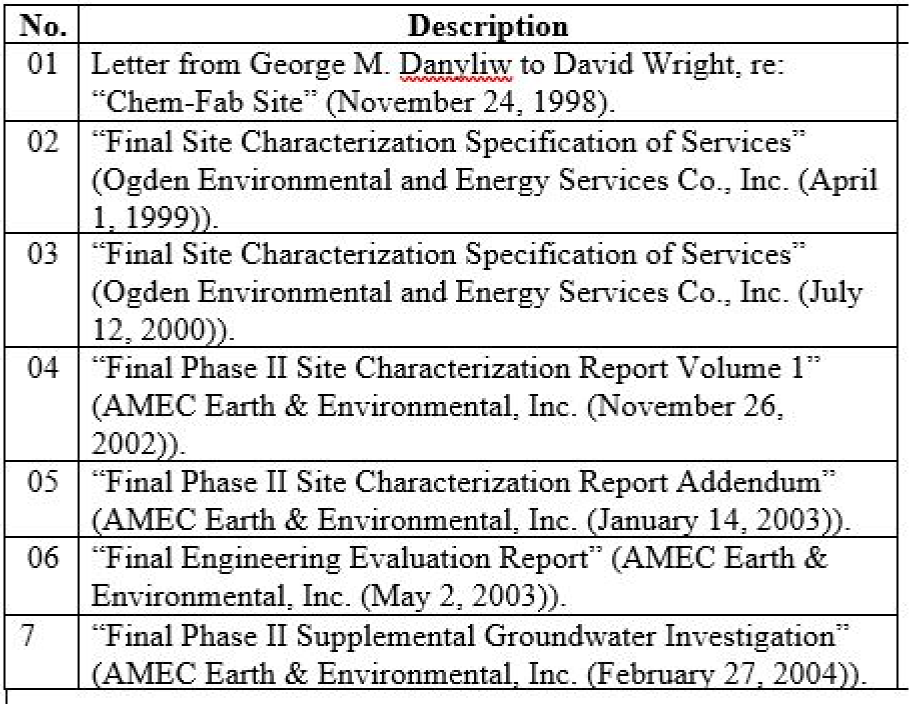
Docket No. CERCLA-03-2019-0111LL FILED July 9, 2021 1:19 PM Regional Hearing Clerk, U.S. EPA Region III

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 3

In the Matter of: :
:
Turog Properties, Limited : **Docket No. CERCLA 03-2019- 0111LL**
:
Chem Fab Superfund Site, :
Doylestown, Bucks County, :
Pennsylvania :
:

EPA'S POST-HEARING BRIEF EXHIBITS



No.	Description
01	Letter from George M. Danyliw to David Wright, re: "Chem-Fab Site" (November 24, 1998).
02	"Final Site Characterization Specification of Services" (Ogden Environmental and Energy Services Co., Inc. (April 1, 1999)).
03	"Final Site Characterization Specification of Services" (Ogden Environmental and Energy Services Co., Inc. (July 12, 2000)).
04	"Final Phase II Site Characterization Report Volume 1" (AMEC Earth & Environmental, Inc. (November 26, 2002)).
05	"Final Phase II Site Characterization Report Addendum" (AMEC Earth & Environmental, Inc. (January 14, 2003)).
06	"Final Engineering Evaluation Report" (AMEC Earth & Environmental, Inc. (May 2, 2003)).
7	"Final Phase II Supplemental Groundwater Investigation" (AMEC Earth & Environmental, Inc. (February 27, 2004)).

08 Hearing Transcript and Hearing Exhibits

Use Bookmark Panel to Navigate Between Exhibits

Reference 22
Chem-Fab Facility

Pennsylvania Department of Environmental Protection
Lee Park, Suite 6010
555 North Lane
Conshohocken, PA 19428

November 24, 1998

Southeast Regional Office

610-832-5949
Fax 610-832-6143

Mr. David Wright, Chief
U.S. Environmental Protection Agency
CEPP and Site Assessment Section
3HS33
1650 Arch Street
Philadelphia, PA 19103

Re: Chem-Fab Site
PAD002323848/PA-1243
300 North Broad Street
Doylestown Borough
Bucks County, PA

Dear Mr. Wright:

This is to serve as written confirmation that the Pennsylvania Department of Environmental Protection (DEP), with the approval of the U.S. Environmental Protection Agency (EPA), has assumed the lead with respect to the environmental assessment of the Chem-Fab Site. The DEP shall provide copies of pertinent documents to the EPA.

Upon completion of the Department's assessment, we shall discuss our findings with you and decide upon the further disposition of the site at that time.

If you have any questions or comments with regard to this matter, please don't hesitate to call me at 610-832-5967, or Mr. Robert Zang, HSCP Supervisor 610-832-6152.

Sincerely,

George M. Danyliw
HSCA Manager
Environmental Cleanup

cc: Mr. Zang
Mr. Timcik
Mr. Hartzell
Ms. Tremont
File
Re 30 (jd98)324-1

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FINAL SITE CHARACTERIZATION SPECIFICATION OF SERVICES

APR 02 1999

CHEM-FAB SITE
DOYLESTOWN TOWNSHIP,
BUCKS COUNTY,
PENNSYLVANIA

PADEP Contract No.:
ME 93936
Work Assignment No.:
21-070

Submitted to:

Commonwealth of
Pennsylvania

Department of
Environmental Protection
Bureau of Land Recycling
and Waste Management
Division of Remediation
Services

April 1, 1999

Ogden Environmental and
Energy Services Co., Inc.
1777 Sentry Parkway West
Abington Hall, Suite 300
Blue Bell, PA 19422-2223

Ogden Project No. 47014-0041

Pennsylvania Department of Environmental Protection

Lee Park, Suite 6010
555 North Lane
Conshohocken, PA 19428
April 21, 1999

Southeast Regional Office

610-832-5949
Fax 610-832-6143

Mr. Peter Gold (3HS33)
U.S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Re: Chem-Fab Investigation
Copy of Final Work Plan

Dear Pete:

As requested, the Department is forwarding the enclosed copy of the Final Work Plan for the investigation of the Chem-Fab Property, in Doylestown Borough, Bucks County. We hope to begin the field work within the next 2-3 weeks. Please note that I have not included Figure 3-2 in your copy. It is a large pull-out chart showing the proposed project schedule. However, due to its overall size and the fact that it is no longer accurate, it was not included. If you have any questions, or wish to discuss this issue, please feel free to give me a call at (610) 832-6202.

Sincerely,

Michael Timcik

Michael Timcik
Project Manager
Environmental Cleanup Program

cc: Mr. Beitler
Mr. Danyliw
Mr. Zang
Mr. McClain
Ms. Tremont
File

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FINAL
SITE CHARACTERIZATION
SPECIFICATION OF SERVICES

CHEM-FAB SITE
DOYLESTOWN TOWNSHIP
BUCKS COUNTY, PENNSYLVANIA

PADEP Contract No.: ME 93936
Work Assignment No.: 21-070

Submitted to:
Commonwealth of Pennsylvania
Department of Environmental Protection
Bureau of Land Recycling and Waste Management
Division of Remediation Services

Submitted by:
Ogden Environmental and Energy Services Co., Inc.
1777 Sentry Parkway West
Abington Hall, Suite 300
Blue Bell, Pennsylvania 19422-2223

Ogden Project No. 47014-0041

April 1, 1999

Prepared By:	Approved By:
Kathy A. McGuire	Paul T. Pettit
Kathy A. McGuire Project Manager Ogden Environmental and Energy Services Co., Inc.	Paul T. Pettit, Jr., P.E. Program Manager Ogden Environmental and Energy Services Co., Inc.

NOTICE

The information in this document has been funded by the Pennsylvania Department of Environmental Protection (PADEP) under Contract No. ME 93936 to Ogden Environmental and Energy Services Co., Inc. (Ogden). This document has been formally released by Ogden to the PADEP.

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1.0 INTRODUCTION

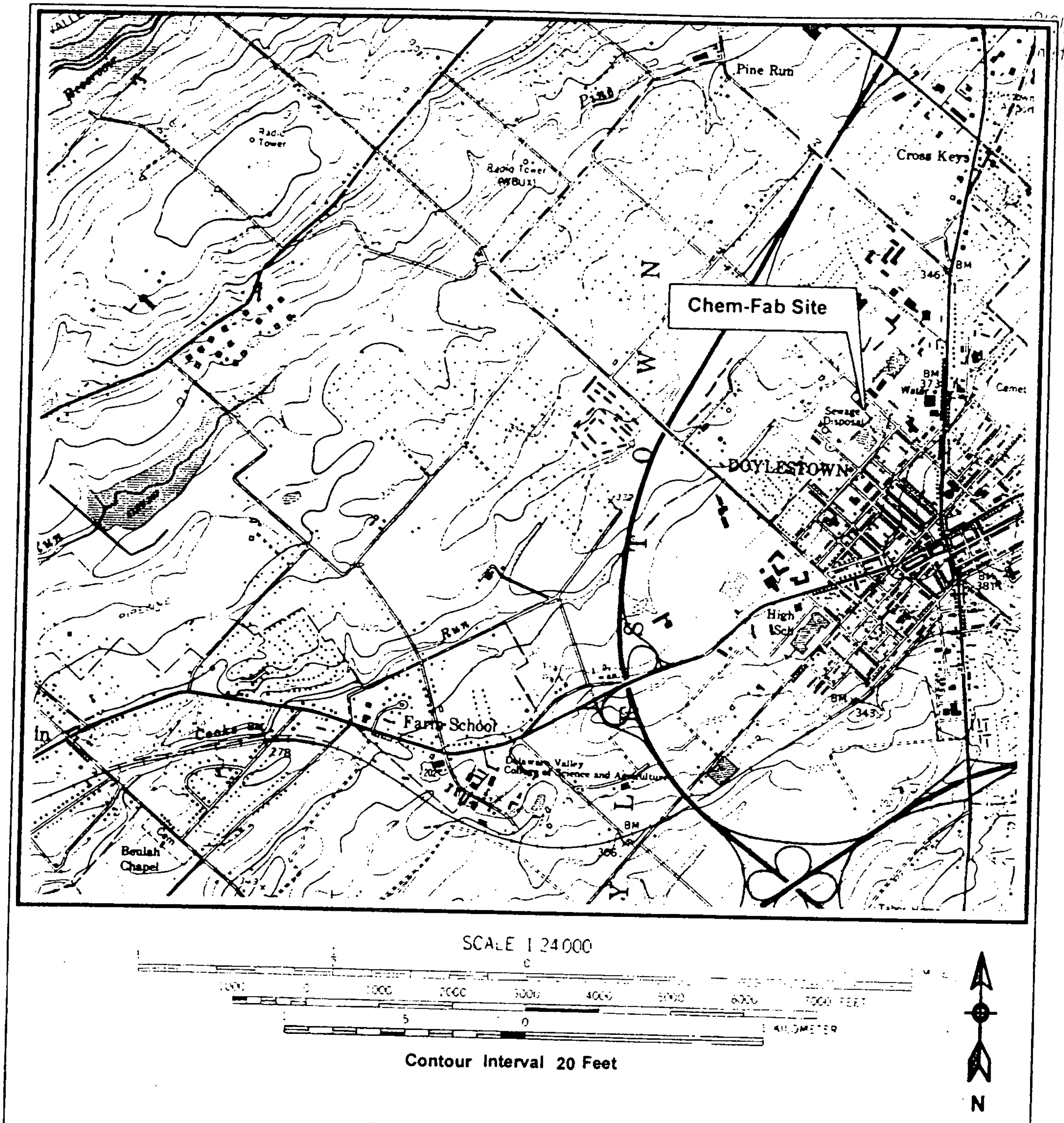
1.1 General Statement

Ogden Environmental and Energy Services Co., Inc. (Ogden) is submitting this Specification of Services (SOS) to the Pennsylvania Department of Environmental Protection (PADEP) in response to Requisition for Contractual Services No. 21-070. This document presents Ogden's technical Scope of Work to assist the PADEP in the characterization of the Chem-Fab site (site), which is located in the Township of Doylestown, Bucks County, Pennsylvania (Figure 1-1). This requisition has been issued under Ogden's General Technical Assistance Contract (GTAC-2) executed pursuant to the Pennsylvania Hazardous Sites Cleanup Act (HSCA), Act 108, October 1988.

1.2 Site Description

The Chem-Fab site is located at 300 North Broad Street, in Doylestown Township, Bucks County, Pennsylvania. The subject site, owned by Chem-Fab Corporation, contains three structures: a large warehouse/manufacturing type building, a smaller storage type building, and a residential home. In addition, the remnants of a tank farm are located onsite. The Chem-Fab site is approximately 1 acre in size.

Based on data from previous investigations, Chem-Fab started operations in 1965. Prior to that, the site operated as a farm. Currently, the buildings are vacant and the warehouse/manufacturing building is in the process of what appeared to be a limited demolition activity. The warehouse/manufacturing building is of slab on grade construction, with block walls and a steel frame. The storage building appeared to be empty and consisted of a two-story structure with a



Contour Interval 20 Feet

Figure 1-1

Site Location Map

Chem-Fab Corporation Site
Doylestown, Bucks County, PA

OGDEN ENVIRONMENTAL AND ENERGY SERVICES CO., INC
1777 SENTRY PARKWAY WEST, ABINGTON HALL, SUITE 300, BLUE BELL, PA 19422

U.S.G.S. Geologic Quadrangle
Doylestown, PA
7.5 Minute Series

basement or crawl space. The residential property consisted of a two and one-half-story structure with a partial basement.

Roll-off containers were onsite for the storage/disposal of the debris from the partial demolition of the warehouse/manufacturing building. The Chem-Fab site is gently sloped, with a few trees and shrubs along the southern edge. The site plan is shown on Figure 1-2.

1.3 Site Background

The large warehouse/manufacturing building, constructed in approximately 1965, was used as an electroplating and etching operation. Chem-Fab manufactured templates for circuit boards. Chem-Fab generated wastes that included ferric chloride, mineral spirits, chromic acid rinse water and sludge, chromic acid, sulfuric acid, sodium bisulfate, sodium hydroxide, and lime. A tetrachloroethylene (TCE) vapor degreasing process was used until 1973.[1,2]

Two diked aboveground storage tank (AST) areas were observed on the subject property, behind the warehouse/manufacturing building. The AST tank farm appeared to have contained two or three former ASTs. According to historical information, up to 5 or 6 tanks were located in this area. An underground catch basin believed to be 1,000 gallons in size was located in one diked area. At the time of the site visit, the basin was full of water, as was the bottom of the diked area. Each area also contained debris, making a full assessment of the conditions impossible. According to historical information, the diked areas were constructed after the building was constructed, in approximately 1974. Additional information from the Doylestown Health Department file review indicated that the catch basin had a history of overflowing.

The smaller storage building appears to be much older than the warehouse/manufacturing building; however, its actual age is unknown. The building is present on the 1965 aerial photograph. Based

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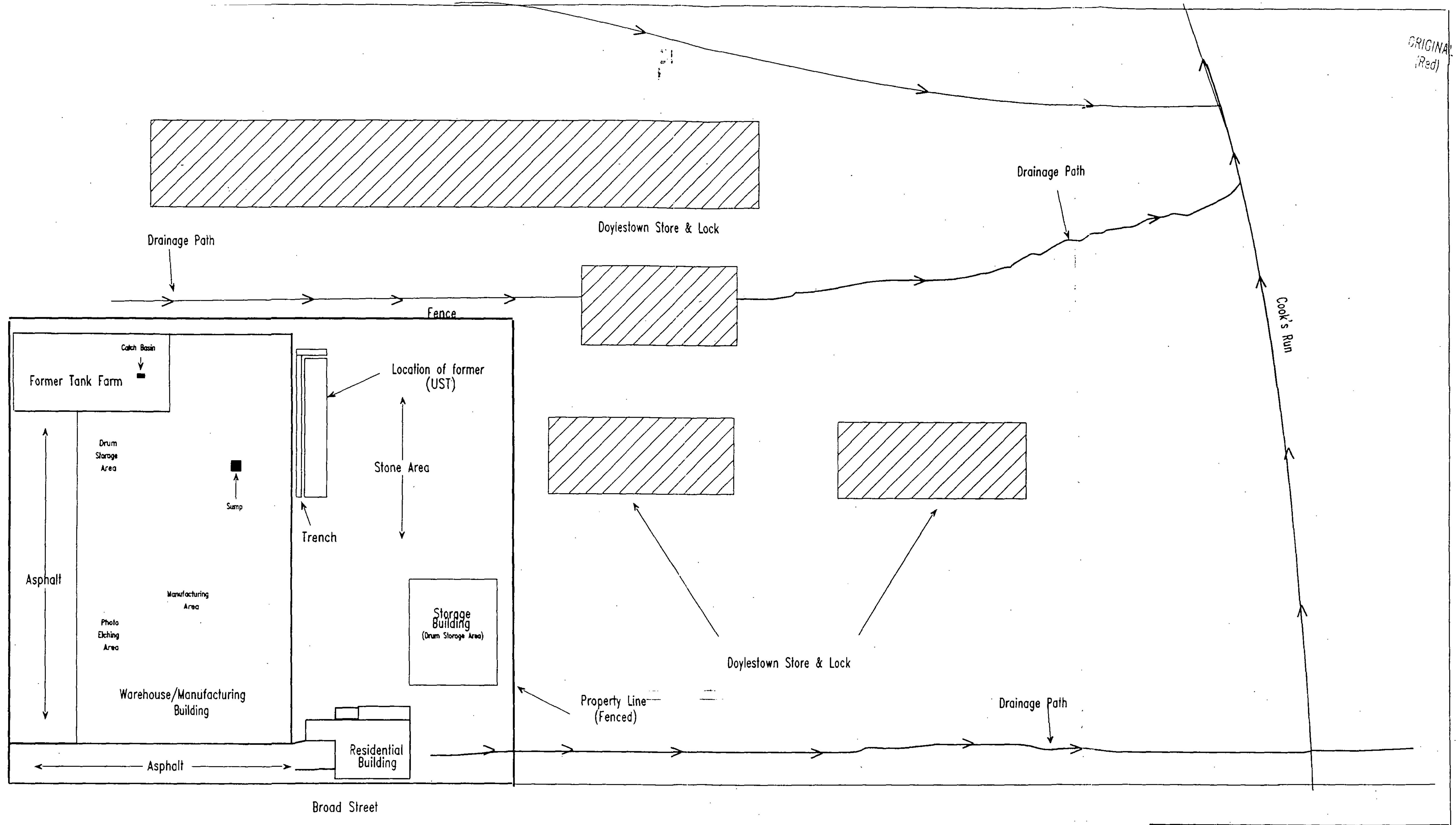

Based on site visit, historical aerials, and NEC report.

Drawing not to scale

▨ Representative Doylestown Store and Lock Bldgs

Figure 1-2
Site Location Map
Chem-Fab Corporation Site
Doylestown, Bucks County, PA

OGDEN ENVIRONMENTAL AND ENERGY SERVICES CO., INC.
1777 SENTRY PARK WEST, ABINGTON HALL, SUITE 300, BLUE BELL, PA 19422

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on information provided to Ogden by the PADEP, this building was most recently used for storage of drums and containers related to the former operations. Currently, the storage building is vacant. The building appears to be of slab on grade construction with block walls and a wooden frame. Ogden did not obtain access to the building.

The residential building consisted of a two and one-half-story structure with a partial basement. This building currently is vacant. The entrance to the basement was open and Ogden observed the heating system and product lines for a tank; however, no tank was observed. A sump was located in this area. Ogden did not obtain access to the building. This building appears to be over 60 years old, and is present on the 1965 aerial photograph; however, its actual age is unknown.

1.3.1 Regulatory Background

The Chem-Fab site has a history of environmental incidents, primarily in the release of chrome wastes into Cook's Run. Onsite contamination of soils has been identified, as well as trichloroethylene (TCE) contaminated groundwater in the vicinity of the subject property.

Chem-Fab operated as an electroplating and metal etching company, which began operations in 1965 and ceased operations around 1994. Historical spills and leaks from underground storage tanks have been documented, as well as contaminated wastes seeping up from the ground. In 1995, the Environmental Protection Agency (EPA) conducted a removal operation that addressed abandoned process chemicals and wastes after it was determined that there was a threat to human health and the environment.

A brief chronology of regulatory site events follows:

In April 1988, NUS Corporation submitted a report entitled "Site Inspection of Chem-Fab Corporation,"[1] to the Hazardous Site Control Division of the EPA. The report documented analytical results of the soil, sediment, and aqueous sampling, revealing constituents above state

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and federal cleanup standards in both onsite and offsite areas. In addition, the liquids/sludges sampled revealed similar results. Drinking water samples revealed elevated concentrations above EPA drinking water standards in several samples collected. Sample parameters included volatile organics, PCBs, pesticides/herbicides, semi-volatile organics, metals, and polyaromatic hydrocarbons.

In March 1994, the EPA performed a "Federal On-Scene Coordinator's After Action Report."[2] The EPA responded to the uncontrolled release of hazardous substances to the environment, which was considered a threat to human health and the environment. During this response action, drums and containers of hazardous waste, as well as underground and aboveground storage tanks, sumps, etc., were sampled to determine contents for disposal purposes. Elevated levels of hexavalent chromium, volatile organics, etc. were identified. Drums and containers were removed from the site for disposal.

In March 1995, the National Enforcement Investigation Center (NEIC) of the EPA performed an "Enforcement Confidential Investigation Report,"[3] for the subject property. The NEIC assisted the FBI in the criminal investigation of the subject property. The object of the investigation was to determine if regulated hazardous waste was being illegally stored or disposed of at the Chem-Fab site. Sampling conducted reported elevated levels of hexavalent chromium; RCRA characteristics of toxicity, ignitability and corrosivity; as well as elevated levels of several constituents. This report was performed in conjunction with the Federal On-Scene Coordinator's Action Report referenced above.

1.3.2 File Review

As part of the background on the subject property, a file review was conducted with the local Health Department on January 5, 1999, in an attempt to determine historical areas of concern regarding the subject property. In addition, tax maps, historical aerials, and Sanborn maps were reviewed. The following presents the findings of the background search.

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- The current tax map for the subject property was obtained. Ogden requested historical tax map information and was informed that the tax map is the same. Tax records indicate the subject property has been owned by Chem-Fab since 1967. The property to the east is owned by General Rivet and the property to the south is owned by Doylestown Store and Lock. Previous ownership for General Rivet included the Tilley family, which resides at 430 N. Broad Street beyond Cook's Run. Previous ownership of Doylestown Store and Lock included Jeffrey Shaak. Jennifer Shaak is listed as a potential PRP. It is unclear if the two Shaak listings are related.

- Historical Sanborn maps were not available for the time between 1949 and the present. Prior to 1949, the site was farmland.

- Historical aerials were reviewed for the subject property. Ogden obtained aerials for the years 1965, 1975, and 1985 in an attempt to determine when construction began and in an effort to determine the location of areas of concern including potential tanks, etc. The 1965 aerial depicted the subject property with three structures. The current warehouse/manufacturing facility building does not appear to be the same size; however, the building could have been renovated with additions. The remaining two buildings appear to be similar to the present conditions. The 1975 aerial also depicts the subject property similar to present conditions. The tank farm is evident; however, the adjacent Doylestown Store and Lock has not been constructed, indicating that the subject property remained one contiguous parcel of land. The drainage path from the southwest side of the subject property to Cook's Run is indicated on the aerial. The 1985 aerial appears similar to the 1975 aerial, with the exception that the subject property is now divided by the adjacent Doylestown Store and Lock, which is under construction.

- A file review was conducted at the local health department. Review of the records indicated that the site has a history of leaks, spills, and involvement from the Health

Department, dating back to almost 1965. The findings corroborated the information in the PADEP files regarding historical environmental concerns at the site.

1.4 Objectives

Specific response action objectives for the Chem-Fab site, based on the current knowledge of site conditions, are as follows:

1. Locate the nature and extent of soil contamination on the subject site and delineate, if found. Identify areas of soil contamination on adjacent properties.
2. Determine impact to groundwater, if encountered, during soils investigation.
3. Determine if onsite contaminants are migrating offsite through drainage pathways.
4. Determine if wells located near the subject site have been impacted by the site.
5. Determine location and disposal requirements of USTs, sumps, and basins that are located onsite.
6. Determine if prior site activities may have contributed to radiological contamination of the site.

The objectives will be met through the performance of a site inspection, multimedia sampling, and analysis as described in Section 2.0, and comparison of the analytical results with PADEP Act 2 cleanup standards to determine whether further action is needed at the site.

1.5 Specification of Services Development

Ogden's proposed SOS for this project is based on PADEP's Requisition of Services letter dated December 7, 1998; information obtained from the PADEP; information obtained during the site visit and scoping meeting held on December 17, 1998; and subsequent conversations with the PADEP Project Officer. Historical aerials, Sanborns, files, and tax maps were obtained in order to determine potential historical areas of concern, drainage patterns, and property boundaries files. In addition, a file review was conducted with the local Health Department on January 5, 1999, in an attempt to determine historical areas of concern regarding the subject property.

Ogden proposes to assist the PADEP on this project in accordance with the Scope of Work described in Section 2.0.

2.0 SCOPE OF WORK

The work breakdown structure provided below is the standard GTAC-2 task breakdown. The tasks necessary to meet the objectives for the Chem-Fab site are described in the sections of this document that follow.

Task 00	Project Management
Task 01	Project Planning
Task 03	Field Investigation
Task 04	Data Validation
Task 05	Data Evaluation/TDM
Task 08	Site Characterization Report

2.1 Task 00 - Project Management

Project management involves contractual considerations, monitoring budget and schedule, directing and coordinating the overall project, preparing and reviewing invoices, ensuring personnel and resource availability, resolving problems and delays, and communicating with PADEP project personnel. It includes project planning, implementing, reporting, coordinating, and project closeout activities. The project management effort will begin at the start of the project and will end upon completion of the work described in the SOS. Project management will occur throughout the duration of the project.

Project management will include the following activities:

- Participation in project meetings with PADEP
- Preparation of Biweekly Project Progress Reports
- Prompt response to and compliance with PADEP written/verbal comments and directives
- Preparation of technical and/or financial documents.

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The Project Manager is responsible for all aspects of project management, including communication between PADEP and Ogden, tracking the budget, and planning project events to remain on schedule and within budget. The project management responsibilities are presented in detail below.

1. Progress Reports - Biweekly progress reports will be provided for this project as required by the PADEP Project Officer. The reports will be prepared in a format as detailed in PADEP Policy and Procedure for Progress Reports.

2. Budget/Schedule Preparation and Tracking - A budget will be prepared based on the approved proposal estimate, which is attached under a separate cover to this SOS, and on the schedule within this SOS. The PADEP Project Officer will be notified of any deviation from the final approved schedule or any impacts on the proposed cost estimate.

3. Project Planning - The allocation of labor and resources will be coordinated through Ogden's Project Manager. All project-related activities will be coordinated through the PADEP Project Officer except for contract-related activities.

2.2 Task 01 - Project Planning

This task includes the planning and scoping efforts needed to produce this SOS. This task will be completed when this SOS and the attached cost estimate are submitted and approved.

2.2.1 Initial Planning

The initial planning stages of this site characterization consisted of a file review, a subsequent site walk, and a scoping meeting. A description of each of these stages is presented below.

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1. File Review - Ogden received file information from Michael Timcik of PADEP on December 17, 1998. A file review was conducted at the local Health Department on January 5, 1999.

2. Site Walk - PADEP and Ogden conducted a site walk of the Chem-Fab site on December 15, 1998 to orient Ogden with current site conditions. Attending the site walk were Michael Timcik, Robert Zang, and Habib Sharifi of PADEP and Paul Pettit and Kathy McGuire of Ogden.

3. Scoping Meeting - The scoping meeting, which consisted of discussions of the site background and the project scope, was held on December 17, 1998. The meeting was attended by Michael Timcik, Robert Zang, and Habib Sharifi of PADEP and Paul Pettit and Kathy McGuire of Ogden.

2.2.2 Project Approach

Ogden proposes to perform a streamlined site characterization program to evaluate the nature and extent of contamination that may be present at the Chem-Fab site. The site characterization program will include a physical inspection of the site to identify drums and other containers, aboveground or underground tanks, fill or vent ports, sumps, or other indicators of potential contamination. Ogden will subsequently perform a surface, subsurface soil, and groundwater investigation to evaluate the nature and extent of contamination that may be present at the site based on previous investigations and the site visit. Ogden's approach to site characterization activities will be flexible, will include the installation of borings, and will allow modifications to the Scope of Work in the field. Ogden's proposed strategy for the collection of data is described more fully in the following sections. Sampling locations are identified on Figure 2-1. The number, type, and location of samples proposed for this site characterization program are summarized in Table 2-1. The following summarizes the scope of work to be performed.

1. Mobilization/demobilization

2. Soil sampling will be conducted as part of the investigation. Ogden will utilize existing data/reports to determine sampling locations; in addition, areas identified as concerns during the site visit will be sampled. Areas consisting of dirt within the warehouse/manufacturing building will be sampled as part of the investigation. Should soil contamination be identified during the investigation, delineation of the area will be conducted. An X-ray fluorescence (XRF) will be utilized to aid in the determination of areas of concern.

3. Groundwater samples will be collected from the soil borings, if encountered. A well search will be conducted to determine if wells are located near the subject property. If found, these wells will be sampled as part of the investigation.

4. Sediment and surface water sampling will be conducted on Cook's Run as part of the investigation. In addition, sediment from the drainage ditch along Broad Street and along the rear of the property will be sampled.

5. Underground storage tanks identified on the subject property, and/or via a ground-penetrating radar (GPR) survey, will be sampled as will the catch basin associated with the AST tank farm. Both liquid and sludge will be sampled, if found.

6. Sumps located on the subject property will be sampled for sludge and liquids, where necessary.

7. A site survey will be performed to identify the site structures and sampling locations. A 1-foot contour interval will be developed during the survey to estimate the area and quantities of impacted areas.

8. A radiation meter will be utilized on the subject property to determine if radioactive waste/levels are present.

9. Laboratory services will be subcontracted to a PADEP-approved laboratory.

10. Historical aerials, Sanborns, files, and tax maps will be obtained in order to determine potential historical areas of concern, drainage patterns, and property boundaries.

11. The adjacent storage facility may be sampled as part of the investigation, pending a review of historical data and PADEP gaining access to the property.

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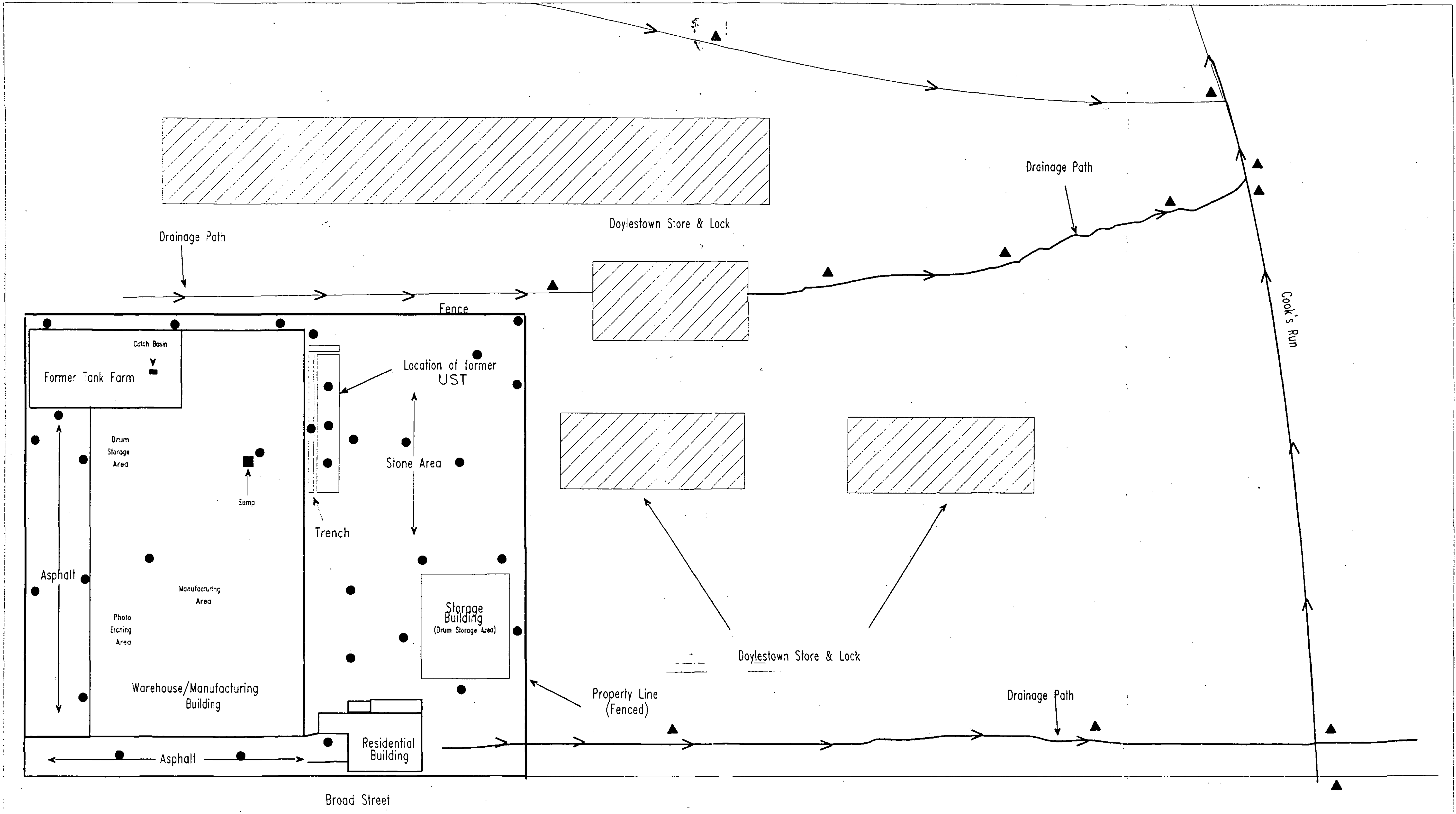

Note: Samples on Doylestown Store & Lock are not shown.
Sample locations will be biased in the field based upon site conditions.

Based on site visit, historical aerials, and NEC report.

Drawing not to scale

● Soil Sample Location

▲ **Surface Water/Sediment Sample Location**

▨ Representative Doylestown Store and Lock Bldgs

Figure 2-1
Sample Location Map
Chem-Fab Corporation Site
Doylestown, Bucks County, PA

OGDEN ENVIRONMENTAL AND ENERGY SERVICES CO., INC.
1777 SENTRY PARK WEST, ABINGTON HALL, SUITE 300, BLUE BELL, PA 19422

Table 2-1
Sampling Plan
Chem-Fab Site

Area of Concern	Sampling Strategy	Sample Type $^{(a,c)}$	Sampling Location	Sampling Interval	Number of Samples	Analytical Parameters $^{(b)}$	QA/QC Samples
Tanks Basin Sumps	Waste characterization sampling and evaluation of disposal options Sample tanks	Sludge/liquid	Site-wide	1/tank 1/basin 1/sump	6	Waste Characterization Parameters, including TCLP, VO, TAL Metals, cyanide, hex Chromium and total chromium	None
Subsurface Soils	Soil boring installation	Soil	Site-wide Adjacent site	Biased	70 10	VOs, SVOCs, TAL Metals, including hex chromium and cyanide	5 trip, 5 field, 5 equip., 5 dup
	XRF	Soil	Areas of Concern	Biased	450	TAL Metals	
Surface Water/ Sediment	Upstream and downstream Drainage paths (2)	Sediment/ Aqueous	Cook's Run Drainage Ditch (3)	1 set/ upstream 1 set/downstream 1/set drainage path(2) 2/set drainage path (1)	12 12	VOs, SVOCs, TAL Metals, including hex chromium and cyanide	2 trip, 2 field, 2 equip., 2 dup
Groundwater	Groundwater sampling Well sampling	Groundwater	Site-wide Offsite wells	1/boring, biased (if encountered) 1/well	5 6	VOs, SVOCs, TAL Metals, including hex chromium and cyanide	2 trip, 2 field, 2 equip., 2 dup

NOTES:

a. Soil boring locations will be based upon field conditions. Soil samples will be obtained from up to three locations within each boring, after XRF analysis, and will be biased toward soils exhibiting indication of contamination (i.e., PID reading, staining, odor, etc.)

b. Laboratory analyses will be performed using USEPA and/or SW-846 methodologies and will include VOCs using USEPA Method 5035/8260, SVOCs by EPA Method 8270, TAL Metals by Method 6010, plus cyanide, hexavalent and total chromium.

c. All soil samples will be sent to a PADEP-approved laboratory, and analyzed on a 28-day turnaround basis.

d. An XRF will be utilized in the field to minimize samples to be submitted to the laboratory

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2.3 Task 03 - Field Investigation

This section contains the Scope of Work for the site characterization program, discussed above, including sampling and analysis requirements, analytical methods, and quality assurance/quality control sample requirements. This section is to be used in conjunction with Ogden's standard operating procedures (SOPs), which are included by reference in the following sections. The field investigation for this site will consist of the subtasks listed below to meet the objectives of the site characterization.

Subtask 01 - Mobilization and Demobilization
Subtask 02 - Geophysical Survey
Subtask 03 - Subsurface Soil and Groundwater Sampling
Subtask 04 - Surface Water/Sediment Sampling
Subtask 05 - Underground Storage Tank/Basin Sump Sampling
Subtask 06 - Site Survey
Subtask 07 - Radiological Survey
Subtask 08 - Offsite Well Sampling
Subtask 09 - Drum Characterization and Disposal
Subtask 10 - Investigation-Derived Wastes

Field activities will be planned and scheduled to streamline data collection efforts. The following section presents details of each of these site characterization components. Laboratory services will be subcontracted to a PADEP-approved laboratory.

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2.3.1 Task 03 Subtask 01 - Mobilization and Demobilization

Mobilization will include planning and setup activities prior to the commencement of field efforts, and will include the following:

1. Procuring subcontractors.
2. Assigning site personnel.
3. Coordinating subcontractors, PADEP, and Ogden personnel for compliance with scheduled events.
4. Obtaining and transporting equipment (i.e., PID, pumps, etc.) to the site. Calibrating the equipment.
5. Obtaining and transporting supplies (i.e., Tyvek, gloves, etc.).
6. Contacting Pennsylvania One-Call prior to any intrusive activities.

Technical specifications for each subcontractor service have been prepared by Ogden as part of the Site Characterization program and are included within this section. These specifications will be incorporated into the bid packages and will be issued to potential subcontractors for bidding purposes. The results of the bids will be reviewed by Ogden with input from PADEP, and a subcontractor will be selected. A Contractor Responsibility Check Form will be prepared and, if the subcontractor is satisfactory and approved by PADEP, Ogden will issue a purchase order and schedule the work. The following subcontracted services will be required to accomplish the Site Characterization program:

- Drilling services, including the installation of Geoprobe® soil borings
- Surveying services
- Geophysical services
- Mobile XRF services
- Laboratory services

- Drum characterization and removal
- Data validation
- IDW disposal services

Field personnel will attend an orientation meeting during mobilization, which will include a review of the site history, layout of the site, and health and safety procedures. A copy of the project plans, including the Health and Safety Plan, field logs, and sign-in sheets, will be maintained onsite.

Demobilization will include efforts to transport personnel, field equipment, and facilities offsite and to conduct an inspection of the site to assure that all demobilization activities are complete.

2.3.2 Task 03 Subtask 02 - Geophysical Survey

Ogden proposes to perform a preliminary scan of the subject property via a geophysical survey to locate potential areas of waste disposal or buried tanks. Based on historical information, one known underground storage tank and several suspected historical storage tanks were located on the subject property. In addition, the site has a history of illegal dumping practices; therefore, the potential exists for buried drums or debris. The geophysical survey will consist of a multi-frequency electromagnetic (EM) survey and a ground-penetrating radar (GPR) survey. It has been Ogden's experience that the use of a multi-frequency instrument provides better subsurface differentiation of large metallic objects in fill areas and of areas with potential metallic interferences. The GPR survey will be used to better define the boundary between fill areas and native soil to confirm the presence of large subsurface objects detected with the multi-frequency EM unit. The GPR will also be utilized inside the warehouse and storage buildings, where feasible. In addition, based on historical information, the former septic field may be located on the Doylestown Store and Lock property. The GPR will be utilized in the area of the former septic field to further help in the delineation of soil samples. The survey in this area shall be limited to open areas.

The following activities will be performed by the geophysical survey subcontractor as part of this Scope of Work.

Subcontractor Scope of Work - Geophysical Survey

- *Mobilization of appropriate equipment and personnel at the start of the project after receipt of Notice to Proceed from Ogden.*
- ***Conduct additional clearing activities, if necessary, along transects to provide for a smooth traverse of the EM and GPR units.***
- *Development of grid system.*
- *Perform EM and GPR surveys. Conduct additional transects based on preliminary data reviewed in the field. Provide a field evaluation of the EM and GPR surveys to Ogden personnel.*
- *Demobilization and removal of equipment and personnel from the site after the completion of field activities.*
- *Contractor shall be Health and Safety trained in accordance with 29 CFR 1910.120 requirements. Field work performed to complete the scope of work specified herein shall be in accordance with OSHA Standards and the site-specific Health and Safety Plan, which will be provided to the bidders upon request, and will be available onsite during field activities.*

Deliverables

- ***Drawings depicting the vertical and horizontal extent of the EM and GPR surveys.***
- *Provide initial field-related deliverables upon demobilization from the field, to include preliminary drawings, and report depicting/describing preliminary field data, with field evaluation assumptions.*

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- *Survey report describing field activities, equipment calibration, and results of the EM and GPR surveys. The deliverables shall be provided to Ogden within 2 weeks following demobilization from the field.*

2.3.3 Task 03 Subtask 03 - Subsurface Soil and Groundwater Sampling

Ogden will conduct soil sampling in the areas of concern identified in the previous reports prepared by NUS Corporation and the EPA, as well as those identified during the site visit. Samples will be collected using the direct-push drilling methodologies such as the Geoprobe®, to install soil borings utilizing Macrocore samplers with acetate liners. As part of the soils investigation, an X-ray fluorescence (XRF) instrument will be utilized in a mobile laboratory setting to assist in the delineation and/or identification of contamination and to reduce the number of samples submitted to the fixed laboratory. The XRF will provide analytical data for metals. Based on the results of the XRF, soil samples will be collected in the areas exhibiting contamination. Ogden will conduct subsurface soil sampling using Macrocore samplers with acetate liners. Ogden will install a total of 32 borings at the locations identified on Figure 2-1.

In identified areas of concern, borings will be sampled continuously and logged to a depth of approximately 25 feet below grade or to the soil/groundwater interface. Soil samples will be field screened using a PID, examined for obvious signs of staining and odor, and the results will be recorded in the field log book. In addition, all borings and samples will be field screened by a radiation meter during field activities. Samples will then be screened/tested by the XRF every foot for metals. Based on these results, Ogden will obtain a total of up to three soil samples for fixed laboratory analysis. If prescreening results are negative, samples for fixed laboratory analysis will be chosen based on PADEP sampling guidelines and will be collected from 0 to 2 feet below ground surface (bgs), the middle of the column, and from the soil/groundwater interface.

Geoprobe® borings conducted in the remaining areas will also be logged and sampled continuously to a depth of approximately 25 feet below grade or to the soil/groundwater interface. Soil samples will be field screened using a PID, examined for obvious signs of staining and odor, and the results will be recorded in the field log book. In addition, all borings and samples will be field screened by a radiation meter during field activities. All samples will then be screened/tested every 3 feet by the XRF. Based on these results, Ogden will obtain a total of up to two soil samples for fixed laboratory analysis. If prescreening results are negative, samples for fixed laboratory analysis will be chosen based on PADEP sampling guidelines and will be collected from 0 to 2 feet below ground surface (bgs), and from the soil/groundwater interface.

For planning purposes, Ogden has identified one area of concern; however, based on the results of the GPR survey, additional areas of concern may be identified and sampled in accordance with the area of concern sampling strategy. Based on the current sampling program, 6 borings are located within the area of concern and will have three samples collected per boring for a total of 18 samples collected for analysis. The remaining 26 samples will have two samples collected per boring for a total of 52 samples.

Samples will also be collected from the adjacent Doylestown Store and Lock facility to assist in the identification and delineation of soil or groundwater contamination from the subject site, assuming access is obtained by PADEP. Sampling on this adjacent property will be biased primarily to open areas of the property, including soil-covered areas along the perimeter of the property, drainage paths, Cook's Run, and the former septic field, if found. Boring locations will be biased in the field based on structures, ground covering, and access.

A minimum of 10% of the soil samples screened will be submitted to the laboratory for analysis. Soil samples will be placed in laboratory-supplied bottleware, sent to a PADEP-approved laboratory, and analyzed for VOCs by EPA Method 5035/8260, SVOCs by EPA Method 8270, TAL Metals by EPA Method 6010, plus cyanide, hexavalent and total chromium.

During the drilling activities, if groundwater is encountered in the soil borings, Ogden will attempt to collect aqueous samples for analysis. Approximately five groundwater samples will be collected for analysis, if possible. Samples will be collected in an attempt to evaluate the shallow groundwater quality beneath the site.

The groundwater samples will be placed in laboratory-supplied bottleware and sent to a PADEP-approved laboratory and analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, TAL Metals by EPA Method 6010, plus cyanide, hexavalent and total chromium.

Equipment decontamination will be conducted according to Ogden SOP FP-D-5, "Equipment Decontamination." A log of events occurring in the field will be kept in accordance with Ogden SOP FP-F-5, "Logbooks."

Subcontractor Scope of Work - Soil Boring Program

- *Mobilization of appropriate drilling equipment, materials, and personnel at the start of the project after receipt of Notice to Proceed from Ogden.*
- *Contractor shall be Health and Safety trained in accordance with 29 CFR 1910.120 requirements. Field work performed to complete the scope of work specified herein shall be in accordance with OSHA Standards and the site-specific Health and Safety Plan, which will be provided to the bidders upon request, and will be available onsite during field activities.*
- *Installation of up to 32 Geoprobe® soil borings at locations shown on Figure 2-1. The borings will be installed using Geoprobe drilling techniques, in accordance with Ogden SOP FP-C-2, "Soil Sampling." Borings are to be advanced to a depth of approximately 25 feet bgs using Macrocore® samplers with acetate liners.*
- *Removal of the Macrocore for geologic logging by Ogden personnel. The drilling contractor will provide drilling equipment, supplies, and a sufficient quantity of suitable Macrocore® samplers and acetate liners to ensure that sampling activities are not delayed because of lack of equipment.*
- *Ogden will utilize an XRF onsite to reduce the number of samples sent to the approved laboratory. Each Macrocore will be screened, and samples will be*

collected onsite for XRF analysis. A reduced number of samples will then be collected for submission to the approved laboratory. The number of field days is estimated to be 12 days.

- *Backfilling and closure of the completed boreholes at the direction of the Ogden representative using soil cuttings.*
- *The Driller will containerize, label, and stage any remaining cuttings in the IDW/waste staging area for offsite disposal by others. The Driller will be responsible for providing sufficient 55-gallon steel drums, drum lids, rings, and gaskets to contain the anticipated volume of cuttings. Ogden personnel will be responsible for the sampling, characterization, and disposal of drill cuttings and liquids used for decontamination generated during drilling activities.*
- *Decontamination of equipment used during borehole installation to minimize the potential for cross-contamination. The Contractor will supply all necessary materials, equipment, and supplies to decontaminate field equipment and to containerize waste materials generated during drilling activities.*
- *Demobilization and removal of equipment and personnel from the site after the completion of project activities.*
- *Restore site to original conditions (i.e., asphalt patch). This shall include refilling of holes on subject property, with appropriate materials.*

2.3.4 Task 03 Subtask 04 - Surface Water/Sediment Sampling

Ogden will collect surface water and sediment samples along Cook's Run and along site drainage paths leading to Cook's Run, which historically has been impacted by the subject property, as shown on Figure 2-1. Sediment and aqueous samples will be collected from the property at two discharge points, both upstream and downstream, and along the drainage path(s) from the subject property. One drainage path lies alongside Broad Street and the other lies parallel to Broad Street along the rear of the property, within the Doylestown Store and Lock property, as shown on Figure 2-1. In addition, two sediment and surface water samples will be collected from the drainage path to the rear of the Doylestown Store and Lock property. A total of twelve (12) sediment and surface water samples will be collected for analysis. The surface water and sediment samples will be collected using Ogden SOPs FP-C-4, "Surface Water Sampling," and FP-C-5, "Sediment Sampling."

The surface water/sediment samples will be placed in laboratory-supplied bottleware and sent to a PADEP-approved laboratory and analyzed for VOCs by EPA Method 5035 (sediment only)/ 8260, SVOCs by EPA Method 8270, TAL Metals by EPA Method 6010, plus cyanide, hexavalent and total chromium, where analyzed.

Equipment decontamination will be conducted according to Ogden SOP FP-D-5, "Equipment Decontamination." A log of events occurring in the field will be kept in accordance with Ogden SOP FP-F-5, "Logbooks."

2.3.5 Task 03 Subtask 05 - Underground Storage Tank/Basin/Sump Sampling

One underground storage tank is known to have existed on the subject property, based on previous reports. In addition, several more tanks are suspected to have been located on the subject property. One catch basin, 1,000 gallons in size, was observed on the subject property during the site visit. Based on previous reports, one sump was located in the warehouse/manufacturing building. This sump was not observed during the site visit.

Ogden did not obtain access to two buildings (the storage and residential buildings); however, according to PADEP, additional sumps may be located in these buildings. The locations of the tank, catch basin, and sump are shown on Figure 2-1. Ogden will obtain soil and/or aqueous samples from the tank, basin, and sump on the site. In addition, if tanks, basins, or containers are identified during the geophysical survey, additional samples of these materials will be collected.

The tank, catch basin, and sump samples, as well as other identified system contents, will be placed in laboratory-supplied bottleware and sent to a PADEP-approved laboratory and analyzed for RCRA hazardous waste characteristics, and TCLP parameters including VOCs, SVOCs, metals, plus cyanide, hexavalent and total chromium.

Equipment decontamination will be conducted according to Ogden SOP FP-D-5, "Equipment Decontamination." A log of events occurring in the field will be kept in accordance with Ogden SOP FP-F-5, "Logbooks."

2.3.6 Task 03 Subtask 06 - Site Survey

Ogden will perform site survey services at the Chem-Fab site to prepare a site contour map as described below. The site consists of approximately 1 acre and includes three buildings.

Surveying work will be subcontracted to a Pennsylvania-licensed surveyor. Ogden will provide personnel onsite during the site survey to supervise the subcontractor, as necessary, to assure that the work is performed in accordance with the Scope of Work and to monitor the need for any changes to the work.

The survey will define the boring and sample locations, locations of buildings, property lines, right-of-ways, easements, property ownership, and topography within and adjacent to the site boundaries. The site survey will be performed in order to prepare a topographic site plan, obtain site profiles, and locate borings and sample locations.

Subcontractor Scope of Work - Site Surveying

- *The site survey shall be performed to define the boring and sample locations, locations of buildings, property lines, right-of-ways, easements, property ownership, and topography within and adjacent to the site boundaries. The site survey shall be performed in order to prepare a topographic site plan, obtain site profiles, and locate boring locations.*

- *Surveying shall be done by a Pennsylvania licensed surveyor. Horizontal locations shall be surveyed to the nearest 0.1 foot and vertical locations shall be surveyed to the nearest 0.01 foot. All horizontal coordinates shall be tied into the Pennsylvania State Plane Coordinate System and all vertical coordinates shall be tied to the National Geodetic Vertical Datum (NGVD) 1988.*

- *Ground surveying shall be conducted to the extent necessary to support the mapping activities and to define all sample locations, the locations of property lines, right-of-ways, easements, and property ownership within and adjacent to the site boundaries.*

- *Horizontal control (±0.1 ft) and vertical control (±0.01 ft) for monitoring wells, soil borings, GPR surveying grid, soil borings, and groundwater well locations shall be established by the subcontractor.*

Mapping

- *Mapping contour lines shall be drawn at 1-foot contour intervals, with well-defined planimetric features (i.e., roads, towers, buildings, tanks, etc.) plotted within 0.02 inch of true positions.*

- *Data obtained during the ground survey shall be plotted as measured, including, but not limited to, property lines, slope, failure scarps, and toe bulges.*

- *Corporate, township, and county boundaries shall be depicted.*

- *Each sheet shall contain route and road identifications, north arrows, and grid lines at 1,000-foot intervals in accordance with the Pennsylvania State Coordinate System.*

- *Cultural features, building, and outlines shall be annotated.*

- *Conventional mapping signs shall be used.*

- *A PADEP title box shall be provided.*

- *The map shall indicate current property boundaries in accordance with property deeds. Existing aerial photography may be used to perform topographic mapping provided that (1) existing photography is of a scale to allow for maintenance of accuracy at specified horizontal and vertical map scale and (2) photography is no older than 5 years.*

- *At a minimum, the AutoCAD drawing file shall provide separate layers for (1) cultural features, (2) hydrologic features, (3) property boundaries, (4) topography, (5) label names, (6) coordinates and control points, and (7) explanatory notes, title block, etc.*

- *The draft site map package shall include two (2) blueline prints of the individual site mapping manuscript which shall be submitted for review. Following incorporation of Ogden's comments, final, reproducible drawings will be prepared on 24-inch by 36-inch mylar sheets. The final site map package shall include an index/cover sheet, individual mapping sheet(s), four (4) blueprints of all sheets, two (2) copies of all AutoCAD maps on 3-1/2" high-density PC compatible diskettes, and a copy of the ASCII data file used to generate the base map.*

Deliverables

Draft site map package (1 set) includes:

- *Two (2) sets of draft blue-line prints.*

Final site map package (1 set) includes:

- *One (1) set of mylar index/cover sheet and individual mapping sheet(s)*
- *Four (4) sets of blue-line prints*
- *Two (2) copies of all AutoCAD data files on 3-1/2" high-density PC compatible diskettes, and one (1) copy of the ASCII data file used to generate the base map.*

2.3.7 Task 03 Subtask 07 - Radiological Survey

Ogden will perform a radiation survey as part of the investigation. The survey will be performed on the property as a whole, prior to the initiation of site activities. In addition, during site sampling activities, the borings will be screened with a radiation meter to determine if levels of radiation are present.

Based on previous reports, several containers of thorium nitrate were found on the subject site. These containers were removed during previous investigations; however, due to the unknown reason for the presence of the radioactive material onsite, additional health and safety precautions will be implemented.

Thorium nitrate is gamma-type radioactive material; therefore, for gamma radiation scanning, a scintillation detector/count rate meter combination will be utilized, preferably the NaI(TI). The detector will be maintained as close to the surface as possible during scanning, moved at a slow speed, and will note increases in radioactive levels by changes in the audible signal from the instruments. The optimum detection sensitivity changes in the instrument response are monitored via the audible output, rather than by noting fluctuations in the analog meter reading. Locations of direct radiation, discernible above the ambient level, are marked on facility maps and identified for further measurements and/or sampling.

The survey will be performed after the site grid is established. Prior to the sampling events, the site will be gamma scanned to identify the presence of elevated direct radiation, which might indicate residual gross activity or hot-spots.

2.3.8 Task 03 Subtask 08 - Drum Characterization and Disposal

Ogden observed approximately 15 drums onsite. The locations of the drums are shown on Figure [illegible]-2. Several drums were observed on the driveway side of the subject property during the site visit. One drum appeared to be bulging. The drums were on an asphalt area; however, no labels were noted on the drums.

No drums were observed in the warehouse/manufacturing building; however, Ogden did not obtain access to the small storage or residential buildings.

Since the site visit, the drums may have been removed from the site by the new owners; therefore, characterization of any drum contents and subsequent removal of such drums will be conducted based on prior approval from the PADEP, if necessary.

If necessary, as part of the scope, Ogden proposes to perform a physical inventory to assess the number, contents, and physical integrity of accessible drums throughout the site. Once inventoried, the drums will be overpacked, if necessary.

The following activities will be performed by the drum sampling subcontractor as part of this Scope of Work, if necessary.

Subcontractor Scope of Work - Drum Sampling and Staging

- *Mobilize appropriate equipment and personnel at the start of the project after receipt of Notice to Proceed from Ogden.*
- *Obtain all necessary permits and approvals prior to implementing drum activities.*
- *Provide equipment and manpower necessary to remove/overpack drums located within the subject property prior to disposal. Contractor will also provide sufficient overpack drums to containerize twenty-five 55-gallon drums.*
- *Provide equipment and manpower to assist Ogden, where necessary, in the remote opening of drums in compliance with safe work practices, and in accordance with Ogden SOP FP-E-1, "Drum Sampling." Ogden will direct the Contractor regarding which drums Contractor will be required to open.*
- *The excavation subcontractor shall also provide necessary materials, equipment, and supplies to decontaminate field equipment and to containerize waste materials generated by site activities.*
- *Contractor shall be Health and Safety trained in accordance with 29 CFR 1910.120 requirements, and prepare a Health and Safety Plan for the site in accordance with Ogden SOPs. Contractor will be responsible for the Health and Safety of Contractor's employees.*

Equipment decontamination will be conducted according to Ogden SOP FP-D-5, "Equipment Decontamination." A log of events occurring in the field will be kept in accordance with Ogden SOP FP-F-5, "Logbooks."

2.3.9 Task 03 Subtask 09 - Offsite Well Sampling

As part of the scope of work, Ogden has performed a well search of the immediate area and proposes to sample selected offsite wells that may have been impacted by the subject property within a quarter mile radius of the subject property.

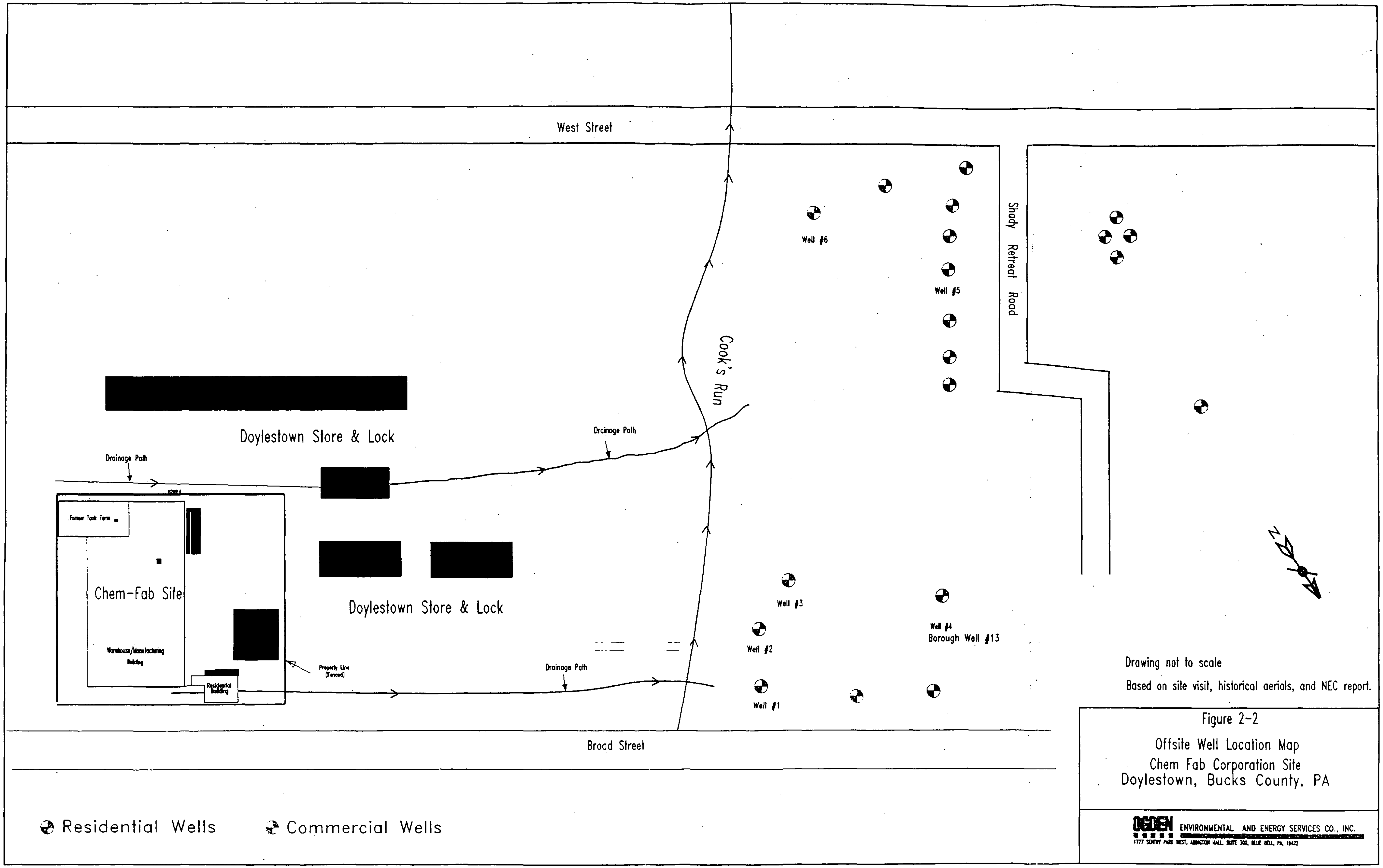
The wells to be sampled are shown on Figure 2-2. It is unknown at this time if these wells remain intact on the subject properties. Ogden will require PADEP's assistance in obtaining access to the adjacent properties. Ogden will provide PADEP with a list of names and addresses for obtaining access.

The well samples will be placed in laboratory-supplied bottleware and sent to a PADEP-approved laboratory and analyzed for VOCs by EPA Method 5035/8260, SVOCs by EPA Method 8270, TAL Metals by EPA Method 6010, plus cyanide, hexavalent chromium, and compared to EPA Drinking Water Parameters.

Equipment decontamination will be conducted according to Ogden SOP FP-D-5, "Equipment Decontamination." A log of events occurring in the field will be kept in accordance with Ogden SOP FP-F-5, "Logbooks."

2.3.10 Task 03 Subtask 10 - Investigation-Derived Waste Disposal

As part of this Site Characterization, IDW will be generated which will require specific handling procedures and management practices. Ogden's SOP FP-B-8, "IDW Management," outlines those



Drawing not to scale

Based on site visit, historical aerials, and NEC report.

Figure 2-2

Offsite Well Location Map
Chem Fab Corporation Site
Doylestown, Bucks County, PA

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procedures and practices that Ogden will follow to handle contaminated material. Ogden will also follow applicable PADEP and EPA protocols to properly manage waste materials. The following section provides a description of the IDW that will be generated during the investigation.

Field activities performed during the site characterization that may generate contaminated material typically include some or all of the wastes listed in Table 2-2.

Table 2-2
Waste Breakdown by Activity
Chem-Fab Site

Activity	Waste
Soil and Groundwater Sampling Surface Water/Sediment Sampling UST/Basin/Sump Sampling	Decontamination fluid, solid/liquid decontamination waste, PPE, intact drums/containers, soil cuttings
Drum Characterization	Soil/liquid decon waste, PPE, intact drums and containers
Site Activities	PPE, solid/liquid decon wastes and decon fluids and solids

PPE = Personnel Protective Equipment.

The wastes listed above may or may not be regulated as hazardous for the purpose of storage, treatment, or disposal. Once the contaminated material is characterized, the proper management of the waste will be determined. In addition to the waste types listed above, general refuse, including packaging materials, broken or cut-off well screening, and well casing, may be generated during field activities. Typically, this refuse is managed as nonhazardous material and disposed accordingly.

IDW disposal will be subcontracted to a licensed disposal contractor. The disposal contractor will perform transportation and disposal of the IDW in an expedited manner, as specified by PADEP. Ogden will provide personnel onsite during the work to supervise the subcontractor, as necessary.

to assure the work is performed in accordance with the Scope of Work and to monitor the need for any changes to the work.

Subcontractor Scope of Work - IDW Disposal

- *The IDW disposal contractor will perform the drum characterization, transportation, and disposal of IDW waste at the Chem-Fab site.*
- *IDW disposal contractor will obtain appropriate permits and approvals prior to transportation of IDW offsite.*
- *IDW transportation and disposal operations shall be conducted by a licensed waste hauler and disposal facility and removal will be supervised by Ogden personnel.*
- *Field work performed to complete the work specified shall be in accordance with OSHA Standards and the site-specific Health and Safety Plan, which will be available onsite during field activities.*
- *The IDW disposal contractor will mobilize the appropriate equipment and personnel to the site at the start of the project after receipt of Notice to Proceed from Ogden.*
- *The IDW disposal contractor will provide trained personnel as necessary to obtain drum content samples for disposal characterization. The IDW disposal contractor will determine the appropriate method of disposal through a review of the results of the drum content sampling. The IDW disposal contractor will identify additional data requirements (i.e., laboratory analysis), if needed, for the characterization and disposal of the IDW at an approved offsite facility.*
- *The IDW disposal contractor will also identify the proposed waste transporter(s) and treatment, storage, and disposal (TSD) facility(s). Transportation will include all material and handling charges required to load and off load the drummed material for disposal. Disposal shall be performed in a manner consistent with all applicable laws and regulations. The IDW disposal contractor will obtain PADEP's approval of the final disposition of the drummed material prior to removal from the site.*
- *The IDW disposal contractor will comply with all applicable labeling, placarding, and manifesting requirements.*
- *The IDW disposal contractor will demobilize and remove all equipment and personnel from the site after the completion of the project activities.*

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- *The original site conditions will be restored upon completion of field activities.*
- *Contractor shall be Health and Safety trained in accordance with 29 CFR 1910.120 requirements. Field work performed to complete the scope of work specified herein shall be in accordance with OSHA Standards and the site-specific Health and Safety Plan, which will be provided to the bidders upon request, and will be available onsite during field activities.*

2.4 Task 04 - Data Validation

The analytical data collected during the field investigation will be validated to ensure accuracy, precision, and usability of the data. Laboratory data generated by the PADEP-approved laboratory will be validated according to PADEP's SOPs and/or SOGs. Criteria that may be applied to organic analyses include, but are not limited to, holding times, performance calibration of instruments, laboratory and field blanks, surrogate recoveries, matrix spike and matrix spike duplicate analyses, performance of internal standards, identification of compounds, quantitation of compounds, reported detection limits, and tentatively identified compounds (TIC).

Data will be validated by qualified personnel who are familiar with accepted laboratory procedures and who have had hands-on experience in the analysis of environmental samples. It is recommended that after the validation procedures, a summary report be prepared that briefly outlines the rationale for and the significance of all qualifier codes applied to the analytical data. The report will be formatted to address only issues of usability and will be presented in a form that facilitates use of the data.

As part of the validation process, the analytical results will be reduced to include only positive results. To ensure accuracy, the data tables will include all qualifier codes and be cross-checked against the result of analysis by an individual other than the preparer. In addition to positive results and qualifier codes, the data tables will include the location and date of the sampling, detection limits and dilution factors, the percentage of solids or moisture for solid samples, and

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laboratory identification numbers. Data generally will be presented according to type of matrix (i.e., soil gas, soil, groundwater, or other).

Scope of Work - Data Validation

- *The successful Contractor will validate the laboratory data generated for the Chem-Fab Site project by the PADEP Contract Lab Program. These data were to be obtained and reported in a manner consistent with USEPA CLP protocols and QC level IV requirements. Data shall be evaluated in accordance with the USEPA document entitled, "The USEPA's Functional Guidelines for the Evaluation of Organic/Inorganic Analyses," and in accordance with PADEP SOPs and/or SOGs. Criteria to be evaluated include, but are not limited to, holding times, performance calibration of instruments, laboratory and field blanks, surrogate recoveries, matrix spike and matrix spike duplicate analysis, performance of internal standards, compound identification, compound qualification, detection limits and tentatively identified compounds. A table identifying the sample analyses performed and the samples to be validated is included within Table 2-2. The analytical data conforms to a Level IV Data Package.*

- *The Contractor shall prepare a detailed report defining the QC criteria evaluated, findings related to those criteria, as well as the presence and rationale for any outliers identified.*

- *The Contractor shall provide Analytical Summary Tables in Excel format for all samples identified within Attachment A. Ogden will provide a disk copy in ASCII format of the data received from the PADEP for this project. Samples validated under this contract shall be highlighted and qualified within the spreadsheet to be provided by the Contractor.*

- *The Contractor shall provide two hard copies of each deliverable to Ogden for review and comment. Draft deliverables are due to Ogden within 30 calendar days of receipt of analytical data by the Contractor. Subsequent to the receipt of comments (if any) from Ogden, the Contractor shall submit two copies of the final deliverables to Ogden. The Contractor shall also submit to Ogden a disk copy of the Analytical Summary Tables in Excel format.*

2.5 Task 05 - Data Evaluation/Technical Directive Memorandum

Ogden will compile, organize, review, and evaluate data collected during the field investigation as it is generated to complete the Site Characterization Report in a timely manner. The types of data to be collected from the corresponding investigation activity and the method of organization are presented in Table 2-3.

Table 2-3
Data Organization
Chem-Fab Site

Investigation Activity	Type of Data	Organization Method
Soil Investigation	Lithologic Information Field Screening Information Visual Observations Laboratory Analytical Data	Field Note Books Soil Boring Logs Geologic Cross Sections Laboratory Data-Computer Database
UST, Basin, Sump Areas Drums	Visual Observations Field Screening Information Laboratory Analytical Data	Field Note Books Laboratory Data-Computer Database
Surface Water/Sediment Investigation	Visual Observations Field Screening Information Laboratory Analytical Data	Field Note Books Laboratory Data-Computer Database
Groundwater Investigation	Well Construction Data Field Screening Information Laboratory Analytical Data	Field Note Books Laboratory Data-Computer Database Well Construction Diagram

Ogden will prepare a Technical Directive Memorandum (TDM) after receipt of the analytical data from the laboratory. The memorandum will provide a summary of the investigative and analytical procedures used for the site characterization. This summary will be provided in letter report format with a site plan noting sample locations and with laboratory data summary tables attached.

2.6 Task 08 - Site Characterization Report

The Site Characterization Report will include a discussion of the procedures followed during the field investigation, including the investigation rationale, chronology of events, site use history, areas of concern, and geology and hydrogeology of the site and region. Field data measurements and sampling methodologies will be presented, and the results of the field investigation activities will be presented in table format. Laboratory sample analytical results will be presented along with sample chain of custody and raw data analytical reports. Figures will include an area map, site plan, drilling logs, groundwater flow plan, contamination concentration plan, and a geologic cross section.

The Site Characterization Report will also discuss conclusions drawn regarding the extent of soil and/or groundwater contamination, and present recommendations for additional investigation activities, if necessary, based on the limited scope of work. Vertical cross sections that identify and delineate soil contamination will be provided, if contamination is found.

Ogden will submit two copies of the draft Site Characterization Report to the PADEP for review and comment. Upon receipt of all comments from PADEP, Ogden will revise the document and submit three copies of the final Site Characterization Report to the Southeast Regional Office and the cover letters from the draft and final to the Central Office. As part of the deliverables package to PADEP, the AutoCAD site maps and laboratory data from all sampling activities will be provided on disk.

3.0 PROJECT MANAGEMENT

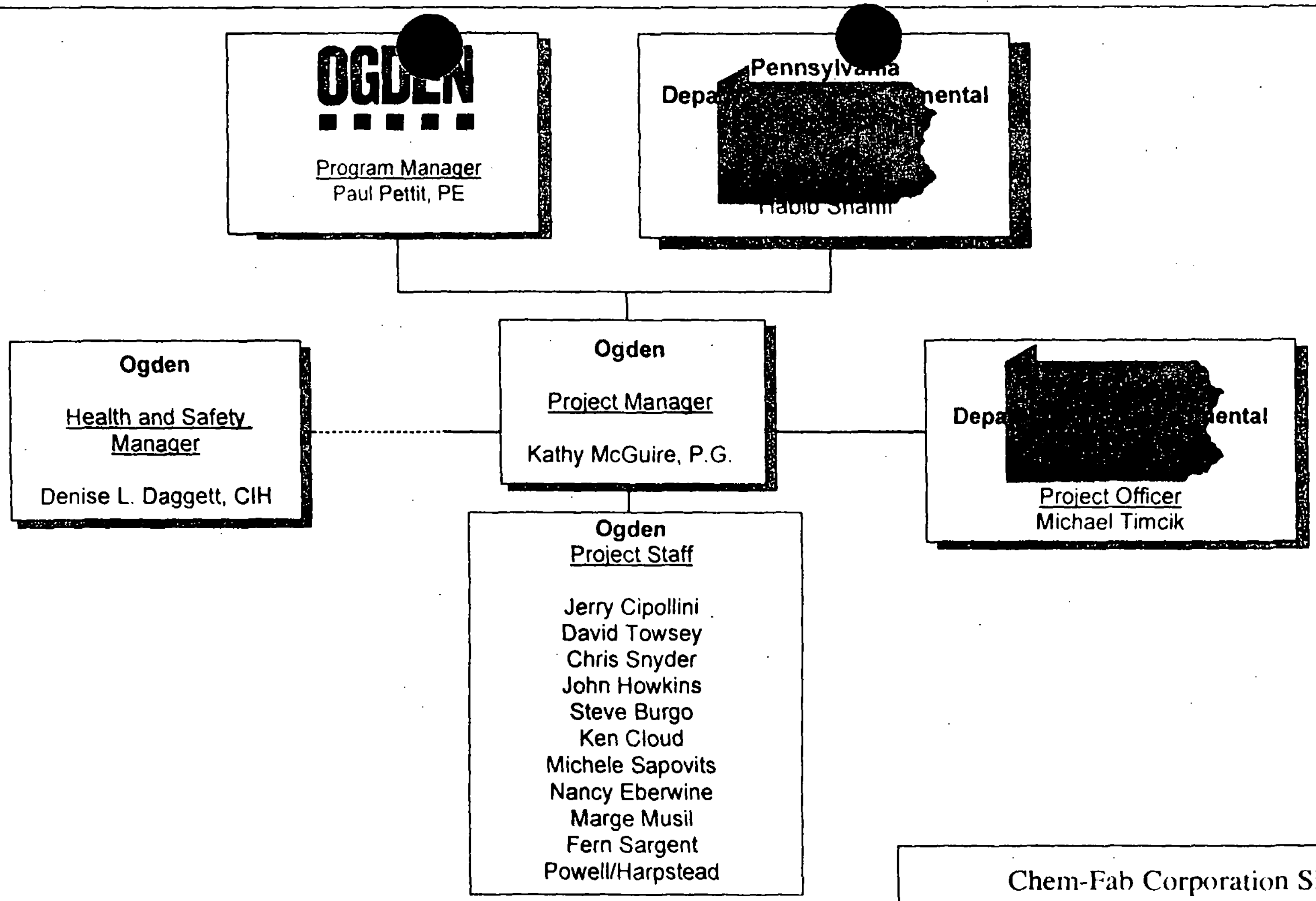
3.1 Organization and Approach

Ogden has been contracted by PADEP to be the contractor responsible for project implementation. Ogden is responsible for providing qualified personnel to execute the Scope of Work and to select and supervise the work of subcontractors needed for the project. Figure 3-1 illustrates the organization and lines of responsibility for the conduct of this Scope of Work. Personnel assigned to individual tasks are also shown. The Ogden team for this project consists of the following personnel.

The Program Manager, Paul Pettit, has overall responsibility for fulfilling contractual obligations to the PADEP under this project. He will administer the program to ensure the necessary resources are available to execute the program and will review progress with respect to conformity with budgets, schedules, and goals. The Program Manager will assign staff to senior positions on this project.

The Project Manager, Kathy McGuire, has responsibility for successful execution of this project in terms of meeting technical, budgetary, and schedule goals. She manages the day-to-day activities of the project; makes or defers technical decisions; designates staffing; approves submittals, specifications, invoice payments: and is the Point of Contact (POC) for PADEP for issues relating to this project. She will also assign and schedule project staff and coordinate subcontractors.

