SECOND FIVE-YEAR REVIEW REPORT

FOR

NATIONAL ELECTRIC COIL SUPERFUND SITE
DAYHOIT
HARLAN COUNTY, KENTUCKY

September 2008

Prepared By:

United States Environmental Protection Agency
Region 4
Atlanta, Georgia

10534451

TABLE OF CONTENTS

LIST OF FIGURES, TABLES, AND APPENDICES i

LIST OF ACRONYMS iii

EXECUTIVE SUMMARY vi

FIVE-YEAR REVIEW SUMMARY FORM viii

1.0 INTRODUCTION 1
- 1.1 Purpose of Review 1
- 1.2 Authority for Conducting Five-Year Review 1
- 1.3 Agency Conducting the Five-Year Review 2
- 1.4 Review Process 2

2.0 SITE CHRONOLOGY 3

3.0 BACKGROUND 6
- 3.1 Physical Characteristics 6
- 3.2 Land and Resource Use 7
- 3.3 History of Contamination 8
- 3.4 Initial Response 9
- 3.5 Basis for Taking Action 9
  - 3.5.1 Contaminants of Concern that Exceed Standards 10
  - 3.5.2 Baseline Risk Assessment 12
  - 3.5.3 Additional PCB Soil Removal 13

4.0 REMEDIAL ACTION 15
- 4.1 Remedy Selection 15
- 4.2 Remedy Implementation 16
- 4.3 Operation and Maintenance 18

5.0 PROGRESS SINCE THE LAST FIVE YEAR REVIEW 21
- 5.1 Varying of Recovery Well Pumping Rates 22
- 5.2 Monitoring Well Sampling Frequency 23
- 5.3 Soil Vapor Extraction Test 23
- 5.4 Evaluation of Catalytic Oxidizer 24

6.0 FIVE YEAR REVIEW FINDINGS 28
- 6.1 Administrative Component 28
- 6.2 Five Year Review Process 29
- 6.3 Site Inspections 29
- 6.4 Community Involvement and Interviews 29

TABLE OF CONTENTS (continued)

6.5 Standards Review 30
6.6 Data Review 32
6.6.1 Alluvial Aquifer Data from Interceptor Trench 33
6.6.2 Bedrock Groundwater Data from Monitoring Wells 34
6.6.2.1 Evaluation of Trends in Contaminant Concentrations in Bedrock Wells 35
6.6.3 Evaluation of Monitored Natural Attenuation 37
6.6.4 Overall Remediation System Performance 40

7.0 TECHNICAL ASSESSMENT 44
7.1 Remedy Evaluation 44
7.2 Applicability of Established Remedial Action Objectives 45
7.2.1 Changes in Standards and To Be Considered 45
7.2.2 Changes in Exposure Pathways, Toxicity, and Other Contaminants 45
7.2.3 Changes in Cleanup Goals 48
7.3 Protectiveness of Remedy 48

8.0 IDENTIFIED ISSUES 49

9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS 50

10.0 PROTECTIVENESS STATEMENT 51

11.0 NEXT REVIEW 52

TABLES

Table 1	Contaminants of Concern in Groundwater
Table 2	Summary of Before and After Excavation Results
Table 3	Ground-Water Monitoring Network
Table 4	Health Based Site-Specific Air Emission Rate Standards
Table 5	Summary of Annual Operation and Maintenance Costs from 1999 – 2007
Table 6	Summary of Recommendations and Follow-up Actions from First Five-Year Review
Table 7	Actual Average Air Concentrations at Cat-Ox Influent (Past 5 Years)
Table 8	Summary of Geochemical Indicator Data
Table 9	Screening of Recent Groundwater Data vs. Vapor Intrusion Target Concentrations

FIGURES

Figure 1	Topographic Map
Figure 2a	Site Facility Layout
Figure 2b	Monitoring Well Locations
Figure 3	Shallow Aquifer (<25') Potentiometric Surface Map
Figure 4	Intermediate Aquifer (30'-80') Potentiometric Surface Map
Figure 5	Deep Bedrock Aquifer (>90') Potentiometric Surface Map
Figure 6	Excavation Area and Sampling Points (Holiday Acres Mobile Home Park)
Figure 7	PCB Sampling Locations in the Vicinity of SS5
Figure 8	Mass (lbs) of 1,2-DCE versus Time
Figure 9	Mass (lbs) of TCE versus Time
Figure 10	Mass (lbs) of Vinyl Chloride versus Time
Figure 11	Influent VOC Concentrations versus Time
Figure 12	Trench Monitoring Data

Figure 13 Five Sample Moving Average, Trench TCE and Total VOC Concentrations
Figure 14 Summary of Wells with and without VOC Detections
Figure 14a Site Ground-Water Chemistry Map
Figure 14b Facility Ground-Water Chemistry Map
Figure 15 CMW-12 Concentration Trends and Time-Concentration Ratios
Figure 16 CMW-7 Concentration Trends and Time-Concentration Ratios
Figure 17 Pre and Post-Recovery Well CMW-7 Ratio Analysis of Vinyl Chloride to 1,2-DCE -System Fully Operational
Figure 18 Total VOC Concentrations versus time for CMW-5-2, CMW-7, and CMW-12
Figure 19 CMW-5-2 Concentration Trends and Time-Concentration Ratios
Figure 20 Total VOC Trend in CMW-5-2

APPENDICES

Appendix A Summary of the Maintenance Activities performed by Eastern Well & Pump
Appendix B Detailed Breakdown of O&M Costs
Appendix C List of Documents Reviewed
Appendix D Photographs of Site Inspection
Appendix E Site Inspection Checklist
Appendix F Copy of Newspaper Ad in Harlan Daily Enterprise
Appendix G Historical Groundwater Analytical Data Summary
Appendix H Historical Air Emission Results and System Efficiency Summary
Appendix I Historical Water Level Data Summary
Appendix J VOC and Groundwater Removed Summary Data

Figure 13 Five Sample Moving Average, Trench TCE and Total VOC Concentrations
Figure 14 Summary of Wells with and without VOC Detections
Figure 14a Site Ground-Water Chemistry Map
Figure 14b Facility Ground-Water Chemistry Map
Figure 15 CMW-12 Concentration Trends and Time-Concentration Ratios
Figure 16 CMW-7 Concentration Trends and Time-Concentration Ratios
Figure 17 Pre and Post-Recovery Well CMW-7 Ratio Analysis of Vinyl Chloride to 1,2-DCE -System Fully Operational
Figure 18 Total VOC Concentrations versus time for CMW-5-2, CMW-7, and CMW-12
Figure 19 CMW-5-2 Concentration Trends and Time-Concentration Ratios
Figure 20 Total VOC Trend in CMW-5-2

APPENDICES

Appendix A Summary of the Maintenance Activities performed by Eastern Well & Pump
Appendix B Detailed Breakdown of O&M Costs
Appendix C List of Documents Reviewed
Appendix D Photographs of Site Inspection
Appendix E Site Inspection Checklist
Appendix F Copy of Newspaper Ad in Harlan Daily Enterprise
Appendix G Historical Groundwater Analytical Data Summary
Appendix H Historical Air Emission Results and System Efficiency Summary
Appendix I Historical Water Level Summary
Appendix J VOC and Groundwater Data Removed Summary

LIST OF ACRONYMS

AOC	Administrative Order on Consent
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
BRA	Baseline Risk Assessment
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CIC	Community Involvement Coordinator
COCs	Contaminants of Concern
CSM	Conceptual Site Model
CWA	Clean Water Act
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
EW&P	Eastern Well & Pump
HAPs	Hazardous Air Pollutants
ICs	Institutional Controls
IR	Ingestion rate
IRIS	Integrated Risk Information System
KPDES	Kentucky Pollutant Discharge Elimination System
KYDEP	Kentucky Department of Environment and Conservation

KYDOT	Kentucky Department of Transportation
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
NCP	National Oil and Pollution Contingency Plan
NEC	National Electric Coil
NES	National Electric Service
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PCBs	Polychlorinated biphenyls
PCOR	Preliminary Closeout Report
POTW	Publicly owned treatment works
PRPs	Potentially Responsible Parties
PTE	Potential to Emit
QA/QC	Quality Assurance Quality
RAOs	Remedial Action Objectives
RAP	Remedial Action Plan
RAR	Remedial Action Report
RD/RA	Remedial Design/Remedial Action
RDR	Remedial Design Report
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager

ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SELs	Significant Emission Levels
TALs	Threshold Ambient Limit
TBCs	To be Considered
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
UAO	Unilateral Administrative Order
USEPA	United States Environmental Protection Agency
VEP	Vapor Extraction Pilot
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

The ground-water remedy for the National Electric Coil / Cooper Industries Site in Dayhoit, Kentucky included ground-water remediation to address contaminated ground water located in the fractured bedrock and alluvial (shallow) aquifers beneath the Site. The goal of the selected remedial action was to restore the impacted ground water to levels below that of applicable Maximum Contaminant Levels, i.e., drinking water standards. The Remedial Action Objectives for this remedy were to control risks posed by direct contact with ground water and minimize migration of contaminants in ground water. The major components of the ground-water remedy included:

- Recovery of contaminated ground water from the impacted alluvial and bedrock aquifers beneath and adjacent to the Site
- Treatment of the recovered water with air stripping
- Catalytic oxidation of the VOC-laden off gas
- Discharge of the treated water to the Cumberland River under an NPDES permit.

It was determined that the passive vapor intrusion pathway (via soil gas) was not evaluated for this Site despite the presence of volatile organic compounds present in ground water at elevated concentrations during the baseline risk assessment. Results of the initial, conservative screening suggested that vapor intrusion from volatile organics in ground water could be an issue at the Site. But a closer look at the contaminants detected, the location of the wells in the subsurface, and the potentiometric surface of each of the aquifers indicated that the vapor intrusion pathway should not pose an unacceptable risk at the Site. Additionally, Cooper Industries is actively working with all the neighboring property owners to adopt institutional controls to restrict the use of groundwater for drinking water purposes until the drinking water aquifer is returned to its beneficial use. The institutional controls will be in the form of an environmental covenant that was prepared in accordance with guidelines provided by the Kentucky Division of Environmental Protection. A detailed analysis of off-gases from the treated ground water was conducted at the beginning of 2008. Based on current and historical data, the EPA has concluded that off-gases from the air stripper do not require treatment

via the catalytic oxidizer to be protective of human health and the environment. Changes to the remedy to include institutional controls and remove catalytic oxidation of the VOC-laden off gas from the air stripper in an enforceable decision document are planned in the upcoming fiscal year.

The ground-water remedy is expected to be protective of human health and the environment, and in the interim, exposure pathways that could result in an unacceptable risks are being controlled. The ground-water exposure pathway that may potentially result in unacceptable risk has been controlled since residences within the path of the ground-water plume have been provided with municipal water via water lines. The vapor intrusion pathway was evaluated; a thorough evaluation of specific data indicated that the VI pathway is not a complete pathway and will not be evaluated further. The direct exposure soil pathway has been addressed through excavation and removal of contaminated soils along the fence line between the NEC property and the Holiday Mobile Home Park.

FIVE-YEAR REVIEW SUMMARY FORM		
SITE IDENTIFICATION		
Site Name (from WasteLAN): National Electric Coil Site		
EPA ID (from WasteLAN): KYD985069954		
Region: 4	**State:** KY	**City/County:** Dayhoit, Harlan County
SITE STATUS		
NPL status: Final		
Remediation status: Complete, Ground-Water Pump and Treat Operation and Maintenance Ongoing		
Multiple OUs? No	**Construction completion date:** 8/23/98	
Has site been put into reuse? Yes		
REVIEW STATUS		
Lead agency: USEPA		
Author name: Keriema S. Newman		
Author title: Remedial Project Manager	**Author affiliation:** United States Environmental Protection Agency, Region 4	
Review period: February 2008 - July 2008		
Date(s) of site inspection: 2/19/08		
Type of review: Policy		
Review number: 2 (second)		
Triggering action: 1st Five Year Review Report		
Triggering action date (from WasteLAN): 9/30/2003		
Due date (five years after triggering action date): 9/30/2008		
*["OU" refers to operable unit.] **[Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]		

FIVE-YEAR REVIEW SUMMARY FORM, cont'd
Issues:
1. Monitoring data from the alluvial aquifer trench monitoring suggest there is a persistent residual source of TCE contamination present. 2. Recovery well flow measurements should be coordinated with ground-water sampling events at the recovery wells, in order to more fully understand the relationships between flow and contaminant concentrations, and to calculate more accurate estimates of contaminant mass flux from the wells. 3. Following 10 years of monitoring and treatment, the influent air stream never exceeded the air emission standards established in the ROD; Therefore, the cat-ox is no longer required to meet KY air emission standards 4. Institutional Controls were not included in the 1996 ROD and are not a part of the remedy. The remedy is to restore ground water to beneficial use, i.e, below MCLs. Therefore, until MCLs have been met, an institutional control in the form of a restriction on the use of ground water within the footprint of the plume is necessary. 5. Property owners have not been receiving copies of analytical sampling results from the monitoring wells sampled on a semi-annual basis by Cooper Industries.

FIVE-YEAR REVIEW SUMMARY FORM, cont'd

Recommendations and Follow-up Actions:

1. Consider strategies to enhance removal or destruction of any residual TCE contamination in the alluvial aquifer.
2. Recovery well flow measurements should be collected with ground-water sampling events at the recovery wells.
3. Treatment system influent flow and concentration measurements should coincide at the same approximate date as sampling and monitoring of individual recovery wells and other monitoring wells.
4. Provide all property owners with copies of analytical data summary of ground water wells sampled on a semi-annual basis.
5. Comprehensive Review of the TCE data from the influent monitoring data should be done to investigate further the notably higher proportions in the treatment system influent to the average proportion of TCE present in the influent over the last six years.
6. Document changes to the remedy to include institutional controls and remove catalytic oxidation of the VOC-laden off gas from the air stripper.

Protectiveness Statement

The ground-water remedy is expected to be protective of human health and the environment, and in the interim, exposure pathways that could result in an unacceptable risks are being controlled. The ground-water exposure pathway that may potentially result in unacceptable risk has been controlled since residences within the path of the ground-water plume have been provided with municipal water via water lines. The vapor intrusion pathway was evaluated; a thorough evaluation of specific data indicated that the vapor intrusion pathway is not a complete pathway and will not be evaluated further. The direct exposure soil pathway has been addressed through excavation and removal of contaminated soils along the fence line between the NEC property and the Holiday Mobile Home Park.

Approved by: **Date:** 9/24/08

Franklin E. Hill, Director
Superfund Division
United States Environmental Protection Agency, Region 4

1.0 INTRODUCTION

1.1 Purpose of Review

The U.S. Environmental Protection Agency, Region 4 (EPA) has conducted a five-year review of the remedial actions undertaken at the National Electric Coil / Cooper Industries Site (Site) in Dayhoit, Harlan County, Kentucky. The purpose of the five-year review is to determine whether a remedy at a Superfund site continues to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in five-year review reports. Additionally, five-year review reports identify issues, if any, and give recommendations to address them.

1.2 Authority for Conducting Five-Year Review

This 2008 five-year review is required to meet the statutory mandate of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121. Five-year reviews are conducted as a matter of EPA policy for a remedial action that, upon completion, will not leave hazardous substances, pollutants, or contaminants on site above levels that allow for unrestricted use or unrestricted exposure, but requires five or more years to complete. CERCLA §121 (c), as amended by the Superfund Amendments and Reauthorization Act (SARA), states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

Under the National Oil and Pollution Contingency Plan (NCP), the Code of Federal Regulations (CFR) states, in 40 CFR §300.430(f)(4)(ii):

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

1.3 Agency Conducting the Five-Year Review

This review was conducted from February 2008 to July 2008 by EPA personnel. A site inspection was conducted on February 19, 2008. This report documents the results of the review for this Site, conducted in accordance with the EPA guidance document, Comprehensive Five-Year Review Guidance, June 2001, OSWER Directive 9355.7-03B-P. Shield Environmental Associates, Inc. (Shield) contractor for Cooper Industries, conducted analyses and provided data in support of the five-year review by EPA. As noted above, this report was prepared with the assistance of the Potentially Responsible Party's (PRP) contractor in accordance with applicable EPA guidance. While the PRP and PRP's contractor provided data for the five year review, EPA managed the preparation of the five-year review, prepared the protectiveness statement and finalized the five-year review.

1.4 Review Process

This is the second five-year review for the Site. The triggering action for this policy review is the date of the first five-year review on September 30, 2003. The Site has one operable unit (OU) that will be discussed in this report. The OU addresses soil, sediment, surface water and ground-water contamination at the Site. The five-year review is required because hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure. This and subsequent five year reviews will be conducted for the Site as a matter of EPA policy, until the ground water cleanup levels specified in the 1996 Record of Decision (ROD) are achieved, allowing unlimited use and unrestricted exposure.

2.0 SITE CHRONOLOGY

Date	Event
August 1, 1987	McGraw-Edison conveyed the facility to Treen Land Company.
February 27, 1989	Kentucky Department of Environmental Protection (KDEP) discovered VOC contamination at Trailer Park well.
April 1, 1989	Aboveground water tanks installed to provide water to contaminated wells.
May 1, 1989	Agreed Order from KYDEP for water line installation.
August 7, 1989	Five-mile water line was installed and trailers/homes with contaminated wells were connected to the water supply. From July 31 through September 15, approximately 150 residents were connected.
April 1, 1990	Air stripper pilot test was performed at the Site.
September 20, 1989	Preliminary Assessment by Lozier
June 1990	About 200 cubic yards of impacted soils excavated at the Site and disposed of at the Chemical Waste Management facility in Kettleman Hills, CA.
June 20, 1990	Site Inspection
October 1, 1990	Removal Action Plan submitted to EPA.
October 11, 1990	EPA issued a Unilateral Administrative Order to Cooper regarding soil removal action.
February 1, 1991	Removal Action report submitted to EPA. About 5,100 tons of contaminated soils were excavated at the Site and disposed of at the Chemical Waste Management facility in Emelle, AL.
July 29, 1991	Proposal to the National Priorities List
May 1, 1992	Draft Work Plan and Project Operations Plan for interim action air stripper operation submitted to EPA.
May 1, 1992	Draft RI/FS work plan submitted to EPA.
May 18, 1992	EPA executed an Administrative Order by Consent for the performance of RI/FS work.
September 30, 1992	"Interim" Record of Decision (ROD) issued by EPA for interim response action to initiate ground water cleanup.
October 14, 1992	The National Electric Coil/Cooper Industries Site included on National Priorities List.
December 1, 1992	EPA approved Work Plan to allow air stripper startup on an interim basis.

Site Chronology (continued)

Date	Event
December 15, 1992	EPA issued a Unilateral Order to Cooper for the performance of interim RD/RA activities associated with ground water cleanup.
July 1, 1993	"Interim" Response Action is initiated to address ground water contamination while remedial investigation/feasibility study (RI/FS) and final ROD are being completed.
August 1, 1993	Remedial Investigation field activities completed.
March 1, 1994	RI/FS report submitted to EPA.
June 1, 1995	Baseline RA finalized by CDM.
April 26, 1996	ROD issued by EPA for ground water cleanup.
May 20, 1996	Remedial Design/Remedial Action UAO issued to Cooper Industries by EPA.
February 1, 1997	EPA submits a Notice of Completion letter for RI/FS Consent Order.
March 1, 1997	The Remedial Design, Specifications and Performance Verification Plan submitted to EPA for approval.
May 1, 1997	EPA approves the Remedial Design.
June 26, 1997	Explanation of Significant Differences
August 1, 1997	Remedial Action (RA) Work Plan and Construction Management QA/QC Plan, Health & Safety Plan and Contingency Plan documents submitted to EPA.
September 1, 1997	The interceptor trenches, deep well and intermediate well were installed. About 490 tons of excess soils generated from the trench excavation were disposed of at EQ's landfill in Michigan.
March 4, 1998	The Remedial Action Report was submitted to EPA.
July 1, 1998	The Final Operation and Maintenance Plan and Construction Completion Drawings were submitted to EPA.
August 23, 1998	Completion of RA on-site construction documented in Preliminary Close Out Report (PCOR) prepared by EPA.
February 1, 1999	Law Environmental submits Remedial Action Progress Report to EPA/KDEP. Ground water remediation system operating as designed and in compliance.
July 1, 2001	KDEP requested a Response Action Plan from Cooper Industries to address PCBs in soil on Trailer Park property.
August 31, 2001	Shield submitted Risk Assessment Report on Trailer Park soil to KYDEP. Report concluded de mimimis PCB levels in the soil.
September 1, 2001	EPA submitted letter to the KDEP that the PCB levels detected in the four trailer park soil samples do not present an unacceptable risk and response action is not warranted.
October 2, 2001	Soil sampling and Removal Action Work Plan submitted and approved by KDEP.
October 1, 2001	PCB soil cleanup and restoration completed on Trailer Park property. About 170 tons of soil and waste disposed of by Waste Management at its Louisville, Kentucky Outer Loop Landfill.

Date	Event
October 26, 2001	Remedial Action Report on the PCB soil cleanup submitted to KDEP.
November 5, 2001	Cooper Industries received KDEP approval of PCB cleanup on Trailer Park property.
March and Septe 2002	Semiannual Ground water Reports submitted.
January 1, 2003	KPDES permit renewal application submitted to KYDEP.
September 30, 2003	First Five Year Review Report
October 2004; April 2005	Ground water remediation system shut down for a period of two months in an attempt to surge the aquifer thereby increasing removal of contaminants.
December-May 2006	Conducted a 6-month vapor extraction pilot (VEP) test to evaluate the efficiency and effectiveness of vapor extraction from the shallow and intermediate aquifers.
March 2008	Completed KPDES permit renewal application
February 19, 2008	Performed site inspection for Second Five-Year Review
May 19, 2008	Conducted interviews for Second Five-Year Review

3.0 BACKGROUND

3.1 Physical Characteristics

The Site is located on Old U.S. 119 adjacent to the Cumberland River in the town of Dayhoit, Harlan County, Kentucky (Figure 1). The Site includes the 3.5 acre manufacturing facility (Figure 2) which is currently in operation as National Electric Services (NES). The facility consists of a main plant building, two smaller buildings, and asphalt paved parking lot with grass cover along the riverbank area. Topographically, the Site is located in the flood plain of the Cumberland River. The Site is relatively flat, except along the riverbank area, which slopes steeply down to the Cumberland River. The topography of the area near the Site consists of northeast-trending ridges of Pine Mountain and Cumberland Mountain and the bottom land associated with the Cumberland River and its tributaries.

The facility property is bordered on the south by the Holiday Mobile Home Trailer Park, and south of the trailer park is a residential community; on the north by the Kentucky Utility Company electrical substation; and on the west by Old Highway 119. The Site is bounded on the east by the Cumberland River. The Cumberland River flows from the north to south and serves as the discharge point for surface water drainage leaving the Site. The Harlan County Municipal water intake is located upstream of the Site at the Poor Fork Branch. The property is fenced on all sides and has a security camera.

The Site is underlain by two water bearing units. The alluvial aquifer spans laterally across the Cumberland River valley and the lower aquifer that flows through the fractured bedrock formation beneath the Site. The uppermost alluvial deposits are 25 – 40 feet thick in the vicinity of the Site. The alluvial deposits consist of well to poorly sorted accumulations of sand, silt, and clay. The alluvium generally contains ground water under unconfined conditions at depths averaging twenty feet below ground surface (bgs). Historically, shallow ground-water flow is generally directed eastward toward the Cumberland River. The alluvium is underlain at a depth of approximately thirty feet by Pennsylvanian–age sedimentary bedrock. The consolidated units of interest (in descending order) include:

- Cawood Sandstone – Sandstone grading laterally into siltstone and thin bedded sandstone with isolated coal steams.
- Hance Coal formation – shale and siltstone underlain by coal seams interbedded with sandstone and shale.

