First Five-Year Review Report

NORTH RAILROAD AVENUE PLUME SUPERFUND SITE ESPANOLA, NEW MEXICO

EPA CERCLIS ID Number - NMD986670156

June 2010

United States Environmental Protection Agency
Region 6

Superfund Division

First Five-Year Review Report

North Railroad Avenue Plume Superfund Site
Española, Rio Arriba County, New Mexico

June 2010

Prepared by:

U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue
Dallas, Texas 75202

Concurred by: ______________________ 6/15/10
Petra Sanchez, U.S. EPA
Remedial Project Manager, 6 SF-RL
Date

Concurred by: ______________________ 6/11/10
Don Williams, U.S. EPA
Deputy Assistant Director, 6 SF-R
Date

Concurred by: ______________________ 6/22/10
Barbara Nann, U.S. EPA
Office of Regional Counsel 6 RC-S
Date

Concurred by: ______________________ 6/29/10
Charles Faultry U..S. EPA
Chief, Louisiana/New Mexico Branch, 6SF-R
Date

Concurred by: ______________________ 07/02/10
Mark A. Peycke, U.S. EPA
Office of Regional Counsel, 6 RC-S
Date

Concurred by: ______________________ 7/14/10
Pamela Phillips, U.S. EPA
Deputy Director, Superfund Division, 6 SF
Date

Approved by: Pamela Phillips, Acting 7/14/10
Samuel Coleman, P.E.
Director, Superfund Division
U.S. EPA Region 6
Date

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

This document utilizes the following organization abbreviations. Abbreviations used in the Contract Documents shall be interpreted according to their recognized and well-known technical or trade meanings; such abbreviations include but are not limited to the following:

EPA (or U.S. EPA)	U.S. Environmental Protection Agency
NMED	New Mexico Environment Department

Common technical abbreviations, which may be found in this report, are listed below:

ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of Concern
COPC	Chemical of Potential Concern
cDCE	cis- 1,2 Dichloroethene
tDCE	trans- 1,2, DCE
DNAPL	Dense Non-Aqueous Phase Liquid
ERD	Enhanced Reductive Dechlorination
FS	Feasibility Study
gpm	Gallons per Minute
GW	Ground Water
GWQB	Ground Water Quality Bureau
HASP	Health and Safety Plan
HRS	Hazard Ranking System
lbs	Pounds
LTRA	Long Term Remedial Action
MCLs	Maximum Contaminant Levels
MCLGs	Maximum Contaminant Level Goals
mg	Milligrams
mg/L	Milligrams per Liter
µg/L	Micrograms per Liter
NCP	National Contingency Plan

ACRONYMS AND ABBREVIATIONS

(Continued)

NMWQCC	New Mexico Water Quality Control Commission Regulations
NPL	National Priorities List
NRAP	North Railroad Avenue Plume
O&M	Operation and Maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PCE	Tetrachloroethylene, perchloroethylene or perc
PRPs	Potentially Responsible Parties
RA	Remedial Action
RAO	Remedial Action Objective
RD	Remedial Design
RG	Remedial Goals
RI	Remedial Investigation
ROD	Record of Decision
RI/FS	Remedial Investigation/Feasibility Study
RPM	EPA Remedial Project Manager
SAP	Sampling and Analysis Plan
SCADA	Supervisory Control And Data Acquisition
SDWA	Safe Drinking Water Act
SEAR	Surfactant Enhanced Aquifer Remediation
SOP	Standard Operating Procedure
SOS	New Mexico Ground Water Quality Bureau’s Superfund Oversight Section
SVE	Soil Vapor Extraction
TCE	Trichloroethylene
TOC	Total Organic Carbon
VC	Vinyl chloride
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

This five-year review report covers the period from June 2005 to June 2010 at the North Railroad Avenue Plume (NRAP) Superfund Site (Site) NPL #NMD986670156 in Española, Rio Arriba County, New Mexico. The results of the review indicate that the remedy has been, and is expected to continue to be protective of human health and the environment. The remedy is functioning as designed, and has been operated and maintained in an appropriate manner. Improvements to the remedial systems are made on a continuous process.