The Site Manager, Jerry Cipollini, has responsibility for overseeing the day-to-day site activities, coordination with project staff, and interfacing with subcontractors. He will provide the Project Manager with daily updates of project progress.



Chem-Fab Corporation Site
Doylestown, Bucks County, PA

Figure 3-1
Project Organization Chart

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The Health and Safety Coordinator, Jerry Cipollini, is responsible for coordinating compliance with Ogden's Corporate Health and Safety Plan. He monitors overall compliance with CFR 1910.120 for the Ogden Blue Bell Office.

Ogden project staff members include those listed above as well as the following personnel. Field personnel will include David Towsey, Engineer/Geologist, and Powell/Harpstead, Engineer/Geologist. Staffing personnel who will prepare and review data and prepare sections of the report include Ken Cloud, Staff Engineer. Christopher Snyder will assist in the review of the report. The Ogden staff consists of geologists, engineers, and environmental scientists. The staff members will be responsible for assisting the Site Officer with the planned field activities. Ogden will assign other staff to assist with project operations, as required.

3.2 Quality Assurance and Data Management

The site-specific quality assurance requirements will conform with the quality assurance and quality control objectives outlined in the PADEP Guidance for Quality Assurance Project Plans for Contracted Services. Maintaining project quality assurance objectives requires that the project staff is aware of the QA/QC procedures and goals. The Project Manager has primary responsibility for maintaining the QA/QC objectives.

3.2.1 QA/QC Sampling Procedures

The purpose of this sampling is to obtain data that accurately represent field conditions. Specific procedures for sampling are outlined in Ogden's SOPs. Those procedures describe methods of acquiring samples that best represent the environmental media. Contamination and cross-contamination of samples from external sources will be controlled through proper decontamination of sampling equipment, as well as through sound sampling techniques. Ogden will ensure the correct use of measuring devices, sampling devices, tubing, or transfer pipes that come in contact with the sample matrix to be analyzed.

The sampling program has been set forth in detail in the SOS and includes:

- Techniques and guidelines used for selecting sampling sites
- Description of sampling sites
- Number of samples to be taken
- Timing of acquisition of samples
- Sampling methods.

Field analyses that are to be performed with portable meters at the Chem-Fab site include pH, specific conductivity, and temperature.

Control, calibration, adjustment, and maintenance of measuring and testing devices used in the field for performing tests will be performed as outlined in Ogden SOP FP-A-1, "Auto Control of Measuring and Test Equipment"; FP-A-2, "Calibration Procedures"; and FP-A-3, "Preventive Maintenance of Test Equipment." A calibration log will be completed following calibration of test equipment. Any test equipment found to be out of calibration will be recalibrated. When test equipment is found to be out of calibration, damaged, lost, or stolen, an evaluation shall be made to ascertain the validity of test results since the last calibration check. If it is necessary to ensure the acceptability of suspect items, the test originally required shall be repeated, using properly calibrated equipment. Any test equipment consistently found to be out of calibration will be repaired or replaced.

The Site Manager will be responsible for ensuring the following:

a. A list is developed that includes the measuring and testing devices to be calibrated and the frequency of calibration of those devices.

b. The measuring and testing devices used are of the proper range, type, and accuracy for the test being performed.

c. A system for issuance, collection, and return of all measuring and testing devices is developed and implemented.

d. Methods are employed to ensure proper handling, storage, and care of the test equipment to maintain the required accuracy of that equipment.

Procedures for the use of blanks, duplicate samples, spiked samples, and surrogate recoveries have been established for assessing data precision and accuracy and are outlined in Ogden SOP FP-F-2, "Field QC Samples (Water, Soil)." If, during field activities, it is determined that field procedures are inadequate or inappropriate, immediate corrective action will be taken to ensure implementation of proper, approved procedures. If samples have been collected under these circumstances, then some samples may be discarded and new samples will be taken. If samples have been sent for analysis, the laboratory will be contacted to terminate analysis.

If sample results indicate unacceptable contamination of field or trip blanks, sampling and analysis may need to be repeated. This decision will be made by the site manager after consultation with the PADEP Project Officer.

Ogden currently anticipates that approximately 36 QA/QC samples will be obtained in the field during the site characterization. QA/QC samples anticipated for this project are listed in Table 2-1 by sample media.

3.2 Project Schedule

A proposed project schedule is presented as Figure 3-2 to indicate the expected duration of project activities. This figure shows the tasks and subtasks to be executed in order to complete the site characterization program. The overall length of the project is estimated to be 33 weeks.

4.0 HEALTH AND SAFETY INFORMATION

This section summarizes the site-specific health and safety procedures and the standard operating procedures (SOPs) to be used during site characterization activities to ensure the safety of personnel associated with the field activities and the protection of the general public and the environment. This section was obtained from the formal Health and Safety Plan (HSP) prepared by Ogden for site activities. This summary was prepared at the request of the PADEP and is not meant to supersede the requirements of 29 CFR 1910 and 1926. A full copy of the complete HSP will be maintained onsite during field activities at all times until field characterization activities are complete.

4.1 Monitoring

4.1.1 Exposure Monitoring

Onsite monitoring will be performed to ensure that all field activities are performed in compliance with the following Ogden field SOPs:

- Personnel Decontamination (SOP HSP-6)
- Drilling Safety (SOP HSP-7)
- Sampling for Organic Vapors and Gases (SOP HSP-8)
- Particulate Monitor

Before beginning any new phase of work, at the beginning of each shift, and as often as necessary, the Site Health and Safety Officer (SHSO) will conduct an area survey to locate hazards and determine appropriate control measures. The monitoring results will be documented in the site log book. All instruments used onsite shall be calibrated and/or field checked in accordance with the manufacturer's specifications on each day that field operations require their use. This calibration data shall also be recorded in the calibration log book.

The air monitoring schedule for the three zones listed below shall be conducted to determine the levels of protection, the size of the exclusion zone, and the location of the contamination reduction zone (CRZ) and support zones. The health and safety zones will be determined in the field and shall be based on location of drilling operations.

1. Exclusion zone air monitoring:
    a. At the beginning of each day and a minimum of two times during the day.
    b. During the initiation of new intrusive activities.
2. Support zone perimeter air monitoring:
    a. At least twice per day during intrusive activities.
3. Breathing zone air monitoring:
    a. Prior to entry onto the site by workers.
    b. Periodically during intrusive activities, as determined by the SHSO.
    c. Prior to and during a new phase of work to characterize the exposure potential.

These guidelines represent the minimum requirement and monitoring frequency that will be maintained or escalated, based on the results of previous monitoring, other signs of organic vapors (odors, etc.), and/or excessive dust reading. Monitoring in the breathing zone will always be conducted in the breathing zone of those with the highest anticipated potential exposure.

High noise levels and heat or cold stress conditions anticipated for segments of this project will dictate the need for the SHSO to monitor the work environment and/or personnel for these physical stresses. Instrumentation anticipated for this use includes sound level meters, noise dosimeters, and wet bulb globe temperature (WBGT) instruments. Noise monitoring will be

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conducted at the initiation of new activities involving heavy equipment to allow for posting of high noise areas and to specify the level of hearing protection.

Field personnel will interface with the SHSO in order to coordinate monitoring efforts and consistent interpretation of results. The instruments listed below are typical for executing the tasks described. Instruments with equivalent capabilities may be used.

Equipment Name or Type	Brand/Model	Contaminant or Hazard to be Detected
Photoionization Detector (PID)	HNU/PI 101/10.2 bulb	Organic vapors
Sound Level Meter	Bruel & Kjaer Precision Sound Level Meter, Type 2232	Personal noise exposures

4.1.2 Action Levels

Action levels for upgrading/downgrading personal protective equipment (PPE), work stoppages, and evacuation are presented in Table 4-1.

4.2 Chemical Exposure

The primary exposure hazards to contaminants present at the site are through three entry routes: (1) inhalation of vapors and dusts, (2) skin contact with contaminated materials, or (3) ingestion of airborne dusts through hand-to-mouth contact due to inadequate personal hygiene. The Site Supervisor will use dust control measures to minimize airborne dusts and ensure air monitoring is conducted, thereby minimizing the potential of exposure. In addition, PPE will be used to further minimize exposures. Personal hygiene will be carefully followed to prevent inadvertent oral exposure. Refer to Table 4-2 for chemical hazards, source, and exposure information.

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Table 4-1
Action Levels
Chem-Fab Site

Equipment/Contaminant	Action Level	Action to be Taken
PID/FID	$\geq$ 35 ppm for 5 minutes in breathing zone (BZ)	Stop activities. Ventilate the area. Return to work when levels have returned to background.
Particulate Monitor	0.1 mg/m^3 for 5 minutes in BZ	Halt work in Level D, upgrade to Level C
Sound Level Meter	$\geq$ 85 dBA	Use hearing protection.

Table 4-2
Chemical Hazards, Source, and Exposure Information

Chemical	Media	Threshold Limit Values (ACGIH TWA unless noted)	Odor Threshold	STEL/ IDLH	LEL/ UEL IP in eV	Route/Symptoms		Properties/ Characteristics
						Route	Symptoms	
TCE	Soil and Liquid	100 ppm	---	1000 ppm	UEL: 10.5% LEL: 8%	Inh Abs Ing Con	Irrit eyes, skin, head, verti; vis dist, ftg, gidd, tremor, som, nau, vomit; derm; card arrhy, pares; liver inj,. (carc)	Colorless liquid (unless dyed blue) with a chloroform like odor
Chromic Acid	Soil and Liquid	0.05 mg/m^3	---	30 mg/m^3	NA	Inh Ing Con	Irrit resp. sys, nasal septum perf; liver, kidney damage;leucyt, leupen, monocy, eosin; eye inj, conj, skin ulcer; sens derm; (carc)	Appearance and odor vary depending upon the specific chromium compound. Cr is dark-red, odorless flakes or powder
1,1-dichloroethene	Liquid	100 ppm	49 to 1359 ppm	3000 ppm	UEL: 11.4% LEL: 5.4%	Inh Ing Con	Irrit skin, CNSdepres; liver, kidney, lung damage	Colorless, oily liquid with a chloroform-like odor
PCE	Liquid	100 ppm	47 ppm	150 ppm	NA	Inh Abs Ing Con	Irrit eyes, nose, throat; nau; flush face, neck; verti, dizz,inco; head, som, skin eryt; liver damage (carc)	Colorless liquid with a mild chloroform like odor

Sources: NIOSH Pocket Guide to Chemical Hazards (June 1994) and Hawley's Condensed Chemical Dictionary (Eleventh Edition).

4.3 Emergency Assistance

This section provides a brief description of how to obtain medical and emergency assistance.

4.3.1 Emergency Contacts

Medical Emergency	911
Hospital - Doylestown	911 or 215-345-2200
Ambulance	911
Fire Dept.	911
Poison Control Hot Line	800-962-1253
Rock Mountain Poison Control Center	800-332-3073
EPA National Response Center	800-424-8802
OSHA (Region V)	614-469-5582
CHEMTREC	800-424-9300
Project Manager (Kathy McGuire)	215-654-1620
Township of Doylestown Police Department (Emergency)	911
PADEP Emergency Response Team (24 hours)	800-373-3398
PADEP Southeast Regional Office	610-832-5937

4.3.2 Hospital Route

Prior to the commencement of work, the accuracy of the hospital route map (Figure 4-1) and site specific directions will be verified with the PADEP. The directions to the hospital from the site are as follows:

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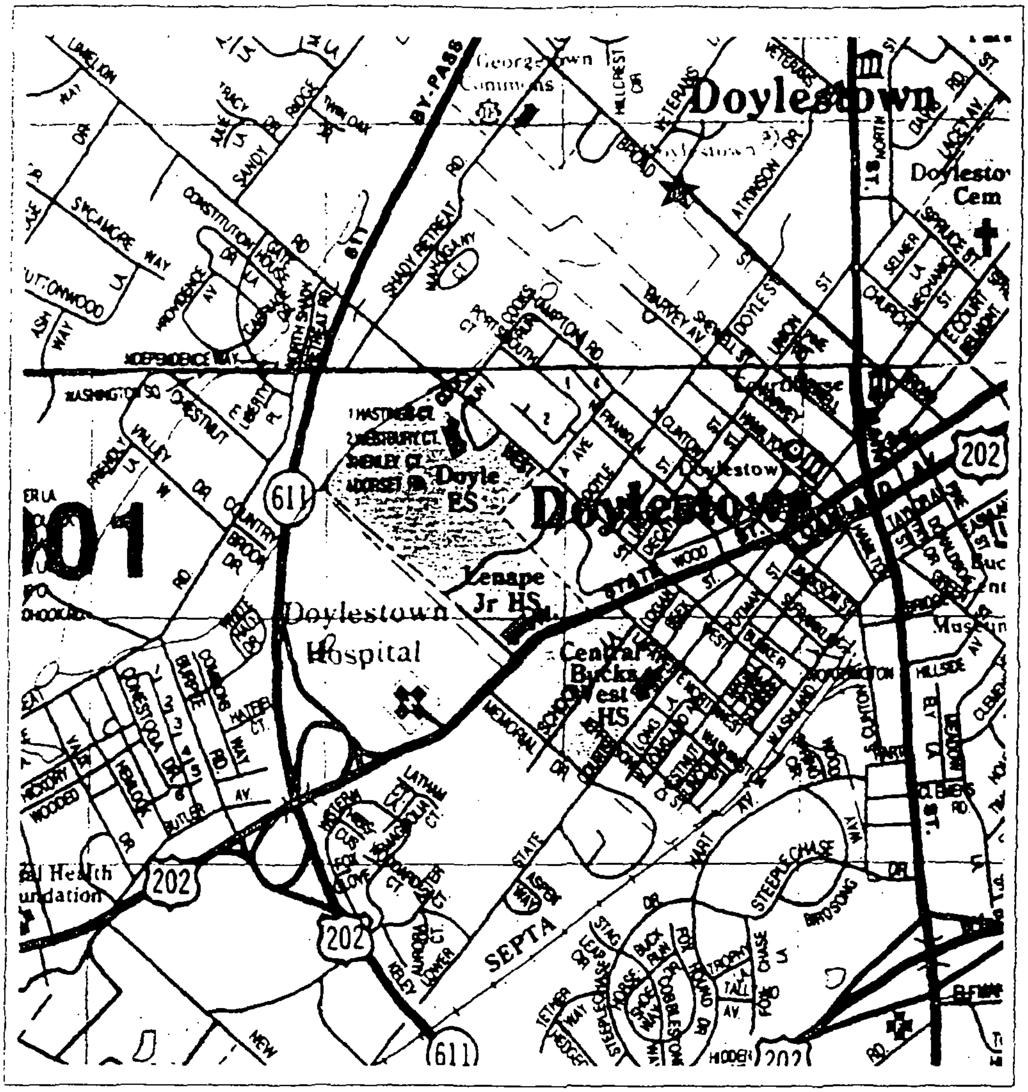

Directions:

From site, East on Broad St.(right)
Continue 1/4 mile to 611 South (right)
From 611 South proceed West on W. State St. (right)
Continue 3/4 mile to Doylestown Hospital (right)

Doylestown Hospital
595 West State Street
Doylestown, PA 18901
(215) 345-2200

Source: Rand McNally
Philadelphia 5 County Street Atlas (1995)

N

Figure 4-1
Hospital Directions

Chem-Fab Corporation Site
Doylestown, Bucks County, PA

OGDEN ENVIRONMENTAL AND ENERGY SERVICES CO., INC.
1777 SENTRY PARK WEST, ABINGTON HALL, SUITE 300 BLUE BELL, PA. 19422

Doylestown Hospital
595 West State Street
Doylestown, PA
215-345-2200

Directions to Hospital from Chem-Fab Site

- From site, east on Broad Street (right out of site)
- Continue ¼ mile to 611 South (make right)
- From 611 South proceed to West State Street (make right).
- Continue ¾ mile west on West State Street to Doylestown Hospital
- Hospital is at 595 West State Street

4.4 Hazard Analysis of Work Tasks

The anticipated tasks for the project site activities are identified below. The hazards of each task are analyzed in detail beginning in Section 4.4.1. These subsections provide charts that describe the potential hazards, the control/protective measures required by the HSP, and the type of protective equipment to be employed by personnel conducting the task. These tasks include:

- Mobilization/Demobilization
- Geophysical Survey
- Subsurface Soil and Groundwater Sampling
- Surface Water/Sediment Sampling
- Underground Storage Tank/Basin/Sump Sampling
- Offsite Well Sampling
- Site Survey
- Radiological Survey
- Drum Characterization and Disposal
- IDW Sampling and Disposal

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4.4.1 Task: Mobilization/Demobilization

Potential Hazards: (Check all that apply to either existing conditions or are a result of site operations)

( ) Rotating Machinery
( ) Heat Stress
(✓) Cold Stress
(✓) Heavy Equipment
( ) Intrusive Activity
( ) Other:

( ) Projectiles
( ) Physical Exertion
( ) Noise (>85 dBA)
(✓) Vehicle Traffic
( ) Fire/Explosion

( ) Confined Space
( ) Biological
(✓) Electrical (utilities)
( ) Chemical Exposure
(✓) Slips, trips, and falls
( ) Contact with contaminated soil, water, and sludge

Control or Protective Measures: (Check all that apply)

(✓) Tailgate Meetings
( ) Operator Training
( ) Engineering Controls:
( ) Other: Wear traffic vests around moving heavy equipment and vehicles

(✓) PPE, Modified Level D
(✓) Site Control

(✓) Safe Work Practices
( ) Decontamination

INITIAL LEVEL OF PERSONAL PROTECTIVE EQUIPMENT FOR ASSIGNED TASK:

Initial levels of PPE have been assigned for this work task per the potential for exposure. Levels may be upgraded or downgraded depending on monitoring data and site conditions, as determined by the protocol outlined in Section 6.0 and deemed necessary by the SHSO.

Level of protection:	( ) A ( ) B	( ) C (✓) D	(✓) Modified
Respirator: (Level C or above)	( ) SCBA, Airline ( ) OV/HEPA Combo Cart.	( ) Fullface Resp ( ) Other Cart._________	( ) 1/2 Face Resp.
Protective clothing:	( ) Encapsulating Suit ( ) Saranex	(✓) Tyvek ( ) Splash Suit	( ) PC Tyvek ( ) Other
Head/eye/ear:	(✓) Hard Hat ( ) Ear Plug	(✓) Safety Glasses with side shields ( ) Other	( ) Goggles ( ) Splash Shield
Gloves: (Outer/Inner)	( ) Nitrile (outer)	( ) Neoprene	( ) PVC - Use with Petroleum Products
	( ) Latex (inner)	( ) Vinyl (inner)	(▲) Other: Cotton/leather (optional)
Footwear:	(✓) Safety-toed Leather ( ) Safety-toed Rubber	(✓) Chemical Overboots ( ) Other	

Modifications allowed: (▲) Leather work gloves may be worn if desired.

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4.4.2 Task: Geophysical Survey

Potential Hazards: (Check all that apply to either existing conditions or are a result of site operations)

( ) Rotating Machinery
(✓) Heat Stress
(✓) Cold Stress
( ) Heavy Equipment
( ) Intrusive Activity
( ) Other:

( ) Projectiles
( ) Physical Exertion
( ) Noise (>85 dBA)
( ) Vehicle Traffic
( ) Fire/Explosion

( ) Confined Space
(✓) Biological
( ) Electrical (utilities)
( ) Chemical Exposure
(✓) Slips, trips, and falls
( ) Contact with contaminated soil, water, and sludge

Control or Protective Measures: (Check all that apply)

( ) Tailgate Meetings
( ) Operator Training
( ) Engineering Controls:
( ) Other: Keep area secure.

(✓) PPE
(✓) Site Control

(✓) Safe Work Practices
( ) Decontamination

INITIAL LEVEL OF PERSONAL PROTECTIVE EQUIPMENT FOR ASSIGNED TASK:

Initial levels of PPE have been assigned for this work task per the potential for exposure. Levels may be upgraded or downgraded depending on monitoring data and site conditions, as determined by the protocol outlined in Section 6.0 and deemed necessary by the SHSO.

Level of protection:	( ) A ( ) B	( ) C (✓) D	( ) Modified D
Respirator: (Level C or above)	( ) SCBA, Airline ( ) OV/HEPA Combo Cart.	( ) Fullface Resp. ( ) Other Cart. GMCH	( ) 1/2 Face Resp.
Protective clothing:	( ) Encapsulating Suit ( ) Saranex	( ) Tyvek ( ) Splash Suit	( ) PC Tyvek ( ) Other:
Head/eye/ear:	(✓) Hard Hat	(✓) Safety Glasses/ Side Shields	( ) Goggles
	( ) Splash Shield	(✓) Ear Plugs	( ) Other
Gloves:(Outer/Inner)	( ) Nitrile (outer)	( ) Neoprene	( ) PVC - Use with Petroleum **Products**
	( ) N-Dex (inner)	( ) Vinyl	(✓) Other: **Cotton/leather** (optional)
Footwear:	(✓) Safety-toed Leather ( ) Safety-toed Rubber	( ) Chemical Overboots (optional) ( ) Other	

Modifications allowed: Not applicable

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4.4.3 Task: Subsurface Soil and Groundwater Sampling

Potential Hazards: (Check all that apply to either existing conditions or are a result of site operations)

( ) Rotating Machinery
(✔) Heat Stress
(✔) Cold Stress
(✔) Heavy Equipment
(✔) Intrusive Activity
( ) Other:

( ) Projectiles
(✔) Physical Exertion
( ) Noise (>85 dBA)
( ) Vehicle Traffic
( ) Fire/Explosion

( ) Confined Space
(✔) Biological
(✔) Electrical (utilities)
(✔) Chemical Exposure
(✔) Slips, trips, and falls
(✔) Contact with contaminated soil, water, and sludge

Control or Protective Measures: (Check all that apply)

(✔) Tailgate Meetings
( ) Operator Training

(✔) PPE
(✔) Site Control

(✔) Safe Work Practices
( ) Decontamination, as applicable

( ) Engineering Controls: Spray down with water.
( ) Other:

INITIAL LEVEL OF PERSONAL PROTECTIVE EQUIPMENT FOR ASSIGNED TASK:

Initial levels of PPE have been assigned for this work task per the potential for exposure. Levels may be upgraded or downgraded depending on monitoring data and site conditions, as determined by the protocol outlined in Section 6.0 and deemed necessary by the SHSO.

Level of protection:	( ) A ( ) B	(▲) C ( ) D	(✔) Modified D
Respirator: (Level C or above)	( ) SCBA, Airline (▲) OV/HEPA Combo Cart.	(▲) Fullface Resp ( ) Other Cart. GMCH	( ) 1/2 Face Resp.
Protective clothing:	( ) Encapsulating Suit ( ) Saranex	(✔) Tyvek ( ) Splash Suit	( ) PC Tyvek ( ) Other
Head/eye/ear:	(✔) Hard Hat ( ) Splash Shield	(✔) Safety Glasses (✔) Ear Plugs	( ) Goggles ( ) Other
Gloves:(Outer/Inner)	(✔) Nitrile (outer) (✔) N-Dex (inner)	( ) Neoprene ( ) Vinyl (inner)	( ) PVC - Use with Petroleum Products (✔) Other: Cotton/leather (optional)
Footwear:	(✔) Safety-toed Leather ( ) Safety-toed Rubber	(✔) Chemical Overboots ( ) Other	
Modifications allowed:	(▲) Level C protection will be required if actions levels shown on Table 4-1 are exceeded. Begin activities in modified Level D, but have provisions available to upgrade to Level C.		

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4.4.4 Task: Surface Water /Sediment Sampling

Potential Hazards: (Check all that apply to either existing conditions or are a result of site operations)

( ) Rotating Machinery
(✔) Heat Stress
(✔) Cold Stress
( ) Heavy Equipment
( ) Intrusive Activity
( ) Other:
( ) Projectiles
(✔) Physical Exertion
( ) Noise (>85 dBA)
( ) Vehicle Traffic
( ) Fire/Explosion
( ) Confined Space
(✔) Biological
(✔) Electrical (utilities)
(✔) Chemical Exposure
(✔) Slips, trips, and falls
(✔) Contact with contaminated soil, water, and sludge

Control or Protective Measures: (Check all that apply)

(✔) Tailgate Meetings
( ) Operator Training
(✔) PPE
(✔) Site Control
(✔) Safe Work Practices
( ) Decontamination, as applicable

( ) Engineering Controls: Spray down with water.
( ) Other:

INITIAL LEVEL OF PERSONAL PROTECTIVE EQUIPMENT FOR ASSIGNED TASK:

Initial levels of PPE have been assigned for this work task per the potential for exposure. Levels may be upgraded or downgraded depending on monitoring data and site conditions, as determined by the protocol outlined in Section 6.0 and deemed necessary by the SHSO.

Level of protection:	( ) A ( ) B	(▲) C ( ) D	(✔) Modified D
Respirator: (Level C or above)	( ) SCBA, Airline (▲) OV/HEPA Combo Cart.	(▲) Fullface Resp ( ) Other Cart. GMCH	( ) 1/2 Face Resp.
Protective clothing:	( ) Encapsulating Suit ( ) Saranex	(✔) Tyvek ( ) Splash Suit	( ) PC Tyvek ( ) Other
Head/eye/ear:	(✔) Hard Hat ( ) Splash Shield	(✔) Safety Glasses (✔) Ear Plugs	( ) Goggles ( ) Other
Gloves:(Outer/Inner)	(✔) Nitrile (outer)	( ) Neoprene	( ) PVC - Use with Petroleum Products
	(✔) N-Dex (inner)	( ) Vinyl (inner)	(✔) Other: Cotton/leather (optional)
Footwear:	(✔) Safety-toed Leather ( ) Safety-toed Rubber	(✔) Chemical Overboots ( ) Other	
Modifications allowed:	(▲) Level C protection will be required if actions levels shown on Table 4-1 are exceeded. Begin activities in modified Level D, but have provisions available to upgrade to Level C.		

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4.4.5 Task: Underground Storage Tank/Basin/Sump Sampling

Potential Hazards: (Check all that apply to either existing conditions or are a result of site operations)

- ( ) Rotating Machinery
- (✓) Heat Stress
- (✓) Cold Stress
- (✓) Heavy Equipment
- (✓) Intrusive Activity
- ( ) Other:
- ( ) Projectiles
- (✓) Physical Exertion
- ( ) Noise (>85 dBA)
- ( ) Vehicle Traffic
- ( ) Fire/Explosion
- ( ) Confined Space
- (✓) Biological
- (✓) Electrical (utilities)
- (✓) Chemical Exposure
- (✓) Slips, trips, and falls
- (✓) Contact with contaminated soil, water, and sludge

Control or Protective Measures: (Check all that apply)

- (✓) Tailgate Meetings
- ( ) Operator Training
- (✓) PPE
- (✓) Site Control
- (✓) Safe Work Practices
- ( ) Decontamination, as applicable
- ( ) Engineering Controls: Spray down with water.
- ( ) Other:

INITIAL LEVEL OF PERSONAL PROTECTIVE EQUIPMENT FOR ASSIGNED TASK:

Initial levels of PPE have been assigned for this work task per the potential for exposure. Levels may be upgraded or downgraded depending on monitoring data and site conditions, as determined by the protocol outlined in Section 6.0 and deemed necessary by the SHSO.

Level of protection:	( ) A ( ) B	(▲) C ( ) D	(✓) Modified D
Respirator: (Level C or above)	( ) SCBA, Airline (▲) OV/HEPA Combo Cart.	(▲) Fullface Resp ( ) Other Cart. GMCH	( ) 1/2 Face Resp.
Protective clothing:	( ) Encapsulating Suit ( ) Saranex	(✓) Tyvek ( ) Splash Suit	( ) PC Tyvek ( ) Other
Head/eye/ear:	(✓) Hard Hat ( ) Splash Shield	(✓) Safety Glasses (✓) Ear Plugs	( ) Goggles ( ) Other
Gloves:(Outer/Inner)	(✓) Nitrile (outer) (✓) N-Dex (inner)	( ) Neoprene ( ) Vinyl (inner)	( ) PVC - Use with Petroleum Products (✓) Other: Cotton/leather (optional)
Footwear:	(✓) Safety-toed Leather ( ) Safety-toed Rubber	(✓) Chemical Overboots ( ) Other	
Modifications allowed:	(▲) Level C protection will be required if actions levels shown on Table 4-1 are exceeded. Begin activities in modified Level D, but have provisions available to upgrade to Level C.		

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4.4.6 Task: Site Survey

Potential Hazards: (Check all that apply to either existing conditions or are a result of site operations)

( ) Rotating Machinery
(✓) Heat Stress
(✓) Cold Stress
( ) Heavy Equipment
( ) Intrusive Activity
( ) Other:

( ) Projectiles
( ) Physical Exertion
( ) Noise (>85 dBA)
( ) Vehicle Traffic
( ) Fire/Explosion

( ) Confined Space
(✓) Biological
( ) Electrical (utilities)
( ) Chemical Exposure
(✓) Slips, trips, and falls
( ) Contact with contaminated soil, water, and sludge

Control or Protective Measures: (Check all that apply)

( ) Tailgate Meetings
( ) Operator Training
( ) Engineering Controls:
( ) Other: Keep area secure.

(✓) PPE
(✓) Site Control

(✓) Safe Work Practices
( ) Decontamination

INITIAL LEVEL OF PERSONAL PROTECTIVE EQUIPMENT FOR ASSIGNED TASK:

Initial levels of PPE have been assigned for this work task per the potential for exposure. Levels may be upgraded or downgraded depending on monitoring data and site conditions, as determined by the protocol outlined in Section 6.0 and deemed necessary by the SHSO.

Level of protection:	( ) A ( ) B	( ) C (✓) D	( ) Modified D
Respirator: (Level C or above)	( ) SCBA, Airline ( ) OV/HEPA Combo Cart.	( ) Fullface Resp. ( ) Other Cart. GMCH	( ) 1/2 Face Resp.
Protective clothing:	( ) Encapsulating Suit ( ) Saranex	( ) Tyvek ( ) Splash Suit	( ) PC Tyvek ( ) Other:
Head/eye/ear:	(✓) Hard Hat ( ) Splash Shield	(✓) Safety Glasses/ Side Shields (✓) Ear Plugs	( ) Goggles ( ) Other
Gloves:(Outer/Inner)	( ) Nitrile (outer) ( ) N-Dex (inner)	( ) Neoprene ( ) Vinyl	( ) PVC - Use with Petroleum Products (✓) Other: Cotton/leather (optional)
Footwear:	(✓) Safety-toed Leather ( ) Safety-toed Rubber	( ) Chemical Overboots (optional) ( ) Other	

Modifications allowed: Not applicable

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4.4.7 Task: Radiological Survey

Potential Hazards: (Check all that apply to either existing conditions or are a result of site operations)

( ) Rotating Machinery
(✓) Heat Stress
(✓) Cold Stress
( ) Heavy Equipment
( ) Intrusive Activity
( ) Other:

( ) Projectiles
( ) Physical Exertion
( ) Noise (>85 dBA)
( ) Vehicle Traffic
( ) Fire/Explosion

( ) Confined Space
(✓) Biological
( ) Electrical (utilities)
( ) Chemical Exposure
(✓) Slips, trips, and falls
( ) Contact with contaminated soil, water, and sludge

Control or Protective Measures: (Check all that apply)

( ) Tailgate Meetings
( ) Operator Training
( ) Engineering Controls:
( ) Other: Keep area secure.

(✓) PPE
(✓) Site Control

(✓) Safe Work Practices
( ) Decontamination

INITIAL LEVEL OF PERSONAL PROTECTIVE EQUIPMENT FOR ASSIGNED TASK:

Initial levels of PPE have been assigned for this work task per the potential for exposure. Levels may be upgraded or downgraded depending on monitoring data and site conditions, as determined by the protocol outlined in Section 6.0 and deemed necessary by the SHSO.

Level of protection:	( ) A ( ) B	( ) C (✓) D	( ) Modified D
Respirator: (Level C or above)	( ) SCBA, Airline ( ) OV/HEPA Combo Cart.	( ) Fullface Resp. ( ) Other Cart. GMCH	( ) 1/2 Face Resp.
Protective clothing:	( ) Encapsulating Suit ( ) Saranex	( ) Tyvek ( ) Splash Suit	( ) PC Tyvek ( ) Other:
Head/eye/ear:	(✓) Hard Hat	(✓) Safety Glasses/ Side Shields	( ) Goggles
	( ) Splash Shield	(✓) Ear Plugs	( ) Other
Gloves:(Outer/Inner)	( ) Nitrile (outer)	( ) Neoprene	( ) PVC - Use with Petroleum Products
	( ) N-Dex (inner)	( ) Vinyl	(✓) Other: Cotton/leather (optional)
Footwear:	(✓) Safety-toed Leather ( ) Safety-toed Rubber	( ) Chemical Overboots (optional) ( ) Other	

Modifications allowed: Not applicable

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4.4.8 Task: Offsite Well Sampling

Potential Hazards: (Check all that apply to either existing conditions or are a result of site operations)

(✓) Rotating Machinery
(✓) Heat Stress
(✓) Cold Stress
( ) Heavy Equipment
(✓) Intrusive Activity
( ) Other:
( ) Projectiles
(✓) Physical Exertion
(✓) Noise (>85 dBA)
(✓) Vehicle Traffic
( ) Fire/Explosion
( ) Confined Space
(✓) Biological
( ) Electrical (utilities)
(✓) Chemical Exposure
(✓) Slips, trips, and falls
( ) Contact with contaminated soil, water, and sludge

Control or Protective Measures: (Check all that apply)

(✓) Tailgate Meetings
( ) Operator Training
( ) Engineering Controls:
( ) Other:
(✓) PPE
(✓) Site Control
(✓) Safe Work Practices
(✓) Decontamination

INITIAL LEVEL OF PERSONAL PROTECTIVE EQUIPMENT FOR ASSIGNED TASK:

Initial levels of PPE have been assigned for this work task per the potential for exposure. Levels may be upgraded or downgraded depending on monitoring data and site conditions, as determined by the protocol outlined in Section 6.0 and deemed necessary by the SHSO.

Level of protection:	( ) A ( ) B	(▲) C ( ) D	(✓) Modified D
Respirator: (Level C or above)	( ) SCBA, Airline ( ) OV/HEPA Combo Cart.	(▲) Fullface Resp. (▲) Other Cart. GMCH	( ) 1/2 Face Resp.
Protective clothing:	( ) Encapsulating Suit ( ) Saranex	(▲) Tyvek ( ) Splash Suit	( ) PC Tyvek ( ) Other:
Head/eye/ear:	( ) Hard Hat	(✓) Safety Glasses/ Side Shields	( ) Goggles
	( ) Splash Shield	(✓) Ear Plug	( ) Other
Gloves:(Outer/Inner)	( ) Nitrile (outer)	( ) Neoprene	( ) PVC - Use with Petroleum Products
	(✓) Latex (inner)	( ) Vinyl	(✓) Other: Cotton/leather (optional)
Footwear:	(✓) Safety-toed Leather ( ) Safety-toed Rubber	(✓) Chemical Overboots (optional) ( ) Other	

Modifications allowed: (●) If contact with sludge or contaminated liquid is a concern, PC Tyvek or Saranex suits will be worn.
(▲) Level C is not anticipated for field activities; however, if action levels outlined in Table 4-1 are exceeded Level C is required. Begin activity in Level D, but have provisions available to upgrade to Level C.

ORIGINAL
(Red)

4.4.9 Task: Drum Characterization and Removal

Potential Hazards: (Check all that apply to either existing conditions or are a result of site operations)

( ) Rotating Machinery
(✓) Heat Stress
(✓) Cold Stress
( ) Heavy Equipment
(✓) Intrusive Activity
( ) Other:
( ) Projectiles
(✓) Physical Exertion
( ) Noise (>85 dBA)
( ) Vehicle Traffic
( ) Fire/Explosion
( ) Confined Space
(✓) Biological
( ) Electrical (utilities)
(✓) Chemical Exposure
(✓) Slips, trips, and falls
(✓) Contact with contaminated soil, water, and sludge

Control or Protective Measures: (Check all that apply)

(✓) Tailgate Meetings
(✓) Operator Training
(✓) PPE, Modified Level D
(✓) Site Control
(✓) Safe Work Practices
(✓) Decontamination, as applicable
( ) Engineering Controls: Barriers
( ) Other: SOPs, Hearing Conservation, Decontamination

INITIAL LEVEL OF PERSONAL PROTECTIVE EQUIPMENT FOR ASSIGNED TASK:

Initial levels of PPE have been assigned for this work task per the potential for exposure. Levels may be upgraded or downgraded depending on monitoring data and site conditions, as determined by the protocol outlined in Section 6.0 and deemed necessary by the SHSO.

Level of protection:	( ) A ( ) B	(▲) C ( ) D	(✓) Modified D
Respirator: (Level C or above)	( ) SCBA, Airline ( ) OV/HEPA Combo Cart.	(▲) Fullface Resp (▲) Other Cart. GMCH	( ) 1/2 Face Resp.
Protective clothing:	( ) Encapsulating Suit ( ) Saranex	(✓) Tyvek ( ) Splash Suit	( ) PC Tyvek ( ) Other
Head/eye/ear:	(✓) Hard Hat ( ) Splash Shield	(✓) Safety Glasses ( ) Ear Plug	( ) Goggles ( ) Other
Gloves:(Outer/Inner)	(✓) Nitrile (outer)	( ) Neoprene	( ) PVC - Use with Petroleum Products
	(✓) N-Dex Nitrile (inner)	( ) Vinyl (inner)	(✓) Other: Cotton/leather **(optional)**
Footwear:	(✓) Safety-toed Leather ( ) Safety-toed Rubber	(✓) Chemical Overboots ( ) Other	

Modifications allowed: (▲) Level C protection will be required if action levels shown on Table 4-1 are exceeded. Begin activities in Modified Level D, but have provisions available to upgrade to Level C.

ORIGINAL (Red)

4.4.10 Task: IDW Sampling and Disposal

Potential Hazards: (Check all that apply to either existing conditions or are a result of site operations)

( ) Rotating Machinery
(✔) Heat Stress
(✔) Cold Stress
( ) Heavy Equipment
(✔) Intrusive Activity
( ) Other:

( ) Projectiles
(✔) Physical Exertion
( ) Noise (>85 dBA)
( ) Vehicle Traffic
( ) Fire/Explosion

( ) Confined Space
(✔) Biological
( ) Electrical (utilities)
(✔) Chemical Exposure
(✔) Slips, trips, and falls
(✔) Contact with contaminated soil, water, and sludge

Control or Protective Measures: (Check all that apply)

(✔) Tailgate Meetings
(✔) Operator Training

(✔) PPE, Modified Level D
(✔) Site Control

(✔) Safe Work Practices
(✔) Decontamination, as applicable

( ) Engineering Controls: Barriers
( ) Other: SOPs, Hearing Conservation, Decontamination

INITIAL LEVEL OF PERSONAL PROTECTIVE EQUIPMENT FOR ASSIGNED TASK:

Initial levels of PPE have been assigned for this work task per the potential for exposure. Levels may be upgraded or downgraded depending on monitoring data and site conditions, as determined by the protocol outlined in Section 6.0 and deemed necessary by the SHSO.

Level of protection:	( ) A ( ) B	(▲) C ( ) D	(✔) Modified D
Respirator: (Level C or above)	( ) SCBA, Airline ( ) OV/HEPA Combo Cart.	(▲) Fullface Resp (▲) Other Cart. GMCH	( ) 1/2 Face Resp.
Protective clothing:	( ) Encapsulating Suit ( ) Saranex	(✔) Tyvek ( ) Splash Suit	( ) PC Tyvek ( ) Other
Head/eye/ear:	(✔) Hard Hat ( ) Splash Shield	(✔) Safety Glasses ( ) Ear Plug	( ) Goggles ( ) Other
Gloves:(Outer/Inner)	(✔) Nitrile (outer)	( ) Neoprene	( ) PVC - Use with Petroleum Products
	(✔) N-Dex Nitrile (inner)	( ) Vinyl (inner)	(✔) Other: Cotton/leather (optional)
Footwear:	(✔) Safety-toed Leather ( ) Safety-toed Rubber	(✔) Chemical Overboots ( ) Other	

Modifications allowed: (▲) Level C protection will be required if action levels shown on Table 4-1 are exceeded. Begin activities in Modified Level D, but have provisions available to upgrade to Level C.

ORIGINAL
(Red)

5.0 REFERENCES

Ogden Standard Operating Procedures (SOPs)

FP-A-1	Auto Control of Measuring and Test Equipment
FP-A-2	Calibration Procedures
FP-A-3	Preventive Maintenance of Test Equipment
FP-B-8	IDW Management
FP-C-2	Soil Sampling
FP-C-10	Asbestos Sampling
FP-D-3	Monitoring Well Sampling
FP-D-5	Equipment Decontamination
FP-E-1	Drum Sampling
FP-E-2	Wipe Samples, Chip Samples, Sweep Tests
FP-F-2	Field QC Samples (Water, Soil)
FP-F-5	Logbooks
HSP-6	Personnel Decontamination
HSP-7	Drilling Safety
HSP-8	Sampling for Organic Vapors and Gases

1. NUS, "Site Inspection of Chem-Fab Corporation," prepared for the EPA, April 1988.

2. National Enforcement Investigation Center (NEIC) of the EPA, "Enforcement Confidential Investigation Report," March 1995.

3. United States Environmental Protection Agency (EPA), "Federal On-Scene Coordinator's After Action Report," March 1994.

GCLB On File

ORIGINAL
(Red)

Pennsylvania Department of Environmental Protection
Lee Park, Suite 6010
555 North Lane
Conshohocken, PA 19428

November 24, 1998

Southeast Regional Office

610-832-5949
Fax 610-832-6143

Mr. David Wright, Chief
U.S. Environmental Protection Agency
CEPP and Site Assessment Section
3HS33
1650 Arch Street
Philadelphia, PA 19103

Re: Chem-Fab Site
PAD002323848/PA-1243
300 North Broad Street
Doylestown Borough
Bucks County, PA

Dear Mr. Wright:

This is to serve as written confirmation that the Pennsylvania Department of Environmental Protection (DEP), with the approval of the U.S. Environmental Protection Agency (EPA), has assumed the lead with respect to the environmental assessment of the Chem-Fab Site. The DEP shall provide copies of pertinent documents to the EPA.

Upon completion of the Department's assessment, we shall discuss our findings with you and decide upon the further disposition of the site at that time.

If you have any questions or comments with regard to this matter, please don't hesitate to call me at 610-832-5967, or Mr. Robert Zang, HSCP Supervisor 610-832-6152.

Sincerely,

George M. Danyliw
HSCA Manager
Environmental Cleanup

cc: Mr. Zang
Mr. Timcik
Mr. Hartzell
Ms. Tremont
File
Re 30 (jd98)324-1

ORIGINAL
(Red)

Agricultural Research Service TEKTRAN

A REEVALUATION OF THE CHROMIC ACID SOIL ORGANIC CARBON PROCEDURE

Author(s):

BOWMAN RUDOLPH A

Interpretive Summary:

The chromic acid soil organic carbon procedure was reevaluated since it can be used effectively where budgets are low, number of soil samples are small, and where free lime may be present. Under the procedure described, accuracy approximates that of the C-N analyzer for soils of the Central Great Plains where soil organic matter (SOM) and clay content are relatively low. At the end of the procedure, the unreacted hazardous hexavalent chromium is reduced with sugars to the less hazardous trivalent chromium . Waste is then neutralized and disposed of in a landfill. This method should be adequate for selectively screening SOM content where speed is important, and sample quantities are small.

Keywords:

nutrient cycling nitrogen phosphorus cropping systems crop rotation crop residue weed ecology weed control ground water quality fertilizer soil water storage water use efficiency organic matter nutrient utilization efficiency weed population dynamics

Contact:

CENTRAL GREAT PLAINS RES
P. O. BOX 400
AKRON
CO 80720
FAX: 970-345-2088
Email: rbowman@lamar.colostate.edu

ARS Report Number: 0000075635

Approved Date: 1996-09-24

TEKTRAN
United States Department of Agriculture
National Agricultural Library
Technology Transfer Information Center

For comments and questions, contact ttic@nal.usda.gov
Updated: 1996-11-06

SATA REMEDIAL AND PA/SI TASKING ASSIGNMENT RECORD

ORIGINAL (RED)

Current Date: 10-21-98

Completion Date: 12-31-98

TDD# (if amended): ☐

TDD Type: ☐

EPA Monitor: Peter Gold

Site Code: ☐

Action Code: 62

Action Sequence #: CO - -

Overtime Approved: YES ☑ NO ☐

Reference Info: Yes ☑ No ☐ Attached ☐ Pick-up ☑

EPA Site Name/Project Name & Operational Unit: Chem-Fab

City: Doylestown

County: Bucks

State: PA

Source of Funds: Remedial ☐ PA/SI ☑

Priority: High ☑ Medium ☐ Low ☐

LOE/Additional: Reg. Hrs. 510 OT Hrs. 20 Total Hrs. 530

Provide a short description of site and specific work to be performed:

The chem-fab site was addressed under a removal action a few years ago. There is possible sub surface and surface soil contamination left unaddressed on the site. SATA is being tasked out to complete a site inspection on the site. This site inspection should include a sampling plan (of up to 20 samples), lab report, and a site inspection report

Comments/Amendment Justification:

Suggested Staffing:

Analytical cost est.:

Please contact ASAP Pete Gold prior to initiation

(SEE REVERSIDE FOR ELEMENTS)

Rev 1/98 (TAR_REM1.98)

SATA REMEDIAL AND PA/SI TASKING ASSIGNMENT RECORD

[Select from ONE category ONLY]

Applies to all categories: ☐ *Amend TDD to Extend Completion Date ☐ *Amend TDD to Add Hours

19 REMEDIAL SUPPORT (CERCLA)
- ☐ Agency Roster/Cards
- ☐ Assist with Assembling Administrative Record
- ☐ Attend Public Meeting
- ☐ Compile Press Clippings
- ☐ Conduct Air Monitoring
- ☐ Conduct Cost Tracking & Documentation
- ☐ Conduct Multimedia Sampling
- ☐ Conduct On-Site Contractor Monitoring
- ☐ Coordinate with State & Local Officials
- ☐ Document On-Site Activities
- ☐ Document Release
- ☐ Document Site Access
- ☐ Lab Report
- ☐ Monitor Site Activities
- ☐ Organize Site Files
- ☐ Prepare Background Info for Reports/Proposed Plans and RODs
- ☐ Provide Chronology of Events
- ☐ Prepare Fact Sheet
- ☐ Provide Photo Documentation
- ☐ Prepare QADP
- ☐ Prepare Safety Plan
- ☐ Prepare Sampling Plan
- ☐ Prepare Site Sketch/Map
- ☐ Provide Slides
- ☐ Provide Toxicological Profile
- ☐ Provide Video Documentation
- ☐ PRP Search
- ☐ Review Site Records/Technical Documents
- ☐ QA/QC Lab Report
- ☐ Site Safety Monitor
- ☐ Special Project/Subcontract
- ☐ Update Information Repository
- ☐ Trip Report
- ☐ Other:____________________

25 REMEDIAL/SITE ASSESSMENT SAMPLING SUPPORT (BM)
- ☑ Conduct Multimedia Sampling
- ☑ Lab Report
- ☑ Maps & Sketches
- ☐ Prepare Safety Plan
- ☑ Prepare Sampling Plan
- ☐ Prepare Trip Report
- ☐ Provide Photo Documentation
- ☐ Provide Slide Documentation
- ☐ Provide Video Documentation
- ☐ QA/QC Lab Report
- ☐ Report Recommendations
- ☐ Research & Recommend Analytical Analyses & Methods
- ☐ Review QA/QC of Analytical Laboratory Facility
- ☐ Other:____________________

27 QA/QC SUPPORT(BM)
- ☐ Perform Site Safety Audit
- ☐ Review Analytical Plans
- ☐ Review Engineering Plans
- ☐ Review Geo-physical Survey Plans
- ☐ Review Safety Plans
- ☐ Review Sampling Plans
- ☐ Review Work Plans
- ☐ Other:____________________

20 REMEDIAL ENFORCEMENT SUPPORT
- ☐ Assist with Assembling Administrative Record
- ☐ Attend PRP Meetings
- ☐ Conduct Air Monitoring
- ☐ Conduct Multimedia Sampling
- ☐ Conduct Split Sampling
- ☐ Document Compliance with Administrative Order
- ☐ Document On-Site Activities
- ☐ Document PRP Cleanup Activities
- ☐ Document Site Access
- ☐ Evaluate Cleanup Measures Proposed
- ☐ Lab Report
- ☐ Organize Site Documentation Files
- ☐ Prepare Chronology of Events
- ☐ Prepare Trip Report
- ☐ Prepare Background Information
- ☐ Prepare Sampling Plan
- ☐ Prepare Site Safety Plan
- ☐ Prepare Site Sketch/Map
- ☐ Provide Mobile Command Post
- ☐ Provide Photo Documentation
- ☐ Provide Toxicological Profile
- ☐ Provide Video Documentation
- ☐ QA/QC Lab Report
- ☐ Review Draft Administrative Order
- ☐ Review PRP Plans & Specs
- ☐ Review PRP Safety Plan
- ☐ Review Site Records/Technical Documents
- ☐ Review Treatment Alternatives
- ☐ Special Project/Subcontract
- ☐ Other:____________________

05 TRAINING RECEIVED
- ☐ Attend Training/Meeting/Conference
- ☐ Brief RPM
- ☐ Identify New Techniques & Report to Region
- ☐ Obtain Available Literature
- ☐ Prepare Report on Training Received
- ☐ Other:____________________

47 INFORMATION MANAGEMENT (TII-B)
- ☐ Attend Training/Meeting
- ☐ Computer Support
- ☐ Conduct Study/Meeting
- ☐ Conference/Seminar/Meeting
- ☐ Data Research & Compilation
- ☐ Graphics/Charts
- ☐ Input Data
- ☐ Logistics Support
- ☐ Organize/Review Files
- ☐ Other:____________________

51 EECA (BM)
- ☐ Compile Existing Data
- ☐ Draft EECA
- ☐ Provide Engineering Technical Services
- ☐ Review Site Records/Technical Documents

54 SITE ASSESSMENT GENERAL TECHNICAL SUPPORT (BM)

55 REMEDIAL GENERAL TECHNICAL ASSISTANCE (BM)
- ☐ Conduct Database Technical Support
- ☐ Organize/Review Files
- ☐ Prepare Report
- ☐ Provide Engineering/Technical Support
- ☐ Provide ARCs Contractor Support
- ☐ Provide Toxicological Profile
- ☐ Research Clean-up Technologies
- ☐ Research Info on Subject
- ☐ Other:____________________
- ☐ Other:____________________
- ☐ Other:____________________
- ☐ Other:____________________

61 PRELIMINARY ASSESSMENT (QB)

62 SITE INSPECTION (QB)

63 SITE INSPECTION PRIORITIZ[illegible]QB)

64 EXPANDED SITE INSPECTION (QB)

65 HRS/NPL PACKAGE (QB)

ORIGINAL
(Red)

WESTON®
MANAGERS DESIGNERS/CONSULTANTS
5 Underwood Court, Delran, New Jersey 08075-1229
609-461-4003 • 215-238-0338 • Fax 609-461-4916

TECHNICAL ASSISTANCE TEAM FOR EMERGENCY RESPONSE REMOVAL AND PREVENTION
EPA CONTRACT 68-WO-0036

MEMORANDUM

TO:	George English, OSC, EPA Region III Eastern Response Section	TDD #9502-23 PCS #1398
FROM:	Marian Murphy, TAT Region III MM	
SUBJECT:	Chem Fab Sample Analytical Review	
DATE:	June 15, 1995, 1995	

This report covers the general review of the data package submitted by Princeton Testing Laboratory, for five (5) soil samples collected at the Chem Fab Site on May 25, 1995. The samples were received at Princeton Testing Laboratory, in Princeton, NJ on May 26, 1995. The analyses requested were volatile organics (VOA), base-neutral and acid extractables (BNA), priority pollutant (PP) metals, and hexavalent chromium.

ANALYTICAL METHODOLOGY

The samples were analyzed for VOAs and BNAs in accordance with EPA Contract Laboratory Program (CLP) Statement of Work (SOW) OLM01.8, for metals by CLP SOW ILM03.0, and for hexavalent chromium by EPA Method 7196.

- Signed chain-of-custody records were received.
- The VOA GC/MS tune data and internal standard data met criteria. The VOA initial and continuing calibration data did not meet criteria for all compounds, however, since none of the compounds were detected, no data was qualified. The hold times were met. The method blank contained acetone at 8.4 ug/Kg. All acetone results should be considered not detected due to blank contamination. The matrix spike/matrix spike duplicate (MS/MSD) recoveries, surrogate spike recoveries, and relative percent difference (RPD) values met criteria.

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- The BNA GC/MS tune data and internal standard data met criteria. The BNA initial and continuing calibration data did not meet criteria for all compounds, however, since none of the compounds were detected, no data was qualified. The hold times were met. The method blank contained diethylphthalate st 490 ug/Kg, dimethylphthalate at 50 ug/Kg, di-n-butylphthalate at 1210 ug/Kg and bis(2-ethylhexyl)phthalate at 87 ug/Kg. These phthalate compounds should be considered not detected due to blank contamination. The surrogate spike recoveries met criteria for all samples except sample SS-01. Five of the six surrogate spike recoveries were below QC limits, therefore, the results for sample SS-01 should be considered biased low. The MS/MSD recoveries and RPD values met criteria.

- The PP metals and hexavalent chromium calibration data met criteria. The method blanks were free of contamination. The MS recoveries and RPD values met criteria except for arsenic, selenium, antimony, chromium and silver. Both spike recoveries were low for selenium and arsenic, therefore, all arsenic and selenium results should be considered biased low. The RPD values for antimony, chromium and silver did not meet criteria, therefore, all antimony, chromium and silver results should be considered approximate.

CONCLUSION

Accept all data with the following exceptions: The acetone, diethylphthalate, dimethylphthalate, di-n-butylphthalate and bis(2-ethylhexyl)phthalate should be considered not detected due to blank contamination. The BNA results for sample SS-01 should be considered biased low due to low surrogate spike recoveries. The arsenic and selenium results should be considered biased low due to low spike recoveries. The chromium, antimony, and silver results should be considered approximate due to RPD values not meeting criteria.

princeton testing
laboratory inc.

P.O. Box 3108
3490 U.S. Route 1
Princeton, NJ 08543-3008
(609) 452-9050
FAX (609) 452-0347

ORIGINAL
(Red)

June 13, 1995

Roy F. Weston, Inc.
5 Underwood Court
Delran, New Jersey 08075

Attn: Marian Murphy

RE: JOB #9501862

Dear Ms. Murphy:

Enclosed please find the results and quality control sheet for the Chromium Hexavalent we had inadvertently left out of our package including the Laboratory Chronicle for Inorganics.

Please insert the numbered sheets in your package, and we are sorry for any inconvenience we may have caused.

Very truly yours,

James E. Dennison

James E. Dennison, Ph.D., CIH
Technical Director
Enclosures
JED/rk

princeton testing laboratory inc.

P.O. Box 3108
3490 U.S. Route 1
Princeton, NJ 08543-3108
(609) 452-9050
FAX (609) 452-0347

PRINCETON TESTING LABORATORY

LABORATORY CHRONICLE

Company: Roy F. Weston, Inc.

Job No. 9501862

Type Samples: Soil

Due Date: 5/30/95

Number: 5

Date Received & Refrigerated: 5/25/95

INORGANICS ANALYTES			OTHER
1. Metals	RBK & TM	Arsenic 5/31/95	Zinc 6/6/95
		Mercury 6/2/95	Selenium 6/5
		Antimony 6/5/95	
		Beryllium 6/5/95	
		Cadmium 6/6/95	
		Chromium 6/6/95	
		Chromium Hex. 5/26/95	
		Copper 6/5/95	
		Lead 6/5/95	
		Nickel 6/5/95	
		Silver 6/5/95	
		Thallium 5/31/95	
2. Cyanides			
3. Phenol			

DIVISION SUPERVISOR REVIEW & APPROVAL:

Date: 6/13/95

QUALITY CONTROL SUPERVISOR REVIEW & APPROVAL:

Date: 6/13/95

If fractions are re-extracted and re-analyzed because initial endeavors did not meet quality control acceptance criteria, include dates for both.

5A

Princeton Testing Laboratory Inc.

P.O. Box 3108
3490 U.S. Route 1
Princeton, NJ 08543-3108
(609) 452-9050
(FAX) (609) 452-1959

ORIGINAL (Red)

Weston, Roy F.,Inc.
5 Underwood Court
Delran, New Jersey 08075

Attention: Marian Murphy

Report Date: 06/13/95
Job Number: 9501862-001
Date Received: 05/25/95

Page: 1

Analysis	*Sample I.D.:*	*SS-01 UST SW 4-6 05/25/95*	*SS-02 UST SE 4-6 05/25/95*	*SS-03 UST WSW 4-6 05/25/95*
Chromium, hexavalent, mg/kg	EPA 3060/7196A	<2.0	<2.0	<2.0

Analysis	*Sample I.D.:*	*SS-04 UST ESE 4-6 05/25/95*	*SS-05 UST NW 4-5 05/25/95*	*Blank 05/26/95*
Chromium, hexavalent, mg/kg	EPA 3060/7196A	<2.0	<2.0	<2.0

James E. Dennison

James E. Dennison, Ph.D., CIH
Technical Director

For inquiries call us at (609) 452-9050 and ask for our Customer Service Department

Member: American Council of Independent Laboratories, Inc.

princeton testing
laboratory inc.

P.O. Box 3108
3490 U.S. Route 1
Princeton, NJ 08543-3108
(609) 452-9050
FAX (609) 452-0347

Roy F. Weston, Inc.
5 Underwood Court
Delran, New Jersey 08075

Date: June 13, 1995
Job #: 9501862-001

Attn: Marian Murphy

QA/QC DATA
- INORGANIC ANALYSIS -

ANALYTE	Sample Result mg/kg	Spike Added mg/kg	Spiked Result mg/kg	REC %
Chromium Hexavalent	<2.0	20	16.4	82

ANALYTE	DUP 1	DUP 2	RPD	
Chromium Hexavalent	<2.0	<2.0	0	

qaqcTBL-01

36A

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

REGION 3
Curtis Bldg., 6th & Walnut Sts.
Philadelphia, Pennsylvania 19106

CHAIN OF CUSTODY RECORD

PROJ. NO. 1398

PROJECT NAME CHEM-FAB INC.

SAMPLERS: *(Signature)* R L Grube

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	VOA	Metals	BNA	HEXAVALENT CHROME			REMARKS
SS-01	5/25/95	1200		x	UST SW 4-6	2	x	x	x	x			
SS-02	5/25/95	1230		x	UST SE 4-6	2	x	x	x	x			
SS-03	5/25/95	1300		x	UST WSW 4-6	2	x	x	x	x			
SS-04	5/25/95	1330		x	UST ESE 4-6	2	x	x	x	x			
SS-05	5/25/95	1400		x	UST NW 4-5	2	x	x	x	x			

Relinquished by: *(Signature)* R L Grube	Date / Time 5/25/95 1650	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks	

Distribution: Original Accompanies Shipme[illegible]y to Coordinator Field Files

ORIGINAL (Red)

WESTON
MANAGERS DESIGNERS CONSULTANTS

EXPENDABLE MATERIALS REQUISITION

ORIGINAL (Red)

No. E ~~237414~~ 03-3453A

PURCHASING USE ONLY
Purchase Order Assigned: 16-3896
Purchase Order Date: May 25, 1995

TO: JANICE CHAPMAN, ZPMO

FROM: MIKE ZICKLER, TATL Date: 5-25-95

Request that we obtain: X Purchase ____ Rent ____ Repair ____ Price Quotation ____ Other

FROM: (Vendor name if preference)
PRINCETON TESTING LABORATORY
P.O. BOX 3108/ U.S. ROUTE 1
PRINCETON, NJ 08543-3108
ATTN: HEATHER MENZEL

SHIP TO: ROY F. WESTON
5 UNDERWOOD COURT
DELRAN, NJ 08075

SHIP VIA:

FOB DEST. TERMS NET 45 DELIVERY REQUIRED BY: 6-6-95

ITEM	QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL
1	6	SOIL SAMPLES FOR VOLATILE ORGANICS (VOA) BY EPA METHOD 8240.	119.00	$714.00
2	1	ONE MATRIX SPIKE AND ONE MATRIX SPIKE DUPLICATE (MS/MSD) ANALYSIS FOR ITEM 1.	178.50	$178.50
3	6	SOIL SAMPLES FOR BASE-NEUTRAL AND ACID EXTRACTABLES BY EPA METHOD 8270.	239.00	$1434.00
4	1	MS/MSD FOR ITEM 3.	358.50	$358.50
5	6	SOIL SAMPLES FOR PRIORITY POLLUTANT METALS.	148.00	$888.00
6	1	MS/MSD FOR ITEM 5.	222.00	$222.00
7	6	SOILS FOR HEXAVALENT CHROMIUM BY EPA METHOD 7196	24.00	$144.00
8	1	MS/MSD ITEM 7.	36.00	$36.00
		DELIVERABLES: SEE ATTACHED		
		CHEM FAB TDD# 9505-L14 PCS# 0514		

Is this purchase in your Operating Plan? Yes ( ) No ( ) **TOTAL COST** $3975.00

Charge above item to: 06300-041-003-0514-00 (Work Order No.) US EPA/TAT (Project/Client Title) FP/000060 (Div./Dept. No.)

Project Director/Manager or Responsible Head Approval ____ Date 5/25/95

Business Mgr. Rev. ____ Date ____

Purchasing Approval ____ Date ____

RFW-04-05-001/C-6/87

ORIGINATOR'S COPY

ORIGINAL
(Red)

DELIVERABLES INCLUDE:

TWO COPIES OF DATA PACKAGE WITH RETURNED SIGNED COPY OF THE CHAIN-OF-CUSTODY FORM SENT WITH THE SAMPLES.

VOLATILE ORGANIC DATA PACKAGES SHOULD INCLUDE:
- Method blank results.
- GC/MS tune data and sample spectra.
- GC/MS initial and continuing calibration data.
- GC/MS internal standard data for samples.
- Surrogate spike recoveries, either on a separate table or with the results, including QC limits.
- Matrix spike recovery tables, including RPD and QC limits.
- Date samples were analyzed, either on a separate sheet, on tune sheet, or on results page.

BASE NEUTRAL AND ACID EXTRACTABLES SHOULD INCLUDE:
- Method blank results.
- GC/MS tune data and sample spectra.
- GC/MS initial and continuing calibration data.
- GC/MS internal standard data for samples.
- Surrogate spike recoveries, either on a separate table or with the results, including QC limits.
- Matrix spike recovery tables, including RPD and QC limits.
- Date samples were analyzed, either on a separate sheet, on tune sheet, or on results page.

METALS DATA PACKAGES SHOULD INCLUDE:
- ICP data should be checked for spectral interferences; a calibration check standard and blank check should be preformed.
- Furnace data should be acquired in duplicate with appropriate standards and blanks analyzed.
- AA and cold vapor should have appropriate standards and blanks analyzed.
- Please give a small case narrative describing calibration verification methods used.
- Please give analysis dates for mercury.
- Method blank results.
- Please provide raw metals data.

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**READING
ENVIRONMENTAL
LABORATORY**
A Division of Eastern Laboratory Services, Inc.

LABORATORY REPORT
ENVIRONMENTAL TESTING

LABORATORY REPORT

Client: Earth Tech
Project Description: Chem Fab Proj. #956-119

Sample ID #: 95-05-11-017

Parameter	Results	Detection Limit (DL) Max. Cont. Level (MCL)	Method	Extracted	Analyzed	Analyst
BOD	NA					
COD	17500. mg/L				05/16/96	SC
[illegible]ity	<1. mg/CaCO3				05/16/95	SC
pH	2.49				05/16/95	SC
Cyanide	<0.10 mg/L				05/12/95	ETD
Sulfide	<1.0 mg/L				05/16/95	ETD
Total Solids	7.5 %				05/16/95	SC
Suspended Solids	7.1 %				05/16/95	SC

Reviewed by: CRA
Craig R. Achenbach
Laboratory Manager

READING ENVIRONMENTAL LABORATORY
A Division of Eastern Laboratory Services, Inc.

LABORATORY REPORT
ENVIRONMENTAL TESTING

LABORATORY REPORT

Client: Earth Tech
Project Description: Chem Fab Proj. #956-119

Sample ID #: 95-05-11-017

Parameter	Results	Detection Limit (DL) Max. Cont. Level (MCL)	Method	Extracted	Analyzed	Analyst
2,4-D	<0.2 mg/L					
Silvex	<0.02 mg/L					
[illegible]drin	<0.002 mg/L					
[illegible]indane	<0.004 mg/L					
Methoxychlor	<0.10 mg/L					
Toxaphene	<0.005 mg/L					
Chlorodane	<0.005 mg/L					
Heptachlor	<0.005 mg/L					
Heptachlor epoxide	<0.005 mg/L					
PCB'S	<1.0 mg/kg				05/15/95	MJT
Total Metals			ICP		05/19/95	MZ
Aluminum	223. mg/L					
Antimony	199. mg/L					
Arsenic	16.4 mg/L					
Barium	536. mg/L					
Beryllium	0.17 mg/L					
Cadmium	0.15 mg/L					
Calcium	135. mg/L					
[illegible]hromium, Total	9540. mg/L					
Cobalt	10.9 mg/L					
Copper	25.7 mg/L					
Iron	3150. mg/L					
Lead	581. mg/L					
Magnesium	48. mg/L					
Manganese	7.61 mg/L					
Mercury	0.02 mg/L					
Nickel	34.5 mg/L					
Potassium	125. mg/L					
Selenium	<0.50 mg/L					
Silver	<0.10 mg/L					
Sodium	346. mg/L					
Thallium	<0.002 mg/L					
Vanadium	<0.0005 mg/L					
Zinc	0.57 mg/L					

Reviewed by:
Craig R. Achenbach
Laboratory Manager

ORIGINAL
(Red)

**READING
ENVIRONMENTAL
LABORATORY**
Division of Eastern Laboratory Services, Inc.

LABORATORY REPORT
ENVIRONMENTAL TESTING

LABORATORY REPORT

NY DOH # 11426
PA DER # 06488

Client: Earth Tech
2229 Tomlynn Street
Richmond, VA 23230

Sample ID #: 95-05-11-017
Sample Date: 05/11/95
Sample Time: 10:00
Sampled by: CK
Received by: ED
Date & Time Recd: 05/11/95 15:30

Project Description: Chem Fab Proj. #956-119
Station Location: Underground Tank (Comp. 9 Samples)

Parameter	Results	Detection Limit (DL) Max. Cont. Level (MCL)	Method	Extracted	Analyzed	Analyst
TCLP- Inorganics			ICP		05/16/95	MZ
Arsenic	4.00 mg/L	5.0 mg/L				
Barium	1.46 mg/L	100.0 mg/L				
Cadmium	<0.01 mg/L	1.0 mg/L				
Chromium	2300. mg/L	5.0 mg/L				
Lead	<0.05 mg/L	5.0 mg/L				
Mercury	0.002 mg/L	0.2 mg/L				
Selenium	<0.05 mg/L	1.0 mg/L				
Silver	<0.01 mg/L	5.0 mg/L				
TCLP- Volatile Organics			GC/MS		05/18/95	BB
Benzene	<0.05 mg/L	0.5 mg/L				
Carbon Tetrachloride	<0.05 mg/L	0.5 mg/L				
Chlorobenzene	<0.05 mg/L	100.0 mg/L				
Chloroform	<0.05 mg/L	6.0 mg/L				
1,2-Dichloroethane	<0.05 mg/L	0.5 mg/L				
1,1-Dichloroethene	<0.05 mg/L	0.7 mg/L				
Tetrachloroethene	0.06 mg/L	0.7 mg/L				
Trichloroethene	0.29 mg/L	0.5 mg/L				
Vinyl Chloride	<0.05 mg/L	0.2 mg/L				
Methyl Ethyl Ketone	<0.05 mg/L	200.0 mg/L				
TCLP- Semi-Volatile Organics & Phenols			GC/MS		05/18/95	BB
o-Cresol	<0.50 mg/L	200.0 mg/L				
m-Cresol	<0.50 mg/L	200.0 mg/L				
p-Cresol	<0.50 mg/L	200.0 mg/L				
Pentachlorophenol	<0.50 mg/L	100.0 mg/L				
2,4,5-Trichlorophenol	<0.50 mg/L	400.0 mg/L				
2,4,6-Trichlorophenol	<0.50 mg/L	2.0 mg/L				
Hexachloroethane	<0.50 mg/L	3.0 mg/L				
Hexachlorobenzene	<0.50 mg/L	0.13 mg/L				
Hexachlorobutadiene	<0.50 mg/L	0.5 mg/L				
Nitrobenzene	<0.50 mg/L	2.0 mg/L				
Pyridine	<0.50 mg/L	5.0 mg/L				
2,4-Dinitrotoluene	<0.50 mg/L	0.13 mg/L				
[illegible]	<0.50 mg/L	7.5 mg/L				

FINAL SITE CHARACTERIZATION REPORT

Volume 1

CHEM-FAB SITE
DOYLESTOWN TOWNSHIP,
BUCKS COUNTY,
PENNSYLVANIA

PADEP Contract No.:
ME 359185
Work Assignment No.:
31-070

Prepared for:

Commonwealth of Pennsylvania

Department of Environmental Protection
Bureau of Land Recycling and Waste Management
Division of Remediation Services

July 12, 2000

Ogden Environmental and Energy Services Co., Inc.
1777 Sentry Parkway West
Abington Hall, Suite 300
Blue Bell, PA 19412-2223

Ogden Project No. 97038-009

FINAL
SITE CHARACTERIZATION REPORT

Volume 1

CHEM-FAB SITE
TOWNSHIP OF DOYLESTOWN,
BUCKS COUNTY, PENNSYLVANIA

PADEP Contract No.: ME 359185
Work Assignment No.: 31-070

Submitted to:
Commonwealth of Pennsylvania
Department of Environmental Protection
Bureau of Land Recycling and Waste Management
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Submitted by:
Ogden Environmental and Energy Services Co., Inc.
1777 Sentry Parkway West
Abington Hall, Suite 300
Blue Bell, Pennsylvania 19412-2223

Ogden Project No. 97038-009

July 12, 2000

Prepared By:	Approved By:
Kathy McGuire, P.G. Project Manager Ogden Environmental and Energy Services Co., Inc.	Paul T. Pettit, Jr., P.E. Program Manager Ogden Environmental and Energy Services Co., Inc.

NOTICE

The information in this document has been funded by the Pennsylvania Department of Environmental Protection (PADEP) under Contract No. ME 359185 to Ogden Environmental and Energy Services Co., Inc. (Ogden). This document has been formally released by Ogden to the PADEP.

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APPENDICES

1.0 INTRODUCTION

Ogden Environmental and Energy Services Co., Inc. (Ogden) is submitting this Final Site Characterization Report to the Pennsylvania Department of Environmental Protection (PADEP) in response to PADEP's Requisitions for Contractual Services 21-070 and 31-070 and the Scope of Work. The requisitions for this project were issued under Ogden's General Technical Assistance Contracts (GTAC-2 [ME 93936] and GTAC-3 [ME 35185]) executed pursuant to the Pennsylvania Hazardous Sites Cleanup Act (HSCA), Act 108, October 1988. This project was conducted in accordance with the Final Specification of Services (SOS) submitted by Ogden (dated April 1, 1999) in response to Project Requisition 21-070, as amended in the revised cost estimate dated October 5, 1999. The initial Notice to Proceed (NTP) was issued to Ogden on April 21, 1999 in accordance with Ogden’s GTAC-2 contract and reissued December 8, 1999 in accordance with Ogden’s GTAC-3 contract. This document presents Ogden's technical report regarding characterization of the Chem-Fab Corporation Site (site), which is located in the Township of Doylestown, Bucks County, Pennsylvania (see Figure 1-1).

1.1 Project Objectives

Specific response action objectives for the Chem-Fab Site, based on the current knowledge of site conditions, are as follows:

- Determine the nature and extent of soil contamination on the subject site and the former septic field (Extra Space Storage of Doylestown) and delineate, if found. Identify areas of soil contamination on adjacent properties.
- Determine impact to ground water, if encountered, during the soils investigations.
- Determine if onsite contaminants are migrating offsite through drainage pathways.
- Determine if the site has impacted wells located near the subject site.
- Determine location and disposal requirements of USTs, sumps, and basins that may be located onsite.

The objectives were met through the performance of a site inspection, multimedia sampling and analysis, and comparison of the analytical results with PADEP cleanup standards to determine what further action, if any, may be needed at the site.

1.2 Report Organization

A description of the site background and environmental setting is presented in Section 2.0 of this report. The site characterization activities performed for this project are discussed in Section 3.0. A discussion of the site geologic and hydrogeologic characterization is contained in Section 4.0. The results of the chemical analytical characterization of the site are discussed in Section 5.0. Conclusions regarding the site are presented in Section 6.0. References used to prepare this Final Site Characterization Report are listed in Section 7.0.

2.0 SITE BACKGROUND AND ENVIRONMENTAL SETTING

This section includes a description of the site location as well as the site background, current conditions, and environmental setting, including climate, soils, potable water supplies, regional geology, hydrogeology, topography, and surface drainage.

2.1 Site Location and Description

The Chem-Fab Site is located at 300 North Broad Street in Doylestown Township, Bucks County, Pennsylvania. The site may be found on the Doylestown, Pennsylvania USGS 7.5 Minute Series topographic maps at 40818'54" north latitude and 75808'06" west longitude (see Figure 1-1). The site, currently owned by the 300 North Broad Street, Ltd., is a one-acre parcel of land that contains three separate buildings where various business ventures have been operated. At the time of the initial site visit (December 1998), the subject property contained three structures; a large warehouse/manufacturing type building, a smaller storage type building, and a residential home. The warehouse/manufacturing building was of slab on grade construction, with block walls and a steel frame. The storage building appeared to be empty and consisted of a two-story structure with a basement or crawl space. The residential property consisted of a two and one-half story structure with a partial crawl space. Roll-off containers were onsite for the storage/disposal of the debris from the partial demolition of the warehouse/storage building. At the time of the field investigation (December 1999), the subject property appeared to have undergone renovations and demolition. The large warehouse/manufacturing building was renovated and partially rented to a tenant. The tank farm area associated with the building was demolished, with only the concrete floor remaining. The small storage building and stone house were undergoing renovations to become office space. Utilities were brought in for the two smaller buildings, and the area between the large warehouse/manufacturing building and Tilley Fire Equipment to the east had a base course of asphalt. Additional concrete was placed along the rear of the warehouse/manufacturing building and more stone was brought into the area to the west of this building. Several roll-off containers remained on site as did several piles of stone.

The site is bordered to the east by an operating business and to the west and south by an active storage facility. The site is bordered to the north by North Broad Street. A site layout map is provided as Figure 2-1. This map is an orthophoto of the site based on an aerial photograph. Site boundary information preliminarily surveyed by Gilmore & Associates, Inc., in May 2000, is provided on the map.

Two creeks, Pine Run and Cooks Run, are located within a 2-mile radius of the site, as shown on Figure 1-1. Based on information from the Borough of Doylestown, residents of Doylestown rely on groundwater as a source of potable drinking water. The area in proximity to the site has a relatively shallow groundwater table and potable wells and a municipal water well are located in close proximity to the site. The municipal well and several of the potable wells have been abandoned for drinking water purposes based on historic groundwater investigations.[6]

2.2 Site Background

Ogden conducted a review of historical site files at the Bucks County Department of Health offices in Doylestown, Pennsylvania and the PADEP offices in Conshohocken, Pennsylvania, in an attempt to determine historical areas of concern regarding the subject property. In addition, Ogden located and reviewed tax maps, historical aerials, and Sanborn maps of the site. Historical information indicated that the property appeared to be one contiguous parcel of farmland prior to 1949. A drainage path from the southwest side of the subject property to Cooks Run was noted on the Sanborn maps.