The ground water in the bedrock aquifer (located beneath and downgradient) of the Site flows through the upper unit of the Hance Formation. Ground water in the bedrock aquifer generally occurs under confined conditions within the bedrock's secondary fractures and faults. Historical pump tests on study wells indicate that ground-water migration is fracture flow dominated and flows in a southwesterly direction downgradient of the Site. Ground-water flow in the bedrock is not influenced by the directional flow of the Cumberland River. The depth to ground water in the shallow aquifer is approximately 25' bgs. The intermediate aquifer is approximately 30' – 80' bgs, and the bedrock aquifer is approximately >90' bgs.

Figure 3 taken from the Second Semi-Annual Ground-Water Monitoring report indicates that ground-water flow in the shallow aquifer is flowing east, away from the main plant building toward the Cumberland River away from the Holiday Mobile Home Trailer Park and the residential neighborhood. This is consistent with the historical ground-water flow in the shallow aquifer. Figure 4 and Figure 5 indicate that the ground water in both the intermediate and deeper bedrock aquifers is flowing in the south-west direction toward the trailer park and neighborhood. This is also consistent with the historical ground-water flow in both the intermediate and shallow aquifers.

3.2 Land and Resource Use

The facility was originally opened in 1951 by the McGraw-Edison Company (McGraw-Edison) and operated as a rebuilding and remanufacturing facility for coal mining and related industrial equipment including electric motors, rewinding electric coils, manufacturing, general machine shop work, and mining equipment repair. McGraw-Edison owned and operated the facility until 1985 when Cooper Industries purchased McGraw-Edison as a wholly-owned subsidiary. McGraw-Edison continued to operate the facility until August 1987. The Treen Land Company of Brookside, Kentucky purchased the National Electric Coil (NEC) property in August of 1987 and the operations were reopened as the NES. The facility currently operates

under the National Electric Services Management Group, owned by Charles Dozier since July 1994. The work performed at the facility includes electrical motor repair work and limited rebuilding of hydraulic systems for the coal industry. The facility currently employs less than 10 people. No change in land-use is anticipated in the near future.

It is expected that the Site itself will remain industrial with the surrounding Dayhoit area remaining residential. The trailer park is adjacent to the Site and the next closest residence is 200 feet downgradient of the Site. Historically, there were residences with open borehole constructed wells into the bedrock aquifers. After the discovery of the contamination, residential ground-water users in areas already contaminated or at risk of future contamination were connected to the Black Mountain Water District municipal water system in August 1989. Funding for construction of the water line extension was funded by Cooper Industries.

3.3 History of Contamination

From 1951 through 1976, NEC cleaned the equipment in a 1,000-gallon vat of trichloroethene (TCE) prior to servicing. Periodically, the vat was cleaned, and the liquid solvent and oils reportedly were allowed to flow overland and/or through a drainage system to the Cumberland River. Sludges from the solvent tank, as well as debris (coal) ash containing high concentrations of heavy metals from a furnace operated on site were disposed of along the river bank. PCB laden oil was also allowed to drain from transformers and other electrical equipment on Site and / or flow through the drainage piping that led to the river. From 1976 to 1985, equipment was cleaned with methylene chloride. From 1985 to 1987, equipment was steam cleaned with a non-solvent cleaner.

In February 1989, the KYDEP, Division of Water, sampled the community well at the adjacent trailer park as well as approximately 80 surrounding private drinking water wells. Anaylses of the samples indicated the presence of volatile organic compounds (VOCs) at concentrations above Maximum Contaminant Levels (MCLs), in twelve of the wells. Beginning in March 1989, bottled water and water from temporary above-ground storage tanks were provided to residences impacted by the contaminated ground water. Residential ground-water

users in areas either already contaminated or at risk of future contamination were connected to the municipal water system in August 1989.

3.4 Initial Response Actions

In October 1990, EPA issued a Unilateral Administrative Order (UAO) to PRPs, McGraw-Edison/Cooper, Treen Land Company, and NES, to conduct an interim removal action of contaminated soils located on Site. Cooper undertook the Site Removal Action activities with the approval of the current Site property owner, NES.

Approximately 5,100 tons of soil were excavated and sent for off-site disposal to CWM in Emelle, Alabama during the Removal Action activities. These activities were conducted to address the immediate threat to human health. The EPA action levels that dictated removal were (1) 10 mg/kg polychlorinated biphenyls (PCBs); (2) 10 mg/kg total VOCs; (3) 5 mg/l toxicity characteristic leaching procedure (TCLP) lead; 5 mg/l TCLP chromium; and (4) 100 mg/kg total lead and chromium. All identified Site soils (surface and subsurface soils) that exceeded EPA clean-up levels were excavated during the 1991 Removal Action. The excavations were then backfilled with clean soils brought from off-site.

Soil removal activities were conducted in five principal areas: (1) the rear of the property along the bank of the Cumberland River where fill material was located; (2) an outfall area, also located along the river at the rear of the property where two drainage pipes leading from the plant discharged; (3) an isolated area along the south fence line and adjacent to the trailer park; (4) an isolated area where equipment and drums were stored; and (5) an area where two drainage lines leading from the plant were located. The Removal Actions were conducted under EPA supervision from October 1990 through October 1991. On March 19, 1992, EPA notified McGraw-Edison Co./Cooper Industries, of its determination that all activities outlined in the UAO had been completed relating to the soil contamination at the Site.

3.5 Basis for Taking Action

The Site was proposed for inclusion of the National Priority List (NPL), as defined in Section 105 of CERCLA, as amended 42 U.S.C. Section 9605, on July 29, 1991. The NPL is a

list of priority releases for long-term evaluation and remedial response, and was promulgated pursuant to section 105 of the CERCLA of 1980, as amended. The NPL is found in the NCP (Appendix B of 40 CFR part 300). The Site was finalized on to the NPL on October 14, 1992.

The Site Remedial Investigation/Feasibility Study (RI/FS) and associated site studies were conducted under the Administrative Order by Consent (AOC) that McGraw-Edison/Cooper Industries, Inc., entered into with the EPA in May 1992. The RI/FS and related site studies were performed by Cooper Industries under the oversight of EPA and KYDEP. The RI/FS was finalized in January 1995. The RI included completing a number of tasks:

- Hydrologic Investigations
- On-site Soil Sampling
- Off-site Soil Sampling
- Sediment Sampling
- Aquatic Assessment (benthic macroinvertebrates and fish)
- Meteorological Study/Air Sampling
- Risk Assessment for Human Health and the Environment

For the FS portion of the project, numerous alternative remedial actions were screened. Selected alternatives underwent detailed analyses and were compared to the nine criteria required by the NCP. The selected remedy from the 1996 ROD is described fully in Section 4.0.

3.5.1 Contaminants of Concern that Exceed Standards

On-site soil samples were collected from subsurface areas where the 1991 Removal Action confirmatory samples indicated that contaminants remained at levels above "non-detect". The purpose of this sampling was to determine whether contaminants remained in subsurface areas in quantities that might leach to ground water. Analyses of the samples indicated that neither VOCs nor inorganics, such as lead and chromium, remained in the subsurface in levels that would significantly impact ground water via contaminant leaching.

Off-site soil samples were collected from the Holiday Mobile Home Park to determine whether soils located there had been impacted by the contaminants originating at the NEC Site. The area sampled at the trailer park stretched the length of the fence line separating the properties, at a maximum distance from the fence line of 100 feet onto the trailer park property. The findings indicated that the soils at the trailer park had not been significantly impacted by the NEC contaminants since only one of the 29 samples collected marginally exceeded the 10 mg/kg PCB action level; no VOCs were detected in the off-site soils and only low levels of semivolatiles and pesticides were detected; only low levels of dioxins and furans were detected in surficial soil samples collected near the fence line at the mobile home park; and inorganic concentrations detected in the off-site soils were consistent with background or naturally occurring levels.

Results from the RI indicated that ground water in the bedrock zone and downgradient of the Site was impacted by TCE, cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride. The VOC plume extended from the Site to a distance of approximately 2,000 feet downgradient (southwest) of the Site with the area of highest concentration located near the southern boundary of the Site. The ground water in the shallow / alluvial ground water at the Site was impacted by TCE and 1,2-DCE. At the completion of the RI, the most concentrated area of VOCs in the shallow ground water was located near the center of the Site.

As described in section 9.3.2 of the ROD, the Safe Drinking Water Act of 1974, as amended in 1986, is relevant for ground water that is used for drinking. MCLs for the following contaminants are relevant and appropriate (and are described further in Section 6.5): 1,1-DCE, cis, trans-1,2-DCE, 1,1,2,2-tetrachloroethane, TCE, and vinyl chloride. Table 1 summarizes the cleanup goals as given in Table 9.2 of the ROD.

Table 1. Contaminants of Concern in Ground Water

Contaminant	Cleanup Level (ug/L)
1,1-Dichloroethene (1,1-DCE)	7.0
cis-1,2 Dichloroethene (1,2-DCE)	70
trans-1,2 Dichloroethene (1,2-DCE)	100
1,1,2,2-Tetrachloroethene	10[a]
Trichloroethene (TCE)	5.0
Vinyl chloride	2.0

[a] The 1,1,2,2-Tetrachloroethane cleanup level equals a risk level of 5.9×10^{-5} for the lifetime residential scenario. No federal or state MCL exist for 1,1,2,2-Tetrachloroethane.

3.5.2 Baseline Risk Assessment

During the baseline risk assessment (BRA) exposures to chemicals through ingestion, dermal contact, and inhalation of ground water, on-site subsurface soils, and off-site surface soils by residents and workers were evaluated. Additionally, ingestion of sediment and fish by residents were considered possible exposure pathways as well as contact with sediment. On-site surficial soils were not considered to be either current or future exposure medium for receptors, because all identified Site soils (including subsurface soils) that exceeded EPA clean-up levels were excavated during the 1991 Removal Action. The excavations were then backfilled with clean soils brought off site. However, on-site subsurface soil samples were collected during the RI to evaluate whether they contained VOCs in sufficient concentrations capable of producing ground-water contamination via leaching. The BRA concluded that the primary health risk posed by the Site was through the ground-water pathway.

Exposure to chemicals through the ground-water pathway was considered possible under both current and future use scenarios. Cancer risks associated with exposure to environmental media by human receptors were calculated for the current and future scenarios for child and adult residents and adult workers. The carcinogenic and noncarcinogenic risks associated with exposures to on-site subsurface soils, off-site surface soils, and sediments were within EPA's acceptable risk range of 10^{-6} - 10^{-4}. However, risks associated with ground water were greater than 1×10^{-4} for the lifetime resident and adult worker, which exceed EPA's carcinogenic risk range. Non-carcinogenic risks for ground water only, were determined to exceed the Hazard Index (HI) of 1 for both future child and future adult residents. Risks associated with the

ingestion of fish exceeded the $1x10^{-4}$ for the current residential scenario due to the levels of PCBs detected in fish samples. However, PCBs were not designated as a COC for fish because the levels detected in fish tissue were comparable to the background levels for fish found in the waters of KY as reported in a Kentucky Division Water study. Furthermore, the PCB levels detected were below the applicable United Standards Food and Drug Administration level.

3.5.3 Additional PCB Soil Removal

PCBs were detected during previous sampling events (1994 and 2001) in surface soils located within the boundaries of the trailer park along the fence line directly adjacent to the NEC Site. While initially considered to be within acceptable federal and state levels, in a letter dated September 26, 2001, the Kentucky Division of Waste Management (KDWM) Risk Assessment Branch recommended that 0.126 mg/kg total PCBs now be applied as a risk-based clean-up guideline for soils outside of the fence line at NEC. A few of the aforementioned sampling results exceeded the proposed guideline. In an effort to address the KDWM agency's concerns, Cooper Industries agreed to perform a surface soil removal action. In October 2001, approximately 170 tons of soil were removed from the areas shown on Figures 6 and 7 and transported to Waste Management's Outer Loop Landfill in Louisville, KY for disposal. Table 2 summarizes the samples and PCB concentrations in soil before and after excavation. Cooper Industries received a "no further action" letter dated November 5, 2001 from the KDWM. The letter written by KDWM served as notice that no additional response action was required as it related to PCB contamination in site soils.

Table 2. Summary of Before and After Excavation Results

Sample ID	PCB Total – TCL (mg/kg)	Sample ID	PCB Total – TCL (mg/kg)
Initial Confirmation Samples		**Over-Excavation Confirmation**	
Drain 1	<0.10	SF2A	0.16
Drain 2	<0.10	SF4A	1.20
Drain 3	<0.10	SF2B	<0.10
SS1	<0.10	SF4B	<0.10
SS2	<0.10	SS5B	0.86
SS3	<0.10	SS5C	0.91
SS4	0.10	SS5D	0.49
SS5	0.16	SS5E	0.56
SS5A	0.37	SS5F	0.64
SS6	0.11	SS5G	0.46
SS7	<0.10	SS5G-A	<0.10
SS8	<0.10	SS5G-B	<0.10
SS9	<0.10	SS5G-C	<0.10
SF1	<0.10		
SF2	0.5 / 0.25*		
SF3	<0.10		
SF4	2.3 / 1.7*		
SF5	<0.10		
SF6	<0.10		
Waste Pile	0.17	* Sample reanalyzed by laboratory yielding two results	

4.0 REMEDIAL ACTIONS

In accordance with CERCLA and the NCP, the overriding goals for any remedial action are protection of human health and the environment and compliance with Applicable or Relevant and Appropriate Requirements (ARARs). A number of remedial alternatives were considered for the Site, and final selection was made based on an evaluation of each alternative against nine evaluation criteria that are specified in Section 300.430(f)(5)(i) of the NCP. The nine criteria include:

1. Overall Protectiveness of Human Health and the Environment
2. Compliance with ARARs
3. Long-Term Effectiveness and Permanence
4. Reduction of Toxicity, Mobility or Volume of Contaminants through Treatment
5. Short-term Effectiveness
6. Implementability
7. Cost
8. State Acceptance
9. Community Acceptance

4.1 Remedy Selection

The ROD was signed on April 26, 1996. The selected remedy included ground-water remediation to address contaminated ground water located in the fractured bedrock and alluvial (shallow) aquifers beneath the Site. The goal of the selected remedial action was to restore the impacted ground-water to levels below that of applicable MCLs, i.e., drinking water standards. The major components of the ground-water remedy included:

- Recovery of contaminated ground water from the impacted alluvial and bedrock aquifers beneath and adjacent to the Site
- Treatment of the recovered water with air stripping
- Catalytic oxidation of the VOC-laden off gas
- Discharge of the treated water to the Cumberland River under an NPDES permit.

The Remedial Action Objectives (RAOs) for this remedy are to control risks posed by direct contact with ground water and minimize migration of contaminants in ground water.

4.2 Remedy Implementation

In October 1990, the EPA issued a UAO (USEPA Docket No. 90-57-C) requiring immediate actions designed to mitigate the release of hazardous substances from the Site. Cooper Industries subsequently contracted with Law Engineering & Environmental Services (Law) to develop and implement a Remedial Action Plan (RAP) in accordance with the UAO. As part of the RAP, monitoring wells were installed at the Site to evaluate the magnitude of the ground-water contamination. A summary of the monitoring wells and the aquifers each of the wells were installed is given in Table 3.

Table 3. Ground-Water Monitoring Network

Shallow Wells	Intermediate Wells	Deep Wells
BH-0	CMW-5-11A	CMW-5-0
BH-1	CMW-5-11B	CMW-12A
BH-2	R-2	CMW-5-2
BH-3	CMW-12	CMW-5-2A
BH-4		CMW-5-10
BH-5		CMW-5-11*
Trench		CMW-6
		CMW-7
		CMW-9
		CMW-12-16
		CMW-13A
		CMW-13
		CMW-85

* Ground-Water Sample Only – No Access for Water Levels

Using existing wells, an Interim Response Action was developed and conducted to control migration of the VOC ground-water plume identified beneath the Site while the RI/FS and the Final ROD were being completed. The "Interim" RA was initiated in July 1993 and consisted of an onsite Recovery Well CMW-5-11 located in the deeper bedrock aquifer zone (at

an approximate depth of 120 feet), an equalization tank, an air stripping tower, and a 10,000 pound activated carbon unit to treat the air stripper off-gas.

The April 1996 Final ROD was implemented at the Site to address contaminated ground-water by continuing use of the ground-water pump and treat system (initiated during the "Interim" response action) to recover ground water and to separate VOCs from extracted ground water, by means of air stripping technology. Off-gases from the air stripping technology were to be addressed using catalytic oxidation.

An Explanation of Significant Differences (ESD) was prepared to summarize a minor change to the ROD July 26, 1997. The ESD described the use of a single interceptor trench to recover the contaminated ground-water from the shallow aquifer instead of small extraction wells. The trench intercepted ground water as it naturally drains along the top of the bedrock formation. The scope of the interim response action was increased by incorporating the use of a ground-water recovery trench located in the shallow alluvial aquifer and an additional ground-water recovery well in the intermediate aquifer with that of the system already operating in the deeper zones of the underlying bedrock aquifer. An additional deep aquifer recovery well was also installed. The air stripper off-gases had been treated using activated carbon. However, the carbon filters were not effective in the removal of vinyl chloride. Therefore, the off-gases were treated through a catalytic oxidation system (instead of activated carbon) prior to being discharged into the atmosphere via an extended 60-foot tall air stack to optimize off-gas dispersion.

The final ground-water recovery system consisted of four recovery units: an interceptor trench located in the shallow alluvial aquifer (approximately 190 feet long and 24 feet deep); Recovery Well R-2 located in the intermediate bedrock aquifer zone (approximately 80 feet deep); Recovery Well CMW-5-2A located in the deeper bedrock aquifer zone (approximately 125 feet deep); and existing Recovery Well CMW-5-11 (approximately 120 feet deep) located in the deeper bedrock aquifer zone. The final ground-water treatment system consisted of a 2,000-gallon double-walled equalization tank, the existing air stripper tower was upgraded, and a catalytic oxidation system to treat the off-gases from the air stripping tower, in accordance with

the EPA approved air emission performance standards. Treated water from the air stripper is discharged to the Cumberland River in compliance with the requirements of a KPDES (Kentucky Pollutant Discharge Elimination System) permit.

In 1997, EPA developed temporary health based site-specific air emission limits for vinyl chloride, TCE, and cis-1,2 DCE. The ROD specified the following air emission limits as performance standards for the Site:

Table 4. Health Based Site-Specific Air Emission Rate Standards

Compound	Allowable Emission Rates			
	Lb/hr pounds per hour	**g/sec** gallons per second	**Ppbv** Parts per billion vapor	**ug/m^3** micrograms per cubic meter
cis-1,2-DCE	98.6	12.4	5,850,000	23,600,000
TCE	0.45	0.06	19,600	107,500
Vinyl chloride	0.0090	0.001	837	2,174

The point of compliance for these emission levels is the 60-foot stack pipe exit point from which emissions are released to the atmosphere. Section 9.2.3 of the ROD specifies that "the air stripper tower will be fitted with a catalytic oxidation unit to control VOC vapors exiting the stack." The existing system, which includes a catalytic oxidizer for off-gas treatment is equipped with a blower that generates a flow rate of 0.7079 m^3/sec.

The final response action activities were conducted between September 1997 and February 1998. The final ground-water recovery systems and the catalytic oxidation (cat-ox) unit started up in February 1998.

4.3 Operation and Maintenance

Nine years of site operation and maintenance (O&M) activities have been completed for the following years 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, and 2007. The O&M activities at the Site are being conducted in accordance with the approved ROD. The O&M at the Site is conducted by Eastern Well & Pump (EW&P) from Harlan, Kentucky on behalf of Cooper Industries. The activities being conducted are summarized as follows:

- General housekeeping and weed control
- Maintenance of fence that surrounds the facility
- Inspection of the condition of ground-water monitoring wells
- Maintenance and upkeep of the pumping wells
- Maintenance and upkeep of the packed tower
- Maintenance and upkeep of the cat-ox unit
- Collection of onsite weather data
- Monitor the system discharge in accordance with the KPDES

The well pumps, cat-ox unit, blowers, transfer pumps, pumping wells and flow meters are generally checked three times a week to see if they are operating properly. All items are repaired as needed to properly perform. The transfer pumps and blowers on the cat-ox and air stripping units are greased monthly. The air stripper is cleaned twice a year to maintain proper operation. In addition, Shield Environmental conducts semi-annual ground-water monitoring of onsite and off-site wells. Semi-annual ground-water reports are prepared summarizing the performance of the pump and treat system as well as the O&M of the system. A summary of the system maintenance activities performed by EW&P is provided in Appendix A.

The selected remedial alternative from the ROD is a combination of ground-water recovery using extraction wells with pumps in the intermediate and deep zones and an interceptor trench in the shallow zone combined with ground-water treatment by air stripping with catalytic oxidation/off-gas treatment. The ROD estimated the present worth of the ground-water recovery using extraction wells with pumps in the intermediate and deep zones and the interceptor trench in the shallow zone as $1,419,900 with an annual O&M cost of $74,000. Additionally, the ROD estimated the present worth of the ground-water treatment by air stripping with catalytic oxidation off-gas treatment as estimated at $2,660,000 with an annual O&M cost of $187,000.

Overall annual O&M costs reported in the Table 5 differ significantly from the anticipated amounts in the ROD. The O&M costs are highly variable and depend on overall recovery rates, volume of water discharged to the NPDES permitted Outfall 001 to the

Cumberland River, laboratory and permitting costs, and energy costs. Energy costs nearly tripled from 2005 to 2007 going from approximately $30,000 to $90,000. Other costs that have varied included O&M costs from EW&P as well as laboratory and permitting costs. A detailed breakdown of O&M costs separated by categories including, utilities, maintenance, consulting, laboratory, permitting, POTW costs, and waste disposal is given in Appendix B.

Table 5. Summary of Annual Operation and Maintenance Costs from 1999 - 2007

Year	Dollar Amount
1999	$ 51,850
2000	$ 126,795
2001	$ 243,643
2002	$ 108,234
2003	$ 137,533
2004	$ 90,951
2005	$ 106,583
2006	$ 217,124
2007	$ 157,948
Total Costs (1999-2007)	$ 1,240,662

Breakdown of O&M Costs not available prior to 1999

The table above summarizes the O&M costs since the system was installed and implemented. As indicated in the 1998 Remedial Action Report for the project, the actual construction costs did not differ significantly from the cost estimate ($328,800) provided in the ROD. Table 5 summarizes the O&M costs over the last nine years. The higher O&M costs for 2001 include approximately $105,000 for PCB remediation not related to O&M of the ground-water treatment system. O&M costs for years 2006 and 2007 include approximately $70,000 for a 6-month vapor extraction pilot test not related to the O&M of ground-water treatment system. Cooper Industries has funded 100 percent of this Remedial Action.

5.0 PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

In August 2003, the First Five-Year Review's protectiveness statement read as follows: "The remedy is expected to be protective of human health and the environment upon attainment of ground-water cleanup goals, through continued ground-water pump and treat, which is expected to require 20 years to achieve. In the interim, exposure pathways that could result in unacceptable risks have been controlled since residences within the path of the ground-water plume have been provided with municipal water via water lines to all impacted residences. Other feasible threats have been addressed through excavation and removal of contaminated soils.

Long-term protectiveness of the remedial action will be verified by obtaining additional ground-water samples to fully evaluate potential migration of the contaminant plume downgradient from the treatment area and towards the river. Current data indicate the plume is being contained and retracted. Current monitoring data indicate that the remedy is functioning as required to achieve ground-water cleanup goals."

During the last five year review the remedy was found to be protective of human health and the environment. No significant issues were identified. Only one recommendation was made in order to improve the effectiveness of the ground-water remediation system. The recommendation proposed alternating pumping rates and/or periods in order to optimize contaminant recovery from the impacted aquifers. While the recommendation would not affect the remedy's protectiveness, the length of the remedial action could be reduced as the result of optimized ground-water contaminant removal.