The remedy for the Site as a whole is protective of both human health and the environment. The response action for ground water is protective of human health and the environment in the short term. There are no response actions needed for surface soils and surface water.

Site Background

The Site consists of an approximately 58-acre, 260-foot deep ground water plume that extends approximately 0.75 miles from the source. The source of contamination has been identified as the former Norge Town Laundry and Dry Cleaners facility located at 113 North Railroad Avenue in the downtown area of Española, Rio Arriba County, New Mexico The Site is a former dry cleaner facility that operated from 1970 until June 2007. The dry cleaner facility released tetrachloroethylene (PCE) to ground water creating an extensive ground water plume. The release is characterized as chlorinated solvents including PCE and its degradation products; trichloroethylene (TCE), cis-1,2 dichloroethene (cDCE), and trans-1,2 DCE (tDCE). Of these contaminants, PCE and to a lesser extent TCE, are the primary contaminants of concern (COCs).

The ground water contamination was first discovered after PCE and TCE were detected in two municipal drinking water supply wells in 1989. The wells were taken off-line and have remained removed from the drinking water supply system. The NMED conducted several investigations between 1990 and 1998 to determine the source and extent of the contamination. The shallow ground water contaminant plume extends approximately 3/4 of a mile (3700 feet) south/southeast of the Norge Town Dry Cleaner facility. The intermediate zone contamination occurs from depths of approximately 55 to 130 feet below ground surface (bgs) and the deep zone contamination occurs from approximately 155 to 200 feet bgs (D1 zone) and 225 to 265 feet bgs (D2 zone). In addition, a small residual source of dense non-aqueous phase liquid, or

DNAPL, source was identified in the shallow ground water adjacent to the dry cleaner facility where the release is thought to have occurred.

EPA proposed the Site to the National Priority List (NPL) on July 30, 1998 and listing of the Site became final on January 19, 1999. The Record of Decision (ROD) was signed in September 2001 following additional investigations to complete the Remedial Investigation and Feasibility Study. The ROD defined the site as one Operable Unit to address the following areas; the source area soil and ground water, the shallow and deep zone "hotspots", and the downgradient and deep zone dissolved-phase ground water plumes. The residual PCE or DNAPL in the source area and the downgradient dissolved-phase ground water plume were identified as principal threat waste at the site. The remedy described in the ROD is intended to meet the statutory requirements and address the entire OU. The original remedy consisted of five components (or phases) of treatment. In 2008 however, the original ROD was modified to accommodate more recent findings made during the Remedial Design and Remedial Action phase. The original ROD included the following remedial response actions:

1. In-situ treatment of saturated soils in the source area using surfactant or co-solvent treatment to remove residual DNAPL;
2. Enhanced in-situ bioremediation of hot spots to destroy chlorinated solvent compounds;
3. Enhanced in-situ bioremediation of the dissolved-phase plume;
4. Soil vapor extraction to treat unsaturated soils in the source area;
5. Monitoring of ground water quality to assess performance of the remedial action.

An Explanation of Significant Differences was signed in March 2008 after additional characterization took place. The ESD changed the Source Area treatment from surfactant /co-solvent treatment to enhanced reductive dechlorination (ERD) treatment following the results of the pilot study. The ESD also eliminated the soil vapor treatment component for treating the contaminated soils.

The final remedy design was completed in December 2003. This Five-Year Review covers the remedy construction phase which began in July 2005 and was completed in April 2008 along with the first two years of Long Term Remedial Action (LTRA). From the time operation of the ERD treatment systems began in April 2008, there have been four rounds of amendment injections made to the Source Area and shallow Hotspot, five rounds of amendment injections at Biocurtain and three rounds of amendment injections at the Deep Zone.

Remedial Goals (RGs) and Remedial Action Objectives (RAOs)

The EPA determined that the remedial alternatives selected in the ROD are necessary to protect the public health or welfare or the environment from actual releases of hazardous substances into the environment, or from the substantial threat of such release. The Site affects a sole source drinking water aquifer that supplies drinking water for the City of Española, Santa Clara Pueblo, and several individual private wells must be protected or kept from further contamination. The remedy is also necessary to prevent further migration (or expansion) of the ground water plume from its current location.