Correspondence between the Chem-Fab Corp. and the Bucks County Department of Health indicated that the site has a history of leaks, spills, and unpermitted discharge of industrial wastes dating back to almost 1965.[6] The information contained in the Health Department files corroborated the information contained in the PADEP files regarding historical environmental concerns at the site.

The site was operated as Chem-Fab, Inc., an electroplating and metal etching company, from 1965 to approximately 1994. The large warehouse/manufacturing building, constructed in approximately 1965, was used as an electroplating and etching operation. Chem-Fab manufactured templates for circuit boards. Chem-Fab generated wastes that included ferric chloride, mineral spirits, chromic acid rinse water and sludge, chromic acid, sulfuric acid, sodium bisulfate, sodium hydroxide, and lime. A tetrachloroethylene (TCE) vapor degreasing process was used until 1973.[1,7]

According to a review of historical information, two diked areas were constructed onsite, south of the large warehouse/manufacturing building. The AST tank farm area appeared to have contained three aboveground storage tanks (ASTs) (including one 2,500-gallon AST, one 4,000-gallon AST, and one 8,500-gallon AST) and one underground catch basin believed to be 1,000 gallons in size. According to historical information, up to five or six tanks were located in this area.

In addition, one UST area was noted on the western side of the building. This tank was believed to be 10,000 gallons in size.

Historical files also indicated that USTs may have been present onsite in the driveway area, located to the east of the manufacturing/warehouse building. However, from the files reviewed, Ogden could not confirm the presence of USTs below the driveway.

Bucks County Health Department and PADEP (previously PADER) records indicate that the Chem-Fab Site was cited several times in the 1960s and 1970s for spills and releases of industrial wastes from the ASTs, USTs, and catch basins to the nearby creek, Cooks Run.[6] Waste Discharge Reports, dating from 1967, issued by the Commonwealth of Pennsylvania Health Department, indicated that discharges observed from the site to the stream (presumably Cooks Run) were abated by removal of seeping abandoned USTs.

According to Bucks County Health Department records, the site was investigated in the early 1970s and confirmed to have released industrial wastes that degraded the quality of surface water in Cooks Run and the drainage ditch leading from the southern portion of the site to Cooks Run. The releases included chromic acid rinse water spills from broken valves on pretreatment tanks and overflows of the catch basin, as documented by the PADER (now PADEP) and the Bucks County Department of Health, which occurred in violation of the Clean Streams Laws of the Commonwealth.

In August 1987, the USEPA performed a Preliminary Assessment (PA) and Site Inspection (SI) of the Doylestown Groundwater Site and the Chem-Fab Site.[1] During this assessment, water samples were collected and analyzed from residential wells and the municipal well located in the vicinity of the Chem-Fab Site. Analytical records indicated that the groundwater in the vicinity of the site was contaminated with volatile organic compounds (VOCs), including concentrations of trichloroethene (TCE) and 1,2-dichloroethene (DCE) in excess of the drinking water equivalent (DWE) and maximum contaminant levels (MCLs) set for public water supplies. In a Special Bulletin dated October 1987, USEPA considered the levels of drinking water contaminants in the vicinity of the site to be high enough to meet the criteria to elicit an emergency removal action, consisting of the delivery of bottled water to the affected residences and the determination and identification of a responsible party(s).

From September 1994 to October 1995, USEPA conducted CERCLA Removal Actions at the Chem-Fab Site. The removal actions included the removal and disposal of 117 drums of wastes and 8,400 gallons of pumped liquid wastes, along with other solid wastes and fuel oils. During the removal actions, the contents of the 10,000-gallon UST were sampled and found to contain hexavalent chromium. Also, one drum was discovered to contain radioactive thorium nitrate. In November 1998, PADEP assumed the lead role from USEPA for assessment of the Chem-Fab Site.

Previous reports, including the Site Inspection Report for the Chem-Fab Site prepared by USEPA (dated April 1988),[7,8] documented analytical results of the soil, sediment, and aqueous sampling, indicating constituents of primarily volatiles and metals above state and federal cleanup standards in both onsite and offsite areas. The liquids/sludges sampled also revealed similar results. Drinking water samples revealed elevated concentrations of volatiles and metals above EPA drinking water standards in several samples collected. Sample parameters included volatile organics, PCBs, pesticides/herbicides, semi-volatile organics, metals, and polyaromatic hydrocarbons.

2.3 Current Conditions

At the time of the initial site visit (December 1998), the subject property contained three structures: a large warehouse/manufacturing type building, a smaller storage type building, and a residential building. The warehouse/manufacturing building was of slab on grade construction, with block walls and a steel frame. An AST tank farm was located to the south of the warehouse/manufacturing building, at the southern edge of the property. The storage building appeared to be empty and consisted of a two-story stone structure with a basement or crawl space. The residential property consisted of a two and one-half story structure with a partial crawl space. Roll-off containers containing debris from the partial demolition of the warehouse/storage building were observed onsite.

At the time of the field investigation (December 1999), the subject property appeared to have undergone renovations and demolition. The warehouse/manufacturing building was renovated and occupied by one tenant. The AST tank farm area located to the south of the warehouse building was demolished, with only the concrete slab remaining. The storage building and stone residential building were undergoing renovations to become office space. Utilities were brought in for the two smaller buildings. The area between the large warehouse/ manufacturing building and Tilley Fire Equipment, located on an adjacent property to the east, had a base course of asphalt recently placed. Additional concrete had been placed along the rear of the warehouse/manufacturing building. Also, stone had been placed in the area to the west of this building. Several roll-off containers remained onsite, as did several piles of stone.

A base course of asphalt was applied to the east side of the warehouse/manufacturing building. The remainder of the parking areas was covered with stone. Roll-off containers have been located onsite for the storage and disposal of the debris from the renovation/demolition activities.

The Chem-Fab Site is gently sloped, with a few trees and shrubs along the southern edge. Assorted debris, lumber, concrete, machinery, and stone material were observed onsite.

2.4 Environmental Setting

The following section provides a discussion of the environmental setting of the Chem-Fab Site, including the climate, soils, geology, hydrogeology, topography, and surface drainage.

2.4.1 Climate

Based on a review of the Soil Survey of Bucks and Philadelphia Counties (1975), Bucks County is part of the Southeast Piedmont climatic division.[2] The climate is classified as humid continental modified by the Atlantic Ocean. Most of the weather systems that affect this area develop in the Midwest and are steered eastward or they form in the southeastern states and move northeastward parallel to the Atlantic. The temperature in this area has moderate extremes with an average temperature of 53°F. The mean annual precipitation is approximately 43 to 45 inches. The summers are warm and humid with temperatures averaging 90°F. Cloudiness is more prevalent in winter than other seasons because cold fronts and coastal low pressure systems are more frequent. The average snowfall is more than 30 inches in much of Bucks County.

2.4.2 Soils

Based on a review of the Soil Survey of Bucks and Philadelphia Counties (1975),[2] the soils at the subject property are associated with the Doylestown Series and Abbottstown Series, consisting of deep, poorly drained, nearly level to gently sloping soils on uplands. The Doylestown soils were formed in silty material overlying a variety of loamy materials generally weathered from shale and sandstone, and the Abbottstown Series consists of deep, somewhat poorly drained, nearly level soils on uplands, formed in loamy material weathered from brown shale and sandstone. The soils onsite consist mainly of the Doylestown silt loam, 0-3 percent slopes. This Doylestown silt loam is found in concave positions along drainageways and the base of slopes and on some ridge tops. The soils are described as a dark grayish-brown silt loam surface layer with a grayish-brown silty clay loam with light brownish-gray and strong brown mottles. The soils are generally wet, and the slow permeability limits most nonfarm uses. The Abbottstown silt loam, 8-15% slopes is also found on the site in areas similar to the Doylestown silt loam. This soil type is described as dark brown to reddish-brown silt loam, shaly silt loam, and shaly clay loam and can also be pink, yellow, brown, and gray mottles at depth. Reddish-brown, mottled shaly, silty clay loam overlies fractured red shale bedrock. Both of these soils have a slow permeability, runoff is slow, available water capacity is moderate, and the seasonal high water table limits most nonfarm uses of the soil. A soils map for the subject property is included as Figure 2-2.

2.4.3 Regional Geology

The Chem-Fab Site is located in Bucks County, which is predominantly an undulating plain characterized by low hills and ridges. Rocks underlying the county consist of schist, gneiss, shale, sandstone, quartzite, conglomerate, and limestone. Bucks County and Philadelphia County lie within two main physiographic divisions: the Appalachian Highlands on the northwest and the Atlantic Coastal Plain on the southeast. The Appalachian Highlands is divided into several provinces, which in the Bucks County area include the Piedmont province, the Triassic-Lowland province, and the New England province.

The Chem-Fab Site lies within the Triassic-Lowland physiographic province in Bucks County. This area is characterized by an uplifted plain formed by easily eroded inclined strata, with residual ridges marking the more resistant, tilted, volcanic rock. Local relief does not exceed 250 feet in elevation change. The bedrock underlying the site is Triassic-age Stockton lithofacies, which consists of light-colored, coarse-grained sandstone and conglomerate, red to brown fine-grained siliceous sandstone, and red shale. The sandstone is more prevalent than the shale in this area. The shale and sandstone are interbedded in no order and repeated with individual bedding planes pinching out in short distances. This geologic unit has an average dip of 10 degrees and has a calculated thickness of approximately 3,000 feet. The formation is cut by a well-developed system of joints and fractures. The geologic map for the subject site is included as Figure 2-3.

2.4.4 Regional Hydrogeology

The Stockton lithofacies is a good source of water in Bucks County. Groundwater is contained in intergranular openings within the sedimentary rock where the cement has been weathered away; therefore, the occurrence and movement of groundwater are functions of the degree of weathering of the rock. Groundwater commonly occurs in artesian conditions where the sandstone and conglomerate beds are interlayered with red shale. This artesian flow is probably a function of the dip and orientation of the bedding. The dip of the Stockton formation averages 10 degrees or more; therefore, a selected water-bearing bed stops bearing water at an appreciable distance down dip, as the bed grades into unweathered bedrock. The formation has a wide range in permeability; recorded yields for the Stockton range from 2 to 440 gallons per minute (gpm) with an average yield of 78 gpm.

2.4.5 Topography and Surface Drainage

The topography of the majority of the site consists primarily of fill areas, partially vegetated land, and gentle slopes. The main portion of the site is covered with the onsite buildings and associated paved driveway and parking areas. The elevation ranges from approximately 360 to 400 feet above mean sea level (MSL), with a gentle downward slope to the southwest toward Cooks Run. The assessment of the site topography is based on a review of the U.S. Geologic Survey (USGS) Doylestown quadrangle[3] for the site and surrounding area (see Figure 1-1) and onsite observations.

Surface drainage is expected to flow to the southwest across the site, toward Cooks Run via overland flow, and infiltrate the fill areas and vegetated areas.

3.0 SITE CHARACTERIZATION ACTIVITIES

The site characterization activities for the Chem-Fab Site were performed in accordance with the Specification of Services dated April 1, 1999, which was prepared by Ogden and submitted to PADEP and approved on April 21, 1999. The site characterization program included:

- A geophysical survey to identify potential areas of waste disposal, buried drums, or underground storage tanks (USTs) on the Chem-Fab property.
- A subsurface soil investigation at both representative areas of concern and throughout the site, to identify any areas impacted by past site activities.
- A surface water and sediment investigation to identify possible site contaminants migrating offsite.
- A groundwater investigation to identify impact to the local groundwater from past activities. This included piezometer, onsite well, and offsite well sampling.

These activities, conducted at the site in December 1999 through May 2000 by Ogden and project subcontractors, are discussed in detail in the following sections. Photographs of the site activities are included in Appendix E.

3.1 Geophysical Survey

On December 8, 1999 through December 13, 1999, MEI Environmental Group, Inc. of Pipersville, Pennsylvania, performed a geophysical survey to identify potential areas of waste disposal, buried drums, or underground storage tanks (USTs) on the Chem-Fab property and the adjacent Extra Space Storage of Doylestown (Chem-Fab's former septic field) property. The survey was conducted on a 10-foot grid using a Geophysical Survey Systems Inc. model SIR-3, Ground Penetrating Radar (GPR) unit, with a 500-mHz antenna and a Geonics Limited EM31-D non-contacting terrain conductivity meter (EM31). The EM31 was used to verify certain GPR targets for metallic composition. Only the EM31 was used in one area where the surface was too rough for the GPR unit to be accurately used. The GPR survey was not performed inside the warehouse, due to a new tenant occupying the warehouse space, or inside the storage building, which was undergoing construction at the time of the geophysical survey.

The 10-foot grid system was developed by MEI Environmental Group personnel to perform the geophysical survey. The grid was based on site accessibility and on the existing site features. Additional transects were surveyed based on preliminary data reviewed in the field, where necessary. MEI Environmental Group provided a field evaluation, preliminary drawings, and data of the EM31 and GPR surveys to Ogden.

The results of the GPR survey indicated 30 notable subsurface targets in the survey areas. Seven of the 30 notable subsurface targets indicated a metal detection reading. The remaining 23 subsurface targets appeared to be non-metallic objects. The results of the EM31 survey indicate there may be metal objects in the subsurface area between the three buildings of the Chem-Fab property. Several utilities are known to run through this area. There were also metal objects on the ground surrounding the grid area, which may interfere with the accuracy of the EM31 data. No additional investigations were performed in this area to confirm the results due to the number of utilities located in this area. The complete geophysical survey report describing field activities, equipment calibration, and results of the EM31 and GPR surveys is included in Appendix A.

3.2 Subsurface Soil Sampling

Ogden and its subcontractor, B&F Environmental Drilling of Blue Anchor, New Jersey, performed subsurface soil investigation at the site from January 4, 2000 through January 14, 2000. The subsurface soil investigation was performed by installing 41 soil borings (plus three duplicates) throughout the Chem-Fab facility using a truck-mounted Geoprobe® unit utilizing Macrocore® samplers with acetate liners. The original scope of work indicated that 32 soil borings would be installed in areas of concern identified in the previous reports prepared by NUS Corporation, in areas identified by the EPA, and areas identified during the initial site visit. The additional 12 borings were installed based upon field conditions (i.e., stone piles, roll-off containers, rubble) to aid in the delineation of areas of the site, in addition to the selection of the borings on the Extra Space property as stated in the SOS. Ogden obtained soil samples from representative areas of concern on the Chem-Fab property and the adjacent Doylestown Extra Space property.

Each soil boring was continuously screened using both the MiniRae 2000 PID and a Ludlum Model 3 radiation meter during field activities. The results were recorded in the field logbook. The results of this screening are presented on the boring logs found in Appendix C. Also, the Niton 700 series X-ray fluorescence (XRF) Spectrum Analyzer, multi-element, serial #U976NR0122, ^{109}cadmium source instrument was used to assist in the delineation and/or identification of contamination. The samples were screened with the XRF every foot for metals.

In areas of concern previously identified, such as the former UST tank area, three samples were to be collected, all other areas of the site were to have two samples collected, one from the groundwater/soil interface (if encountered) and one from the bedrock/soil interface, unless elevated PID readings were detected. The results are presented in Section 5.0.

A total of 83 soil samples were collected from the 41 soil borings. Two soil samples were collected from each boring location with the exception of SB-03, where three samples were collected due to an elevated PID reading, and at SB-11, SB-12, and SB-13 where only one sample was collected from each due to the presence of stone in the former tank void. (Originally, three samples were to be collected in this area.) Three duplicate samples were collected (SB-27-01, SB-35-01, and SB-41-01); the samples were duplicates of SB-25-01, SB-34-02, and SB-40-01, respectively. The soil samples were designated by the location and then by the sample number (i.e., SB-01-01). The locations of the soil boring locations are shown on Figure 3-1. Table 3-1 summarizes the subsurface soil sampling program conducted at the site.

The soil samples were collected in accordance with Ogden SOP FP-C-2, “Soil Sampling.” The down-hole equipment was decontaminated between each sample in accordance with Ogden SOP FP-D-5, “Equipment Decontamination.” Drill cuttings and macrocore liners were labeled, and staged in the IDW/waste staging area for offsite disposal by the subcontractor. In addition, purge water, and personal protective equipment were staged in the IDW area. A log of events occurring in the field was kept in accordance with Ogden SOP FP-F-5, "Logbooks." Soil boring logs are contained in Appendix C.

Soil samples were placed in laboratory-supplied bottleware; sent to Quality Control, Inc., of Southhampton, Pennsylvania, a PADEP-approved laboratory; and analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, and TCL metals by EPA Method 6010, plus cyanide, hexavalent and total chromium. Recordkeeping, sample labeling, chain-of-custody information, sample handling, storage, and shipment was performed in accordance with Ogden SOP FP-F-6, “Recordkeeping, Sample Labeling, and Chain of Custody,” and FP-F-7, “Sample Handling, Storage, and Shipping.” EPA Method 5035 was utilized for sample collection and preservation for the volatile organics and Method 8260 was used for the laboratory analysis. Copies of the chain-of-custody forms for the subsurface soil samples collected during the soil boring program are contained in Appendix B.

XRF Analysis Procedures

The XRF unit was used to field analyze the soil column every foot in each boring. When the continuous macrocore liner was removed from the boring, at each foot interval, a stainless steel spoon was used to collect a portion of the soil from each soil boring, and the soil was placed into a resealable plastic bag. The bagged soil was crushed by hand to homogenize the soil’s consistency. The bag was placed under the XRF unit for analysis. Once stabilized, the readings were then recorded, and the next sample was placed for analysis.

The XRF unit was calibrated with a NIST 2710 high standard and a blank standard prior to sampling activities began each day. The NIST 2710 high standard checks calibration of lead, copper, arsenic, mercury, and zinc. Each time the unit was calibrated, the detected concentrations of these metals were compared to the manufacturer's specifications to ensure proper operation of the unit. The concentrations were within proper working range with the exception of mercury, which was consistently detected at much higher than allowable concentrations. According to the manufacturer, this was due to interference with lead or arsenic. There may have been "bleed-in" from lead into mercury, which could cause erroneous results. The manufacturer also stated that if a metal is in the sampling media for which the XRF unit has not been calibrated, the unit may report that substance as a metal closely resembling a metal for which the unit was calibrated. For example, tungsten in the soil may be interpreted by the unit as mercury because the unit is not calibrated for tungsten and the two elements have a similar molecular composition. Table 5-1e includes the XRF screening results.

3.3 Surface Water/Sediment Sampling

On January 24, 2000 and February 17, 2000, Ogden collected 6 surface water and one duplicate (SW-01-01 through SW-06-01 and SW-014-01) and 14 sediment and one duplicate (SED-01-01 through SED-15-01) samples along the four drainage path(s) on the Doylestown Extra Space property and along Cooks Run. The sample locations were selected during field investigative activities to determine if contaminants were migrating from the site into Cooks Run. During surface water and sediment sampling activities, personal protective equipment was placed in IDW drums located on the subject site. The surface water and sediment samples were collected using Ogden SOPs FP-C-4, "Surface Water Sampling" and FP-C-5, "Sediment Sampling." In addition, the duplicate samples were collected for QA/QC purposes. The sample locations are shown on Figure 3-1. Table 3-2 summarizes the surface water and sediment sampling program conducted at the site.

The surface water/sediment samples were placed in laboratory-supplied bottleware, and picked up at the end of the day by Quality Control, Inc., a PADEP-approved laboratory, and analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, and TAL metals by EPA Method 6010. Recordkeeping, sample labeling, chain-of-custody information, sample handling, storage, and shipment were performed in accordance with Ogden SOPs FP-F-6 and FP-F-7. Copies of the chain-of-custody forms for the surface water and sediment samples are contained in Appendix B.

3.4 Groundwater Sampling

Ogden conducted a groundwater investigation to determine if site contaminants are migrating into groundwater. This investigation included the installation, sampling, and analysis of piezometers; sampling and analysis of an onsite well; and sampling and analysis of offsite residential and commercial wells. During the groundwater sampling activities, personal protective equipment was placed in IDW drums located on the subject site.

3.4.1 Piezometer Well Installation and Sampling

Ogden collected groundwater samples from five piezometer wells installed by B&F Environmental Drilling of Blue Anchor, New Jersey, during soil boring installation. The samples were collected to evaluate the shallow groundwater beneath the site. These groundwater samples were identified as GW-01-01, GW-02-01, GW-03-01, GW-04-01, and GW-05-01.

The groundwater samples were placed under proper chain of custody, and picked up at the end of the day by Quality Control, Inc. laboratory, a PADEP-approved laboratory, and analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, and TAL metals by EPA Method 6010. Copies of the chain-of-custody forms are contained in Appendix B. Table 3-3 presents a summary of the groundwater-sampling program for the site.

Equipment decontamination was conducted according to Ogden SOP FP-D-5, "Equipment Decontamination." A log of events occurring in the field was kept in accordance with Ogden SOP FP-F-5, "Logbooks." Recordkeeping, sample labeling, chain-of-custody information, sample handling, storage, and shipment was performed in accordance with Ogden SOPs FP-F-6 and FP-F-7.

3.4.2 Onsite Well Sampling

On May 11, 2000, Ogden uncovered the buried wellhead of an inactive potable well located on the property near the stone building. Ogden excavated through asphalt at the location provided by the site owner to uncover the PVC cap of the top of the well, a depth of approximately 1 foot below ground surface (bgs). Ogden removed the cap of the 6-inch diameter well and measured the well depth as 57 feet. The depth to groundwater was observed at 3.5 feet bgs. The well was constructed with a 6-inch steel casing starting 34 inches below grade. At the top of the steel casing, a 6-inch section of PVC was added, extending 22 inches with a PVC cap on the top. The PVC riser was probably used as an extension for the top of the well.

On May 12, 2000, the well was purged using the EPA low-flow method. The pH, temperature, conductivity, and dissolved oxygen concentration were recorded at regular time intervals. The groundwater sample was collected after the readings of the four parameters stabilized (within 5% of the previous reading). Approximately 30 gallons of water were purged from the well prior to collecting a sample. The sample was collected in an attempt to evaluate the shallow groundwater beneath the site. The groundwater sample was identified as GW-06-01. An equipment blank (EB-3) was collected prior to purging the well. After sampling activities were completed, the cap was replaced over the well, recovered with soil, and the surface area was repatched with asphalt. Purge water was collected and placed in a drum on site for IDW disposal. In addition, personal protective equipment was placed in the appropriate drum for IDW disposal.

The groundwater sample and equipment blank were placed under proper chain of custody, and hand delivered to Quality Control, Inc. laboratory, a PADEP-approved laboratory, and analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, and TAL metals by EPA Method 6010. Copies of the chain-of-custody forms are contained in Appendix B. Table 3-3 presents a summary of the onsite well-sampling program for the site.

Equipment decontamination was conducted according to Ogden SOP FP-D-5, "Equipment Decontamination." A log of events occurring in the field was kept in accordance with Ogden SOP FP-F-5, "Logbooks." Recordkeeping, sample labeling, chain-of-custody information, sample handling, storage, and shipment were performed in accordance with Ogden SOPs FP-F-6 and FP-F-7.

3.4.3 Offsite Well Sampling

Ogden performed a well search of selected offsite wells within a quarter-mile radius that may have been impacted by the subject property. Based on information obtained from the Bucks County Health Department regarding wells in the vicinity of the site, six wells were selected for sampling.

On March 2 and 3, 2000, Ogden collected five groundwater samples (OSW-BF-01, OSW-BW13-01, OSW-TH-01, OSW-RH-01, and OSW-QC-01) and one duplicate sample (OSW-RH-2-01) from residential and commercial potable water wells and an inactive municipal potable water well. The samples were collected from wells at the following properties:

- Brinker Fuels (OSW-BF-01)
- Doylestown Borough Well #13 (OSW-BW13-01)
- Tilley residence (OSW-TH-01)
- Romanczak residence (OSW-RH-01) and duplicate sample (OSW-RH-2-01)
- Quigley Corporation (OSW-QC-01).

A potable water well at a house adjacent to the Quigley Corporation, which Quigley owns, was scheduled to be sampled. This well is located in an underground vault in a grassy area outside the home, and is connected to a treatment unit. Ogden attempted to collect a sample from this well; however, the treatment system could not be bypassed and a sample was not collected. The location of the wells may be found on Figure 3-2.

The samples were collected from an outdoor faucet after allowing the water to run and flush the water tank and piping for approximately 20 minutes. Although the majority of the residential and commercial properties are supplied with public drinking water, the faucets at which the samples were collected were connected directly to the well, without any treatment system.

At each well, three 40-mL vials of groundwater were collected for VOC analysis, one 1/2-L plastic bottle was collected for TAL metals analysis, one 1/2-L plastic bottle was collected for cyanide analysis, one 1/2-L plastic bottle was collected for hexavalent chromium analysis, and two 1-L glass bottles were collected for SVOC analysis. The groundwater samples were placed under proper chain of custody, and delivered at the end of the day to Quality Control, Inc. laboratory, a PADEP-approved laboratory, and analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, TAL metals by EPA Method 6010, cyanide by EPA Method 9010/9014, and hexavalent chromium by EPA Method 3060A. Copies of the chain-of-custody forms are contained in Appendix B. Table 3-4 presents a summary of the offsite well sampling program for the site.

A log of events occurring in the field was kept in accordance with Ogden SOP FP-F-5, "Logbooks." Record keeping, sample labeling, chain-of-custody information, sample handling, storage, and shipment was performed in accordance with Ogden SOPs FP-F-6 and FP-F-7.

Ogden contacted the resident of 400 N. Broad Street, Mrs. Bess Henning, to schedule a convenient time to collect a water sample from her well. Mrs. Henning was not comfortable allowing access to her home and refused sample collection from her well.

Ogden also contacted the Property Manager of Doylestown Commons, located along Shady Retreat Road. The Property Manager was uncomfortable allowing access to the well and requested to speak with the PADEP Project Officer, Mike Timcik. Ogden subsequently contacted the Property Manager, who then stated that the well had been closed for several years. Based upon this information, a water sample from the well at Doylestown Commons was not collected.

4.0 SITE GEOLOGIC/HYDROGEOLOGIC CHARACTERIZATION

This section represents the findings of the site geologic characterization program. This section includes a detailed discussion of the physical properties of the unconsolidated soil underlying the study area. The lithology encountered at the site consists primarily of clay, silt, and sand. Geologic cross sections (A-A', B-B', and C-C') were prepared for selected soil borings. The cross section location map is included as Figure 4-1.

Cross section A-A' is presented as Figure 4-2. Cross section A-A' depicts the profiles for borings SB-29, SB-07, SB-05, SB-04, and SB-03 and spans the patched asphalt area and the former tank farm area. Lithology encountered below the asphalt, which was present at SB-3, SB-4, and SB-7, consisted of varying amounts of tan to brown sands and clay and red clayey silt and sands. Refusal was encountered between 10 and 13 feet bgs in this area. Groundwater was encountered at the bottom of borings SB-04 and SB-05. Groundwater was not encountered in the other borings in this area.

Cross section B-B' depicts the profiles of SB-5, SB-10, SB-37, SB-17, SB-16, and SB-42 spanning the former tank farm, the former UST area, and then continuing northwest. The cross section B-B is illustrated on Figure 4-3. Unconsolidated material in this area consists primarily of brown silt and clay and reddish-brown clayey silt and sand. Refusal was encountered at approximately 12 feet bgs in the area. Groundwater was encountered only at the bottom of SB-05.

Cross section C-C', illustrated on Figure 4-4, depicts the profiles for borings SB-30, SB-36, SB-34, SB-17, SB-20, and SB-22. The cross section runs roughly south to north in the western portion of the site. Soil in this area consisted mostly of tan to dark brown and reddish brown silty clay with a few areas of sand inclusions. Refusal was encountered between 11 and 16 feet bgs. Groundwater was encountered only at the bottom of boring SB-34 in this area.

5.0 CHEMICAL ANALYTICAL CHARACTERIZATION RESULTS

Section 5 presents a discussion of the results of the soil and groundwater sampling program conducted at the subject property, as well as the laboratory reporting limits and limitations.

5.1 Subsurface Soil Sampling Results

Ogden collected soil samples from a total of 41 boring locations installed by Ogden and the drilling subcontractor, B&F Drilling, during site investigative activities conducted in January 2000. Two soil samples were collected from each boring location with the exception of SB-03, where three samples were collected due to an elevated PID reading, and SB-11, SB-12, and SB-13 where only one sample was collected from each due to shallow bedrock. Three duplicate samples were collected (SB-27, SB-35, and SB-41). These samples were duplicates of SB-25-01, SB-34-02, and SB-40-01, respectively. The soil samples were designated by the location and then by the sample number (i.e., SB-01-01). A total of 83 samples were collected and submitted to Quality Control, Inc. laboratory for analysis.

Soil boring samples were submitted for analysis of VOCs by EPA Method 8260, SVOCs by EPA Method 8270, and TAL metals by EPA Method 6010. These samples were collected using the procedures discussed in Section 3.0. The results were compared to the Act 2 Standards contained in Pennsylvania Bulletin, Vol. 27, No. 33, August 16, 1997, Appendix A, Table 3A, Non-Residential Medium Specific Concentrations (MSCs) for Organic Regulated Substances in Soil from 0 to 2 feet or 2 to 15 feet, and Appendix A, Table 4, Non-Residential MSCs for Inorganic Regulated Substances in Soil, 0 to 2 feet and 2 to 15 feet; Table 3B, MSCs for Organic Regulated Substances in Soil, Soil to Groundwater Values and Table 4B, MSCs for inorganic regulated substances in soil, soil to groundwater value. These results are presented in Tables 5-5a through 5-5c, and Table 5-d presents a summary of the results exceeding the Act 2 standards.

The Quality Control, Inc. laboratory analytical data reports for the 83 soil samples are contained in Appendix D.

Numerous TCL semi-volatile organics and TAL metal constituents were detected in the boring samples at concentrations exceeding the Method Detection Limits (MDLs); however, no samples were reported above their respective Act 2 standards. Volatile organic constituents were also detected in several borings; however, only three exceeded the cleanup standard: methylene chloride, tetrachloroethene, and trichloroethene. Methylene chloride was detected in one soil sample, SB-05-02, at a concentration of 752J ug/kg, above the Act 2 standard of 300 ug/kg. The "J" indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. Tetrachloroethene was detected in 9 of the 83 soil samples (SB-04-01, SB-04-02, SB-05-01, SB-05-02, SB-06-02, SB-07-01, SB-07-02, SB-28-02 and SB-29-02) above the Act 2 standard of 500 ug/kg. The values ranged in concentration from 618 ug/kg in soil sample SB-04-02 to 81,700 ug/kg in soil sample SB-05-01. Four of the samples (SB-05-01, SB-06-02, SB-07-01, and SB-07-02) were also qualified with a "J". These samples were collected in proximity to the former AST tank farm. Trichloroethene was detected in 9 of the 83 soil samples (SB-02-01, SB-02-02, SB-05-01, SB-05-02, SB-07-01, SB-07-02, SB-19-01, SB-28-02, and SB-29-02) above the Act 2 standard of 500 ug/kg; the values ranged in concentration from 528 ug/kg in soil sample SB-02-01 to 30,100 ug/kg in soil sample SB-05-01. Four of the samples (SB-05-02, SB-07-01, SB-07-02, and SB-19-01) were qualified with a "J". Six of these were also located in proximity to the former AST tank farm area. The results are presented in Table 5-1d.

In addition, several volatile and semi-volatile constituents were detected, although not above cleanup standards, in the samples in close proximity to the former tank farm area. These constituents include naphthalene, toluene, phenanthrene, and xylenes. The presence of these constituents indicates that a fuel spill had occurred previously on the property. Previous metal etching site activities may also have contributed to the onsite contamination.

It should be noted that the laboratory method detection limit exceeded the Direct Contact Value or Soil to Groundwater value for several volatile organics and semi-volatile organics, although the constituents were reported as non-detect.

XRF Screening Results

Two XRF metals, arsenic and mercury, were detected in concentrations exceeding the Act 2 standard. Arsenic was detected in one sample, SB-20-10, exceeding the Act 2 standard of 53 ppm at a concentration of 60.8 ppm. Concentrations of mercury were detected in 167 samples exceeding the Act 2 standard of 10 ppm, ranging from 240.6 ppm in soil sample SB-31-03 to 1,920 ppm in soil samples SB-08-03 and SB-036-06. Laboratory analysis did not confirm the presence of the analytes. Therefore, the detection of the parameters may have been the result the XRF being influenced by other metals with a metal of similar molecular composition for which the XRF unit is not typically calibrated. The XRF screening results are presented in Table 5-1e.

5.2 Surface Water and Sediment Sampling Results

Six surface water and sediment samples were collected from the subject site during field activities along Cooks Run and along Doylestown Extra Space drainage paths in January and February 2000. The sampling effort was delayed by winter weather conditions, including negative wind chills, snow, and ice. Surface water samples were labeled SW-01 through SW-06, with SW-04 collected as a duplicate of SW-03. Surface sediment samples were labeled SED-01 through SED-04, with SED-04 collected as a duplicate of SED-03.

The surface water and sediment samples were submitted to Quality Control, Inc. laboratory, for analysis. The analyses included VOCs by EPA Method 8260, SVOCs by EPA Method 8270, and TAL metals by EPA Method 6010. These samples were collected using the procedures discussed in Section 3.0. The surface water results were compared to the Water Quality for Toxic Substances, Fish and Aquatic Life Criteria, Pennsylvania Code, Title 25, Chapter 16, Appendix A, Table 1, dated June 20, 1998. The sediment sample results were compared to the Effects Range Median Values, USEPA, The National Sediment Contaminant Point Source Inventory (EPA 832-R-97-008), Table 2, September 1997 and the Apparent Effects Threshold, USEPA, The National Sediment Contaminant Point Source Inventory (EPA 832-R-97-008), Table A-2, September 1997. Tables 5-2a through 5-2c present the results of the surface water sampling, and Tables 5-3a through 5-3c present the results of the sediment sampling.

Surface Water Analytical Results

TCL VOCs and SVOCs constituents were detected in several surface water samples at concentrations exceeding the MDLs; however, no samples were reported above their respective standards. TAL metal constituents were detected in several samples; however, only two exceeded the cleanup standard, copper and manganese. Copper was detected in one sample SW-04-01 at a concentration of 147 ug/L exceeding the standard of 22.76 ug/L. Manganese was detected exceeding the standard of 1.0 ug/L in each of the six surface water samples. The values ranged in concentration from 69.7 ug/L in surface water sample SW-05-01 to 165 ug/L in surface water sample SW-04-01.

Sediment Analytical Results

TAL metals constituents were detected in several sediment samples at concentrations exceeding the MDLs; however, only three samples exceeded the Apparent Effects Threshold or the Effects Range Median (AQ-ERM). Samples SED-13-01 and SED-15-01 reported chromium at concentrations of 391 mg/kg and 1,040 mg/kg exceeding the Apparent Effects Threshold cleanup standard of 270 mg/kg. Nickel was detected in sample SED-15-01 at 63.4 mg/kg, exceeding the Effects Range Median (AQ-ERM) cleanup standard of 51.6 mg/kg. One VOC (tetrachloroethene) and one SVOC constituent (hexachlorobenzene) were detected in several sediment samples at concentrations exceeding the MDLs and above their respective standards. Tetrachloroethene was detected at a concentration exceeding the Apparent Effects Threshold standard of 140J ug/kg at 238 ug/kg in sediment sample SED-15-01. Hexachlorobenzene was detected exceeding the Apparent Effects Threshold standard of 230 ug/kg at 1,360J ug/kg in sediment sample SED-15-01. The "J" indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

5.3 Groundwater Sampling Results

The following sections present the results of the groundwater investigation, which included the sampling and analysis of piezometers, sampling and analysis of an onsite well, and sampling and analysis of offsite residential wells.

5.3.1 Piezometer Sampling Results

Ogden collected groundwater samples from five piezometer wells installed by B&F Environmental Drilling of Blue Anchor, New Jersey during soil boring installation. The samples were collected to evaluate the shallow groundwater beneath the site. These groundwater samples were identified as GW-01, GW-02, GW-03, GW-04, and GW-05. The groundwater samples were analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, and TAL metals by EPA Method 6010. These samples were collected using the procedures discussed in Section 3.0. The results were compared to the Act 2 standards contained in Pennsylvania Bulletin, Vol. 27, No. 33, August 16, 1997, Appendix A, Organic Regulated Substances in Groundwater, Table 1, and MSCs for Inorganic Regulated Substances in Groundwater Table 2. Tables 5-4a through 5-4c present the results of the piezometer sampling.

TAL metals and TCL SVOC and VOC constituents were detected in several piezometer samples at concentrations exceeding the MDLs and above their respective Act 2 standard. Six TAL metal constituents [antimony, cadmium, chromium (III), manganese, nickel, and chromium (VI)] were detected in piezometer samples exceeding the standard. Antimony was detected in three piezometer samples (GW-02a-01, GW-03a-01, and GW-04-01) exceeding the Act 2 standard of 6 ug/L at concentrations of 148 ug/L and 241 ug/L, respectively. Cadmium was detected in one piezometer sample, GW-02a-01, exceeding the Act 2 standard of 5 ug/L at a concentration of 5.3 ug/L. Chromium (III) was detected in four piezometer samples (GW-01a-01, GW-02a-01, GW-03a-01, and GW-04-01) exceeding the Act 2 standard of 100 ug/L at concentrations ranging from 199 ug/L in piezometer sample GW-01a-01 to 22,400 ug/L in piezometer sample GW-03a-01. Manganese was detected in five piezometer samples (GW-01a-01, GW-02a-01, GW-03a-01, GW-04-01, and GW-05-01) exceeding the Act 2 standard of 50 ug/L at concentrations ranging from 112 ug/L in piezometer sample GW-05-01 to 5740 ug/L in piezometer sample GW-02a-01. Nickel was detected in two piezometer samples (GW-02a-01 and GW-03a-01) exceeding the Act 2 standard of 100 ug/L at concentrations of 865 ug/L and 677 ug/L, respectively. Chromium (VI) was detected in one piezometer sample, GW-04-01, exceeding the Act 2 standard of 510 ug/L at a concentration of 945 ug/L.

Nine TCL volatile constituents (1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, ethylbenzene, methylene chloride, tetrachloroethene, trichloroethene, vinyl chloride, and cis-1,2-dichloroethene) were detected in several piezometer samples at concentrations exceeding the MDLs and above their respective Act 2 standard. 1,1,1-trichloroethane was detected in two piezometer samples (GW-01-01 and GW-02-01) exceeding the Act 2 standard of 200 ug/L at concentrations of 219 ug/L and 1,320J ug/L, respectively. 1,1-dichloroethane was detected in one piezometer sample, GW-04-01, exceeding the Act 2 standard of 110 ug/L at a concentration of 148 ug/L. 1,1-dichloroethene was detected in two piezometer samples (GW-01-01 and GW-04-01) exceeding the Act 2 standard of 7 ug/L at concentrations of 80.4 ug/L and 67.6 ug/L, respectively. Ethylbenzene was detected in one piezometer sample, GW-02-01, exceeding the

Act 2 standard of 700 ug/L at a concentration of 1,260J ug/L. Methylene chloride was detected in three piezometer samples (GW-01-01 GW-02-01, and GW-03-01) exceeding the Act 2 standard of 5 ug/L at concentrations of 31.4J ug/L, 210J ug/L, and 74 ug/L, respectively. Tetrachloroethene was detected in four piezometer samples (GW-01-01 through GW-04-01) exceeding the Act 2 standard of 5 ug/L; the values ranged in concentrations from 9.54 ug/L in piezometer sample GW-04-01 to 4,330 ug/L in piezometer sample GW-02-01. Two samples, GW-02-01 and GW-03-01 were qualified with a "J" indicating the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. Trichloroethene was detected in four piezometer samples (GW-01-01 through GW-04-01) exceeding the Act 2 standard of 5 ug/L; the values ranged in concentrations from 230 ug/L in piezometer sample GW-04-01 to 6,230 ug/L in piezometer sample GW-02-01. Samples GW-02-01 and GW-03-01 were also qualified with a "J". Vinyl chloride was detected in two piezometer samples (GW-01-01 and GW-04-01) exceeding the Act 2 standard of 2 ug/L at estimated concentrations of 56.0J ug/L and 2.22J ug/L, respectively. Cis-1,2-dichloroethene was detected in four piezometer samples (GW-01-01 through GW-04-01) exceeding the Act 2 standard of 70 ug/L; the values ranged from 79.9 ug/L in piezometer sample GW-04-01 to 6,740J ug/L in piezometer sample GW-02-01.

Two SVOC constituents, bis(2-ethylhexyl) phthalate and naphthalene, were detected in several piezometer samples at concentrations exceeding the MDLs and above their respective Act 2 standard. Bis(2-ethylhexyl) phthalate was detected in three of the piezometer samples (GW-01-01, GW-02-01, and GW-03-01) at concentrations exceeding the Act 2 standard of 6 ug/L; the values ranged from 10.8B ug/L in piezometer sample GW-03-01 to 69.2B ug/L in piezometer sample GW-02-01. The "B" validation code indicates that there is presumed contamination from the preparation (method) blank. Bis(2-ethylhexyl) phthalate was also detected in the laboratory blank and is a common lab contaminant. Naphthalene was detected in one piezometer sample, GW-02-01, exceeding the Act 2 standard of 20 ug/L at a concentration of 69.6 ug/L.

It should be noted in addition to soil samples from the same area, naphthalene was detected in the groundwater in close proximity to the former tank farm area, although several samples were not above cleanup standards. The presence of these constituents indicates a fuel spill may have previously occurred on the property. Previous metal etching site activities may also have contributed to the onsite contamination.

5.3.2 Onsite Well Sampling Results

On May 15, 2000, Ogden removed the asphalt and dug approximately 2 feet to uncover the plastic cover to the onsite abandoned well. Ogden purged the well and sampled the onsite well (GW-06-01). The groundwater sample was analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, TAL metals by EPA Method 6010, cyanide by EPA Method 9010/9014, and hexavalent chromium by EPA Method 3060A. The results were compared to the Act 2 Standards contained in Pennsylvania Bulletin, Vol. 27, No. 33, August 16, 1997, Appendix A, MSCs for Organic Regulated Substances in Groundwater Table 1, and Inorganic Regulated Substances in Groundwater Table 2.

VOC and SVOC constituents were detected at concentrations exceeding the MDLs, but not above their respective Act 2 standard. One TAL metal was detected at concentrations exceeding the MDL and above the Act 2 standard. Mercury was detected in the sample at concentrations exceeding the Act 2 standard of 0.002 mg/l, reporting 0.0052 mg/l.

5.3.3 Offsite Well Sampling Results

On March 2 and 3, 2000, Ogden collected five groundwater samples (OSW-BF-01, OSW-BW13-01, OSW-TH-01, OSW-RH-01, and OSW-QC-01) and one duplicate sample (OSW-RH-2-01) from residential and commercial potable water wells and an inactive municipal potable water well. The groundwater samples were analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, TAL metals by EPA Method 6010, cyanide by EPA Method 9010/9014, and hexavalent chromium by EPA Method 3060A. These samples were collected using the procedures discussed in Section 3.0. The results were compared to the Act 2 Standards contained in Pennsylvania Bulletin, Vol. 27, No. 33, August 16, 1997, Appendix A, MSCs for Organic Regulated Substances in Groundwater Table 1, and Inorganic Regulated Substances in Groundwater Table 2. Tables 5-5a through 5-5c present the results of the offsite well sampling.

TAL metals and TCL VOC constituents were detected in several offsite well samples at concentrations exceeding the MDLs and above their respective Act 2 standard. Three TAL metals (iron, manganese, and vanadium) were detected in concentrations exceeding Act 2 standards. Iron was detected in sample OSW-TH-01 exceeding the Act 2 standard of 300 ug/L at a concentration of 362 ug/L. Manganese was detected in sample OSW-BW-13-01 exceeding the Act 2 standard of 50 ug/L at a concentration of 79.2 ug/L. Vanadium was detected in sample OSW-BF-01 exceeding the Act 2 standard of 2.1 ug/L at a concentration of 2.41 ug/L.

Four TCL volatile constituents (1,1-dichloroethene, 1,1,2,2-tetrachloroethane, tetrachloroethene, and trichloroethene) were detected in several samples at concentrations exceeding the MDLs and above their respective Act 2 standard. 1,1-dichloroethene was detected in three offsite well samples (OSW-TH-01, OSW-RH-01, and OSW-RH-2-01) exceeding the Act 2 standard of 7 ug/L at concentrations of 33.5J ug/L, 19.3J ug/L, and 18.0J ug/L, respectively. The “J” indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. 1,1,2,2-tetrachloroethane was detected in one offsite well sample, OSW-QC-01, exceeding the Act 2 standard of 0.74 ug/L at a concentration of 1.69J ug/L. Tetrachloroethene was detected in three offsite well samples (OSW-TH-01, OSW-RH-01, and OSW-RH-2-01) exceeding the Act 2 standard of 5 ug/L at concentrations of 32J ug/L, 13.6J ug/L, and 13.9 ug/L, respectively. Trichloroethene was detected in four offsite well samples (OSW-BW13-01, OSW-TH-01, OSW-RH-01, and OSW-RH-2-01) exceeding the Act 2 standard of 5 ug/L at concentrations of 8.38J ug/L, 94.3J ug/L, 39.5J ug/L, and 37.0J ug/L, respectively.

No TCL SVOC constituents were detected in the offsite well sampling.

5.4 Validation Summaries

The laboratory sample analytical data reports for this project were validated by Ogden data validators. The findings of data validation were reviewed and incorporated into the laboratory sample analytical data results discussed in this section.

Three issues associated with the analysis of water and soil samples for the Chem-Fab site were noted by the data validation group. These issues included sample dilutions due to sample matrix interferences, inconsistent performance of the methodology for mercury analysis, and recoveries for matrix spike and matrix spike duplicate analyses outside established QA/QC control limits. These issues are discussed below.

The data validation group noted that the laboratory performed dilutions on many of the water and soil samples analyzed for ICP metals due to matrix interferences encountered by the laboratory in these samples. As a result of these dilutions, reporting limits were raised for many of the water and soil samples analyzed for ICP metals. The data validators qualified these samples, but did not reject them.

The data validation group also noted that the laboratory performed the mercury analysis of many water and soil samples differently than the analysis of the calibration curve standards. While these analyses should have been performed in the same manner, the data validators qualified these sample analyses, but did not reject them.

Several constituents within the semivolatile and volatile organics analysis for subsurface soils and sediment samples reported MDLs above their respective Act 2 Cleanup standards. All aqueous samples reported constituents above the MDLs for their respective analyses and Act 2 Cleanup standards. Surface water semi-volatiles and metals reported MDLs above the Act 2 Cleanup standards. Upon validation, this appears to be from matrix interference resulting in elevated MDLs. The constituents in which the MDL exceeded the Act 2 Cleanup standard, have resulted in data gaps due to the loss of information for these constituents.

Recoveries for the matrix spike and matrix spike duplicate analyses for selected metals were noted by the validator to have been performed by the laboratory for 9 of the soil boring samples outside the established control limits. As a result, the data validators qualified but did not reject the analysis of these selected metals for the associated soil boring samples.

The data validators noted that as evaluation criteria for the calibrations, the volatile and semi-volatile QC limits for either initial or continuing calibrations were used for all target compounds. Several semi-volatile and volatile organic analytes initial calibration or continuing calibration fell below the QC limits set. As a result, the data validators qualified but did not reject the positive analysis of these selected analytes for the associated soil boring samples, and rejected or qualified the negative or nondetected results.

Volatile target compounds methylene chloride and acetone were noted by the validator to be present in several soil method blanks and associated samples were qualified as nondetects in the sample if the sample concentrations were less than 10 times that in the blank.

The data validators noted that sample preservation, handling and transportation within the data management for less than 10% of the selected samples exceeded the temperature limits. As a result, the data validators qualified but did not reject the analysis of these selected analytes for the associated samples.

Several semivolatile analytes were noted by the validator to be adjusted for percent moisture, sample amount and dilution. A review of the sample chromatograms indicated the presence of high concentrations of nondetect compounds. This suggests matrix interference within the samples.

The raw data for arsenic for sediment samples SED-01-01, SED-02-01, and SED-04-01 was originally reported as non-detect. Upon review by the validator, these sediment samples did have a detection of this analyte. The results for sediment samples SED-01-01, SED-02-01, and SED-04-01 have been revised to reflect an arsenic concentration of 0.947 ug/L, 0.968 ug/L, and 1.39 ug/L, respectively.

The raw data for cadmium for sediment samples SED-03-01, SED-04-01, and SED-05-01 was originally reported as non-detect. Upon review by the validator, these sediment samples did have a detection of this analyte. The results for sediment samples SED-03-01, SED-04-01, and SED-05-01 have been revised to reflect a cadmium concentration of 0.555 ug/L, 0.32 ug/L, and 0.391 ug/L, respectively.

The raw data for copper for surface water sample SW-01-01 was originally reported as non-detect. Upon review by the validator, this surface water sample did have a detection of this analyte. The results for surface water sample SW-01-01 have been revised to reflect a copper concentration of 2.7 ug/L.

The raw data for nickel for surface water sample SW-14-01 was originally reported as non-detect. Upon review by the validator, this surface water sample did have a detection of this analyte. The results for surface water sample SW-14-01 have been revised to reflect a nickel concentration of 1.51 ug/L. Vanadium was reported as non-detected for GW-01-01a; however, the result was 0.331, which is over the reporting limit, and therefore the number was changed to reflect this. The reporting limits for vanadium for the offsite well samples did not match the provided instrument MDL. To correspond to the MDLs that were provided, the validator revised the reporting limits.

The raw data for arsenic and copper for offsite well sample OSW-BW13-01 was originally reported as non-detect. Upon review by the validator, the offsite well sample did have a detection of these analytes. The results for offsite well sample OSW-BW13-01 have been revised to reflect a concentration of 3.540 ug/L of arsenic and 2.69 ug/L of copper. The raw data for nickel for offsite well sample OSW-TH-01 was originally reported as non-detect. Upon review by the validator, the offsite well sample did have a detection of this analyte. The results for offsite well sample OSW-TH-01 have been revised to reflect a concentration of 3.46 ug/L of nickel.

The raw data for beryllium, cobalt, and nickel for offsite well sample OSW-RH-01 was originally reported as non-detect. Upon review by the validator, the offsite well sample did have a detection of these analytes. The results for offsite well sample OSW-RH-01 have been revised to reflect a concentration of 0.175 ug/L of beryllium, 0.675 ug/L of cobalt, and 7.64 ug/L of nickel.

The raw data for beryllium and nickel for offsite well sample OSW-RH-2-01 was originally reported as non-detect. Upon review by the validator, the offsite well sample did have a detection of these analytes. The results for offsite well sample OSW-RH-2-01 have been revised to reflect a concentration of 0.169 ug/L of beryllium and 6.660 ug/L of nickel.

6.0 CONCLUSIONS

The following sections discuss the distribution and possible migratory pathways of the contaminants of concern (COCs) detected throughout the Chem-Fab Site. Site COCs were detected at concentrations exceeding Act 2 standards throughout site soil and groundwater samples.

6.1 Subsurface Soils Investigation

Based on the evaluation of sample analytical data discussed in Section 5.0, Ogden identified COCs in subsurface soils exceeding Act 2 standards. The area-specific COCs (trichloroethene, tetrachloroethene, and methylene chloride) were detected above Act 2 soil to groundwater standards. These COCs were detected in subsurface soils ranging from 3 to 10.5 feet bgs in the former tank farm area located south of the former manufacturing building and the patched asphalt area located east of the former manufacturing building (see Figure 6-1). The source of the area-specific COCs in site soils is likely to be historic site operations in and adjacent to the tank farm area.

In addition, trichloroethene was detected in excess of the Act 2 soil to groundwater standard in one soil boring (SB-19) within the courtyard area between the three site buildings. This may be a result of former operations in this area.

Several volatile and semi-volatile constituents were also detected in the samples in close proximity to the former tank farm area, although not above cleanup standards. These constituents include naphthalene, toluene, phenanthrene, and xylenes. The presence of these constituents indicates a fuel spill may have previously occurred on the property. Previous metal etching site activities may also have contributed to the onsite contamination. In addition, during the course of the investigation, Ogden spoke to surrounding property owners and learned that, historically, hexavalent chromium (yellow ooze) was observed bubbling up out of the ground on the vacant land southwest of the Store and Lock property, before Cooks Run. This information may suggest that the contaminant plume has migrated off site. This area was not included as a part of the original investigation.

6.2 Groundwater Investigation

Based on an evaluation of the site characterization data, groundwater is present at the site from approximately 10 to 14 feet bgs. Based on topography and historical reports, groundwater has an assumed flow direction to the west in the direction of Cooks Run tributary. Based on an evaluation of the sample analytical data discussed in Section 5.0, Ogden has identified COCs in the onsite and the offsite groundwater at the Chem-Fab Site.

The COCs detected in onsite groundwater at concentrations in excess of the Act 2 standards for groundwater in used aquifers include six metals (antimony, cadmium, chromium (III) and (VI), manganese, nickel, vanadium) and eight volatile organic compounds (1,1,1-trichloroethane, 1,1-dichloroethene, 1,1-dichloroethane, methylene chloride, tetrachloroethene, trichloroethene, vinyl chloride, cis-1,2-dichloroethene) and two semi-volatile compounds, bis(2-ethylhexyl)phthalate and naphthalene. The majority of these contaminants are distributed among four of the five piezometers located in the western portion of the site near the former UST area and in the southern portion of the site in the former tank farm area (see Figure 6-2).

The onsite well, with a depth of 57 feet, reported mercury in the groundwater at concentrations in excess of the Act 2 standards for groundwater in used aquifers.

In addition, naphthalene was detected in the samples in close proximity to the former tank farm area. The presence of this constituent, along with soil sample constituents found, indicates that a fuel spill may have previously occurred on the property. Previous metal etching site activities may also have contributed to the onsite contamination.

The COCs detected in offsite groundwater at concentrations in excess of the Act 2 standards for groundwater in used aquifers include four volatile organic compounds (1,1-dichloroethene, 1,1,2,2-tetrachloroethane, tetrachloroethene, and trichloroethene). These compounds were detected in several offsite well samples at concentrations exceeding the MDLs and above their respective Act 2 standard. These contaminants were detected in residential, commercial, and municipal wells located west of the site and across Cooks Run. The depths of these wells are not known; however, they are likely to extend into bedrock.

Based on the validated on and off site groundwater analytical data, several issues arose including, calibration, recoveries and dilutions. The calibration and recovery issues resulted in qualifiers being placed on the constituents of concern. The dilution issues resulted in potential data gaps in the information received due to the loss of information for several constituents in the metals, volatiles and semivolatiles analysis.

6.3 Surface Water and Sediment Investigation

Surface water and sediment samples were collected from drainage pathways draining the Chem-Fab site at locations shown on Figure 3-1. Surface water samples collected from Cooks Run contain concentrations of two metals (copper and manganese) in excess of the cleanup standard, and sediment samples collected reported concentrations of two metals (chromium and nickel) in excess of the cleanup standards. Copper was detected in one of the six surface water samples. Manganese was detected in each of the six surface water samples. Chromium was detected in two of the sediment samples and nickel was detected in one. One VOC (tetrachloroethene) and one SVOC (hexachlorobenzene) were detected in one sediment sample (SED-15-01) at concentrations above standards. This sample was located offsite on the Extra Space property, south of the Chem-Fab Site (see Figure 3-1).

Based on the validated surface water and sediment analytical data, several issues arose including, calibration, recoveries and dilutions. The calibration and recovery issues resulted in qualifiers being placed on the constituents of concern. The dilution issues resulted in potential data gaps in the information received due to the loss of information for several constituents in the metals, volatiles and semivolatiles analysis.

7.0 REFERENCES

1. PADEP Hazardous Site Assessment Report, September 1998.

2. U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Bucks County, Pennsylvania, 1996, pp. 99-101.

3. U.S. Geologic Quadrangle for Doylestown, Pennsylvania (7.5 Minute Series).

4. U.S. Geologic Survey Topographic Quadrangle (7.5 Minute Series) for Doylestown, PA, 1966, which was compiled by photogrammetric methods from imagery dated 1950, field checked 1952, revised from aerials taken 1965, and photorevised in 1983.

5. Pennsylvania Bulletin, Vol. 27, No. 33 (dated August 16, 1997), Act 2 Medium Specific Concentrations for Organic Regulated Substances in Groundwater for Used Aquifers in Residential Areas (Appendix A, Table 1).

6. Bucks County Health Department File Review, Doylestown, PA

7. Site Inspection of Chem-Fab Corporation, prepared by NUS Corporation, February 26, 1988.

8. Site Inspection Report for Chem-Fab Site, prepared by USEPA, April 1988.

Ogden Standard Operating Procedures

FP-C-2	Soil Sampling
FP-C-4	Surface Water Sampling
FP-C-5	Sediment Sampling
FP-D-3	Monitoring Well Sampling
FP-D-5	Equipment Decontamination
FP-F-1	Laboratory QC Samples (Water, Soil)
FP-F-5	Logbooks
FP-F-6	Recordkeeping, Sample Labeling, and Chain of Custody
FP-F-7	Sample Handling, Storage, and Shipping

APPENDIX E

Photographs

FINAL – PHASE II
SITE CHARACTERIZATION REPORT

Volume 1

CHEM-FAB SITE
DOYLESTOWN,
BUCKS COUNTY, PENNSYLVANIA

PADEP Contract No.: ME 359185
Work Assignment No.: 31-070

Submitted to:
Commonwealth of Pennsylvania
Department of Environmental Protection
Bureau of Land Recycling and Waste Management
Division of Remediation Services

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AMEC Project No. 97038-009

November 25, 2002

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NOTICE

The information in this document has been funded by the Pennsylvania Department of Environmental Protection (PADEP) under Contract No. ME 359185 to AMEC Earth & Environmental, Inc. (AMEC). This document has been formally released by AMEC to the PADEP.

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1.0 INTRODUCTION

AMEC Earth & Environmental, Inc. (AMEC) is submitting this Final Phase II Site Characterization Report to the Pennsylvania Department of Environmental Protection (PADEP) in response to PADEP's Requisitions for Contractual Services 21-070 and 31-070 and the Scope of Work. The requisitions for this project were issued under AMEC's General Technical Assistance Contracts (GTAC-2 [ME 93936] and GTAC-3 [ME 359185]) executed pursuant to the Pennsylvania Hazardous Sites Cleanup Act (HSCA), Act 108, October 1988. This project was conducted in accordance with the Final Workplan Addendum submitted by AMEC (dated December 18, 2000) in response to Project Requisition 21-070, as amended in the revised cost estimate dated October 5, 1999. The initial Notice to Proceed (NTP) was issued to AMEC on April 21, 1999 in accordance with AMEC’s GTAC-2 contract and reissued December 8, 1999 in accordance with AMEC’s GTAC-3 contract. The initial Site Characterization Report was submitted in July 2000. This document presents AMEC’s technical report regarding the further characterization of the Chem-Fab Corporation Site (site), which is located in Doylestown, Bucks County, Pennsylvania (see Figure 1-1).

1.1 Project Objectives

Specific response action objectives for the Chem-Fab Site, based on the current knowledge of site conditions, are as follows:

- Further delineate soil conditions on the subject site and surrounding properties based on analytical data to date, and conduct soil sampling in areas to fill in data gaps and/or confirm initial sampling data.
- Install monitoring wells to assist in the determination of the extent of groundwater contamination on the subject site and surrounding properties and to determine actual groundwater flow direction and potential plume migration.

The objectives were met through the performance of a site inspection, multimedia sampling and analysis, and comparison of the analytical results with PADEP cleanup standards to determine what further action, if any, may be needed at the site.

1.2 Report Organization

A description of the site background and environmental setting is presented in Section 2.0 of this report. The site characterization activities performed for this project are discussed in Section 3.0. A discussion of the site geologic and hydrogeologic characterization is contained in Section 4.0. The results of the chemical analytical characterization of the site are discussed in Section 5.0. Conclusions regarding the site are presented in Section 6.0. References used to prepare this Final Phase II Site Characterization Report are listed in Section 7.0.

2.0 SITE BACKGROUND AND ENVIRONMENTAL SETTING

This section includes a description of the site location as well as the site background, current conditions, and environmental setting, including climate, soils, potable water supplies, regional geology, hydrogeology, topography, and surface drainage.

2.1 Site Location and Description

The Chem-Fab Site is located at 300 North Broad Street in Doylestown, Bucks County, Pennsylvania. The site may be found on the Doylestown, Pennsylvania USGS 7.5 Minute Series topographic map at 40°18'54" north latitude and 75°08'06" west longitude (see Figure 1-1). The site, currently owned by 300 North Broad Street, Ltd., is a one-acre parcel of land that contains three separate buildings where various business ventures have been operated. At the time of the initial site visit (December 1998), the subject site contained three structures: a large warehouse/manufacturing type building, a smaller storage type building, and a residential home. The warehouse/manufacturing building was of slab on grade construction, with block walls and a steel frame. The storage building appeared to be empty and consisted of a two-story structure with a basement or crawl space. The residential building consisted of a two and one-half story structure with a partial crawl space. Roll-off containers were onsite for the storage/disposal of the debris from the partial demolition of the warehouse/storage building. At the time of the field investigation (December 1999), the subject site appeared to have undergone renovations and demolition. The large warehouse/manufacturing building was renovated and partially rented to a tenant. The tank farm area associated with the building was demolished, with only the concrete floor remaining. The small storage building and stone house were undergoing renovations to become office space. Utilities were brought in for the two smaller buildings, and the area between the large warehouse/manufacturing building and Tilley Fire Equipment to the east had a base course of asphalt. Additional concrete was placed along the rear of the warehouse/manufacturing building and more stone was brought into the area to the west of this building. The site remains the same as when the initial field investigation was conducted in 1999.

The site is bordered to the east by Tilley Fire Equipment, to the west and south by Extra Space Storage of Doylestown, and to the north by North Broad Street. Farther north is the Daily Intelligencer. An orthophoto of the site based on an aerial photograph is provided as Figure 2-1, the site plan. Site boundary information, preliminarily surveyed by Gilmore & Associates, Inc., in May 2000, is provided on the map.

Two creeks, Pine Run and Cooks Run, are located within a 2-mile radius of the site, as shown on Figure 1-1. Based on information from the Borough of Doylestown, residents of Doylestown rely on groundwater as a source of potable drinking water. The area in proximity to the site has a relatively shallow groundwater table, and several potable wells and a municipal water well are located in close proximity to the site. Several of the potable wells have been abandoned for drinking water purposes based on historic groundwater investigations.(1) The municipal well was taken out of service for a period of time; an air stripper was added to the well, and it was brought back on line. Based on analytical results of the ongoing investigation, the well as been temporarily removed from service again.

2.2 Site Background

During the initial investigation, AMEC conducted a review of historical site files at the Bucks County Department of Health offices in Doylestown, Pennsylvania and the PADEP offices in Conshohocken, Pennsylvania, in an attempt to determine historical areas of concern regarding the subject site. In addition, AMEC located and reviewed tax maps, historical aerials, and Sanborn maps of the site. The following paragraph summarizes this information, which can be found in further detail in the initial Site Characterization Report.

The site was operated as Chem-Fab, Inc., an electroplating and metal etching company, from 1965 to approximately 1994. The large warehouse/manufacturing building, constructed in approximately 1965, was used as an electroplating and etching operation. Chem-Fab manufactured templates for circuit boards. Chem-Fab generated wastes that included ferric chloride, mineral spirits, chromic acid rinse water and sludge, chromic acid, sulfuric acid, sodium bisulfate, sodium hydroxide, and lime. A tetrachloroethylene (TCE) vapor degreasing process was used until 1973.(2,3)

According to a review of historical information, two diked areas were constructed onsite, south of the large warehouse/manufacturing building. The AST tank farm area appeared to have contained three aboveground storage tanks (ASTs) (including one 2,500-gallon AST, one 4,000-gallon AST, and one 8,500-gallon AST) and one underground catch basin believed to be 1,000 gallons in size. According to historical information, up to five or six tanks were located in this area. In addition, one UST area was noted on the western side of the building. This tank was believed to be 10,000 gallons in size.

Documented records of spills, releases of products and violations of the Clean Streams Laws of the Commonwealth were found in the records review. The USEPA performed an investigation of the site and surrounding area and determined that groundwater in the vicinity of the site was contaminated with volatile organic compounds (VOCs), including concentrations of trichloroethene (TCE) and 1,2-dichloroethene (DCE) in excess of the drinking water equivalent (DWE) and maximum contaminant levels (MCLs) set for public water supplies. The USEPA conducted CERCLA Removal Actions of both solid and liquid wastes at the Chem-Fab Site. Previous reports documented analytical results of the soil, sediment, and aqueous sampling, indicating constituents of primarily volatiles and metals above state and federal cleanup standards in both onsite and offsite areas. Drinking water samples revealed elevated concentrations of volatiles and metals above USEPA drinking water standards in several samples collected.

2.3 Site Characterization Background

AMEC performed an initial site investigation from December 1999 through April 2000 to determine if the subject site and the adjacent Extra Space Storage of Doylestown property had been adversely impacted from former activities at the subject site. Based on the analytical results, both soils and groundwater were found to have been impacted by historical operations.

Soils analytical results revealed trichloroethene, tetrachloroethene, and methylene chloride were detected in the former tank farm area and the patched asphalt area above Act 2 soil to groundwater standards. In addition, trichloroethene was detected in excess of the Act 2 soil to groundwater standard within the courtyard area between the three site buildings. Several volatile and semi-volatile organic compounds (SVOCs) were also detected in the samples in close proximity to the former tank farm area, although not above cleanup standards. These constituents include naphthalene, toluene, phenanthrene, and xylenes.

The constituents detected in onsite groundwater at concentrations in excess of the Act 2 standards for groundwater in used aquifers included six metals (antimony, cadmium, chromium (III) and (VI), manganese, nickel, vanadium), eight VOCs (1,1,1-trichloroethane, 1,1-dichloroethene, 1,1-dichloroethane, methylene chloride, tetrachloroethene, trichloroethene, vinyl chloride, cis-1,2-dichloroethene), and two SVOCs (bis(2-ethylhexyl)phthalate and naphthalene). The onsite historical potable well, with a depth of 57 feet, reported mercury in the groundwater at concentrations in excess of the Act 2 standards for groundwater in used aquifers.

In addition, naphthalene was detected in the samples in close proximity to the former tank farm area. The constituents of concern (COCs) detected in offsite groundwater at concentrations in excess of the Act 2 standards for groundwater in used aquifers include four VOCs (1,1-dichloroethene, 1,1,2,2-tetrachloroethane, tetrachloroethene, and trichloroethene). These compounds were detected in several offsite well samples at concentrations exceeding the maximum detection limits (MDLs) and above their respective Act 2 standard. These contaminants were detected in residential, commercial, and municipal wells located west of the site and across Cooks Run. The depths of these wells are not known; however, they are likely to extend into bedrock.

The surface water samples collected from Cooks Run contain concentrations of two metals (copper and manganese) in excess of the cleanup standard, and the sediment samples collected had concentrations of two metals (chromium and nickel) in excess of the cleanup standards. One VOC (tetrachloroethene) and one SVOC (hexachlorobenzene) were detected in one sediment sample at concentrations above standards.

2.4 Environmental Setting

The following sections provide a discussion of the environmental setting of the Chem-Fab Site, including the climate, soils, geology, hydrogeology, topography, and surface drainage.

2.4.1 Climate

Based on a review of the Soil Survey of Bucks and Philadelphia Counties (1975), Bucks County is part of the Southeast Piedmont climatic division.(2) The climate is classified as humid continental modified by the Atlantic Ocean. Most of the weather systems that affect this area develop in the Midwest and are steered eastward or they form in the southeastern states and move northeastward parallel to the Atlantic. The temperature in this area has moderate extremes with an average temperature of 53°F. The mean annual precipitation is approximately 43 to 45 inches. The summers are warm and humid with temperatures averaging 90°F. Cloudiness is more prevalent in winter than other seasons because cold fronts and coastal low pressure systems are more frequent. The average snowfall is more than 30 inches in much of Bucks County.

2.4.2 Soils

Based on a review of the Soil Survey of Bucks and Philadelphia Counties (1975),(2) the soils at the subject site are associated with the Doylestown Series and Abbottstown Series, consisting of deep, poorly drained, nearly level to gently sloping soils on uplands. The Doylestown soils were formed in silty material overlying a variety of loamy materials generally weathered from shale and sandstone, and the Abbottstown Series consists of deep, somewhat poorly drained, nearly level soils on uplands, formed in loamy material weathered from brown shale and sandstone. The soils onsite consist mainly of the Doylestown silt loam, 0-3 percent slopes. This Doylestown silt loam is found in concave positions along drainageways and the base of slopes and on some ridge tops. The soils are described as a dark grayish-brown silt loam surface layer with a grayish-brown silty clay loam with light brownish-gray and strong brown mottles. The soils are generally wet, and the slow permeability limits most nonfarm uses. The Abbottstown silt loam, 8-15% slopes is also found on the site in areas similar to the

Doylestown silt loam. Based on the Soil Survey of Philadelphia and Bucks County, this soil type is described as dark brown to reddish-brown silt loam, shaly silt loam, and shaly clay loam and can also be pink, yellow, brown, and gray mottles at depth. Reddish-brown, mottled shaly, silty clay loam overlies fractured red shale bedrock. Both of these soils have a slow permeability, runoff is slow, available water capacity is moderate, and the seasonal high water table limits most nonfarm uses of the soil. The permeability is described as the physical flow properties of the soils, which limit the ability of fluids to move through them. Soil types encountered during the investigation concur with the descriptions above. A soils map for the subject site is included as Figure 2-2.

2.4.3 Regional Geology

The Chem-Fab Site is located in Bucks County, which is predominantly an undulating plain characterized by low hills and ridges. Rocks underlying the county consist of schist, gneiss, shale, sandstone, quartzite, conglomerate, and limestone. Bucks County and Philadelphia County lie within two main physiographic divisions: the Appalachian Highlands on the northwest and the Atlantic Coastal Plain on the southeast. The Appalachian Highlands is divided into several provinces, which in the Bucks County area include the Piedmont province, the Triassic-Lowland province, and the New England province.

The Chem-Fab Site lies within the Triassic-Lowland physiographic province in Bucks County. This area is characterized by an uplifted plain formed by easily eroded inclined strata, with residual ridges marking the more resistant, tilted, volcanic rock. Local relief does not exceed 250 feet in elevation change. The bedrock underlying the site is Triassic-age Stockton lithofacies, which consists of light-colored, coarse-grained sandstone and conglomerate, red to brown fine-grained siliceous sandstone, and red shale. The shale and sandstone are interbedded in no order and repeated with individual bedding planes pinching out in short distances. This geologic unit has an average dip of 10 degrees and has a calculated thickness of approximately 3,000 feet. The formation is cut by a well-developed system of joints and fractures. Bedrock encountered during site activities concur with the geology discussed above. The geologic map for the subject site is included as Figure 2-3.

2.4.4 Regional Hydrogeology

The Stockton lithofacies is a good source of water in Bucks County. Groundwater is contained in intergranular openings within the sedimentary rock where the cement has been weathered away; therefore, the occurrence and movement of groundwater are functions of the degree of weathering of the rock. Groundwater commonly occurs in artesian conditions where the sandstone and conglomerate beds are interlayered with red shale. This artesian flow is probably a function of the dip and orientation of the bedding. The dip of the Stockton formation averages 10 degrees or more; therefore, a selected water-bearing bed stops bearing water at an appreciable distance down dip, as the bed grades into unweathered bedrock. The formation has a wide range in permeability; recorded yields for the Stockton range from 2 to 440 gallons per minute (gpm) with an average yield of 78 gpm. According to the geologic map for the area, dip at the site is approximately 10 degrees towards Cooks Run.

2.4.5 Topography and Surface Drainage

The topography of the majority of the site consists primarily of fill areas, partially vegetated land, and gentle slopes. The main portion of the site is covered with the onsite buildings and associated paved driveway and parking areas. The elevation ranges from approximately 360 to 400 feet above mean sea level (MSL), with a gentle downward slope to the southwest toward Cooks Run. The assessment of the site topography is based on a review of the U.S. Geologic Survey (USGS) Doylestown quadrangle(5) for the site and surrounding area (see Figure 1-1) and onsite observations.

Surface drainage is expected to flow to the southwest across the site, toward Cooks Run via overland flow, and infiltrate the fill areas and vegetated areas.

3.0 SITE CHARACTERIZATION ACTIVITIES

The site characterization activities for the Chem-Fab Site were performed in accordance with the Final Workplan Addendum, and Change Orders #3 through #8, which were prepared by AMEC, submitted to PADEP and approved between January 2001 and March 2002. The site characterization program included further delineation of soil conditions on the subject site and surrounding properties based on analytical data to date; soil sampling in areas to fill in data gaps and/or confirm initial sampling data; and the installation of monitoring wells, including clustered wells to assist in the determination of the horizontal and vertical extent of groundwater contamination on the subject site and surrounding properties and to determine actual groundwater flow direction and potential plume migration. In addition, during site activities, further investigation was conducted in the identified areas of concern.

These activities, conducted at the site between April 2001 through May 2002 by AMEC and project subcontractors, are discussed in detail in the following sections. Photographs are included in Appendix A.

3.1 Geophysical Logging

Packer testing and geophysical logging were conducted on the wells drilled to determine potential fractures zones in the bedrock, receiving zones, potential contaminant zones and bedding planes in an attempt to assist in the determination of the final well installation requirements and depths. Geophysical logging included temperature, conductivity, down-hole video, natural gamma, single point resistivity, caliper, and fluid resistivity.

On April 23, 2001 through April 25, 2001, Eichelbergers, Inc. of Mechanicsburg, Pennsylvania, performed packer testing on three of the four newly drilled wells (MW-02, MW-03, and MW-04) and one existing onsite well (DW) formerly used as a potable water well. These wells were located on the Chem-Fab Site and the adjacent Extra Space Storage property. Packer testing was not performed on MW-01 due to a lack of water encountered during the initial drilling of the well. Packer testing was to be performed at 25-foot intervals in each well and was altered in the field based upon actual water conditions found in the wells.

Based upon historic operations at the site, hexavalent chromium, which appears yellow in groundwater, was a constituent of concern. Because yellow water was encountered during the drilling and packer testing of MW-2, AMEC performed preliminary analytical testing on this well in an attempt to identify the constituents and to further re-define the health and safety procedures to be utilized on the site, if necessary. Groundwater samples (MW-02-25 and MW-02-75) were collected from two zones and were submitted to the PADEP contract laboratory for analysis until the portable gas chromatograph unit could be brought to the site. Cadmium, chromium, thallium, aluminum, beryllium, copper, iron, manganese, magnesium, nickel, vanadium, and zinc were detected above Act 2 cleanup standards. The chromium levels reported were 61,800 ug/l, and the Act 2 cleanup standard for chromium is 100 ug/l. Other metals detected, but below cleanup standards, included silver, barium, calcium, cobalt, potassium, mercury, and sodium. Volatile organic analysis revealed vinyl chloride, methylene chloride, 1,1,-dichloroethene, 1,1,1-trichloroethane, trichloroethene, tetrachloroethene, toluene, ethylbenzene, xylenes, and cis-1,2-dichloroethene reported in both zones. The majority of these constituents exceeded their respective Act 2 cleanup standards.

On May 3, 2001, the Eichelberger subcontractor, Mid-Atlantic Geosciences of Centreville, Maryland, conducted geophysical logging on MW-01, MW-03, and DW-01.

The geophysical logging activities included temperature, conductivity, down-hole video, natural gamma, single point resistivity, caliper, and fluid resistivity. During the geophysical logging of MW-04, the water appeared to be yellow in color and Mid-Atlantic Geosciences determined that they did not want to continue performing the geophysical tasks because of potential damage to their equipment. Earth Data of Exton, Pennsylvania, was contracted for the remainder of the geophysical tasks, and completed the geophysical logging of MW-02 and MW-04 on May 25, 2001.