Table 6. Summary of Recommendations and Follow-up Actions from First Five-Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
None listed (First Five Year Review)	In order to improve the effectiveness of the ground-water remediation system it is suggested that the PRP propose alternate pumping rates and / or periods in order to optimize contaminant recovery from the impacted aquifers. While these actions are not expected to affect the Remedy's protectiveness, the length of the remedial action may be reduced as the result of optimized ground-water contaminant removal.	PRP	None given	Varying of Recovery Well Pumping Rates	December 2004 / June 2005

In an effort to optimize the ground-water remediation system and ground-water monitoring plan, the recovery well pumping rates were altered, the monitoring well frequency was modified, a soil vapor extraction pilot test was conducted, and an evaluation of the catalytic oxidizer was conducted since the last five-year review. The following discussion summarizes follow up actions that have been taken in order to address the underlying recommendation from the last five-year review, optimizing ground-water contaminant.

5.1 Varying of Recovery Well Pumping Rates

As recommended in the 2004 First Semi-Annual Monitoring Report, and addressed in the December 2004 memorandum from the EPA, the system was shut down in October 2004 and again in April 2005 for a period of two months prior to the semi-annual sampling events conducted in December 2004 and June 2005. A ground-water sample collected from the intermediate bedrock aquifer (R-2) showed a 66% decrease in the concentration of 1,2-DCE and an 84% decrease in the concentration of TCE during the first two month shutdown period in 2004. The sample collected from R-2 following the second two month shutdown period in June 2008 showed a 12% decrease in the concentration of 1,2-DCE and 28% decrease in the concentration of TCE.

The reductions in concentration of contaminants in R-2 could be attributed to limited vertical migration of contaminants because of the well not being pumped. Conversely, the sample collected form the trench indicated a 250% increase in TCE levels in the shallow ground water during the first two month shutdown in October 2004 and an additional 50% increase after one month of operation in January 2005. The TCE levels increased approximately 180% following the second two month shutdown in June 2005. The vinyl chloride concentrations in the trench remained relatively stable during the referenced time periods. TCE concentrations also increased significantly in ground-water samples collected from the deep recovery well CMW-5-2A.

5.2 Monitoring Well Sampling Frequency

The 2005 Second Semi-Annual Monitoring Report recommended annual sampling (instead of semi-annual sampling) on wells that historically contained concentrations below detectable levels or had concentrations detected below the applicable standard. A review of the ground-water data indicated that concentrations in those wells had been below detectable levels or below MCLs. EPA did concur with a reduction in the sampling frequency of monitoring wells CMW-85, CMW-6, CMW-12-16, CMW-13. CMW-9, CMW-5-10, CMW-5-0, BH-0 and BH-1. However, EPA advised Cooper Industries that the sampling frequency should be increased back to a semi-annual basis if a significant trend or increase in concentration is observed above the MCL in any of the above mentioned wells for the COCs.

5.3 Soil Vapor Extraction Pilot Test

A pilot test involving pumping only from the shallow (sump/trench) and intermediate (R-2) aquifers and shutting off the pumps in the deep aquifer was approved. The approved pilot test was conducted during the period of December 6, 2006 through June 19, 2007. The Vapor Extraction Pilot (VEP) was conducted to determine if the mass removal of VOCs could be enhanced through vapor extraction. The vacuum was applied to the recovery trench and recovery well R1.

Alluvial wells BH-0 through BH-5 and intermediate wells CMW-5-11A and CMW-5-11-B were monitored for vacuum during the pilot study to determine an estimated zone

of influence. The airflow rate from the trench ranged from 20 to 55 cubic feet per minute (cfm), with an average rate of 43 cfm. Airflow from R1 ranged from 12 to 36 cfm, with an average rate of 23 cfm. The system operated for two short periods (14 days and 19 days, respectively) during the months of December 2006 and January 2007 and operated continuously from February 16 until June 19, 2007. During the 101 days of operation, the VEP system removed a total of 2.431 lbs of VOCs. By comparison, the ground-water pump and treat system removed approximately 45 lbs of VOCs during 128 days of operation during the same time frame.

Upon evaluation of the VEP test results. Cooper Industries concluded that a permanent VEP system would not effectively expedite the removal of VOCs from the shallow and intermediate aquifers.

5.4 Evaluation of Catalytic Oxidizer

Air samples are collected quarterly at the effluent from the air stripper prior to entering the cat-ox influent. During the past 10 years, concentrations of cis-1,2-DCE, TCE and vinyl chloride in the cat-ox influent samples have never exceeded the emission standards outlined in Table 2. Furthermore, total CVOC emissions from the system currently average less than 0.4 pound per day. Average concentrations for 1,2-DCE, TCE and vinyl chloride in the cat-ox influent air samples over the past five years are summarized in Table 7.

Table 7. Actual Average Air Concentrations at Cat-Ox Influent (Past 5 Years)

Average Emission Rates versus Allowable Emission Rate Standards				
Compound	**Lb/hr**	**g/sec**	**Ppbv**	**ug/m^3**
1,2-Dichloroethene	0.035 / 98.6	4.4E-03 / 12.4	1566 / 5,850,000	6209 / 23,600,000
Trichloroethene	0.0032 / 0.45	4.0E-04 / 0.06	105 / 19,600	564 / 107,500
Vinyl Chloride	0.0023 / 0.0090	2.9E-04 / 0.001	159 / 1837	406 / 2,174

Figures 8, 9 and 10 show a steady decline in pounds of 1,2-DCE, TCE and vinyl chloride removed from the ground water respectively, over the past 10 years. Figure 8 shows a decrease in pounds of cis-1,2-DCE from over 350 pounds annually (0.96 pounds per day) to approximately 100 pounds annually (0.27 pounds per day). Figure 9 shows a decrease in pounds of TCE from approximately 80 pounds annually (0.22 pounds per day) to approximately 12 pounds annually (0.03 pounds per day). Figure 10 shows a decrease in pounds of vinyl chloride

from approximately 22 pounds annually (0.06 pounds per day) to approximately 11 pounds annually (0.03 pounds per day). Figure 11 shows influent VOC concentrations versus time for the last 15 years for Total VOCs, 1,2-DCE, TCE and vinyl chloride in the treated water.

During the development of the ROD and subsequent RD/RA, actual air emission levels for the ground water treatment system were well below EPA's risk based standards using activated carbon treatment. In 1998, the system was equipped with a catalytic oxidation unit to treat the off-gases. Following 10 years of treatment and monitoring, it is now known that CVOC concentrations in the influent air stream (prior to treatment by the cat-ox unit) have never exceeded the air emission levels established in the ROD. Furthermore, CVOC concentrations in the influent water have dropped by a factor of seven over the past 10 years and by a factor of over 10 over the past 15 years. It is apparent, based on these data, the off-gases do not require treatment to comply with the emission standards set forth in the ROD.

The Commonwealth of Kentucky repealed its toxic substances air emission standards on January 19, 1999, and adopted the federal hazardous air pollutant (HAP) regulations. However, 401 KAR 63:021 Section 1 states, "A source in existence on the effective date of this administrative regulation which was issued a permit pursuant to 401 KAR 50:035 with conditions based on this administrative regulation or 401 KAR 63:022 shall continue to comply with all conditions based on this administrative regulation or 401 KAR 63:022 unless it can demonstrate that a condition is no longer necessary to protect human health and the environment."

Although Cooper Industries was not issued an air emission permit by KYDEP for operating the air stripper as part of the remedial action for this Superfund Site, Kentucky's air toxic regulations were considered as ARARs. However, construction and operating permits for the system were filed with KYDEP. To demonstrate compliance with these former regulations, calculations were performed utilizing the maximum concentrations of target compounds measured during the year from the air stripper exhaust gas. These concentrations and volumes of chemicals were compared to Kentucky's Threshold Ambient Limits (TALs) and Significant Emission Levels (SELs) without adjustment for height of emissions release, which is up to 60

feet in the air (allowable levels are approximately 490 times greater when adjusted for the stack height). The maximum air stripper emission concentrations were only 33.8 percent and 25.8 percent of Kentucky's TALs for cis-1,2-DCE and TCE, respectively, and only 11.8 percent and 9.0 percent of the SELs for cis-1,2-DCE and TCE, respectively. No emission levels were specified by Kentucky for vinyl chloride. Even under these extremely conservative computations, the air emission levels are substantially below the regulated levels contained in Kentucky's former air toxic regulations and would only emit about 276 pounds per year of total VOCs worst case during system operation. Analytical data from influent water samples indicate that approximately 44.7 pounds of VOCs were actually removed during the period of January 15, 2007 to May 23, 2007.

Kentucky's total allowable VOC emissions are 10 tons per year, 20,000 pounds per year, or 1,667 pounds per month or less than 55 pounds per day. By comparison, during the first half of 2007 the maximum VOC emissions from the air stripper discharge would only have been approximately 0.76 lbs per day for the entire six month period. This further substantiates the fact that the cat-ox unit is not required to meet Kentucky air emission standards. The Kentucky Administrative Code (401 KAR 52:070) establishes criteria for registration of designated air contamination sources. These regulations apply to sources that emit or have the potential to emit (PTE) 2-tons (4,000 lbs) per year or more, but less than 10 tons (20,000 lbs) per year, of a HAP. Additionally, the Kentucky Division for Air Quality establishes criteria for the designation of insignificant activities as the PTE 1,000 pounds of combined HAPs per year, or 5 tons per year of any nonhazardous regulated air pollutant.

Based on the data provided in the appendices and the analyses of the VOC emissions from the air stripper, the worst case emissions with continuous system operation of 276 pounds per year, of HAPs and total VOCs from the air stripper, as calculated using the highest measured concentrations on March 30, 2007 for vinyl chloride, March 1, 2007 for cis-1,2-DCE, and April 3, 2007 for TCE emissions, are all well below the criteria for registration as a designated source with KYDEP. Finally, the average total VOC air emissions from the cat-ox stack are less than 0.5 pound per year and well below applicable standards. Therefore, a recommendation to eliminate the catalytic oxidizer from the ground-water pump and treat system will be discussed

in Section 9.0. Furthermore, an amendment to the ROD outlining the discontinuation of the cat-ox unit will be prepared by the USEPA.

6.0 FIVE-YEAR REVIEW PROCESS

6.1 Administrative Components

The Site's second five-year review was conducted by Keriema S. Newman, EPA Remedial Project Manager. The RPM notified KYDEP and Cooper Industries of the initiation of the five-year review process on January 8, 2008. The RPM led the five-year review team and was assisted by:

- Stedman Southall, Site Attorney
- Bill Osteen, Hydrogeologist
- Tim Frederick, Human Health Risk Assessor
- Linda George, Ecological Risk Assessor
- L'Tonya Spencer, Community Involvement Coordinator (CIC)

Additional support was provided by:

- Daniel Phelps, KYDEP
- Jerri Higginbotham, KYDEP
- Nelson Olavarria, Cooper Industries
- Keith Odenweller, Cooper Industries
- Mike Morris, Shield Environmental

The five-year review schedule comprised of the following:

- Initial Kickoff Meeting of Review Team (EPA)
- Community Notification
- Kickoff Meeting and Site Inspection (EPA, Cooper Industries and KYDEP)
- Community Interviews
- Document Review
- Data Review
- Five-Year Review Report Development and Review

6.2. Five-Year Review Process

The five-year review of the Site was conducted by EPA in cooperation with Cooper Industries and KYDEP. The purpose of the review was to determine if the implemented remedy for the Site (i.e.,ground-water pump and treat) continued to be protective of human health and the environment. The components of the five-year review include document review, personnel interviews, site inspection, standards review, data review, and technical assessment. The documents reviewed as part of the five-year review are listed in Appendix C.

6.3 Site Inspection

The site inspection was conducted on February 19, 2008. The inspection team consisted of Keriema S. Newman from EPA, and Daniel Phelps and Jerri Higginbotham from KYDEP, Nelson Olavarria from Cooper Industries, and Mike Morris from Shield Environmental. The PRP's consultant conducted an overview of the operational history of the air stripper system components. Visual inspection of extraction wells and monitoring wells utilized during the monitoring program was carried out as well. The ground-water treatment system and associated wells appeared to be in good condition and operational. Photographs taken during the Site inspection are included in Appendix D. Additionally, a copy of the Five-Year Review Site Inspection Checklist is included as Appendix E.

6.4 Community Involvement and Interviews

An advertisement was placed in the Harlan Daily Enterprise on February 13, 2008 announcing that the five-year review was in progress and requesting that any interested parties contact EPA personnel for additional information. A copy of the newspaper ad is given as Appendix F.

During the week of May 19th L'Tonya Spencer, CIC and Keriema Newman, RPM conducted interviews on both May 19th and 20th. Individuals interviewed included the current property owner of the NEC Site, Mr. Charles Dozier; two nearby property owners, and Judge Gieshop, an elected official in Harlan County. During the interviews, a set of questions were asked to each of the individuals interviewed. The questions are summarized below:

- What is your impression of the activities at the Site?
- Have there been any effects on the surrounding community related to Site operations?
- Are you aware of any events, incidents or activities, such as trespassing, vandalism, emergency responses, etc., at the Site?
- Do you feel well informed about the Site activities or progress?
- Do you have any comments, suggestions or recommendations regarding the Site's activities or operation?

The responses given by the individuals during the interviews overall were favorable. The individuals believed that the cleanup was adequately being addressed by the PRP. Three out of the four individuals stated that they were being informed about the Site progress. One of the property owners was interested in receiving copies of the analytical results from the monitoring well sampled on his property. All of the individuals interviewed inquired about the progress of the cleanup. Specifically, the property owners wanted to know were contaminant concentrations decreasing and was the ground-water treatment system and remedy performing as intended. One property owner indicated that he planned on selling his property to another resident in the neighborhood. Copies of the interview records will be given to the PRP to ensure that any outstanding concerns are addressed. Other items discussed during the interview included pending litigation and the increased incidence of cancer among residents of the area.

The Second Five-Year Review report will be available in the site file maintained in Atlanta at EPA's Region 4 Office at 61 Forsyth Street, Atlanta, GA 30303 and in the local repository located at the Harlan County Public Library, 107 N. Third Street, Harlan, KY, 19422. Within thirty (30) calendar days of finalizing the Second Five-Year Review Report, a notice will be published in the Harlan Daily Enterprise announcing that the Second Five-Year Review Report for the Site is complete.

6.5 Standards Review

ARARs for the Site were identified in the April 1996 ROD. This five-year review report includes identification of and evaluation of changes in the ROD-specified ARARs to determine whether such changes may affect the protectiveness of the selected remedy.

Section 121 (d) (2) (A) of CERCLA specifies that Superfund remedial actions must meet any federal standards, requirements, criteria, or limitations that are determined to be legally ARARs. ARARs are those standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. To-Be-Considered criteria (TBCs) are nonpromulgated advisories and guidance that are not legally binding, but should be considered in determining the necessary level of cleanup for protection of human health or the environment. While TBCs do not have the status of ARARs, EPA's approach to determining if a remedial action is protective of human health and the environment involves consideration of TBCs along with ARARs.

Chemical-specific ARARs are specific numerical quantity restrictions on individually listed contaminants in specific media. Examples of chemical-specific ARARs include the MCLs specified under the Safe Drinking Water Act as well as the ambient water quality criteria that are enumerated under the Clean Water Act. Because there are usually numerous contaminants of potential concern for any Site, various numerical quantity requirements can be ARARs. The final remedy selected for this Site was designed to meet or exceed all chemical-specific ARARs and meet location- and action-specific ARARs. The ROD identified the following as ARARs:

Location Specific ARARs

- 40 CFR 264.18(b), Floodplain management
- 40 CFR 6.302, Fish and Wildlife Coordination Act

Chemical Specific ARARs

- 401 KAR 63:022 (regulates the emission of 1,2-DCE to atmosphere)
- Safe Drinking Water Act MCLs (40 CFR Part 141)

Action Specific ARARs

- Kentucky Pollutant Discharge Elimination System (401 KAR 5, specifically Parts 031, 065), which has been authorized to implement the National Pollutant Discharge

Elimination System (NPDES) program under authority of the Clean Water Act (CWA) 402. Section 402 of the CWA incorporates sections 301, 302, 306, and 307.

- KRS 151.140; withdrawal of water from public waters within the Commonwealth of Kentucky

To be Considered (TBCs)

- Estimation of Air Impacts for Air Stripping of Contaminated Water (EPA-450/1-91-002)

Since the ROD, KYDEP revised their PCB soil guidance level and that resulted in the removal of additional soil from the trailer park adjacent to the NEC Site as discussed in Section 3.5.3. Additionally, the Kentucky Division of Air Quality repealed its air toxics standards program in 1999 and adopted the federal regulations.

6.6 Data Review

The second five-year review consisted of a review of relevant documents, including the RI/FS report, the BRA, the 1996 ROD, the Administrative Order, O&M Records, Semi-Annual Ground-Water Monitoring Reports, and the First Five-Year Review. A complete list of all the documents reviewed as a part of this five-year review is found in Appendix C. Six VOCs were identified as COCs in the ROD. The MCLs for 1,1-DCE, cis, trans-1,2-DCE, 1,1,2,2-tetrachloroethane, trichloroethene, and vinyl chloride were identified as ARARs in the ROD.

The ground water at this Site is sampled twice a year usually in June and December. The ground water is analyzed for six VOCs as well as MNA parameters. The ground water has been sampled consistently on a semi-annual basis since 1993. As noted in Section 4.1, the 1996 ROD did not include MNA as a component within the selected remedy for this Site. However, MNA parameters are collected in order to determine whether MNA may be occurring at the site. Additionally, the discharged ground water is monitored quarterly to demonstrate compliance with the KPDES requirements.

The Site currently operates under KPDES Permit No. KY0093149. In January 2008, Cooper Industries submitted a renewal application for the permit which was scheduled to expire

on July 31, 2008. The KPDES Branch of the Division of Water (DOW) issued a letter dated March 14, 2008 indicating that the application was complete. Subsequently, the DOW requested additional information that was provided by Cooper in a revised application dated August 13, 2008. The DOW has not requested any additional information and is currently conducting a final review of the application. A recent conversation with a representative of the DOW indicated that Cooper remains in compliance with the KPDES permit and Cooper continues to sample the system effluent on a quarterly basis in accordance with the permit requirements.

This section of the report includes an evaluation of current ground-water conditions and considers potential options for enhancement of the ground-water remedial action. The data are systematically evaluated as follows:

- Alluvial aquifer (trench) data
- Bedrock ground-water data from monitoring wells
- Indicators of natural attenuation of ground-water contaminants
- Bedrock ground-water data from recovery wells
- Overall recovery well system evaluation

6.6.1 Alluvial Aquifer Data from Interceptor Trench

Data from the alluvial aquifer are available for ground water removed from the interceptor trench during the period from March 1998 through November 2007. These data include results for a number of VOCs. The only contaminants of significance that have been detected in samples from the trench are TCE and its degradation products 1,2-DCE and vinyl chloride.

Figure 12 shows the trench sample data plotted against the sample date. Concentration data are plotted on a log scale to better depict the concentration trends for results with relatively low concentrations. The vinyl chloride data show consistently nondetect concentrations (not shown on Figure 12), with the exception of one 7.4 ug/L concentration observed in May 2004.

The TCE data in particular show a great degree of overall concentration variability, with the highest concentration of 2,700 ug/L being more than two orders of magnitude greater than the lowest reported concentration of 17 ug/L. For this reason, and to better illustrate trends in concentration, five-sample moving averages were plotted for TCE and total VOCs (TCE plus 1,2-DCE and vinyl chloride). A five-sample moving average is simply the arithmetic average of five successive samples. Figure 13 shows the five-sample moving average of the trench TCE and total VOC data. Figure 13 shows more clearly than Figure 12 that TCE is by far the predominant VOC present in the samples from the trench (with one exception, TCE is from 92% to 100% of the total VOCs).

Of more relevance to this data review is the fact that most of the ground-water contamination that has been and is being extracted from the trench consists of TCE, rather than its degradation products. As is discussed below, this condition is not consistent with conditions observed in the bedrock, where the relative amount of TCE versus its degradation products is different. The presence of significant concentrations of TCE in the alluvial materials 30 years after the last usage of TCE at the facility indicates there may be persistent, nonaqueous source of TCE present in the shallow subsurface. This nonaqueous phase may either be TCE sorbed to the aquifer materials or could be some residual nonaqueous phase liquid.

6.6.2 Bedrock Ground-water Data from Monitoring Wells

According to the data available for this review, bedrock ground-water data (data collected after initiation of the full recovery well system) from wells includes results from the monitoring wells CMW-5-2, CMW-6, CMW-7, CMW-9, CMW-5-10, CMW-12, CMW-12-16, CMW-13, and CMW-85. At several of these wells, there have been no recent detections of any of the monitored VOCs. At other wells, VOCs have recently been detected, but have been consistently below the performance standard or MCL for TCE, 1,2-DCE, and vinyl chloride. Figure 14 shows the bedrock monitoring wells included in routine sampling. Wells are identified where (1) contaminants remain above performance standards, (2) where VOCs are currently present but are below performance standards (consistently below the performance standard for at least the last four sample results), and (3) where VOCs have not been detected for at least the last four sampling events. Analysis of bedrock monitoring well data focuses on the three

monitoring wells (CMW-12, CMW-7, and CMW-5-2) where contaminant concentrations currently exceed one or more MCLs.

6.6.2.1 Evaluation of Trends in Contaminant Concentrations in Bedrock Wells

Drinking water MCLs are exceeded at bedrock monitoring wells CMW-12, CMW-7, and CMW-5-2. As indicated on Figure 14, CMW-12 is the farthest of these three wells from the NEC Site and has the lowest level of overall contamination that exceeds one or more MCLs, based on recent sampling. For this well, virtually all of the contamination present is either 1,2-DCE or vinyl chloride.

Figure 15 shows the CMW-12 concentrations of TCE, 1,2-DCE and vinyl chloride over time and also shows the ratio of vinyl chloride to 1,2-DCE. Concentrations are shown on a log scale to better illustrate lower concentration data. Since 1993, 1,2-DCE has been the predominate contaminant at this well and TCE has generally been nondetect and has consistently been an inconsequential constituent of samples from this well.

Figure 15 shows no apparent trend in the ratio of vinyl chloride to 1,2-DCE. 1,2-DCE concentrations increased from November 1996 to September 1997, apparently in response to full-scale operation of the recovery well system at the NEC property. Since the peak 1,2-DCE concentration of 150 ug/L in September 1997, 1,2-DCE concentrations have decreased. 1,2-DCE concentrations over the last 7 years have apparently stabilized at a value approximately equivalent to the 70 ug/L MCL. Thus, 1,2-DCE and vinyl chloride concentrations at this well appear to be stable or with a very slight downward trend over time. Both of these VOCs are present at concentrations approximately equal to or slightly higher than their respective MCLs.

CMW-7 is located closer to the NEC property than CMW-12. Concentrations of TCE, 1,2-DCE, and vinyl chloride have all exceeded their respective MCLs in samples from this well. There has been some evolution in contaminant concentrations over time at CMW-7 which are notable, in contrast to the more stable recent conditions present at CMW-12. Figure 16 shows the CMW-7 time-concentration trends for TCE, 1,2-DCE, and vinyl chloride. Concentrations are shown on a log scale to better illustrate lower concentration data.

At CMW-7, TCE concentrations prior to full recovery well system startup were roughly equivalent to the concentrations of vinyl chloride. Once the recovery well system became fully operational in 1997, TCE concentrations showed a notable decrease. By September 2002, TCE was consistently nondetect in the CMW-7 samples. The full operation of the recovery well system probably also had an effect on the vinyl chloride and 1,2-DCE concentrations. Vinyl chloride concentrations appear to show a more notable initial decrease than 1,2-DCE concentrations after full system operation began in 1997 (Figure 16), but this apparent condition may be misleading because of the log scale of the figure. Figure 17 shows the ratio of vinyl chloride to 1,2-DCE, and also the ratio of concentrations of these contaminants observed after full recovery well system operation (1997) to the average concentration of these contaminants for samples obtained before 1997 (pre-1997 average vinyl chloride was 84 ug/L; pre-1997 average 1,2-DCE was 730 ug/L). Figure 17 shows that after the recovery well system became fully operational in 1997, the ratio of 1,2-DCE to the average 1,2-DCE concentration observed in CMW-7 samples before the recovery well system was fully operational (1993-1996 samples) began to decrease, then showed a large decrease from April to December 2003. Further notable decreases in the 1,2-DCE concentration occurred after that. No such change is apparent for the vinyl chloride results.