The remedial goals and objectives were developed by specifying contaminants and media of concern. The potential exposure pathways were evaluated to establish acceptable exposure levels that are protective of human health and the environment. Based on the Human Health Risk Assessment, the primary medium of concern is the ground water. The RAOs identified in the ROD include:

- Prevent human ingestion, inhalation, or dermal contact of ground water containing Site related Contaminants of Concern (COCs) at concentrations that exceed their corresponding non-zero Maximum Contaminant Level Goals (MCLGs) or MCLs where their corresponding MCLGs are zero as established under the Safe Drinking Water Act (SDWA).

- Restore the ground water at the site such that concentrations of COCs and Contaminants of Potential Concern (COPCs) are less than the MCLs.

- Prevent residual-phase PCE, DNAPL, from causing concentrations of COCs in ground water to exceed their MCLs.

- Prevent the transport of COCs from ground water to surface water at concentrations that may exceed the ARARs in the receiving surface water body.

- Prevent ground water from being impacted above MCLs through transport from the unsaturated zone soils at levels greater than 0.019 milligrams per kilogram (mg/L) PCE.

The remedial goals for the COCs and COPCs in ground water are as follows:

- PCE, 5 µg/l;
- TCE, 5 µg/l;
- cis-1,2, DCE, 70 µg/l;

- trans- 1,2 DCE, 100 µg/l; and
- vinyl chloride, 1.0 µg/l.

The COPCs are defined as PCE and TCE degradation products that have not been observed to exceed their respective MCLs but may occur as part of the treatment process.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name *(from CERCLIS)*: North Railroad Avenue Plume		
EPA ID *(from WasteLAN)*: NMD986670156		
Region: 6	**State: NM**	**City/County: Española/Rio Arriba**
SITE STATUS		
NPL status: Final Other (specify)		
Remediation status (choose all that apply): Under Construction **x Operating x Complete**		
Multiple OUs?* YES **NO X**	**Construction completion date: _06__ / _30__ / __2008____**	
Has site been put into reuse? YES NO: The former dry cleaner building is operating as a retail store.		
REVIEW STATUS		
Lead agency: EPA **fl State** Tribe Other Federal Agency ______________________		
Author name: Petra Sanchez		
Author title: Remedial Project Manager	**Author affiliation: U.S. EPA Region 6**	
Review period:** __06_ / 08___ / _2005_____ to __06_ / _08__ / _2010_____		
Date(s) of site inspection: __4_ / _7-8__ / _2010_____		
Type of review: **X Post-SARA** Pre-SARA NPL-Removal only Non-NPL Remedial Action Site NPL State/Tribe-lead Regional Discretion		
Review number: fl 1 (first) 2 (second) 3 (third) Other (specify) __________		
Triggering action: **X Actual RA Onsite Construction at OU #_1__** Actual RA Start at OU#____ Construction Completion Previous Five-Year Review Report Other (specify)		
Triggering action date *(from CERCLIS)*: _06__ / _08__ / __2005____		
Due date *(five years after triggering action date)*: 06___ / _08__ / __2010____		

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in CERCLIS.]

Five-Year Review Summary Form cont'd.

Issues:

1. Elevated methane levels which could present an explosive hazard were discovered in well vaults and in the soil within the Source Area/Hotspot treatment area.

2. Indoor air impacts have been identified at three commercial buildings located near the Source Area. The levels are within the EPA's established acceptable risk range. It is anticipated that these impacts will be relatively short lived given the substantial contaminant reductions that have been observed during the initial two years of operations. The ROD does not provide specific remedial objectives or remedial goals for indoor air.

3. Mechanical and plumbing issues associated clogging/biofouling and corrosion of the extraction pumps and associated piping is an ongoing maintenance and cost issue.

4. The Deep Zone ERD system may not be directly treating the deep zone reaches of the aquifers.

5. Lack of effective definition of the lateral extent of the Deep Zone plume is a concern while evaluating the treatment effectiveness in the deep zone.

6. The existing Deep Zone intermediate injection wells may not be installed in an area where they serve the intended purpose. Ground water samples collected from the wells and nearby monitoring wells indicate that the contamination is much lower (< 3 times the MCL) than previously thought.