Earth Data performed the remaining packer testing and geophysical logging of MW-06 through MW-20, which were subsequently added to the scope of work (Change Orders #5 and #6). These geophysical activities were conducted during separate field events between May and December 2001 in conjunction with the drilling of these wells. The packer test summary table is included as Table 3-1. Per PADEP, on-site gas chromatograph (GC) testing was added to the geophysical scope for Earth Data. Monitoring wells MW-05 and MW-08 through MW-20 were sampled for a range of volatile organic constituents. Figure 3-2a-u summarizes the GC analytical data from the samples collected during the packer testing.

The geophysical survey reports prepared by Eichelbergers and Earth Data are included in Appendix B, and the reports describing field activities, results of the logging, and video logging forms are included in Appendix C.

3.2 Subsurface Soil Sampling

The following sections detail the soil sampling that occurred as part of the investigative activities. A soil sample and monitoring well location map is included as Figure 3-1. Analytical data summaries are included in Appendix D.

Exterior Chem-Fab Site

AMEC and its subcontractor, B&F Environmental Drilling of Blue Anchor, New Jersey, performed the initial subsurface soil investigation at the site from May 1, 2001 through May 4, 2001. The subsurface soil investigation was performed by drilling 20 soil borings throughout the Chem-Fab facility site and the adjacent Extra Space Storage of Doylestown property, using a hollow stem auger and split spoon samplers. The original scope of work indicated that 23 soil borings would be installed in areas of concern identified in the Interim Final Report prepared by AMEC. Three of the borings were to be located on the adjacent Henning's property; however, access was not obtained at this time.

AMEC obtained soil samples from representative areas of concern on the Chem-Fab Site and the adjacent Doylestown Extra Space Storage property. During field activities, each soil boring was continuously screened using a photoionization detector (PID). The results were recorded in the field logbook. The results of this screening are presented on the boring logs found in Appendix E.

Samples were collected from two areas within the borings, biased in the field to elevated PID readings and the soil/water or bedrock/soil interface. A total of 35 soil samples were collected from the 20 soil borings and designated by the location and then by the sample number (i.e., B-01-01). Two soil samples were collected from each boring location with the exception of B-09, B-13, B-15, B-19, and B-20, where only one sample was collected from each due to low PID readings and/or low recovery. One duplicate sample was collected (B-08-02); this sample was a duplicate of B-08-01.

On September 24 to September 27, 2001, additional subsurface soil investigations were performed to investigate a portion of the interior area of the former Chem-Fab warehouse building and the swale area located on the Extra Space Storage property.

Interior Chem-Fab Site

AMEC installed a 10-foot grid, approximately 25 feet by 65 feet, over the interior of the Chem-Fab former warehouse, and conducted geoprobe soil sampling based on this grid system. Fifteen soil borings, identified as IB-01 to IB-15, were drilled to a depth of 8’4” to 11’4”, based on refusal. The concrete floor was initially jackhammered, and the concrete was repaired after sampling was complete. The borings were field screened continuously using a PID and examined for obvious signs of staining and odor. The screening results and soil characteristics were recorded in the field log book. Samples were collected from two areas within the borings, biased in the field to elevated PID readings and the bedrock/soil interface. Thirty-two soil samples (two per boring plus two duplicate samples) were collected for laboratory analysis based on PADEP sampling guidelines. Samples IB-16-01 and IB-16-02 are duplicates of IB-12-01 and IB-12-02, respectively. During soil sampling activities, the borings remained open briefly to observe if water entered the boring. Where encountered, water was collected into glass containers for visual review. Several samples were yellow in color. No aqueous samples were submitted for analysis.

Exterior Extra Space Property Swale

Based on surficial water contamination observed during the field activities, AMEC conducted geoprobe sampling in an area of concern on the Extra Space Storage property adjacent to the surface swale, in the southwest corner of the property, which exhibited yellow water and a sheen. Preliminary gas chromatograph results, collected at an earlier date when yellow water was first observed, indicated the area had elevated concentrations of volatiles. The current soil sampling program was implemented in an attempt to determine the source of the yellow water and contamination in the surface swale. A total of 16 soil borings (designated as XB-01 to XB-16) were subsequently drilled in this area of concern. Samples were collected from two areas within the borings, biased in the field to elevated PID readings and the soil/water or bedrock/soil interface. AMEC collected 32 samples for laboratory analysis based on PADEP sampling guidelines. During the soil sampling activities, as with the interior of the Chem-Fab building, the borings remained open and where water was encountered, grab water containers were collected for visual observation. Many of the containers were yellow in color. However, no distinct pattern was identified from the containers/locations.

The soil samples were collected in accordance with AMEC SOP FP-C-2, “Soil Sampling.” The down-hole equipment was decontaminated between each sample in accordance with AMEC SOP FP-D-5, “Equipment Decontamination.” Drill cuttings were containerized in 55-gallon drums, labeled, and staged in the IDW/waste staging area pending characterization for offsite disposal by the IDW subcontractor. A log of events occurring in the field was kept in accordance with AMEC SOP FP-F-5, "Logbooks." Soil boring logs are contained in Appendix E. The soil boring locations are shown on Figure 3-1. Table 3-2 summarizes the subsurface soil sampling program conducted at the site. Soil samples were placed in laboratory-supplied bottleware; sent to Severn Trent Laboratories, Inc., of Pittsburgh, Pennsylvania, a PADEP-contract laboratory; and analyzed for VOCs by USEPA Method 5035/8260, SVOCs by USEPA Method 8270, TAL Metals by USEPA Method 6010, and cyanide and hexavalent and total chromium. Recordkeeping, sample labeling, chain-of-custody information, sample handling, storage, and shipment were performed in accordance with AMEC SOP FP-F-6, “Recordkeeping, Sample Labeling, and Chain of Custody,” and FP-F-7, “Sample

Handling, Storage, and Shipping." USEPA Method 5035 was utilized for sample collection and preservation for the VOCs, and Method 8260 was used for the laboratory analysis. Copies of the chain-of-custody forms for the subsurface soil samples collected during the soil-boring program are contained in Appendix F.

3.3 Surface Water and Sediment Sampling

During the initial investigation, yellow water was observed in the swale on the Extra Space Storage property. Per PADEP, AMEC personnel collected samples of the sediment and surface water. A total of four surface water and four sediment samples were collected from the drainage swale: one set upgradient, two in the area of concern, and one set downgradient. Geoprobe sampling, as discussed in the previous section, was conducted in this area to further delineate the yellow standing water. Table 3-3 summarizes the surface water and sediment sampling. Analytical data summaries are included in Appendix D.

Samples were placed in laboratory-supplied bottleware; sent to Severn Trent Laboratories, Inc., of Pittsburgh, Pennsylvania, a PADEP-contract laboratory; and analyzed for VOCs by USEPA Method 5035/8260, SVOCs by USEPA Method 8270, TAL Metals by USEPA Method 6010, and cyanide and hexavalent and total chromium. Recordkeeping, sample labeling, chain-of-custody information, sample handling, storage, and shipment were performed in accordance with AMEC SOP FP-F-6, "Recordkeeping, Sample Labeling, and Chain of Custody," and FP-F-7, "Sample Handling, Storage, and Shipping." Copies of the chain-of-custody forms for the samples collected during the surface water and sediment sampling program are contained in Appendix F.

3.4 Groundwater Investigation

AMEC conducted a multi-phased groundwater investigation to determine if site contaminants were migrating into groundwater. This investigation included the installation, sampling, and analysis of monitoring wells as well as sampling and analysis of an onsite well. Initially, five wells were to be installed as part of this investigation: however, based on site conditions, the number of wells was increased to 20. These wells were installed in phases from April 2001 through December 2001.

Throughout this phase of the investigation, five monitoring wells were installed on the Chem-Fab Site, ten monitoring wells were installed on the Extra Space Storage of Doylestown property, two monitoring wells were installed on the Bucks County Sewer & Water Authority property, two monitoring wells were installed on the adjacent Henning's property, and one monitoring well was installed on the adjacent Tilley's property. Analytical data summaries are included in Appendix D. The following provides a summary of the monitoring wells installed, their locations, and dates of installation.

Wells Installed between 4/23/01 – 5/30/01

MW-01	Installed on Chem-Fab SIte
MW-02	Installed on Chem-Fab Site
MW-03	Installed on Chem-Fab Site
MW-04	Installed on Extra Space Storage property

Wells Installed between 5/23/01 – 5/30/01

MW-06	Installed on Chem-Fab Site
MW-07	Installed on Chem-Fab Site

Wells Installed between 6/12/01 – 6/20/01

MW-02	Installed 4/01 - Reopened due to cave in
MW-05	Installed on Extra Space Storage property

MW-08	Installed on Extra Space Storage property
MW-09	Installed on Extra Space Storage property
MW-10	Installed on Extra Space Storage property

Wells Installed between 8/13 - 8/29/01

MW-11	Installed on Extra Space Storage property
MW-12	Installed on Extra Space Storage property
MW-13	Installed on Extra Space Storage property
MW-14	Installed on Extra Space Storage property

Wells Installed between 12/10/01 - 12/20/01

MW-15	Installed on Extra Space Storage property
MW-16	Installed on Tilley Fire Equipment
MW-17	Installed on Henning's property
MW-18	Installed on Henning's property
MW-19	Installed on Bucks County Water and Sewer Authority property
MW-20	Installed on Bucks County Water and Sewer Authority property

The next section details the installation activities for the 20 wells by period of installation (including the existing on site well DW-01). The monitoring well construction details are included in Table 3-4.

3.4.1 Monitoring Well Installation

Well Installations between 4/23/01-5/30/01

Initially, a total of five wells were to be installed as part of the investigation; three on the Chem-Fab site, one on the Henning's property and one on the Extra Space Storage of Doylestown property. On April 23, 2001 through April 25, 2001, B&F Environmental Drilling of Blue Anchor, New Jersey, and its subcontractor Sensenig & Weaver, Inc. of Denver, Pennsylvania, drilled three monitoring wells (MW-01, MW-02, and MW-03) on the Chem-Fab Site and one monitoring well (MW-04) on the adjacent Extra Space Storage property. A fifth monitoring well was to be installed on the adjacent Henning's property; however, due to access issues, this well was not installed during this field event.

During the geophysical portion of the installation of the onsite wells and the Extra Space Storage well, water in some of the wells changed from clear to yellow. A grab sample of the water revealed numerous constituents, including hexavalent chromium at concentrations in excess of PADEP cleanup levels.

Access to the Henning's property was to be obtained and, due to site conditions, a track-mounted rig was brought in for the monitoring well installation. However, once mobilized, it was determined that access had not been obtained. Thus, AMEC and PADEP proceeded to delineate the contamination around MW-02 on the Chem-Fab Site. A nested well (two wells, one hole) was to be installed; however, during installation, PADEP and AMEC decided to cluster the wells. On May 23 and 24, 2001, the track-mounted drill rig was utilized to install MW-06 and MW-07 on the Chem-Fab Site, clustered around MW-02.

On June 20, 2001, MW-01, MW-03, MW-04, MW-06, MW-07, and DW-01 were sampled. Sampling results are explained in detail in Section 3.3.2; however, based on the analytical results more wells were added to the investigation in an attempt to further delineate the vertical and horizontal extent of contamination. It should be noted that

MW-02 was not sampled due to a cave-in of the bottom of the well. The well was scheduled for cleaning during the next well installation. In addition, a portable GC unit was added to the packer testing for the remaining well installation activities.

Well Installations between 6/13/01-6/20/01

Based on the analytical results from the first series of wells, three additional wells were added to the scope. The three wells (MW-08, MW-09, and MW-10) were installed on the Extra Space Storage property when AMEC personnel and its subcontractors, B&F Environmental Drilling and Sensenig & Weaver, mobilized to the field on June 13, 2001. The well originally proposed for installation on the Henning's property during the April mobilization, but postponed due to access, was moved to the Extra Space property and installed at this time. MW-05 was added as a cluster well, next to MW-04, on the Extra Space Storage property. MW-02 was cleaned out during this phase of the investigation. Geophysical logging and video logging were performed as part of the installation activities, as was GC testing, utilizing a portable GC unit during packer testing. Initial GC results indicated that the extent of contamination had not been reached, which was confirmed by laboratory data collected from the five wells (MW-08 through MW-10, MW-05, and MW-02) sampled on July 5, 2001. Analytical results are discussed in further detail in Section 3.3.2.

Well Installations between 8/13/01-8/29/01

Four additional monitoring wells were installed on the Extra Space Storage property to further delineate both the horizontal and vertical extent of contamination. On August 13, 2001, AMEC, PADEP, B&F Environmental Drilling, and Sensenig & Weaver mobilized to the site and installed MW-11 through MW-14. MW-11, MW-12, and MW-13 were clustered in proximity to MW-10, MW-8, and MW-9, respectively. MW-14 was installed in a downgradient direction, toward the southwest edge of the Extra Space Storage property. As with each of the previous installations, geophysical logging and video logging were performed as part of the installation activities, as was GC testing, utilizing a portable GC unit during packer testing.

On October 23, 2001, all 14 of the monitoring wells installed to date and the domestic well were sampled. Based on the portable GC unit results and the laboratory data from this round of sampling, additional wells were proposed for installation to delineate the plume migration both horizontally and vertically.

Well Installations between 12/10/01-12/20/01

Six additional wells were to be installed as part of this phase of the investigation. One well, MW-15, was added as a cluster well around MW-14. MW-16 was added to the adjacent property to the east, Tilley Fire Equipment. MW-17 and MW-18 were installed on the Henning’s property to the west along Cooks Run, and MW-19 and MW-20 were installed on the Bucks County Water and Sewer property to the south.

On December 10, 2001, AMEC, PADEP, B&F Environmental Drilling, and Sensenig & Weaver drilled the six additional wells. The geophysical subcontractor, Earth Data, was also onsite to perform packer testing, GC data results, and geophysical logging on the wells. Copies of the GC results can be found on Figures 3-2a-u.

3.4.2 Monitoring Well Sampling

Sampling dates for the 21 wells varied based upon installation. The following is a breakdown of the sampling activities for the 21 wells by period of installation. The groundwater samples were identified by the well number (i.e., MW-01) and then by the sampling round (i.e., MW-01-01). See Table 3-5 for a summary of sampling activities.

Week of 6/20/01

AMEC and PADEP personnel mobilized to the site on June 20, 2001 to begin monitoring well sampling activities. Monitoring wells MW-01, MW-03, and MW-04 and the domestic well DW were sampled. Monitoring well MW-02 was skipped due to a cave-in of materials in the bottom of the well. This well was rescheduled for sampling at a later date after the well was cleaned out.

Week of 7/05/01

AMEC and PADEP personnel mobilized to the site on July 7, 2001 to begin monitoring well sampling activities. Sampling activities were to be performed on the newly installed wells and MW-02, which was cleaned out. During this sampling event, monitoring wells MW-02, MW-05, MW-08, MW-09, and MW-10 were sampled.

Week of 9/20/01

AMEC and PADEP personnel mobilized to the site on September 9, 2001 to perform monitoring well sampling activities. The last set of monitoring wells installed to date, MW-11, MW-12, MW-13 and MW-14, were sampled as part of this sampling event. Following the groundwater sampling for these wells, AMEC and PADEP decided to sample all the wells installed to date during the next sampling event.

Week of 10/23/01

AMEC and PADEP personnel mobilized to the site on October 23, 2001 to perform monitoring well sampling activities. All of the wells installed to date, monitoring wells MW-01 through MW-14, were sampled. In addition, the domestic well DW was sampled and labeled DW-02 (02-second round, this well).

Week of 1/07/02

AMEC and PADEP personnel mobilized to the site on January 7, 2002 to sample all of the monitoring wells installed to date, which included MW-01 through MW-16 and MW-18 through MW-20 as well as the domestic well DW. MW-17 was skipped at this time because it was not completed as a FLUTe well. Sampling of MW-17 was to be performed during the next sampling round.

During each sampling event, the wells were purged using the USEPA low-flow method. The pH, temperature, conductivity, oxidation reduction potential, and dissolved oxygen concentration were recorded at regular time intervals. A groundwater sample was collected after the readings of the parameters stabilized (within 5% of the previous reading). Groundwater samples were collected in an attempt to evaluate the groundwater conditions beneath the site. Purge water was collected and placed in the tank onsite for IDW disposal. In addition, personal protective equipment was placed in the appropriate drums for IDW disposal.

The groundwater samples were placed under proper chain of custody, and shipped to Severn Trent Laboratories, Inc., of Pittsburgh, Pennsylvania, a PADEP-contract laboratory; and analyzed for VOCs by USEPA Method 5035/8260, SVOCs by USEPA Method 8270, TAL Metals by USEPA Method 6010, and cyanide and total chromium. Metals analysis included both filtered and unfiltered. In addition, samples were couriered to Lancaster Laboratories of Lancaster, Pennsylvania, a PADEP-contract laboratory and analyzed for hexavalent chromium. For sampling activities conducted during the week of 1/7/02, Lancaster Laboratories was selected to analyze the samples for all the constituents. Copies of the chain-of-custody forms are contained in Appendix F. Table 3-4 presents a summary of the groundwater-sampling program for the site.

Equipment decontamination was conducted according to AMEC SOP FP-D-5, "Equipment Decontamination." A log of events occurring in the field was kept in accordance with AMEC SOP FP-F-5, "Logbooks." Recordkeeping, sample labeling, chain-of-custody information, sample handling, storage, and shipment were performed in accordance with AMEC SOPs FP-F-6 and FP-F-7.

3.4.3 Installation and Geophysical Testing Results

This section provides information on the overall drilling depths and both site and geophysical data, which resulted in the overall installed depths for the wells on site. Figures 3-3a through 3-3t summarize this data.

Monitoring well MW-01 was cased off to 20 feet (into bedrock), drilled to 50 feet and no water was encountered. PADEP Hydrogeologist, Bruce McClain decided to drill to 75 feet and if no water was encountered to back the well off to 55 feet and install. No water was encountered and the well was backed off to 55 feet for final installation. No packer testing was conducted since no water was encountered. Static water levels for the first three rounds are indicated on the figures and show a decreasing trend, possibly indicative of drought conditions. Monitoring well MW-02 was drilled to an overall depth of 75 feet (with 25 foot intervals for packer testing) and water was encountered at each zone. Two samples of the water were sent off-site for analysis. No portable GC unit was on site at this time. Based on this data and geophysical data including the video logging, indicating possible fracture zones, receiving zones, changes in lithology, etc. the well was installed at 75 feet. Monitoring well MW-03 was drilled to a depth of 75 feet and then based on video logging and geophysical logging was backed off to 50 feet. No water was encountered during the installation activities, therefore no packer testing was conducted. Monitoring well MW-04 was similar to MW-03 in that no water was encountered. Based on the geophysical and video logging of this well, it was installed to 75 feet. MW-05 was installed next to MW-04 as a shallow well and based on the video logging and geophysical logging of MW-04, MW-05 was installed to a depth of 37 feet. No water was encountered during drilling and no packer testing was conducted. Static water levels for the first three rounds of sampling show a decreasing trend. It should be noted that in most of these wells, no water was encountered during drilling, possibly due to the air rotary rig installation, the fracturing or other geologic conditions. Static water levels for most of these wells is shallow at approximately 5 feet.

In order to screen the zones of interest, the wells were cased off into bedrock at 20 feet, then 4” PVC slotted screen sections with solid risers were placed in the zones of interest with sand packs extending where needed to include the full zones where, based on geophysical and video data, the groundwater and/or contamination was expected to be.

MW-06 and MW-07 were installed directly next to MW-02 and were installed at 125 and 37 feet, respectively. No logging of materials was conducted, based on the proximity to MW-02. Packer testing was conducted on MW-06 and elevated concentrations were found. Monitoring wells MW-08, MW-09 and MW-10 were drilled to and installed at 75 feet. The installation depth was based on geophysical data, video logging and the portable GC results indicating contamination is the zones. During drilling, water levels were considerably lower than actual water conditions observed during sampling.

Monitoring well MW-11 was drilled to 225 feet and based on the video, drilling, packer testing, geophysical testing and GC results, the well was installed at 195 feet. MW-12 was a shallow well, installed at 37 feet around an existing well to monitor the shallow water conditions. MW-13 was drilled to 225 feet and packer tested for much of the zones. Based on the geophysical data, video logging indicating fractures, and the GC results the final well depth was 195 feet. As with the other wells the depth to water encountered during drilling was not indicative of groundwater conditions. It should be noted that this well had 75 feet of outer steel casing installed. The well adjacent to it MW-09, extended to 75 feet and it was decided to case this off, to get true conditions beneath that zone. MW-14 was initially drilled to a depth of 215 feet where a substantial groundwater flow was encountered, estimated to be over 70 gpm. Based on this information and the geophysical results, the well was grouted and installed at 178 feet. MW-15 was installed next to MW-14 and based on the information from MW-14 and other wells in the area, MW-15 was installed at 80 feet. The screened interval and sand pack for this well was extended in an attempt to collect water from what appeared to be the dominant fractures or receiving zones.

MW-16 was drilled to 75 feet and installed at 70 feet. This was a lateral gradient well and the depth was selected based on data from the on-site wells MW-02, MW-06 and MW-07. This zone appeared to be the zone most likely to have contamination from these wells, if found. MW-17 is the flute well. This well was drilled to a depth of 150 feet and completed at 125 feet with three zones for sampling. The flute design allows for a 10 foot section to be “screened” for collection. The three zones were 30-40 feet, 80-90 feet and 110-120 feet. The zones were selected based on the video logging, geophysical logging, GC analysis and drilling activities. During the installation of this well, the nearby creek, appeared to be receiving the water forced out by the air rotary rig at deeper depths. MW-18 was drilled to 115 feet and installed at 73 feet based on the geophysical data, video log and GC results. MW-19 was drilled to a depth of 140 feet and completed at a depth of 115 feet based on data collected. MW-20 was initially drilled to a depth of 150 feet and based on data, the video log and visual observations of the “yellow” water, the well was installed at 75 feet.

4.0 SITE GEOLOGIC/HYDROGEOLOGIC CHARACTERIZATION

This section presents the findings of the site geologic characterization program and includes a detailed discussion of the physical properties of the unconsolidated soil underlying the study area.

4.1 Groundwater Flow

Groundwater contours for the subject property were determined based on information obtained from the site survey. Based on the ground surface elevation and groundwater elevation, the groundwater contours and the presumed groundwater flow direction were determined. It should be noted that the wells were screened in different intervals and that the connectivity of the fractured bedrock beneath the site is unclear. The groundwater contours and presumed groundwater flow direction are included on Figure 4-1. Figure 4-1a through Figure 4-1c represent groundwater elevations above mean sea level (amsl) for each of the rounds of sampling, along with a presumed groundwater flow direction.

4.2 Geologic Cross Sections

The bedrock lithology encountered at the site consists primarily of sandstone, siltstone, and shale of the Stockton formation. Geologic cross sections (A-A’, B-B’, and C-C’) were prepared for selected monitoring well locations. The cross section location map is included as Figure 4-2.

Cross section A-A’ is presented as Figure 4-2a. Cross section A-A’ depicts the profiles for monitoring wells MW-1, MW-2, MW-4, MW-5, MW-6, MW-7, MW-10, MW-11, and MW-19. The cross section spans the patched asphalt area and the former tank farm area on the Chem-Fab property, the Extra Space Storage property, and the edge of the Buck County Water & Sewer Authority property. Bedrock lithology encountered in this series of wells included weathered shale with clayey sediments, sandstone, banded shale and sandstone. The shale encountered varied in color from red to reddish brown, gray and dark gray. The sandstone varied from tan to yellow and brown.

Cross section B-B’ depicts the profiles of MW-2, MW-3, MW-6, MW-7, MW-8, MW-12, and MW-17 spanning the former tank farm, the former UST area, and then continuing northwest from the Chem-Fab property to the adjacent Henning’s property. The cross section B-B is illustrated on Figure 4-2b. Bedrock lithology encountered in this series of wells included weathered shale with clayey sediments, sandstone, banded shale, and sandstone. The shale encountered varied in color from red to reddish brown, gray and dark gray. The sandstone varied from tan to yellow and brown.

Cross section C-C’, illustrated on Figure 4-2c, depicts the profiles for the domestic well (DW), MW-3, MW-10, MW-11, MW-14, and MW-15. The cross section runs from the northeast edge of the Chem-Fab property to the southwestern edge of the Extra Space Storage property. Bedrock lithology encountered in this series of wells included weathered shale with clayey sediments, sandstone, banded shale, and sandstone. The shale encountered varied in color from red to reddish brown, gray and dark gray. The sandstone varied from tan to yellow and brown.

Geophysical summary logs containing the video logging, caliper, resistivity, gamma, temperature, and conductivity are included in Appendix C.

5.0 ANALYTICAL CHARACTERIZATION RESULTS

Section 5 presents a discussion of the results of the soil and groundwater sampling program conducted at the subject site, as well as the laboratory reporting limits and limitations.

5.1 Subsurface Soil Sampling Results

AMEC and the drilling subcontractor, B&F Environmental Drilling, conducted subsurface soil investigations on the Chem-Fab property and adjacent Extra Space Storage property between May and December 2001. The areas of this investigation included the exterior areas surrounding the former warehouse onsite (extending onto the Extra Space Storage property), the interior of the former warehouse, and the swale area located on the Extra Space Storage property.

Soil boring samples were submitted for analysis of VOCs by USEPA Method 8260, SVOCs by USEPA Method 8270, and TAL metals by USEPA Method 6010. These samples were collected using the procedures discussed in Section 3.0. The results were compared to the Act 2 Standards contained in Pennsylvania Bulletin, Vol. 27, No. 33, August 16, 1997, Appendix A, Table 3A, Non-Residential Medium Specific Concentrations (MSCs) for Organic Regulated Substances in Soil from 0 to 2 feet or 2 to 15 feet; Table 4, Non-Residential MSCs for Inorganic Regulated Substances in Soil, 0 to 2 feet and 2 to 15 feet; Table 3B, MSCs for Organic Regulated Substances in Soil, Soil to Groundwater Values and Table 4B, MSCs for Inorganic Regulated Substances in Soil, Soil to Groundwater Values. These results are presented in Tables 5-1a through 5-1c. The laboratory analytical data reports for the soil samples are contained in Appendix D. The following is a description of the soil sampling results for each area investigated.

Exterior Chem-Fab Site

Of the 35 soil samples collected, only soil samples B-01-01, B03-01, B-03-02, B-04-01, B-04-02, B-05-02, B-06-01, and B-06-02 reported volatile organic constituents above state cleanup levels. Soil boring B-01 was collected from the 2-4 foot interval, soil boring B-03 from the 4-6 and 10-12 foot intervals, soil boring B-04 from the 6-8 and 10-12 foot intervals, soil boring B-05 from the 8-10 foot interval, and soil boring B-06 from the 2-4 and 6-8 foot intervals. Volatile organic constituents were also detected in many of the borings; however, only 11 borings had constituents that exceeded their respective cleanup standard. Of these, trichloroethene, tetrachloroethene, and 1,2-dichloroethene were reported above cleanup standards. Soil samples B-01-01, B-03-01, B-03-02, B-04-02, and B-05-02 contained tetrachloroethene at concentrations ranging from 680 ug/kg in B-05-02 to 190,000 ug/kg in B-03-01. Trichloroethene was reported in soil samples B-01-01, B-03-01, B-03-02, B-04-01, B-04-02, B-05-02, B-06-01, B-06-02, B-08-01, B-08-02, and B-18-02 at concentrations ranging from 210J ug/kg at B-05-02 to 4,000,000 ug/kg at B-06-02. 1,2-Dichloroethene was reported in soil sample B-04-02 at 7200 ug/kg. The cleanup standards for tetrachloroethene, trichloroethene, and 1,2-dichloroethene are 500 ug/kg, 500 ug/kg, and 7,000 ug/kg, respectively.

Several semi-volatile organics were detected in the soil samples at concentrations exceeding the Method Detection Limits (MDLs); however, no samples were reported above their respective Act 2 standards. Numerous TAL Metals were detected in the soil samples at concentrations exceeding the MDL; however, lead and hexavalent chromium were the two constituents detected over Act 2 cleanup standards. Lead and hexavalent chromium were detected in B-03-02 at 10-12 feet at concentrations of 521 mg/kg and 568 mg/kg, respectively. The cleanup standard for lead is 450 mg/kg and the standard for chromium is 190 mg/kg. Hexavalent chromium was also detected above cleanup standards in B-03-01 at 243 mg/kg.

This data and the initial data collected from the first round of sampling suggest that soil contamination exists throughout the soils zone in and around the former warehouse building in the vicinity of the former tank farm and extends onto the Extra Space Storage property.

It should be noted that the laboratory method detection limit exceeded the Direct Contact Value or Soil to Groundwater value for several volatile organics and semi-volatile organics, although the constituents were reported as non-detect.

Interior Chem-Fab Site

Thirty-two soil samples (two per boring plus two duplicate samples) were collected and submitted for laboratory analysis. Five samples (IB-01-02, IB-06-01, IB-12-01, IB-12-02, and IB-16-01) reported constituents above Act 2 cleanup standards. No SVOC constituents were detected above cleanup standards. Although numerous TAL metals were reported, none exceeded their respective cleanup standard for the interior samples. Several volatile organic constituents were detected; however, only two volatile organic constituents were detected above cleanup standards: trichloroethene and tetrachloroethene. Trichloroethene was detected in samples IB-01-02, IB-06-01, IB12-01 and IB-16-01 at 1,200 ug/kg, 3,700 ug/kg, 610 ug/kg, and 960 ug/kg, respectively, above the cleanup standard of 500 ug/kg. Tetrachloroethene was detected in IB-06-01 at 1,400 ug/kg above the cleanup standard of 500 ug/kg.

Exterior Extra Space Property Swale

Based on surficial contamination observed during the field activities, 16 soil borings (designated as XB-01 to XB-16) were drilled in this area. No SVOC constituents were detected above cleanup standards. Although numerous TAL metals were reported, none exceeded their respective cleanup standard for the samples. Several volatile organic constituents were detected; however, only trichloroethene was detected in sample XB-03-01 at 920 ug/kg, above the cleanup standard of 500 ug/kg.

In addition, a total of four surface water/sediment samples (identified as XSW and XSD) were collected from the drainage swale. These samples were compared to the Fish and Aquatic Life Criteria cleanup standards. Regarding the surface water samples, no SVOC constituents were detected above cleanup standards and although several volatile organics were reported, none exceeded their respective cleanup standard for the samples. Numerous TAL Metals were reported in the samples; however, only chromium (total), copper, lead, manganese, nickel, and hexavalent chromium were reported above their respective cleanup standards. Copper was reported above the cleanup standard of 7.07 ug/l for total metals for all four samples at 7.9B ug/l, 14.4B ug/l, 14.4B ug/l, and 15.6 B ug/l. Dissolved copper was detected in three of the four samples at 12B ug/l, 13.6 B ug/l, and 15.3B ug/l. Lead was reported in two total samples at 2.8B ug/l and 2.1B ug/l and in one dissolved at 3.1 ug/l, above the cleanup standard of 1.86 ug/l. Manganese was reported above its cleanup standard (1ug/l) for all four samples for both dissolved and totals. Total manganese was reported at 9B ug/l, 9.9b ug/l, 2.8B ug/l, and 8B ug/l. Dissolved manganese was reported at 3.1B ug/l, 3.1 ug/l, 1.2B ug/l, and 1.2B ug/l. Nickel was detected in two samples for both dissolved and totals. Dissolved nickel was reported at 57.2 ug/l and total nickel was reported at 59.6 ug/l and 41.9 ug/l, above the cleanup standard of 41.1 ug/l. Hexavalent chromium was reported above cleanup standards for all four samples at 37.2 ug/l, 392 ug/l, 1,730 ug/l, and 1,470 ug/l, with a cleanup standard of 10 ug/l.

Sediment samples were compared to the USEPA Apparent Effects Threshold and Effects Range Median AQ-ERM standards. Regarding the sediment samples, no SVOC constituents were detected above cleanup standards and although several volatile organics were reported, none exceeded their respective cleanup standard for the samples. Numerous TAL Metals were reported in the samples; however, only chromium (total) and nickel were reported above their respective cleanup standards of 270 mg/kg and 51.6 mg/kg. Chromium was detected in three of the samples at concentrations of 278e mg/kg, 409E mg/kg, and 447B mg/kg. Nickel was detected in three of the samples at concentrations of 83.9N mg/kg, 151N mg/kg, and 134 mg/kg. These results are presented in Tables 5-2a through 5-2c.

It should be noted that the laboratory method detection limit exceeded the Direct Contact Value or Soil to Groundwater value for several volatile organics and semi-volatile organics although the constituents were reported as non-detect.

5.2 Groundwater Sampling Results

The following sections present the results of the groundwater investigation, which included the sampling and analysis of 19 monitoring wells and the onsite domestic well. The wells were sampled at different times during the investigation, and this section discusses the sampling conducted per well for the number of sampling events conducted on that particular well. These results are presented in Tables 5-3a through 5-3c. The laboratory analytical data reports for the soil samples are contained in Appendix D. Three representative constituents were selected for mapping of the concentrations. Figures 5-1a and 5-1b represent hexavalent concentrations per depth zone. Figures 5-2a and 5-2b represent trichloroethene concentrations by zone, and Figures 5-3a and 5-3b represent tetrachloroethene by zone.

5.2.1 Monitoring Well Sampling Results

Between June 2001 and January 2002, AMEC conducted a groundwater investigation of the Chem-Fab property and adjacent properties. Samples were collected to evaluate the groundwater conditions beneath the site. These groundwater samples were identified by the well number and then by the sampling round (i.e., MW-01-01). The wells were sampled during three separate sampling events, based on installation dates. MW-01, MW-04, MW-06, MW-07, and the domestic well were sampled between June 20 and 22, 2001; MW-02, MW-05, MW-08, MW-09, and MW-10 were sampled between July 5 and 6, 2001; MW-11 through MW-14 were sampled on September 20 and 21, 2001. The sampling of these 14 wells is designated as the first sampling event.

The first 14 wells were sampled again between September 23 and 29, 2001 (second sampling event). On January 7 through January 14, 2002, five of the remaining six wells (MW-15, MW-16, MW-18, MW-19, and MW-20) were sampled for the first time. During this field event, monitoring wells 1 through 14 were sampled again (third sampling event).

MW-01

Monitoring well MW-01 was sampled during each of the sampling events listed above. No semivolatile organic constituents were detected in the groundwater samples for the three rounds of sampling. Numerous TAL Metals were reported in the samples for each round; however, only iron and manganese were reported above their respective cleanup standards for the well. Iron was reported in the first round of sampling at 515 ug/l, above the cleanup standard of 300 ug/l. The next two rounds were below the cleanup standard (both dissolved and total). Manganese was reported in round one and two above Act 2 Cleanup standards at 2,350 ug/l (round one - total), 103 ug/l, and 95.6 ug/l (round two - dissolved and total), respectively, with a cleanup standard of 50 ug/l.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, tetrachloroethene, and trichloroethene were detected above cleanup standards for all three rounds. 1,1-Dichloroethene was detected at 9.4 ug/l, 13 ug/l, and 12 ug/l, respectively, above the cleanup standard of 7 ug/l. Tetrachloroethene was detected at 18 ug/l, 9.5 ug/l, and 15 ug/l, respectively, above the cleanup standard of 5 ug/l; trichloroethene was detected at 36 ug/l. 74 ug/l, and 59 ug/l, respectively, above the cleanup standard of 5 ug/l.

MW-02

Monitoring well MW-02 was sampled during each of the sampling events listed above. No semivolatile organic constituents were detected above the cleanup standards in the well for the three rounds of sampling. Numerous TAL Metals were reported in the samples for each round; however, only antimony, chromium (total), manganese, thallium, and hexavalent chromium were reported above their respective cleanup standards for the well. Antimony was reported above the cleanup standard of 6 ug/l in the third round for dissolved metals, at a concentration of 53.5J ug/l. Manganese was reported above its cleanup standard (50ug/l) at a concentration of 82.4 ug/l for round one total metals. Thallium was reported above its cleanup standard of 2 ug/l at a concentration of 8.7 ug/l and 10.3 ug/l total metals for rounds one and two, respectively. Both dissolved and total chromium was detected above cleanup standards for all three rounds. Total chromium was reported at 21,600 ug/l, 16,600E ug/l, and 11,500 ug/l for the three rounds. Dissolved results were 22,200 ug/l, 16,700E ug/l, and 10,500 ug/l for the three rounds. Hexavalent chromium was reported above cleanup standards at 19,800 ug/l, 15,300 ug/l, and 11, 500 ug/l for the three rounds (total). Based on the chromium and hexavalent chromium total results, it appears that most of the chromium present is hexavalent.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, trichloroethene, and vinyl chloride were detected above cleanup standards. 1,1-Dichloroethene was detected at 23J ug/l, 13J ug/l, and 22 ug/l, respectively, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was analyzed in round three only and was reported above the cleanup standard of 70 ug/l at 250 ug/l. Methylene chloride was detected in all three rounds at 150 ug/l, 98 ug/l, and 91 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 620 ug/l, 140 ug/l, and 200 ug/l, respectively, above the cleanup standard of 5 ug/l; trichloroethene was detected at 1,700 ug/l. 1,000 ug/l, and 810 ug/l, respectively, above the cleanup standard of 5 ug/l. Vinyl chloride was detected during round three at 5 ug/l, above the cleanup standard of 2 ug/l.

MW-03

Monitoring well MW-03 was sampled during each of the sampling events listed above. Monitoring well MW-03 was also used for duplicate sampling each round due to the number of constituents detected. As indicated on the tables, the samples designated with a letter “A” or “B” represent the duplicates and are not discussed here.

No semivolatile organic constituents were detected above the cleanup standards in the well for the three rounds of sampling. Most TAL Metals were reported in the samples for each round. Aluminum, antimony, arsenic, beryllium, chromium (total), manganese, nickel, thallium, and hexavalent chromium were reported above their respective cleanup standards for this well. Aluminum was reported above the cleanup standard of 200 ug/l in the second and third rounds for dissolved and total metals at concentrations of 307 ug/l, 334 ug/l (round two, dissolved and total), and 264 ug/l and 301 ug/l (round three-dissolved and total). Antimony was reported above the cleanup standard of 6 ug/l in the third round for dissolved metals, at a concentration of 581 ug/l. Arsenic was reported in both dissolved and total metals above the cleanup standard of 50 ug/l in round two at concentrations of 101 ug/l and 104 ug/l, respectively. In round three, the dissolved metal was reported above the cleanup standard at 201 ug/l. Beryllium was reported in round two in both the dissolved and total metals. Concentrations of 4.3BE ug/l and 4.4BE ug/l were reported above the cleanup standard of 4 ug/l. Manganese was reported above its cleanup standard (50 ug/l) at a concentration of 2,920 ug/l for round one total metals and was reported in both dissolved and totals above cleanup standards for rounds two and three at concentrations of 2,500 ug/l, 2,510 ug/l, and 3,730 ug/l and 3,930 ug/l. Nickel was reported above its cleanup standard (100 ug/l) at a concentration of 1,380 ug/l for round one total metals and was reported in both dissolved and totals above cleanup standards for round two and three at concentrations of 428E ug/l, 456E ug/l, 437 ug/l, and 438 ug/l, respectively. Thallium was reported above its cleanup standard of 2 ug/l at a concentration of 32.9 ug/l total metals for round one and at 56.2 ug/l and 63.4 ug/l in round two. Round three reported the dissolved thallium at 17.5J ug/l. Chromium was detected above cleanup standards for all three rounds, both dissolved and total. Total chromium was reported at 112,000 ug/l, 166,000 ug/l, and 129,000 ug/l for the three rounds. Dissolved results were reported for rounds two and three only at 166,000 ug/l and 124,000 ug/l. Hexavalent chromium was reported above cleanup standards at 81,300 ug/l, 232,000 ug/l, and 116,000 ug/l for the three rounds (total). Based on the chromium and hexavalent chromium total results, it appears that most of the chromium present is hexavalent. The designation “J” indicates the sample concentration is estimated. The "E" indicates the concentration exceeded the calibration range. The "B" indicates the compound was found in the method blank.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 64 ug/l, 27J ug/l, and 49 ug/l, respectively, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was analyzed in round three only and was reported above the cleanup standard of 70 ug/l at 210 ug/l. Methylene chloride was detected in all three rounds at 1,900 ug/l, 320 ug/l, and 360 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 150 ug/l, 54J ug/l, and 60 ug/l, respectively, above the cleanup standard of 5 ug/l; trichloroethene was detected at 13,000 ug/l, 3,000 ug/l, and 4,000 ug/l, respectively, above the cleanup standard of 5 ug/l.

MW-04

Monitoring well MW-04 was sampled during each of the sampling events listed above. No semivolatile organic constituents were detected above the cleanup standards in the well for the three rounds of sampling. Most TAL Metals were reported in the samples for each round. Antimony, arsenic, cadmium, chromium (total), manganese, nickel, thallium, and hexavalent chromium were reported above their respective cleanup standards for this well. Antimony was reported above the cleanup standard of 6 ug/l in the third round for dissolved metals at 243 ug/l. Arsenic was reported above the cleanup standard of 50 ug/l in the third round for dissolved metals at 90.8 ug/l. Cadmium was reported above the cleanup standard of 5 ug/l in the first round for total metals at 6 ug/l. Manganese was reported above its cleanup standard (50 ug/l) at total concentrations of 1,150 ug/l, 501 ug/l, and 559 ug/l. Dissolved manganese was reported from round two at 505 ug/l. Nickel was reported above its cleanup standard (100 ug/l) at total concentrations of 2,540 ug/l, 1,100E ug/l, and 1,240 ug/l. Dissolved nickel was reported in round two at 1,120E ug/l. Thallium was detected above its cleanup standard of 2 ug/l in all three rounds. Total thallium was reported at 33.4 ug/l, 16.0 ug/l, and 15.1 J ug/l. Dissolved thallium was reported in round two at 23.8 ug/l. Chromium was detected above cleanup standards for all three rounds, both dissolved and/or total. Total chromium was reported at 110,000 ug/l, 52,100 ug/l, and 49,700 ug/l for the three rounds. Dissolved chromium was above cleanup standards during rounds two and three at 51,600 ug/l and 48,600 ug/l. Hexavalent chromium was reported above cleanup standards in all rounds at 133,000 ug/l, 41,400 ug/l, and 51,800 ug/l (total).

Numerous volatile organic constituents were detected in the samples; however, only chloroform, 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. Chloroform was detected in round one at 120J ug/l above the cleanup standard of 100 ug/l. 1,1-Dichloroethene was detected in rounds one and three at 200J ug/l and 74 ug/l, respectively, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was analyzed in round three only and was reported above the cleanup standard of 70 ug/l at 100 ug/l. Methylene chloride was detected in all three rounds at 7,700 ug/l, 3,000 ug/l, and 2,700 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected in rounds one and three at 500 ug/l and 96 ug/l, respectively, above the cleanup standard of 5 ug/l; trichloroethene was detected at 18,000 ug/l, 9,800 ug/l, and 9,800 ug/l, respectively, above the cleanup standard of 5 ug/l.

MW-05

Monitoring well MW-05 was sampled during each of the sampling events listed above. One semivolatile organic constituent was detected above the cleanup standards in the well for the three rounds of sampling. Bis(2-ethylhexyl)phthalate was detected at 16 ug/l above the cleanup standard of 6 ug/l for round one. No other semivolatile organic constituents were detected above cleanup standards. Most TAL Metals were reported in the samples for each round. Barium, chromium (total), iron, manganese, nickel, and hexavalent chromium were reported above their respective cleanup standards for this well. Barium was reported above the cleanup standard of 2,000 ug/l in the first round for dissolved and total metals at concentrations of 2,720 ug/l and 2,890 ug/l. Iron was reported above the cleanup standard of 300 ug/l in all rounds for total metals and round one and three for total metals. Total iron was reported as 40,300 ug/l, 5,420 ug/l, and 4,310 ug/l, whereas dissolved iron was reported at 35,400 ug/l (round one) and 770 ug/l (round three). Manganese was reported above its cleanup standard (50 ug/l) at total concentrations of 10,500 ug/l, 8,240 ug/l, and 8,020 ug/l. Dissolved manganese was reported at 10,600 ug/l, 8,140 ug/l, and 8,340 ug/l. Nickel was reported above its cleanup standard (100 ug/l) at total concentrations of 326 ug/l, 648E ug/l, and 493 ug/l. Dissolved nickel was reported at 378 ug/l, 639E ug/l, and 515 ug/l. Chromium was detected above cleanup standards for all three rounds, both dissolved and/or total. Total chromium was reported at 287 ug/l, 1720 ug/l, and 761 ug/l for the three rounds. Dissolved chromium was above cleanup standards during round two only at 433 ug/l. Hexavalent chromium was reported above cleanup standards in round two at 1,850 ug/l (total).

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected in rounds one and three at 160 ug/l and 120J ug/l, respectively, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was analyzed in round three only and was reported above the cleanup standard of 70 ug/l at 1,200 ug/l. Methylene chloride was detected in all three rounds at 2,800 ug/l, 3,100 ug/l, and 3,200 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected in rounds one and three at 330 ug/l and 210 ug/l, respectively, above the cleanup standard of 5 ug/l; trichloroethene was detected at 30,000 ug/l, 29,000 ug/l, and 32,000 ug/l, respectively, above the cleanup standard of 5 ug/l.

MW-06

Monitoring well MW-06 was sampled during each of the sampling events listed above. No semivolatile organic constituents were detected above the cleanup standards in the well for the three rounds of sampling. Most TAL Metals were reported in the samples for each round. Antimony, chromium (total), manganese, and hexavalent chromium were reported above their respective cleanup standards for this well. Antimony was reported above the cleanup standard of 6 ug/l in the third round for dissolved metals at a concentration of 14.2J ug/l. Manganese was reported above its cleanup standard (50 ug/l) at 85.7 ug/l for round one. Chromium was detected above cleanup standards for all three rounds, both dissolved and/or total. Total chromium was reported at 4,510 ug/l, 2,840E ug/l, and 2,580 ug/l for the three rounds. Dissolved chromium was above cleanup standards during rounds two and three at 2,820E ug/l and 2,430 ug/l. Hexavalent chromium was reported above cleanup standards in all three rounds at 4,290 ug/l, 2,460 ug/l, and 2,350 ug/l (total).

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, trichloroethene, and vinyl chloride were detected above cleanup standards. 1,1-

Dichloroethene was detected in all rounds at 49 ug/l, 32 ug/l, and 21 ug/l, respectively, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was analyzed in round three only and was reported above the cleanup standard of 70 ug/l at 72 ug/l. Methylene chloride was detected in rounds one and two at 26 ug/l and 6.8 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected in all three rounds at 200 ug/l, 60 ug/l, and 100 ug/l, respectively, above the cleanup standard of 5 ug/l; trichloroethene was detected at 640 ug/l, 440 ug/l, and 880 ug/l, respectively, above the cleanup standard of 5 ug/l. Vinyl chloride was detected in the first round at 2.2J ug/l above the cleanup standard of 2 ug/l.

MW-07

Monitoring well MW-07 was sampled during each of the sampling events listed above. No semivolatile organic constituents were detected above the cleanup standards in the well for the three rounds of sampling. Most TAL Metals were reported in the samples for each round. Aluminum, antimony, arsenic, beryllium, cadmium, chromium (total), cobalt, copper, iron, manganese, nickel, thallium, and hexavalent chromium were reported above their respective cleanup standards for this well. Aluminum was reported above the cleanup standard of 200 ug/l in all rounds for total metals at concentrations of 1,810 ug/l, 2,040 ug/l, and 4,080 ug/l. Dissolved aluminum concentrations were detected in the second and third rounds at 862 ug/l and 2,370 ug/l. Antimony was detected at 842 ug/l in the third round dissolved phase, above the cleanup standard of 6 ug/l. Arsenic was detected in rounds two and three at 82.3b ug/l and 271 ug/l (dissolved) and 88.7B ug/l total (round two), which are above the cleanup standard of 50 ug/l. Beryllium was detected in rounds two and three, both dissolved and total. Dissolved beryllium was reported at 20.9 ug/l and 47.2 ug/l, and total was reported at 24.5 ug/l and 47.4 ug/l. The cleanup standard is 4ug/l. Cadmium was detected in rounds two and three, both dissolved and total. Dissolved Cadmium was reported at

17.6 ug/l and 24.5 ug/l. Total Cadmium was reported at 18.3 ug/l and 23.8 ug/l, above the cleanup standard of 5 ug/l. Cobalt was detected in rounds two and three, both dissolved and total. Dissolved cobalt was reported at 4,510 ug/l and 5,220 ug/l, and total was reported at 4,800 ug/l and 5,170 ug/l. The cleanup standard is 2,000 ug/l. Copper was detected in rounds two and three, both dissolved and total. Dissolved copper was reported at 3,160 ug/l and 4,840 ug/l, and total was reported at 3,420 ug/l and 4,880 ug/l. The cleanup standard is 1,000 ug/l. Iron was reported above the cleanup standard of 300 ug/l in round one for total metals at 1,140 ug/l. Manganese was reported above its cleanup standard (50 ug/l) for rounds two and three at total concentrations of 9,040 ug/l and 2,290 ug/l. Dissolved manganese was reported at 8,500 ug/l and 11,600 ug/l. Nickel was reported above its cleanup standard (100 ug/l) for rounds two and three at total concentrations of 11,800 ug/l and 13,500 ug/l. Dissolved nickel was reported at 11,100 ug/l and 13,600 ug/l. Thallium was reported in rounds two and three above the cleanup standard of 2 ug/l. Dissolved thallium was reported at 44.6 ug/l and 29.2 ug/l, and total thallium was reported in round two only at 42.8 ug/l. Chromium was detected above cleanup standards for all three rounds, both dissolved and/or total. Total chromium was reported at 14,200 ug/l, 133,000E ug/l, and 38,600 ug/l for the three rounds. Dissolved chromium was above cleanup standards during rounds two and three at 122,000E ug/l and 199,000 ug/l. Hexavalent chromium was reported above cleanup standards in all three rounds at 12,800 ug/l, 125,000 ug/l, and 160,000 ug/l (total).

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, 111-trichloroethane, trichloroethene, and vinyl chloride were detected above cleanup standards. 1,1-Dichloroethene was detected in all rounds at 27J ug/l, 69J ug/l, and 160 ug/l, respectively, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was analyzed in round three only and was reported above the cleanup standard of 70 ug/l at

390 ug/l. Methylene chloride was detected in all three rounds at 140 ug/l, 380 ug/l, and 860 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected in all rounds at 650 ug/l, 600 ug/l, and 1,000 ug/l, respectively, above the cleanup standard of 5 ug/l; trichloroethene was detected at 1,500 ug/l, 2,900 ug/l, and 5,800 ug/l, respectively, above the cleanup standard of 5 ug/l. 1,1,1-Trichloroethane was detected in round three only at 290 ug/l, above the cleanup standard of 200 ug/l. Vinyl chloride was detected in round three at 11 J ug/l, above the cleanup standard of 2 ug/l.

MW-08

Monitoring well MW-08 was sampled during each of the sampling events listed above. No semivolatile organic constituents were detected above the cleanup standards in the well for the three rounds of sampling. Most TAL Metals were reported in the samples for each round; however, none exceeded their respective cleanup standards.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected in all rounds at 12J ug/l, 8.4J ug/l, and 11 ug/l, respectively, above the cleanup standard of 7 ug/l. Trichloroethene was detected at 90 ug/l, 66 ug/l, and 74 ug/l, respectively, above the cleanup standard of 5 ug/l.

MW-09

Monitoring well MW-09 was sampled during each of the sampling events listed above. One semivolatile organic constituent was detected above the cleanup standards in the well for the first round of sampling. Bis(2-ethylhexyl)phthalate was detected at 8J ug/l above the cleanup standard of 6 ug/l for round one. No other semivolatile organic constituents were detected above cleanup standards. Most TAL Metals were reported in the samples for each round; however, only aluminum, iron, and manganese exceeded their respective cleanup standards. Aluminum was detected in round one for total metals at 695 ug/l. Iron was reported above the cleanup standard of 300 ug/l in round one for total metals at 1,240 ug/l. Manganese was reported above its cleanup standard (50 ug/l) for round one for both dissolved and total at 140 ug/l and 141 ug/l, respectively.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected in all rounds at 38 ug/l, 37 ug/l, and 50 ug/l, respectively, above the cleanup standard of 7 ug/l. Tetrachloroethene was detected in all rounds at 25 ug/l, 26 ug/l, and 23 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 670 ug/l, 600 ug/l, and 610 ug/l, respectively, above the cleanup standard of 5 ug/l.

MW-10

Monitoring well MW-10 was sampled during each of the sampling events listed above. One semivolatile organic constituent was detected above the cleanup standards in the well for the first round of sampling. Bis(2-ethylhexyl)phthalate was detected at 6.7J ug/l above the cleanup standard of 6 ug/l for round one. No other semivolatile organic constituents were detected above cleanup standards. Most TAL Metals were reported in the samples for each round; however, only barium, iron, manganese, and thallium exceeded their respective cleanup standards. Barium was detected in all three rounds for both dissolved and total metals. Total barium was reported at 7,960N ug/l, 3,360 ug/l, and 3,770 ug/l. Dissolved barium was detected at 7,510N ug/l, 3,220 ug/l, and 3,520 ug/l. Iron was reported above the cleanup standard of 300 ug/l in all three rounds for both total and dissolved metals. Total iron was reported at 28,000 ug/l, 850N ug/l, and 10,500 ug/l. Dissolved iron was detected at 25,000 ug/l, 349 N ug/l, and 8,380 ug/l. Manganese was reported above its cleanup standard (50 ug/l) for all rounds for both dissolved and total. Total manganese was reported at 34,100 ug/l, 21,900 ug/l, and 22,500 ug/l. Dissolved manganese was reported at 33,400 ug/l, 21,500 ug/l, and 22,800 ug/l. Thallium was reported in round two only for total metals at 13B ug/l above its cleanup standard of 2 ug/l. The "N" designation indicates the sample recovery is not within control limits.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, tetrachloroethene, trichloroethene, and vinyl chloride were detected above cleanup standards. 1,1-Dichloroethene was detected in rounds one and three at 87 ug/l and 53 ug/l, respectively, above the cleanup standard of 7 ug/l. Cis-1,2dichloroethene was detected in round three at 210 ug/l, above the cleanup standard of 70 ug/l. Tetrachloroethene was detected in rounds one and three at 160 ug/l and 60 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected in all three rounds at 15,000 ug/l, 9,800 ug/l, and 8,300 ug/l, respectively, above the cleanup standard of 5 ug/l. Vinyl chloride was detected in round one at 3J ug/l above the cleanup standard of 2 ug/l.

MW-11

Monitoring well MW-11 was sampled during each of the sampling events listed above and was duplicated for the third round. No semivolatile organic constituents were detected above the cleanup standards in the well for the three rounds. Most TAL Metals were reported in the samples for each round; however, only aluminum exceeded its respective cleanup standard. Aluminum was detected in round three for total metals at 402 ug/l.

Numerous volatile organic constituents were detected in the samples; however, only carbon tetrachloride was detected above cleanup standards. Carbon tetrachloride was detected in all three rounds at 8.3 ug/l, 9 ug/l, and 7.7 ug/l, respectively, above the cleanup standard of 5 ug/l.

MW-12

Monitoring well MW-12 was sampled during each of the sampling events listed above. No semivolatile organic constituents or TAL metals were detected above the cleanup standards in the well for the three rounds. Several volatile organic constituents were detected in the samples; however, only trichloroethene was detected above cleanup standards. Trichloroethene was detected in all three rounds at 39 ug/l, 38 ug/l, and 36 ug/l, respectively, above the cleanup standard of 5 ug/l.

MW-13

Monitoring well MW-13 was sampled during each of the sampling events listed above. No semivolatile organic constituents or TAL metals were detected above the cleanup standards in the well for the three rounds. Several volatile organic constituents were detected in the samples; however, only carbon tetrachloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. Carbon tetrachloride was detected in round one at 5.4 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected in rounds one and three at 6 ug/l and 7 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected in round three at 14 ug/l, above the cleanup standard of 5 ug/l.

MW-14

Monitoring well MW-14 was sampled during each of the sampling events listed above. No semivolatile organic constituents were detected above the cleanup standards in the well for the three rounds. Numerous TAL Metals were detected; however, only lead and manganese were detected above cleanup standards. Lead was detected in round two at 8.6 ug/l for dissolved metals, above the cleanup standard of 5 ug/l. Manganese was detected in rounds two and three for both dissolved and total metals. Total manganese was reported at 119 ug/l and 84.6 ug/l, and dissolved manganese was reported at 123 ug/l and 82.8 ug/l, above the cleanup standard of 50 ug/l. Several volatile organic constituents were detected in the samples; however, only carbon tetrachloride and trichloroethene were detected above cleanup standards. Carbon tetrachloride was detected in round one at 5.4 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected in rounds two and three at 5.3 ug/l and 8 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected in rounds two and three at 5.5 ug/l and 6 ug/l, above the cleanup standard of 5 ug/l.

MW-15

Monitoring well MW-15 was sampled during the third round only, based on the date of installation and was duplicated. No semivolatile organic constituents were detected above the cleanup standards in the well. Numerous TAL Metals were detected; however, only chromium and hexavalent chromium were detected above cleanup standards. Chromium was detected for both dissolved and total at 4,940 ug/l and 5,180 ug/l, above the cleanup standard of 100 ug/l. Total hexavalent chromium was detected at 4,770 ug/l, above the cleanup standard of 100 ug/l.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 32 ug/l, above the cleanup standard of 7 ug/l. Cis-1,2 dichloroethene was detected at 290 ug/l, above the cleanup standard of 70 ug/l. Methylene chloride was detected at 19 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 120 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 3,800 ug/l, above the cleanup standard of 5 ug/l.

MW-16

Monitoring well MW-16 was sampled during the third round only, based on the date of installation and was duplicated. No semivolatile organic constituents in the well were detected above the cleanup standards. Numerous TAL Metals were detected; however, only chromium and hexavalent chromium were detected above cleanup standards. Chromium was detected for both dissolved and total at 128 ug/l and 139 ug/l, above the cleanup standard of 100 ug/l. Total hexavalent chromium was detected at 135 ug/l , above the cleanup standard of 100 ug/l.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, tetrachloroethene, 1,1,1-trichloroethane, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 240 ug/l, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was detected at 130 ug/l, above the cleanup standard of 70 ug/l. Tetrachloroethene was detected at 200 ug/l, above the cleanup standard of 5 ug/l. 1,1,1-Trichloroethane was detected at 270 ug/l, above the cleanup standard of 200 ug/l. Trichloroethene was detected at 250 ug/l, above the cleanup standard of 5 ug/l.

MW-17

Monitoring well MW-17 was not sampled, because it was not completed as a FLUTe well by the time of sampling.

MW-18

Monitoring well MW-18 was sampled during the third round only, based on the date of installation and was duplicated. No semivolatile organic constituents in the well were detected above the cleanup standards. Numerous TAL Metals were detected; however, only aluminum was detected above cleanup standards. Total aluminum was detected at 283 ug/l, above the cleanup standard of 200 ug/l.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 8 ug/l, above the cleanup standard of 7 ug/l. Trichloroethene was detected at 47 ug/l, above the cleanup standard of 5 ug/l.

MW-19

Monitoring well MW-19 was sampled during the third round only, based on the date of installation and was duplicated. No semivolatile organic constituents in the well were detected above the cleanup standards. Numerous TAL Metals were detected; however, only chromium, manganese, and hexavalent chromium were detected above cleanup standards. Chromium was detected for both dissolved and total at 349 ug/l and 370 ug/l, above the cleanup standard of 100 ug/l. Total hexavalent chromium was detected at 305 ug/l, above the cleanup standard of 100 ug/l. Manganese was detected at 83 ug/l and 118 ug/l for dissolved and total metals, above the cleanup standard of 50 ug/l.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, tetrachoroethene and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 13 ug/l, above the cleanup standard of 7 ug/l. Tetrachloroethene was detected at 14 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 580 ug/l, above the cleanup standard of 5 ug/l.

MW-20

Monitoring well MW-20 was sampled during the third round only, based on the date of installation and was duplicated. No semivolatile organic constituents were detected above the cleanup standards in the well. Numerous TAL Metals were detected; however, only antimony, chromium, and hexavalent chromium were detected above cleanup standards. Antimony was detected for dissolved metals at 88.5J ug/l, above the cleanup standard of 6 ug/l. Chromium was detected for both dissolved and total at 17,000 ug/l and 17,300 ug/l, above the cleanup standard of 100 ug/l. Total hexavalent chromium was detected at 16,000 ug/l, above the cleanup standard of 100 ug/l.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 34 ug/l, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was detected at 96 ug/l, above the cleanup standard of 70 ug/l. Methylene chloride was detected at 9 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 93 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 1,300 ug/l, above the cleanup standard of 5 ug/l.

DW - Domestic Well

Monitoring well DW was sampled during each of the sampling events listed above. No semivolatile organic constituents were detected in the groundwater samples for the three rounds of sampling. Numerous TAL Metals were reported in the samples for each round; however, only iron and manganese were reported above their respective cleanup standards for the well. Iron (total) was reported in all three rounds of sampling. Total iron was detected in all three rounds at 32,200 ug/l, 23,900 ug/l, and 55,100 ug/l. Dissolved iron was detected in rounds two and three at 22,000 ug/l and 31,800 ug/l. Total manganese was detected in all three rounds at 3,890 ug/l, 3,050 ug/l, and 3,020 ug/l. Dissolved manganese was detected in rounds two and three at 3,100 ug/l and 2,870 ug/l.

Numerous volatile organic constituents were detected in the samples; however, only trichloroethene was detected above cleanup standards for rounds one and two. Trichloroethene was reported at 8 ug/l and 7 ug/l, above the cleanup standard of 5 ug/l.

Groundwater samples were analyzed for VOCs by USEPA Method 8260, SVOCs by USEPA Method 8270, TAL metals by USEPA Method 6010, cyanide by USEPA Method 9010/9014, and hexavalent chromium by USEPA Method 3060A. The results were compared to the Act 2 Standards contained in Pennsylvania Bulletin, Vol. 27, No. 33, August 16, 1997, Appendix A, MSCs for Organic Regulated Substances in Groundwater Table 1, and Inorganic Regulated Substances in Groundwater Table 2.

5.3 Validation Summaries

The laboratory sample analytical data reports for this project were sent to Environmental Data Quality for validation. The validation reports have not all been received to date and are not included as part of the report. A follow up letter report will review the validation and report the results, when available.

5.4 Geochemical Data

The chem.-fab site has complex site conditions, including complicated geochemical and geologic conditions, which will impact the effectiveness of future remedial technologies for the site. Table 5-4 indicates the hexavalent chromium and total chromium results along with several geochemical and analytical parameters collected during the investigation. The parameters reinforce the complexities at the site. Variations in the pH occur throughout the site, even in close proximity to other wells. DO ranges indicate aerobic and anerobic conditions. ORP fluctuates considerably as does the conductivity. These fluctuations and varying conditions reflect the complex conditions at the site. This data provides further useful tools for defining the feasible remedial actions to be undertaken at the site.

6.0 CONCLUSIONS

The following sections discuss the distribution and possible migratory pathways of the contaminants of concern (COCs) detected throughout the Chem-Fab Site. Site COCs were detected at concentrations exceeding Act 2 standards throughout site soil and groundwater samples.

6.1 Subsurface Soils Investigation

Based on the evaluation of sample analytical data discussed in Section 5.0, AMEC identified COCs in subsurface soils exceeding Act 2 standards from the previous investigation and this Phase II investigation. The borings which reported level above the cleanup standards for the first round were SB-1, SB-3, SB-4, SB-7 through SB-12, SB-14 and SB-17. The borings detected in the phase II investigation above cleanup standards include B-01, B-03 through B-06, B-08 and B-18. The area-specific COCs (trichloroethene, tetrachloroethene, 1,1-dichloroethene, methylene chloride, hexavalent chromium, and lead) were detected above Act 2 soil to groundwater standards. These COCs were detected in subsurface soils ranging from 3 to 10.5 feet bgs in the former tank farm area located south of the former manufacturing building and the patched asphalt area located east of the former manufacturing building (see Figure 6-1). The source of the area-specific COCs in site soils is likely to be historic site operations in and adjacent to the tank farm area.

In addition, trichloroethene was detected in excess of the Act 2 soil to groundwater standard in one soil boring (SB-19) within the courtyard area between the three site buildings. This may be a result of former operations in this area.

As stated previously, several volatile and semi-volatile constituents were also detected in the samples in close proximity to the former tank farm area, although not above cleanup standards. These constituents include naphthalene, toluene, phenanthrene, and xylenes. The presence of these constituents indicates a fuel spill may have occurred on the site. Previous metal etching site activities may also have contributed to the onsite contamination.

In addition, during the course of the investigation, AMEC obtained access to the interior of the former warehouse area of the Chem-Fab building. Soil sampling was conducted in this area, and several volatile organics were detected above cleanup levels. Tricholorethene and tetrachloroethene were detected in the soils beneath the building above cleanup levels. It should be noted that although not collected for analysis, several borings contained groundwater which appeared yellow.

6.2 Groundwater Investigation

Based on the initial evaluation of the site characterization data, shallow groundwater is present at the site from approximately 10 to 14 feet bgs. This part of the investigation concentrated on the groundwater below this depth. Each well was cased off to at least 20 feet bgs and then completed to depth ranging from 37 feet bgs to 220 feet bgs. Based on groundwater flow maps and topography, groundwater has an assumed flow direction to the west in the direction of Cooks Run tributary. It would appear that the deeper groundwater may be flowing in a different direction, due to natural site conditions or other regional influences. Based on an evaluation of the sample analytical data discussed in Section 5.0, AMEC has identified COCs in the onsite and the offsite groundwater at the Chem-Fab Site, varying in depths from the shallow water previously investigated at 11-14 feet bgs to the deeper depths of over 200 feet bgs investigated as part of this investigation. Groundwater contamination was found throughout the water column; however, based on data collected and represented on the distribution maps, a larger percentage of the contamination appears to be found at depths between 37 feet and 125 feet. Based on the geophysical results, drilling, and video logging, it is unclear as to whether these represent distinct zones or are hydraulically connected via the extensive fracturing.

The COCs detected in onsite groundwater for both phases of the investigation at concentrations in excess of the Act 2 standards for groundwater in used aquifers include 17 metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium (III) and (VI), cobalt, copper, iron, lead, manganese, mercury, nickel, thallium, and vanadium), 10 volatile organic compounds (1,1,1-trichloroethane, 1,1-dichloroethene, 1,1-dichloroethane, methylene chloride, tetrachloroethene, trichloroethene, vinyl chloride, cis-1,2-dichloroethene, chloroform, carbon tetrachloride), and two semi-volatile compounds (bis(2-ethylhexyl)phthalate and naphthalene). Contaminant distribution varies as there appear to be two sources. One, the onsite source has been identified during the investigation; the other potential source is located near the swale area on the Extra Space Storage property and has not been identified to date. However, the contaminants identified appear to be related to the historic activities conducted on the Chem-Fab site.

6.3 Surface Water and Sediment Investigation

As part of the investigation, an area of the swale on the Extra Space Storage property was sampled to determine if contamination was present in the yellow surface water observed. As part of this, soil sampling was conducted in and around the swale in an attempt to determine the source. Trichloroethene was detected above cleanup standards in the soil samples. In the sediment samples, chromium and nickel were reported above cleanup standards. Also, in these borings, several water samples were collected and appeared yellow in color, although none was submitted to the laboratory for analysis.

7.0 REFERENCES

1. Bucks County Health Department File Review, Doylestown, PA
2. PADEP Hazardous Site Assessment Report, September 1998.
3. Site Inspection of Chem-Fab Corporation, prepared by NUS Corporation, February 26, 1988.
4. U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Bucks and Philadelphia Counties, Pennsylvania, 1975.
5. U.S. Geologic Survey Quadrangle for Doylestown, Pennsylvania (7.5 Minute Series).
6. U.S. Geologic Survey Topographic Quadrangle (7.5 Minute Series) for Doylestown, PA, 1966, which was compiled by photogrammetric methods from imagery dated 1950, field checked 1952, revised from aerials taken 1965, and photorevised in 1983.
7. Pennsylvania Bulletin, Vol. 27, No. 33 (dated August 16, 1997), Act 2 Medium Specific Concentrations for Organic Regulated Substances in Groundwater for Used Aquifers in Residential Areas (Appendix A, Table 1).
8. Site Inspection Report for Chem-Fab Site, prepared by USEPA, April 1988.

AMEC Standard Operating Procedures

FP-C-2	Soil Sampling
FP-C-4	Surface Water Sampling
FP-C-5	Sediment Sampling
FP-D-3	Monitoring Well Sampling
FP-D-5	Equipment Decontamination
FP-F-1	Laboratory QC Samples (Water, Soil)
FP-F-5	Logbooks
FP-F-6	Recordkeeping, Sample Labeling, and Chain of Custody
FP-F-7	Sample Handling, Storage, and Shipping

FINAL – PHASE II
SITE CHARACTERIZATION REPORT
ADDENDUM

CHEM-FAB SITE
DOYLESTOWN,
BUCKS COUNTY, PENNSYLVANIA

PADEP Contract No.: ME 359185
Work Assignment No.: 31-070

Submitted to:
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NOTICE

The information in this document has been funded by the Pennsylvania Department of Environmental Protection (PADEP) under Contract No. ME 359185 to AMEC Earth & Environmental, Inc. (AMEC). This document has been formally released by AMEC to the PADEP.

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APPENDICES

1.0 INTRODUCTION

AMEC Earth & Environmental, Inc. (AMEC) is submitting this Final Phase II Site Characterization Report Addendum to the Pennsylvania Department of Environmental Protection (PADEP) in response to PADEP's Requisitions for Contractual Services 21-070 and 31-070 and the Scope of Work. This addendum is a continuation of the Final Phase II Site Characterization Report dated November 25, 2002, and consists of conducting two additional rounds of groundwater sampling on the six (6) onsite monitoring wells and the fifteen (15) offsite monitoring wells. This document presents AMEC's technical report regarding the further characterization of the Chem-Fab Corporation Site (site), which is located in Doylestown, Bucks County, Pennsylvania (see Figure 1-1).

2.0 SITE BACKGROUND AND ENVIRONMENTAL SETTING

This section includes a brief description of the site location. A detailed description of the Chem-Fab Site, including the site background and environmental setting, can be found in the Final Phase II Site Characterization Report, dated November 25, 2002.

2.1 Site Location and Description

The Chem-Fab Site is located at 300 North Broad Street in Doylestown, Bucks County, Pennsylvania. The site may be found on the Doylestown, Pennsylvania USGS 7.5 Minute Series topographic map at 40°18'54" north latitude and 75°08'06" west longitude (see Figure 1-1). The site, currently owned by the 300 North Broad Street, Ltd., is a one-acre parcel of land that contains three separate buildings where various business ventures have been operated. The site was formerly operated as Chem-Fab, Inc., an electroplating and metal etching company, from 1965 to approximately 1994.

The site is bordered to the east by Tilley Fire Equipment, to the west and south by Extra Space Storage of Doylestown, and to the north by North Broad Street. Two creeks, Pine Run and Cooks Run, are located within a 2-mile radius of the site, as shown on Figure 1-1.

2.2 Site Characterization Background

AMEC performed an initial site investigation (Phase I) from December 1999 through April 2000 to determine if the subject site and the adjacent Extra Space Storage of Doylestown property had been adversely impacted from former activities at the subject site. A subsequent Phase II Site Investigation was conducted from May 2001 to January 2002 to further investigate the migration of contamination, and expanded to include the entire Extra Space Storage property and the adjacent surrounding properties (Tilley Fire Equipment, Henning's Property, and the Bucks County Sewage and Water Authority). Based on the analytical results, both soils and groundwater were found to have been impacted by historical operations.

3.0 SITE CHARACTERIZATION ACTIVITIES

This Addendum to the site characterization program includes further delineation of groundwater conditions on the subject site and surrounding properties based on analytical data from two additional rounds of sampling. These activities, conducted by AMEC at the site in May 2002 and September 2002, are discussed in detail in the following sections.

3.1 Groundwater Investigation

AMEC previously conducted three rounds of groundwater sampling as part of the Phase II groundwater investigation to determine if site contaminants were migrating into the groundwater. This addendum to the investigation includes two additional rounds of sampling on the six (6) onsite monitoring wells (MW-01, MW-02, MW-03, MW-06, MW-07, and DW [Domestic Well]) and the fifteen (15) offsite monitoring wells (MW-04, MW-05, and MW-08 through MW-20) located on the adjacent properties (see Figure 3-1). The newly installed FLUTe well, MW-17, was sampled for the first time during this investigation.

3.1.1 FLUTe WELL INSTALLATION

On April 30, 2002, Flexible Liner Underground Technologies (FLUTe) of Santa Fe, New Mexico, installed a flexible liner (FLUTe) sampling system in MW-17. The FLUTe is a sealed, pressurized liner system that allows groundwater to be sampled from multiple zones within the same well. Water pressure within the liner acts to seal the sides of the borehole around spacers, which are set at designated depths and which allow water to be drawn from specific areas in the formation. Groundwater flows through ports in the spacers into the port tubing, and then into a "U"-shaped tube through check valves.

Using compressed nitrogen as a driving force, the water in the tubing is expelled through the sampling port (see Figure 3-2, FLUTe Well).

The FLUTe at MW-17 was installed to a depth of 125 ft bgs, with three zones (two ports per zone) set at 30-40 ft bgs, 80-90 ft bgs, and 110-120 ft bgs. These depths were chosen as probable water-bearing zones through information gathered from geophysical and down-hole video data.

3.1.2 Monitoring Well Sampling

AMEC and PADEP personnel mobilized to the site on May 6, 2002 to sample monitoring wells MW-01 through MW-20, and the domestic well (DW). During this field event, the newly installed FLUTe well at MW-17 was sampled for the first time. On September 9, 2002, AMEC and PADEP personnel mobilized to the site for the fifth round of sampling. This round included all 21 wells (MW-01 to MW-20 and DW).

During each sampling event, the monitoring wells, with the exception of MW-17, were purged using the EPA low-flow method. The pH, temperature, conductivity, oxidation reduction potential and dissolved oxygen concentration were recorded at regular time intervals. A groundwater sample was collected after the readings of the parameters stabilized (within 5% of the previous reading). Groundwater samples were collected in an attempt to evaluate the groundwater conditions beneath the site. Purge water was collected and placed in the IDW disposal tank onsite. In addition, personal protective equipment was placed in the appropriate drums for IDW disposal.

The FLUTe well (MW-17) was sampled at the three designated zones (shallow, middle, and deep). Each zone was purged using compressed nitrogen gas to drive the groundwater through the tubing associated with each port (zone). Once the water in the tubing was evacuated, the zone was allowed to recharge, and was purged once again before sampling. Temperature, pH, conductivity, oxidation reduction potential, and dissolved oxygen concentration were recorded. The zones were sampled using the same method to purge; however, the driving pressure used to evacuate the water in the tubing was reduced to minimize the disturbance of volatiles in the water.

The groundwater samples were placed under proper chain of custody, and picked up by a lab courier for delivery to Lancaster Laboratories of Lancaster, Pennsylvania, a PADEP-contract laboratory. As with the previous three rounds of sampling, the samples were analyzed for VOCs by EPA Method 5035/8260, SVOCs by EPA Method 8270, TAL Metals by EPA Method 6010, plus cyanide, total chromium, and hexavalent chromium. Metals analysis included both filtered and unfiltered samples. In addition, the samples collected during the May 2002 and September 2002 field events were analyzed for the following constituents: phenols, chemical oxygen demand (COD), biological oxygen demand (BOD), total dissolved solids (TDS), total organic carbon (TOC), sulfate, alkalinity, bromide, fluoride, chloride, magnesium, sodium, potassium, and calcium. These constituents were added to the scope to further evaluate the geophysical properties of the groundwater and the underlying aquifers. Copies of the chain-of-custody forms are contained in Appendix A. Table 3-1 presents a summary of the groundwater-sampling program for the site.