The progressive, significant removal of TCE followed by significant removal of 1,2-DCE and relative stability of the vinyl chloride contamination at CMW-7 may indicate generally effective capture of contaminated ground water from areas of upgradient of the well. As the full-scale recovery well system has become operational, ground-water quality at CMW-7 has become more similar to that observed at well CMW-12 and less like ground-water quality observed at CMW-5-2 (Figure18). This condition is consistent with ground-water flow in the CMW-7 area being inward toward the recovery wells.

Over time, the concentrations of 1,2-DCE and vinyl chloride have become more similar in samples from CMW-7. This condition indicates there is some continuing dechlorination of 1,2-DCE producing vinyl chloride in the area of this well.

CMW-5-2 is the bedrock monitoring well located closest to the contaminant source areas (Figure 14). Ground-water quality at CMW-5-2 is characterized by initial TCE concentrations of a magnitude comparable to 1,2-DCE concentrations and the highest overall concentrations of TCE and its degradation products, compared to concentrations at CMW-7 and CMW-12. Figure 19 shows contaminant concentration trends at CMW-5-2. Figure 19

shows that over time, TCE concentrations have substantially decreased, while 1,2-DCE concentrations have remained relatively stable, although concentrations of 1,2-DCE have continued to decrease over time. Vinyl chloride decreased substantially shortly after full recovery well system startup, but has apparently stabilized at a concentration about an order of magnitude higher than the 2 ug/L MCL. Figure 20 shows how total VOC concentrations have decreased over time at CMW-5-2.

Figure 20 shows that total VOCs at CMW-5-2 decreased most dramatically prior to the full recovery well system operation in 1997, probably in response to the operation of initial recovery well CMW-5-11, which is located approximately 250 feet away from CMW-5-2. Figure 20 shows that although the rate of concentration decreases in the vicinity of CMW-5-2 appears to have slowed in the last few years, there is still a significant concentration decrease observed, mostly due to declining concentrations of 1,2-DCE.

6.6.3 Evaluation of Monitored Natural Attenuation

Natural attenuation of ground-water contamination includes a variety of processes that act to reduce contaminant concentrations. In all settings, some processes act to attenuate contaminant concentrations in ground water. Contaminant removal or transformation by biodegradation is often an especially advantageous type of natural attenuation, resulting in the in-situ destruction of environmental contaminants. Where natural attenuation is a part of a ground-water remedial action, the progress of natural attenuation and the geochemical conditions that contribute to or inhibit natural attenuation are monitored (monitored natural attenuation, or MNA). As noted in Section 4.1, the 1996 ROD did not include MNA as a component within the selected remedy for this Site. However, an analysis was conducted as part of this five-year review to assess whether MNA may be occurring at the Site.

Specific to the Site, the reductive dechlorination of TCE is a natural attenuation process that has produced less chlorinated daughter products (1,2-DCE, primarily the *cis* isomer, and vinyl chloride). Figure 19 is an example showing probable reductive dechlorination. Figure 19 shows that at CMW-5-2, initial concentrations of TCE comparable to concentrations of 1,2-DCE have greatly decreased, relative to the concentrations of 1,2-DCE, suggesting that TCE has undergone progressive dechlorination over time.

Monitoring well CMW-5-10 is the single background monitoring location, and data from this well are compared to data from the other wells monitoring Site-impacted ground water. Note that three of the wells with MNA indicator data are recovery wells that were likely to have yielded ground water representative of pumping conditions when the MNA data were collected. Data from these wells may not be representative of conditions applicable to other areas of impacted ground water outside of the immediate areas of ground-water withdrawal.

MNA indicator parameters that have been monitored at the Site are alkalinity, chloride, ferrous iron, nitrate, sulfate, total sulfide, ethane, ethene, methane, and total organic carbon (TOC). Table 8 shows the results of analyses of these constituents from the NEC Site. The significance of each of these variables is discussed below. EPA's guidance Technical Protocol for the Evaluation of Monitored Natural Attenuation of Chlorinated Solvents in Ground Water (EPA, 1998) is the source for information regarding the significance of each of the variables.

Table 8. Summary of Geochemical Indicator Data

Analyte	CMW-5-10 Background	CMW-7 MW	CMW-12 MW	CMW-5-2A Recovery	CMW5-11 Recovery	R-2 Recovery	Shallow zone trench Recovery
Alkalinity	200	310	150	190	210	170	280
Chloride	18	17	71	18	22	11	7
Ferrous iron	0.66	1.1	5.6	4.2	1.6	6.3	<0.1
Nitrate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.1
Sulfate	65	24	34	39	29	70	27
Total sulfide	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ethane	0.00026	0.00318	0.00044	0.00192	0.00294	0.00097	<0.00001
Ethene	<0.00001	0.00133	0.00007	0.00039	0.00041	0.00115	0.00001
Methane	0.083	0.7518	0.2416	0.5468	0.7274	0.2709	0.0011
Total Organic Carbon (TOC)	2.4	2.4	2	1.6	1.7	1.5	2.4

The units are given in the table as ug/L. "MW" in the above table refers to monitoring well.

Considering the data presented in Table 8 along with chlorinated solvent concentration trends in Site monitoring wells, the following observations are made regarding reductive dechlorination and biodegradation at the Site:

- There is no clear evidence of significant shallow ground water reductive dechlorination or biodegradation based on the quality of ground water monitored by the shallow zone interceptor trench. This conclusion is supported by the volatile organic contaminant data from the interceptor trench, which show that TCE is the predominant contaminant present (Figure 13).

- The low concentration of TOC in the ground water indicates that reductive dechlorination is unlikely to remove a significant additional mass of TCE, regardless of the previous contaminant biodegradation processes that have previously occurred.

- Relative to background concentrations of potential or probable TCE degradation products (chloride, ethene, ethane, methane), concentrations of these indicators in samples from areas of impacted ground water suggest that while some removal of chlorinated ethenes is ongoing, there is probably not a significant amount of biodegradation presently occurring and of the degradation that is occurring, complete reduction of vinyl chloride to non-chlorinated end products is not a significant process within the low oxygen plume area at the Site. However, downstream where the oxygen levels are recovering, the vinyl chloride is expected to oxidize to carbon dioxide, water and chlorides. This observation is supported by ground-water quality data, which indicate generally stable concentrations of vinyl chloride at the Site and total VOC concentrations in recent samples from bedrock monitoring and recovery wells.

- Current reductive dechlorination is probably less significant in ground water closer to the source areas and more significant in areas further from the source areas. This point is supported by the interceptor trench data (much more TCE than 1,2-DCE and inconsequential vinyl chloride production); data from CMW-5-2 (TCE concentrations nearly stable and nearly depleted and 1,2-DCE and vinyl chloride concentrations nearly stable); and CMW-5-7 data (ongoing loss of 1,2-DCE and nearly stable concentrations of vinyl chloride, indicating preferential removal of 1,2-DCE, most likely through reductive dechlorination).

6.6.4 Overall Remediation System Performance

Overall recovery well system performance was considered in this evaluation. Typically, over the life of a ground-water pump and treat system, the cumulative volume of water pumped increases at a rate that exceeds the rate of increase of the cumulative mass removed. If the cumulative mass removed approaches a flat line, an alternative pumping scheme should be considered. Site data indicate that while the slope of the cumulative mass trend line has flattened over time, it is still increasing appreciably. However, most recently, data indicate that relatively high flow volumes have been associated with less mass removal, compared to equivalent mass

removal at lower flow volumes. This situation suggests that at some of the recovery wells it would be advantageous to reduce the flow rate.

Recovery well R-2 is a shallow bedrock recovery well. Data from R-2 suggest there is, for at least some range of pumping rates reported, a relationship between well discharge and contaminant concentrations, at least for the more recent data. The recent R-2 data suggest that at the current approximate average well discharge rate, the removal efficiency for this well appears to be acceptable. From December 2005 to June 2006, contaminant mass flux at an average discharge rate of 1.32 liters per minute was 1756 ug/minute, whereas from October 2006 to November 2007, the mass flux at an average discharge rate of 9.9546 liters per minute was 10,343 ug/min. For a pumping rate increase of approximately 7.54*x* there was a 5.89*x* increase in mass flux. Based upon a conceptual site model, there is some higher pumping rate where the relative increase in pumping rate would greatly exceed the relative increase in mass flux and such a higher pumping rate would not be warranted. The pumping rate at which this point of diminishing return would be reached cannot be reliably determined from the available data.

Similar to data from recovery well R-2, data from recovery well CMW-5-2A indicate an inverse relationship between the average discharge from the well and the concentration of total VOCs. CMW-5-2A is pumping at a much higher average rate than R-2 and is still extracting ground water with a substantive concentration of total VOCs. Although the average pumping rate at CMW-5-2A has decreased somewhat when comparing the data before and after late 2005 (recently average discharge of 66.39 l/min versus an earlier average discharge of 79.6 l/min), the mass flux removal by CMW-5-2A has remained nearly constant (recent mass flux of 48,100 ug/min versus an earlier mass flux of 47,520 ug/min). Data from this well do not indicate a current need for any further downward adjustment in pumping rate to maintain a favorable ratio of water pumped to contaminant concentration.

Recovery well CMW-5-11 has been pumped for a longer period and at a higher average rate than either CMW-5-2A or recovery well R-2. Contaminant concentrations are lower in the CMW-5-11 samples than in water extracted by the other recovery wells. For October 2005 and later, an average discharge of 290 l/min from CMW-5-11 was associated with an average mass

flux of 61,546 ug/min. This value is higher than the average mass flux from the other two recovery wells. However, by comparison, the CMW-5-11 removal efficiency is lower than that for CMW-5-2A. The difference in removal efficiency may be related to the difference in pumping rates between the wells, the difference in the duration of pumping at the two wells, or to both factors. It is uncertain if pumping CMW-5-11 at a lower rate would improve the concentration to pumping rate ratio, or how a reduction in pumping might affect the containment of ground water contamination around CMW-5-11. Recent CMW-5-11 data suggest that pumping this well at a somewhat lower rate would increase the well efficiency but would decrease the mass flux.

Recovery well flow measurements need to be better coordinated with ground-water sampling events at the recovery wells, in order to more fully understand the relationships between flow and contaminant concentrations, and to calculate more accurate estimates of contaminant mass flux from the wells.

Concentrations of individual VOCs and ratios of parent TCE and daughter products over time were considered for the recovery wells. For all three recovery wells, the ratio of TCE to combined 1,2-DCE and vinyl chloride has decreased since 1993. This decline is consistent with a conceptual model of a decreasing contaminant source (decreasing, but apparently not depleted, as indicated by the alluvial aquifer trench data). However, the decline may also indicate a sustained TCE source and dissolved phase biodegradation of TCE.

Overall recovery well system performance was considered in this evaluation. Typically, over the life of a ground-water pump and treat system, the cumulative volume of water pumped increases at a rate that exceeds the rate of increase of the cumulative mass removed. If the cumulative mass removed approaches a flat line, an alternative pumping scheme should be considered. Site data indicate that while the slope of the cumulative mass trend line has flattened over time, it is still increasing appreciably. However, most recently, data indicate that relatively high flow volumes have been associated with less mass removal, compared to equivalent mass removal at lower flow volumes. This situation suggests that at some of the recovery wells it would be advantageous to reduce the flow rate.

Summaries of analytical results over time are presented in Appendix G. Appendix H summarizes the analytical results of the air stripper exhaust gas (cat-ox influent) and the cat-ox air stack effluent for the reporting period. The concentrations of VOCs in both the influent and stack effluent samples were well below the cleanup standards established by EPA in Table 9.2 of the ROD.

Since the RA system became fully operational, approximately 2,968 pounds of VOCs have been removed from the ground water and approximately 4,682 pounds of VOCs have been removed since July 1993. Appendix J summarizes the remediation system performance in a table detailing VOCs and gallons of water removed.

7.0 TECHNICAL ASSESSMENT

7.1 Remedy Evaluation

Question A: Is the remedy functioning as intended by the decision documents?

The review of the ground-water data, documents, ARARs, risk assumptions, and the results of the site inspection indicate that the ground-water pump and treat remedy is functioning as intended by the ROD, as amended by the ESD.

Site O&M activities are performed by Eastern Well & Pump. Other than occasional iron fouling of the pumping wells and the packed-column stripper requiring semi-annual cleaning, no major issues have been identified with the system. General maintenance is also performed at this time and the system is generally shut down for a two-week period. Other than these semi-annual scheduled events, the system has not been shut down for any extended period of time.

The ground-water treatment system continues to be effective at removing VOCs from the ground water extracted from the shallow, intermediate, and deep aquifer recovery wells. Since the system became fully operational in February 1998, approximately 2,900 pounds of VOCs have been removed. The interceptor trench / shallow aquifer (>30 feet deep) is demonstrating capture of the shallow ground water onsite. The intermediate bedrock aquifer (30 to 75 feet deep) demonstrates capture at the DOT state highway garage and well CMW-12. The capture zone developed in the deep zone (>100 feet deep) extends well beyond the leading edge of the plume. Most recent data indicate the presence of an elongated cone of depression surrounding the deep pumping wells, CMW-5-2A and CMW-5-11, and extending toward wells CMW-12A on the DOT State Highway Garage property and beyond to well CWM-85 located across the Cumberland River.

The Site continues to be enclosed by a chain-link fence to restrict access to the Site. Furthermore, a remote monitoring security system has been installed by NES personnel. Onsite and off-site monitoring wells are securely locked to limit access. Access agreements are in place with the property owners on-site and off-site in order to perform for ground-water sampling and system operation and maintenance.

Although institutional controls (ICs) were not required in the selected remedy within the ROD, it is the intent to place ICs in the form of restrictive covenants on the titles of properties within the footprint of the plume. The ICs are to ensure that future users do not come in contact with contaminated ground water within the alluvial, intermediate, and bedrock aquifers beneath the site above the cleanup goals as specified in the ROD.

The PRP is currently working with several property owners to get covenants in place to restrict the use of ground water onsite and offsite within the footprint of the plume. Specifically, Cooper Industries is actively working with all the neighboring property owners to adopt ICs to restrict the use of ground water for drinking water purposes until the drinking water aquifer is returned to its beneficial use. As discussed in Section 3.4 and Section 3.5.2, the soil contamination has been excavated above action levels and restrictive covenants on soil are not necessary. The affected residents have all been placed on municipal drinking water. A recommendation for ICs in the form of a covenant to restrict the ground water within the footprint of the plume will be discussed further in the Section 9.0 of the report.

7.2 Applicability of Established Remedial Action Objectives

Question B. Are the exposure assumptions, toxicity data, clean up levels and RAOs used at the time of remedy selection still valid?

7.2.1 Changes in Standards and To Be Considered

KYDEP revised their PCB soil guidance level and that resulted in the removal of additional soil from the trailer park adjacent to the NEC plant site. In March 2004, the KYDEP revised the standard again to match the October 1, 2002 USEPA Region 9 Preliminary Remediation Goals (PRGs). Additionally, the Kentucky Division of Air Quality repealed its air toxics standards program in 1999 and adopted the federal regulations. Since air emissions were not a problem at the Site, this change had no effect on the monitoring program.

7.2.2 Changes in Exposure Pathways, Toxicity and Other Contaminants

The conceptual site model (CSM) presented in the BRA was reviewed to ensure that all potential exposure pathways had been evaluated and considered in the BRA and in the

development of the ROD. Although inhalation of volatile contaminants was evaluated as part of a residential showering scenario, it was determined that the passive vapor intrusion pathway (via soil gas) was not considered for this Site despite the presence of VOCs present in ground water at elevated concentrations.

Each of the ground-water contaminants identified as a COC in the ROD is sufficiently toxic and sufficiently volatile to warrant evaluation for the vapor intrusion pathway based upon the screening criteria presented in Table 2c of the OSWER Draft Vapor Intrusion Guidance (EPA 2002). The maximum detected concentrations from the most recent available ground-water data (Table 7 of the Second Semi-Annual Ground-water Monitoring Report – March 2008) were compared to the Generic Screening Levels presented in Table 2c (Risk target = $1x10^{-6}$). The results are presented below in Table 9.

Table 9. Screening of Recent Ground-Water Data vs. Vapor Intrusion Target Concentrations

Chemical	Max Detect (µg/L)	VI Target Ground-Water Concentration	MCL	Exceeds VI Target?	# of wells exceeding VI Target	Monitoring Wells with VOC concentrations that exceed VI target	Location of well in subsurface
Benzene	19	5	5	Yes	1	CMW-5-11B*	intermediate
1,1-Dichloroethene	<5	190	7	No		--	--
***cis*-1,2-Dichloroethene**	2100	210	70	Yes	3	CMW-5-11A*, CMW-5-11B, CMW-5-2	intermediate, intermediate, deeper
***trans*-1,2-Dichloroethene**	19	180	100	No	--	--	--
1,1,2,2-Tetrachloroethane	<5	3.3	N/A	No	--	--	--
Trichloroethene	550	5	5	Yes	4	BH-2, CMW-5-11A* CMW-5-11B, CMW-5-2	alluvial, intermediate, intermediate, deeper
Vinyl Chloride	89	2	2	Yes	5	CMW-7, CMW-5-2, CMW-12, CMW-5-11A, CMW-5-11B*	deeper, deeper, intermediate, intermediate, intermediate

*denotes the maximum concentration detected in well

Results of this initial, conservative screening suggest that vapor intrusion from volatile organics in ground water may be an issue at the Site. Specifically, the initial screening indicated that Site COCs benzene, cis-1,2-DCE, TCE, and vinyl chloride should be investigated further. The only contaminant reported at concentrations above detection limits in the surficial aquifer sample was TCE at 28 μg/L in BH-2 vs. 550 μg/L detected in CMW-5-11. The maximum concentrations for cis-1,2-DCE (2100 ug/L, 1600 ug/L, and 640 ug/L respectively) were detected in intermediate and bedrock monitoring wells CMW-5-11A, CMW-5-11B, and CMW-5-2, respectively. The maximum concentration for both benzene and vinyl chloride was also detected in bedrock well CMW-5-11B. The monitoring wells (CMW-5-11A, CMW-5-11B, and CMW-5-2) are located on the NEC property and completed in the intermediate and bedrock aquifers at depths of 75, 50, and 125 feet respectively with most recent depth to water levels ranging from approximately 30 – 66 feet bgs.

The Second Semi-Annual 2007 Ground-Water Monitoring report indicates that ground-water flow in the shallow aquifer is flowing east, away from the main plant building toward the Cumberland River away from the Holiday Mobile Home Trailer Park and the residential neighborhood. The ground-water flow direction in both the intermediate and deeper bedrock aquifers is flowing toward the south-west toward the trailer park and neighborhood. Therefore, contaminants present in the surficial aquifer do not flow underneath the main plant building or toward the residential areas to the west of the Site. Furthermore, monitoring wells CMW-5-11A, CMW-5-11B, and CMW-5-2 are not located in the adjacent residential areas. Both Figure 14a and Figure 14b indicate that the concentration of VOCs in offsite wells (downgradient residential area) are non detect except for cis-1,2-DCE and vinyl chloride detected in CMW-7 and CMW-12. Cis-1,2-DCE was detected below the MCL (70 ppb) in both CMW-7 and CMW-12. Vinyl chloride was detected in both CMW-7 and CMW-12 at concentrations of 39 ppb and 4.5 ppb, respectively which is slightly above the MCL of 2 ppb. After consideration of the potentiometric surfaces in both the surficial and deeper aquifers, depths to water in the wells, monitoring well concentration data, and the current operations at the Site involving the use of BTEX-based solvents, it is not recommended that the vapor intrusion pathway be investigated further at the Site.

7.2.3 Changes in Cleanup Goals

Remedial goals were evaluated to ensure that the goals selected remain current and appropriate. The "performance goals" for ground water are presented in Table 1 of this report. The remedial goals selected were based upon EPA's MCLs for six VOCs noted in Section 9.3.2 of the ROD which are noted in Table 1 of this five-year review report, with one exception, 1,1,2,2-tetrachloroethane, which did not have an MCL. None of the MCLs have changed for the contaminants of concern. The remaining remedial goal (10 µg/l for 1,1,2,2-tetrachloroethane) was a risk-based goal corresponding to an estimated risk of 5.9×10^{-5} for the lifetime residential scenario. The toxicity criteria for 1,1,2,2-tetrachloroethane have not changed.

7.3 Protectiveness of Remedy

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

As discussed in Section 7.2.2 of this report, the passive vapor intrusion pathway (via soil gas) was not evaluated for this Site despite the presence of volatile organic compounds present in ground water at elevated concentrations during the BRA. Results of the initial, conservative screening suggest that vapor intrusion from volatile organics in ground water could be an issue at the Site. But a thorough examination of the contaminants detected, the location of the wells in the subsurface, and the potentiometric surface of each of the aquifers and their relation to residential indicated that the vapor intrusion pathway it not expected to pose an unacceptable risk at the Site.

Additionally, Cooper Industries is actively working with all the neighboring property owners to adopt institutional controls to restrict the use of ground water for drinking water purposes until the drinking water aquifer is returned to its beneficial use. The ground-water remedy is effectively reducing contaminant concentrations within the footprint of the plume. The ground-water remedy is expected to be protective of human health and the environment, and in the interim, exposure pathways that could result in an unacceptable risks are being controlled.