7. There are too few monitoring wells in the shallow aquifer plume between the Hotspot and Biocurtain systems to evaluate future progress in remediation in this down-gradient area of the plume.

8 Primary and secondary drinking water standards for arsenic, manganese and iron have increased above background levels and exceed water quality standards in response to ERD amendment injection. The manganese and iron have ground water standards regulated under the New Mexico Water Quality Act and are considered ARARs. It is unclear how efficient natural attenuation will be in treating these metals.

9. A number of highway and downtown redevelopment projects have been impacted through delays by perceived issues associated with the NRAP Superfund Site.

Recommendations and Follow-up Actions:

General – Protection of human health and worker safety will remain a priority to system operations. An improved contingency plan will be developed to address this methane issue and will be coordinated with local officials in case of an on-site emergency. Source Area, Biocurtain, and Deep Zone will continue scheduled system operations as planned and in response to air and ground water monitoring results. Monitoring COCs at the Hotspot area will help determine if additional amendment injections are warranted. Hotspot area will be monitored for methane gas and all other planned actions will respond as appropriate to protect human health and worker safety.

1. NMED has initiated a temporary soil vapor extraction unit to remove the accumulated methane from the subsurface soil and well vaults. A monitoring program has also been established to ensure protection

of the building occupants and monitor the subsurface soils.

2. An indoor air monitoring program that includes metrics for triggering an appropriate remedial response has been established for addressing the potential inhalation health risk. An amendment to the ROD might need to be considered to incorporate the indoor air in the decision document if indoor air levels do not continue to decrease as anticipated.

3. Evaluate operational changes to move from continual recirculation to intermittent circulation during amendment injection. Evaluate design changes to minimize flow restrictions in the manifolds.

4. NMED is currently evaluating whether the removal of the shallow aquifer source will have an impact on the deep zone aquifers. A cost benefit analysis may be required over time to determine if more injections points, higher injection volumes (to increase the radius of influence (ROI)), or a recirculation system should be considered for the Deep Zone treatment.

5. At least three additional D1 and D2 zone wells might be required to better define the required treatment area of the Deep Zone plume.

6. NMED is currently evaluating whether the removal of the shallow aquifer source will have an impact on the deep zone aquifers over time. In the interim, additional amendment injections at intermediate wells locations will be halted. The deeper intermediate zone from 70 to 120 feet bgs in this area will be better characterized to determine if the contamination exists at depth. Plans may also include installing new wells and injecting amendment near the R-09 well cluster

7. Up to 4 new monitoring wells may need to be installed between Paseo de Onate Street and at the Biocurtain to better track contaminant reductions in this area of the shallow plume.

8. Technical options to resolve exceedances of dissolved metals (ARARs) will be evaluated. Response actions will be considered after the chlorinated solvent contamination has been addressed. Further analysis will be performed on improving rates of natural attenuation.

9. The NMED and EPA will continue to commit to working with the City and NMDOT to resolve issues that may arise for proposed redevelopment projects.

Protectiveness Statement(s):

The site consists of one operable unit. The ground water remedy is operating and functioning in accordance with the design and associated modifications and has significantly reduced COC concentrations. The ground water remedy at the Site is expected to be protective of human health and the environment upon attainment of the ground water RGs. However, hazardous substances remain in ground water at the Site at concentration levels that are above health-based levels and that allow for unlimited use of the ground water and unlimited exposure to the ground water.

The temporary Institutional Controls (IC) are serving their intended purpose in restricting access to ground water from private well installation. Currently, the municipal water supply obtains ground water from other sources, so exposure is under control.

Other Comments:

None

{This Page Intentionally Left Blank}

North Railroad Avenue Plume Superfund Site
Española, Rio Arriba County, New Mexico
First Five-Year Review Report
NPL #NMD986670156

I. Introduction

The purpose of the Five-Year Review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

This Five-Year Review was conducted pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 121(c), 42 U.S.C. § 9621(c), the National Contingency Plan (NCP) (40 CFR § 300.430 (f)(4)(ii)), Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-02 (May 23, 1991), OSWER Directive 9355.7-02A (July 26, 1994), OSWER Directive 9355.7-03A (December 21, 1995), and The Comprehensive Five-Year Review Guidance, OSWER Directive 9355.7-03B-P, dated June 2001.