Equipment decontamination was conducted according to AMEC SOP FP-D-5, "Equipment Decontamination." A log of events occurring in the field was kept in accordance with AMEC SOP FP-F-5, "Logbooks." Recordkeeping, sample labeling, chain-of-custody information, sample handling, storage, and shipment were performed in accordance with AMEC SOPs FP-F-6 and FP-F-7.

3.2 Groundwater Flow

Groundwater contours for the subject property were determined based on information obtained from the site survey. Based on the ground surface elevation and groundwater elevation, the groundwater contours were determined, as well as the presumed groundwater flow direction. It should be noted that the wells were screened in different intervals and it is unclear as to the connectivity of the fractured bedrock beneath the site. The groundwater contour map and presumed groundwater flow direction, for the May and September sampling events, are included on Figures 3-3, 3-3a, 3-4, and 3-4a.

4.0 CHEMICAL ANALYTICAL CHARACTERIZATION RESULTS

Section 4 presents a discussion of the results of the groundwater sampling program conducted at the subject site, as well as the laboratory reporting limits and limitations.

4.1 Groundwater Sampling Results

The following sections present the results of the groundwater investigation, which included the sampling and analysis of 19 monitoring wells, the FLUTe well and the onsite domestic well. The original three rounds of data are provided in the tables for comparison; however, rounds 4 and 5 are discussed in the following section. These results are presented in Tables 4-1a through 4-1c. The laboratory analytical data reports for the soil samples are contained in Appendix B. Three representative constituents were selected for mapping of the concentrations. Figures 4-1a and 4-1b through 4-3a and 4-3b represent hexavalent chromium concentrations, trichloroethene, and tetrachloroethene concentrations per depth zone for the May round of sampling, and Figures 4-4a and 4-4b through 4-6a and 4-6b represent hexavalent concentrations, trichloroethene, and tetrachloroethene concentrations per depth zone for the September sampling round.

In May 2002 and September 2002, AMEC conducted additional groundwater sampling associated with the initial Phase II site investigation and groundwater investigation of the Chem-Fab property and adjacent properties. Samples were collected to evaluate the groundwater conditions beneath the site. These groundwater samples were identified by the well number and then by the sampling round (i.e., MW-01-04).

MW-01

Monitoring well MW-01 was sampled during May and September of 2002, as indicated above. No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Numerous TAL Metals were reported in the samples; however, only total chromium was reported above its respective cleanup standard of 100 ug/l. Total chromium was detected in the September sample at a concentration of 103 ug/l. Although not above cleanup standards, hexavalent chromium was detected in MW-01 in the September sampling, for the first time. Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, 1,2-dichloroethane, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 9.0 ug/l above the cleanup standard of 7 ug/l. 1,2-Dichloroethane was detected at 8.0 ug/l above the cleanup standard of 5 ug/l; tetrachloroethene was detected at 15 ug/l above the cleanup standard of 5 ug/l, and trichloroethene was detected at 46 ug/l above the cleanup standard of 5 ug/l.

MW-02

Monitoring well MW-02 was sampled during May and September of 2002, as indicated above. No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Numerous TAL Metals were reported in the samples for each well sampling; however aluminum, beryllium, chromium (total), manganese, nickel, and hexavalent chromium were reported above their respective cleanup standards for the well. Aluminum was detected in the September sample above its cleanup standard (200 ug/l) at a concentration of 222 ug/l for total metals. Beryllium was detected in the September sample above the cleanup standard of 4 ug/l for both dissolved and total metals, with concentrations of 5.1J ug/l and 5.3J ug/l, respectively. Manganese was reported above its cleanup standard (50 ug/l) at concentrations of 1,320 ug/l and 2,200 ug/l for total metals. Dissolved manganese had concentrations of 1,330 ug/l and 2,100 ug/l. Nickel was reported above its cleanup standard of 100 ug/l at concentrations of 1,390 ug/l and 1,380 ug/l (total and dissolved) and 2,200 ug/l and 2,100 ug/l (total and dissolved). Both dissolved and total chromium were detected well above the cleanup standard of 100 ug/l. Total chromium was reported at concentrations of 63,400 ug/l and 105,000 ug/l for both samples. Dissolved results were reported at concentrations of 61,600 ug/l and 109,000 ug/l. Hexavalent chromium was reported at concentrations of 59.0 mg/l and 106 mg/l (total), which is equivalent to 59,000 ug/l and 106,000 ug/l in comparison to the cleanup standard for total chromium (100 ug/l).

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene, and vinyl chloride were detected above cleanup standards. 1,1-Dichloroethene was detected at 76 ug/l and 120 ug/l, in May and September, respectively, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was detected above the cleanup standard of 70 ug/l at 190 ug/l and 390 ug/l. Methylene chloride was detected in May and September at 420 ug/l and 700 ug/l, respectively, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 720 ug/l and 1,800 ug/l above the cleanup standard of 5 ug/l; trichloroethene was detected at 3,500 ug/l and 6,600 ug/l above the cleanup standard of 5 ug/l. 1,1,1-Trichloroethane was detected above the cleanup standard of 200 ug/l at 210 ug/l and 480 ug/l. Vinyl chloride was detected at 5J ug/l and 10J ug/l above the cleanup standard of 2 ug/l. The designation “J” indicates the sample concentration is estimated.

MW-03

Monitoring well MW-03 was sampled during May and September of 2002, as indicated above. Monitoring well MW-03 was also used for duplicate sampling due to the number of constituents detected. As indicated on the tables, the samples designated with a letter “C” or “D” represent the duplicates and are not discussed here.

No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Most TAL Metals were reported in the samples. Chromium (total), aluminum, manganese, nickel, and hexavalent chromium were reported above their respective cleanup standards. Aluminum was reported in the May sample for total metals at a concentration of 205 ug/l, above the cleanup standard of 200 ug/l. Manganese was reported above its cleanup standard (50 ug/l) at concentrations of 4,340 ug/l and 6,250 ug/L for total metals, and was also reported in dissolved metals, above cleanup standards, at concentrations of 4,290 ug/l and 5,960 ug/l. Nickel was reported above its cleanup standard (100 ug/l) at 291 ug/l and 342 ug/l for total metals, and was reported above cleanup standards for dissolved metals at concentrations of 288 ug/l and 328 ug/l. Chromium was detected above the cleanup standard (100 ug/l) for both samples, dissolved and total. Total chromium was reported at 95,500 ug/l and 85,000 ug/l. Dissolved chromium was reported at concentrations of 92,700 ug/l and 87,500 ug/l. Hexavalent chromium was reported at concentrations of 77.2 mg/l and 71.8 mg/l for both the samples (total), which is equivalent to 77,200 ug/l and 71,800 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium. Based on the chromium and hexavalent chromium total results, it appears that most of the chromium present is hexavalent.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 39 ug/l and 54 ug/l, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was detected at 160 ug/l and 200 ug/l, above the cleanup standard of 70 ug/l. Methylene chloride was detected in both samples at 300 ug/l and 320 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 65 ug/l and 73 ug/l, above the cleanup standard of 5 ug/l; trichloroethene was detected at 5,000 ug/l and 5,300 ug/l, above the cleanup standard of 5 ug/l.

MW-04

Monitoring well MW-04 was sampled during May and September of 2002, as indicated above. No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Most TAL Metals were reported in both of the samples. Aluminum, antimony, arsenic, beryllium, cadmium, chromium (total), cobalt, copper, manganese, nickel, and hexavalent chromium were reported above their respective cleanup standards for this well. Aluminum was reported above the cleanup standard of 200 ug/l for dissolved and total metals. Total aluminum concentrations were reported at 476 ug/l and 595 ug/l. Dissolved aluminum was reported at concentrations of 521 ug/l and 526 ug/l for both samples. Antimony was reported above the cleanup standard of 6 ug/l in the September sample for dissolved metals at 841 ug/l; arsenic was reported above the cleanup standard of 50 ug/l for dissolved metals in the May sample at 152 ug/l. Beryllium (total) was reported in the May and September sampling at 4.5J ug/l and 7.7J ug/L, respectively, above the cleanup standard of 4 ug/l. Dissolved beryllium was reported above the cleanup standard at 7.8J ug/l and 5.5Jug/l. Cadmium total was reported above the cleanup standard of 5 ug/l at concentrations of 21.8 ug/l and 21.5 ug/l, respectively. Dissolved cadmium was reported above the cleanup standard at concentrations of 22.3 ug/l and 21.2 ug/l. Copper in the September sample was reported above the cleanup standard of 1,000 ug/l for total and dissolved metals at

1,040 ug/l and 1,090 ug/l. Manganese was reported above its cleanup standard (50 ug/l) at total concentrations of 3,350 ug/l and 3,470 ug/l. Dissolved manganese was reported above its cleanup standard at concentrations of 3,540 ug/l and 3,340 ug/l. Nickel was reported above its cleanup standard (100 ug/l) at total concentrations of 9,240 ug/l and 9,250 ug/l. Dissolved nickel was reported above the cleanup standard at 9,790 ug/l and 8,950 ug/l. Dissolved and total chromium was detected above the cleanup standard (100 ug/l). Total chromium was reported at 235,000 ug/l and 238,000 ug/l for both samples. Dissolved chromium was reported above the cleanup standard at 233,000 ug/l and 240,000 ug/l. Hexavalent chromium was reported in both samples at concentrations of 220 mg/l and 229 mg/l (total), which is equivalent to 220,000 ug/l and 229,000 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium. The hexavalent chromium concentrations detected appear to represent the majority of the total chromium detected.

Numerous volatile organic constituents were detected in the samples; however, only chloroform, 1,1-dichloroethane, cis-1,2-dichloroethene, 1,1-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. Chloroform was detected in both samples at 160 ug/l, above the cleanup standard of 100 ug/l. 1,1-Dichloroethane was detected in the May sample at 250 ug/l, above the cleanup standard of 110 ug/l; 1,1-Dichloroethene was detected in the September sample at 260 ug/l, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was reported above the cleanup standard of 70 ug/l at 580 ug/l and 600 ug/l. Methylene chloride was detected at concentrations of 9,700 ug/l and 9,400 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 530 ug/l and 550 ug/l, above the cleanup standard of 5 ug/l; trichloroethene was detected in both samples at 35,000 ug/l, above the cleanup standard of 5 ug/l.

MW-05

Monitoring well MW-05 was sampled during May and September of 2002, as indicated above. No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Most TAL Metals were reported in the samples. Cadmium, chromium (total), iron, manganese, and nickel were reported above their respective cleanup standards for this well. Cadmium was reported above its cleanup standard (5 ug/l) for the September sample at concentrations of 7.0J ug/l and 7.3J ug/l for dissolved and total metals, respectively. Iron was reported above the cleanup standard of 300 ug/l in both samples for total metals. Total iron was reported as 4,590 ug/l and 1,450 ug/l. Manganese was reported above its cleanup standard (50 ug/l) at total concentrations of 7,460 ug/l and 7,970 ug/l. Dissolved manganese was reported at 8,200 ug/l and 7,880 ug/l. Nickel was reported above its cleanup standard (100 ug/l) at total concentrations of 645 ug/l and 1,170 ug/l. Dissolved nickel was reported at 680 ug/l and 1,140 ug/l. Chromium was detected above cleanup standards (100 ug/l) for all samples, both dissolved and total. Total chromium was reported at 1,480 ug/l and 4,190 ug/l for the samples. Dissolved chromium was reported at 209 ug/l and 3,720 ug/l. Hexavalent chromium was reported in the September sample at 3.38 mg/l (total), which is equivalent to 3,380 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium. It appears that most of the total chromium is hexavalent chromium.

Numerous volatile organic constituents were detected in the samples; however, only carbon tetrachloride, 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, 1,1,2,2-tetrachloroethane, tetrachloroethene, 1,1,2-trichloroethane, and trichloroethene were detected above cleanup standards. Carbon tetrachloride was reported above the cleanup standard of 5 ug/l for the September sample at a concentration of 10 ug/l. 1,1-Dichloroethene was detected at 54J ug/l and 110 ug/l, above the cleanup standard of

7 ug/l. Cis-1,2-dichloroethene was reported above the cleanup standard of 70 ug/l at 1,400 ug/l and 1,100 ug/l. Methylene chloride was detected at 2,400 ug/l and 4,400 ug/l, above the cleanup standard of 5 ug/l. 1,1,2,2-Tetrachloroethane was reported above its cleanup standard (0.3 ug/l) for the September sample at 3J ug/l; 1,1,2-trichloroethane was reported above the cleanup standard of 5 ug/l for the September sample at a concentration of 10 ug/l. Tetrachloroethene was detected at 260 ug/l and 190 ug/l, above the cleanup standard of 5 ug/l; trichloroethene was detected at 32,000 ug/l and 28,000 ug/l, above the cleanup standard of 5 ug/l. The designation “J” indicates the sample concentration is estimated.

MW-06

Monitoring well MW-06 was sampled during May and September of 2002, as indicated above. No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Most TAL Metals were reported in the samples for each sample. Manganese, nickel, chromium (total), and hexavalent chromium were reported above their respective cleanup standards for this well. Total and dissolved manganese were reported above the cleanup standard (50 ug/l) at concentrations of 72.1 ug/l and 79.8 ug/l, respectively, for the September sample. Nickel was reported above its cleanup standard (100 ug/l) at a total concentration of 106 ug/l for the September sample. Chromium was detected above cleanup standards for both samples, dissolved and total. Total chromium was reported at concentrations of 8,150 ug/l and 9,780 ug/l for samples. Dissolved chromium was above cleanup standards at 8,010 ug/l and 8,660 ug/l. Hexavalent chromium was reported at concentrations of 7.82 mg/l and 7.09 mg/l (total), which is equivalent to 7,820 ug/l and 7,090 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium. Based on the chromium and hexavalent chromium total results, it appears that most of the chromium present is hexavalent.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected in all samples at 58 ug/l and 56 ug/l, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was analyzed and reported above the cleanup standard of 70 ug/l at 180 ug/l for both samples. Methylene chloride was detected at 39 ug/l and 21 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected in all samples at 250 ug/l and 210 ug/l, above the cleanup standard of 5 ug/l; trichloroethene was detected at 2,200 ug/l and 1,600 ug/l, above the cleanup standard of 5 ug/l.

MW-07

Monitoring well MW-07 was sampled during May and September of 2002, as indicated above. No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Most TAL Metals were reported in the samples for each round. Aluminum, beryllium, cadmium, chromium (total), cobalt, copper, manganese, nickel, and hexavalent chromium were reported above their respective cleanup standards for this well. Aluminum was reported above the cleanup standard of 200 ug/l for total metals at concentrations of 3,840 ug/l and 12,100 ug/l. Dissolved aluminum concentrations were detected at 1,220 ug/l and 11,100 ug/l. Beryllium was reported above the cleanup standard (4 ug/l) for both dissolved and total metals. Dissolved beryllium was reported at 16.4 ug/l and 39 ug/l, and total was reported at 16.9 ug/l and 38.9 ug/l. Cadmium was detected in both samples, both dissolved and total. Dissolved cadmium was reported at 8.4J ug/l and 17.3 ug/l, and total was reported at 8.2J ug/l and 18.4 ug/l. The cleanup standard is 5 ug/l. Cobalt was detected above its cleanup standard of 2,000 ug/l in the September sample. Dissolved cobalt was reported at 3,680 ug/l and total was reported at 3,630 ug/l.

Copper was detected in the samples, both dissolved and total. Dissolved copper was reported at 1,500 ug/l and 4,750 ug/l, and total was reported at 1,440 ug/l and 4,800 ug/l. The cleanup standard is 1,000 ug/l. Manganese was reported above its cleanup standard (50 ug/l) at total concentrations of 3,910 ug/l and 7,980 ug/l. Dissolved manganese was reported at 4,060 ug/l and 7,390 ug/l. Nickel was reported above its cleanup standard (100 ug/l) at total concentrations of 4,970 ug/l and 10,600 ug/l. Dissolved nickel was reported at 5,100 ug/l and 9,810 ug/l. Chromium was detected above the cleanup standard (100 ug/l), both dissolved and total. Total chromium was reported at 78,000 ug/l and 183,000 ug/l, and dissolved chromium was reported at 80,200 ug/l and 177,000 ug/l. Hexavalent chromium was reported at 77.9 mg/l and 175 mg/l (total), which is equivalent to 77,900 ug/l and 175,000 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium. The hexavalent chromium concentrations detected appear to represent the majority of the total chromium detected.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene, and vinyl chloride were detected above cleanup standards. 1,1-Dichloroethane was detected in the September sample at a concentration of 160 ug/l, above its cleanup standard of 110 ug/l. 1,1-Dichloroethene was detected at 75 ug/l in the May sample, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was reported above the cleanup standard of 70 ug/l at 180 ug/l and 430 ug/l. Methylene chloride was detected at 440 ug/l and 1,000 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 590 ug/l and 1,900 ug/l, above the cleanup standard of 5 ug/l; trichloroethene was detected at 3,600 ug/l and 9,600 ug/l, above the cleanup standard of 5 ug/l. 1,1,1-Trichloroethane was detected at 620 ug/l in the September sample, above the cleanup standard of 200 ug/l.

Vinyl chloride was detected at 4 J ug/l in the May sample, above the cleanup standard of 2 ug/l. The designation "J" indicates the sample concentration is estimated.

MW-08

Monitoring well MW-08 was sampled during May and September of 2002, as indicated above. No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Most TAL Metals were reported in the samples; however, none exceeded their respective cleanup standards. It should be noted that the hexavalent chromium results are increasing in concentration in MW-08, although they are still below cleanup standards. This may be indicative of plume migration.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected in both rounds at 24 ug/l and 32 ug/l, above the cleanup standard of 7 ug/l. Trichloroethene was detected at 180 ug/l and 210 ug/l, above the cleanup standard of 5 ug/l.

MW-09

Monitoring well MW-09 was sampled during May and September of 2002, as indicated above. No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Most TAL Metals were reported in the samples for each round; however, only antimony and thallium exceeded their respective cleanup standard. Antimony was reported for the May sample above the cleanup standard of 6 ug/l for total metals at a concentration of 12.9J ug/l. Thallium was reported in the September sample above the cleanup standard of 2 ug/l for total metals at a concentration of 9.5J ug/l.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2 dichloroethene, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected in all samples at 59 ug/l and 54 ug/l, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was reported above the cleanup standard of 70 ug/l at 77 ug/l for both samples. Tetrachloroethene was detected in both samples at 40 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 720 ug/l and 740 ug/l, above the cleanup standard of 5 ug/l.

MW-10

Monitoring well MW-10 was sampled during each of the sampling events listed above. No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Most TAL Metals were reported in the samples for each round; however, only barium, iron, manganese, and thallium exceeded their respective cleanup standards. Barium was detected for both dissolved and total metals. Total barium was reported at 7,720 ug/l and 7,010 ug/l. Dissolved barium was detected at 7,720 ug/l and 6,740 ug/l. The cleanup standard for barium is 2,000 ug/l. Iron was reported above the cleanup standard of 300 ug/l for both total and dissolved metals. Total iron was reported at 35,500 ug/l and 35,200 ug/l. Dissolved iron was detected at 31,900 ug/l and 28,400 ug/l. Manganese was reported above its cleanup standard (50 ug/l) for both dissolved and total metals. Total manganese was reported at 29,200 ug/l and 26,100 ug/l. Dissolved manganese was reported at 29,800 ug/l and 26,100 ug/l. Thallium was detected in the September sample above the cleanup standard of 2 ug/l for both dissolved and total metals. Dissolved thallium was reported at 25.9 ug/l, and total thallium was reported at 37.3 ug/l.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 89 ug/l and 70J ug/l, above the cleanup standard of 7 ug/l. Cis-1,2dichloroethene was detected at 310 ug/l and 280 ug/l above the cleanup standard of 70 ug/l. Tetrachloroethene was detected at 160 ug/l and 140 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 13,000 ug/l and 11,000 ug/l, above the cleanup standard of 5 ug/l. The designation “J” indicates the sample concentration is estimated.

MW-11

Monitoring well MW-11 was sampled during each of the sampling events listed above. No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Most TAL Metals were reported in the samples; however, only aluminum exceeded its respective cleanup standard of 200 ug/l. Total aluminum was reported in the September sample at a concentration of 1,060 ug/l.

Numerous volatile organic constituents were detected in the samples; however, only carbon tetrachloride was detected above cleanup standards. Carbon tetrachloride was detected at 9 ug/l for both samples, above the cleanup standard of 5 ug/l.

MW-12

Monitoring well MW-12 was sampled during each of the sampling events listed above. No semi-volatile organic constituents or TAL metals were detected above the cleanup standards for any of the sampling events. Several volatile organic constituents were detected in the samples; however, only trichloroethene was detected above cleanup standards. Trichloroethene was detected at 27 ug/l and 26 ug/l, above the cleanup standard of 5 ug/l.

MW-13

Monitoring well MW-13 was sampled during each of the sampling events listed above. No semi-volatile organic constituents or TAL metals were detected above the cleanup standards for any of the sampling events. Several volatile organic constituents were detected in the samples; however, only carbon tetrachloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. Carbon tetrachloride was detected at 6 ug/l and 5 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 8 ug/l and 7 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected in the September sample at a concentration of 7 ug/l, above the cleanup standard of 5 ug/l.

MW-14

Monitoring well MW-14 was sampled during each of the sampling events listed above. No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Numerous TAL Metals were detected; however, only chromium (total) and hexavalent chromium were detected above cleanup standards. Chromium was detected at 377 ug/l and 917 ug/l for dissolved metals. Total chromium was reported at 399 ug/l and 899 ug/l, above the cleanup standard of 100 ug/l. Hexavalent chromium was reported at 0.361 mg/l and 0.891 mg/l (total), which is equivalent to 361 ug/l and 891ug/l in comparison to the cleanup standard of 100 ug/l for total chromium. It should be noted that the hexavalent and total chromium concentrations detected above cleanup standards for these two rounds were not observed prior to this round, although these constituents were detected. This may be an indicator of plume migration.

Several volatile organic constituents were detected in the samples; however, only carbon tetrachloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. Carbon tetrachloride was detected at 13 ug/l and 12 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was at 8 ug/l and 6 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 99 ug/l and 130 ug/l, above the cleanup standard of 5 ug/l.

MW-15

Monitoring well MW-15 was sampled during each of the sampling events listed above. No semi-volatile organic constituents were detected above the cleanup standards for any of the sampling events. Numerous TAL Metals were detected; however, only chromium and hexavalent chromium were detected above cleanup standards. Chromium was detected at 7,480 ug/l and 7,420 ug/l for dissolved metals, above the cleanup standard of 100 ug/l. Total chromium was reported at 7,550 ug/l and 7,170 ug/l. Hexavalent chromium was reported at concentrations of 7.32 mg/l and 7.46 mg/l (total), which is equivalent to 7,320 ug/l and 7,460 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 40 ug/l and 38 ug/l, above the cleanup standard of 7 ug/l. Cis-1,2 dichloroethene was detected at 330 ug/l for both samples, above the cleanup standard of 70 ug/l. Methylene chloride was detected in the May sample at 12J ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 170 ug/l and 180 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 4,400 ug/l and 4,800 ug/l, above the cleanup standard of 5 ug/l. The designation "J" indicates the sample concentration is estimated.

MW-16

Monitoring well MW-16 was sampled during each of the sampling events listed above. No semi-volatile organic constituents were detected above the cleanup standards for the sampling events. Numerous TAL Metals were detected; however, only antimony, chromium, and hexavalent chromium were detected above cleanup standards. Total antimony was detected at 31.4J ug/l in the May sample, above the cleanup standard of 6ug/l. Dissolved chromium was detected at 166 ug/l and 157 ug/l, above the cleanup standard of 100 ug/l. Total chromium was detected at 172 ug/l and 137 ug/l. Hexavalent chromium was detected at 0.167 mg/l and 0.149 mg/l, which is equivalent to 167 ug/l and 149 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium. The designation "J" indicates the sample concentration is estimated.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 280 ug/l and 250 ug/l, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was detected at 120 ug/l and 100 ug/l, above the cleanup standard of 70 ug/l. Tetrachloroethene was detected at 220 ug/l and 180 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 230 ug/l and 200 ug/l, above the cleanup standard of 5 ug/l.

MW-17

Monitoring well MW-17 was sampled during each of the sampling events listed above. Samples were collected from three zones (shallow, middle, and deep) during each sampling event. No semi-volatile organic constituents were detected above the cleanup standards for either event. Several TAL metals and volatile organic constituents were detected in the samples; however, no concentrations were reported above their respective cleanup standards.

MW-18

Monitoring well MW-18 was sampled during each of the sampling events listed above. No semi-volatile organic constituents or TAL metals were detected above the cleanup standards for any of the sampling events.

Several volatile organic constituents were detected in the samples; however, trichloroethene was detected above cleanup standards. Trichloroethene was detected at 46 ug/l and 47 ug/l, above the cleanup standard of 5 ug/l.

MW-19

Monitoring well MW-19 was sampled during each of the sampling events listed above. No semi-volatile organic constituents in the well were detected above the cleanup standards for the sampling events. Numerous TAL Metals were detected; however, only chromium and hexavalent chromium were detected above cleanup standards. Dissolved chromium was detected at 644 ug/l and 565 ug/l, above the cleanup standard of 100 ug/l. Total chromium was reported at 645 ug/l and 531 ug/l. Hexavalent chromium was detected at 0.609 mg/l and 0.572 mg/l, which is equivalent to 609 ug/l and 572 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected in the May sample at 8 ug/l, above the cleanup standard of 7 ug/l. Tetrachloroethene was detected at 26 ug/l and 19 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 870 ug/l and 650 ug/l, above the cleanup standard of 5 ug/l.

MW-20

Monitoring well MW-20 was sampled during each of the sampling events listed above. No semi-volatile organic constituents in the well were detected above the cleanup standards for the sampling events. Numerous TAL Metals were detected; however, only aluminum, beryllium, chromium, iron, and hexavalent chromium were detected above cleanup standards. Aluminum was detected in the May sample for total metals at 490 ug/l, above the cleanup standard of 200 ug/l. Beryllium was detected in the May sample for dissolved metals at 5.6J ug/l, above the cleanup standard of 4 ug/l. Chromium was detected for both dissolved and total metals. Dissolved chromium was detected at 23,700 ug/l and 21,200 ug/l, above the cleanup standard of 100 ug/l. Total chromium was detected at 24,200 ug/l and 21,200 ug/l. Iron was detected in the May sample for total metals at 528 ug/l, above the cleanup standard of 300 ug/l. Hexavalent chromium was detected at 24.5 mg/l and 20 mg/l, which is equivalent to 24,500 ug/l and 20,000 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 43 ug/l and 34 ug/l, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was detected at 77 ug/l and 79 ug/l, above the cleanup standard of 70 ug/l. Tetrachloroethene was detected at 87 ug/l and 91 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 1,600 ug/l and 1,300 ug/l, above the cleanup standard of 5 ug/l.

DW - Domestic Well

Monitoring well DW was sampled during each of the sampling events listed above. No semi-volatile organic constituents were detected in the groundwater samples for the three rounds of sampling. Numerous TAL Metals were reported in the samples for both rounds; however, only iron, manganese, and nickel were reported above their respective cleanup standards. Iron (total) was reported at 26,100 ug/l and 15,300 ug/l. Dissolved iron was detected at 25,700 ug/l and 14,900 ug/l. The cleanup standard for iron is 300 ug/l. Total manganese was detected at 4,290 ug/l and 3,890 ug/l. Dissolved manganese was detected at 4,250 ug/l and 3,810 ug/l. The cleanup standard for manganese is 50 ug/l. Nickel was detected in the September sample for both dissolved and total metals, at concentrations of 121 ug/l and 122 ug/l, respectively. The cleanup standard for nickel is 100 ug/l.

Numerous volatile organic constituents were detected in the samples; however, only tetrachloroethene and trichloroethene were detected above their respective cleanup standards. Tetrachloroethene was reported at 6 ug/l for both samples, above the cleanup standard of 5 ug/l. Trichloroethene was reported at 7 ug/l and 10 ug/l, above the cleanup standard of 5 ug/l.

Groundwater samples were analyzed for VOCs by USEPA Method 8260, SVOCs by USEPA Method 8270, TAL metals by USEPA Method 6010, cyanide by USEPA Method

9010/9014, and hexavalent chromium by USEPA Method 3060A. The results were compared to the Act 2 Standards contained in Pennsylvania Code, Title 25, November 24, 2001, Appendix A, MSCs for Organic Regulated Substances in Groundwater Table 1, and Inorganic Regulated Substances in Groundwater Table 2.

Of special note in the Act 2 standards, dated November 2001, is that the cleanup standard of 100 ug/l for total chromium is used in correlation to hexavalent chromium, whereas prior to this change, hexavalent chromium had a separate, less stringent cleanup standard.

5.0 CONCLUSIONS

The following sections discuss the distribution and possible migratory pathways of the contaminants of concern (COCs) detected throughout the Chem-Fab Site. Site COCs were detected at concentrations exceeding Act 2 standards throughout the site groundwater samples.

5.1 Groundwater Investigation

Based on the initial evaluation of the site characterization data, shallow groundwater is present at the site from approximately 10 to 14 feet bgs. This part of the investigation concentrated on the groundwater below this depth. Each well was cased to at least 20 feet and then completed from 37 feet bgs to 220 feet bgs. Based on groundwater flow maps and topography, groundwater has an assumed flow direction to the west in the direction of Cooks Run tributary. It would appear that the deeper groundwater may be flowing in a different direction or may be influenced. Based on an evaluation of the sample analytical data discussed in Section 5.0, AMEC has identified COCs in the onsite and offsite groundwater at the Chem-Fab Site, varying in depths from the shallow water previously investigated at 11-14 feet bgs, to the deeper depths of over 200 feet bgs investigated as part of this investigation. Groundwater contamination was found throughout the water column; however, based on data collected and represented on the distribution maps, a larger percentage of the contamination appears to be found at depths between 37 feet and 125 feet. Based on the geophysical results, drilling, and video logging, it is unclear as to whether these represent distinct zones or are hydraulically connected via the extensive fracturing.

The volatile organic compounds and TAL Metals detected above cleanup standards in the monitoring wells are consistent with the previous rounds of the investigation.

However, it should be noted that while most wells remained constant in concentrations with little fluctuations, several wells reported elevated concentrations of either volatiles or metals or both.

Monitoring wells MW-04 and MW-06 reported elevated concentrations of volatiles. These wells are located on or near the source. MW-02 and MW-07 reported elevated concentrations of volatiles and metals and are both located at the source area on-site. Monitoring well MW-15 reported an increase in metals. MW-15 is located near the area of a suspected second source on the Extra Space property. The other well in this area, MW-14, reported hexavalent chromium and total chromium above cleanup standards for these two rounds, whereas previous rounds were reported below cleanup standards, indicating possible migration or leaking from a second potential source.

This potential source, located near the swale area on the Extra Space property, has not been identified to date. However, the contaminants identified are related to the historic activities conducted on the Chem-Fab Site.

6.0 REFERENCES

1. U.S. Geologic Quadrangle for Doylestown, Pennsylvania (7.5 Minute Series).

2. U.S. Geologic Survey Topographic Quadrangle (7.5 Minute Series) for Doylestown, PA, 1966, which was compiled by photogrammetric methods from imagery dated 1950, field checked 1952, revised from aerials taken 1965, and photorevised in 1983.

3. Pennsylvania Bulletin, Vol. 27, No. 33 (dated August 16, 1997), Act 2 Medium Specific Concentrations for Organic Regulated Substances in Groundwater for Used Aquifers in Residential Areas (Appendix A, Table 1).

4. Final Phase II Site Characterization Report for Chem-Fab Site, prepared by AMEC, November 2002.

AMEC Standard Operating Procedures

FP-D-3	Monitoring Well Sampling
FP-D-5	Equipment Decontamination
FP-F-1	Laboratory QC Samples (Water, Soil)
FP-F-5	Logbooks
FP-F-6	Recordkeeping, Sample Labeling, and Chain of Custody
FP-F-7	Sample Handling, Storage, and Shipping

FINAL
ENGINEERING EVALUATION REPORT

CHEM-FAB SITE
DOYLESTOWN,
BUCKS COUNTY, PENNSYLVANIA

PADEP Contract No.: ME 359185
Work Assignment No.: 31-070

Submitted to:

Commonwealth of Pennsylvania
Department of Environmental Protection
Bureau of Land Recycling and Waste Management
Division of Remediation Services

Submitted by:

AMEC Earth & Environmental, Inc.
One Plymouth Meeting
Suite 850
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Project No. 97038-009
May 2, 2003

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Prepared by:	**Reviewed by:**	**Approved by:**
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NOTICE

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EXECUTIVE SUMMARY

AMEC Earth & Environmental, Inc. (AMEC) has conducted a Site Characterization, Site Characterization Phase II, an Addendum Phase II and an Engineering Evaluation with associated reports for the Chem-Fab Site located in Doylestown, Bucks County, Pennsylvania, at the request of the Pennsylvania Department of Environmental Protection (PADEP).

The subject property is identified as Chem-Fab Corporation, a former metal plating company, and encompasses an area of approximately 1.0 acre. The Chem-Fab Site is located at 300 North Broad Street in Doylestown Township, Bucks County, Pennsylvania. The subject property contains three structures; a large office building, formerly the warehouse/manufacturing building, a small office building, formerly a storage building, and a former residential home converted into office space.

The site is bordered to the east by an operating business and to the west and south by an active storage facility. The site is bordered to the north by Broad Street. A small creek, Cooks Run, is located near the property to the west. Based on information from the Borough of Doylestown, residents of Doylestown rely on groundwater as a source of potable drinking water. The area in proximity to the site has a relatively shallow groundwater table and potable wells and a municipal water well are located in close proximity to the site.

Based on the investigations conducted to date, AMEC has identified potential risks/limitations associated with the Chem-Fab site, which may impact potential remediation technologies.

- Hexavalent Chromium, Trichloroethene (TCE) and Tetrachloroethene (PCE), along with other volatile organics and metals have been identified at the subject site, well in excess of the PADEP cleanup standards.
- The pH on site varies from location to location, ranging from 3-14.
- Extensive fractured bedrock
- Contamination extends vertically to depths of 200 feet.
- The chem-fab site is limited in size; consisting of less than one acre with three structures on it and tenants occupying it.
- Downgradient potable wells including borough municipal drinking well.

Bedrock at the Chem-Fab site was encountered at depths ranging from 8-18 feet below ground surface (bgs), and is comprised of weathered gray shale and sandstone. The dip at the site is approximately 10 degrees, oriented towards Cooks Run, with a rate of increase of 1 foot for every 5 feet of horizontal distance. The geometric mean of hydraulic conductivity was estimated at 0.6 ft/day.

Concentrations of TCE were highest in the shallow zone, with a reduction in the intermediate zone and a considerable reduction in the deep zone. PCE and Hexavalent Chromium were elevated in the shallow zone, increased in concentration in the intermediate zone and reported considerable less in the deeper zone. Based on this, the majority of the contamination can be found within the shallow and intermediate zones.

The geometry of the contaminant plume in the intermediate zone suggests transport along the formation strike (northeast-southwest). Groundwater flow at the site flows along preferential flow paths, due to the extensive bedding and fractures present.

The highest concentrations of hexavalent chromium and volatile organics are present in shallow groundwater on or near the existing one-story (former warehouse) tenant building. Hexavalent chromium concentrations are highest in the vicinity of MW-03, which is adjacent to the former UST that may have been used for plating liquid disposal. Volatile organic concentrations are highest in the vicinity of the former tank farm and MW-05, located approximately 50 ft to the west of the Chem-Fab site on the "Extra Space" property. Therefore, elevated volatile organics and hexavalent chromium in groundwater in these areas are considered the primary source of the groundwater contaminant plume.

Of the remedial technologies reviewed, no action and groundwater monitoring are not suitable for the Chem-Fab site. A combination of groundwater monitoring with groundwater extraction, some form of ex-situ treatment and aquifer reinjection is suitable for the site. This combination with either hydrofracturing and/or reductant addition would be most effective, by employing both insitu and exsitu remedial technologies to maximize effectiveness and minimize duration.

1.0 INTRODUCTION

AMEC Earth & Environmental, Inc. (AMEC) is submitting this Final Engineering Evaluation Report to the Pennsylvania Department of Environmental Protection (PADEP) in response to PADEP's Requisitions for Contractual Services 21-070 and 31-070 and the Scope of Work. This evaluation is based on the ongoing Phase II Site Characterization and consists of data from two rounds of groundwater sampling as well as pump testing data. The evaluation includes assembled combinations of remedial technologies, based on the site-specific groundwater concerns, to provide an appropriate range of options and sufficient information to allow for comparative analysis. As part of the engineering evaluation, different treatment options were compared, including biological, physical/chemical and containment. The results include a range of treatment and containment options, with each remedial alternative evaluated with respect to its effectiveness, implementability, and cost. A timeframe for when cleanup might be achieved is presented.

This document presents AMEC's technical report regarding the engineering evaluation and further characterization of the Chem-Fab Corporation Site (site), which is located in Doylestown, Bucks County, Pennsylvania (see Figure 1-1). The Site Plan with monitoring well locations is provided as Figure 1-2.

1.1 Site Geology

The Chem-Fab Site is located in Bucks County, which is predominantly an undulating plain characterized by low hills and ridges. Rocks underlying the county consist of schist, gneiss, shale, sandstone, quartzite, conglomerate, and limestone. Bucks County and Philadelphia County lie within two main physiographic divisions: the Appalachian Highlands on the northwest and the Atlantic Coastal Plain on the southeast. The Appalachian Highlands is divided into several provinces, which in the Bucks County area include the Piedmont province, the Triassic-Lowland province, and the New England province. (***Geology and Mineral Resources of Bucks County, Pennsylvania***, Pennsylvania Geologic Survey, 1959)

The Chem-Fab Site lies within the Triassic-Lowland physiographic province in Bucks County. This area is characterized by an uplifted plain formed by easily eroded inclined strata, with residual ridges marking the more resistant, tilted, volcanic rock. Local relief does not exceed 250 feet in elevation change. The bedrock underlying the site is Triassic-age Stockton lithofacies, which consists of light-colored, coarse-grained sandstone and conglomerate, red to brown fine-grained siliceous sandstone, and red shale. The shale and sandstone are interbedded in no order and repeated with individual bedding planes pinching out in short distances. This geologic unit has an average dip of 10 degrees and has a calculated thickness of approximately 3,000 feet. The formation is cut by a well-developed system of joints and fractures (***Geology and Mineral Resources of Bucks County, Pennsylvania***, Pennsylvania Geologic Survey, 1959 and the ***Geology and Mineral Resources of the Quakerstown-Doylestown Districts***, US Dept. of the Interior, 1931). The bedrock lithology encountered during site investigation activities is consistent with that described in the regional geologic literature. The geologic map of the subject site, including structural features (strike and dip) is included as Figure 1-3.

Bedrock was encountered at depths ranging from 8-18 ft. below ground surface (bgs) on-site, and is comprised of a weathered gray shale or sandstone. The bedrock surface drops to the north and east, where overburden sediments are observed to increase in thickness. The rocks of the Stockton are cut by a well developed system of joints and are extensively faulted. The beds commonly show ripple marks, mud cracks and raindrop impressions. Crossbedding, lensing and pinch and swell structures are characteristic features of the bedding, especially the arkose and conglomerate (***Groundwater Resources of Bucks County***, USGS 1955).

Overburden materials at the site are primarily comprised of silty sandy or clayey loam weathered from red and brown shale and sandstone. Lateral continuity of many of the lithologies appears to be limited based on a review of the boring logs.

1.2 Regional Hydrogeology

The Stockton lithofacies is a good source of water in Bucks County. Groundwater is contained in intergranular openings within the sedimentary rock where the cement has been weathered away; therefore, the occurrence and movement of groundwater are functions of the degree of weathering of the rock. Groundwater commonly occurs under artesian conditions where the sandstone and conglomerate beds are interlayered with red shale. This corresponds with the geophysical logs and contamination present, which appears to occur at the sandstone or conglomerate interfaces and in highly fractured rock. This artesian flow is probably a function of the dip and orientation of the bedding. The dip of the Stockton formation (as that of the Newark rocks), averages 10 degrees or more, northwest; therefore, a selected water-bearing bed stops bearing water at an appreciable distance down dip, as the bed grades into unweathered bedrock (***Geology and Mineral Resources of the Quakerstown-Doylestown Districts***, US Dept. of the Interior, 1931). According to the geologic map for the area (Figure 1-3), dip at the site is approximately 10 degrees and is oriented towards Cooks Run. There are numerous faults parallel to the northeast-southwest strike. Along strike, rapid variations in the character of sediment are evident. Due to the homoclinal dip of the rocks, the stratigraphy changes perpendicular to the strike of the formation so that for the average dip of 10 degrees reported for the project area, the rate of increase in depth of a given bed is approximately 1 foot for each 5 feet of horizontal distance. According to the ***Geology and Hydrology of the Stockton Formation in Southeastern Pennsylvania***, USGS 1962, vertical joints are common in the Stockton formation. The formation has a wide range in permeability; recorded yields for the Stockton range from 2 to 440 gallons per minute (gpm) with an average yield of 78 gpm.

The Stockton formation has been subdivided into three members as follows: the lower arkose member, characterized by the abundance of coarse-grained sandstone and arkosic conglomerate; the middle arkose member, which is characterized by the abundance of fine and medium grained arkosic sandstone; and the upper shale member, characterized by the predominance of shale and siltstone. Average specific capacities in these three zones are upper: 0.4 gpm/ft drawdown; middle: 4.8 gpm/ft drawdown; and lower: 3.1 gpm/ft drawdown.

The west-east cross-section (D-D'; oriented roughly normal to strike) prepared for the ***Phase II Site Characterization Report*** (SCR) (AMEC, 2002) is contained on the Cross Section Location Map, Figure 1-4 and the Cross Section Map, Figure 1-4a and illustrates the structural relationships described above. This figure also depicts pertinent aspects of site topography and hydrology; for example, the decreasing topographic elevation to the west of the Chem-Fab site resulting in a progressively shallower depth to the water table.

The orientation of ground water flow across the project site trends generally from east to west in the shallow (37-57 ft) and intermediate depth (58-85 ft) water bearing zones (toward Cooks Run), and appears to be oriented from west to east in the deep (86-210 ft) water bearing zone.

The hydraulic gradient within each of the three monitoring zones established on-site was estimated from water level monitoring data obtained in May and September of 2002. Within the shallow zone, the hydraulic gradient was estimated at 0.006 in May 2002 and 0.001 in September 2002, using data from wells MW-01 and MW-12. Within the intermediate depth zone, the hydraulic gradient was estimated at 0.009 in May 2002 and 0.004 in September 2002, using data from wells MW-02 and MW-18. Within the 85-210 ft monitoring zone, the hydraulic gradient was estimated at 0.007 in May 2002 and 0.008 in September 2002, using data from wells MW-06 and MW-13. The groundwater level elevation contour maps for each zone are included as Figures 1-5a and 1-5b.

The geometric mean of lateral hydraulic conductivity estimates associated with the shale and sandstone is 0.6 ft/day (2 x 10^{-4} cm/sec), based on ranges of hydraulic conductivity values from Domenico and Schwartz, 1990. The porosity for the site ranges from 5-35% for sandstone to <1-10% for shale (***Groundwater***, Freeze and Cherry, 1979). Aquifer parameter data derived the performance of on-site pump tests are discussed subsequently.

The elevation of Cooks Run is 3-4 ft. below the groundwater elevation of the adjacent wells MW-18 and MW-17, indicating an upward vertical groundwater hydraulic gradient. This suggests that under natural flow conditions, the stream represents a local or regional groundwater discharge corridor, and as such, acts as a barrier to the lateral movement of groundwater (and the migration of contaminants).

During the well installation program, screened intervals were completed within clean zones beneath the highest contaminant zone. The depths of the well screens, as indicated on the D-D' Dip Orientation Map (Figure 1-6), do not strongly suggest a correlation between bedding plane partings and yield (although potential correlation may be evident along dip between wells MW-07 and MW-10 based on geochemical and solvent contamination distribution data). As discussed subsequently, preferential flow (and contaminant migration) appears to be biased within vertical fractures oriented sub-parallel to the strike of the formation.

1.3 Water Chemistry

General indicators of groundwater chemistry are provided by the concentration distribution of dissolved solids (cations and anions) present in the formation water. The natural inorganic chemical composition of the groundwater depends chiefly on the mineralogy of the associated rock matrix. As reported in ***The Geology of Pennsylvania***, Pennsylvania Geological Survey, 1999, the inorganic chemical composition of Newark Basin Jurassic and Triassic sedimentary rocks is represented primarily by a calcium-magnesium-bicarbonate signature, similar in composition to limestone and dolomite. The geochemical composition observed at the project site is discussed in more detail in section 2.1.3.

Field measurements of indicator parameters also provide a basis for groundwater characterization. Table 1-1 presents the results from the sampling at Chem-Fab. Fluctuations in the pH, specific conductance, DO and ORP suggest interference with the probes, potentially from the contaminant concentrations present. Significant variation in these parameters was observed between wells; pH variation over several orders of magnitude occurs in wells adjacent to one another, and significant variation in DO and ORP is observed between wells. Geochemical sampling data used subsequently to characterize the on-site ground water formation chemistry, are provided in Table 1-2.

2.0 ENGINEERING EVALUATION ACTIVITIES

AMEC conducted the engineering evaluation in four phases: (1) baseline data generation; (2) identification of potential remedial technologies; (3) screening of technologies relative to site specific applicability; and (4) combination of technologies into a range of remedial alternatives, and screening of the alternatives relative to a series of evaluation criteria. Baseline data generation is discussed in this report section; remedial technology and alternatives assessment is provided in Section 3.

As part of the engineering evaluation, AMEC compiled literature data and evaluated site-specific boring log data to characterize the physical and structural characteristics of the local geology; characterized aquifer hydrology through synchronous groundwater level elevation monitoring and the performance of pump tests; identified the nature and distribution of contaminants on-site within three water bearing (groundwater monitoring) zones; and evaluated groundwater chemistry and geochemistry to assist in the evaluation of potential remedial options and contaminant migration pathways.

2.1 Baseline Data Generation

This section summarizes the results of the ***Site Characterization Report (SCR)*** (Ogden 2000), the ***Phase II Site Characterization Report*** (AMEC, 2002) and the ***Phase II Site Characterization Addendum Report*** (AMEC, 2002) relative to the distribution of site contamination, and the conceptual ground water flow and geochemical models that have been developed to describe contaminant transport and fate. The primary constituents of concern (CoC) at the project site consist of the volatile organic compound (VOC) solvents tetrachloroethene (PCE), trichloroethene (TCE), and associated daughter (breakdown) products; fuel oil related contaminants (BTEX); and hexavalent chromium. Figure 2-1 provides a summary distribution of PCE, TCE, cis1-2 DCE, 1-1 DCE, and vinyl chloride concentrations at the site for all wells (May 2002 sampling round).

2.1.1 Ground Water

This program is focused on characterization of the shallow (37-57 ft bgs), intermediate (58-85 ft bgs) and deeper monitoring zones (86-220 ft bgs), regarding the distribution of dissolved contaminants on-site.

Figure 2-2a and 2-2b (TCE), Figure 2-3a and 2-3b (PCE) and Figure 2-4a and 2-4b (hexavalent chromium) graphically summarize the contaminant distribution for these three constituents within the three previously identified monitoring zones for the May and September sampling rounds. As noted previously, these zones were selected based on the identification of water bearing strata during the drilling program.

Concentrations of TCE in the shallow water-bearing zone ranged from approximately 12,000 ppb to 34,000 ppb (relative to the PADEP cleanup standard of 5 ppb). Generally, an order of magnitude reduction was observed in the intermediate depth zone, with concentrations ranging from approximately 2,000 ppb to 18,000 ppb; a small area exhibits elevated concentrations in the range of 20,000 to 34,000 ppb. The deeper water-bearing zone exhibited a considerable reduction in the concentration distribution, ranging from <5 ppb to approximately 2,000 ppb.

Concentrations of PCE within the shallow water-bearing zone ranged from non detect to 600 ppb (relative to the PADEP cleanup standard of 5 ppb). Concentrations observed within the intermediate zone were similar, ranging from approximately 25 ppb to 700 ppb. A considerable decrease in concentration was observed in the deep zone, ranging from approximately 5 ppb to 250 ppb.

Concentrations of hexavalent chromium detected within the shallow water-bearing zone ranged from approximately 0.1 ppm to 90 ppm (relative to the PADEP cleanup standard of 0.1 ppm). An increase in the concentration was observed in the intermediate zone, with levels ranging from approximately 0.1 ppm to 220 ppm. A reduction in concentration was observed in the deep zone, with levels ranging from less than 0.1 ppm to approximately 8 ppm.

The highest concentrations of hexavalent chromium, in both the May and September sampling events, are detected in the intermediate zone in the vicinity of MW-04. Similarly, the highest concentrations of trichloroethene (TCE), in May and September, are also found in the intermediate zone at MW-04. The highest concentrations of tetrachloroethene (PCE) are detected in the intermediate zone at MW-02. The geometry of the contaminant plumes in the intermediate depth zone suggests preferential transport along the orientation of the formation strike (northeast-southwest).

2.1.2 Pump Test

Pumping tests provide a means of estimating aquifer hydraulic properties, and evaluating the hydraulic continuity and/or heterogeneity of the flow system within the aquifer matrix. The response to pumping (water level drawdown) is observed in several wells over time, recorded and evaluated. The literature indicates that the Stockton formation generally does not respond to pumping as an ideal (isotropic) aquifer would, due to heterogeneities associated with preferential flow paths along bedding plane partings and high angle fractures oriented sub-parallel to the strike of the formation (Morin et al., 1997). According to the **Geology and Hydrology of the Stockton Formation in Southeastern Pennsylvania**, USGS 1962, analyses of pumping tests indicate coefficients of transmissivity ranging from 1,000 gallons per day (gpd) per foot to 25,000 gpd per foot and coefficients of storage from $1.9\mathrm{X}10^{-5}$ to 5.4×10^{-4}.

AMEC conducted an aquifer pump test at the Chem-Fab site between August 9, 2002 and August 16, 2002. The objectives of the pump test were to: (1) estimate aquifer hydraulic parameters within the shallow and/or deeper water bearing zones (based on the ability of the pumping well(s) to provide a sustained yield), and (2) evaluate preferential flow pathways within the zone of influence of the test, in support of the site remediation planning process.

The pump test program consisted of an antecedent monitoring period (August 9th through August 12th); a step test (performed in well MW-06 on August 12); pump testing of MW-02, MW-03, MW-04 and MW-06 (conducted from August 12th to August 16th); and a recovery monitoring period (August 16th).

Water levels in the pumping well and selected observation wells were measured using installed pressure transducers and recorded using a data logger, which digitally records the changes in water level versus time. Water level meters (Solinst) were also used periodically to monitor non-instrumented wells. AMEC utilized the Hermit 3000 eight-channel data logger and eleven In-Situ MiniTroll pressure transducers for the pump test. The Hermit was set up on the pumping well and adjacent wells, while the MiniTrolls were placed in observation wells further from the pumping well. In addition, a laptop computer was used to monitor the data during the field activities. AMEC utilized a 2-inch submersible pump (Grundfos) to induce drawdown in the aquifer. Groundwater discharge from the pump testing was routed directly into a tanker truck for disposal. The on-site 5,000-gallon above ground storage tank was temporarily utilized for storage during the period when the tanker truck was mobilized off-site for water disposal.

Antecedent Monitoring

In order to evaluate background influences and natural fluctuations within the groundwater flow system, In-Situ MiniTroll data logger/pressure transducers were placed in the following wells: MW-01, MW-02, MW-03, MW-04, MW-06, MW-07, MW-12, MW-15, MW-16 and DW. Each probe was programmed to record data linearly (every thirty minutes) for a period of approximately 70 hours; MW-16, was programmed to collect data every 15 minutes. Fluctuations observed during the antecedent monitoring period could indicate rhythmic, diurnal atmospheric pressure changes, cycling associated with local production or supply wells, or regional recharge or discharge trends that would need to be accommodated during the derivation of aquifer parameters from the time-drawdown data. Antecedent monitoring data derived from the project site over the period of August 9-12 are provided on Figure 2-5.

Step Test

AMEC conducted a step test to assist in the estimation of a pumping rate to be utilized during the long term pump test; i.e., a rate that would provide measurable drawdown without leading to well dewatering. MW-02 was selected for the step-test based on proximity to the source, contaminant concentrations, and depth of the well. MW-02 is constructed with a 20 foot steel outer casing to bedrock, and a 4-inch PVC screen to a depth of 75 feet, with the sand pack set at approximately 55 feet. This well is set in a cluster of wells with depths ranging from 35 to 125 feet, with MW-02 representing the intermediate depth zone. The test was conducted for approximately 20 minutes with the data logger recording data linearly every 30 seconds. Water level monitoring was also performed in the wells previously instrumented for the antecedent monitoring program. The initial pumping rate selected was 5 gallons per minute (gpm), which resulted in dewatering of the well within 25 minutes. The pumping rate was subsequently adjusted to 2 gpm, which resulted in no appreciable drawdown. The pump rate was then increased to 3.5 gpm. The duration of the step test was approximately 4 hours.

Pump Test

The pump test was initiated at MW-02; however, the well dewatered after 40 minutes at a pumping rate of 2 gpm. A protocol was then established to attempt pump testing at source area wells that had exhibited reasonable yields during prior purging and sampling activities. Testing at shallow and intermediate depth source area wells were to be targeted first. Consequently, MW-03 was selected next. MW-03 is a 50-foot well constructed with 20 feet of steel casing and a screened interval of 15 feet. This well dewatered after 1.5 hours at a rate of 2 gpm. Testing was then initiated at MW-04 (75-foot well with 20 feet of steel casing and a screen placement at 60-75 feet bgs). The pumping rate was 2 gpm and the well was pumped for 35 minutes before it went dry. Finally, testing was performed at deep well MW-06. This well is a125 foot well with a screened interval at 110-125 feet bgs. The pumping rate was set at 2 gpm, and this well was utilized for the remainder of the test program. The total volume of water generated over the 46 hour duration of the test was estimated at 8,000 gallons.

Recovery Monitoring

AMEC monitored water level recovery at MW-06 and the surrounding wells for approximately 6 hours. MW-06 recovered to approximately 96% of its static water level by the end of the period.

Results of the Pump Test Program

The analysis of antecedent, piezometric-surface trends in wells DW, MW-01, MW-02, MW-03, MW-04, MW-06, MW-07, MW-12, MW-15, and MW-16 revealed evidence of two types of regional variations. First, a site-wide linear decrease in piezometric surface elevations was observed, which was characterized by a rate of change of 0.05 to 0.13 ft/day. The rate of change within individual wells was observed to be relatively constant throughout the monitoring period. This decreasing change in head is presumed to represent discharge from the regional flow system. Second, periodic water-level fluctuations were observed with an amplitude ranging from ±0.01 to 0.06 ft, which were characteristic of the water-level variations induced by "earth tides" (earth tide refers to the response of the solid earth to the same gravitational forces that create tides in the ocean; Domenico and Schwartz, 1990). The tidal fluctuations were readily distinguishable from anthropogenic influences (such as off-site pumping), on the basis of their consistent amplitude, semiduirnal cycle, and a forward phase-shift of approximately 1 hour per day.

The piezometric-surface trend within each well was characterized using a least-squares linear regression analysis of water-level (drawdown) vs. time. A 48-hour time interval was chosen for the analyses, which extended from 6:00 a.m. on August 9, 2002 to 6:00 on August 12. A time interval approximately equal to two complete tidal cycles was used in the analysis, so that the tidal effects would "cancel out" in the regression calculations. The regression analyses yielded slopes of 0.05 to 0.13 ft/day of drawdown. The corresponding coefficient of determination (R^2) values ranged from 0.82 to 0.99, which indicated a close agreement between the linear models and the field observations. Well MW-10, which was used as an observation well during subsequent pumping tests, was not included in the antecedent monitoring. Therefore, linear trend corrections for this well were estimated using the average slope and intercept values obtained from the two nearest intermediate-depth wells (MW-04 and MW-15).

Linear corrections were applied to the water-level measurements made during the pumping tests based on the results of the regression analyses (the tidal fluctuations, which were of lesser magnitude than the linear trends, were not corrected). The antecedent trends were extrapolated forward through the measurement period (August 12-16, 2002), and a corresponding trend correction was applied to each water-level measurement.

The transmissivity (T) and hydraulic conductivity (K) of the shallow and intermediate-depth flow systems were calculated using trend-corrected time-recovery measurements from wells MW-03 and MW-04. As noted in Section 2.1.2, wells MW-03 and MW-04 were completely de-watered during initial pumping tests on August 13, 2002, which precluded effective application of time-drawdown or distance-drawdown methods to the pumping test data. However, sufficient data were available concerning the residual drawdown in the wells from which to calculate T and K, using the method outlined by Driscoll (1986). Using this method, a transmissivity of 2.2 ft^2/day

(16.7 gpd/ft) and a corresponding K value of 1.5 x 10^{-1} ft/day (5.3 x 10^{-5} cm/sec) was calculated for well MW-03 (Figure 2-6a). The values of T and K calculated for well MW-04 were 1.3 ft^2/day (9.5 gpd/ft) and 8.4 x 10^{-2} ft/day (3.0 x 10^{-5} cm/sec), respectively (Figure 2-6b). The screened intervals within wells MW-03 and MW-04 are 35 to 50 feet and 60 to 75 feet below grade respectively. The derived aquifer parameters are consistent with the minimal yield observed in these wells.

The results of the 46-hour pumping test at well MW-06 were used to estimate the transmissivity of the intermediate/deep flow system and to investigate patterns of ground water flow. A drawdown (corrected for linear trend) of 5.7 feet was observed in pumping well MW-06 after 45 hours of pumping at typical rates of 3-4 gallons per minute (gpm). The corresponding drawdown values of 0.8 to 2.8 feet were measured in the seven observation wells monitored during this period (DW, MW-01, MW-02, MW-07, MW-10, MW-12, and MW-16). A plot of drawdown values obtained approximately midway (22 hours) through the pumping test shows evidence of an elongated cone of depression, with the axis of elongation oriented approximately parallel to the inferred strike of bedrock (Figure 2-7). These results are suggestive of preferential groundwater flow parallel to strike, consistent with the literature (Michalski and Britton, 1997).

Values of T and K were estimated for the intermediate/deep flow system using both the Cooper-Jacob Time-Drawdown and Theis Methods. The time-drawdown data used in these analyses were obtained from observation well MW-16. The data used in the analyses were obtained over an 18.5-hour period during the first day of the pumping test. These data were judged to be the most reliable, based on the consistency of the pumping rates measured in the field across that period. A confined aquifer and an infinite horizontal extent was assumed in the calculations. The T and K values calculated using the Cooper-Jacob Time-Drawdown Method were 609 ft^2/day (4,560 gpd/ft) and 5.63 ft/day (3.97x10^{-3} cm/sec), respectively (Figure 2-8a). The T and K values calculated using the Theis Method were 968 ft^2/day (7,260 gpd/ft) and 8.95 ft/day (6.31x10^{-3} cm/sec), respectively (Figure 2-8b). The transmissivity values lie within the range reported by the USGS for the Stockton Formation in Southeastern Pennsylvania (USGS, 1996). While the monitoring well array was not designed to allow for aquifer analysis using fracture flow techniques, preliminary evaluation of the test data using such methods (e.g., Moench, 1993), suggest a storage coefficient on the order of 2×10^{-5}; this value is consistent with the regional literature (USGS, 1996), and is likely more representative of the flow system in the project area.

2.1.3 Geochemistry

As water flows through an aquifer it assumes a diagnostic chemical composition as a result of interaction with the lithologic framework. Hydrochemical facies are areas of groundwater with different chemical composition, which is a function of the lithology, solution kinetics and flow pattern of the aquifer (***Applied Hydrogeology***, CW. Fetter, 1994). Shallow ground water chemistry may often exhibit a "signature" that varies substantially from that associated with deeper water bearing units due to variation in the composition of overburden deposits (e.g., river sediments, construction fill) and anthropogenic influences (e.g., waste disposal, road salt, etc.)

More than 90% of the dissolved solids in groundwater can be attributed to eight ions: Na^+; Ca^{2+}, K^+, Mg^{2+}, $S0_4^{2-}$, Cl^-, HCO_3^- and CO_3^{2-}. A trilinear diagram can show the percentage composition of these positively and negatively charged ions (cations and anions, respectively) in groundwater, thereby allowing for differentiation between formation water types. Figure 2-9 represents a trilinear (Piper) diagram showing the chemical character of groundwater in the Stockton formation, exhibiting a calcium-magnesium-bicarbonate signature. As indicated, this chemical composition plots predominantly in the left-center quadrant of the central diamond shape field of the Piper diagram (which represents water composition with respect to the concentration distribution of both cation and anions). There is no distinct chemical difference between members of the Stockton as reported in the **Geology and Hydrology of the Stockton Formation in Southeastern Pennsylvania**, USGS 1962.

Trilinear diagrams developed from groundwater sampling performed at the project site in May and September 2002 are indicated on Figure 2-10. These data fall within three zones: (1) dilute natural groundwater exhibiting the characteristic calcium-magnesium-bicarbonate signature of the Stockton formation; (2) highly concentrated calcium-chloride dominated waters; associated primarily with the shallow and intermediate depth waters exhibiting solvent and chromium contamination (note that the size of the circular data point associated with each well in the central diamond of the Piper plot is proportional the total dissolved solids (TDS) concentration); and (3) a zone characteristic of mixing between these two water types.

A second type of graphical presentation of geochemical data is the Stiff diagram, which is a polygonal shape created from four parallel horizontal axes extending on either side of a vertical zero axis. Cations are plotted in milliequivalents per liter on the left and anions are plotted on the right. As with the Piper trilinear diagram, the Stiff diagram is useful to compare water from different sources. The characteristic shapes produced by the Stiff diagram are often easier to interpret than the zone distributions provided by the Piper diagram. Stiff diagrams prepared from groundwater sampling performed at the project site in May and September 2002 are indicated on Figure 2-11. As indicated, concentrated calcium-chloride waters (associated with contaminated wells MW-02, MW-03, MW-04, MW-05, MW-06, MW-07, MW-09, MW-10 and MW20) are clearly distinguished from dilute natural waters exhibiting the calcium-magnesium-bicarbonate signature of the Stockton formation.

2.1.4 Conceptual Flow Model

Both permeability and storage of bedrock formations in the Newark Basin are fracture controlled, with the possible exception of the sandstone facies. The weathered zone generally exhibits a lower permeability and a greater storage than the deeper bedrock. Below the weathered zone, the prevailing groundwater flow direction tends to be subparallel to the strike of the beds. The prevalence of flow within high angle fractures oriented along strike in the Newark Basin bedrock is due apparently to the impedence of flow in the downdip direction by a reduction of bedding parting apertures and permeability at greater depths. As noted in ***The Role of Bedding Fractures in the Hydrogeology of Sedimentary Bedrock-Evidence from the Newark Basin, New Jersey***, Michalski and Britton, 1997, even if permeability within a dipping bedding fracture were constant, a flow pathway along strike would be favored over a longer flow pathway involving a downdip flow component and subsequent updip flow near a discharge zone. Preferential flow along the formation strike within the project site is suggested through review of Figures 2-2a and 2-2b, Figures 2-3a and 2-3b and Figure 2-4a and 2-4b. The geometry of the contaminant plumes for PCE and TCE, and to a limited extent hexavalent chromium appear to be oriented along a NE-SW axis. This relationship was also observed in terms of the anisotropy of the groundwater flow field recorded (in terms of drawdown) during performance of the on-site pump test program (Figure 2-7).

2.1.5 Estimated Contaminant Volume and Mass

Volume and mass estimates for contaminated ground water were derived from the mapped distribution of noted volatile organic compounds (PCE, TCE) and hexavalent chromium documented in the Site Characterization Report (SCR), Phase II SCR and the Phase II SCR Addendum.

The volume of contaminated ground water on-site is estimated based on a lateral plume geometry area of approximately 679,918 ft^2, an approximate thickness of 220 ft, and a sediment/rock porosity of 0.1 (10%). These volume data were integrated with the mapped contaminant distribution within each of the on-site monitoring zones to estimate contaminant mass. The associated total mass of hexavalent chromium is estimated to be approximately 1,160 lb. in the shallow water bearing zone, 3,680 lb. in the intermediate depth water bearing zone, and 620 lb. in the deep water bearing zone. The associated total mass of trichloroethene (TCE) is estimated to be approximately 380 lb. in the shallow zone, 640 lb. in the intermediate zone, and 145 lb. in the deep zone. The associated total mass of tetrachloroethene (PCE) is estimated to be approximately 8 lb. in the shallow zone, 37 lb. in the intermediate zone, and 19 lb. in the deep zone. These estimates are based on the plume geometry and contaminant concentration distribution documented in the SCR, a porosity of 0.1, and an assumed plume thickness of 46 ft in the shallow zone, 43 ft. in the intermediate zone and 120 ft. in the deep zone.

3.0 REMEDIAL ALTERNATIVES ANALYSIS

AMEC conducted an engineering review of the Chem-Fab Site to identify interim and long-term actions that could be taken to address hexavalent chromium and chlorinated volatile organic compounds (CVOCs) present in groundwater. Preliminary cost estimates associated with these remedial options have also been developed for budgeting purposes.

3.1 Interim Remedial Action (IRM)

The highest concentrations of hexavalent chromium and CVOCs are present in shallow groundwater on or near the existing one story block building. Hexavalent chromium concentrations are highest in the vicinity of MW-03, which is adjacent to the former UST that may have been used for plating liquid disposal. CVOC concentrations are highest in the vicinity of the former tank farm and MW-05, located approximately 50 ft to the west of the Chem-Fab site on the "Extra Space" property. Therefore, elevated CVOC and hexavalent chromium in groundwater in these areas are considered the primary source of the groundwater contaminant plume. The interim remedial action has been focused on this area, with the remedial action objective to reduce source area groundwater concentrations to levels that would not provide a continuing source of CVOCs and hexavalent chromium to groundwater.

3.1.1 Technology Screening

A summary of potential remedial technology's and response actions is outlined in Table 3-1, organized by general response action and remedial technology. This overview provides the framework from which a qualitative assessment of potential technology applicability to the project site was performed. The initial screening assessment was based primarily on technology effectiveness relative to both physical site characteristics (i.e. bedrock/fracture flow system) and the nature of site contamination (i.e. organic and inorganic constituents). The results of the screening assessment are provided below and summarized in Table 3-2.

3.1.1.1 No Action

Under this option, no further action is taken to address long-term contaminant mass transfer from the source area to groundwater, or monitor the effectiveness of natural, in-situ biodegradation processes. This alternative does not address the remedial action objective for the project site, but is maintained in the assessment process as a baseline.

3.1.1.2 Minimal Action

Evaluation of the natural attenuation approach requires an understanding of contaminant transport and fate, as well as the performance of a comprehensive geochemical investigation of the background areas of the site, the source area, and the contaminant plume to document the occurrence and effectiveness of in-situ biodegradation processes. The Site Characterization Report, addendum and this engineering evaluation provided a framework for geochemical characterization at the project site. This alternative does not address the remedial action objective (within the near-term) for the project site. The geochemical characterization and long-term monitoring components of this option normally supplement other active remediation alternatives.

3.1.1.3 Containment

Containment options entail the installation of subsurface barriers to prevent the migration of contaminated ground water. They are typically installed to isolate (encircle) an area of recalcitrant source zone contamination (i.e. DNAPL) in lieu of source zone extraction/treatment. A range of alternatives are available for this purpose, including the driving of sheet piles, trenching and filling with low permeability soil material (e.g. cement/soil-bentonite slurry wall) or grout injection. Construction of such barriers is difficult or impossible beneath structures, or into bedrock (unless grouted). Unless the isolation area is capped, groundwater extraction (and subsequent treatment and disposal) may be required to control hydraulic mounding; i.e. “bathtub effect”. The cost of barrier construction increases significantly with depth. Containment options were not deemed applicable to the project site due to the depth of contamination and the nature of contaminated media (fractured bedrock).

3.1.1.4 Collection

Air sparging, soil vapor/dual phase extraction (SVE/DPE), and thermal extraction technologies are normally applied to near-surface contamination zones within unconsolidated sediments, and are effective only for organic constituents (e.g., CVOCs). As such, these remedial technologies are not practically applicable to the project site. Pumping of ground water (through interceptor trenches or vertical or horizontal wells) is the most widely implemented method of ground water extraction, providing hydraulic control as well as mass transfer from the subsurface. The long-term effectiveness of this approach is often compromised due to recalcitrant contaminant sorption within the soil/rock matrix. For this reason, it is often desirable to improve the permeability of the aquifer matrix (especially in fracture flow dominated systems) in order to increase the surface area exposed to the induced flow system and improve mass transfer. Hydrofracturing of the soil/rock matrix (using high pressure water injection) or blast fracturing of the rock matrix (using explosives placed at depth) are techniques that would be applicable to the project site to achieve this objective.

3.1.1.5 Treatment

The treatment options are segregated between in-situ and ex-situ physical/chemical or biological processes. In-situ processes relate to the subsurface injection or installation of media/amendments within the contaminated saturated zone, while ex-situ processes represent the application of liquid or vapor phase treatment processes to waste streams delivered to the surface by the collection processes identified previously. All of these technologies can be further segregated into active or passive approaches, with the distinction being primarily one of long-term maintenance and energy input; i.e., following engineering design and/or construction, active approaches require on-going maintenance or energy input, while passive approaches typically do not.

- ***In-Situ processes***

In-situ chemical oxidation (ISCO) entails the injection of any of a range of formulations (hydrogen peroxide/Fenton's Reagent, sodium/potassium permanganate) to the saturated zone through a subsurface delivery system; *i.e.,* injection wells or points, or a combined injection/extraction recirculation well network. ISCO results in the nearly immediate oxidation and destruction of organic constituents in the subsurface within the effective application area. Several phases of injection may be required to achieve desired levels of contaminant destruction (due to a phenomenon known as "rebound", where contaminant desorption from untreated soil materials migrates into previously treated zones). Since ISCO is primarily effective relating to CVOCs, it would not represent an optimal solution to site remediation.

Various formulations may also be injected into the subsurface to chemically alter in-situ geochemistry and facilitate the establishment of reducing conditions (to enhance hexavalent chromium reduction to insoluble trivalent chromium salts). Such formulations include calcium polysulfide and sodium metabisulfite.

Granular zero-valent iron (alone or mixed with various catalysts) represents a media that is effective in the abiotic destruction of CVOCs and the reduction of hexavalent chromium to insoluble trivalent chromium salts. It is most commonly used to provide perimeter control of a contaminant plume (through perimeter slurry injections or excavated trench emplacement within the context of a "permeable reactive barrier" or PRB), but can also be injected as a slurry directly into the contaminant source area and/or plume. The latter approach would potentially be applicable to the project site (trench excavation would not represent a feasible option at the site).

Relative to chlorinated hydrocarbons, enhanced in-situ bioremediation refers primarily to the injection of amendments (e.g. HRC, molasses) that act to decrease ambient dissolved oxygen concentrations and/or increase dissolved hydrogen concentrations, thereby creating a geochemical environment that supports anaerobic microbial respiration (and associated in-situ destruction of solvent constituents). These amendments are designed to gradually influence and subsequently maintain an altered subsurface geochemistry until the amendment is depleted. Several phases of injection may be required to achieve target levels of contaminant destruction. It is often desirable to initially perform bench scale laboratory studies to insure for the presence of an in-situ microbiological population that will result in complete solvent dechlorination (i.e. *Dehalococcoids*).

- ***Ex-Situ Processes***

Ex-situ treatment processes consist of a range of conventional or innovate technologies that are designed to remove contaminants from the extracted liquid and/or vapor phase waste streams.

Granular activated carbon (entailing contaminant absorption onto GAC media enclosed within a treatment vessel) and air stripping (entailing air contact volatilization of contaminants in ground water) represent the most widely used technologies for this application. GAC media must ultimately be disposed in a secure landfill, or reconditioned through steam regeneration. The air stripping vapor waste stream requires treatment, typically either through GAC sorption or catalytic oxidation (high temperature destruction).

A range of conventional wastewater treatment plant unit processes are available for metals precipitation (lime/sodium hydroxide addition) and removal (settling/ion exchange). Similarly, calcium polysulfide or sodium metabisulfate can be added to the treatment process to chemically reduce hexavalent chromium, or consumable iron electodes can be incorporated within a unit process to electrochemically reduce hexavalent chromium. Application of any of these techniques would require a separate unit process to extract CVOCs.

In addition to its potential in-situ application, zero valent iron may also be used as an ex-situ treatment process for the destruction of CVOCs and the reduction of hexavalent chromium. In such an application, the media would be placed within a reaction vessel as a component of the treatment process train.

3.1.1.6 Discharge

Discharge options must be considered for technology process options that entail ground water extraction and ex-situ treatment. Disposition of the treated (effluent) waste stream would be accomplished either through subsurface injection/infiltration on-site, or discharge to a surface water (stream), storm sewer, or sanitary sewer. The latter discharge options would require discharge permit approvals, and would entail annual or flow-based fees.

Subsurface injection of treated ground water on-site within a zone of enhanced permeability (as part of a controlled flow network with a corresponding array of ground water extraction wells) is believed to represent an attractive technology option for the project site. In addition to enhancing contaminant flushing from the subsurface, such an approach would allow for the addition of various amendments (discussed previously) to facilitate in-situ contaminant degradation.

3.1.2 Development of Alternatives

As a result of the technology screening process, five potential Interim Remedial Measures (IRMs) were developed for further consideration, as follows:

1. No Action.
2. Groundwater Monitoring.
3. Groundwater Monitoring, Groundwater Extraction, Ex-Situ Treatment, and Aquifer Re-injection.
4. Goundwater Monitoring, Groundwater Extraction in Hydrofractured Bedrock, Ex-Situ Treatment, and Aquifer Re-injection.
5. Groundwater Monitoring, Groundwater Extraction in Hydrofractured Bedrock, Ex-Situ Treatment, Reductant Addition, and Aquifer Re-injection.

3.1.3 Screening of Alternatives

Each alternative was evaluated according to three criteria: effectiveness, implementability, and cost. These screening criteria are defined as follows:

- Effectiveness refers to three considerations: (1) the potential ability to restore the estimated area or volume of impacted material to site cleanup action levels; (2) the potential impacts to human health and the environment during remediation; and (3) the extent to which the remedial action is proven and reliable under site conditions;
- Implementability is considered in order to rule out technologies that are clearly ineffective or unworkable, either due to technical or administrative factors; and
- Cost includes capital, operation and maintenance, and present net worth costs. The estimates are expected to provide a level of accuracy of +50% to –30%. A more detailed estimate is prepared during the design phase.

The following subsections discuss the remedial alternatives in terms of the above referenced evaluation criteria. Each subsection provides a brief description of the alternative, and an evaluation of how the alternative would address the contaminants of concern at the Chem-Fab site.

3.1.4 IRM Remedial Action Alternative 1 - No Action

Remedial alternative 1 constitutes the no action alternative, and provides a baseline for the site. In the case of the Chem-Fab site, the no action alternative would include the current uncontrolled use of the site and no action to address soil and groundwater that is impacted by CVOCs and hexavalent chromium.

Effectiveness

Since no action would be taken, this remedial action would not effectively address the elevated concentrations of CVOCs and hexavalent chromium in the source areas. Risks to human health and the environment would be equal to the current risk conditions.

Implementability

Since no action would not address risks to human health and the environment, it does not represent an implementable remedy.

Cost

No costs would be generated for the no action alternative.