8.0 IDENTIFIED ISSUES

Issues	Affects Protectiveness (Y/N)	
	Current	Future
1. Data from the alluvial aquifer trench monitoring suggest there is a persistent residual source of TCE contamination present.	N	Y
2. Recovery well flow measurements need to be better coordinated with ground-water sampling events at the recovery wells, in order to more fully understand the relationships between flow and contaminant concentrations, and to calculate more accurate estimates of contaminant mass flux from the wells.	N	Y
3. Following 10 years of monitoring and treatment, the influent air stream never exceeded the air emission standards established in the ROD; Therefore, the cat-ox is no longer required to meet KY air emission standards	N	Y
4. Institutional Controls were not mentioned in the 1996 ROD and are not a part of the remedy. The remedy is to restore ground-water levels below MCL. Therefore, until MCLs have been met, an institutional control in the form of a restriction on the use of ground water within the footprint of the plume is necessary.	N	Y
5. Property owners have not been receiving copies of analytical sampling results from the monitoring wells sampled on a semi-annual basis by Cooper Industries.	N	Y

9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Recommendations / Follow-up Actions	Party Responsible	Lead Oversight Agency	Support Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
					Current	Future
Recommend PRP consider strategies to enhance removal or destruction of any residual TCE contamination in the alluvial aquifer.	Cooper Industries	EPA	KYDEP	1st QTR 2010	N	Y
Recommend recovery well flow measurements are collected with ground-water sampling events at the recovery wells.	Cooper Industries	EPA	KYDEP	1st QTR 2009	N	Y
Recommend treatment system influent flow and concentration measurements coincide at the same approximate date as sampling and monitoring of individual recovery wells and other monitoring wells.	Cooper Industries	EPA	KYDEP	1st QTR 2009	N	Y
Provide all property owners with copies of analytical data summary of ground water wells sampled on a semi-annual basis.	Cooper Industries	EPA	KYDEP	1st QTR 2009	N	Y
Institutional Controls Implementation Plan	Cooper Industries	EPA	KYDEP	2nd QTR 2009	N	Y
Document changes to the remedy to include institutional controls and remove catalytic oxidation of the VOC-laden off gas from the air stripper in an enforceable decision document.	EPA	EPA	KYDEP	1st QTR 2010	N	Y

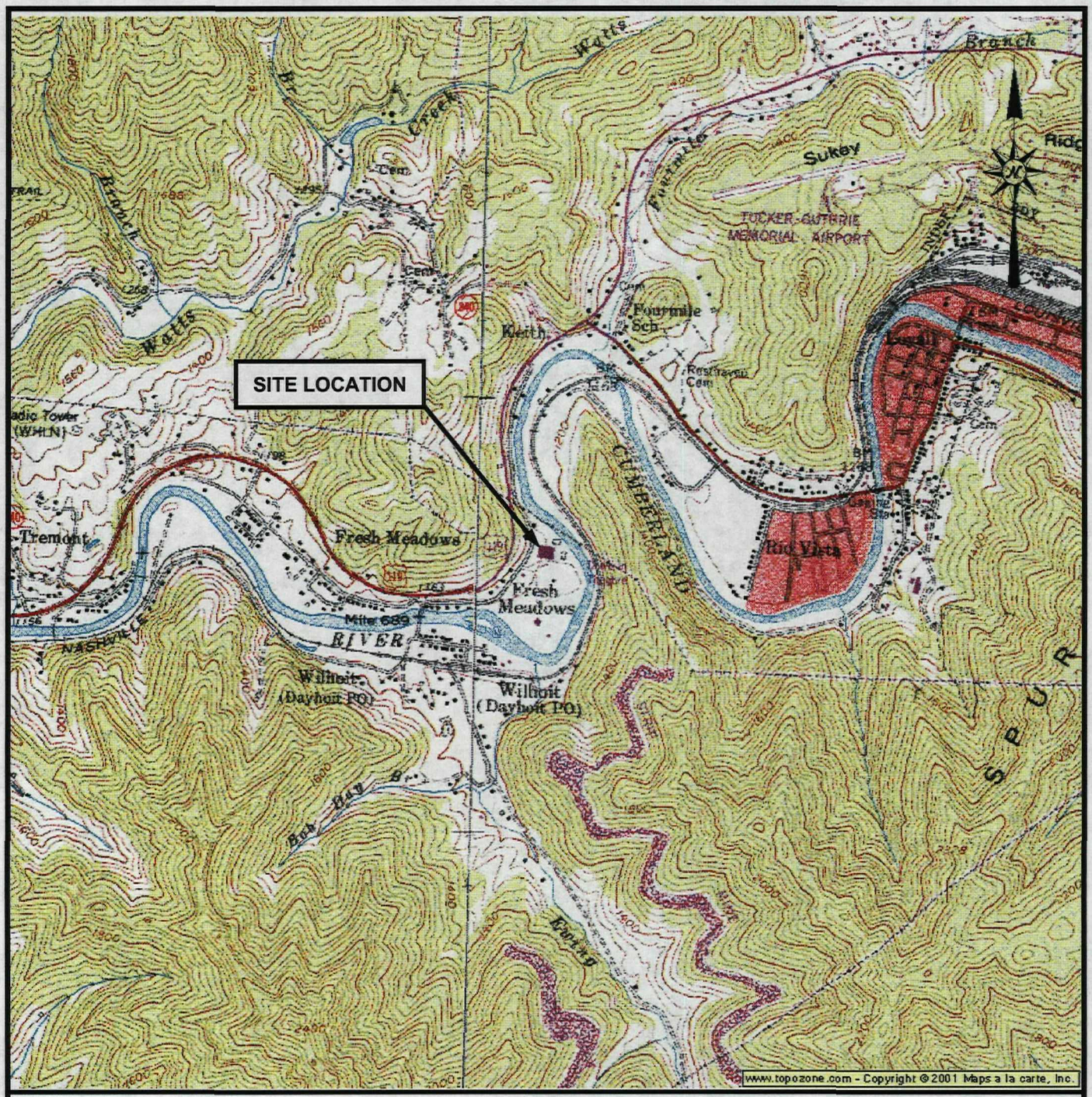
10.0 PROTECTIVENESS STATEMENT

The ground-water remedy is expected to be protective of human health and the environment, and in the interim, exposure pathways that could result in an unacceptable risks are being controlled. The ground-water exposure pathway that may potentially result in unacceptable risk has been controlled since residences within the path of the ground-water plume have been provided with municipal water via water lines. The vapor intrusion pathway was evaluated; a thorough evaluation of specific data indicated that the VI pathway is not a complete pathway and will not be evaluated further. The direct exposure soil pathway has been addressed through excavation and removal of contaminated soils along the fence line between the NEC property and the Holiday Mobile Home Park.

11.0 NEXT REVIEW

Five-year reviews are to be conducted at this Site until contaminant levels are below the cleanup goals established by EPA in Table 9.2 of the ROD (i.e., drinking water standards for identified COCs). Because Site contaminant levels remain above cleanup levels, the next five-year review will be completed within five years of the date of this report. The due date for the next five-year review is September 30, 2013.

FIGURES



SOURCE: USGS 7.5' TOPOGRAPHIC QUADRANGLE MAP
HARLAN, KENTUCKY 1978

0' 1,000' 2,000' 3,000'

JANUARY 2008

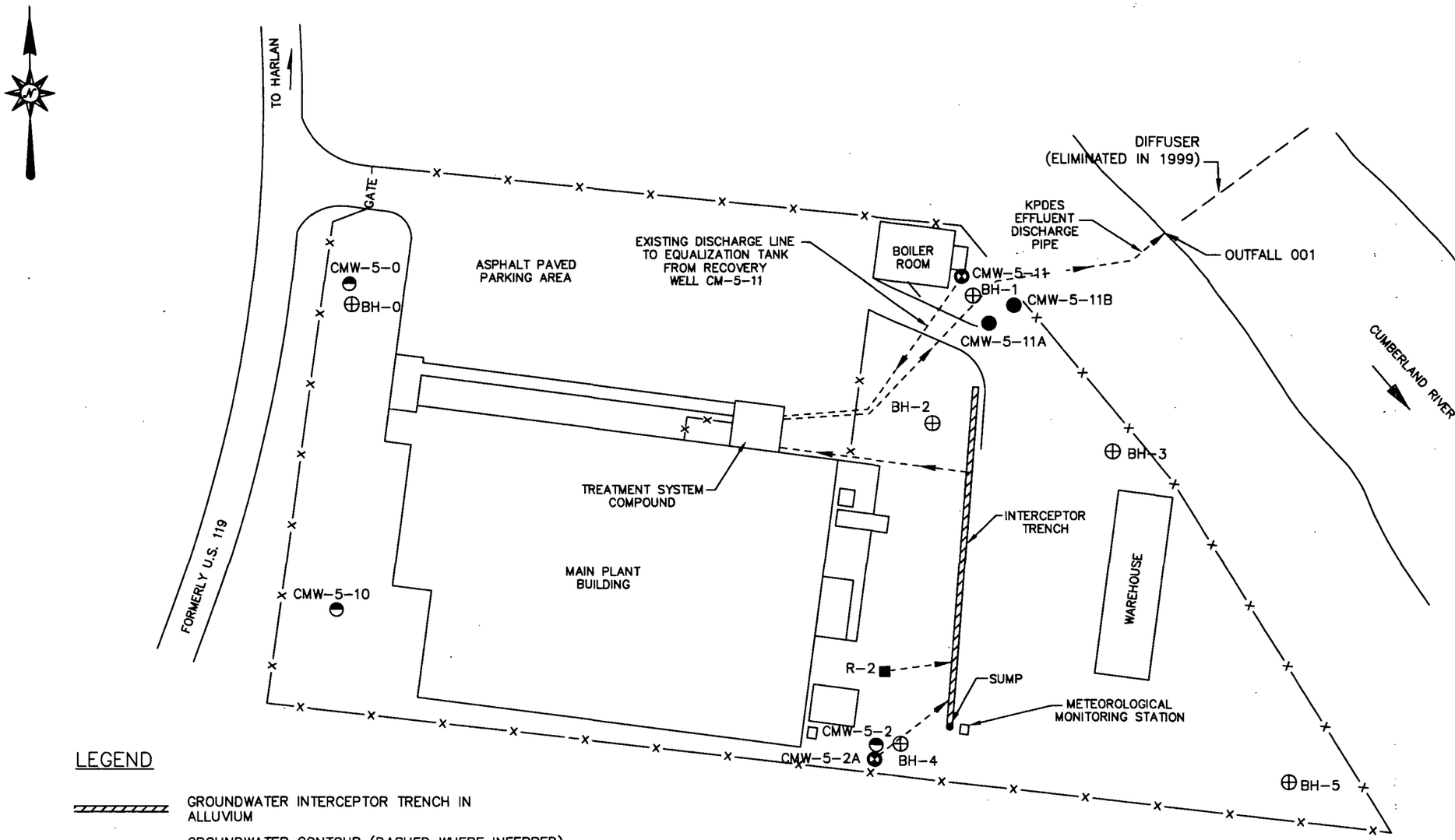
PROJECT NO.: 303-1360
DRAWN BY: DH
APPROVED BY: MM

FIGURE 1
TOPOGRAPHIC MAP
NATIONAL ELECTRIC COIL SITE
HARLAN, KENTUCKY

SHIELD ENVIRONMENTAL ASSOCIATES, INC.

948 Floyd Drive
Lexington, KY 40505
(859) 294-5155

P:\303-1360\TOPO



LEGEND

- GROUNDWATER INTERCEPTOR TRENCH IN ALLUVIUM
- GROUNDWATER CONTOUR (DASHED WHERE INFERRED)
- BH-2 ALLUVIAL AQUIFER WELL
- R-2 INTERMEDIATE BEDROCK AQUIFER RECOVERY WELL
- CMW-5-2 DEEPER BEDROCK AQUIFER RECOVERY WELL
- CMW-5-2 BEDROCK AQUIFER WELL

DRAWING SOURCE– CIVIL & ENVIRONMENTAL CONSULTANTS INC.
PITTSBURGH, PA.
12/8/02

0' 30' 60' 90'

FIGURE 2a

FACILITY LAYOUT
NATIONAL ELECTRIC COIL SITE
HARLAN, KENTUCKY

JANUARY 2008

PROJECT NO.:	303-1360
DRAWN BY:	DH
APPROVED BY:	MM

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
948 Floyd Drive
Lexington, KY 40505
(859) 294-5155

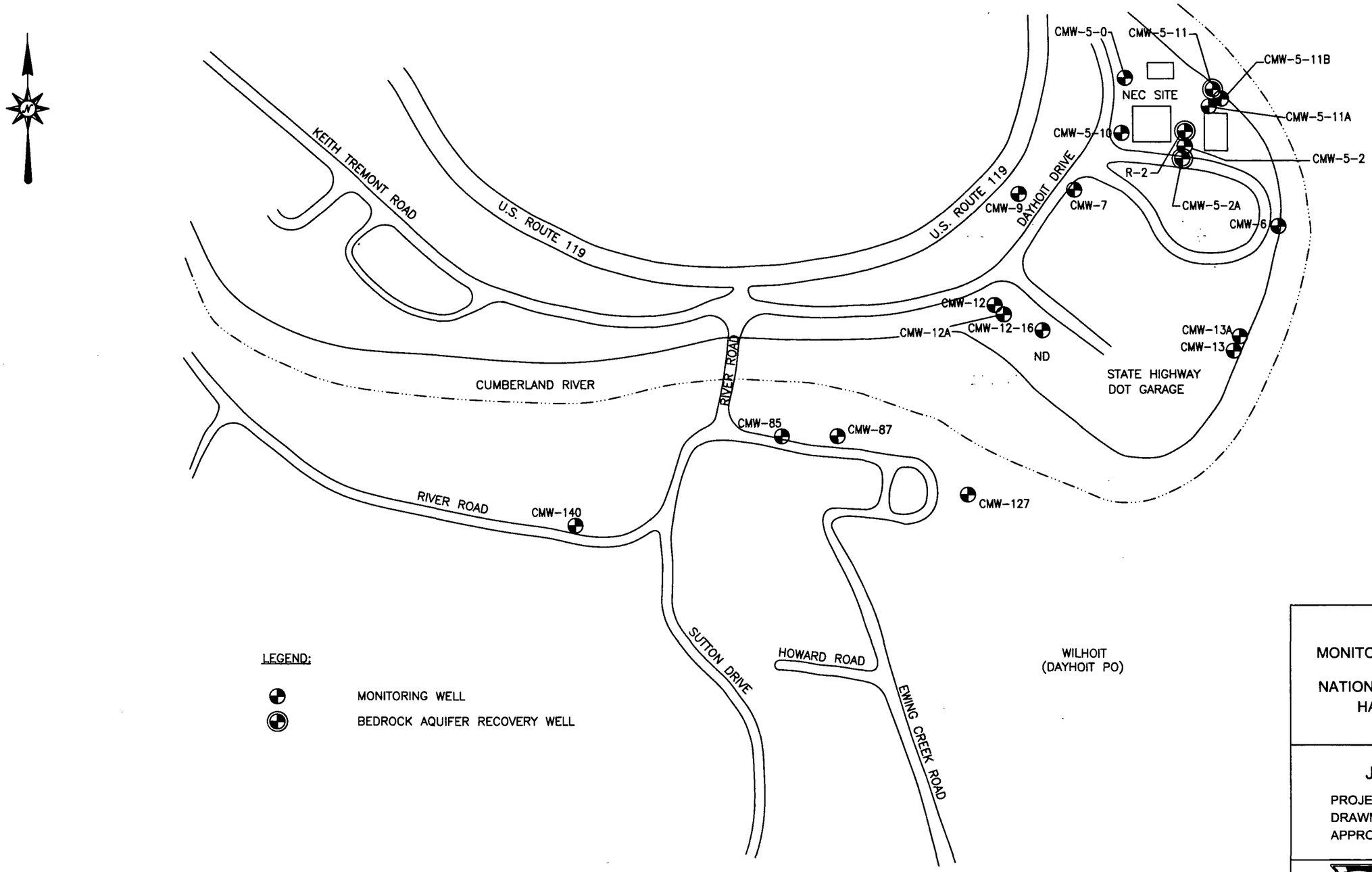


FIGURE 2b

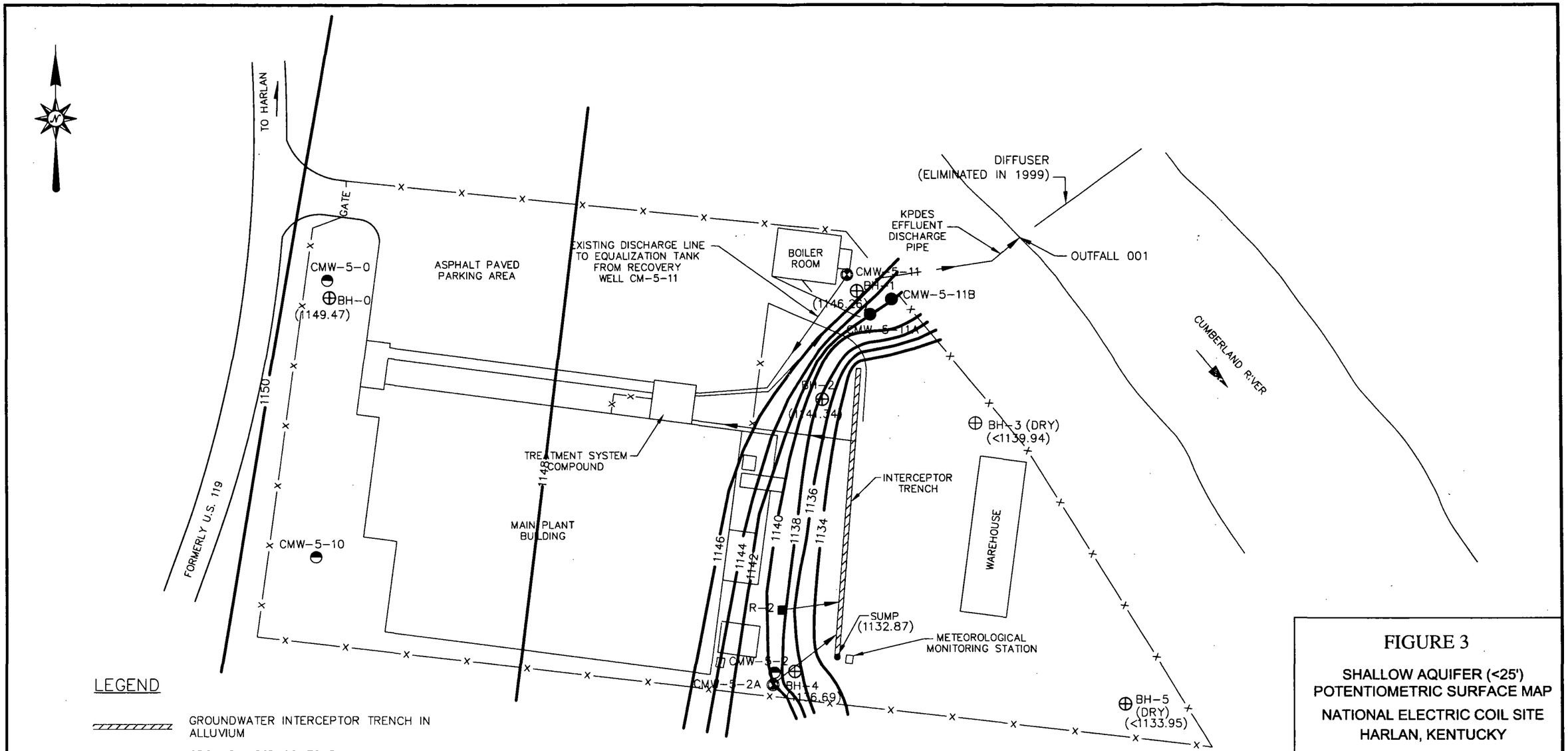
MONITORING WELL LOCATIONS

NATIONAL ELECTRIC COIL SITE
HARLAN, KENTUCKY

JANUARY 2008

PROJECT NO.:	303-1360
DRAWN BY:	DH
APPROVED BY:	MM

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
948 Floyd Drive
Lexington, KY 40505
(859) 294-5155



LEGEND

	GROUNDWATER INTERCEPTOR TRENCH IN ALLUVIUM
	GROUNDWATER CONTOUR
BH-2 ⊕	ALLUVIAL AQUIFER WELL
R-2 ■	INTERMEDIATE BEDROCK AQUIFER RECOVERY WELL
CMW-5-2	DEEPER BEDROCK AQUIFER RECOVERY WELL
CMW-5-2	BEDROCK AQUIFER WELL

DRAWING SOURCE– CIVIL & ENVIRONMENTAL CONSULTANTS INC.
PITTSBURGH, PA.
12/8/02

FIGURE 3

SHALLOW AQUIFER (<25') POTENTIOMETRIC SURFACE MAP

NATIONAL ELECTRIC COIL SITE
HARLAN, KENTUCKY

JANUARY 2008

PROJECT NO.:	303-1360
DRAWN BY:	DH
APPROVED BY:	MM

SHIELD ENVIRONMENTAL ASSOCIATES, INC.
948 Floyd Drive
Lexington, KY 40505
(859) 294-5155

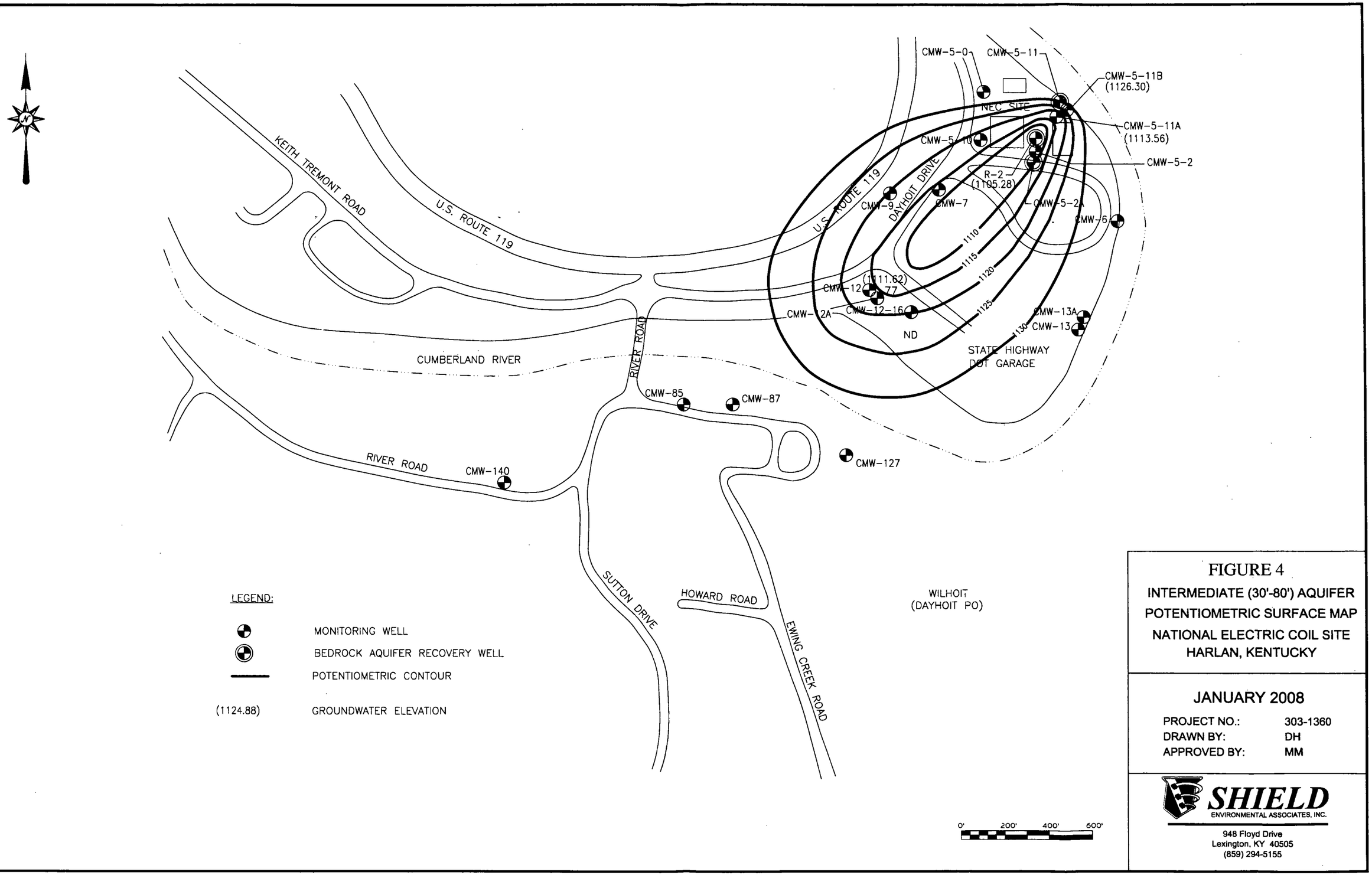


FIGURE 4

INTERMEDIATE (30'-80') AQUIFER
POTENTIOMETRIC SURFACE MAP
NATIONAL ELECTRIC COIL SITE
HARLAN, KENTUCKY

JANUARY 2008

PROJECT NO.:	303-1360
DRAWN BY:	DH
APPROVED BY:	MM

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
948 Floyd Drive
Lexington, KY 40505
(859) 294-5155

