battelle, Monterey, CA.

Henn, K.W., J.S. Wright, C. Pike, and M. T. Perry, 2006, Optimization – It's not only needed after the remedy implementation, EPA 2006 Design and Construction Issues at Hazardous

Waste Sites Conference, Philadelphia, PA, April 19-20, Presentation and Panel Discussion.

Lebrón, C., E. Petrovskis, F. Löffler, C. Casey, K. Henn, 2006, Interim Guidance Protocol, Application of Nucleic Acid-Based Tools for Monitoring MNA, Biostimulation, and Bioaugmentation at Chlorinated Solvent Sites, DoD Environmental Security Technology Certification Program (ESTCP); Project # CU-0518, In Press.

Rome, S., D. Waddill, P. McGinnis, G. Roof, H. Davis, and K. Henn, 2006, "Rethinking the Conceptual Model and Technical Approach of a
Legacy DNAPL Source," 1st International Conference on DNAPL Characterization and Remediation, Pittsburgh, PA September 25-28, 2006.

Rome, S., Waddill D., McGinnis P., Roof, G, Davis, H., and K. Henn, 2006, "Rethinking the Conceptual Model and Technical Approach of a Legacy DNAPL Source," 1st International Conference on DNAPL Characterization and Remediation, Pittsburgh, PA September 25-28, 2006.

Henn, K. and K. Ward, 2006, "Overview of Passive Sampler Technologies and their Application at DNAPL Sites," 1st International Conference on DNAPL Characterization and Remediation, Pittsburgh, PA September 25-28, 2006.

Henn, K. and G. Walker, 2007, "Injection of Gaseous Oxygen for Aerobic Respiration of Petroleum Hydrocarbons," Ninth In Situ and On-Site Bioremediation Symposium, Battelle, Baltimore, MD; May 7-10, 2007 (accepted).

Henn, K. S. Rome, and G. Roof, 2007, "Lab Evaluation of bioremediation and Chemical reduction of Pesticides," Ninth In Situ and On-Site Bioremediation Symposium, Battelle, Baltimore, MD; May 7-10, 2007 (accepted).

Petrovskis, E., C. Lebron, F. Loeffler, K. Henn, K. and C. Casey, , 2007, "Application of Nucleic Acid-Based Tools, for Monitoring, Chlorinated Solvent Site Bioremediation," Ninth In Situ and On-Site Bioremediation Symposium, Battelle, Baltimore, MD; May 7-10, 2007 (accepted).

Singletary, M. and K. Henn, 2007, "Changes in Groundwater Geochemistry Caused by Biosparging in Anaerobic Aquifers," Ninth In Situ and On-Site Bioremediation Symposium, Battelle, Baltimore, MD; May 7-10, 2007 (accepted).

Henn K, 2007, "Optimization of Legacy DNAPL Source Conceptual Model," 2007 Joint Services Environmental Management & Geospatial Information & Services Conference and Exposition, Columbus, Ohio, May 21-24, 2007 (accepted).

2000-present, numerous Tetra Tech NUS, Inc. Internal brownbags (educational seminars and presentations).

Henn, K., 2000-present, Numerous nationwide U.S. Navy publications [e.g., Remedial Project Manager News, Navy Currents, Encompass, BRAC Talk, and others].

WORKSHOPS (chronological order):

US EPA Workshop on Nanotechnology for Site Remediation, Washington, DC. October 20 – 21 Invited speaker: Henn, K. 2005, Implementation of Nanoscale Zero Valent Iron for In Situ Source Remediation – From the Lab to the Field,

In situ Chemical Oxidation (ISCO) Technology Practices Workshop, Colorado School of Mines, Golden Colorado March 7-8, 2007, Invited Participant and Panelist. Panel II: ISCO feasibility study; oxidant selection and delivery approaches; lab and field tests.