3.1.5 IRM Remedial Action Alternative 2 - Groundwater Monitoring

Remedial alternative 2 includes groundwater monitoring. Quarterly monitoring of the existing monitoring well network would be conducted. Transport and fate of the groundwater contaminant plume would be evaluated numerically, and the potential for continued off-site migration of the groundwater plume would be determined. This option would provide warning to potential off-site receptors, including the owner of the production well located downgradient of the site. In the event that the groundwater plume threatened to impact groundwater drinking supplies, additional remedial measures could be taken.

Effectiveness

This remedial action would act to prevent the ingestion of groundwater impacted by site CVOCs and hexavalent chromium, but would not address the elevated contaminant concentrations in the source areas. Risks to human health and the environment would be equal to the current risk conditions.

Implementability

Groundwater monitoring is easily implemented. Sampling, analytical, and numerical modeling services are available to the PADEP through existing contract mechanisms.

Cost

There would be no capital costs for remedial alternative 2. Annual O&M costs are estimated to be approximately $618,000 and would include labor to perform quarterly well purging and sampling, analytical testing, report preparation, and numerical modeling. The PNW is estimated to be approximately $9,500,000. A summary of the projected cost for this alternative is included in Table 3-3. The cost basis is provided in Appendix A.

3.1.6 IRM Remedial Action -Alternative 3 - Groundwater Monitoring, Groundwater Extraction, Ex-Situ Treatment, and Aquifer Re-injection

This alternative would include the following components:

Groundwater Monitoring - Quarterly monitoring of the existing monitoring well network would be conducted. The groundwater plume would be modeled, and the potential for continued off-site migration of the groundwater plume would be evaluated. This program would provide sufficient warning to potential off-site receptors, including the owner of the production well located downgradient of the site. In the event that the groundwater plume threatened to impact groundwater drinking supplies, additional remedial measures could be taken.

Groundwater Extraction - Groundwater would be extracted from three wells, located in the former tank farm, adjacent to the former UST, and on the adjacent "Extra Space" storage property in the vicinity of MW-05. Each well would be constructed of 6-inch schedule 80 PVC and would be fitted with a submersible pump and high/low level floats. Below grade piping would be installed to each well, and discharged to an equalization tank.

Ex-Situ Groundwater Treatment - Groundwater would be treated to remove hexavalent chromium, metals, and CVOCs. The treatment train would include:

- PH adjustment for hexavalent chromium reduction
- Hexavalent chromium reduction
- PH adjustment for metals precipitation
- Settling, thickening, and pressing of metal hydroxide sludge
- Water filtration
- Carbon adsorption for CVOC removal

Aquifer Re-injection - The treated water would be re-injected through an array of approximately 10 wells. The location of the injection wells would need to be optimized through the performance of numerical ground water flow analysis. Figure 3-1 provides a conceptual treatment system schematic for this alternative.

Effectiveness

This remedial action would effectively minimize the continued off-site migration of contaminants from the site by capturing the source groundwater impacted by site CVOCs and hexavalent chromium. However, the system would need to be operated for an extended period of time, since the literature indicates that groundwater extraction alone does not result in complete extraction of contaminants (due to aquifer matrix sorption/desorption). Risks to human health and the environment would be reduced relative to current conditions, since groundwater with the highest concentrations of hexavalent chromium and CVOCs would be captured by the remedial system. Monitoring and groundwater extraction, treatment, and re-injection are proven and reliable methods to evaluate groundwater contaminant migration and control the migration of contaminants in groundwater.

Implementability

This remedial action would be easily implemented. Groundwater extraction and treatment is a standard technology that could be implemented by local contractors. Permits would be required for construction and re-injection of groundwater. Groundwater monitoring is easily implemented. Sampling, analytical, and numerical flow analysis services are available to the PADEP through existing contract mechanisms.

Cost

The capital cost for remedial Alternative 3 is estimated to be approximately $1,280,000, and would include installation of the groundwater extraction, treatment, and re-injection system. Annual O&M costs are estimated to be approximately $765,000, and would include operation and maintenance of the remedial system, quarterly groundwater monitoring, the sampling rounds, analytical testing, report preparation, and numerical flow analysis. The PNW is estimated to be approximately $13,029,000. A summary of the projected cost for this alternative is included in Table 3-3. The cost basis is provided in Appendix A.

3.1.7 IRM Remedial Action Alternative 4 - Groundwater Monitoring, Groundwater Extraction in Hydrofractured Bedrock, Ex-Situ Treatment, and Aquifer Re-injection

This alternative would include the following components:

Groundwater Monitoring - Quarterly monitoring of the existing monitoring well network would be conducted. The groundwater plume would be modeled, and the potential for continued off-site migration of the groundwater plume would be evaluated. This program would provide sufficient warning to potential off-site receptors, including the owner of the production well located downgradient of the site. In the event that the groundwater plume threatened to impact groundwater drinking supplies, additional remedial measures could be taken.

Groundwater Extraction - Groundwater would be extracted from three wells, located in the former tank farm, adjacent to the former UST, and on the "Extra Space" property in the vicinity of MW-05. Each well would be constructed of 6-inch schedule 80 PVC and would be fitted with a submersible pump and high/low level floats. Below grade piping would be installed to each well and discharged to an equalization tank.

Hydrofracturing - The shallow bedrock (identified at this time as a zone extending to a depth of approximately 50 ft bgs), will be hydrofractured in the collection and re-injection areas to increase permeability and the interception of fractured zones. This would be accomplished by drilling open boreholes through the target zone on a 50 ft spacing, and then lowering two packers into the borehole isolating specific zones to be treated. High-pressure water would then be pumped into the isolated area to flush and increase the size of existing fractures in the rock matrix. Specific boreholes would then be completed as recovery or re-injection wells.

Ex-Situ Groundwater Treatment - Groundwater would be treated to remove hexavalent chromium, metals, and CVOCs. The treatment train would include:

- PH adjustment for hexavalent chromium reduction
- Hexavalent chromium reduction
- PH adjustment for metals precipitation
- Settling, thickening, and pressing of metal hydroxide sludge
- Water filtration
- Carbon adsorption for CVOC removal

Aquifer Re-injection - The treated water would be re-injected through an array of approximately 10 wells. The location of the injection wells would need to be optimized through the performance of numerical ground water flow analysis.

Effectiveness

This remedial action would effectively minimize the continued off-site migration of contaminants from the site by capturing the source groundwater impacted by site CVOCs and hexavalent chromium. Hydrofracturing would enhance the ability of the system to control contaminant migration and discharge the treated groundwater. However, the system would need to be operated for an extended period of time, since the literature indicates that groundwater extraction alone does not result in complete extraction of contaminants (due to aquifer matrix sorption/desorption). Due to improved capture efficiency, this alternative would be be more effective at in-situ contaminant mass reduction than Alternative 3. Risks to human health and the environment would be reduced relative to current conditions, since groundwater with the highest concentrations of hexavalent chromium and CVOCs would be captured by the remedial system. Monitoring, groundwater extraction, treatment, and re-injection, and hydrofracturing are proven and reliable methods to evaluate groundwater contaminant migration and control the migration of contaminants in groundwater.

Implementability

This remedial action would be easily implemented. Groundwater extraction and treatment and hydrofracturing are standard technologies that could be implemented by local contractors. Permits would be required for construction and re-injection of groundwater. Groundwater monitoring is easily implemented. Sampling, analytical, and numerical flow analysis services are available to the PADEP through existing contract mechanisms.

Cost

The capital cost for remedial Alternative 4 is estimated to be $1,582,000, and would include hydrofracturing the bedrock, and installation of the groundwater extraction, treatment, and re-injection system. Annual O&M costs are estimated to be $765,000, and would include operation and maintenance of the remedial system, quarterly groundwater monitoring, analytical testing, report preparation, and numerical flow analysis. The PNW is estimated to be $13,400,000. A summary of the projected cost for this alternative is included in Table 3-3. The cost basis is provided in Appendix A.

3.1.8 IRM Remedial Action Alternative 5 - Groundwater Monitoring, Groundwater Extraction in Hydrofractured Bedrock, Ex-Situ Treatment, Aquifer Re-injection, and *In-situ* Groundwater Treatment

This alternative would include the following components:

Groundwater Monitoring - Quarterly monitoring of the existing monitoring well network would be conducted. The groundwater plume would be modeled, and the potential for continued off-site migration of the groundwater plume would be evaluated. This program would provide sufficient warning to potential off-site receptors, including the owner of the production well located downgradient of the site. In the event that the groundwater plume threatened to impact groundwater drinking supplies, additional remedial measures could be taken.

Groundwater Extraction - Groundwater would be extracted from three wells, located in the former tank farm, adjacent to the former UST, and on the "Extra Space" property in the vicinity of MW-05. Each well would be constructed of 6-inch schedule 80 PVC and would be fitted with a submersible pump and high/low level floats. Below grade piping would be installed to each well and discharged to an equalization tank.

Hydrofracturing - The shallow bedrock (identified at this time as a zone extending to a depth of approximately 50 ft bgs), will be hydrofractured in the collection and re-injection areas to increase permeability and the interception of fractured zones. This would be accomplished by drilling open boreholes through the target zone on a 50 ft spacing, and then lowering two packers into the borehole isolating specific zones to be treated. High-pressure water would then be pumped into the isolated area to flush and increase the size of existing fractures in the rock matrix. Specific boreholes would then be completed as recovery or re-injection wells.

Ex-Situ Groundwater Treatment - Groundwater would be treated to remove hexavalent chromium, metals, and CVOCs. The treatment train would include:

- PH adjustment for hexavalent chromium reduction
- Hexavalent chromium reduction
- PH adjustment for metals precipitation
- Settling, thickening, and pressing of metal hydroxide sludge
- Water filtration
- Carbon adsorption for CVOC removal

Reductant Addition and Aquifer Re-Injection - A reducing agent would be added to the treated groundwater, and the water would be re-injected through a series of approximately 10 wells and the former UST excavation, which is filled with stone. The reducing solution would flow with the groundwater from the injection points and toward the extraction wells, creating a reaction front through the bedrock formation that would reduce the highly soluable hexavalent chromium to very low soluable trivalent hydroxide salt and creating a reducing environmental that would promote the reduction of CVOCs.

Effectiveness

This remedial action would effectively minimize the continued off-site migration of contaminants from the site by capturing the source groundwater impacted by reducing the CVOCs and hexavalent chromium in the aquifer. Hydrofracturing would enhance the ability of the system to control contaminant migration and discharge the treated groundwater. Reductant addition to the re-injection stream would act to effectively reduce the CVOCs and hexavalent chromium in-situ, shortening the project duration. Risks to human health and the environment would be reduced relative to current conditions(more effectively than the previously identified alternatives), due to the integration of both ex-situ and in-situ treatment technologies. The in-situ processes would include reduction of hexavalent chromium to insoluable trivalent chromium, and destruction of CVOCs in groundwater through reductive dechlorination. Monitoring, groundwater extraction, treatment, reductant addition, and re-injection, and hydrofracturing are proven and reliable methods to evaluate groundwater contaminant migration and remove or biodegrade contaminants in groundwater. Laboratory bench scale and in-situ pilot studies would need to be performed to optimize the reaction chemistry associated with reductant addition.

Implementability

This remedial action could be implemented. Groundwater extraction and treatment and hydrofracturing are standard technologies that could be implemented by local contractors. Permits would be required for construction and re-injection of groundwater. Groundwater monitoring is easily implemented. Sampling, analytical, and numerical flow analysis services are available to the PADEP through existing contract mechanisms. Amendment injection performance would need to be demonstrated through one or more treatability studies.

Cost

The capital cost for remedial Alternative 5 is estimated to be $1,600,000, and would include hydrofracturing the bedrock, and installation of the groundwater extraction, treatment, amendment addition, and re-injection systems. Annual O&M costs are estimated to be $780,000, and would include operation and maintenance of the remedial system, the sampling rounds, analytical testing, report preparation, and modeling. The PNW is estimated to be $4,900,000, which reflects a presumably shortened timeframe to complete the remedial action due to the extraction/reinjection and in-situ treatment components of this alternative). A summary of the projected cost for this alternative is included in Table 3-3. The cost basis is provided in Appendix A.

3.1.9 IRM Selection

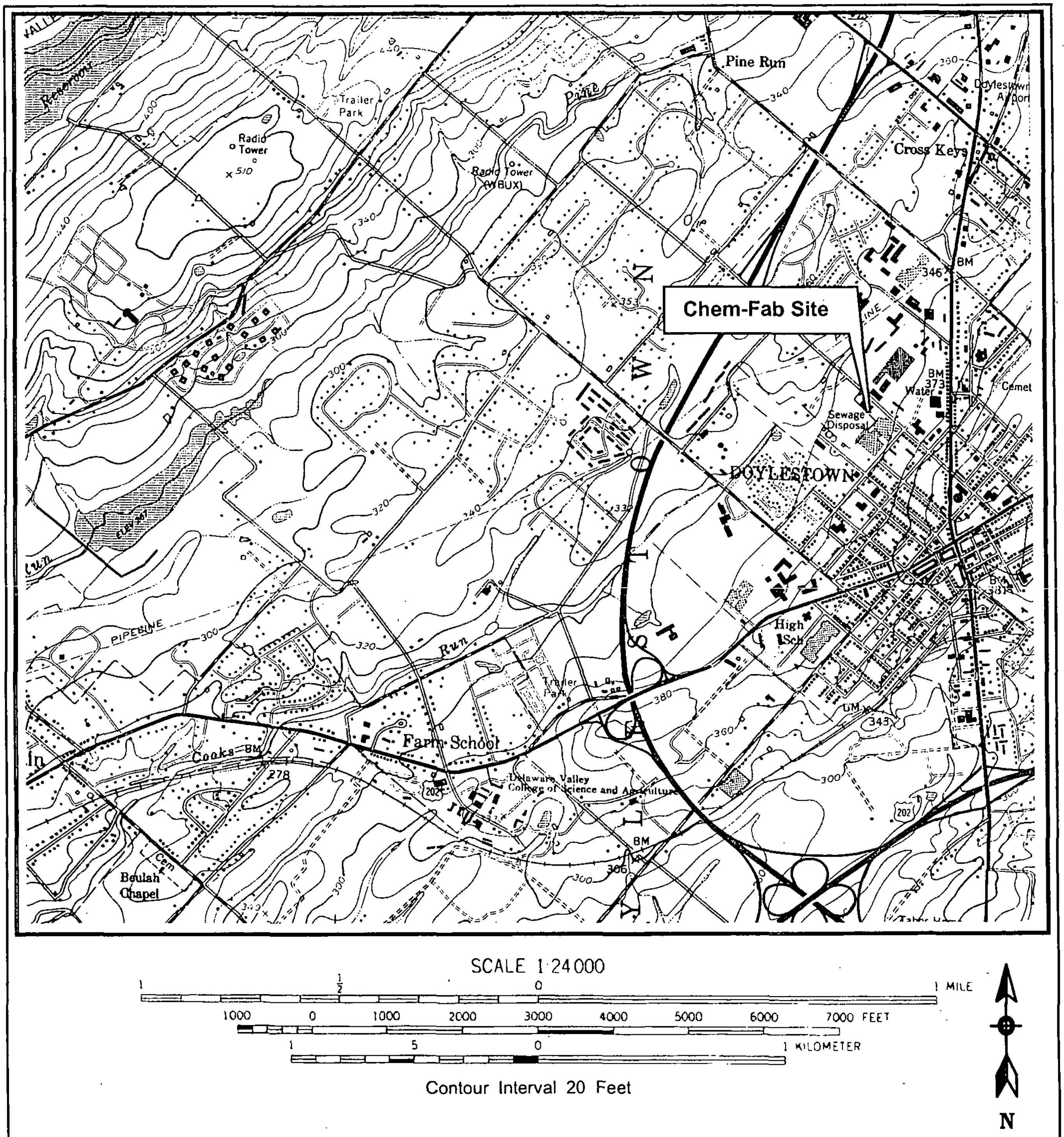
Based on the evaluation of project alternatives described above, Alternative 5 has been identified as the most effective option for contaminant extraction, treatment, and control of the groundwater contaminant plume. Pending the results of bench and/or pilot scale treatability studies, Alternative 5 is implementable. Estimated capital costs associated with this alternative are analogous to the other extraction and treatment options, while the PNW may be slightly lower due to the potential for accelerated contaminant mass destruction as a result of combining both in-situ and ex-situ treatment processes.

3.2 Full Scale Remedial Action

In addition to the primary contaminant source area identified through the performance of well installation and monitoring activities (i.e., IRM treatment area indicated on Figure 3-1), an additional area of ground water contamination has been identified in the southern area of the Chem-Fab property (MW-20 area). It is assumed that full-scale site remediation would require capture and treatment of contaminants in this area as well as those associated with the source/IRM area. Appropriate remedial technologies to address this area would not be conceptually different from those identified and evaluated under the IRM alternatives assessment. Consequently, conceptual design and cost basis data were developed for the project site to include addition of remedial action within the MW-20 area. As indicated on Figure 3-2, such action would include the addition of a well extraction/injection array (RA Treatment Area) to the IRM Treatment Area, with connection of this area to the proposed treatment system.

Due to the perimeter location of the RA Treatment Area, a sixth alternative was added to the five evaluated under the IRM screening process for the full scale site remediation evaluation. In lieu of an extraction/injection well array, this alternative consists of a perimeter permeable reactive barrier (consisting of a blasted bedrock zone). The dimensions of this zone have not been fully defined due to the limited data available in this area. Reductant would be injected into ground water as it passes through this zone to facilitate degradation of CVOCs and hexavalent chromium prior to off-site migration.

Table 3-4 provides a summary of estimated capital, O&M, and PNW costs for full-scale site remedial action (IRM plus RA Treatments Areas). The cost basis for these estimates is provided in Appendix B.



Contour Interval 20 Feet

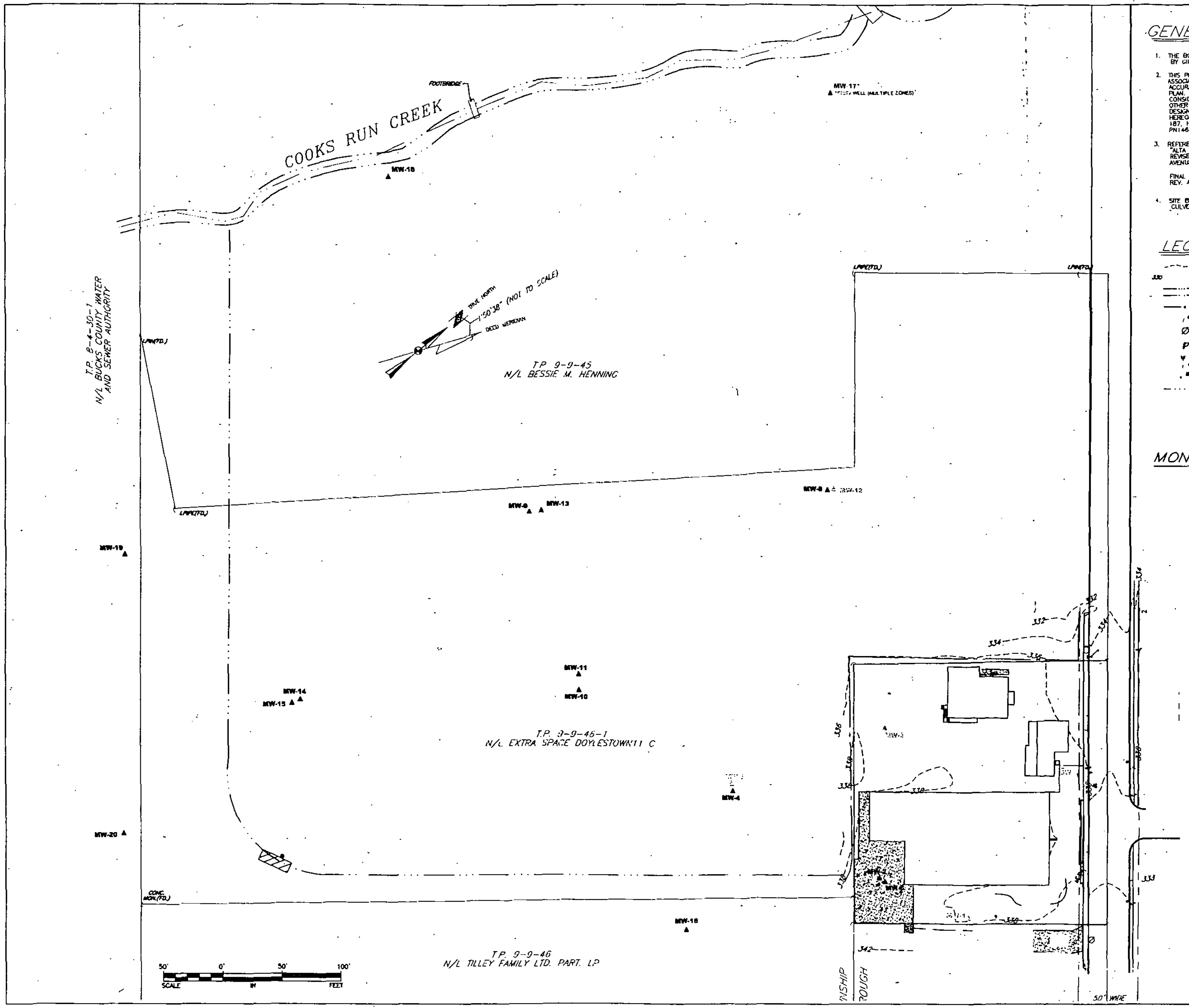
Figure 1-1

Site Location Map

Chem-Fab Site
Doylestown, Bucks County, PA

U.S.G.S. Geologic Quadrangle
Doylestown, PA
7.5 Minute Series

amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850, PLYMOUTH MEETING, PA 19462-1308



GENERAL NOTES:

1. THE BOUNDARY AND TOPOGRAPHY AS SHOWN IS BASED ON A FIELD SURVEY PERFORMED BY GILMORE & ASSOCIATES INC IN MAY OF 2001 AND JAN. 2002.
2. THIS PLAN HAS BEEN PREPARED ON THE BASIS OF SURVEYS PERFORMED BY GILMORE & ASSOCIATES, INC. ONLY THE VISIBLE LOCATIONS SHOWN SHALL BE CONSIDERED TRUE AND ACCURATE. NO DIGGING OR EXCAVATIONS WERE DONE IN THE PREPARATION OF THIS PLAN. THEREFORE, ALL UNDERGROUND UTILITIES SHOWN OR DEPICTED SHOULD BE CONSIDERED APPROXIMATE IN LOCATION, DEPTH AND SIZE. THE POTENTIAL EXISTS FOR OTHER UNDERGROUND UTILITIES AND/OR FACILITIES NOT SHOWN HEREON. ALL DESIGNERS AND CONTRACTORS UTILIZING THIS PLAN AND THE INFORMATION CONTAINED HEREON ARE CAUTIONED TO COMPLY WITH THE REQUIREMENTS OF PENNSYLVANIA ACT 187, HOUSE BILL 2627, AMENDING THE ACT OF DECEMBER 17, 1974 (P.L. 852, NO. 287) PN1460 1996 EFFECTIVE 12/19/96
3. REFERENCE PLANS:
   "ALTA SURVEY" DOYLESTOWN STORE & LOCK DATED 6/18/99 AND LAST REVISED 6/30/99. PREPARED BY SHOWALTER & ASSOCIATES 116 EAST BUTLER AVENUE CHALFONT, PA 18914.

   FINAL PLAN DOYLESTOWN RIVET & MACHINE CO. TRACT DATED MARCH 11, 1974 REV. APRIL 2, 1974 BY WEISEL & GILMORE #27-614/73-1010
4. SITE BENCHMARK IS A STANDARD U.S.G.S. DISK SET IN WEST HEADWALL OF A CONC. CULVERT 19' WEST OF THE CENTERLINE OF BARRETT DRIVE ELEV. 314.18(NAVD 88)

LEGEND:

CONTOURS
330 INDEX CONTOURS
STREAM LINE
FENCE LINE
C.O. CLEANOUT / VENT
Ø SANITARY SEWER MANHOLE
TELEPHONE MANHOLE
F.H. FIRE HYDRANT
C.S. CURB STOP
W.V. WATER VALVE
SWALE
U.P. UTILITY POLE
S SIGN
GAS VALVE
INLET/ CATCH BASIN
CULV. CULVERT
M.B. MAILBOX
325.5 EXISTING SPOT ELEVATION
SANITARY SEWER LINE
STORM DRAINAGE FACILITIES
SOIL BORING LOCATION (MAY 2001)
SOIL BORING LOCATION (SEPT. 2001)
SEDIMENT SAMPLE LOCATION (SEPT. 2001)
SURFACE WATER SAMPLE LOCATION (SEPT. 2001)
▨ AREA OF SWALE WITH YELLOW WATER

MONITORING WELL COLOR CODE:

GREEN - Monitoring Wells 37'-47' deep

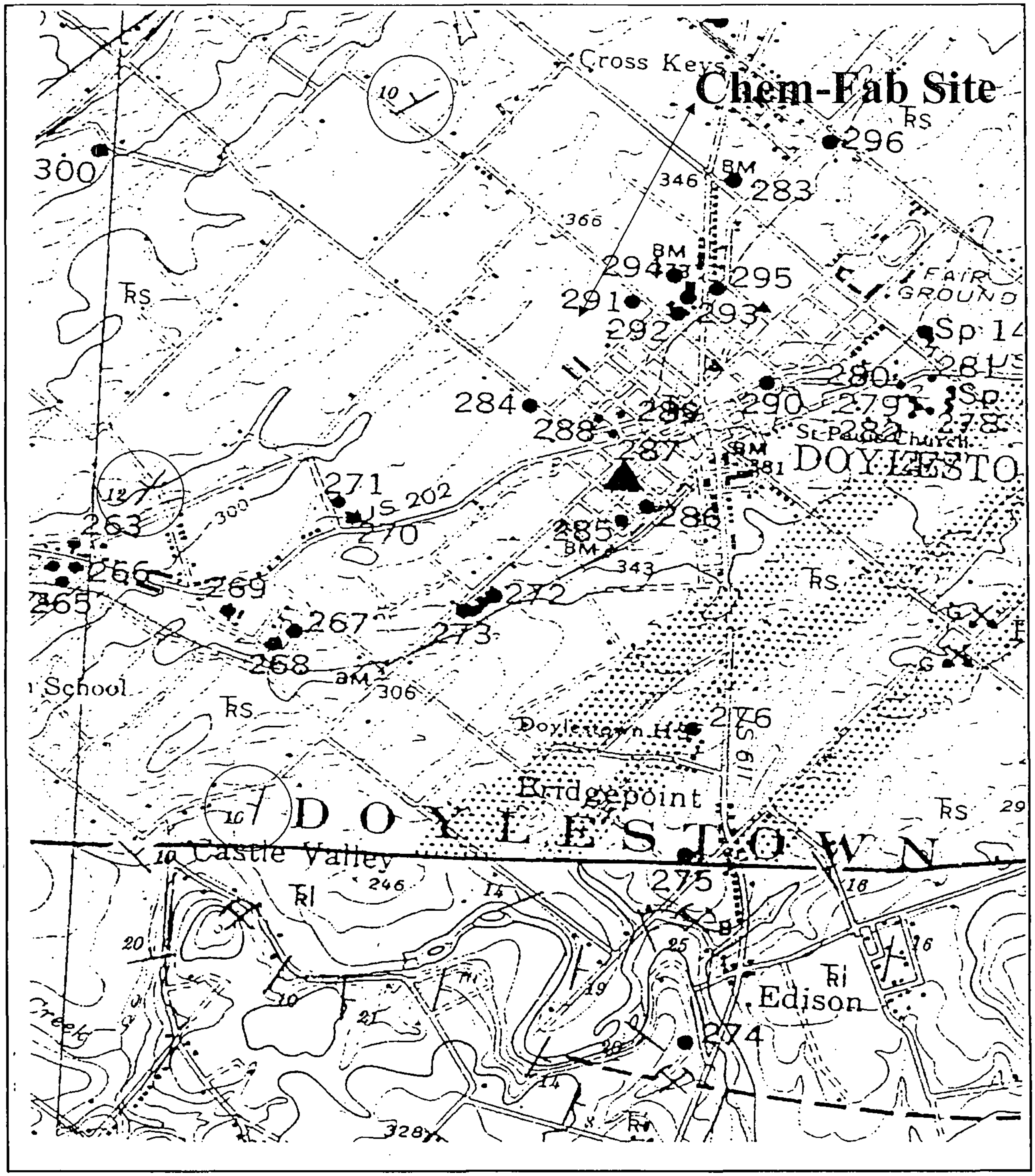
BLUE - Monitoring Wells 73'-80' deep

RED - Monitoring Wells 115'-220' deep

FIGURE 1-2
SITE PLAN
with MONITORING WELL LOCATIONS

CHEM FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308



LEGEND

10 -DEGREE OF DIP

⅄ -STRIKE AND DIP DIRECTION

TRS -TRIASSIC-STOCKTON FORMATION

Figure 1-3

Geologic Map indicating Structural Features

Chem-Fab Site
Doylestown, Bucks County, PA

Source:
Ground Water Resources of Bucks County, PA
Pennsylvania Geologic Survey, 1955

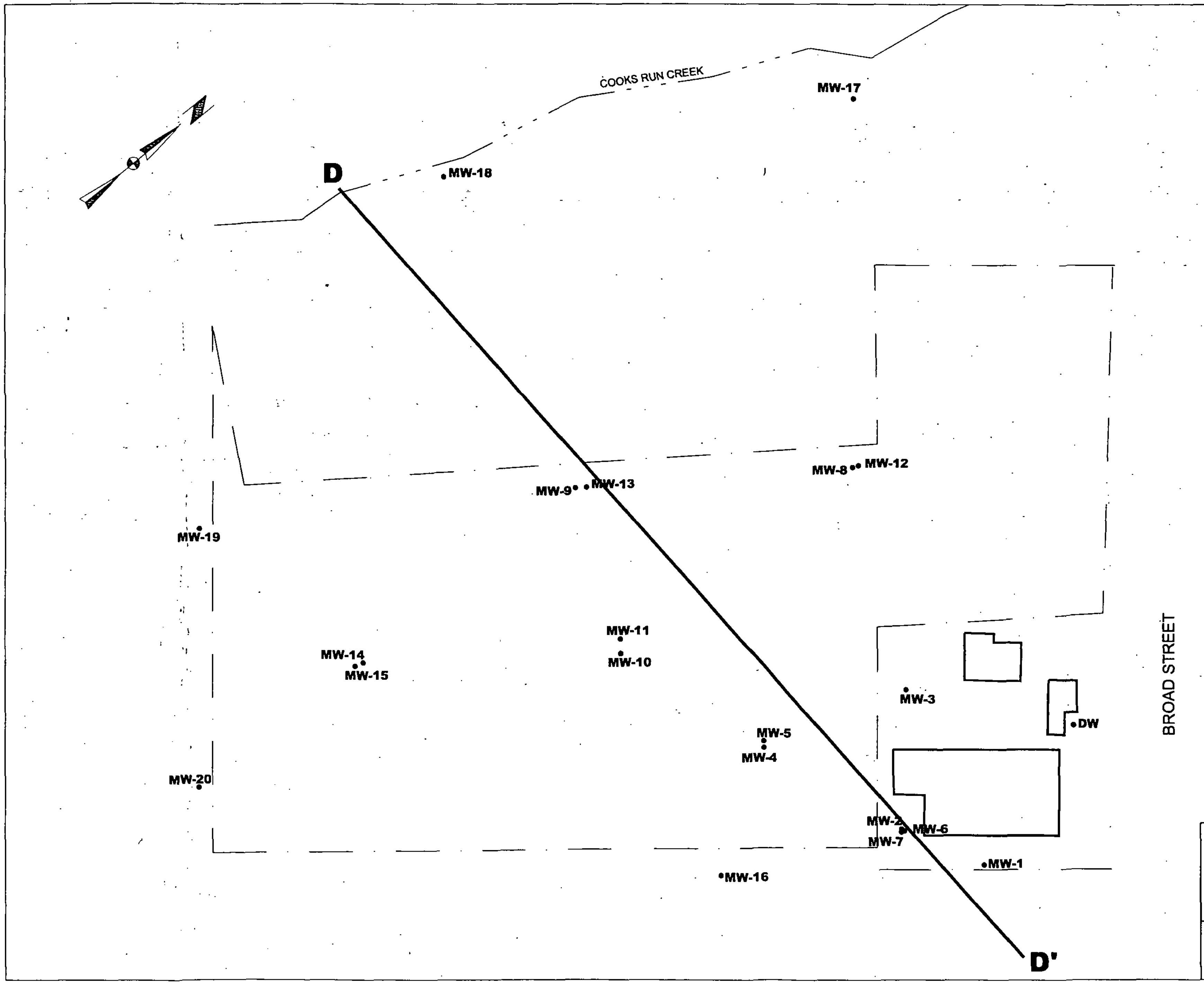


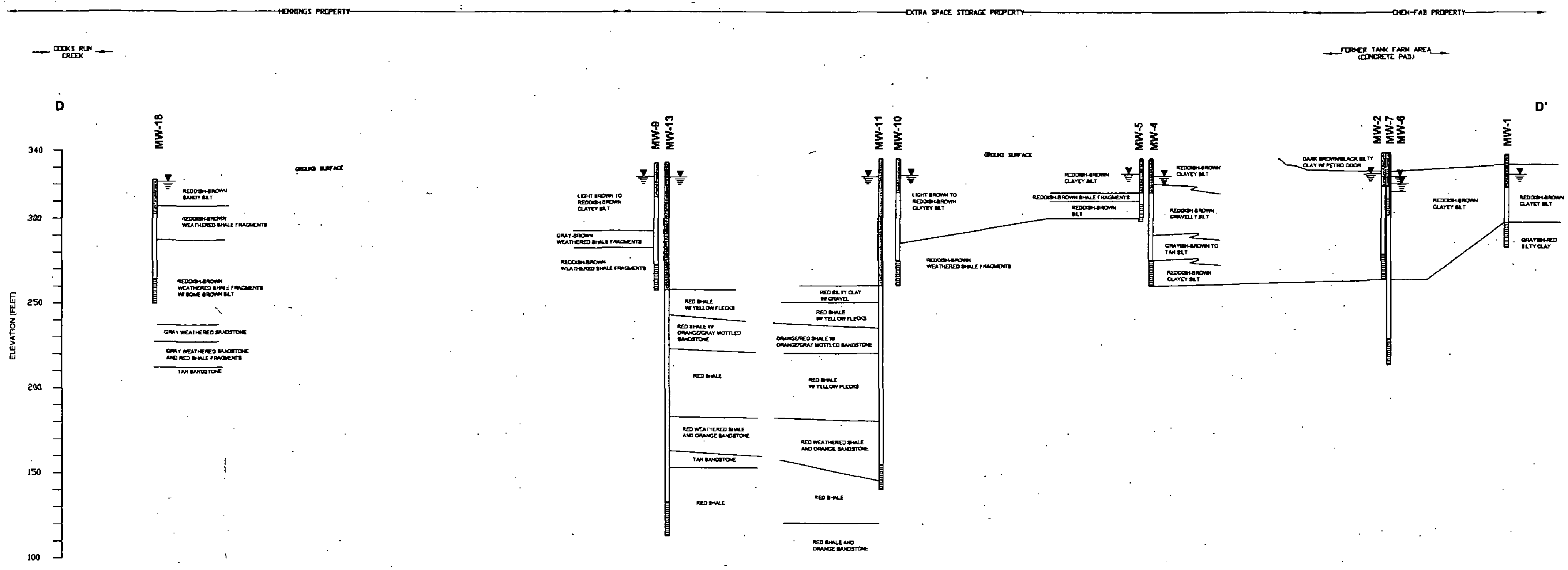
FIGURE 1–4

CROSS SECTION LOCATION MAP

CHEM FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308

FILE –DATE –DRAFT
SCALE



LEGEND

▥	STEEL CASING
▤	SCREENED INTERVAL

COLOR CODE

MONITORING WELLS - 37'-67' DEEP
MONITORING WELLS - 73'-80' DEEP
MONITORING WELLS - 115'-120' DEEP

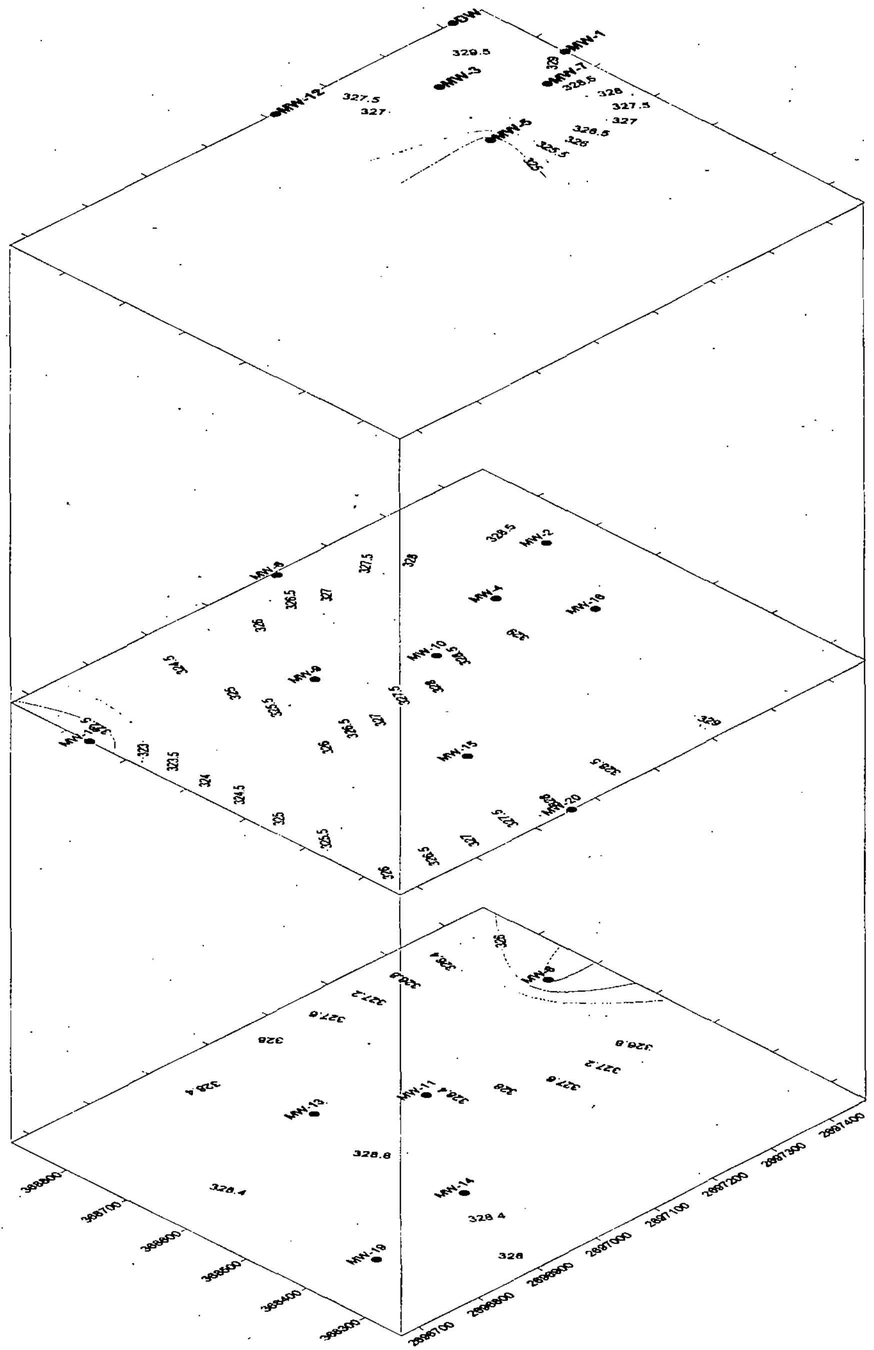
FIGURE 1-4a

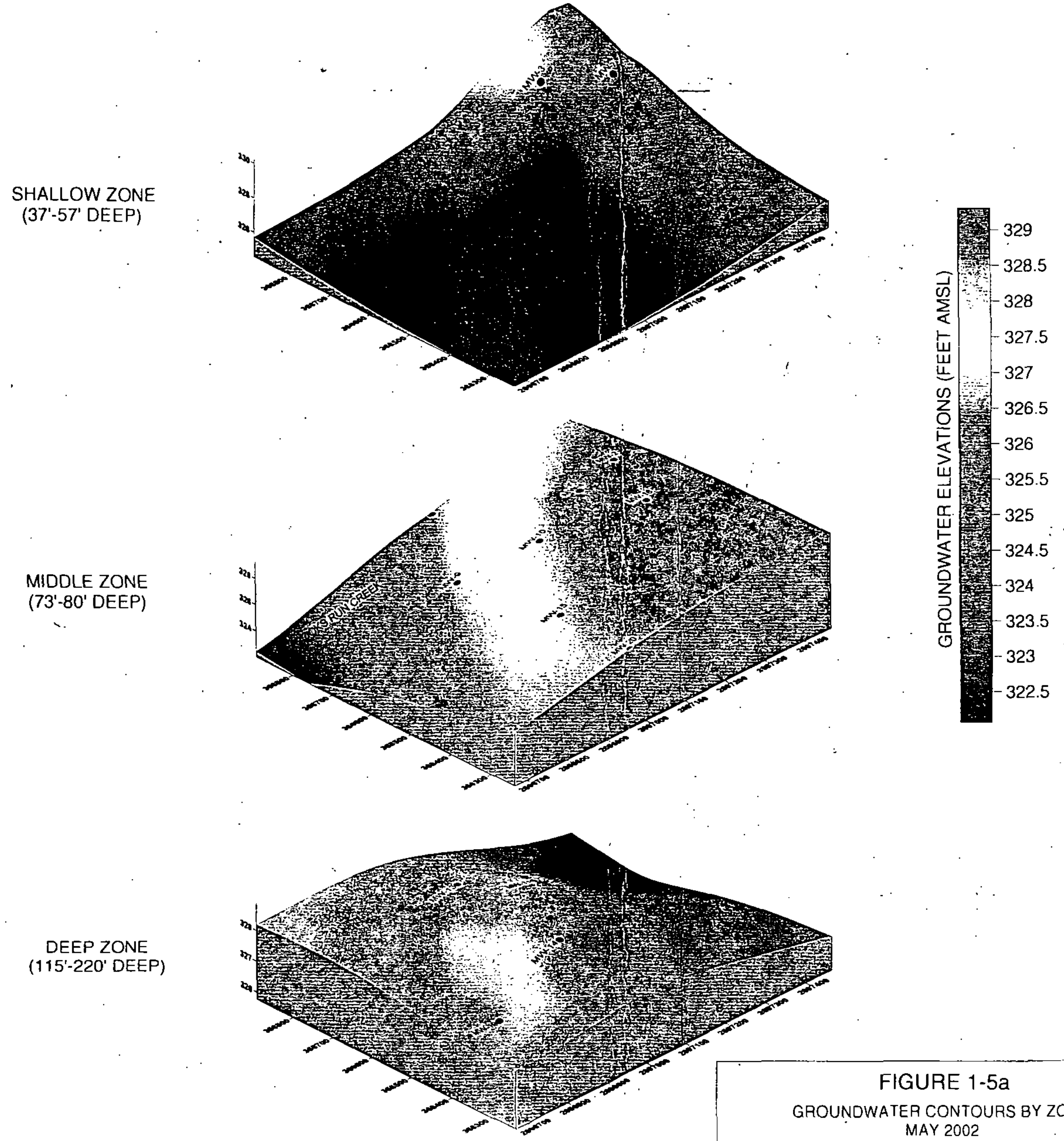
GEOLOGIC CROSS SECTION D-D'

CHEM FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308

FILE — DATE — DRAFT
SCALE





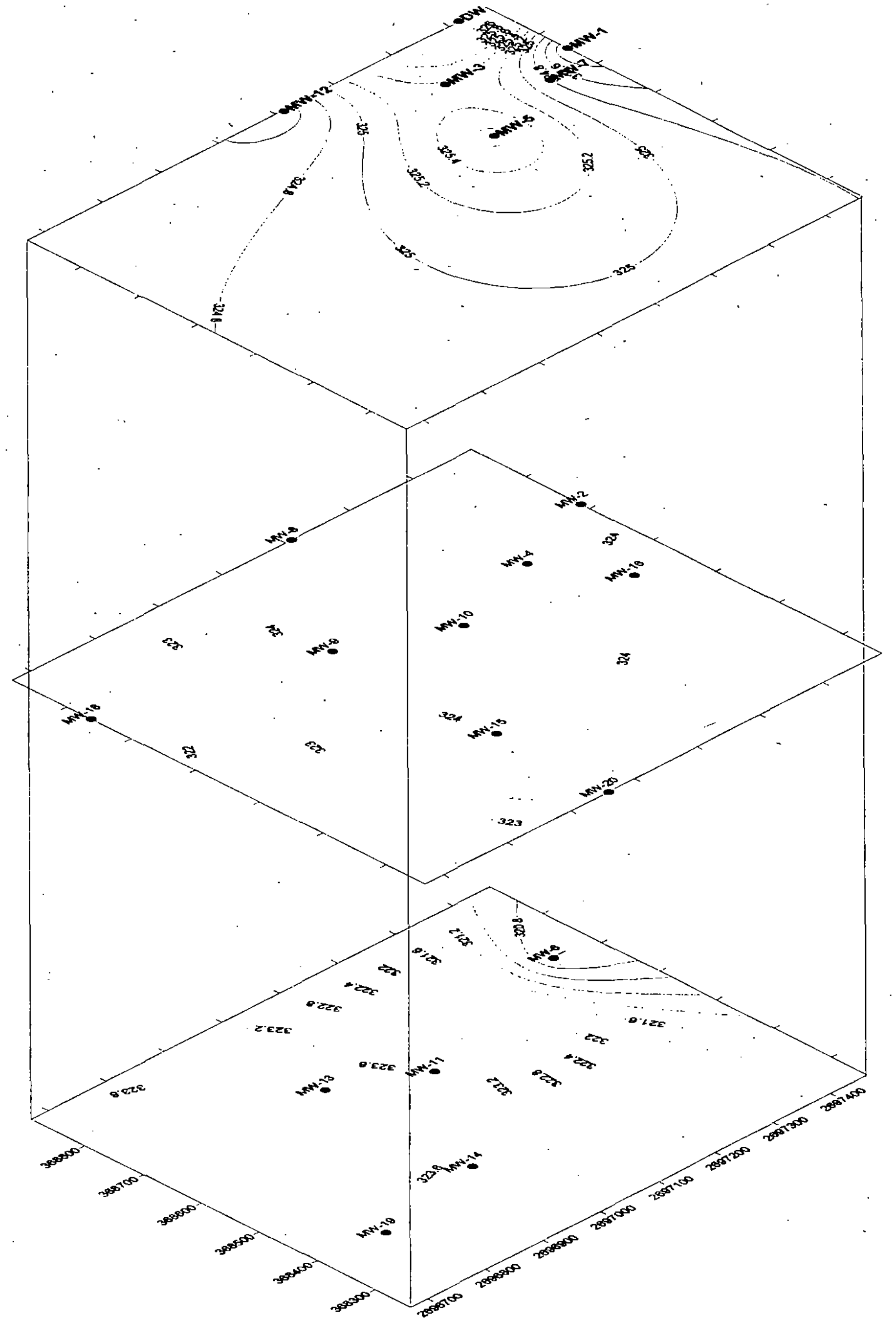
GROUNDWATER ELEVATIONS BASED ON
FIELD DATA FROM MAY 2002

FIGURE 1-5a

GROUNDWATER CONTOURS BY ZONE
MAY 2002

CHEM-FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

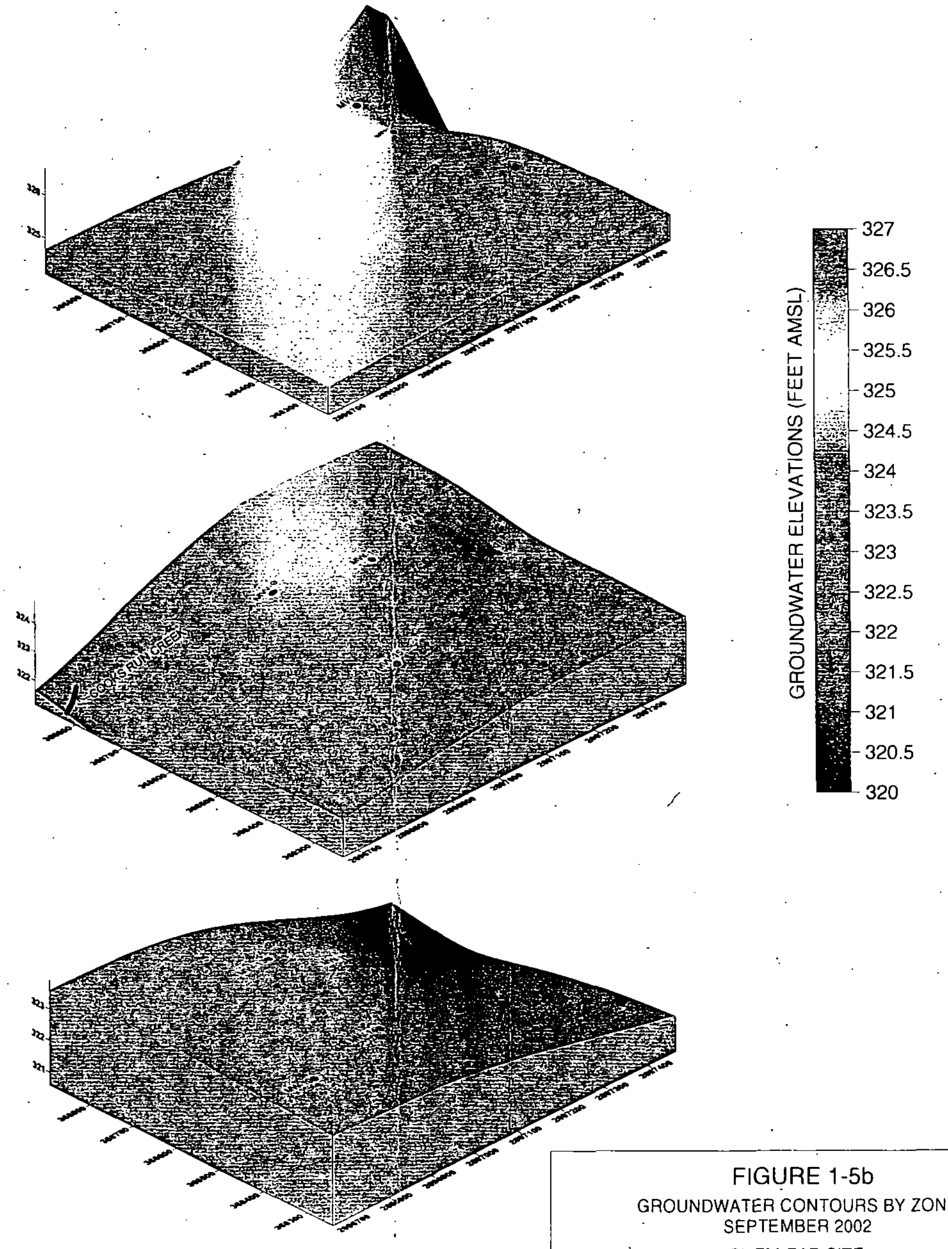
amec
EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308



SHALLOW ZONE
(37'-57' DEEP)

MIDDLE ZONE
(73'-80' DEEP)

DEEP ZONE
(115'-220' DEEP)



GROUNDWATER ELEVATIONS BASED ON
FIELD DATA FROM SEPTEMBER 2002

FIGURE 1-5b

GROUNDWATER CONTOURS BY ZONE
SEPTEMBER 2002

CHEM-FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

amec
EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308

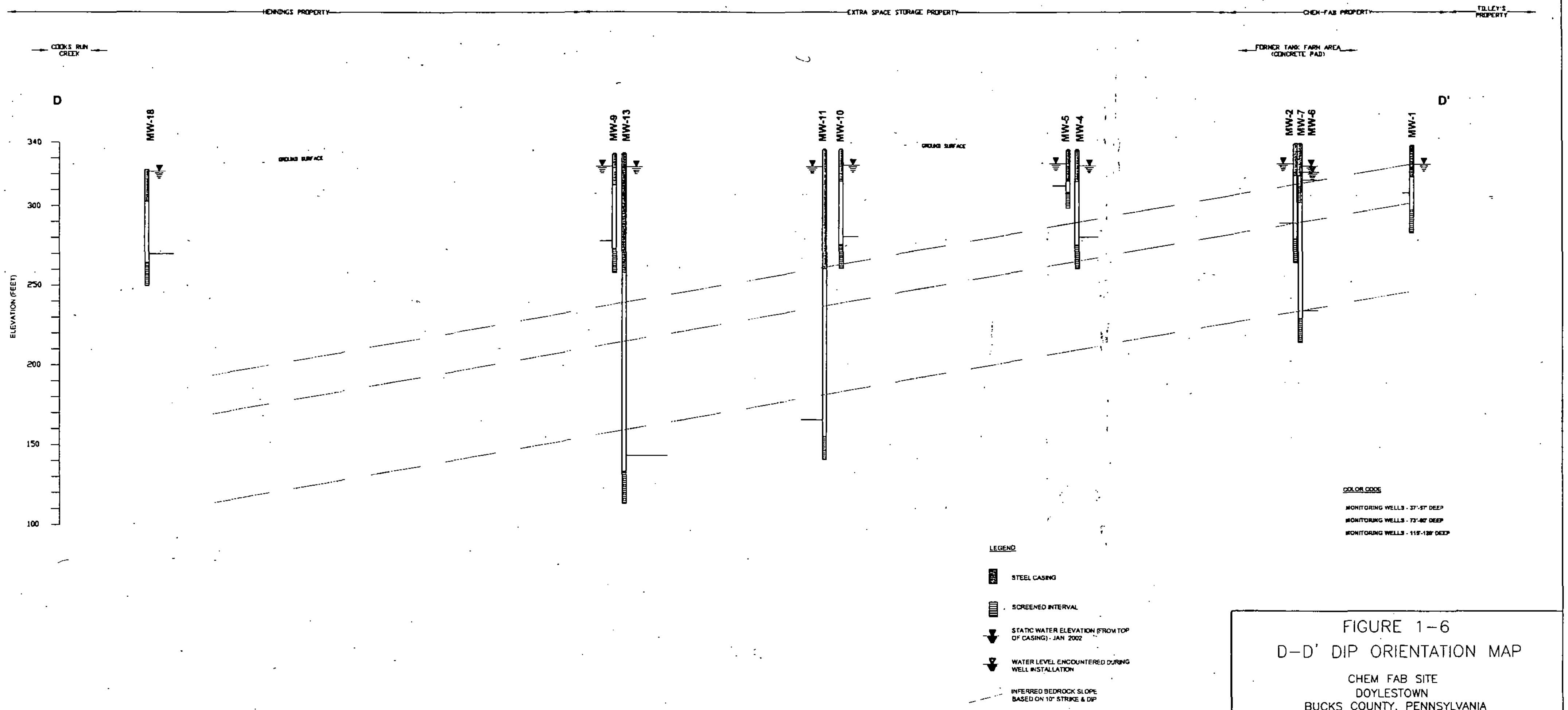


FIGURE 1–6

D–D' DIP ORIENTATION MAP

CHEM FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308

FILE – DATE – DRAFT
SCALE

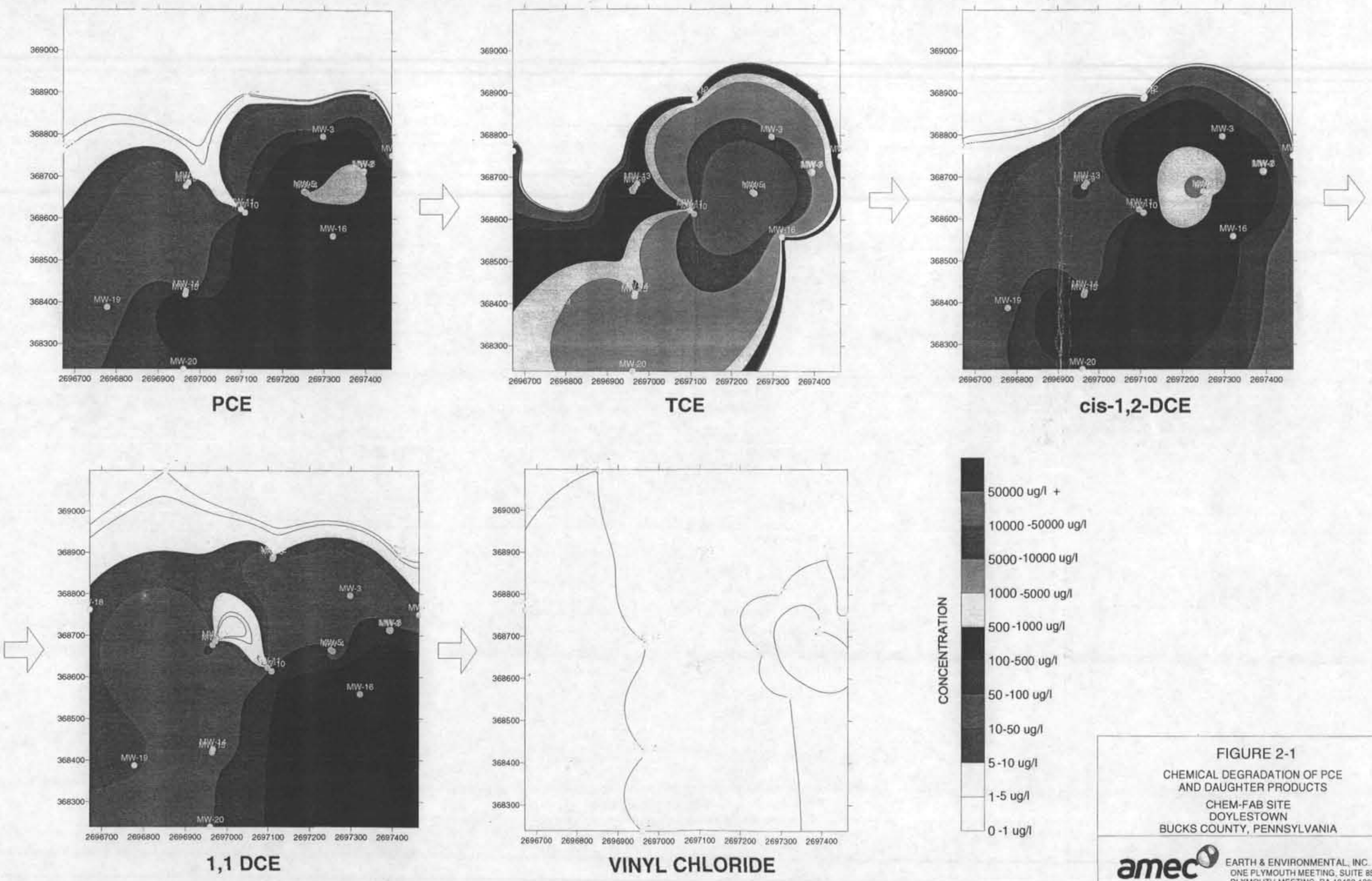
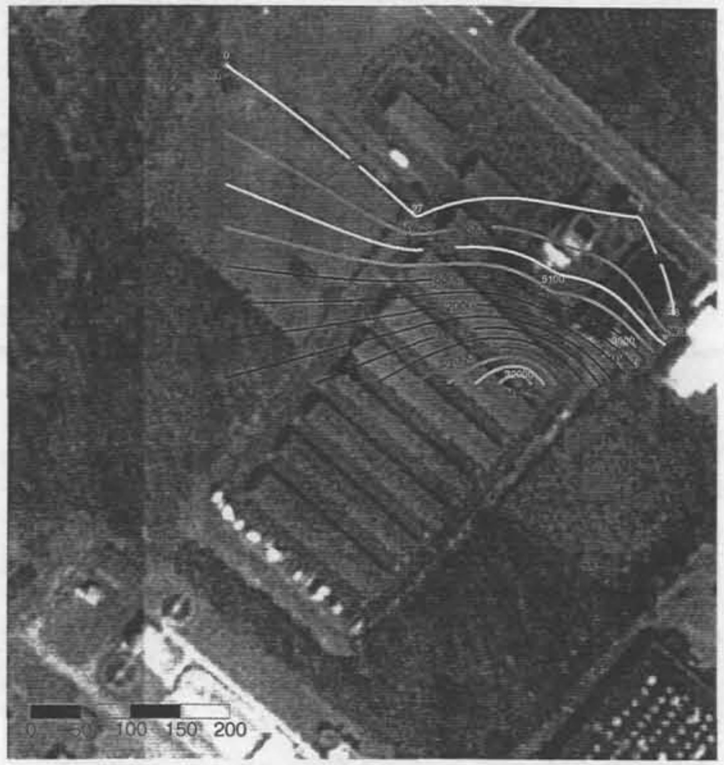


FIGURE 2-1

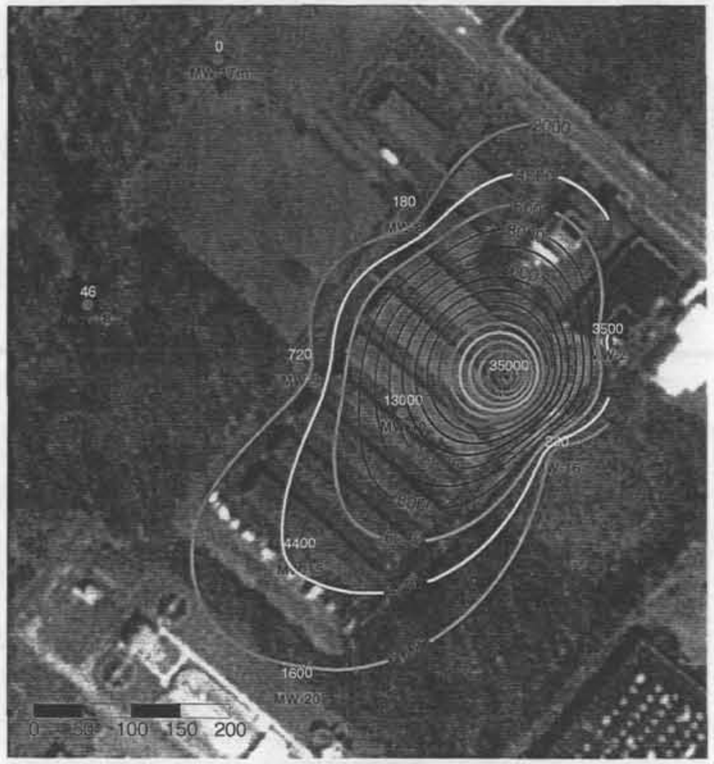
CHEMICAL DEGRADATION OF PCE AND DAUGHTER PRODUCTS

CHEM-FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

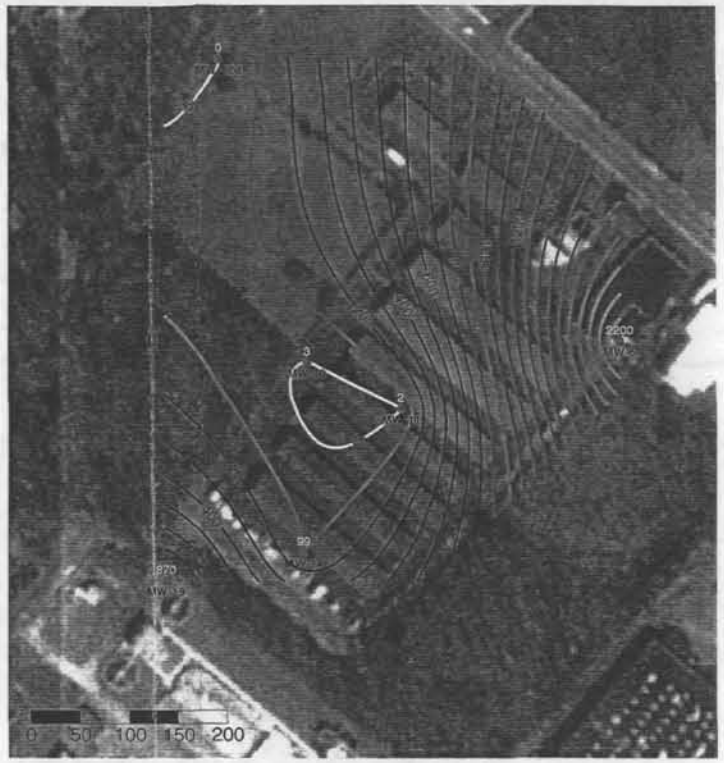
amec
EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308



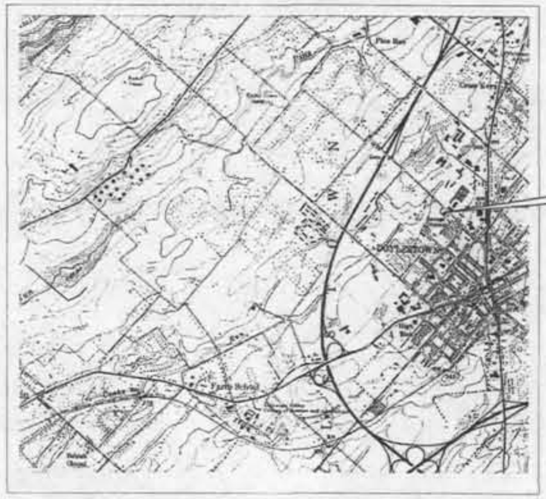
SHALLOW ZONE
(37'-57' DEEP)



MIDDLE ZONE
(73'-80' DEEP)



DEEP ZONE
(115'-220' DEEP)



TOPOGRAPHIC LOCATION MAP

NOTES:

1. Contours shown have been generated using reported trichloroethene concentrations specific to monitoring well locations. Contours extending beyond well locations are extrapolated based on this data.
2. Contours shown illustrate trichloroethene concentrations above the PADEP Act 2 Clean up standard of 5 ppb, and do not reflect monitoring wells with concentrations below the standard.

CONC. SCALE IN PARTS PER BILLION (ppb)

34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
1000
500
200
50
0

PADEP ACT 2 CLEANUP STANDARD (5 ppb)

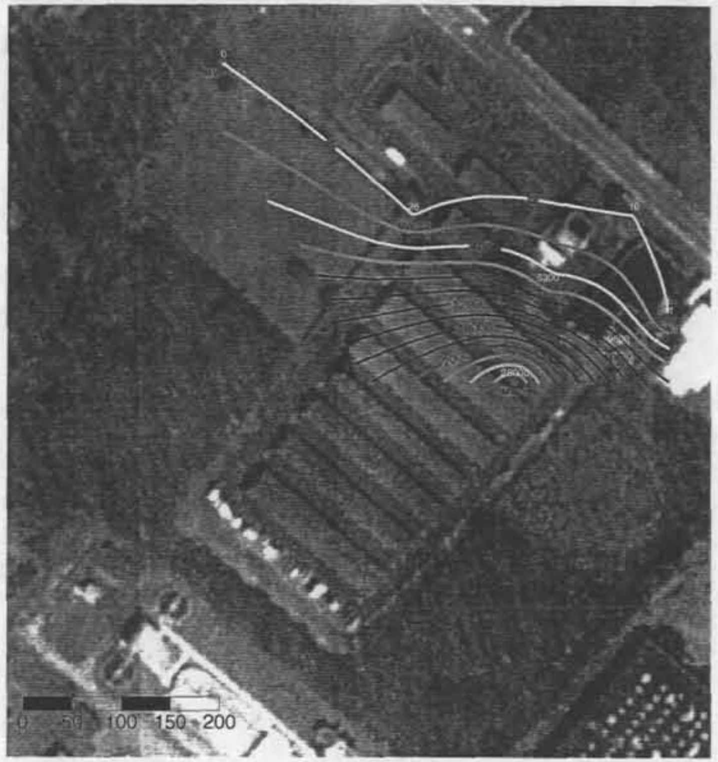
LEGEND

10.0 -*CONCENTRATION*
●
MW-1 -*WELL ID*

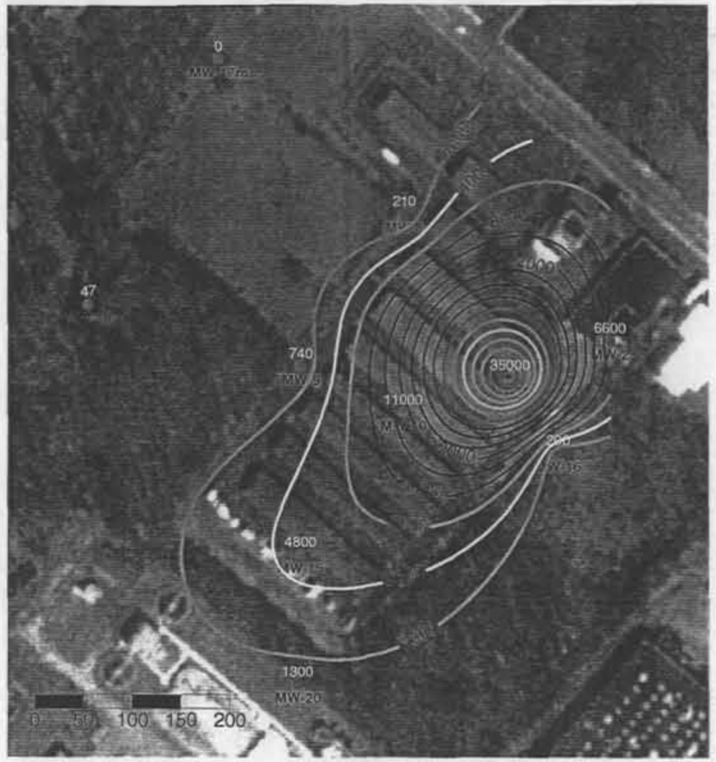
FIGURE 2-2a

TRICHLOROETHENE (TCE) DISTRIBUTION BY ZONE
MAY 2OO2
CHEM-FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

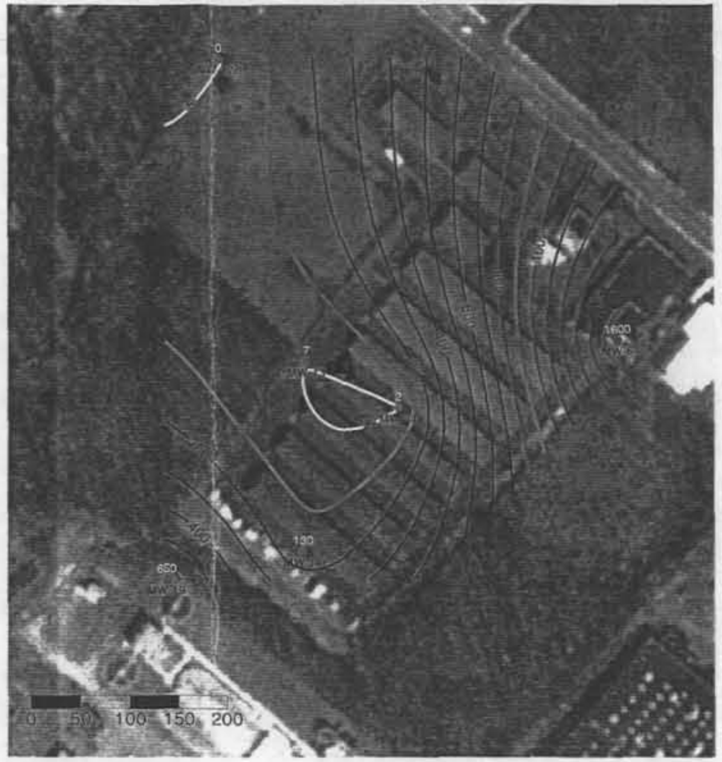
amec
EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308



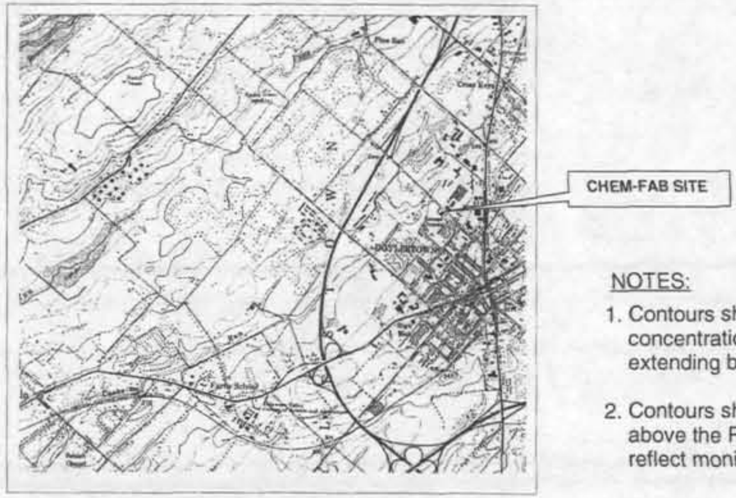
SHALLOW ZONE
(37'-57' DEEP)



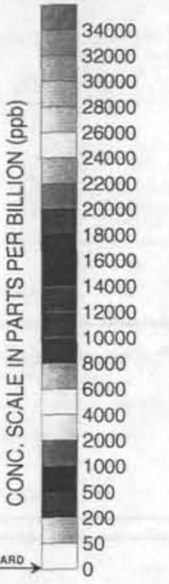
MIDDLE ZONE
(73'-80' DEEP)



DEEP ZONE
(115'-220' DEEP)



TOPOGRAPHIC LOCATION MAP



NOTES:

1. Contours shown have been generated using reported trichloroethene concentrations specific to monitoring well locations. Contours extending beyond well locations are extrapolated based on this data.

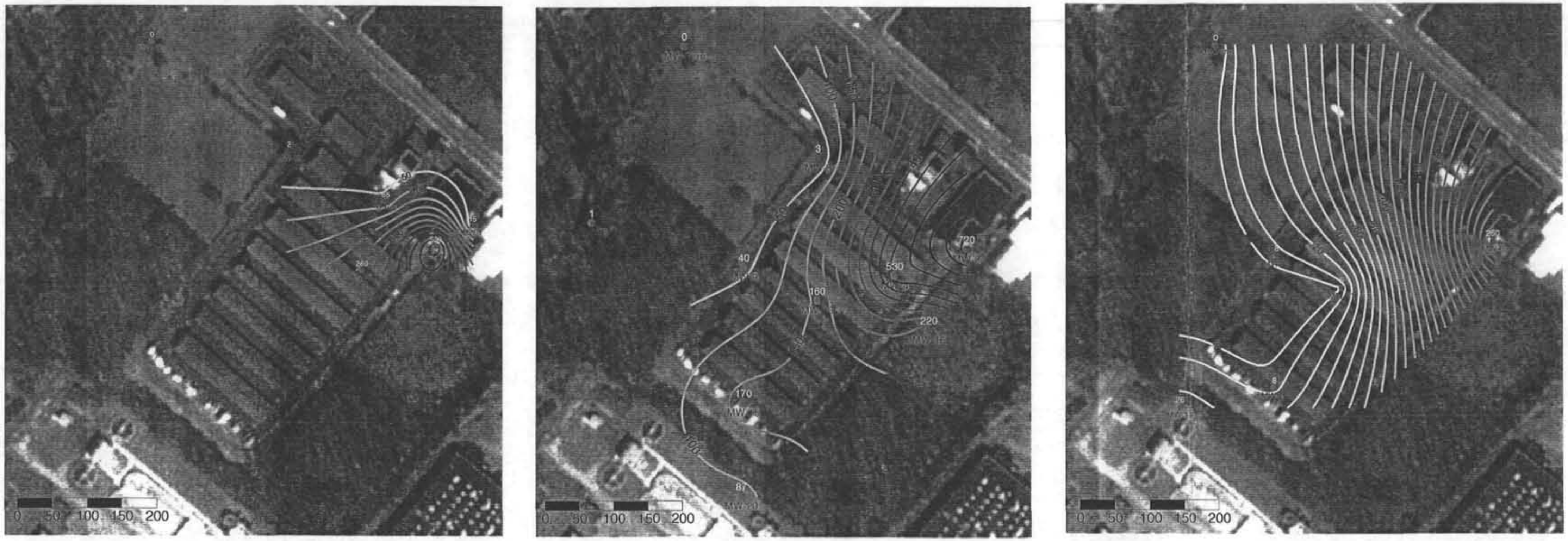
2. Contours shown illustrate trichloroethene concentrations above the PADEP Act 2 Clean up standard of 5 ppb, and do not reflect monitoring wells with concentrations below the standard.