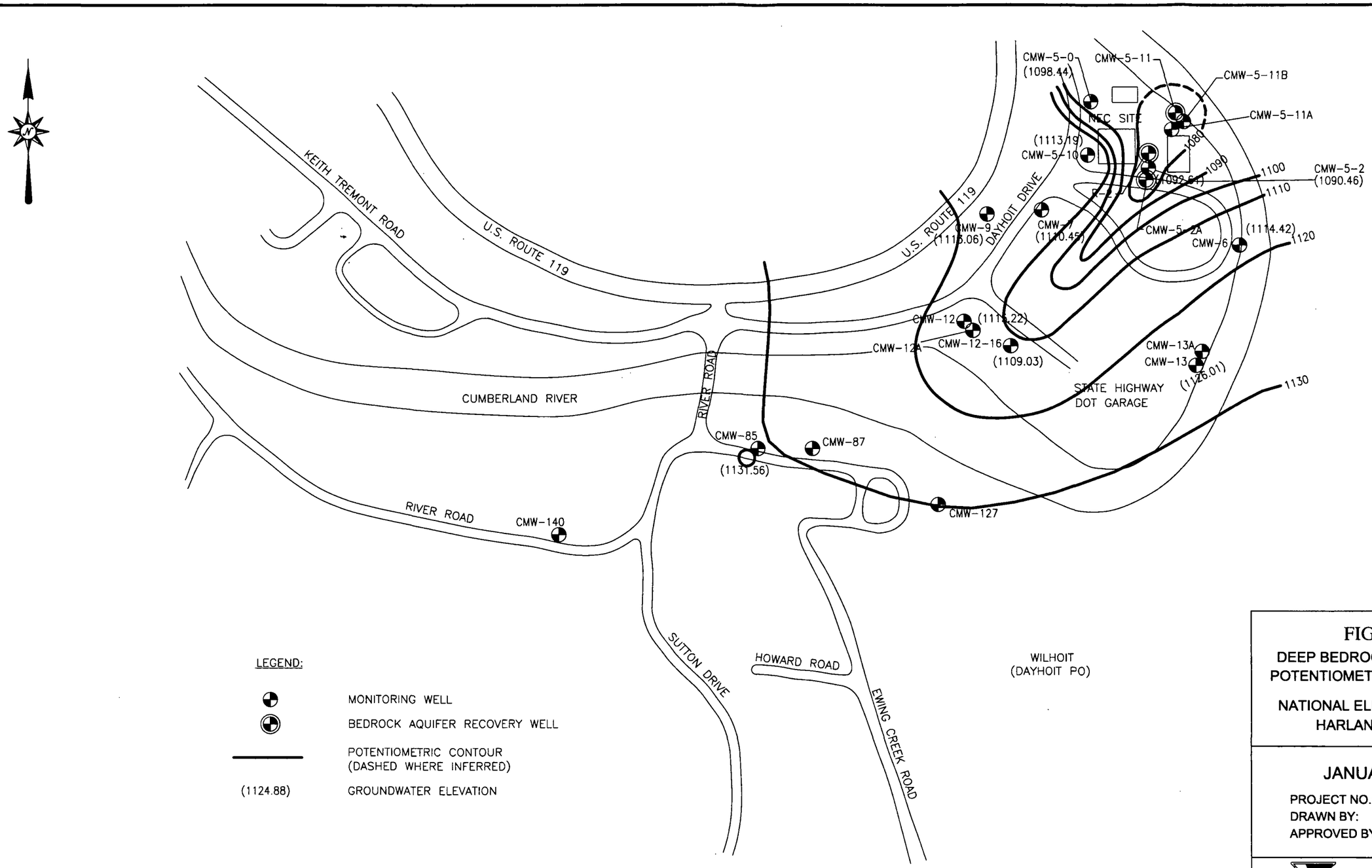


FIGURE 5

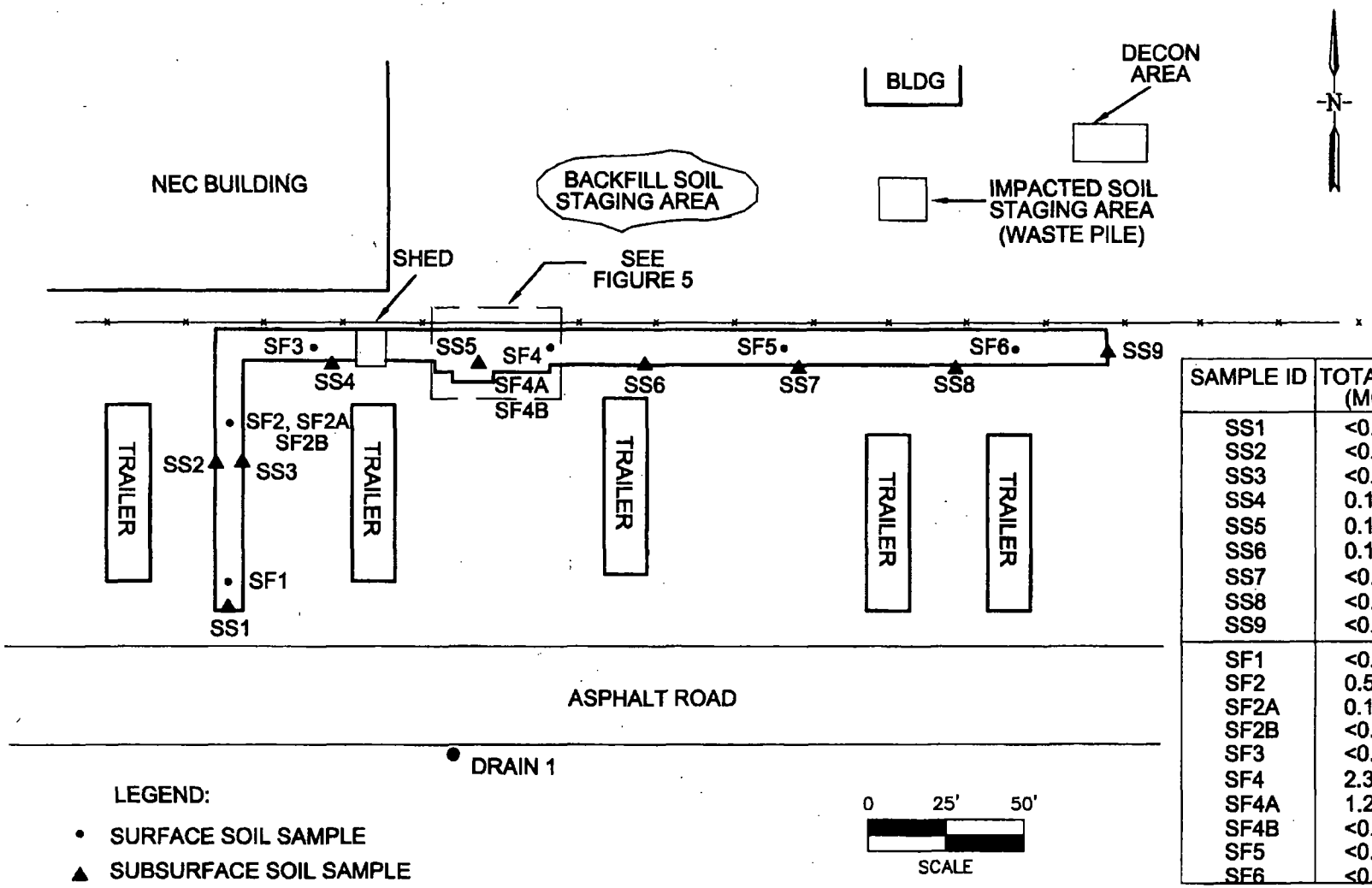
DEEP BEDROCK AQUIFER (>90')
POTENTIOMETRIC SURFACE MAP

NATIONAL ELECTRIC COIL SITE
HARLAN, KENTUCKY

JANUARY 2008

PROJECT NO.:	303-1360
DRAWN BY:	DH
APPROVED BY:	MM

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
948 Floyd Drive
Lexington, KY 40505
(859) 294-5155



SAMPLE ID	TOTAL PCBs (MG/KG)
SS1	<0.10
SS2	<0.10
SS3	<0.10
SS4	0.10
SS5	0.16
SS6	0.11
SS7	<0.10
SS8	<0.10
SS9	<0.10
SF1	<0.10
SF2	0.5/0.25
SF2A	0.16
SF2B	<0.10
SF3	<0.10
SF4	2.3/1.7
SF4A	1.20
SF4B	<0.10
SF5	<0.10
SF6	<0.10

OCTOBER 29, 201

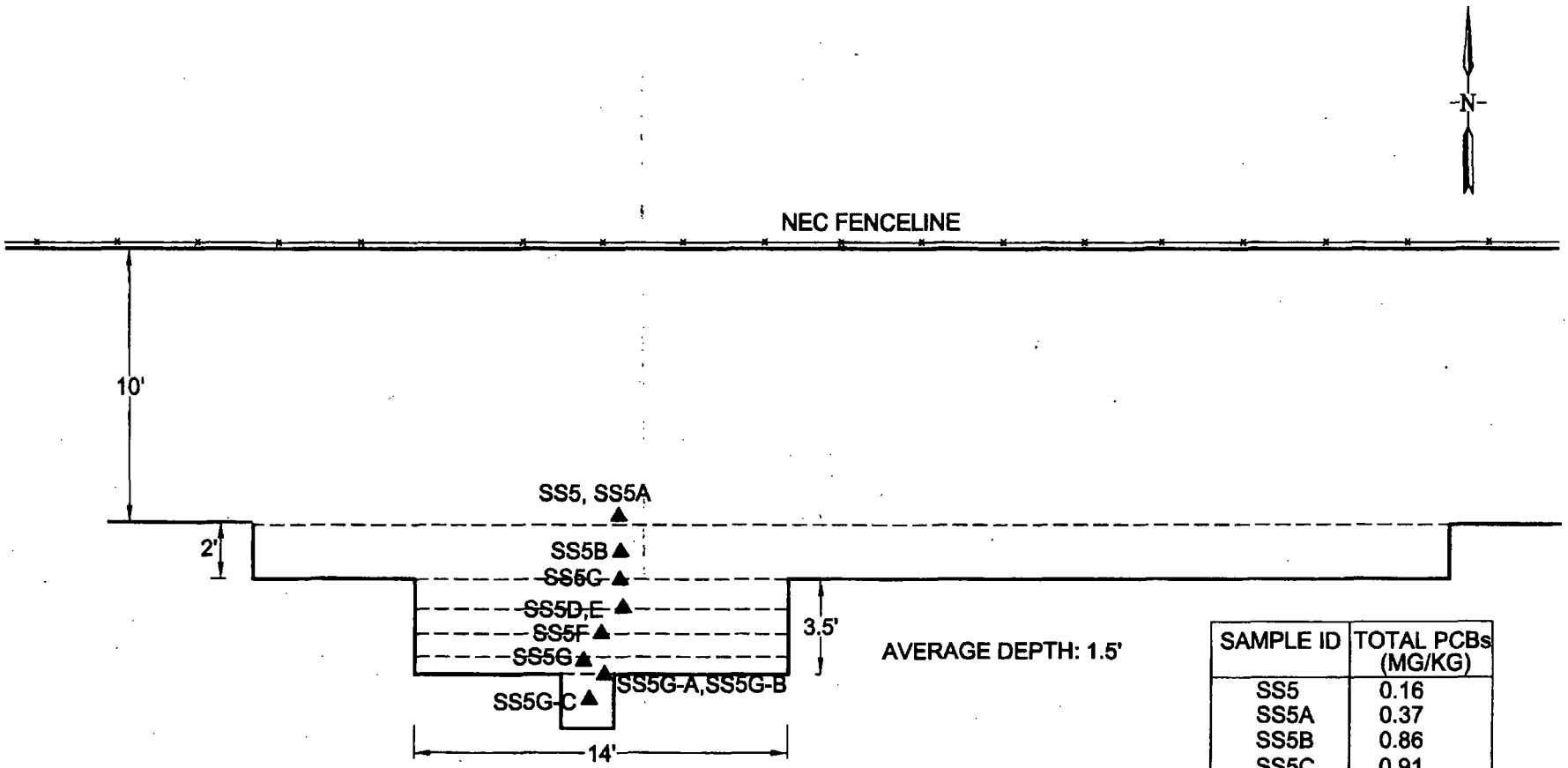
PROJECT NO.: 301-1370
DRAWN BY: P.D.H.
APPROVED BY: M.M.

FIGURE 6

EXCAVATION AREA AND SAMPLING POINTS
NATIONAL ELECTRIC COIL SITE AND
HOLIDAY ACRES MOBILE HOME PARK
DAYHOIT, KENTUCKY

SHIELD ENVIRONMENTAL ASSOCIATES, INC.
2456 Fortune Drive, Suite 100
Lexington, KY 40509
859-294-5155

1370-



SAMPLE ID	TOTAL PCBs (MG/KG)
SS5	0.16
SS5A	0.37
SS5B	0.86
SS5C	0.91
SS5D	0.49
SS5E	0.56
SS5F	0.64
SS5G	0.46
SS5G-A	<0.10
SS5G-B	<0.10
SS5G-C	<0.10

OCTOBER 29, 2001

PROJECT NO.: 301-1370
DRAWN BY: P.D.H.
APPROVED BY: M.M.

FIGURE 7

SAMPLING LOCATIONS IN THE VICINITY OF SS5
NATIONAL ELECTRIC COIL SITE AND
HOLIDAY ACRES MOBILE HOME PARK
DAYHOIT, KENTUCKY

SHIELD ENVIRONMENTAL ASSOCIATES, INC.
2456 Fortune Drive, Suite 100
Lexington, KY 40509
859-294-5155

1370-

Figure 8
Mass (lbs) of 1,2-DCE Removed versus Time
NEC Superfund Site

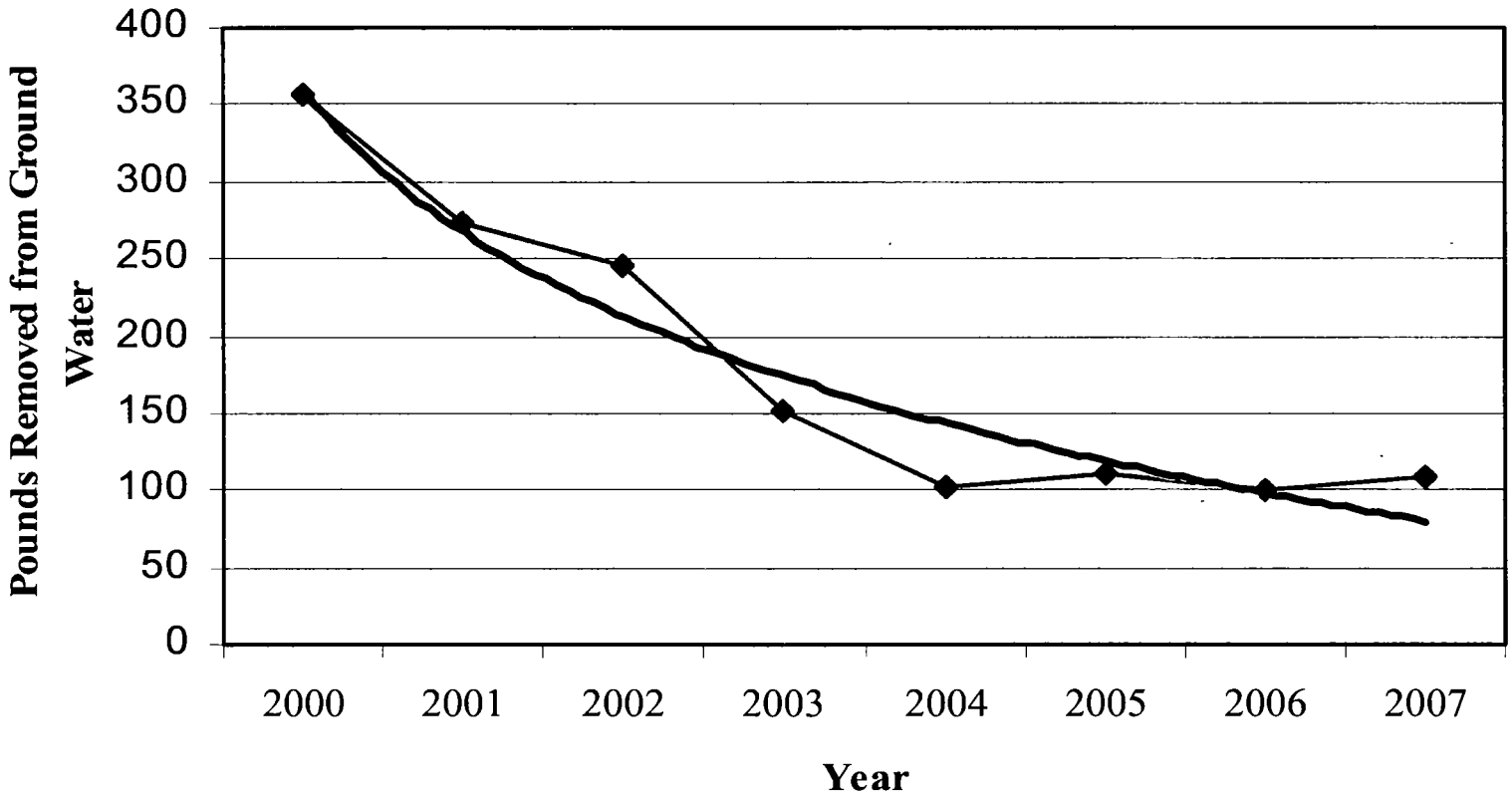


Figure 9
Mass (lbs) of TCE Removed versus Time
NEC Superfund Site

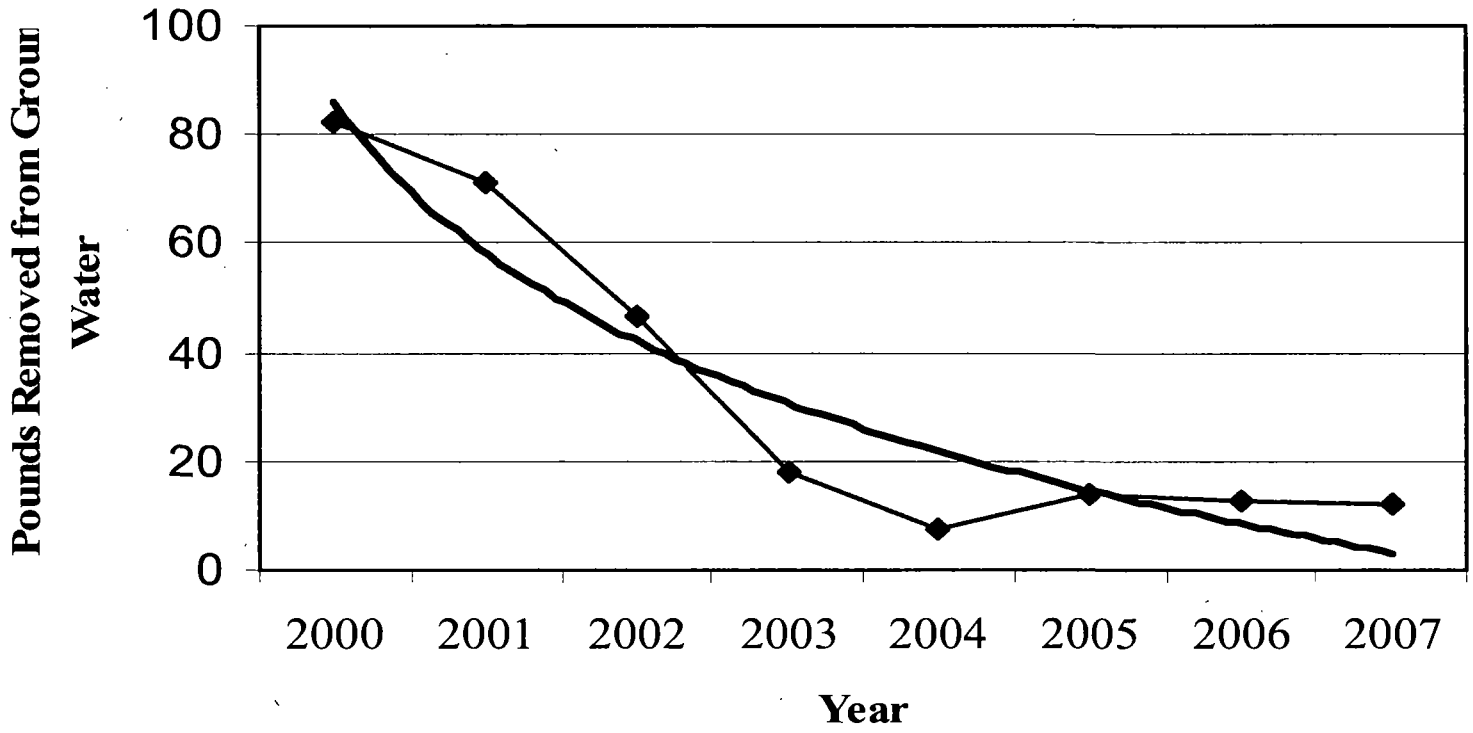


Figure 10
Mass (lbs) of Vinyl Chloride Removed versus Time
NEC Superfund Site

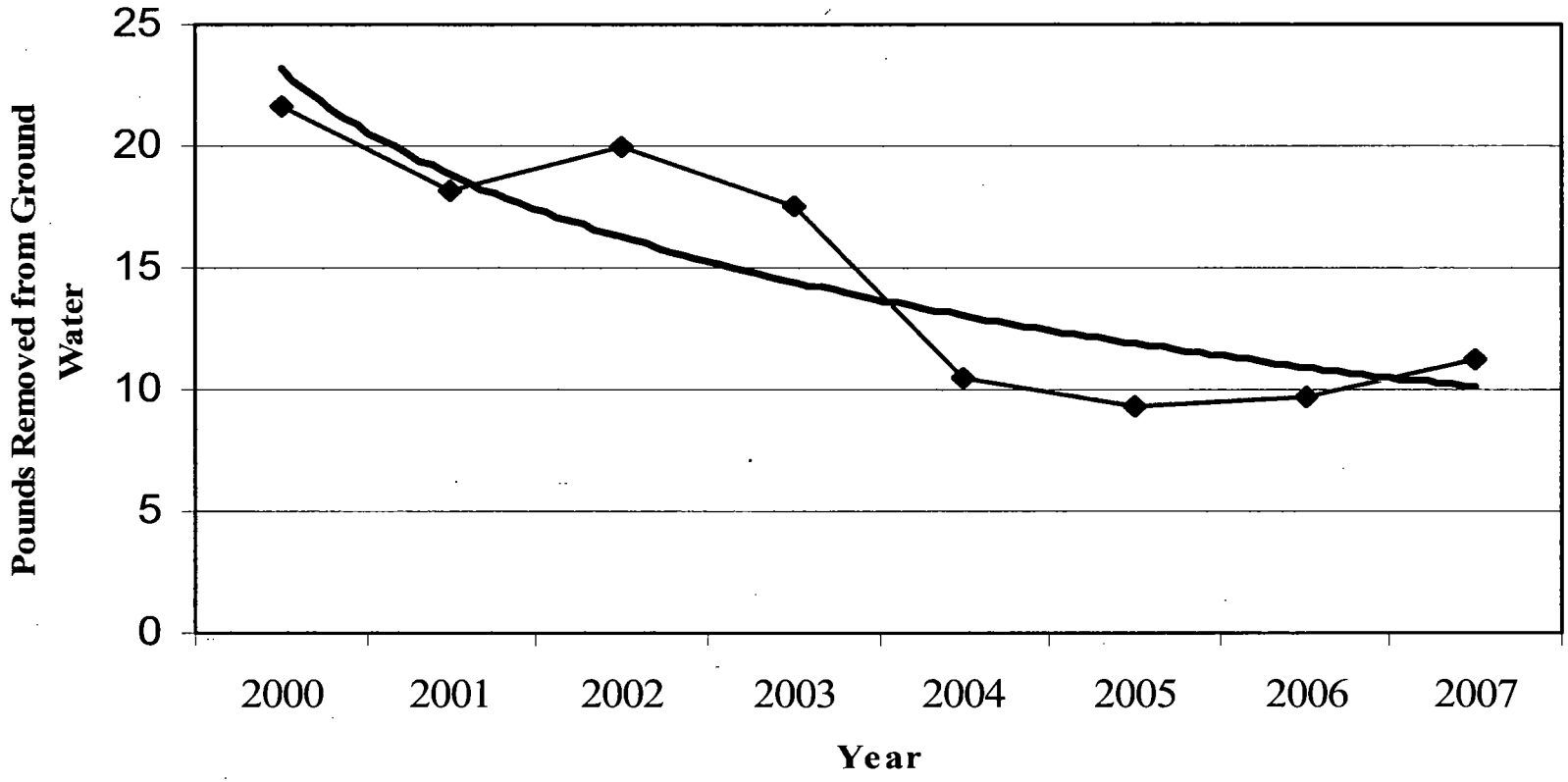


Figure 11
Influent VOC Concentrations versus Time

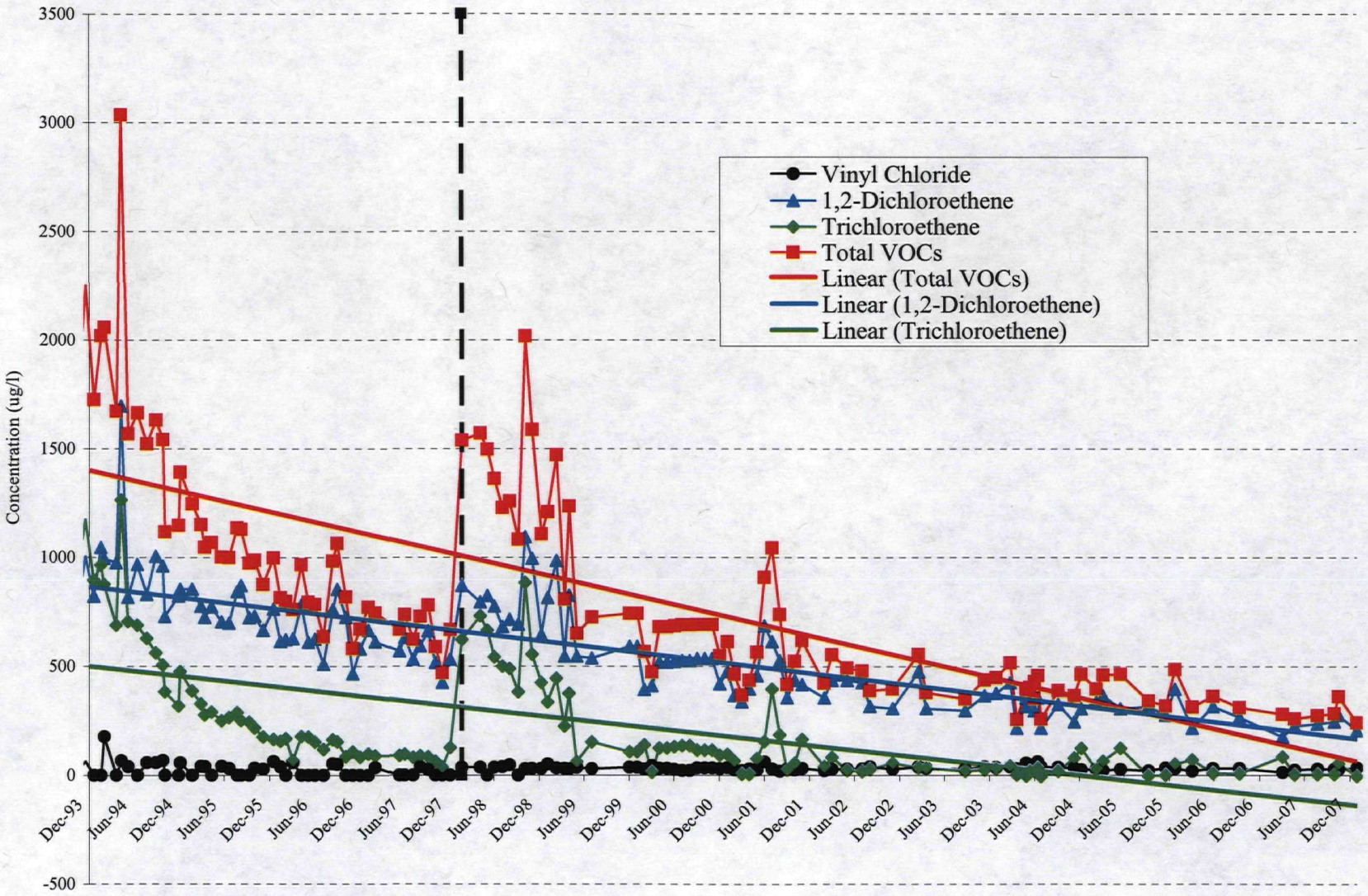


Figure 12. Trench Monitoring Data

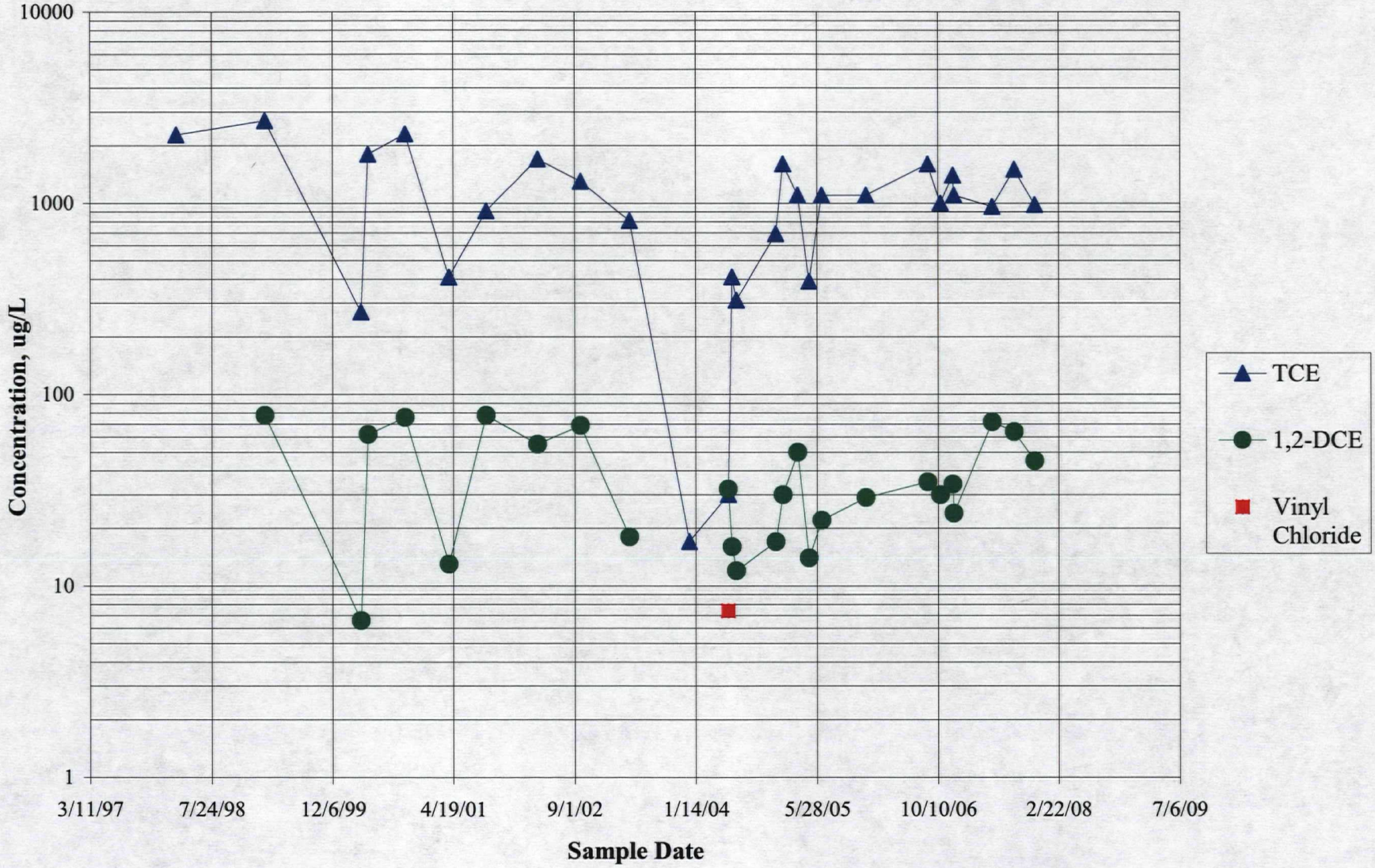


Figure 13. Five Sample Moving Average, Trench TCE and Total VOC Concentrations

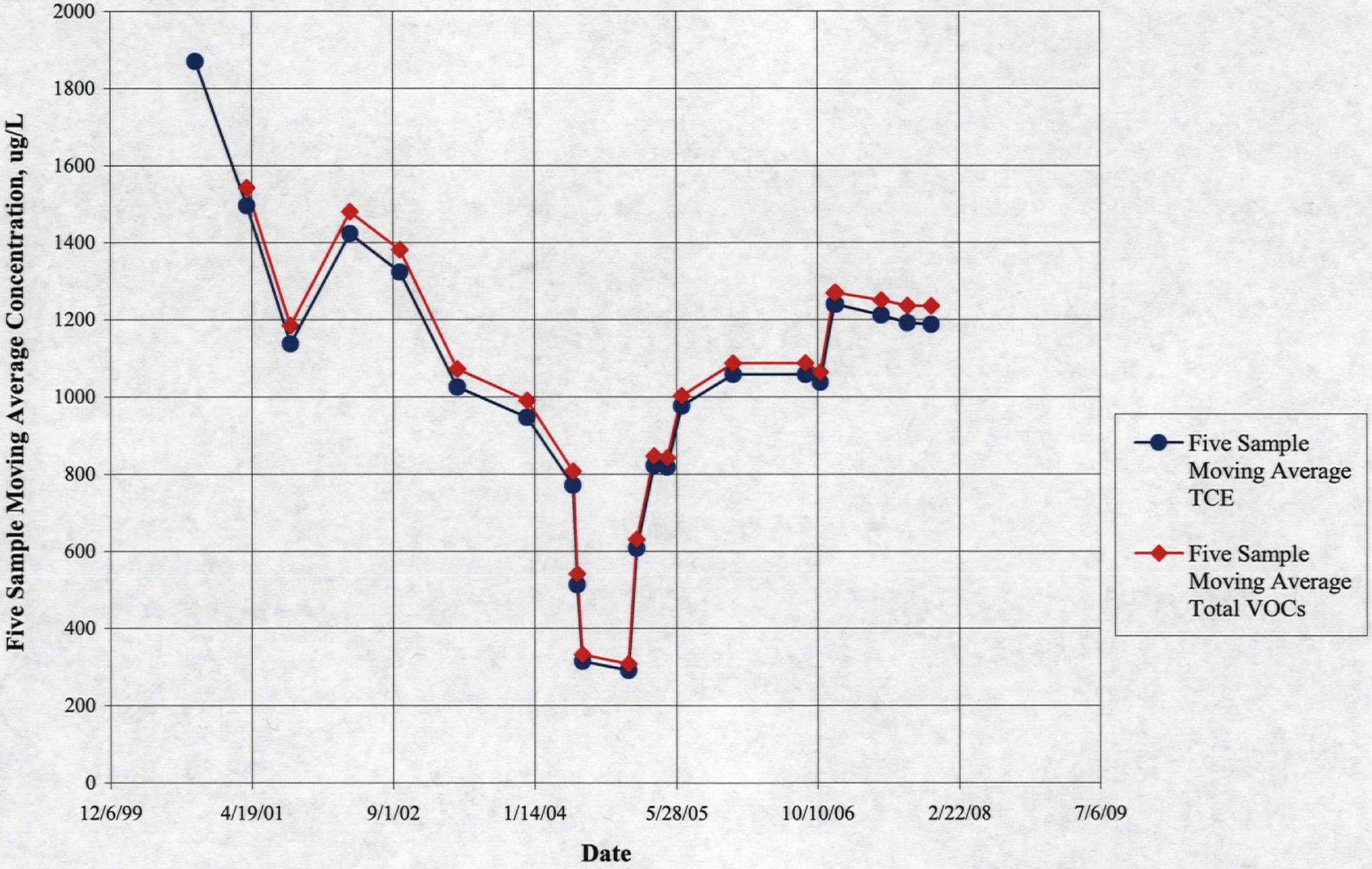
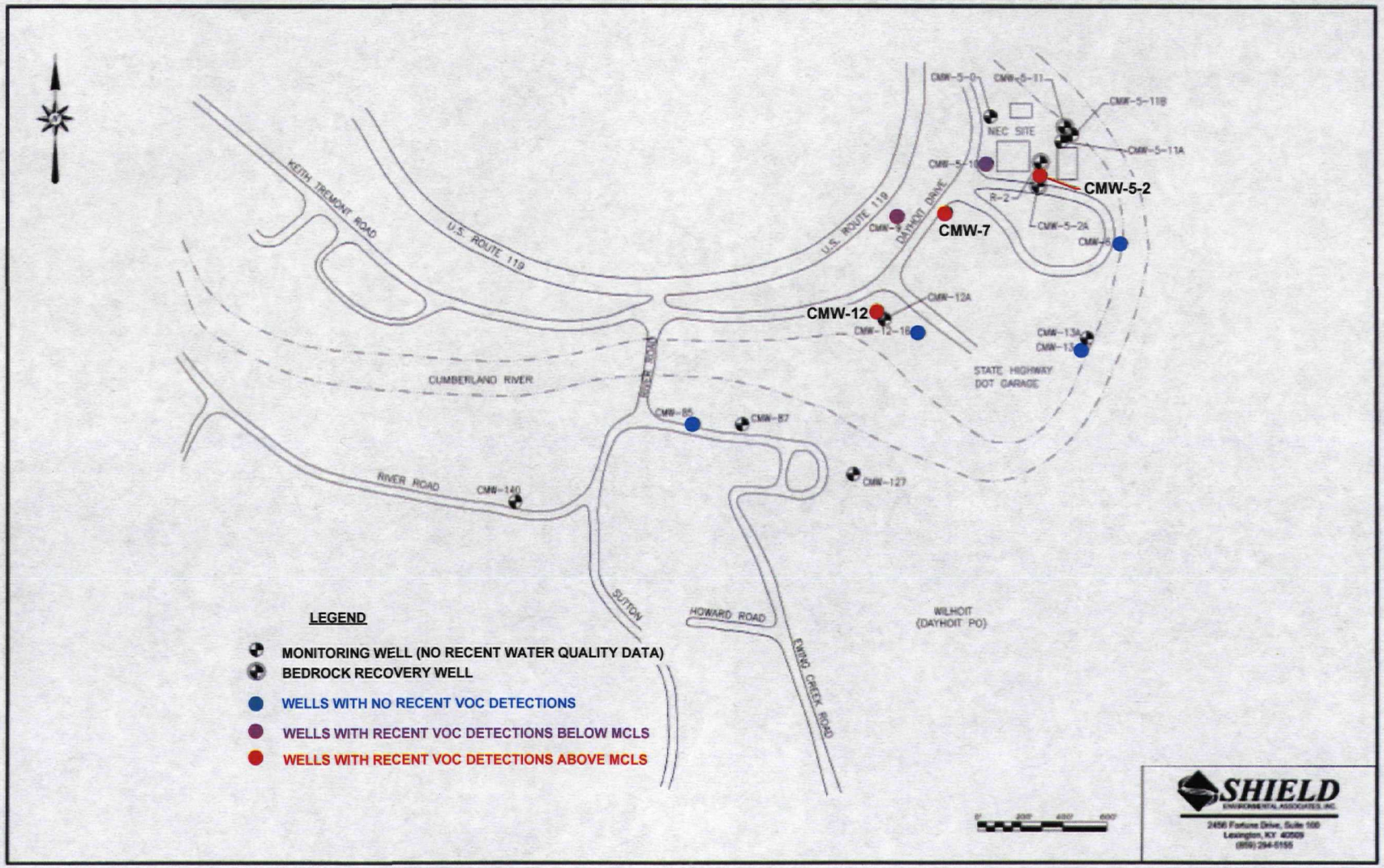
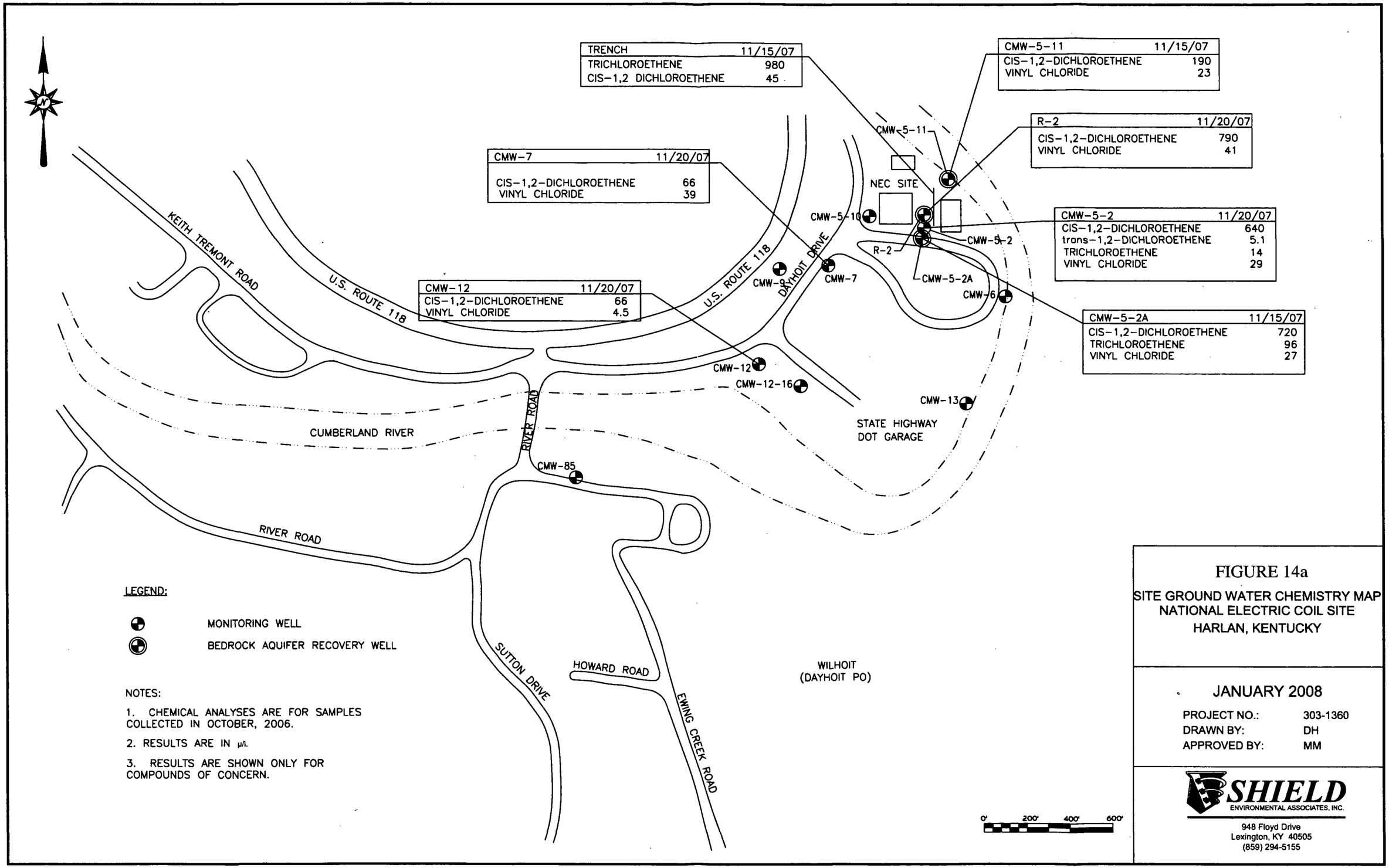


Figure 14. Summary of Wells with and without VOC Detections





LEGEND:

MONITORING WELL

BEDROCK AQUIFER RECOVERY WELL

NOTES:

1. CHEMICAL ANALYSES ARE FOR SAMPLES COLLECTED IN OCTOBER, 2006.
2. RESULTS ARE IN µ/l.
3. RESULTS ARE SHOWN ONLY FOR COMPOUNDS OF CONCERN.

FIGURE 14a

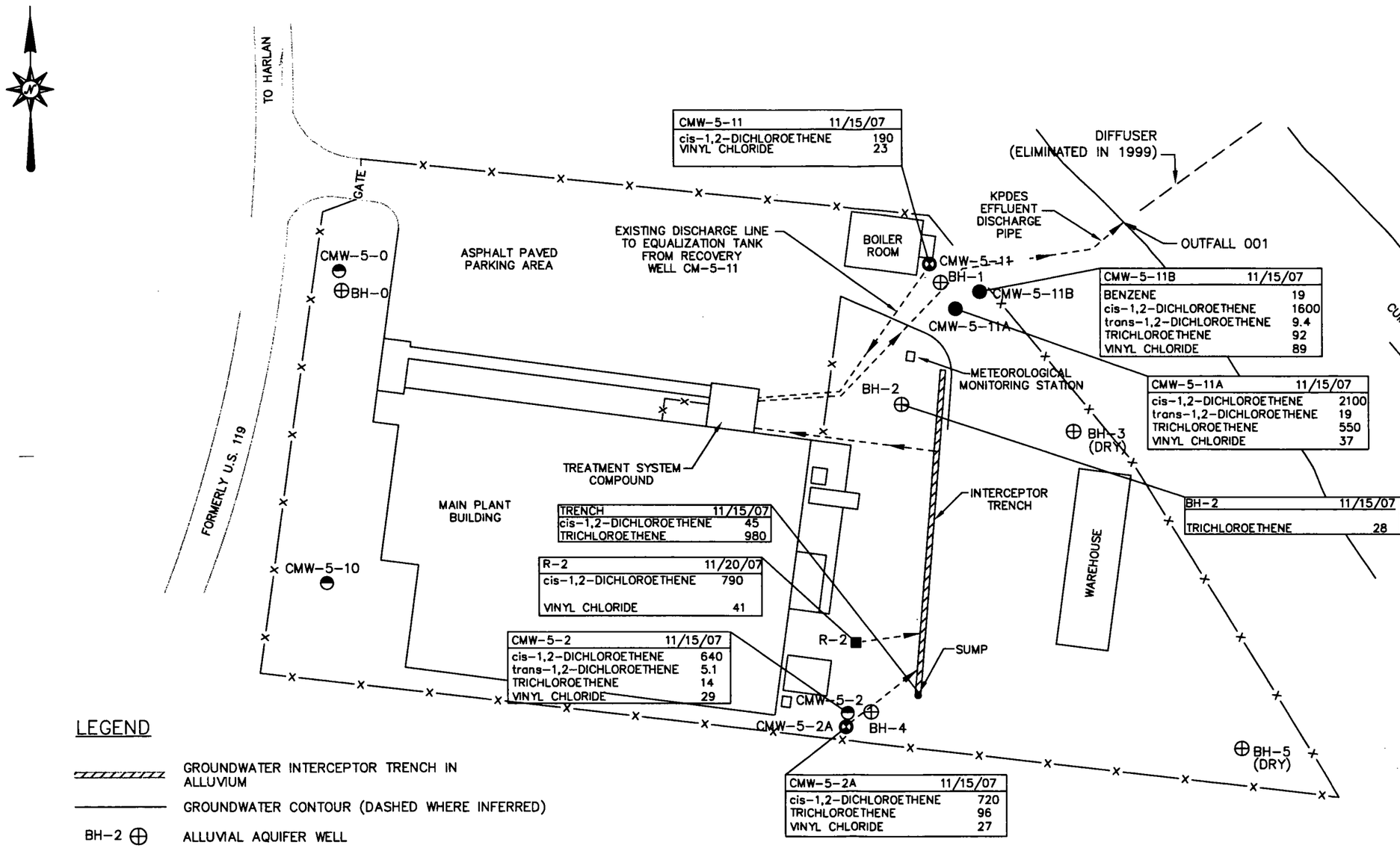
SITE GROUND WATER CHEMISTRY MAP
NATIONAL ELECTRIC COIL SITE
HARLAN, KENTUCKY

JANUARY 2008

PROJECT NO.: 303-1360
DRAWN BY: DH
APPROVED BY: MM

SHIELD ENVIRONMENTAL ASSOCIATES, INC.