LEGEND

10.0 -*CONCENTRATION*
●
MW-1 -*WELL ID*

FIGURE 2-2b
TRICHLOROETHENE (TCE) DISTRIBUTION BY ZONE
SEPTEMBER 2002
CHEM-FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

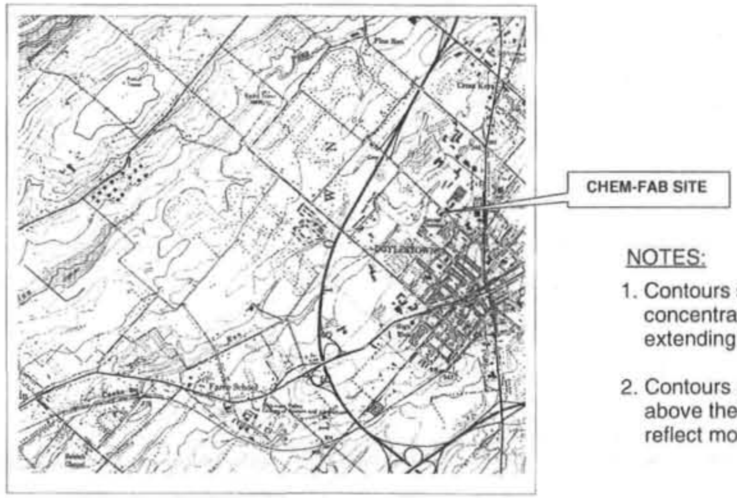
amec
EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308



SHALLOW ZONE
(37'-57' DEEP)

MIDDLE ZONE
(73'-80' DEEP)

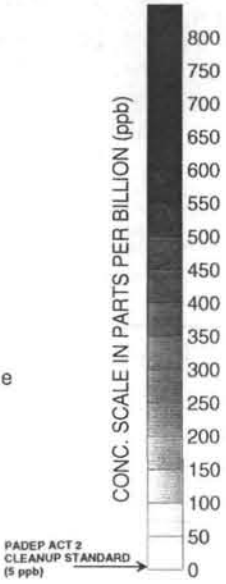
DEEP ZONE
(115'-220' DEEP)



TOPOGRAPHIC LOCATION MAP

NOTES:

1. Contours shown have been generated using reported tetrachloroethene concentrations specific to monitoring well locations. Contours extending beyond well locations are extrapolated based on this data.
2. Contours shown illustrate tetrachloroethene concentrations above the PADEP Act 2 Clean up standard of 5 ppb, and do not reflect monitoring wells with concentrations below the standard.



LEGEND

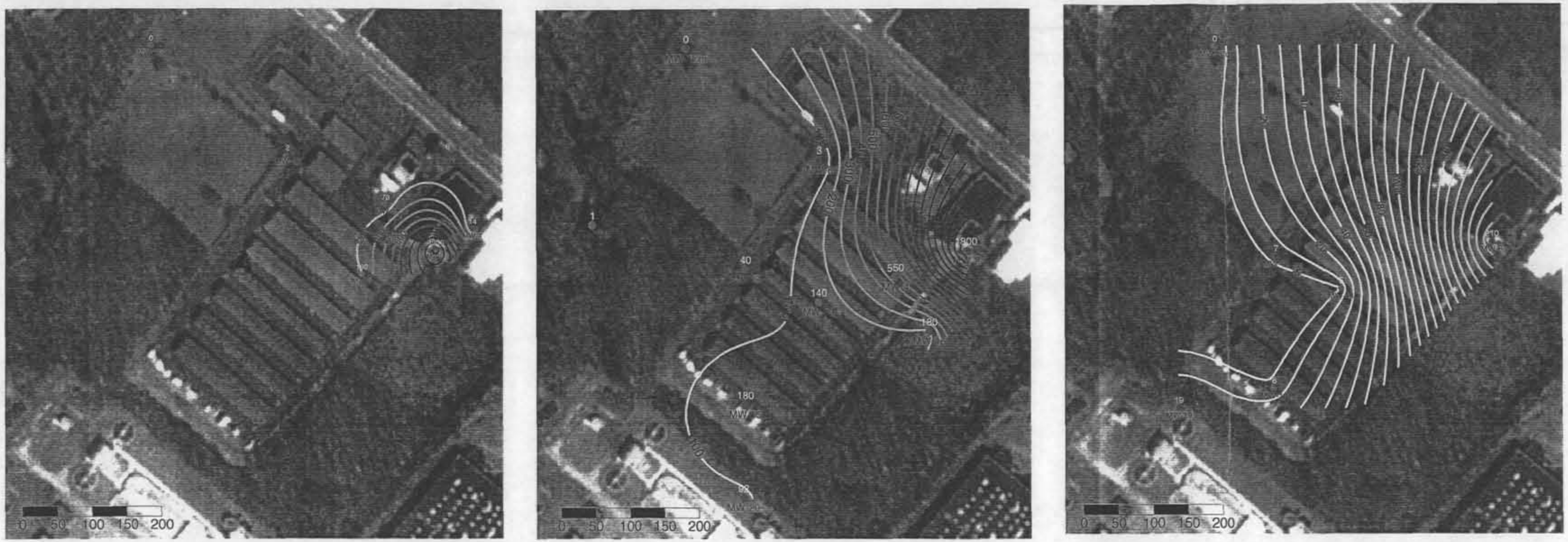
10.0	-*CONCENTRATION*
● MW-1	-*WELL ID*

FIGURE 2-3a

TETRACHLOROETHENE (PCE) DISTRIBUTION BY ZONE
MAY 2002

CHEM-FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

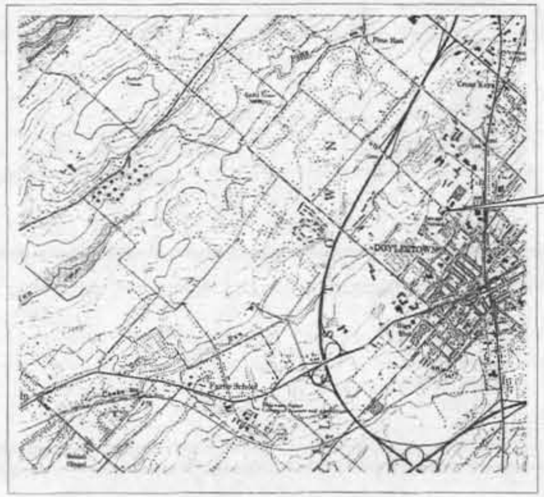
amec
EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308



SHALLOW ZONE
(37'-57' DEEP)

MIDDLE ZONE
(73'-80' DEEP)

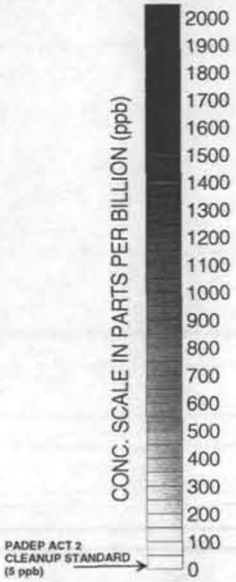
DEEP ZONE
(115'-220' DEEP)



TOPOGRAPHIC LOCATION MAP

NOTES:

1. Contours shown have been generated using reported tetrachloroethene concentrations specific to monitoring well locations. Contours extending beyond well locations are extrapolated based on this data.
2. Contours shown illustrate tetrachloroethene concentrations above the PADEP Act 2 Clean up standard of 5 ppb, and do not reflect monitoring wells with concentrations below the standard.

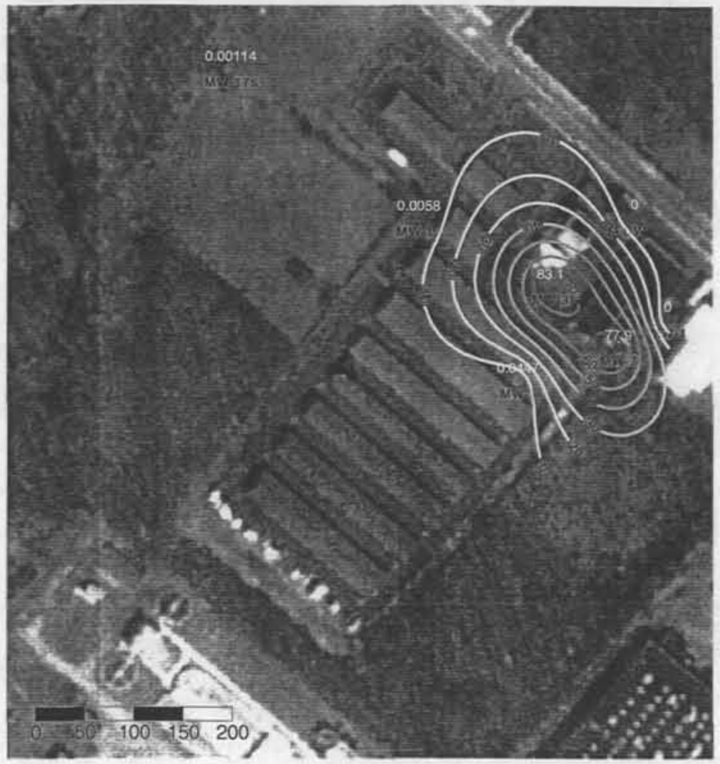


LEGEND

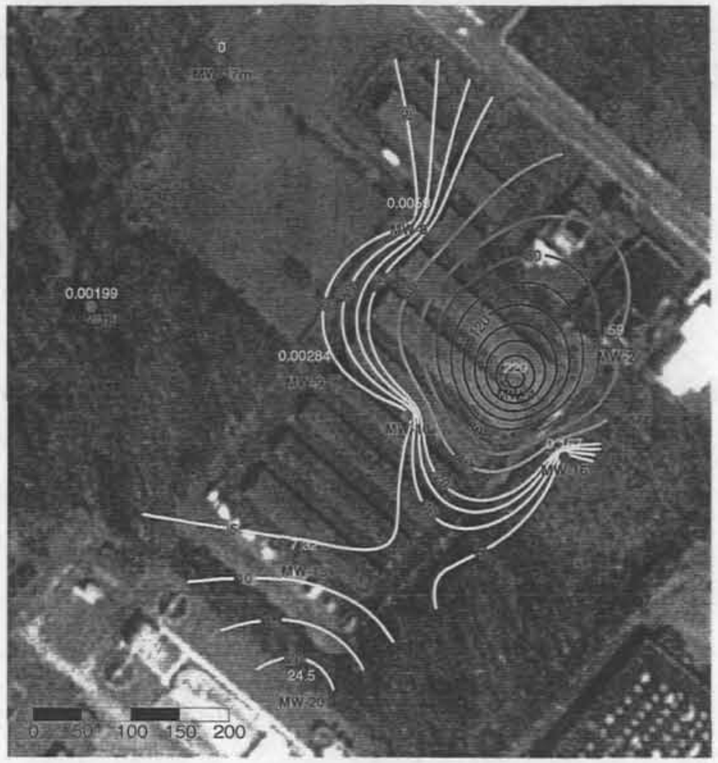
10.0 *-CONCENTRATION*
● MW-1 *-WELL ID*

FIGURE 2-3b
TETRACHLOROETHENE (PCE) DISTRIBUTION BY ZONE
SEPTEMBER 2002
CHEM-FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

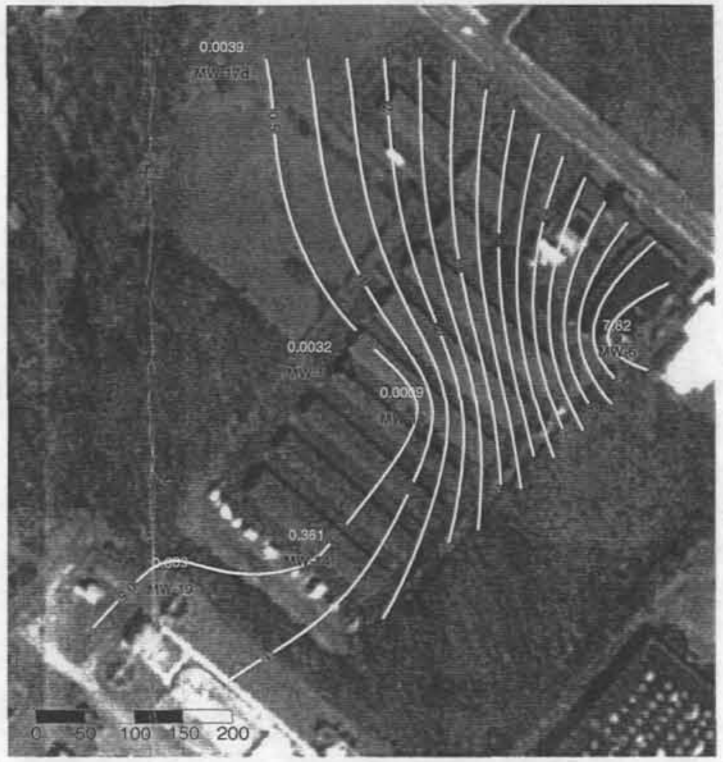
amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308



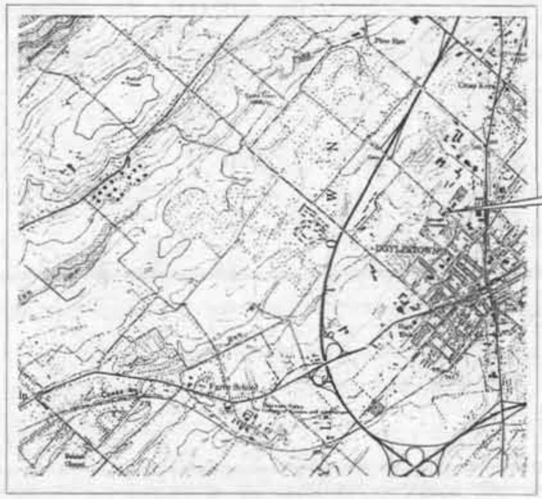
SHALLOW ZONE
(37'-57' DEEP)



MIDDLE ZONE
(73'-80' DEEP)



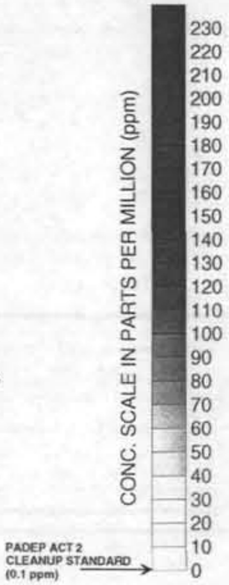
DEEP ZONE
(115'-220' DEEP)



TOPOGRAPHIC LOCATION MAP

NOTES:

1. Contours shown have been generated using reported hexavalent chromium concentrations specific to monitoring well locations. Contours extending beyond well locations are extrapolated based on this data.
2. Contours shown illustrate hexavalent chromium concentrations above the PADEP Act 2 Clean up standard of 0.1 ppm, and do not reflect monitoring wells with concentrations below the standard.



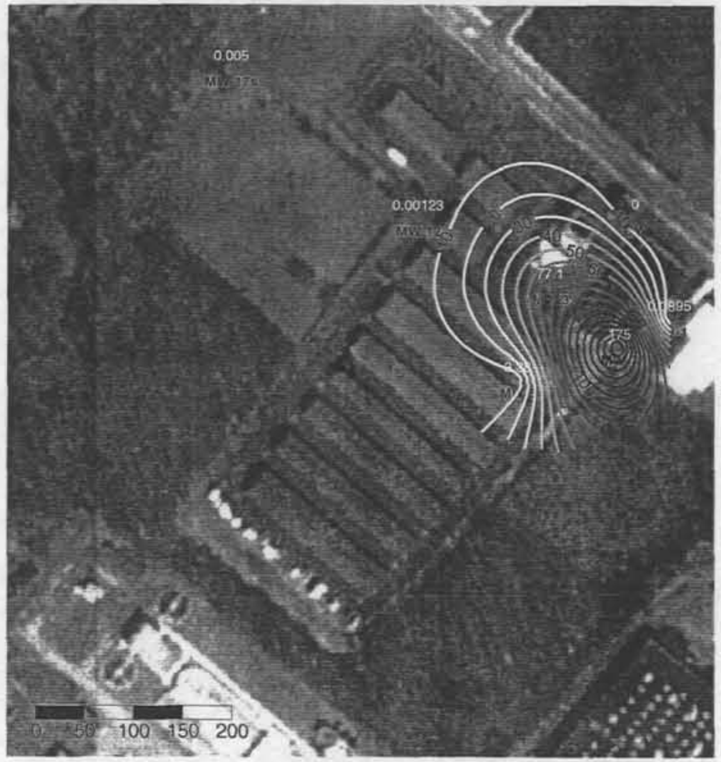
LEGEND

10.0 -*CONCENTRATION*
● MW-1 -*WELL ID*

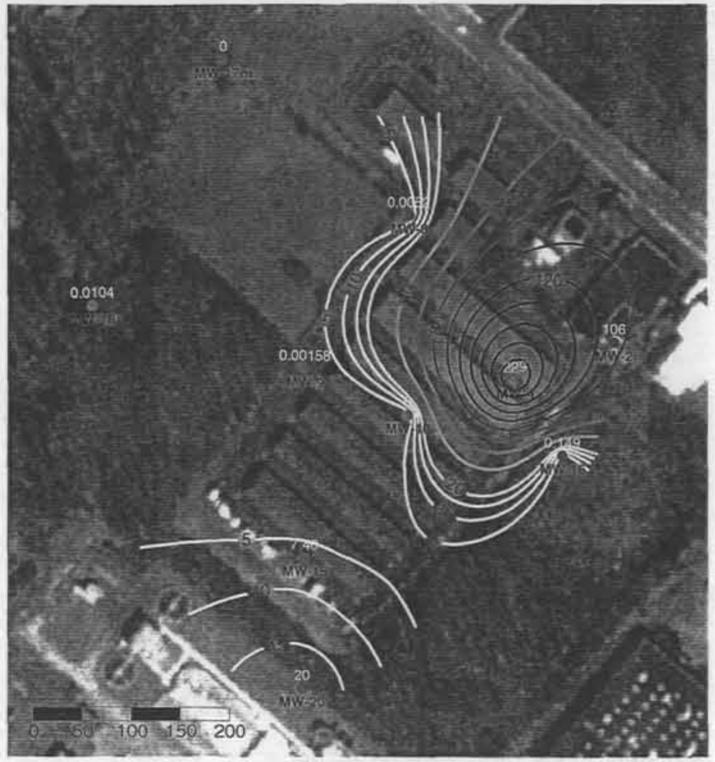
FIGURE 2-4a

HEXAVALENT CHROMIUM DISTRIBUTION BY ZONE
MAY 2002
CHEM-FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

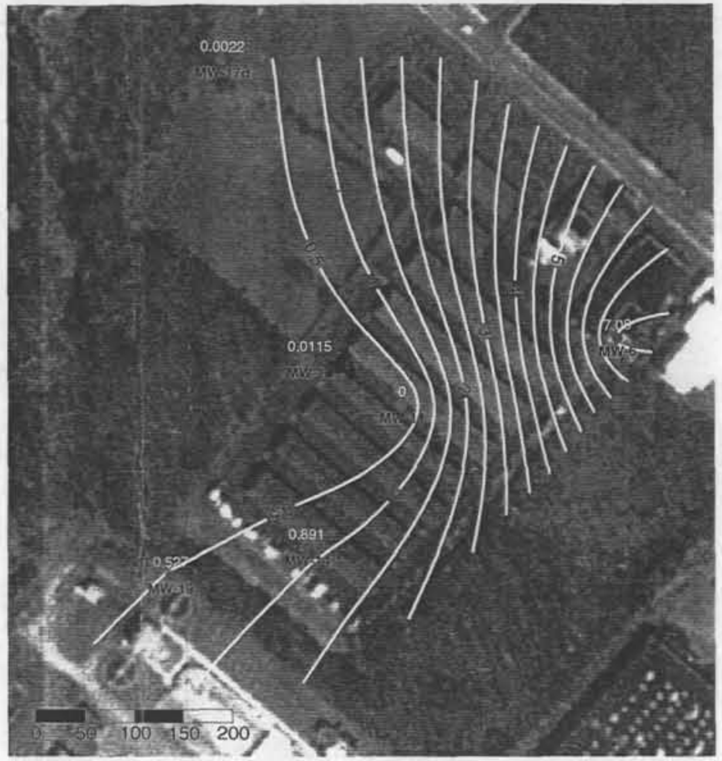
amec
EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308



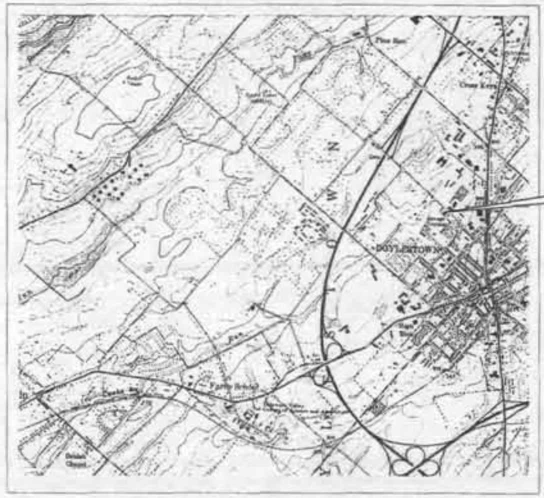
SHALLOW ZONE
(37'-57' DEEP)



MIDDLE ZONE
(73'-80' DEEP)



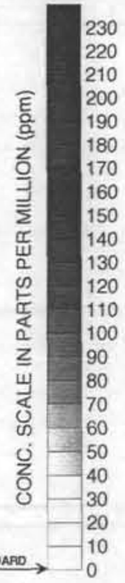
DEEP ZONE
(115'-220' DEEP)



TOPOGRAPHIC LOCATION MAP

NOTES:

1. Contours shown have been generated using reported hexavalent chromium concentrations specific to monitoring well locations. Contours extending beyond well locations are extrapolated based on this data.
2. Contours shown illustrate hexavalent chromium concentrations above the PADEP Act 2 Clean up standard of 0.1 ppm, and do not reflect monitoring wells with concentrations below the standard.



LEGEND

10.0 ● MW-1

10.0	*-CONCENTRATION*
● MW-1	*-WELL ID*

FIGURE 2-4b

HEXAVALENT CHROMIUM DISTRIBUTION BY ZONE
SEPTEMBER 2002
CHEM-FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

amec
EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850
PLYMOUTH MEETING, PA 19462-1308

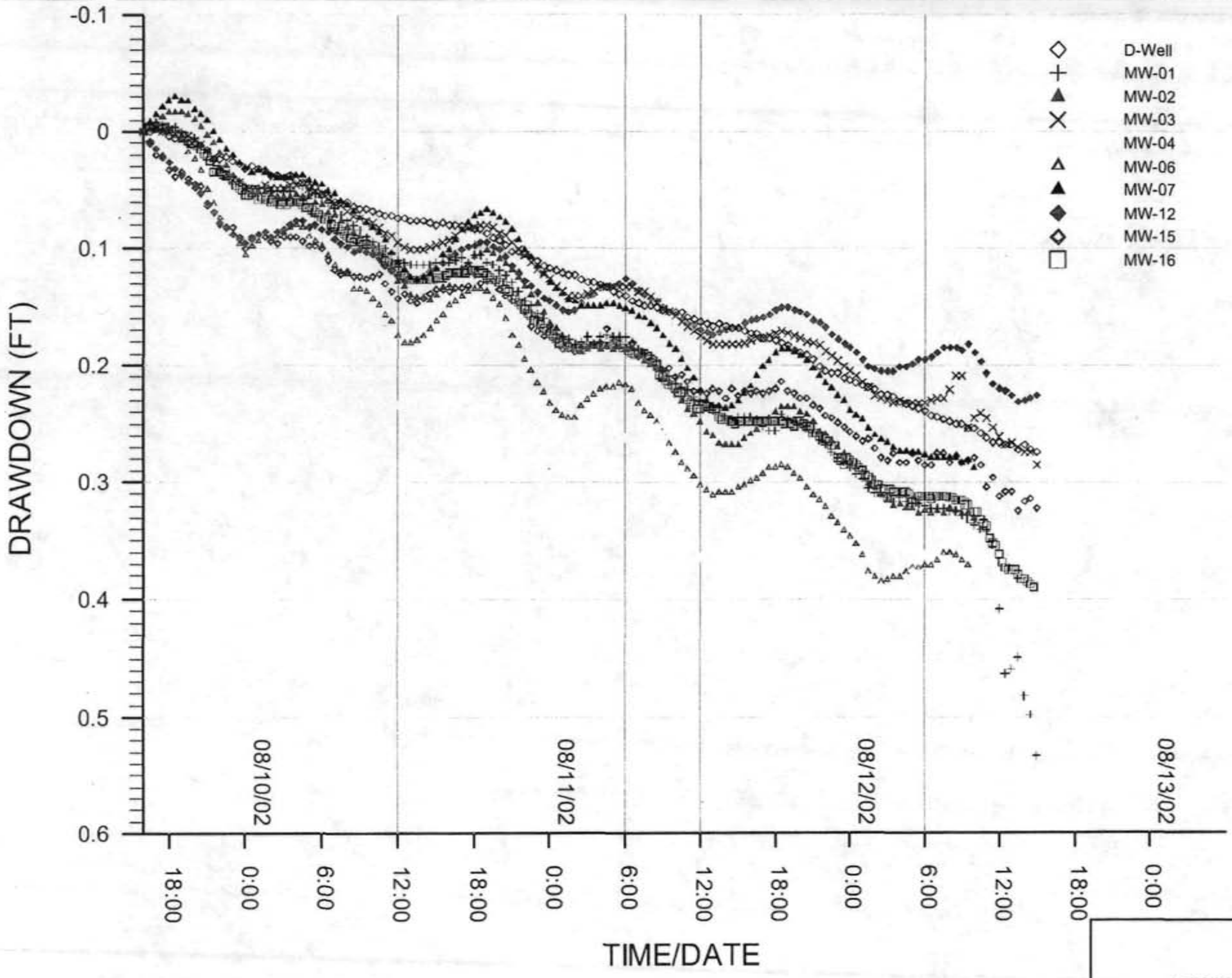
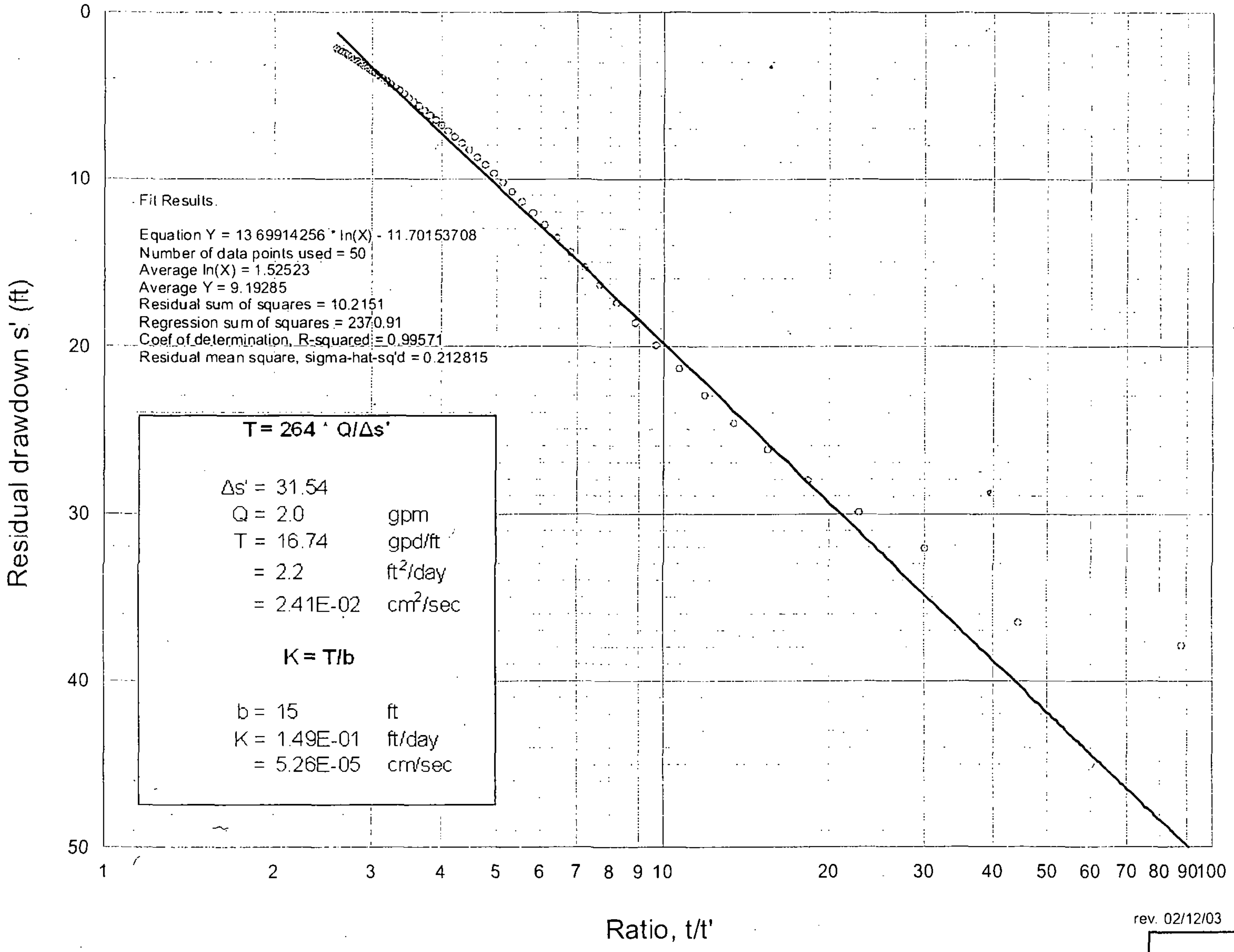


Figure 2-5

ANTECEDENT WATER-LEVEL
MONITORING DATA

Chem-Fab Site
Doylestown, Bucks County, PA

amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850, PLYMOUTH MEETING, PA 19462-1308



Fit Results.

Equation Y = 13 69914256 * ln(X) - 11.70153708
Number of data points used = 50
Average ln(X) = 1.52523
Average Y = 9.19285
Residual sum of squares = 10.2151
Regression sum of squares = 2370.91
Coef of determination, R-squared = 0.99571
Residual mean square, sigma-hat-sq'd = 0.212815

T = 264 * Q/Δs'

Δs' =	31.54	
Q =	2.0	gpm
T =	16.74	gpd/ft
=	2.2	ft^2/day
=	2.41E-02	cm^2/sec

K = T/b

b =	15	ft
K =	1.49E-01	ft/day
=	5.26E-05	cm/sec

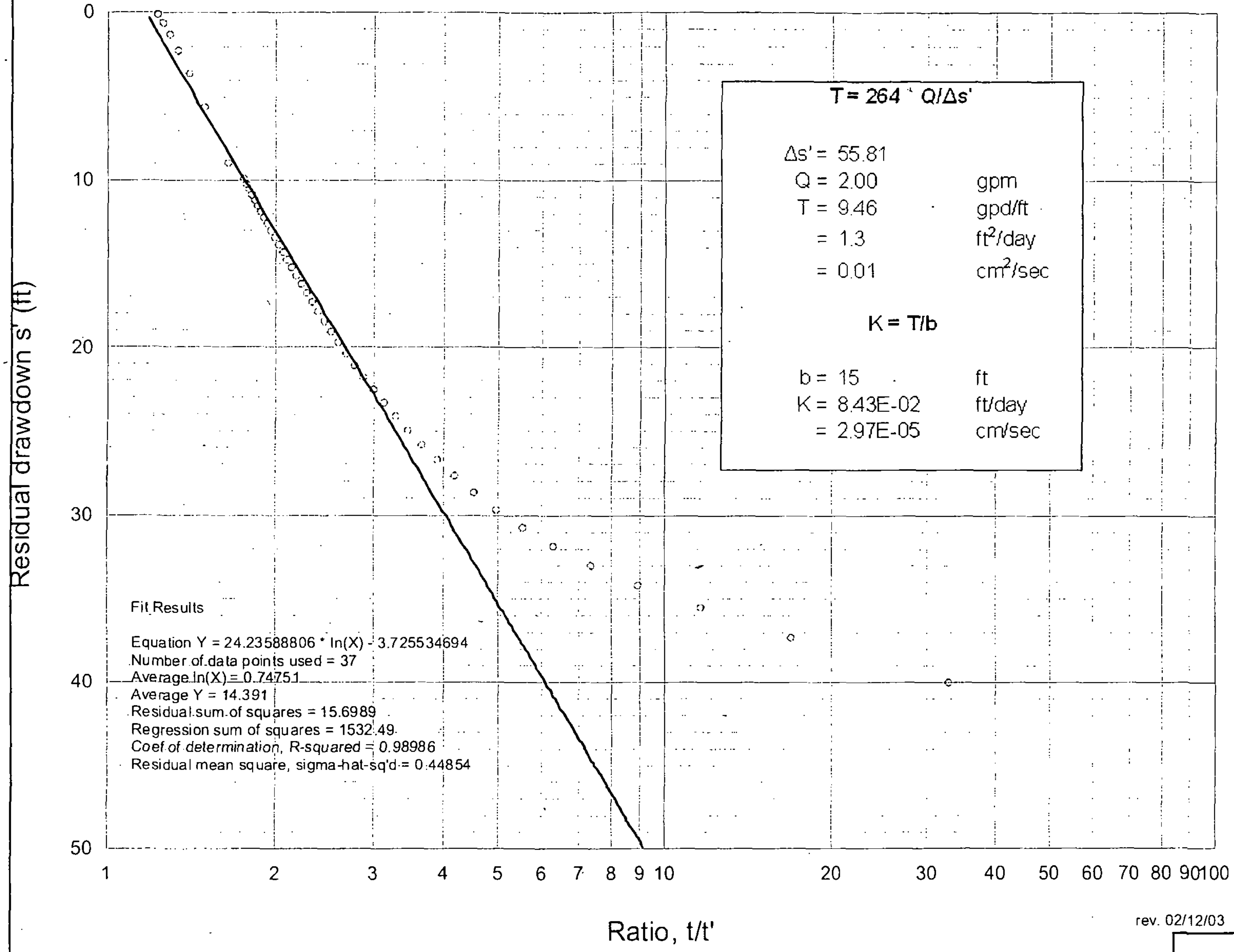
rev. 02/12/03

Figure 2-6a

RESIDUAL DRAWDOWN PLOT
OF WELL MW-03

Chem-Fab Site
Doylestown, Bucks County, PA

amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850, PLYMOUTH MEETING, PA 19462-1308



T = 264 * Q/Δs'

Δs' = 55.81
Q = 2.00 gpm
T = 9.46 gpd/ft
= 1.3 ft^2/day
= 0.01 cm^2/sec

K = T/b

b = 15 ft
K = 8.43E-02 ft/day
= 2.97E-05 cm/sec

Fit Results

Equation Y = 24.23588806 * ln(X) - 3.725534694
Number of data points used = 37
Average ln(X) = 0.74751
Average Y = 14.391
Residual sum of squares = 15.6989
Regression sum of squares = 1532.49
Coef of determination, R-squared = 0.98986
Residual mean square, sigma-hat-sq'd = 0.44854

rev. 02/12/03

Figure 2-6b

RESIDUAL DRAWDOWN PLOT
OF WELL MW-04

Chem-Fab Site
Doylestown, Bucks County, PA

amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850, PLYMOUTH MEETING, PA 19462-1308

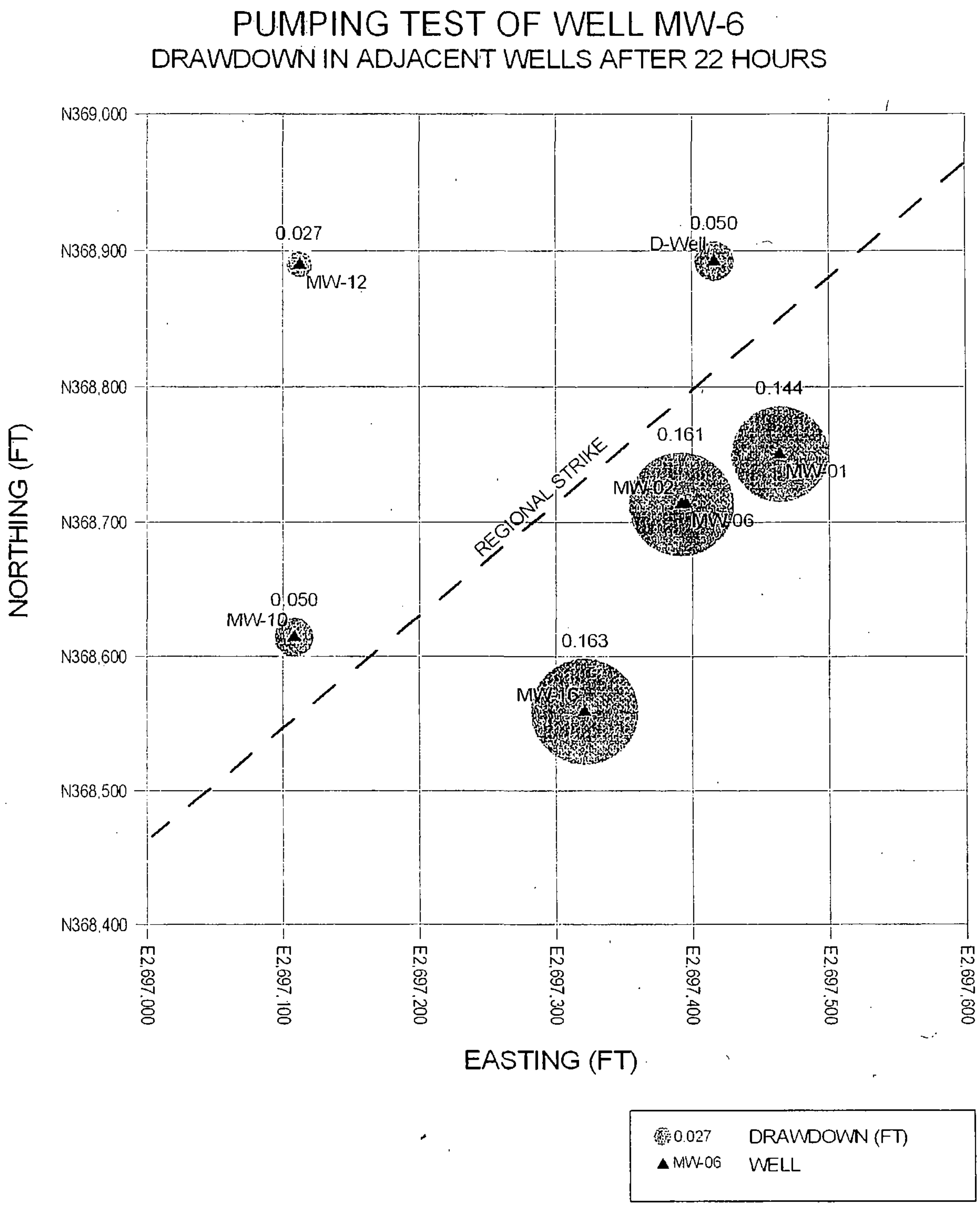
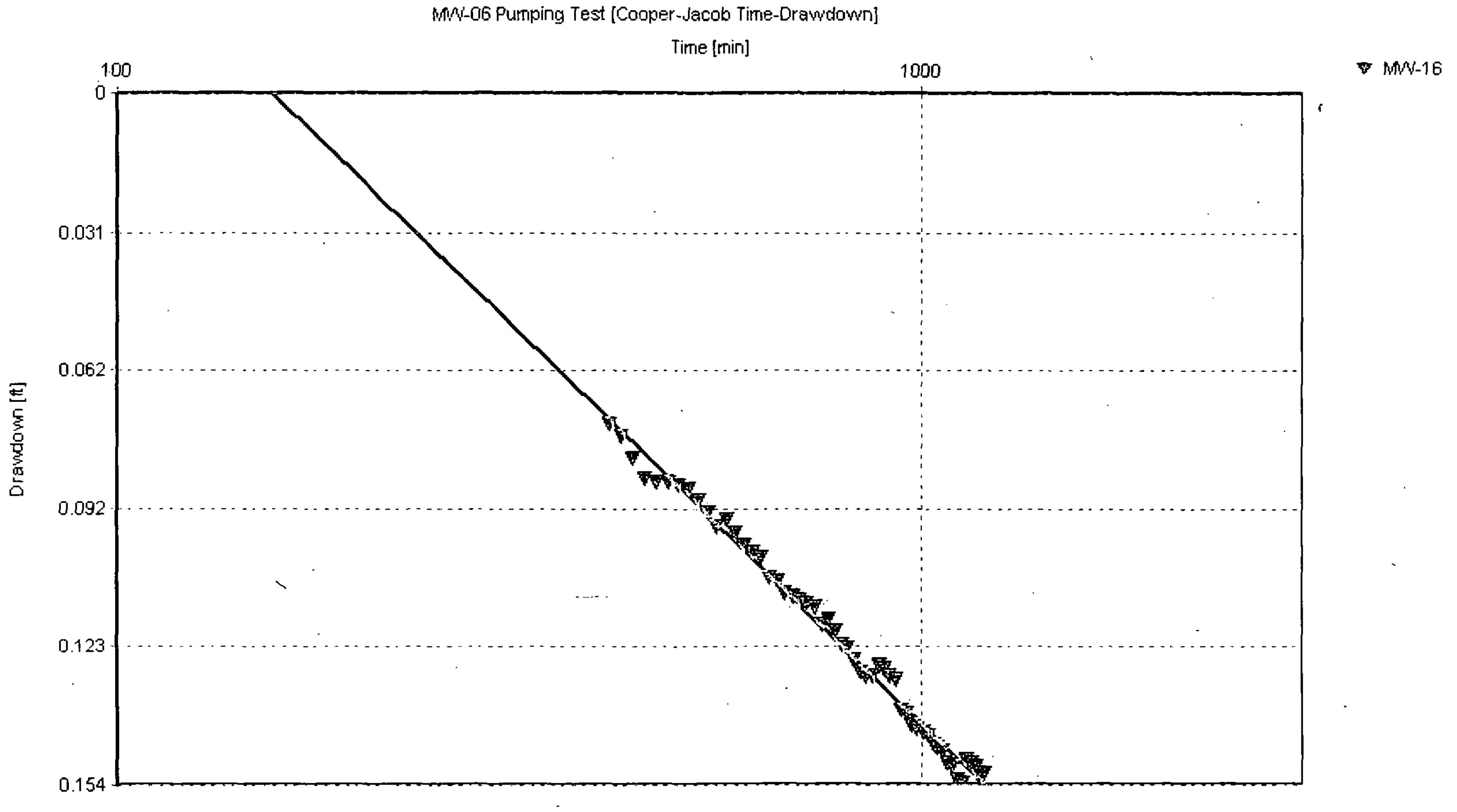


Figure 2-7

FLOW SYSTEM ANISOTROPY
OBSERVED DURING PUMPING TEST

Chem-Fab Site
Doylestown, Bucks County, PA

amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850, PLYMOUTH MEETING, PA 19462-1308



Transmissivity: 6.09E+2 ft²/d

Storativity: 5.00E-3

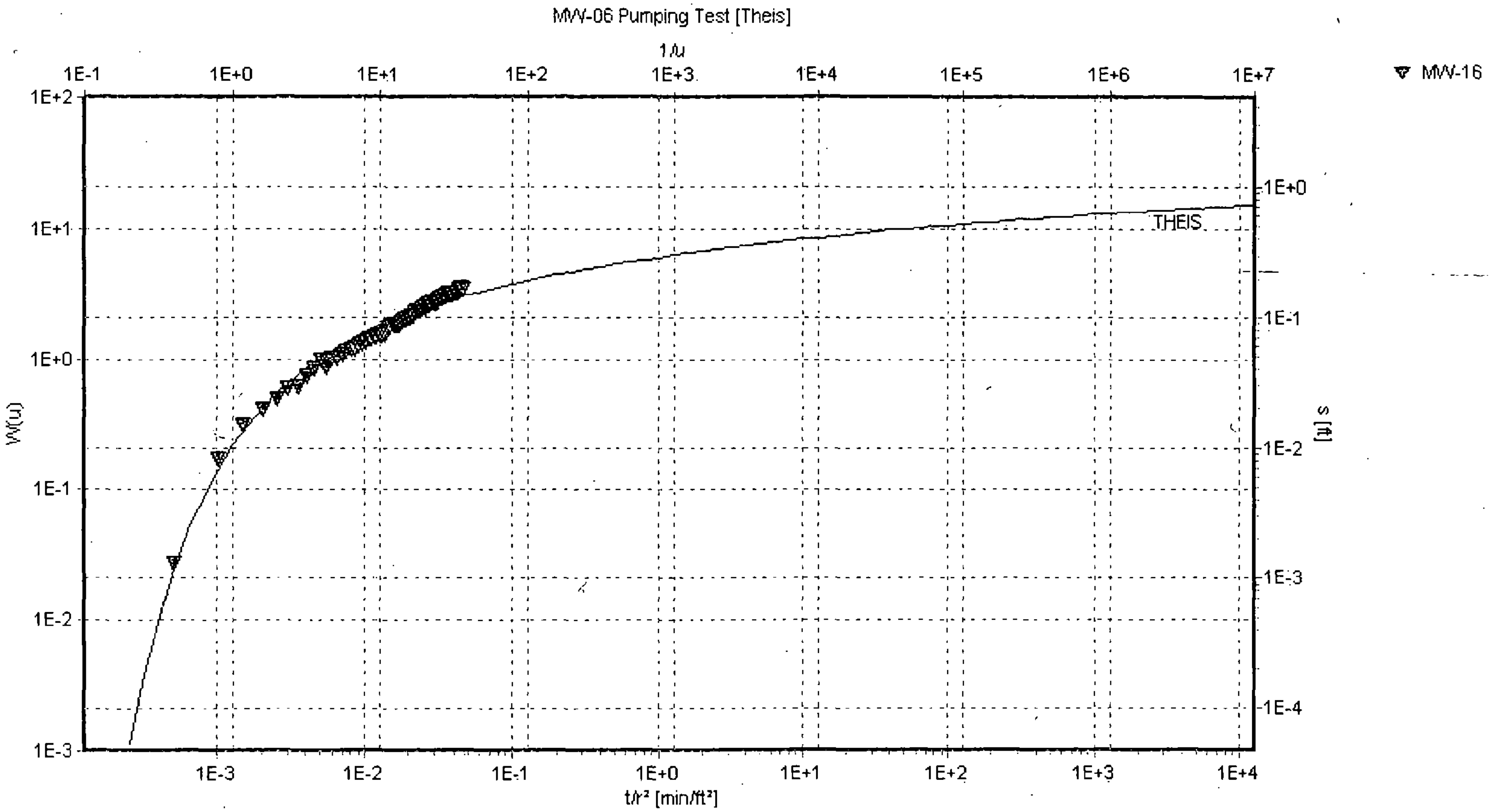
Conductivity: 5.63E+0 ft/d

Figure 2-8a

TIME-DRAWDOWN ANALYSIS
USING THE COPPER-JACOB METHOD

Chem-Fab Site
Doylestown, Bucks County, PA

amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850, PLYMOUTH MEETING, PA 19462-1308



MW-06 Pumping Test [Theis]

Transmissivity: 9.68E+2 ft²/d

Storativity: 3.46E-3

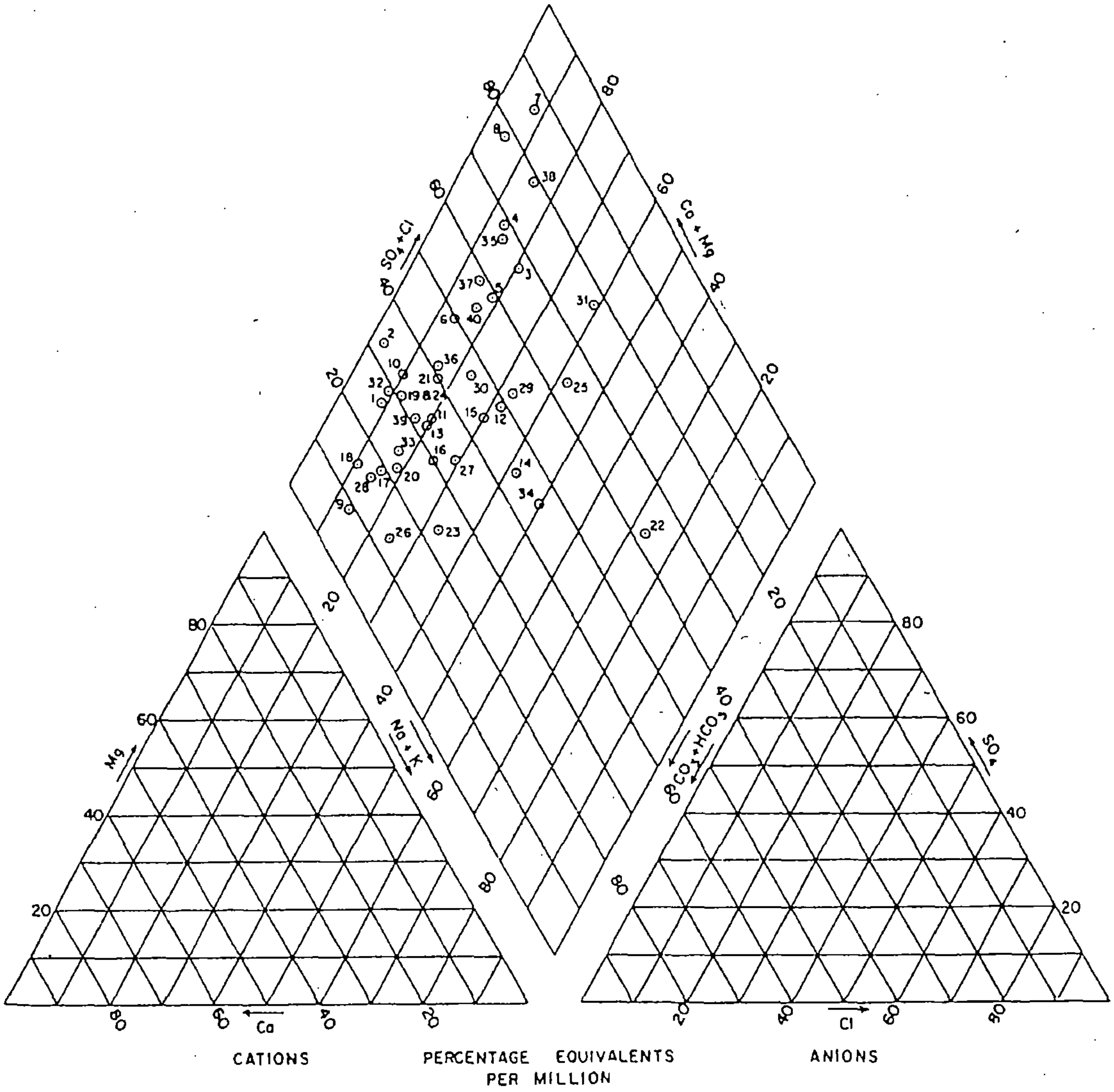
Conductivity: 8.95E+0 ft/d

Figure 2-8b

TIME-DRAWDOWN ANALYSIS
USING THE THEIS METHOD

Chem-Fab Site
Doylestown, Bucks County, PA

amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850, PLYMOUTH MEETING, PA 19462-1308



Trilinear diagram showing the chemical character of ground water in the Stockton formation in Montgomery and Chester Counties, PA.

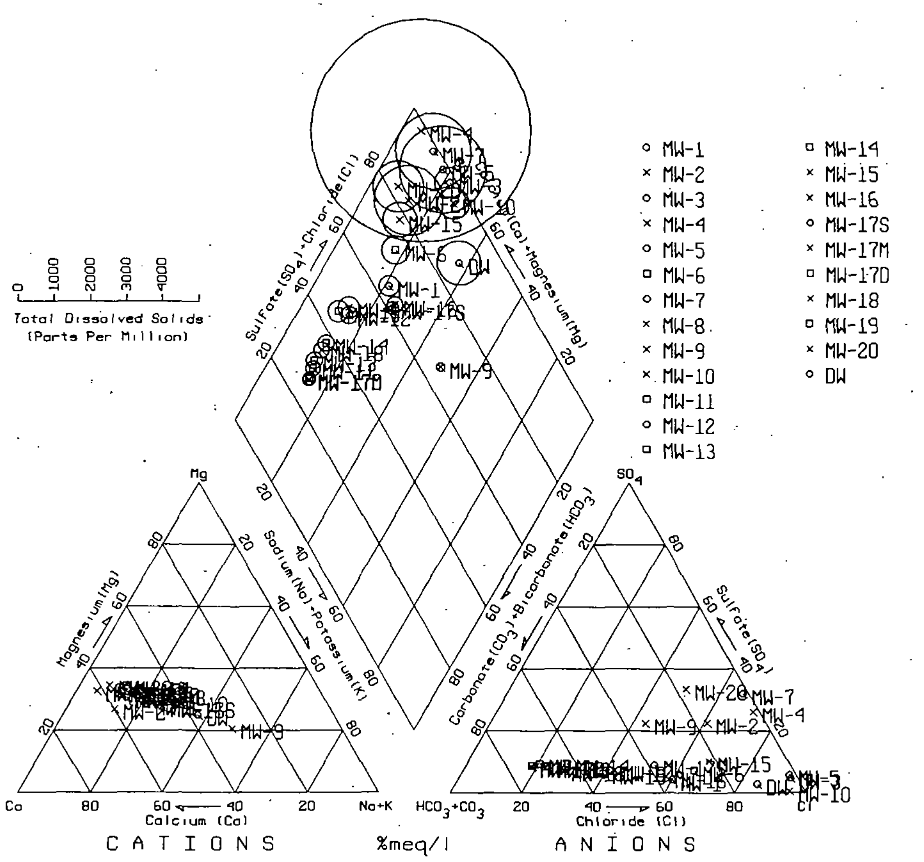
Source:
Geology and Hydrology of the Stockton Formation in Southeastern Pennsylvania, 1962,
United States Geological Survey

Figure 2-9

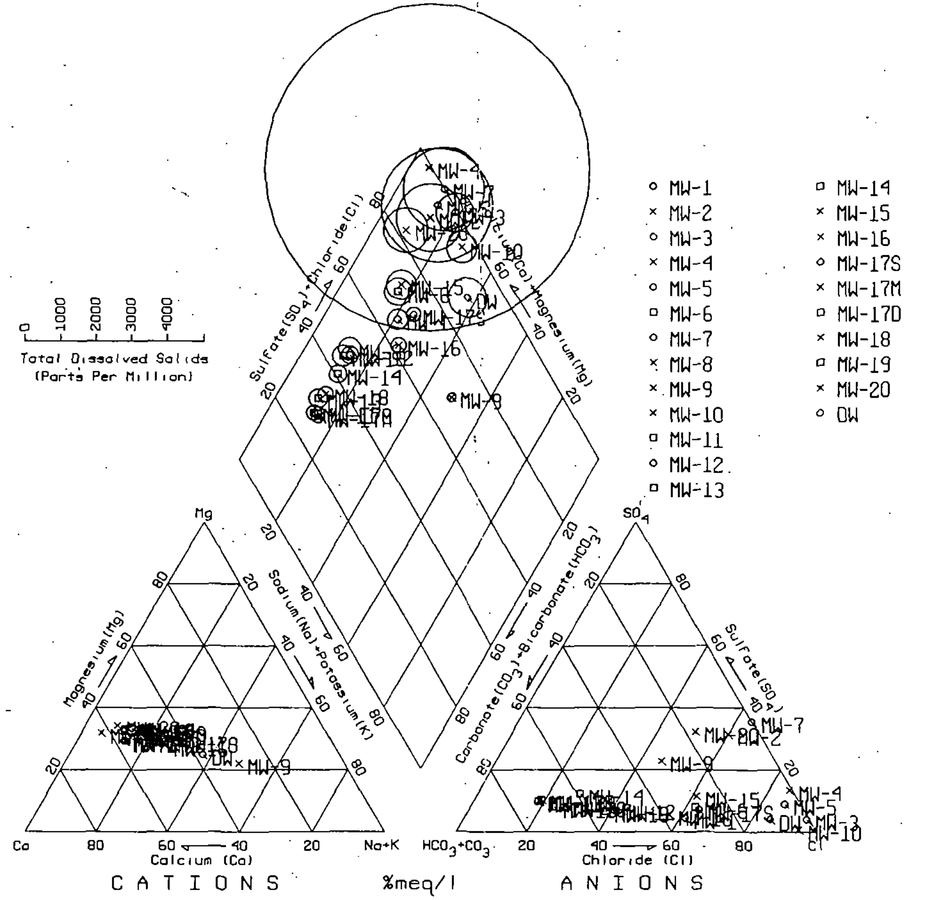
TRILINEAR DIAGRAM OF THE STOCKTON FORMATION

Chem-Fab Site
Doylestown, Bucks County, PA

amec EARTH & ENVIRONMENTAL, INC.
ONE PLYMOUTH MEETING, SUITE 850, PLYMOUTH MEETING, PA 19462-1308



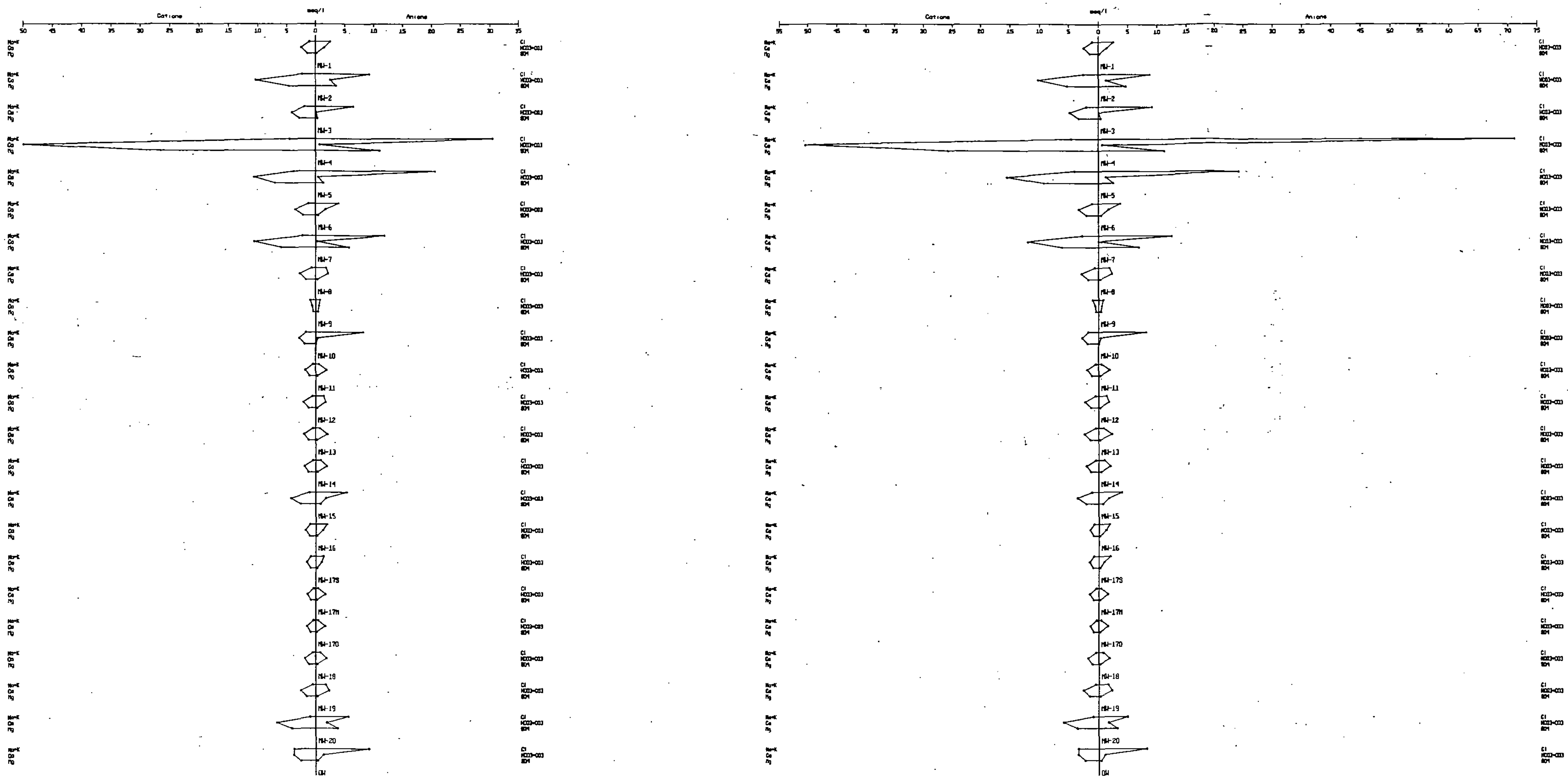
MAY 2002
(ROUND #4)



SEPTEMBER 2002
(ROUND #5)

FIGURE 2-10
TRILINEAR (PIPER) DIAGRAMS
MAY AND SEPTEMBER 2002
CHEM FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

amec EARTH AND ENVIRONMENTAL, INC.
One Plymouth Meeting, Suite 850
Plymouth Meeting, PA 19462

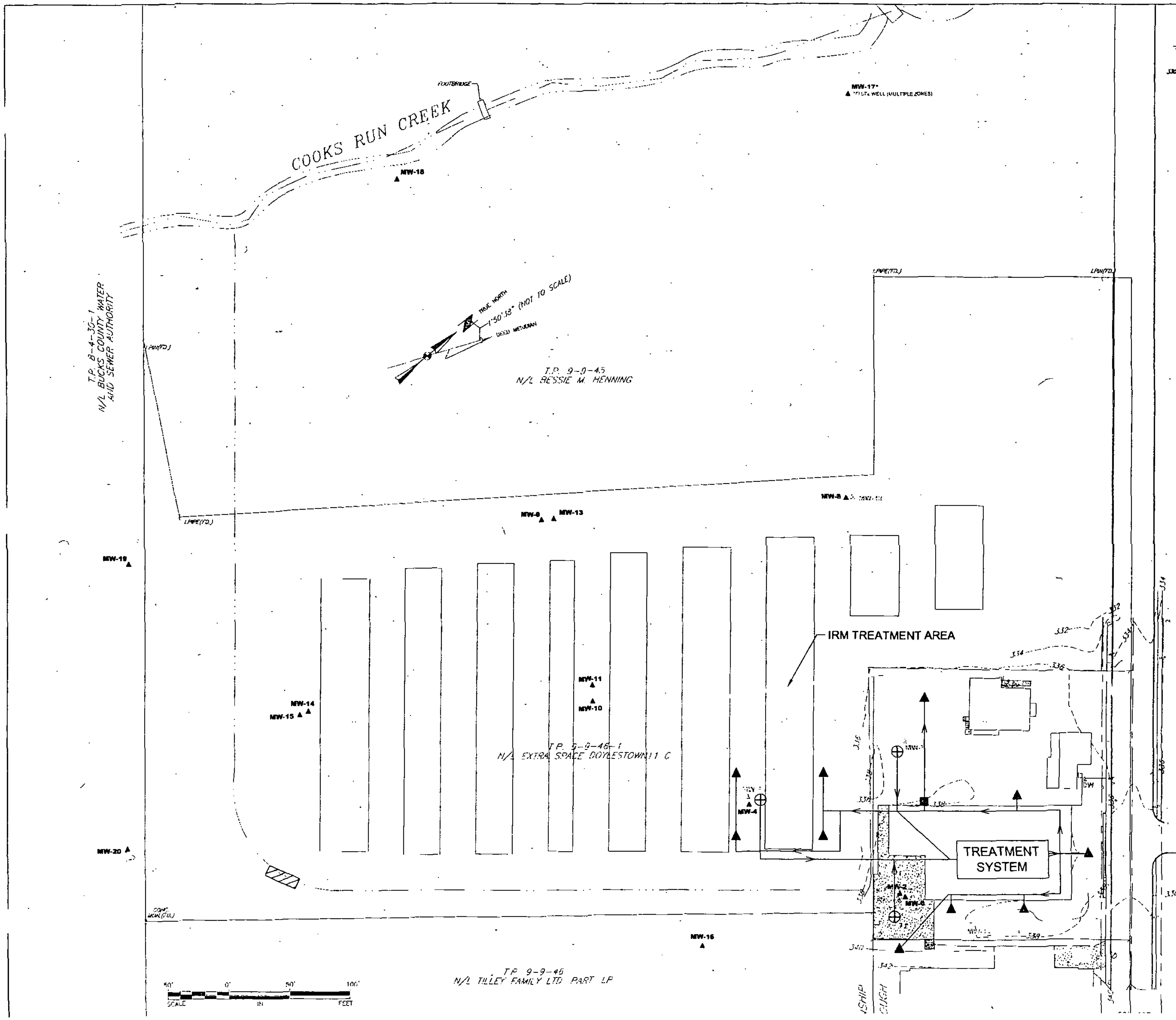


MAY 2002
(ROUND #4)

SEPTEMBER 2002
(ROUND #5)

FIGURE 2–11
STIFF DIAGRAMS
MAY AND SEPTEMBER 2002
CHEM FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

amec EARTH AND ENVIRONMENTAL, INC.
One Plymouth Meeting, Suite 850
Plymouth Meeting, PA 19462



LEGEND:

- CONTOURS
- 330 INDEX CONTOURS
- STREAM LINE
- FENCE LINE
- C.O. CLEANOUT / VENT
- Ø SANITARY SEWER MANHOLE
- TELEPHONE MANHOLE
- F.H. FIRE HYDRANT
- C.S. CURB STOP
- W.V. WATER VALVE
- SWALE
- ▲ GROUNDWATER RECOVERY WELL
- ⊕ REINJECTION WELL
- ■ PIT
- U.P. UTILITY POLE
- S SIGN
- GAS VALVE
- INLET/ CATCH BASIN
- CULV. CULVERT
- M.B. MAILBOX
- 325.5 EXISTING SPOT ELEVATION
- SANITARY SEWER LINE
- STORM DRAINAGE FACILITIES
- SOIL BORING LOCATION (MAY 2001)
- SOIL BORING LOCATION (SEPT. 2001)
- SEDIMENT SAMPLE LOCATION (SEPT. 2001)
- SURFACE WATER SAMPLE LOCATION (SEPT. 2001)
- ▨ AREA OF SWALE WITH YELLOW WATER

MONITORING WELL COLOR CODE:

GREEN - Monitoring Wells 37'-47' deep

BLUE - Monitoring Wells 73'-80' deep

RED - Monitoring Wells 115'-220' deep

arrows backward
legend to small

FIGURE 3-1

CONCEPTUAL TREATMENT SYSTEM
SCHEMATIC – IRM TREATMENT AREA

CHEM FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

amec EARTH AND ENVIRONMENTAL, INC.
One Plymouth Meeting, Suite 850
Plymouth Meeting, PA 19462

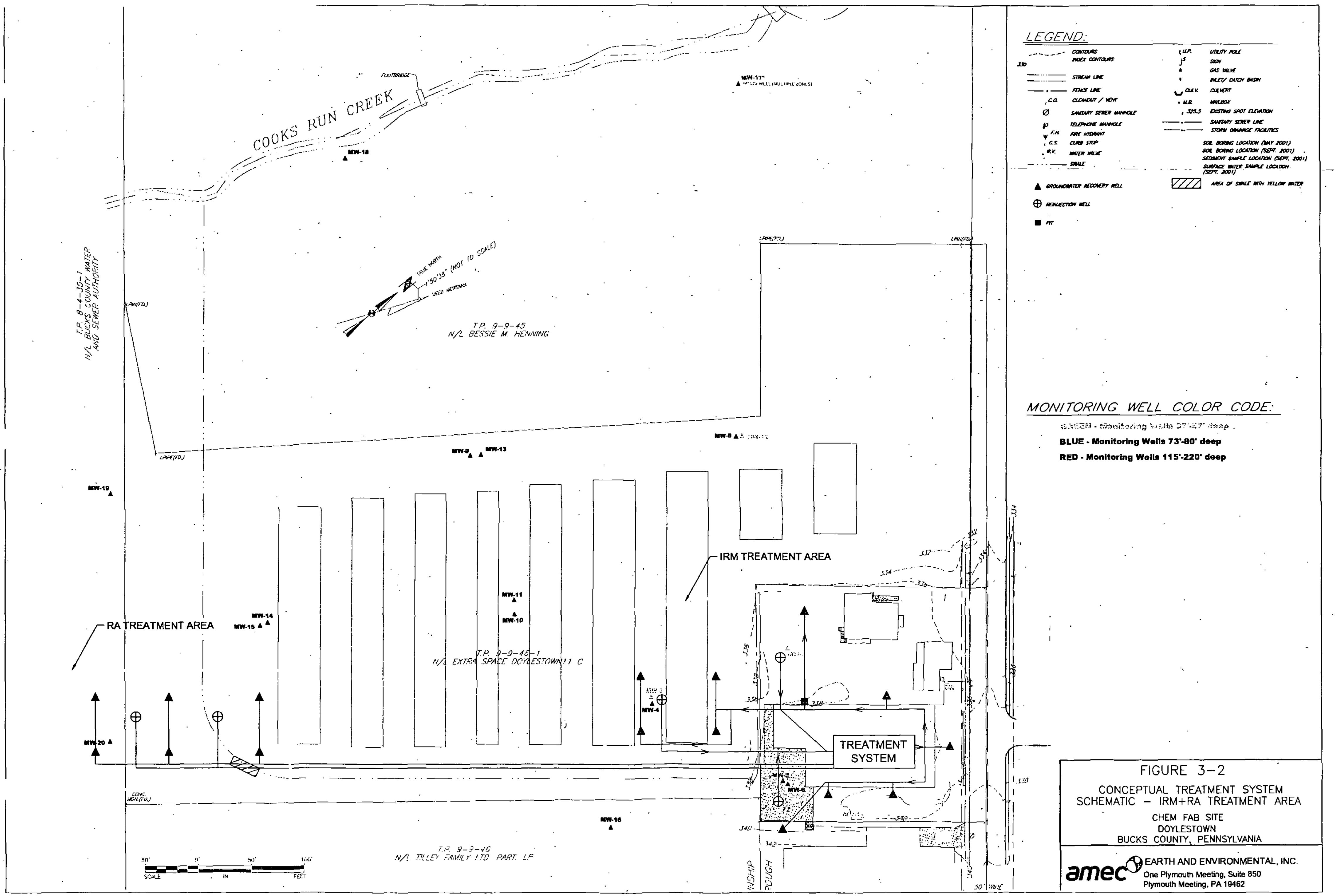


FIGURE 3-2

CONCEPTUAL TREATMENT SYSTEM
SCHEMATIC – IRM+RA TREATMENT AREA

CHEM FAB SITE
DOYLESTOWN
BUCKS COUNTY, PENNSYLVANIA

amec EARTH AND ENVIRONMENTAL, INC.
One Plymouth Meeting, Suite 850
Plymouth Meeting, PA 19462

Table 1-1
Field Indicator Parameter Data Summary
Chem-Fab Site, Doylestown, Bucks County, Pennsylvania

WELL ID	MW-01									
Date Sampled	06/20/2001		10/23/2001		01/08/2002		05/06/2002		09/09/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	4.25	-	7.31	-	11.84	-	8.7	-	13.39	-
PID reading (ppm)	450	-	6.3	-	4.4	-	1.5	-	10.9	-
Time Elapsed	905	1045	850	945	830	920	1325	1535	1215	1400
Temperature (C)	15.54	15.99	15.67	15.56	14.11	13.72	15.2	15.0	16.14	16.23
pH	6.09	6.03	6.59	6.4	6.19	6.78	6.09	6.14	3.63	3.45
SpCond	1141	995	0.412	0.55	0.06	0.034	-	-	-	-
Conductivity	934	826	-	-	-	-	0.55	0.621	260	432
DO	8.51	0.66	1.06	0.86	1.66	1.72	0.53	0.76	0.14	0.13
ORP	254.2	227	313	318	97	99	213	185	663.1	787.9
Turbidity	84.1	1283.4	-	-	-	-	-2.1	86.9	-	-
TDS	-	-	-	-	-	-	0.36	0.4	-	-
Gallons purged	1	14	2	7.5	1.25	7	1.25	28	2.5	24.5

WELL ID	MW-02									
Date Sampled	07/05/2001		10/23/2001		01/08/2002		05/07/2002		09/10/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	4.45	-	9.9	-	12.5	-	9.84	-	14.42	-
PID reading (ppm)	-	-	15.3	-	41.5	-	66.4	-	47.6	-
Time Elapsed	850	930	1020	1115	1325	1410	1300	1535	840	1240
Temperature (C)	16.53	15.55	15.19	15.36	13.67	13.72	14.7	15.1	15.36	15.83
pH	10.23	11.07	10.6	10.6	10.84	10.91	10.02	6.53	7.27	0.8
SpCond	0.616	0.626	0.346	0.351	0.002	0	-	-	-	-
Conductivity	-	-	-	-	-	-	1.35	2.05	1618	1465
DO	3.87	3.24	0.62	0.02	0.57	0.18	0.53	0.15	0.03	0.26
ORP	206	194	268	241	106	119	196	231	213	597.7
Turbidity	-	-	-	-	-	-	6.3	133	-	-
TDS	-	-	-	-	-	-	0.9	1.3	-	-
Gallons purged	1.5	8	0.75	7.5	0.5	6.5	2.25	21	2	42.5

WELL ID	MW-03									
Date Sampled	06/21/2001		10/24/2001		01/09/2002		05/09/2002		09/16/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	4.09	-	7.8	-	11.31	-	8.41	-	11.61	-
PID reading (ppm)	115	-	201	-	209	-	166	-	46.9	-
Time Elapsed	920	1015	855	1000	826	925	1030	1230	900	1020
Temperature (C)	13.8	13.9	14.11	14.17	12.94	13	13.3	13.4	14.05	13.95
pH	5.73	5.43	4.4	4.66	4.3	4.56	4.49	4.8	4.96	5.10
SpCond	2106	2305	0.695	0.694	0.373	0.385	-	-	-	-
Conductivity	1639	1816	-	-	-	-	0.79	0.896	664	890
DO	0.8	0.34	0.16	0.03	0.87	0.14	5.1	16.2	0.00	0.00
ORP	278.8	371	445	399	279	193	401	388	297.5	276.4
Turbidity	118	31.2	-	-	-	-	2.9	999	-	-
TDS	-	-	-	-	-	-	0.51	0.57	-	-
Gallons purged	3	12	1	8	0.5	8	1.75	27	2	25

WELL ID	MW-04									
Date Sampled	06/22/2001		10/24/2001		01/09/2002		05/16/2002		09/17/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	2.05	-	6.52	-	10.2	-	5.79	-	10.54	-
PID reading (ppm)	318	-	347	-	310	-	417	-	133	-
Time Elapsed	1230	1310	1318	1358	1450	1540	900	1220	815	1125
Temperature (C)	15.97	15.61	16.48	15.82	14.22	13.78	14.1	14.2	14.87	14.58
pH	5.95	5.96	6.05	6.18	6.14	6.25	6.27	5.16	5.59	5.10
SpCond	6087	5996	3.18	3.13	0.81	0.066	-	-	-	-
Conductivity	-	-	-	-	-	-	5.66	7.73	4758	6023
DO	2.42	2.23	0.4	0.12	0.29	0.18	2.74	0.23	0.83	0.02
ORP	56	24.4	354	275	104	108	250	415	196.3	420.4
Turbidity	-	-	-	-	-	-	22.7	243	-	-
TDS	-	-	-	-	-	-	3.6	4.9	-	-
Gallons purged	1.5	8	1	5.75	0.75	8	4	44	4.5	52