948 Floyd Drive
Lexington, KY 40505
(859) 294-5155



LEGEND

- GROUNDWATER INTERCEPTOR TRENCH IN ALLUVIUM
- GROUNDWATER CONTOUR (DASHED WHERE INFERRED)
- BH-2 ⊕ ALLUVIAL AQUIFER WELL
- R-2 ■ INTERMEDIATE BEDROCK AQUIFER RECOVERY WELL
- CMW-5-2 DEEPER BEDROCK AQUIFER RECOVERY WELL
- CMW-5-2 BEDROCK AQUIFER WELL

DRAWING SOURCE– CIVIL & ENVIRONMENTAL CONSULTANTS INC. PITTSBURGH, PA. 12/8/02

NOTE: ALL VALUES REPORTED IN μ/L RESULTS ARE SHOWN ONLY FOR COMPOUNDS OF CONCERN

0' 30' 60' 90'

FIGURE 14b

FACILITY GROUND WATER CHEMISTRY
NATIONAL ELECTRIC COIL SITE
HARLAN, KENTUCKY

JANUARY 2008

PROJECT NO.: 303-1360
DRAWN BY: DH
APPROVED BY: MM

SHIELD ENVIRONMENTAL ASSOCIATES, INC.
2456 Fortune Drive, Suite 100
Lexington, KY 40509
(859) 294-5155

Figure 15. CMW-12 Concentration Trends and Time-Concentration Ratios

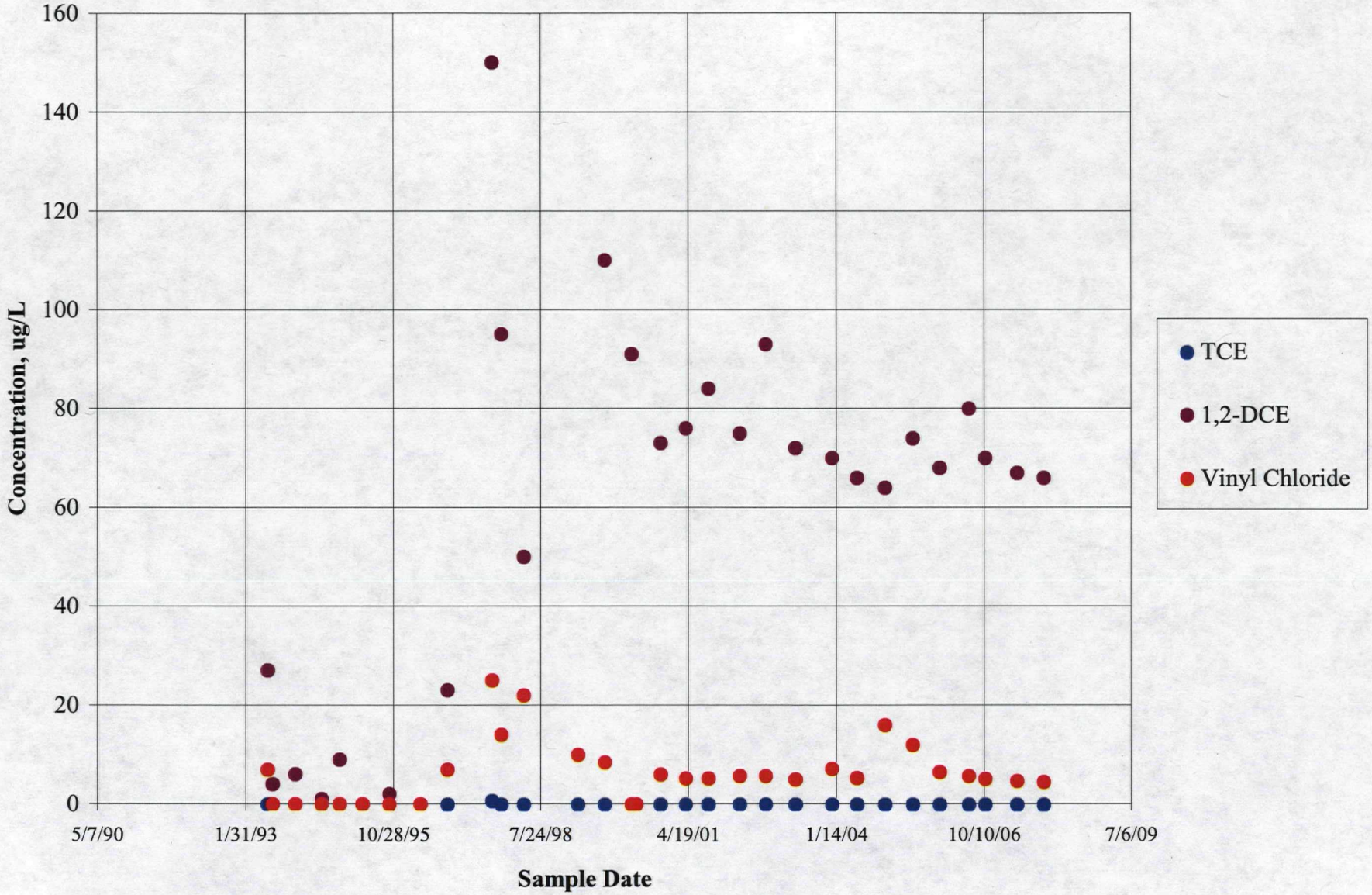


Figure 16. CMW-7 Concentration Trends and Time-Concentration Ratios

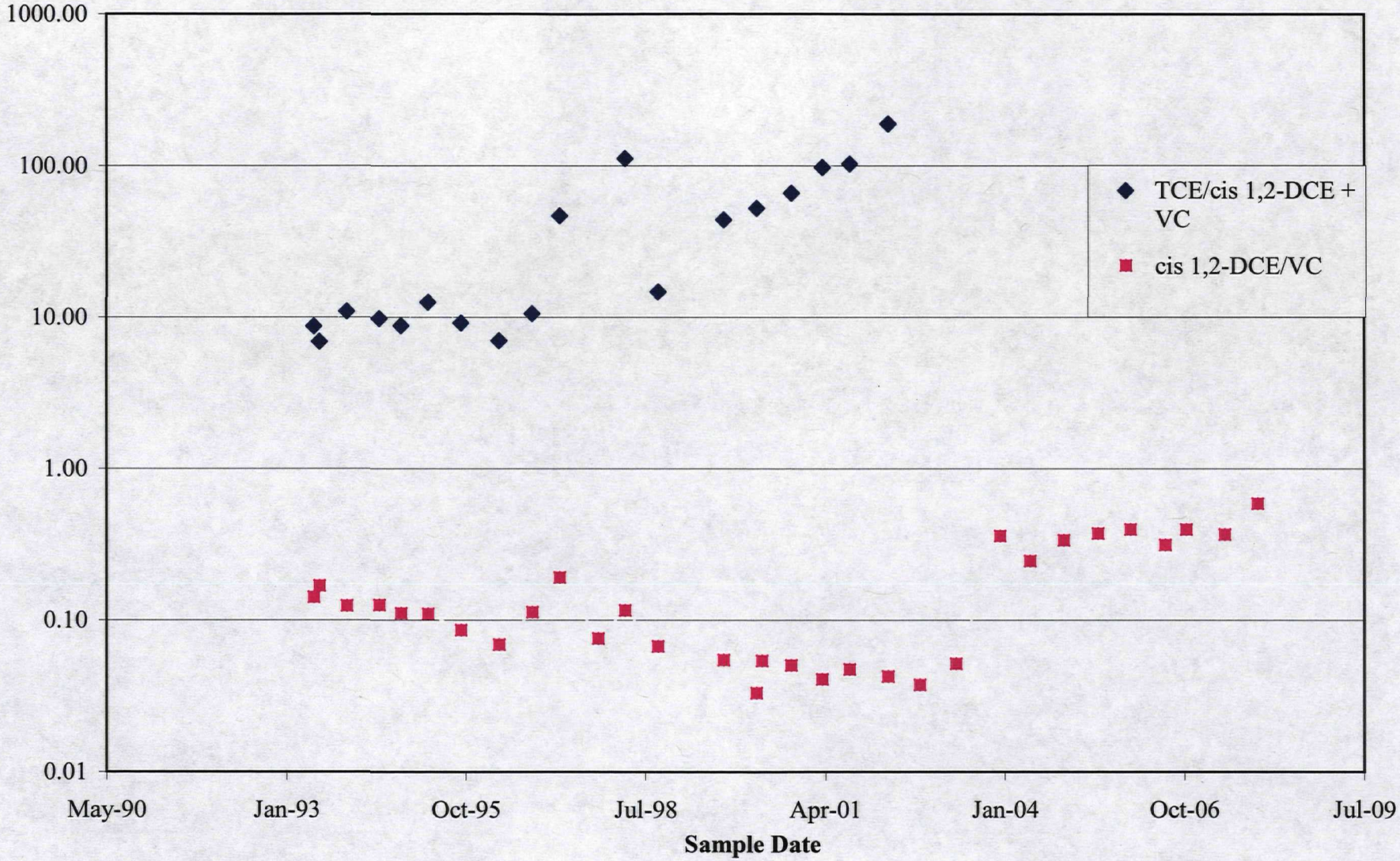


Figure 17. Pre and Post Recovery Well System Fully Operation Ratios Analysis, CMW-7

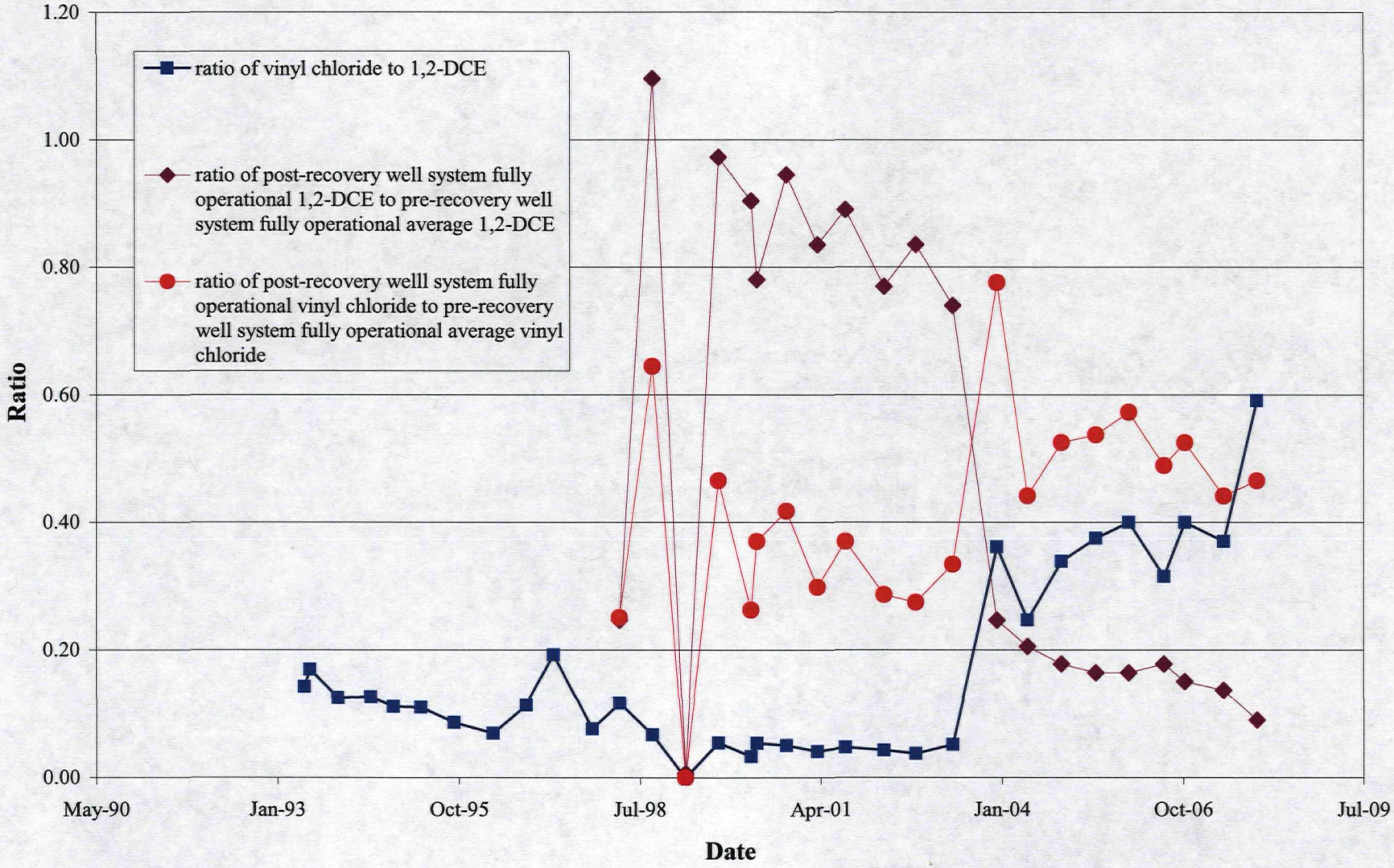


Figure 18. Total VOCs Concentrations versus time CMW-5-2, CMW-7, and CMW-12

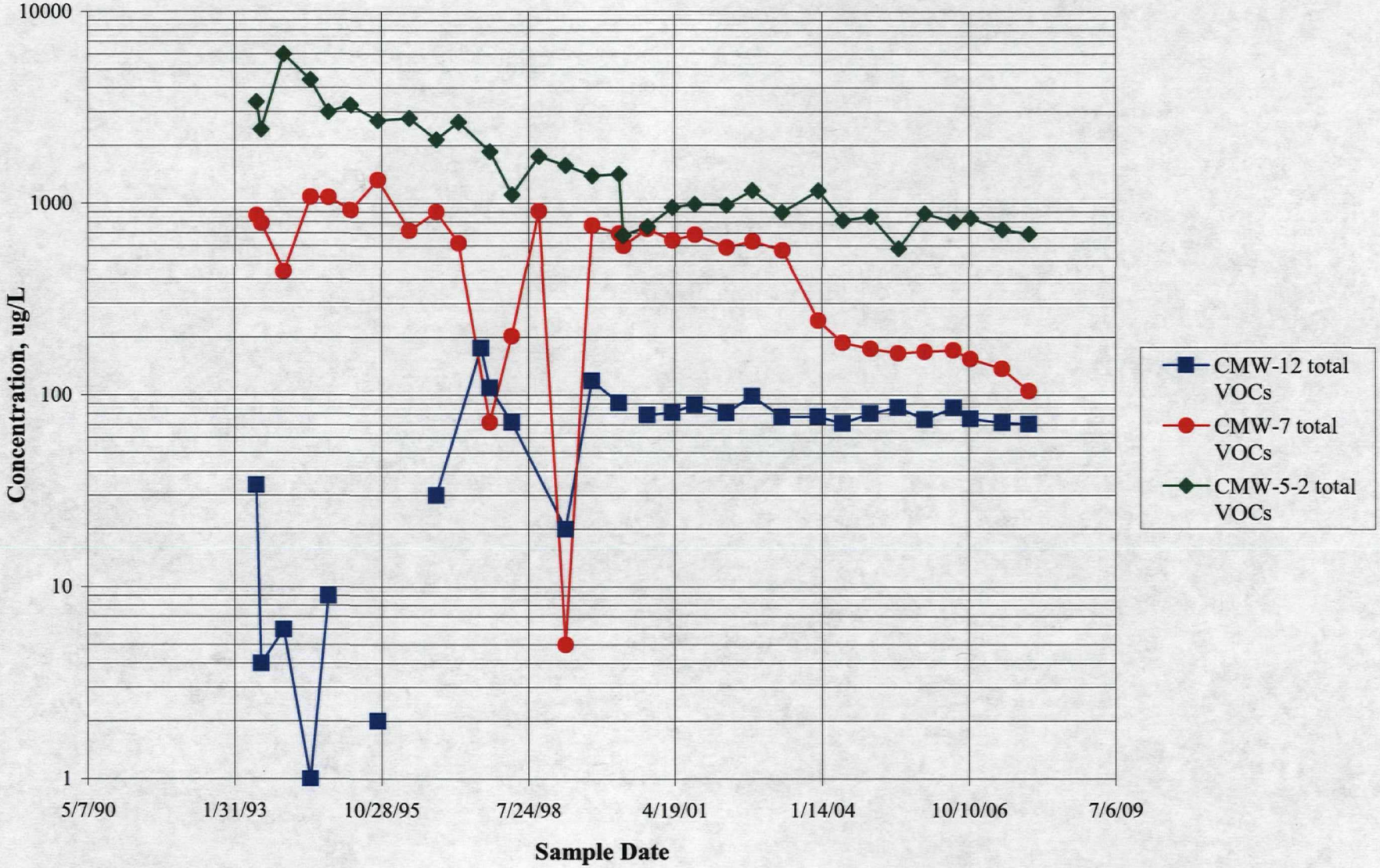


Figure 19. CMW-5-2 Concentration Trends and Time-Concentration Ratios

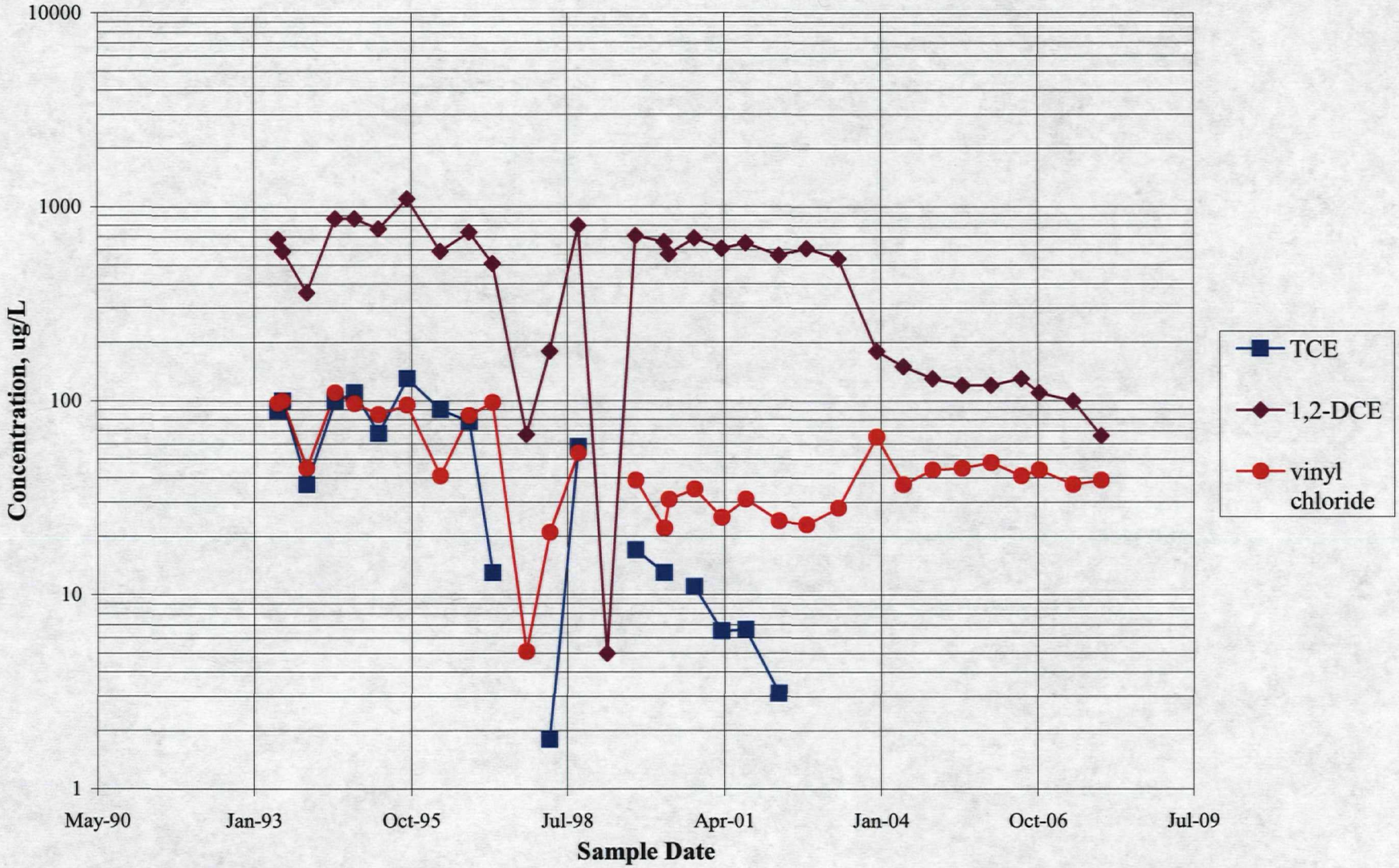
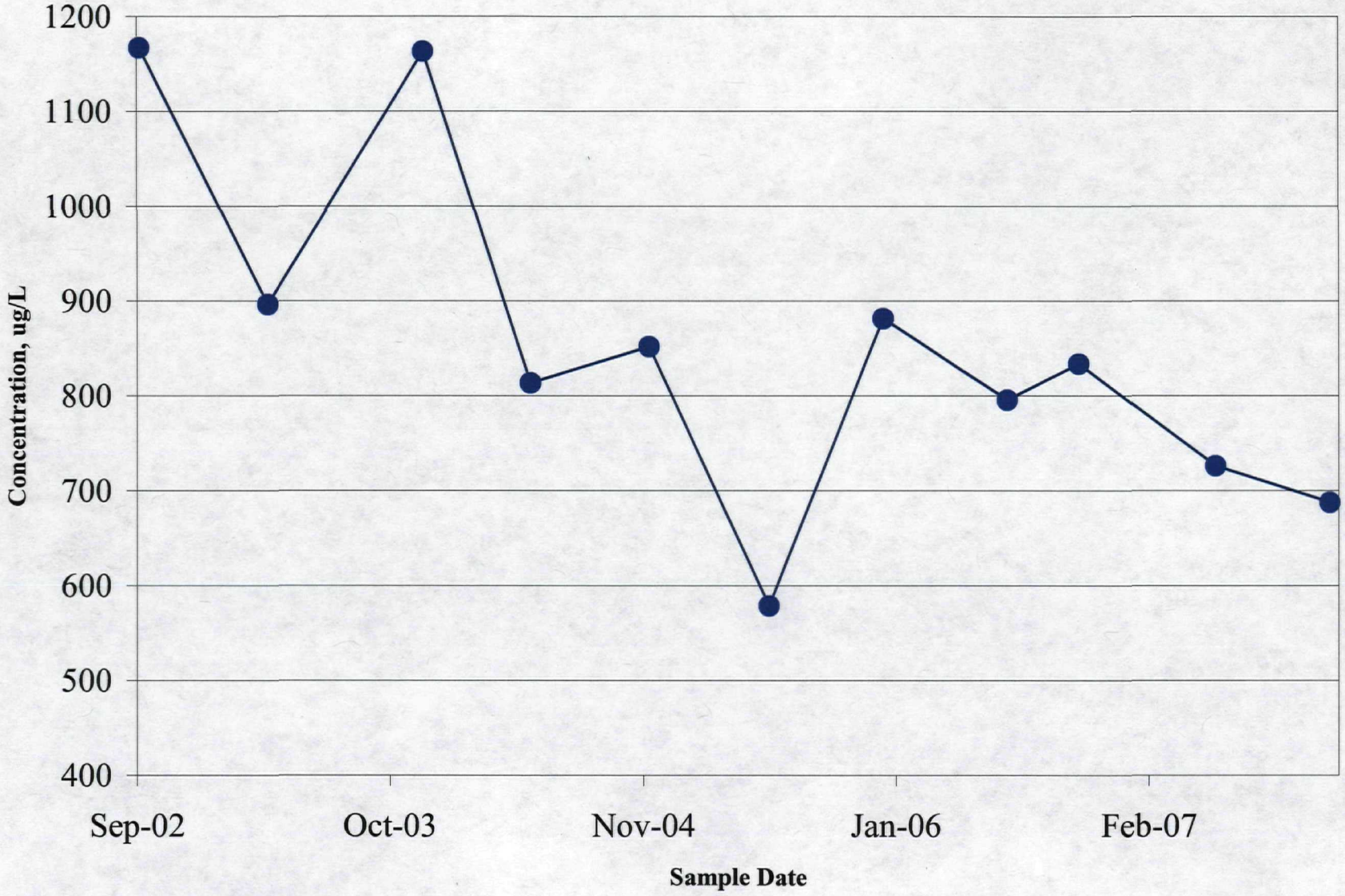


Figure 20. Total VOC Trends in CMW-5-2 (September 2002-November 2007)



Appendices for this Five-Year Review are available by placing a request using the Customized CERCLIS/RODS Report Order Form.

http://www.epa.gov/superfund/sites/phonefax/rods.htm