Table 1-1
Field Indicator Parameter Data Summary
Chem-Fab Site, Doylestown, Bucks County, Pennsylvania

WELL ID	MW-05									
Date Sampled	07/05/2001		10/24/2001		01/09/2002		05/14/2002		09/10/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	4.05	-	5.37	-	8.92	-	10.28	-	9.32	-
PID reading (ppm)	-	-	559	-	994	-	929	-	168	-
Time Elapsed	1040	1135	1100	1150	1315	1433	915	1035	1410	1520
Temperature (C)	16.39	15.85	16.3	16.43	14.06	14.06	13.80	14.00	16.61	15.67
pH	7.75	5.5	5.66	5.37	5.9	5.47	5.58	5.4	3.63	2.79
SpCond	3.02	2.13	2.9	2.3	0	0	-	-	-	-
Conductivity	-	-	-	-	-	-	3.12	2.49	1835	1707
DO	3.19	2.62	0.17	0.02	0.44	1.39	0.42	1.04	0.09	0.12
ORP	223	197	445	397	58	107	285	255	255.2	741.8
Turbidity	-	-	-	-	-	-	24.6	47.7	-	-
TDS	-	-	-	-	-	-	2	1.6	-	-
Gallons purged	1.5	9.5	1.25	5.25	0.75	8	2.5	19.5	2.5	21

WELL ID	MW-06									
Date Sampled	06/20/2001		10/23/2001		01/08/2002		05/09/2002		09/11/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	4.5	-	11.86	-	18.02	-	12.97	-	18.14	-
PID reading'(ppm)	50	-	31	-	22.4	-	89.0	-	16.6	-
Time Elapsed	1213	1313	1150	1300	1210	1250	915	1515	855	1255
Temperature (C)	17.01	18.03	15.5	15.14	13.78	13.67	13.8	13.7	15.20	15.03
pH	5.23	4.65	7.03	6.67	6.56	6.64	6.54	6.20	6.10	5.89
SpCond	5.23	4.65	0.589	0.499	0.01	0	-	-	-	-
Conductivity	729	735	-	-	-	-	0.519	0.642	553	550
DO	0.58	0.35	1.84	1.74	2.46	1.96	2.11	1.05	0.71	0.05
ORP	445.1	551.5	300	316	170	146	266	263	254.3	404.8
Turbidity	89.7	286	-	-	-	-	36.8	141	-	-
TDS	-	-	-	-	-	-	0.33	0.41	-	-
Gallons purged	-	8	1.25	7.5	0.25	4.5	4	70	1.5	60

WELL ID	MW-07									
Date Sampled	06/20/2001		10/23/2001		01/08/2002		05/07/2002		09/09/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	5.55	-	9.86	-	14.1	-	9.89	-	14.07	-
PID reading (ppm)	136	-	37	-	45.2	-	224	-	81.9	-
Time Elapsed	1400	1525	1335	1525	1015	1135	830	1000	910	1110
Temperature (C)	19.34	15.62	19.39	16.83	14.67	14.78	14.1	14.8	15.82	16.48
pH	5.99	5	7.95	5.72	5.81	5.23	4.77	5.25	4.15	2.75
SpCond	1	838	0.78	2.09	0.026	0.268	-	-	-	-
Conductivity	1	689	-	-	-	-	2.65	2.31	2458	1916
DO	11.03	0.79	0.53	0.25	0.68	0.24	2.38	0.48	22.2	0.12
ORP	352.3	526.2	293	113	218	262	310	304	443	693.3
Turbidity	3.1	45	-	-	-	-	3.8	205	-	-
TDS							1.7	1.5	-	-
Gallons purged	3	16	1.5	13	0.5	9.5	1.5	19	3	26.5

WELL ID	MW-08									
Date Sampled	07/05/2002		10/25/2001		01/10/2002		05/08/2002		09/11/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	6.02	-	8.22	-	8.54	-	7.07	-	8.87	-
PID reading (ppm)	-	-	3.2	-	4.2	-	3.6	-	29.3	-
Time Elapsed	1220	1305	900	1010	1344	1425	1315	1530	910	1150
Temperature (C)	16.57	15.36	15.47	15.2	14.39	14.33	14.4	14.1	15.14	14.72
pH	6.39	6.99	6.81	6.79	6.9	6.67	6.59	6.67	6.62	6.49
SpCond	0.361	0.383	0.352	0.285	0.013	0.008	-	-	-	-
Conductivity	-	-	-	-	-	-	0.403	0.488	330	401
DO	3.73	3.11	1.7	1.27	2.88	1.57	1.16	0.6	1.88	0.93
ORP	211	227	391	373	105	118	295	239	133.7	145.7
Turbidity	-	-	-	-	-	-	1	52.6	-	-
TDS							0.26	0.32	-	-
Gallons purged	2.5	10	1	10	1.5	6.5	2.5	33.5	2.5	42.5

Table 1-1
Field Indicator Parameter Data Summary
Chem-Fab Site, Doylestown, Bucks County, Pennsylvania

WELL ID	MW-09									
Date Sampled	07/05/2001		10/25/2001		01/11/2002		05/10/2002		09/13/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	6.9	-	7.95	-	7.96	-	6.4	-	8.65	-
PID reading (ppm)	-	-	1.2	-	28.5	-	19.2	-	29.6	-
Time Elapsed	1350	1435	1050	1200	845	940	835	1150	830	1110
Temperature (C)	16.21	15.02	16.03	15.41	13.5	13.33	13.9	14.3	14.60	14.35
pH	6.53	5.94	6.09	5.75	5.65	5.56	5.83	5.4	5.6	5.28
SpCond	0.044	0.218	0.187	0.166	0.008	0.006	-	-	-	-
Conductivity	-	-	-	-	-	-	0.216	0.212	161	171
DO	4.39	2.99	0.67	0.03	0.57	0.3	7.4	4.1	0.73	0.17
ORP	251	261	417	380	106	106	214	258	206.1	237.3
Turbidity	-	-	-	-	-	-	-10	228	-	-
TDS							0.14	0.14	-	-
Gallons purged	1.25	8	0.5	8.5	0.5	7	3	44	2.5	42.5

WELL ID	MW-10									
Date Sampled	07/06/2001		10/29/2001		01/11/2002		05/10/2002		09/13/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	3.42	-	7.56	-	9.97	-	6.86	-	10.4	-
PID reading (ppm)	-	-	107	-	408	-	419	-	226	-
Time Elapsed	931	1015	905	955	1330	1430	845	1230	820	1040
Temperature (C)	15.15	15.23	14.99	14.79	13.78	13.94	14.4	14.5	15.12	14.62
pH	5.5	5.68	5.2	5.69	5.72	5.62	5.03	5.88	6.19	5.24
SpCond	1.16	1.161	0.412	0.434	0.142	0.17	-	-	-	-
Conductivity	-	-	-	-	-	-	0.762	1.07	636	755
DO	3.73	2.42	0.52	0.06	0.91	0.12	2.87	0.18	-0.01	0.04
ORP	353	267	365	320	112	104	307	-2	51.4	106.5
Turbidity	-	-	-	-	-	-	41.4	119	-	-
TDS	-	-	-	-	-	-	0.49	0.7	-	-
Gallons purged	1.5	8	1.25	7.5	0.2	7	2.5	44	2.5	42.5

WELL ID	MW-11									
Date Sampled	09/21/2001		10/29/2001		01/11/2002		05/13/2002		09/12/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	4.85	-	7.66	-	10.77	-	6.77	-	11.77	-
PID reading (ppm)	2.1	-	2.2	-	1	-	1	-	16.9	-
Time Elapsed	858	1120	1032	1315	1455	1554	910	1530	838	1225
Temperature (C)	15.55	14.76	15.04	14.69	13.28	12.94	13.5	13.5	14.8	14.45
pH	7.31	7.3	7.2	7.27	7.16	7.19	6.98	7.12	7.31	7.17
SpCond	0.413	0.335	0.076	0.079	0.013	0.002	-	-	-	-
Conductivity	-	-	-	-	-	-	0.306	0.3	279	262
DO	1.01	3.34	0.44	2.22	0.33	2	1.77	3.98	0.04	0.08
ORP	235	195	323	314	99	104	283	253	248.7	414.6
Turbidity	-	-	-	-	-	-	50.4	78.2	-	-
TDS	-	-	-	-	-	-	0.2	0.19	-	-
Gallons purged	1.9	24	1	17.5	0.75	8.5	3.25	55.5	1	44.5

WELL ID	MW-12									
Date Sampled	09/21/2001		10/24/2001		01/10/2002		05/08/2002		09/10/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	7.92	-	8.43	-	8.6	-	7.2	-	9.16	-
PID reading (ppm)	2.2	-	4.7	-	4	-	2.4	-	29.2	-
Time Elapsed	1215	1325	1445	1539	1210	1310	920	1040	1425	1537
Temperature (C)	16.15	15.58	17.31	16.39	15.11	14.39	15	14.8	15.97	15.41
pH	6.8	6.72	6.77	6.82	6.93	6.61	6.52	6.58	6.4	6.36
SpCond	0.003	0	0.196	0.201	0.024	0.022	-	-	-	-
Conductivity	-	-	-	-	-	-	0.406	0.382	361	322
DO	1.39	1.82	0.83	1.6	1.27	1.71	5.51	1.98	2.55	1.75
ORP	196	205	355	349	109	117	346	300	139.4	191.2
Turbidity	-	-	-	-	-	-	7.5	42.9	-	-
TDS	-	-	-	-	-	-	0.26	0.25	-	-
Gallons purged	2.5	15	0.75	6.75	0.2	8.5	1.5	19.5	2.5	18

Table 1-1
Field Indicator Parameter Data Summary
Chem-Fab Site, Doylestown, Bucks County, Pennsylvania

WELL ID	MW-13									
Date Sampled	09/20/2001		10/25/2001		01/11/2002		05/13/2002		09/12/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	3.1	-	4.62	-	8.7	-	4.29	-	9.26	-
PID reading (ppm)	6	-	1.6	-	2.4	-	1.3	-	15.9	-
Time Elapsed	950	1200	1330	1500	1010	1105	900	1530	830	1230
Temperature (C)	15.41	14.59	15.3	14.92	12.83	12.72	13.2	13	14.08	14.15
pH	7.19	7.27	6.86	7.08	6.98	7.01	7.14	7.12	7.11	7.05
SpCond	0.342	0.345	0.264	0.193	0	0	-	-	-	-
Conductivity	-	-	-	-	-	-	0.353	0.343	348	298
DO	4.07	4.02	3.2	3.66	1.79	1.95	16.6	3.7	1.85	3.18
ORP	215	186	388	387	94	103	103	131	84.7	134.6
Turbidity	-	-	-	-	-	-	5.9	85.6	-	-
TDS	-	-	-	-	-	-	0.23	0.22	-	-
Gallons purged	2	25	0.5	14	0.5	7.5	3	88.5	2.5	60

WELL ID	MW-14									
Date Sampled	09/20/2001		10/29/2001		01/14/2002		05/14/2002		09/16/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	3.84	-	6.3	-	8.36	-	4.87	-	10.16	-
PID reading (ppm)	1.5	-	3.3	-	1.6	-	2.8	-	2.2	-
Time Elapsed	1345	1536	1410	1525	1005	1055	855	1325	845	1225
Temperature (C)	16.02	15.77	15.96	15.29	13.56	13.78	13.4	13.5	14.8	14.85
pH	6.66	7.28	6.79	6.79	7.25	7.2	7.49	7.48	7.26	7.34
SpCond	0.961	0.463	0.126	0.282	0	0	-	-	-	-
Conductivity	-	-	-	-	-	-	0.795	0.347	464	297
DO	0.89	3.21	0.93	0.03	2.24	0.23	5	3.4	0.15	4.16
ORP	164	173	333	278	87	98	80	91	68.7	4.16
Turbidity	-	-	-	-	-	-	3.2	194	-	-
TDS	-	-	-	-	-	-	0.51	0.23	-	-
Gallons purged	1.75	20	1.25	8.25	0.9	6.7	3.25	87	2.5	53.75

WELL ID	MW-15						MW-16					
Date Sampled	01/14/2002		05/16/2002		09/17/2002		01/07/2002		05/06/2002		09/10/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	8.62	-	5.46	-	9.34	-	14.41	-	9.31	-	14.78	-
PID reading (ppm)	119	-	-	-	37.8	-	3.6	-	22.1	-	21.5	-
Time Elapsed	835	930	850	1140	830	1130	1305	1415	905	1125	910	1120
Temperature (C)	13.33	13.5	13.9	14.1	14.61	14.66	11.67	11.44	12.3	12.6	12.9	13.2
pH	6.54	6.47	6.64	6.5	6.35	6.19	6.21	6.18	5.87	5.94	5.91	5.85
SpCond	0.263	0.243	-	-	-	-	0.09	0.023	-	-	-	-
Conductivity	-	-	1.13	0.817	559	583	-	-	0.453	0.5	282	256
DO	2.2	0.98	5.2	1.7	0.69	0.47	1.71	2.24	1.2	1.86	1.04	1.46
ORP	82	95	154	200	162	231.8	104	105	190	215	147	174.4
Turbidity	-	-	-8.4	85.1	-	-	-	-	8.2	228	-	-
TDS	-	-	0.7	0.52	-	-	-	-	0.29	0.32	-	-
Gallons purged	0.5	7.1	4	49.5	2.5	47.5	1	8.75	2	30	2.5	35

**MW-18 has a riser, approx. 2.29 ft above ground surface

WELL ID	MW-17						MW-18					
	SHALLOW ZONE		*MIDDLE ZONE*		*DEEP ZONE*							
Date Sampled	05/15/2002		05/15/2002		05/16/2002		01/14/2002		05/17/2002		09/17/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	-	-	-	-	-	-	1.02	-	0.67	-	1.56	-
PID reading (ppm)	-	-	-	-	-	-	4	-	-	-	0	-
Time Elapsed	1430	1433	1446	1450	1448	1455	1205	1300	845	1055	1330	1530
Temperature (C)	12.6	14.2	12.6	13	15.7	13	10.83	10.89	12	12.1	13.08	12.78
pH	7.17	6.98	6.99	7.07	7.27	7.28	6.96	6.93	7.04	6.93	6.55	6.93
SpCond	-	-	-	-	-	-	0.145	0.085	-	-	-	-
Conductivity	0.328	0.322	0.261	0.251	0.295	0.295	-	-	0.376	0.356	274	262
DO	0.95	12.3	2.15	0.96	6.7	6.9	1.85	1.91	7.9	3.1	1.01	0.02
ORP	187	183	170	163	105	96	97	97	100	130	270.5	354.2
Turbidity	38.4	35.3	2.15	0.96	-10	-1	-	-	-9.3	-10	-	-
TDS	0.21	0.2	0.17	0.16	0.19	0.19	-	-	0.24	0.23	-	-
Gallons purged	0.5	1	0.5	1	1	1.5	1	8.7	3	48	2.5	30

Table 1-1
Field Indicator Parameter Data Summary
Chem-Fab Site, Doylestown, Bucks County, Pennsylvania

WELL ID	MW-19						MW-20					
Date Sampled	01/10/2002		05/15/2002		09/18/2002		01/10/2002		05/15/2002		09/18/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	3.47	-	0	-	4.11	-	9.69	-	5.55	-	10.42	-
PID reading (ppm)	31.7	-	-	-	36.5	-	76.3	-	-	-	15.7	-
Time Elapsed	1023	1120	855	1315	815	1155	830	930	900	1200	820	1100
Temperature (C)	12.89	13	12.8	13.1	14.13	13.95	12.11	12.28	12.7	13	13.53	13.6
pH	6.76	6.88	6.82	6.95	7.17	6.84	6.37	6.31	6.52	6.44	6.3	6.22
SpCond	0.119	0.155	-	-			0.058	0.024	-	-		
Conductivity	-	-	0.435	0.434	375	373	-	-	0.82	1.24	692	74
DO	*1.2*	*1.4*	2.59	2.73	*-0.05*	*0.01*	1.32	*1.06*	5.4	1.9	0.68	0.55
ORP	111	109	301	175	163.2	375.1	90	99	181	207	159	220.2
Turbidity	-	-	48.1	129	-	-	-	-	217	149	-	-
TDS	-	-	0.28	0.28	-	-	-	-	0.53	0.8	-	-
Gallons purged	0.75	9	5.5	76.5	3	58	1	6.5	3	46	2.5	42.5

WELL ID	DW-01									
Date Sampled	06/22/2001		10/30/2001		01/09/2002		05/10/2002		09/09/2002	
	START	FINAL	START	FINAL	START	FINAL	START	FINAL	START	FINAL
Static Water Level (below TOC)	2.48	-	6.81	-	9.97	-	6.12	-	9.71	-
PID reading (ppm)	-	-	2	-	0.7	-	-	-	21.6	-
Time Elapsed	1105	1145	915	1005	1025	1130	1430	1545	930	1320
Temperature (C)	14.7	14.37	15.92	15.77	13.5	13.78	13.9	13.9	15.7	15.88
pH	6.36	6.13	6.28	6.04	6.28	6.14	6.64	6.22	6.38	5.6
SpCond	1003	928	0.001	0.001	0.181	0.176	-	-	-	-
Conductivity	-	-	-	-	-	-	1.35	1.26	940	816
DO	0.25	0.39	0.28	0.05	0.27	0.24	4.7	6.2	0.15	0.18
ORP	-45.8	-29	303	241	1	37	-112	-58	-169	-124.3
Turbidity	-	-	-	-	-	-	103	*866*	-	-
TDS	-	-	-	-	-	-	0.9	0.8	-	-
Gallons purged	2	10	1	6	1.25	8.5	4	23	2.5	60

Table 1-2
Geochemical Groundwater Sampling Data
Chem-Fab Site, Doylestown, Bucks County, Pennsylvania

Parameter	Unit	**MW-01-04**	**MW-01-05**	**MW-02-04**	**MW-02-05**	**MW-03-04**	**MW-03-05**	**MW-04-04**	**MW-04-05**	**MW-05-04**	**MW-05-05**	**MW-06-04**	**MW-06-05**
DO	mg/l	0.76	0.13	0.15	0.26	16.2*	0	0.23	0.02	1.04*	0.12	1.05	0.05
ORP	mV	185	787.9	231	597.7	388	276.4	415	420.4	255	741.8	263	404.8
pH	0-14	6.14	3.45	6.53*	0.8	4.8	5.1	5.16	5.1	5.4	2.79	6.2	5.89
Alk to pH 8.3	mg/l	ND	0.41	ND	0.41	ND	0.41	ND	0.41	ND	0.41	ND	0.41
Alk to pH 4.5	mg/l	92.4	86.4	153	76.4	8.3	4.5	45.8	40.7	25.6	75.4	105	105
COD	mg/l	2.4 J	6.6 J	ND	17	ND	17	ND	17	10.6	13	ND	1.7
BOD	mg/l	ND	2	ND	0.78	ND	1.1	ND	0.72	ND	1	ND	1.3
TOC	mg/l	1.03 J	1.13 J	1.76 J	2.8	2.2	2.7	4.4	4.2	2.4	2.8	0.81 J	1.61 J
TDS	mg/l	364	295	1390	1230	642	790	6100	5540	1410	1940	445	405
Sulfate	mg/l	8.7	9	166	222	16	18.8	530	540	63	121	21.4	22.6
Chloride	mg/l	90	90.7	330	312	230	323	1080	2520	730	857	141	130
Fluoride	mg/l	ND	0.4	0.51	0.73	ND	0.59	ND	0.74	ND	0.4	ND	0.4
Bromide	mg/l	ND	2	ND	2	ND	2	ND	2	ND	2	ND	2
Phenols	mg/l	ND	0.009	ND	0.009	ND	0.009	ND	0.009	ND	0.009	ND	0.009
Na	mg/l	23.1	22.9	50.3	56.1	42.7	45.7	99.3	102	84.5	90.9	26.6	24
K	mg/l	**1.42**	**1.42**	3.28	2.98	2.36	2.36	5.39	5.05	4.41	4.55	1.44	1.36
Ca	mg/l	49.3	49.3	207	206	82.5	96.1	1000	1010	213	312	70	66.9
Mg	mg/l	16.9	17.3	56.3	63.9	33.9	40.2	322	313	85.4	113	26	24.5
Cl	mg/l	90	90.7	330	312	230	323	1080	2520	730	857	141	130
HCO_3	mg/l	92.4	86.4	153	76.4	8.3	4.5	45.8	40.7	25.6	75.4	105	105
CO_3	mg/l	0	0	0	0	0	0	0	0	0	0	0	0
SO_4	mg/l	8.7	9	166	222	16	18.8	530	540	63	121	21.4	22.6

* indicates that the reading is inconsistent in comparrison to the readings recorded during previous sampling events.

1- Parmeter readings and analytical results are from the May 2002 sampling event (04) and the September 2002 sampling event (05).

Table 3-2
Technology Screening Matrix
Chem Fab, Bucks County, Pennsylvania

General Response Action	Technology	Process Option	Description	Screening Results	Retained for Further Evaluation
No Action	None	None	No remedial action to address site conditions; does not meet Remedial Action Objective.	Used as baseline for comparison.	**Yes**
Minimal Action	Long-Term Monitoring	Quarterly ground water geochemical and contaminant monitoring	Necessary to document site conditions over time; used in conjunction with other technologies.	*Readily implementable*	**Yes**
Containment	Piling/Slurry	Sheet Pilling	Sheet pilling driven into the subsurface or clay/cement mixture slurried into excavation to provide physical barrier to contamiant migration.	Depth of contamination and aquifer matrix (fractured bedrock) precludes applicability at project site.	No
		Clay Slurry			
		Cement Slurry			
	Injection	Grout	Injection of grout to create a low permeability wall from a series of regularly spaced injection borings.	Potentially implementable, but would required detailed mapping of the fracture system.	No
Collection	Ground Water Extraction	Interceptor Trenches	Excavation of trench to intercept and collect shallow groundwater contamination.	Depth of contamination and aquifer matrix (fractured bedrock) precludes applicability of shallow interceptor trench construction.	No
		Extraction Wells	Recovery wells screened across significant fracture zones.	Typically, low yield recovery from isolated fractures.	**Yes**
		Extraction Wells in Hydrofractured Bedrock	Use of high pressure water to create a fractured bedrock trench or zone to increase subsurface permeability.	Increased recovery through fracturing of bedrock.	**Yes**
		Extraction Wells in Blasted Recovery Trench	Use of explosives to create a fractured bedrock trench or zone to increase subsurface permeability	Significantly increased recovery through fracturing of bedrock.	**Yes**
	Vapor Extraction	Air Sparging	Injection of air into the saturated zone facilitates mass transfer of ground water contaminants to the vapor phase, where they are collected with a vapor extraction system (horizontal/vertical wells installed inthe vadose zone).	Typically applied to shallow groundwater contamination in unconsolidated sediments; not effective for inorganic contaminants.	No
		Soil Vapor/Dual Phase Extraction (SVE/DPE)	Vaccuum applied to vadose zone (SVE) or vadose zone and shallow saturated zone (DPE) facilitate mass transfer of contaminated soil vapor for ex-situ treatment..		
		Thermal Extraction	Resistive heating provided by probes driven into the subsurface heat contaminated groundwater and facilitate mass transfer to vapor phase, where contaminants are collected with a vapor extraction system.		

Table 3-2
Technology Screening Matrix
Chem Fab, Bucks County, Pennsylvania

General Response Action	Technology	Process Option	Description	Screening Results	Retained for Further Evaluation
In-SituTreatment	Chemical Treatment	Chemical Oxidation	Injection of oxidizing agent (hydrogen peroxide/Fenton's reagent, permanganate) into subsurface to destroy CVOCs.	Not effective for hexavalent chromium reduction.	No
		Calcium Polysulfide Reduction	Injection/reinjection of treated groundwater with calcium polysulfide.	Potentially applicable.	**Yes**
		Sodium Metabisulfite Reduction	Injection/reinjection of treated groundwater with sodium metabisulfite.	Potentially applicable.	**Yes**
		Zero Valent Iron	Injection/reinjection of treated groundwater with zero valent iron slurry.	Potentially applicable.	**Yes**
	Enhanced Bioremediation	Hydrogen Release Compound (HRC) / molasses	Direct injection of amendment to subsurface to facilitate microbiological destruction of CVOCs.	Difficult Injection into bedrock due to material properties; limited demonstrated effectiveness for hexavalent chromium reduction.	No
	Permeable Reactive Barrier	Zero Valent Iron Wall	Installation of media within constructed trench excavation.	Due to significant length and depth required, not practical for implementation.	No
		Calcium Polysulfide Amendment	Injection of amendment amendndment into high permeability (blast) trench.	Potentially applicable.	**Yes**
		Sodium Metabisulfite Amendment	Injection of amendment amendndment into high permeability (blast) trench.	Potentially applicable.	**Yes**
		Zero Valent Iron Slurry	Injection of slurry into high permeability (blast) trench.	Potentially applicable.	**Yes**
Ex-SituTreatment	Hexavalent Chromium Reduction	Calcium Polysulfide	Chemical addition at neutral pH to reduce hexavalent chromium to insoluble trivalent chromium hydroxide salt.	Potentially applicable.	**Yes**
		Sodium Metabisulfite	Chemical addition at pH 2.5 to reduce hexavalent chromium to insoluble trivalent chromium salt.	Potentially applicable.	**Yes**
		Zero Valent Iron	Flow through reaction vessel reduces hexavalent chromium to insoluble trivalent chromium salt.	Potentially applicable.	**Yes**
		Electrochemical Reduction	Hexavalent chromium reduction usiong ferrous iron from consumable iron electrodes.	Potentially applicable.	**Yes**
	Physical/Chemical Treatment (Metals)	Precipitation	Calcium carbonate or sodium hydroxide addition to raise pH and preciptate metals as carbonates or hydroxides, respectively.	Potentially applicable.	**Yes**
		Removal	Settling of precipitated metals into a sludge layer or chemical (ion) exchange of metal cations for hydrogen or sodium.	Potentially applicable.	**Yes**
	Physical/Chemical Treatment (CVOCs)	Air Stripping	High volume air flow through groundwater to promote volatilization/mass transfer to vapor phase.	Potentially applicable.	**Yes**
		Carbon Absorption	Absorption of CVOCs to granular activated carbon media.	Potentially applicable.	**Yes**
Discharge	On-Site Reinjection	Injection Wells in Bedrock	Injection wells screened across significant fractures.	Flux to the subsurface limited by existing fracture flow network.	No
		Injection Wells in Hydrofractured Bedrock	Injection wells screened within high permeability trench or zone created by injecting high pressure water into the fractured bedrock matrix.	Improved rates of injection possible due to enhanced permeability.	**Yes**
		Injection Wells in Blasted Recovery Trench	Injection wells screened within very high permeability trench or zone created by using explosives at depth to fracture/refracture the aquifer matrix.	Improved rates of injection possible due to enhanced permeability.	**Yes**
	On-Site Infiltration	Infiltration Gallery	Percolation of treated groundwater through permeable media into bedrock.	Potentially applicable in former UST field filled with high permeability backfill.	**Yes**
	Off-Site	Surface Water	Discharge treated groundwater to Cooks Run Creek.	Potentially applicable	Yes
		Storm Water Sewer	Discharge treated groundwater to local storm sewer.	Potentially applicable	Yes
		POTW	Discharge treated groundwater to local sanitary sewer.	Potentially applicable	Yes

Table 3-3
Interim Remedial Action
Cost Summary
Chem-Fab
Bucks County, Pennsylvania

Alternative No.	Years of Operation	Estimated Costs		
		Capital (Yearly)	O&M (Yearly)	PNW
1 No Action	30	$ -	$ -	$ -
2 Groundwater Monitoring	30	$ -	$ 485,760	$ 7,467,103
3 Groundwater Monitoring, Groundwater Extraction, Ex-Situ Treatment, and Aquifer Reinjection	30	$ 1,279,950	$ 600,496	$ 10,510,767
4 Groundwater Monitoring, Groundwater Extraction in Hydrofractured Bedrock, Ex-Situ Treatment, and Aquifer Reinjection	30	$ 1,581,825	$ 600,496	$ 10,812,642
5 Groundwater Monitoring, Groundwater Extraction in Hydrofractured Bedrock, Ex-Situ Treatment, and Aquifer Reinjection with In-Situ Groundwater Treatment	5	$ 1,597,925	$ 613,146	$ 4,252,232

Notes:

Present Net Worth (PNW) based on 5% Interest

See Appendices A-1 and A-2 for Detailed Cost Estimate

Table 3-4
Final Remedial Action
Cost Summary
Chem-Fab
Bucks County, Pennsylvania

Alternative No.	Years of Operation	Estimated Costs		
		Capital (Yearly)	O&M (Yearly)	PNW
1 No Action	30	$ -	$ -	$ -
2 Groundwater Monitoring	30	$ -	$ 485,760	$ 7,467,103
3 Groundwater Monitoring, Groundwater Extraction, Ex-Situ Treatment, and Aquifer Reinjection	30	$ 1,449,000	$ 651,728	$ 11,467,363
4 Groundwater Monitoring, Groundwater Extraction in Hydrofractured Bedrock, Ex-Situ Treatment, and Aquifer Reinjection	30	$ 1,932,000	$ 651,728	$ 11,950,363
5 Groundwater Monitoring, Groundwater Extraction in Hydrofractured Bedrock, Ex-Situ Treatment, and Aquifer Reinjection with In-Situ Groundwater Treatment	5	$ 1,948,100	$ 677,028	$ 4,878,954
6 Groundwater Monitoring, Groundwater Extraction in Hydrofractured Bedrock, Ex-Situ Treatment, Aquifer Reinjection with In-Situ Groundwater Treatment, and Permeable Reactive Barrier Wall	5	$ 2,173,500	$ 727,628	$ 5,323,402

Appendix A-1 **Capital Cost Estimate** **Interim Remedial Action Alternatives** **Chem-Fab** **Doylestown, Pennsylvania**	Unit Cost Per Item	Units	Subtotal	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Treatment System - VOCs/Hex Chrom located in 1 story block bldg/50 gpm								
Equalization Tank (10,000 gal)	$ 20,000	1 Year	$ 20,000					
Multimedia Filter/bag filter back wash (Great Lakes package)	$ 40,000	1 Year	$ 40,000					
Air Stripper (5 tray)	$ 20,000	1 Year	$ 20,000					
Carbon (10 vent sorbs)	$ 5,000	1 Year	$ 5,000					
pH adjustment to app neutral pH (3,000 gal tank)	$ 10,000	1 Year	$ 10,000					
Calcium polysulfide chrom reduction (3,000 gal tank)	$ 10,000	1 Year	$ 10,000					
Gravity settler	$ 30,000	1 Year	$ 30,000					
Sludge Thickener	$ 10,000	1 Year	$ 10,000					
Filter Press	$ 20,000	1 Year	$ 20,000					
PLC	$ 50,000	1 Year	$ 50,000					
Electrical Connection	$ 75,000	1 Year	$ 75,000					
Mechanical Connection	$ 100,000	1 Year	$ 100,000					
Civil Construction (tank pads, raise roof for tall equipment)	$ 200,000	1 Year	$ 200,000					
Subtotal			$ 590,000			$ 590,000	$ 590,000	$ 590,000
Hydro-Fracture								
25 Borings/50 ft	$ 5,000	25 Borings	$ 125,000				$ 125,000	$ 125,000
Hydro-Fracture	$ 2,500	25 Borings	$ 62,500				$ 62,500	$ 62,500
Extraction Wells								
Three 6-in wells (50 ft)/vaults/submersible pumps/on-off floats	$ 10,000	3 Wells	$ 30,000			$ 30,000	$ 30,000	$ 30,000
Reinjection Wells								
10 6-in wells (50 ft)/vaults	$ 10,000	10 Wells	$ 100,000			$ 100,000	$ 100,000	$ 100,000
Distribution Piping/Conduit	$ 25	2000 Feet	$ 50,000			$ 50,000	$ 50,000	$ 50,000
Paving	$ 5	5000 Cu. Feet	$ 25,000			$ 25,000	$ 25,000	$ 25,000
In-Situ Groundwater Treatment								
Calcium polysulfide addition for reinjection	$ 10,000	1 Year	$ 10,000					$ 10,000
Total Contractor Costs				$ -	$ -	$ 795,000	$ 982,500	$ 992,500
Markup (15%)				$ -	$ -	$ 119,250	$ 147,375	$ 148,875
Engineering (20%)				$ -	$ -	$ 182,850	$ 225,975	$ 228,275
Construction Management (20%)				$ -	$ -	$ 182,850	$ 225,975	$ 228,275
Total Project Cost				$ -	$ -	$ 1,279,950	$ 1,581,825	$ 1,597,925

Appendix A-2 **O&M Cost Estimate** **Interim Remedial Action Alternatives** **Chem-Fab** **Doylestown, Pennsylvania**	Unit Cost Per Item	Units	Subtotal	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Treatment System - VOCs/Hex Chrom located in 1 story block bldg/50 gpm								
Operator - 4 hrs/day/5 days/week/$50/hr	$ 1,000	52 Weeks	$ 52,000					
Electricity ($2,000/month)	$ 2,000	12 Months	$ 24,000					
Water/Phone/Misc. Utilities ($100/month)	$ 100	12 Months	$ 1,200					
Carbon Changeout	$ 1,000	10 Vessels	$ 10,000					
Chemicals	$ 20,000	1 Year	$ 20,000					
Sludge Disposal	$ 10,000	1 Year	$ 10,000					
System Maintenance	$ 10,000	1 Year	$ 10,000					
Subtotal			$ 127,200			$ 127,200	$ 127,200	$ 127,200
Extraction Wells								
Bi-Annual Redevelopment	$ 1,500	3 Wells	$ 4,500			$ 4,500	$ 4,500	$ 4,500
Reinjection Wells								
Bi-Annual Redevelopment	$ 1,500	10 Wells	$ 15,000			$ 15,000	$ 15,000	$ 15,000
In-Situ Groundwater Treatment								
Calcium polysulfide addition for reinjection	$ 10,000	1 Year	$ 10,000					$ 10,000
Quarterly Groundwater Monitoring -22 wells (including labor)	$ 3,500	22 88 Wells/quarter	$ 308,000		$ 308,000	$ 308,000	$ 308,000	$ 308,000
Quarterly Reports	$ 5,000	4 Quarterly	$ 20,000		$ 20,000	$ 20,000	$ 20,000	$ 20,000
IDW	$ 14,000	4 Quarterly	$ 56,000		$ 56,000			
Total Contractor Costs				$ -	$ 384,000	$ 474,700	$ 474,700	$ 484,700
Markup (15%)				$ -	$ 57,600	$ 71,205	$ 71,205	$ 72,705
Engineering (5%)				$ -	$ 22,080	$ 27,295	$ 27,295	$ 27,870
Construction Management (5%)				$ -	$ 22,080	$ 27,295	$ 27,295	$ 27,870
Total Project Cost				$ -	$ 485,760	$ 600,496	$ 600,496	$ 613,146

Appendix B-1 **Capital Cost Estimate** **Final Remedial Action Alternatives** **Chem-Fab** **Doylestown, Pennsylvania**	Unit Cost Per Item	Units	Subtotal	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Treatment System - VOCs/Hex Chrom located in 1 story block bldg/50 gpm									
Equalization Tank (10,000 gal)	$ 20,000	1 Year	$ 20,000						
Multimedia Filter/bag filter back wash (Great Lakes package)	$ 40,000	1 Year	$ 40,000						
Air Stripper (5 tray)	$ 20,000	1 Year	$ 20,000						
Carbon (10 vent sorbs)	$ 5,000	1 Year	$ 5,000						
pH adjustment to app neutral pH (3,000 gal tank)	$ 10,000	1 Year	$ 10,000						
Calcium polysulfide chrom reduction (3,000 gal tank)	$ 10,000	1 Year	$ 10,000						
Gravity settler	$ 30,000	1 Year	$ 30,000						
Sludge Thickener	$ 10,000	1 Year	$ 10,000						
Filter Press	$ 20,000	1 Year	$ 20,000						
PLC	$ 50,000	1 Year	$ 50,000						
Electrical Connection	$ 75,000	1 Year	$ 75,000						
Mechanical Connection	$ 100,000	1 Year	$ 100,000						
Civil Construction (tank pads, raise roof for tall equipment)	$ 200,000	1 Year	$ 200,000						
Subtotal			$ 590,000			$ 590,000	$ 590,000	$ 590,000	$ 590,000
Hydro-Fracture									
40 Borings/50 ft	$ 5,000	40 Borings	$ 200,000				$ 200,000	$ 200,000	$ 200,000
Hydro-Fracture	$ 2,500	40 Borings	$ 100,000				$ 100,000	$ 100,000	$ 100,000
Extraction Wells									
Five 6-in wells (50 ft)/vaults/submersible pumps/on-off floats	$ 10,000	5 Wells	$ 50,000			$ 50,000	$ 50,000	$ 50,000	$ 50,000
Reinjection Wells									
15 6-in wells (50 ft)/vaults	$ 10,000	15 Wells	$ 150,000			$ 150,000	$ 150,000	$ 150,000	$ 150,000
Distribution Piping/Conduit	$ 25	3000 Feet	$ 75,000			$ 75,000	$ 75,000	$ 75,000	$ 75,000
Paving	$ 5	7000 Cu. Feet	$ 35,000			$ 35,000	$ 35,000	$ 35,000	$ 35,000
In-Situ Groundwater Treatment									
Calcium polysulfide addition for reinjection	$ 10,000	1 Year	$ 10,000					$ 10,000	$ 10,000
Permeable Reactive Barrier Wall									
Wall Installation	$ 200	700 Feet	$ 140,000						$ 140,000
Total Contractor Costs				$ -	$ -	$ 900,000	$ 1,200,000	$ 1,210,000	$ 1,350,000
Markup (15%)				$ -	$ -	$ 135,000	$ 180,000	$ 181,500	$ 202,500
Engineering (20%)				$ -	$ -	$ 207,000	$ 276,000	$ 278,300	$ 310,500
Construction Management (20%)				$ -	$ -	$ 207,000	$ 276,000	$ 278,300	$ 310,500
Total Project Cost				$ -	$ -	$ 1,449,000	$ 1,932,000	$ 1,948,100	$ 2,173,500

Appendix B-2 **O&M Cost Estimate** **Final Remedial Action Alternatives** **Chem-Fab** **Doylestown, Pennsylvania**	Unit Cost Per Item	Units	Subtotal	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Treatment System - VOCs/Hex Chrom located in 1 story block bldg/50 gpm									
Operator - 4 hrs/day/5 days/week/$50/hr	$ 1,000	52 Weeks	$ 52,000						
Electricity ($2,500/month)	$ 2,000	12 Months	$ 24,000						
Water/Phone/Misc. Utilities ($100/month)	$ 100	12 Months	$ 1,200						
Carbon Changeout	$ 1,000	10 Vessels	$ 10,000						
Chemicals	$ 50,000	1 Year	$ 50,000						
Sludge Disposal	$ 10,000	1 Year	$ 10,000						
System Maintenance	$ 10,000	1 Year	$ 10,000						
Subtotal			$ 157,200			$ 157,200	$ 157,200	$ 157,200	$ 157,200
Extraction Wells									
Bi-Annual Redevelopment	$ 1,500	5 Wells	$ 7,500			$ 7,500	$ 7,500	$ 7,500	$ 7,500
Reinjection Wells									
Bi-Annual Redevelopment	$ 1,500	15 Wells	$ 22,500			$ 22,500	$ 22,500	$ 22,500	$ 22,500
In-Situ Groundwater Treatment									
Calcium polysulfide addition for reinjection	$ 20,000	1 Year	$ 20,000					$ 20,000	$ 20,000
Permeable Reactive Barrier Wall									
Chemical Addition/Maintenance	$ 40,000	1 Year	$ 40,000						$ 40,000
Quarterly Groundwater Monitoring -22 wells (including labor)	$ 3,500	22 88 Wells/quarter	$ 308,000		$ 308,000	$ 308,000	$ 308,000	$ 308,000	$ 308,000
Quarterly Reports	$ 5,000	4 Quarterly	$ 20,000		$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000
IDW	$ 14,000	4 Quarterly	$ 56,000		$ 56,000				
Total Contractor Costs				$ -	$ 384,000	$ 515,200	$ 515,200	$ 535,200	$ 575,200
Markup (15%)				$ -	$ 57,600	$ 77,280	$ 77,280	$ 80,280	$ 86,280
Engineering (5%)				$ -	$ 22,080	$ 29,624	$ 29,624	$ 30,774	$ 33,074
Construction Management (5%)				$ -	$ 22,080	$ 29,624	$ 29,624	$ 30,774	$ 33,074
Total Project Cost				$ -	$ 485,760	$ 651,728	$ 651,728	$ 677,028	$ 727,628

FINAL – PHASE II
SUPPLEMENTAL GROUNDWATER INVESTIGATION

CHEM-FAB SITE
DOYLESTOWN,
BUCKS COUNTY, PENNSYLVANIA

PADEP Contract No.: ME 359185
Work Assignment No.: 31-070

Submitted to:
Commonwealth of Pennsylvania
Department of Environmental Protection
Bureau of Land Recycling and Waste Management
Division of Remediation Services

Submitted by:
AMEC Earth & Environmental, Inc.
One Plymouth Meeting, Suite 850
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AMEC Project No. 97038-009

February 27, 2004

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NOTICE

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Appendix A	Sample Chain-of-Custody Forms
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1.0 INTRODUCTION

AMEC Earth & Environmental, Inc. (AMEC) is submitting this Final Phase II Supplemental Groundwater Investigation Report to the Pennsylvania Department of Environmental Protection (PADEP) in response to PADEP's Requisitions for Contractual Services 21-070 and 31-070 and the Scope of Work. This supplemental report is a continuation of the Final Phase II Site Characterization Report dated November 25, 2002 and the Final Phase II Site Characterization Report Addendum dated January 14, 2003. This report consists of data from two additional rounds of groundwater sampling for six (6) onsite monitoring wells and ten (10) offsite monitoring wells. This document presents AMEC's technical report regarding the further characterization of the Chem-Fab Corporation Site (site), which is located in Doylestown, Bucks County, Pennsylvania (see Figure 1-1).

2.0 SITE BACKGROUND AND ENVIRONMENTAL SETTING

This section includes a brief description of the site location. A detailed description of the Chem-Fab Site, including the site background and environmental setting, can be found in the Final Phase II Site Characterization Report, dated November 25, 2002.

2.1 Site Location and Description

The Chem-Fab Site is located at 300 North Broad Street in Doylestown, Bucks County, Pennsylvania. The site may be found on the Doylestown, Pennsylvania USGS 7.5 Minute Series topographic map at 40°18'54" north latitude and 75°08'06" west longitude (see Figure 1-1). The site, currently owned by the 300 North Broad Street, Ltd., is a one-acre parcel of land that contains three separate buildings where various business ventures have been operated. The site was formerly operated as Chem-Fab, Inc., an electroplating and metal etching company, from 1965 to approximately 1994.

The site is bordered to the east by Tilley Fire Equipment, to the west and south by Extra Space Storage of Doylestown, and to the north by North Broad Street. Two creeks, Pine Run and Cooks Run, are located within a 2-mile radius of the site, as shown on Figure 1-2.

2.2 Site Characterization Background

AMEC performed an initial site investigation (Phase I) from December 1999 through April 2000 to evaluate if the subject site and the adjacent Extra Space Storage property had been adversely impacted from former activities at the subject site. A subsequent Phase II Site Investigation was conducted from May 2001 to January 2002 to further investigate the migration of contamination, and expanded to include the entire Extra

Space Storage property and the adjacent surrounding properties (Tilley Fire Equipment, Henning's Property, and the Bucks County Sewage and Water Authority). Based on the analytical results, both soils and groundwater were found to have been impacted by historical operations. The investigation was further expanded to include two additional rounds of groundwater sampling, conducted in May and September of 2002, as described in the Phase II Site Characterization Report Addendum, dated January 14, 2003. Both rounds of sampling indicate that the contaminated groundwater plume has migrated further downgradient on the affected properties.

In addition to the site characterization, AMEC also conducted an Engineering Evaluation to assess potential remedial technologies for the Site. The Engineering Evaluation included the analysis of geochemical data collected during two groundwater sampling rounds, and aquifer testing to evaluate the hydraulic properties of the aquifer. Through the interpretation of the data collected for this evaluation and the previous site characterizations, several treatment options were compared, including biological, physical/chemical and contaminant, based on site-specific groundwater concerns and evaluated with respect to effectiveness, implementability, and cost.

3.0 SITE CHARACTERIZATION ACTIVITIES

This Phase II Supplemental Groundwater Investigation report includes further delineation of groundwater conditions on the subject site and surrounding properties based on analytical data from two additional rounds of sampling. These activities, conducted by AMEC at the site in July 2003 and October 2003, are discussed in detail in the following sections.

3.1 Groundwater Investigation

AMEC previously conducted five rounds of groundwater sampling as part of the Phase II groundwater investigation to evaluate if site contaminants were migrating into the groundwater. This supplemental report includes two additional rounds of sampling on the six (6) onsite monitoring wells (MW-01, MW-02, MW-03, MW-06, MW-07, and DW [Domestic Well]) and ten (10) of the fifteen offsite monitoring wells (MW-04, MW-05, MW-09, MW-10, MW-11, MW-15, MW-16, MW-18, MW-19 and MW-20) located on the adjacent properties (see Figure 3-1). Five offsite monitoring wells (MW-08, MW-12, MW-13, MW-14 and MW-17S,M,D) were not included during either sampling event, as directed by PADEP, due to historically low (below PADEP Act 2 standards) or non-detect concentrations of contaminants reported during previous rounds of sampling.

3.1.1 Monitoring Well Sampling

AMEC and PADEP personnel mobilized to the site on July 7, 2003 to conduct the sixth round of sampling at the Chem-Fab Site. During this sampling round, sixteen (16) monitoring wells [MW-01 through MW-07, MW-09 through MW-11, MW-15, MW-16, MW-18 through MW-20, and the domestic well (DW)] were sampled. On October 6, 2003, AMEC and PADEP personnel mobilized to the site for the seventh round of sampling. This round included the same sixteen wells sampled during the sixth round.

During each sampling event, the monitoring wells were purged using the EPA low-flow method. The pH, temperature, conductivity, oxidation reduction potential and dissolved oxygen concentration were recorded at regular time intervals. A groundwater sample was collected after the readings of the parameters stabilized (within 5% of the previous reading). Groundwater samples were collected in an attempt to evaluate the groundwater conditions beneath the site. Purge water was collected and placed in the 55-gallon drums staged onsite. In addition, personal protective equipment was placed in the appropriate drums for IDW disposal.

The groundwater samples were placed under proper chain of custody, and picked up by a lab courier for delivery to Lancaster Laboratories of Lancaster, Pennsylvania, a PADEP-contract laboratory. The samples were analyzed for VOCs by USEPA Method 8260, TAL metals by USEPA Method 6010, cyanide by USEPA Method 9010/9014, and hexavalent chromium by USEPA Method 3060A. Metals analysis included both filtered and unfiltered samples. Copies of the chain-of-custody forms are contained in Appendix A. Table 3-1 presents a summary of the groundwater-sampling program for the site.

Equipment decontamination was conducted according to AMEC SOP FP-D-5, "Equipment Decontamination." A log of events occurring in the field was kept in accordance with AMEC SOP FP-F-5, "Logbooks." Recordkeeping, sample labeling, chain-of-custody information, sample handling, storage, and shipment were performed in accordance with AMEC SOPs FP-F-6 and FP-F-7.

3.2 Groundwater Flow

Groundwater contours for the subject property were developed based on information obtained from the site survey and groundwater data collected during the July and October 2003 sampling rounds. Based on the ground surface elevation and groundwater elevation, the groundwater contours were developed, as well as the presumed groundwater flow direction. It should be noted that the wells are screened across different intervals and the connectivity of the fractured bedrock beneath the site is unclear. The groundwater contour map by zone and groundwater elevation plan, which indicates presumed groundwater flow direction, are included as Figure 3-2 and 3-2a for the July 2003 sampling event. Figures 3-3 and 3-3a represent the October 2003 sampling event.

4.0 CHEMICAL ANALYTICAL CHARACTERIZATION RESULTS

Section 4 presents a discussion of the results of the groundwater sampling program conducted at the subject site, as well as the laboratory reporting limits and limitations.

4.1 Groundwater Sampling Results

The following sections present the results of the groundwater investigation, which included the sampling and analysis of 16 monitoring wells, including the onsite domestic well. The original rounds of data are provided in the tables for comparison; however, rounds 6 and 7 are discussed in the following section. These results are presented in Tables 4-1a through 4-1b. The laboratory analytical data reports for the soil samples are contained in Appendix B. Three representative constituents were selected for mapping of the concentrations. Figures 4-1 through 4-3 represent hexavalent chromium concentrations, trichloroethene, and tetrachloroethene concentrations per zone (depth) for the July round of sampling, and Figures 4-4 through 4-6 represent hexavalent concentrations, trichloroethene, and tetrachloroethene concentrations per zone (depth) for the October sampling round. The laboratory analytical results for all constituents, with the exception of hexavalent chromium, were reported in micrograms per liter (ug/l), which is equivalent to parts per billion (ppb). Hexavalent chromium was reported in milligrams per liter (mg/l), which is equivalent to parts per million (ppm).

In July 2003 and October 2003, AMEC conducted additional groundwater sampling of the Chem-Fab property and adjacent properties. Samples were collected to evaluate the groundwater conditions beneath the site. These groundwater samples were identified by the well number and then by the sampling round (i.e., MW-01-04). Due to the low detection of semi-volatile constituents during the previous five (5) rounds, no semi-volatile analysis was conducted for the July or October 2003 sampling events.

MW-01

Monitoring well MW-01 was sampled during July and October 2003, as indicated above. Numerous TAL Metals were reported in the samples; however, only barium and manganese were reported above their respective cleanup standards of 2,000ug/l and 50ug/l. Barium (both total and dissolved) was detected in July and October. The October sample reported 2,380ug/l (dissolved) and 2,480 ug/l (total). Barium detected in the November sample was at 2,300 ug/l (dissolved) and 2,380 ug/l (total). Manganese was detected at 1,460 ug/l and 1,490 ug/l (dissolved and total) in the July sample, and 1,570 ug/l and 1,610 ug/l (dissolved and total) in the November sample.

Numerous volatile organic constituents were also detected in the samples; however, only 1,1-dichloroethene, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected in the July sample at 7.9 ug/l, above the cleanup standard of 7 ug/l. Tetrachloroethene was detected above the cleanup standard of 5 ug/l in the July and October samples at 20 ug/l and 14 ug/l, respectively; and trichloroethene was detected at 17 ug/l and 19 ug/l, above the cleanup standard of 5 ug/l.

MW-02

Monitoring well MW-02 was sampled during July and October 2003, as indicated above. Numerous TAL Metals were reported in the two samples; however, only chromium (total), manganese, nickel, and hexavalent chromium were reported above their respective cleanup standards for the well. Total chromium was detected in the July sample above its cleanup standard (100 ug/l) at a concentration of 30,800 ug/l for dissolved metals and 29,700 for total metals. Total chromium was also detected in the October sample at 23,400 ug/l and 24,400 ug/l, for both dissolved and total metals, respectively. Manganese was reported above its cleanup standard (50 ug/l) at concentrations of 444 ug/l and 829 ug/l for dissolved and total metals in the July sample, and 359 ug/l and 353 ug/l (dissolved and total) in the October sample. Dissolved nickel was reported above its cleanup standard of 100 ug/l at a concentration of 581 ug/l in the July sample. Nickel, both dissolved and total was reported at concentrations of 472 ug/l and 473 ug/l in the October sample. Hexavalent chromium was reported at concentrations of 36.5 mg/l and 23.6 mg/l (total), which is equivalent to 35,500 ug/l and 23,600 ug/l in comparison to the cleanup standard for total chromium (100 ug/l).

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, trichloroethene, and vinyl chloride were detected above cleanup standards. 1,1-Dichloroethene was detected at 62 ug/l and 61 ug/l, in July and October, respectively, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was detected above the cleanup standard of 70 ug/l at 170 ug/l in July and 150 ug/l in October. Methylene chloride was detected in July and October at 270 ug/l and 250 ug/l, respectively, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 590 ug/l and 550 ug/l above the cleanup standard of 5 ug/l; trichloroethene was detected at 3,200 ug/l and 2,900 ug/l above the cleanup standard of 5 ug/l. Vinyl chloride was detected at 4.2J ug/l and 3.6J ug/l above the cleanup standard of 2 ug/l. The designation “J” indicates the sample concentration is estimated.

MW-03

Monitoring well MW-03 was sampled during July and October of 2003, as indicated above. Monitoring well MW-03 was also used for duplicate sampling due to the number of constituents detected. As indicated on the tables, the samples designated with a letter “E” or “F” represent the duplicates and are not discussed here.

Most TAL Metals were reported in the samples. Arsenic, chromium (total), aluminum, manganese, nickel, and hexavalent chromium were reported above their respective cleanup standards. Aluminum was reported in the July sample for total metals at a concentration of 212 ug/l, above the cleanup standard of 200 ug/l. Arsenic (dissolved and total) was reported in the July sample at 164 ug/l and 167 ug/l, above the cleanup standard of 50 ug/l; dissolved arsenic was reported at 61.6 ug/l in the October sample. Manganese was reported in both samples above its cleanup standard (50 ug/l) at concentrations of 3,950 ug/l and 3,480 ug/L for total metals, and 3,790 ug/l and 3,410 ug/l for dissolved metals. Nickel was reported above its cleanup standard (100 ug/l) at 1,670 ug/l and 1,920 ug/l for total metals, and for dissolved metals at concentrations of 1,690 ug/l and 1,890 ug/l. Chromium was detected above the cleanup standard (100 ug/l) for both samples, dissolved and total. Total chromium was reported at 113,000 ug/l and 121,000 ug/l. Dissolved chromium was reported at concentrations of 114,000 ug/l and 117,000 ug/l. Hexavalent chromium was reported at concentrations of 113 mg/l and 117 mg/l for both the samples (total), which is equivalent to 113,000 ug/l and 117,000 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium. Based on the chromium and hexavalent chromium total results, it appears that most of the chromium present is hexavalent.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 58 ug/l and 74 J ug/l, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was detected at 150 ug/l and 120 ug/l, above the cleanup standard of 70 ug/l. Methylene chloride was detected in both samples at 1200 ug/l and 1400 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 140 ug/l and 120 ug/l, above the cleanup standard of 5 ug/l; trichloroethene was detected at 12,000 ug/l in each sample, above the cleanup standard of 5 ug/l. The designation “J” indicates the sample concentration is estimated.

MW-04

Monitoring well MW-04 was sampled during July and October of 2003, as indicated above. Most TAL Metals were reported in both of the samples. Aluminum, beryllium, cadmium, chromium (total), manganese, nickel, thallium and hexavalent chromium were reported above their respective cleanup standards for this well. Aluminum was reported above the cleanup standard of 200 ug/l for dissolved and total metals in the July sample at 224 ug/l and 222 ug/l, respectively. Beryllium was detected above its cleanup standard (4 ug/l) in the July sample (for both dissolved and total) at concentrations of 4.1J ug/l and 40J ug/l. Cadmium was reported in the July and October samples at total concentrations of 17.1 ug/l and 13.3 ug/l, and dissolved concentrations at 16.9 ug/l and 12.7 ug/l. The cleanup standard for cadmium is 5 ug/l. Manganese was reported above its cleanup standard (50 ug/l) at total concentrations of 2,690 ug/l and 2,090 ug/l. Dissolved manganese was reported above its cleanup standard at concentrations of 2,670 ug/l and 2,030 ug/l. Nickel was reported above its cleanup standard (100 ug/l) at total concentrations of 7,220 ug/l and 5,610 ug/l. Dissolved nickel was reported above the cleanup standard at 7,160 ug/l and 5,330 ug/l. Dissolved thallium was reported in the July sample at 2.1 ug/l, above it respective cleanup standard of 2 ug/l. Dissolved and total chromium was detected above the cleanup standard (100 ug/l). Total chromium was reported at 183,000 ug/l and 154,000 ug/l for both samples. Dissolved chromium was reported above the cleanup standard at 185,000 ug/l and 140,000 ug/l. Hexavalent chromium was reported in both samples at concentrations of 172 mg/l and 146 mg/l (total), which is equivalent to 172,000 ug/l and 146,000 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium. The hexavalent chromium concentrations detected appear to represent the majority of the total chromium detected.

Numerous volatile organic constituents were detected in the samples; however, only chloroform, 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. Chloroform was detected in both samples at 160 ug/l and 140J ug/l, above the cleanup standard of 100 ug/l. 1,1-Dichloroethene was detected in the both samples at 270 ug/l and 260 ug/l, above the cleanup standard of 7 ug/l; Cis-1,2-dichloroethene was reported above the cleanup standard of 70 ug/l at 530 ug/l and 440 ug/l. Methylene chloride was detected at concentrations of 8,200 ug/l and 7,600 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 530 ug/l and 430 ug/l, above the cleanup standard of 5 ug/l; trichloroethene was detected in both samples at 32,000 ug/l and 24,000 ug/l, above the cleanup standard of 5 ug/l. The designation “J” indicates the sample concentration is estimated.

MW-05

Monitoring well MW-05 was sampled during July and October of 2003, as indicated above. Most TAL Metals were reported in the samples. Cadmium, arsenic, chromium (total), manganese, nickel and hexavalent chromium were reported above their respective cleanup standards for this well. Cadmium was reported above its cleanup standard (5 ug/l) for the July sample at concentrations of 7.0J ug/l for both dissolved and total metals. The October sample also reported concentrations above cleanup standards at 14.5 ug/l and 14 ug/l (dissolved and total). Arsenic was reported above the cleanup standard of 50 ug/l in the October sample for dissolved and total metals at 157 ug/l and 495 ug/l. Manganese was reported above its cleanup standard (50 ug/l) at total concentrations of 7,670 ug/l and 2,340 ug/l. Dissolved manganese was reported at 7,720 ug/l and 2,150 ug/l. Nickel was reported above its cleanup standard (100 ug/l) at total concentrations of 1,330 ug/l and 5,970 ug/l. Dissolved nickel was reported at 1,320 ug/l and 5,920 ug/l. Chromium was detected above cleanup standards (100 ug/l) for all samples, both dissolved and total. Total chromium was reported at 14,000 ug/l and 167,000 ug/l for the samples. Dissolved chromium was reported at 14,300 ug/l and 159,000 ug/l. Hexavalent chromium was reported both samples at 13.6 mg/l (total) and

156 ug/l, which is equivalent to 13,600 ug/l and 156,000 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium. It appears that most of the total chromium is hexavalent chromium.

Numerous volatile organic constituents were detected in the samples; however, only chloroform, 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. Chloroform was reported above the cleanup standard of 100 ug/l for the October sample at a concentration of 160 ug/l. 1,1-Dichloroethene was detected in the October sample at 2,40J ug/l, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was reported in both samples above the cleanup standard of 70 ug/l at 990 ug/l and 420 ug/l. Methylene chloride was detected at 3,200 ug/l and 8,500 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 250 ug/l and 430 ug/l, above the cleanup standard of 5 ug/l; trichloroethene was detected at 28,000 ug/l and 27,000 ug/l, above the cleanup standard of 5 ug/l.

MW-06

Monitoring well MW-06 was sampled during July and October of 2003, as indicated above. Most TAL Metals were reported in the samples. Only chromium (total) and hexavalent chromium were reported above their respective cleanup standards for this well. Chromium was detected above cleanup standards for both samples, dissolved and total. Total chromium was reported at concentrations of 427 ug/l and 365 ug/l for both samples. Dissolved chromium was above cleanup standards at 425 ug/l and 349 ug/l. Hexavalent chromium was reported at concentrations of 0.43 mg/l and 0.38 mg/l (total), which is equivalent to 430 ug/l and 380 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium. Based on the chromium and hexavalent chromium total results, it appears that most of the chromium present is hexavalent.

Numerous volatile organic constituents were detected in the samples; however, only 1,2-dichloroethane, 1,1-dichloroethene, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,2-Dichloroethane was detected in the July sample at 6 ug/l, above the cleanup standard of 5 ug/l. 1,1-dichloroethene was analyzed and reported above the cleanup standard of 7 ug/l at 50 ug/l and 58 ug/l for July and October samples, respectively. Tetrachloroethene was detected in both samples at 110 ug/l, above the cleanup standard of 5 ug/l; trichloroethene was detected at 220 ug/l and 230 ug/l, above the cleanup standard of 5 ug/l.

MW-07

Monitoring well MW-07 was sampled during July and October of 2003, as indicated above. Most TAL Metals were reported in the samples for each round. Aluminum, chromium (total), manganese, nickel, and hexavalent chromium were reported above their respective cleanup standards for this well. Aluminum was reported in the July sample above the cleanup standard of 200 ug/l for total metals at a concentration of 209 ug/l. Manganese was reported above its cleanup standard (50 ug/l) at total concentrations of 783 ug/l and 649 ug/l. Dissolved manganese was reported at 795 ug/l and 672 ug/l. Nickel was reported above its cleanup standard (100 ug/l) at total concentrations of 989 ug/l and 818 ug/l. Dissolved nickel was reported at 1,020 ug/l and 838 ug/l. Chromium was detected above the cleanup standard (100 ug/l), both dissolved and total. Total chromium was reported at 18,600 ug/l and 15,400 ug/l, and dissolved chromium was reported at 19,600 ug/l and 16,200 ug/l. Hexavalent chromium was reported at 18.4 mg/l and 15.6 mg/l (total), which is equivalent to 18,400 ug/l and 15,600 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium. The hexavalent chromium concentrations detected appear to represent the majority of the total chromium detected.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 44 ug/l and 41 ug/l in the July and October samples, respectively, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was reported above the cleanup standard of 70 ug/l at 100 ug/l and 97 ug/l. Methylene chloride was detected at 200 ug/l and 180 ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 390 ug/l and 330 ug/l, above the cleanup standard of 5 ug/l; trichloroethene was detected at 2,600 ug/l and 2,300 ug/l, above the cleanup standard of 5 ug/l.

MW-08

Monitoring well MW-08 was not sampled during the July and October 2003 sampling events.

MW-09

Monitoring well MW-09 was sampled during July and October of 2003, as indicated above. Several TAL Metals were reported in the samples for each round; however, none exceeded their respective cleanup standard. Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, tetrachloroethene and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected in all samples at 39 ug/l and 40 ug/l, above the cleanup standard of 7 ug/l. Tetrachloroethene was detected in both samples at 27 ug/l and 24 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 700 ug/l in both samples, above the cleanup standard of 5 ug/l.

MW-10

Monitoring well MW-10 was sampled during each of the sampling events listed above. Most TAL Metals were reported in the samples for each round; however, only barium, iron and manganese exceeded their respective cleanup standards. Barium was detected for both dissolved and total metals. Total barium was reported at 9,890 ug/l and 9,950 ug/l. Dissolved barium was detected at 9,820 ug/l and 9,760 ug/l. The cleanup standard for barium is 2,000 ug/l. Iron was reported above the cleanup standard of 300 ug/l for both total and dissolved metals. Total iron was reported at 47,000 ug/l and 44,700 ug/l. Dissolved iron was detected at 40,700 ug/l and 39,600 ug/l. Manganese was reported above its cleanup standard (50 ug/l) for both dissolved and total metals. Total manganese was reported at 36,800 ug/l and 38,000 ug/l. Dissolved manganese was reported at 37,800 ug/l and 37,300 ug/l.

Numerous volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected in the October sample at 98J ug/l, above the cleanup standard of 7 ug/l. Cis-1,2dichloroethene was detected at 400 ug/l and 390 ug/l above the cleanup standard of 70 ug/l. Tetrachloroethene was detected in both samples at 140 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 16,000 ug/l and 15,000 ug/l, above the cleanup standard of 5 ug/l. The designation “J” indicates the sample concentration is estimated.

MW-11

Monitoring well MW-11 was sampled during each of the sampling events listed above. Several TAL Metals were reported in the samples; however, none exceeded their respective cleanup standards. Numerous volatile organic constituents were detected in the samples; however, only carbon tetrachloride and tetrachloroethene were detected above cleanup standards. Carbon tetrachloride was detected at 10 ug/l for both samples, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 5.1 ug/l in the July sample, above its cleanup standard of 5 ug/l.

MW-12

Monitoring well MW-12 was not sampled during the July and October 2003 sampling events.

MW-13

Monitoring well MW-13 was not sampled during the July and October 2003 sampling events.

MW-14

Monitoring well MW-14 was not sampled during the July and October 2003 sampling events.

MW-15

Monitoring well MW-15 was sampled during July and October of 2003. Numerous TAL Metals were detected; however, only chromium and hexavalent chromium were detected above cleanup standards. Chromium was detected at 13,300 ug/l and 10,500 ug/l for dissolved metals, above the cleanup standard of 100 ug/l. Total chromium was reported at 12,000 ug/l and 9,750 ug/l. Hexavalent chromium was reported at concentrations of 12.8 mg/l and 10.2 mg/l (total), which is equivalent to 12,800 ug/l and 10,200 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, methylene chloride, tetrachloroethene and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 24 ug/l and 25 ug/l, above the cleanup standard of 7 ug/l. Methylene chloride was detected in the July sample at 19J ug/l, above the cleanup standard of 5 ug/l. Tetrachloroethene was detected at 61 ug/l and 53 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 1,900 ug/l and 1,700 ug/l, above the cleanup standard of 5 ug/l. The designation “J” indicates the sample concentration is estimated.

<u>MW-16</u>

Monitoring well MW-16 was sampled during July and October of 2003. Several TAL Metals were detected; however, only chromium and hexavalent chromium were detected above cleanup standards. Dissolved chromium was detected at 257 ug/l for both the July and October samples, above the cleanup standard of 100 ug/l. Total chromium was detected at 243 ug/l and 261 ug/l. Hexavalent chromium was detected at 0.24 mg/l and 0.25 mg/l, which is equivalent to 240 ug/l and 250 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 280 ug/l and 250 ug/l, above the cleanup standard of 7 ug/l. Cis-1,2-dichloroethene was detected at 120 ug/l and 100 ug/l, above the cleanup standard of 70 ug/l. Tetrachloroethene was detected at 220 ug/l and 180 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 230 ug/l and 200 ug/l, above the cleanup standard of 5 ug/l. The hexavalent chromium concentrations detected appear to represent the majority of the total chromium detected.

MW-17

Monitoring well MW-17 was not sampled during the July and October 2003 sampling events.

MW-18

Monitoring well MW-18 was sampled during each of the sampling events listed above. No TAL metals were detected above the cleanup standards for either of the sampling events.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene and trichloroethene were detected above cleanup standards. 1,1-dichloroethene was detected above it cleanup standard (7 ug/l) at concentrations of 8.2 ug/l and 8.5 ug/l, for the July and October sampling events, respectively. Trichloroethene was detected at 44 ug/l and 51 ug/l, above the cleanup standard of 5 ug/l.

MW-19

Monitoring well MW-19 was sampled during each of the sampling events listed above. Numerous TAL Metals were detected; however, only aluminum, chromium, manganese and hexavalent chromium were detected above cleanup standards. Total aluminum was detected in the July sample above the cleanup standard (200 ug/l) at a concentration of 213 ug/l. Total manganese was also detected in the July sample above its cleanup standard of 50 ug/l at 62 ug/l. Dissolved chromium was detected at 847 ug/l and 646 ug/l, above the cleanup standard of 100 ug/l. Total chromium was reported at 898 ug/l and 605 ug/l. Hexavalent chromium was detected at 0.8 mg/l and

0.68 mg/l, which is equivalent to 800 ug/l and 680 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium.

Several volatile organic constituents were detected in the samples; however, only tetrachloroethene and trichloroethene were detected above cleanup standards. Tetrachloroethene was detected at 14 ug/l and 9.4 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 280 ug/l and 250 ug/l, above the cleanup standard of 5 ug/l.

MW-20

Monitoring well MW-20 was sampled during each of the sampling events listed above. Numerous TAL Metals were detected; however, only thallium, chromium and hexavalent chromium were detected above cleanup standards. Thallium was detected in the July sample for total metals at 2.8J ug/l, above the cleanup standard of 2 ug/l. Chromium was detected for both dissolved and total metals. Dissolved chromium was detected at 3,070 ug/l and 2,740 ug/l, above the cleanup standard of 100 ug/l. Total chromium was detected at 3,930 ug/l and 2,860 ug/l. Hexavalent chromium was detected at 3.1 mg/l and 2.5 mg/l, which is equivalent to 3,100 ug/l and 2,500 ug/l in comparison to the cleanup standard of 100 ug/l for total chromium.

Several volatile organic constituents were detected in the samples; however, only 1,1-dichloroethene, tetrachloroethene and trichloroethene were detected above cleanup standards. 1,1-Dichloroethene was detected at 25 ug/l and 21 ug/l, above the cleanup standard of 7 ug/l. Tetrachloroethene was detected at 51 ug/l and 44 ug/l, above the cleanup standard of 5 ug/l. Trichloroethene was detected at 340 ug/l and 410 ug/l, above the cleanup standard of 5 ug/l.

DW - Domestic Well

Monitoring well DW was sampled during each of the sampling events listed above. Numerous TAL Metals were reported in the samples for both rounds; however, only iron, manganese, and nickel were reported above their respective cleanup standards. Iron (total) was reported at 50,200 ug/l and 27,600 ug/l. Dissolved iron was detected at 20,100 ug/l and 19,600 ug/l. The cleanup standard for iron is 300 ug/l. Total manganese was detected at 4,000 ug/l and 3,820 ug/l. Dissolved manganese was detected at 4,010 ug/l and 3,870ug/l. The cleanup standard for manganese is 50 ug/l. Nickel was detected in the July and October samples for total metals, at concentrations of 226 ug/l and 104 ug/l, respectively. The cleanup standard for nickel is 100 ug/l.

Numerous volatile organic constituents were detected in the samples; however, only tetrachloroethene and trichloroethene were detected above their respective cleanup standards. Tetrachloroethene was reported at 5.2 ug/l for the July sample, above the cleanup standard of 5 ug/l. Trichloroethene was reported for both samples, July and October, at 8.2 ug/l and 6.7 ug/l, above the cleanup standard of 5 ug/l.

Groundwater samples obtained during the July and October 2003 sampling events were analyzed for VOCs by USEPA Method 8260, TAL metals by USEPA Method 6010, cyanide by USEPA Method 9010/9014, and hexavalent chromium by USEPA Method 3060A. Metals analysis included both filtered and unfiltered samples. The results were compared to the Act 2 Standards contained in Pennsylvania Code, Title 25, November 24, 2001, Appendix A, MSCs for Organic Regulated Substances in Groundwater Table 1, and Inorganic Regulated Substances in Groundwater Table 2.

Of special note in the Act 2 standards, dated November 2001, is that the cleanup standard of 100 ug/l for total chromium is used in correlation to hexavalent chromium, whereas prior to this change, hexavalent chromium had a separate, less stringent cleanup standard.

5.0 CONCLUSIONS

The following sections discuss the distribution and possible migratory pathways of the contaminants of concern (COCs) detected throughout the Chem-Fab Site. Site COCs were detected at concentrations exceeding Act 2 standards throughout the site groundwater samples.

5.1 Groundwater Investigation

Based on the initial evaluation of the site characterization data, groundwater flow maps and topography, the groundwater beneath the site flows to the west towards Cooks Run tributary. It would appear that the deeper groundwater may be flowing in a different direction or may be influenced by other pumping wells or lithology. Based on the geophysical results, drilling, and video logging, it is unclear as to whether these represent distinct zones or are hydraulically connected via the extensive fracturing.

From the previous site characterization investigations, AMEC has identified COCs in the onsite and offsite groundwater at the Chem-Fab Site, varying throughout the water column; a greater percentage of the contamination appears to be found at depths between 37 feet and 125 feet. Based on an evaluation of the sample analytical data collected from the July and October 2003 sampling events (discussed in Section 5.0), the identified COCc are still present, and there appears to be additional vertical migration of the contaminants from the site to the adjacent Extra Space property.

The volatile organic compounds and TAL Metals detected above Act 2 cleanup standards in the monitoring wells remained consistent with previous sampling rounds. However, it should be noted that while most wells remained consistent, several wells reported elevated, or significantly decreasing, concentrations of either volatiles or metals or both.

Monitoring well MW-05 reported a significant increase in chromium (total) and hexavalent chromium concentrations, in comparison to the previous rounds of data. In contrast, monitoring Wells MW-02, MW-06 and MW-07 reported decreases in chromium and hexavalent chromium concentrations, as well as volatile concentrations (tetrachloroethene, trichloroethene). This data may suggest a trend in the movement of contaminants offsite, following the groundwater flow direction and the general geometry of the contaminant plume (as discussed in the Engineering Evaluation), along the formation strike (northeast-southwest). Heavy rainfall events may have also been a contributing factor, although likely to a lesser degree. The influx of water during a significant rainfall event might affect the general groundwater flow beneath the site, thus influencing the movement of contaminants.

MW-15 also showed significant increases in concentrations of chromium and hexavalent chromium compared to the previous rounds. MW-19 also showed slightly greater concentrations of these two constituents. MW-20 reported significantly lower concentrations of both chromium and hexavalent chromium. These three wells are located in the general area of a suspected second source on the Extra Space property. This data suggests possible migration or leaking from a second potential source.

During the July and October sampling events, standing yellow water was observed in the swale. A grab sample, collected during the July sampling event, indicated hexavalent chromium to be present (at a concentration of 29.1 ug/l) in the swale. This potential source, located near the swale area on the Extra Space property, had not been identified to date. However, the contaminants identified are related to the historic activities conducted on the Chem-Fab Site.

6.0 RECOMMENDATIONS

Based on a review of the findings from this supplemental investigation, it appears that the contaminant plume continues to migrate off site. Several offsite wells located on the Extra Space Storage property reported elevated concentrations of total chromium and hexavalent chromium. In contrast, several wells onsite reported decreased concentrations of both metals and volatile constituents.

In addition, wells located downgradient of a potential second source of contamination on the Extra Space property, reported elevated concentrations of both chromium and hexavalent chromium. These increases in concentrations throughout the water column, along with the presence of contaminated water in the swale area, substantiate the need to investigate and remove this potential second source of contamination.

AMEC recommends that the use of geophysical techniques, such as enhanced GPR technology provided by Witton Technologies in the area of the second potential source on the Extra Space property, to assist in identifying the source of the groundwater and surface water contamination in this area. In addition, AMEC recommends the continued monitoring of groundwater conditions, to include quarterly monitoring for one year, in conjunction with the on-going treatability and alternatives analysis, to further analyze the extent and migration of contamination.

AMEC also recommends as part of the quarterly sampling that the borough well be sampled during one quarter to determine if contaminants have migrated to the well.

7.0 REFERENCES

1. U.S. Geologic Quadrangle for Doylestown, Pennsylvania (7.5 Minute Series).

2. U.S. Geologic Survey Topographic Quadrangle (7.5 Minute Series) for Doylestown, PA, 1966, which was compiled by photogrammetric methods from imagery dated 1950, field checked 1952, revised from aerials taken 1965, and photorevised in 1983.

3. Pennsylvania Bulletin, Vol. 27, No. 33 (dated August 16, 1997), Act 2 Medium Specific Concentrations for Organic Regulated Substances in Groundwater for Used Aquifers in Residential Areas (Appendix A, Table 1).

4. Final Phase II Site Characterization Report for Chem-Fab Site, prepared by AMEC, November 2002.

5. Final Phase II Site Characterization Report Addendum for Chem-Fab Site, prepared by AMEC, January 2003.

6. Final Engineering Evaluation for Chem-Fab Site, prepared by AMEC, May 2003

AMEC Standard Operating Procedures

FP-D-3	Monitoring Well Sampling
FP-D-5	Equipment Decontamination
FP-F-1	Laboratory QC Samples (Water, Soil)
FP-F-5	Logbooks
FP-F-6	Recordkeeping, Sample Labeling, and Chain of Custody
FP-F-7	Sample Handling, Storage, and Shipping