> CERCLA §121 (c) requires that "*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 5 years after initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being 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 review*".

Under the NCP and 40 CFR §300.430(f)(4)(ii) which implement CERCLA, EPA is required to conduct Five-Year Reviews of a remedial action,

> "*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*".

Although CERCLA Section 121(c) authorizes "the President" to undertake five year reviews, the President's authority was delegated to the Administrator of the EPA by Executive Order 12580 (52 Fed. Reg. 2926, January 29, 1987), and this authority was further delegated to the EPA's Regional Administrators on September 13, 1987, by EPA Delegation No. 14-8-A. Finally, the authority was delegated to the Director of the Superfund Division by EPA Region 6 Delegation No. R6-14-8-A on August 4, 1995.

This review is required because hazardous substances, pollutants, or contaminants remain in the subsurface at concentrations that are above levels that allow for the unrestricted use of ground water and for the unrestricted exposure to soil and ground water.

This report provides information gathered during the First Five-Year Review of the North Railroad Avenue Plume (NRAP) Superfund Site (Site) during the period from June 2005 to June 2010. Ground water data reviewed for this report is through the November 2009 semi-annual ground water sampling event. Remediation system operations cover the construction and operations through March 2010.

This Five-Year Review report summarizes:

- Background information;
- Remedial action activities;
- Performance and operational monitoring results;
- Semi-annual ground water monitoring results;
- Data review; and
- Progress and status remediation for the Site.

Most of the information summarized in this Five-Year Review was obtained from the Remedial Action Construction As-built Report, Annual Long Term Remedial Action (LTRA) Report, the Interim Remedial Action Report for the Site, Semi-Annual Ground Water Sampling Reports and the quarterly progress reports. Attachment 1 lists all of the documents that were reviewed for the compilation of this report.

II. Chronology of Events

Table 1 contains the Site chronology, listing milestones from initial discovery to the present.

Table 1: Site Chronology

Date	Event
1989	Chlorinated solvent contamination was discovered in ground water samples collected from two City of Española municipal supply wells, the Jemez and Bond wells.
March 1990	NMEID wrote a letter to the City of Española recommending that they not use the Jemez and Bond wells.
July 1990	A Preliminary Assessment (PA) was performed by the NMEID (NMEID, 1990). PCE and TCE were identified as the primary COPCs. Ground water was considered to be the primary pathway of concern.
March 1992	A Screening Site Inspection (SSI) Report was submitted to the EPA by NMED Ground Water Quality Bureau (GWQB) Superfund Oversight Section (SOS) for additional site work performed in September through November 1991 (NMED, 1992b).
April 1993	A Listing Site Inspection (LSI) Report was submitted to the EPA by NMED-SOS (NMED, 1992a).
January 1994	The NMED-SOS completed the *City of Española New Mexico Wellhead Protection Study* (NMED, 1994).
December 1996	The NMED-SOS prepared the Española Wells Site 1996 Investigation Report (NMED, 1996). During this investigation, PCE concentrations of 100 to 100,000 µg/L were found in ground water downgradient from the Norge Town facility.
June 1997	NMED performed State-lead removal action to remove material from the lint trap and additional source area investigation adjacent to the Norge Town facility.
October 1997	Funding through a Cooperative Agreement between EPA and NMED was used to begin the RI process. At this time, the Site was renamed the North Railroad Avenue Plume Site.
June/July 1998	The RI/FS plan (NMED, 1998a) approved by EPA.
July 20, 1998	Site proposed to National Priorities List (NPL)
January 1999	Site added to the final NPL on January 19, 1999, with a Hazard Ranking Score of 50. NMED served as technical lead on this Fund-

Date	Event
	lead Site with EPA serving as technical support and oversight during the RIFS.
October 1999	NMED-Superfund Oversight Section (SOS) completed the installation of three new deep wells and one shallow well to completed the characterization of the ground water plume.
November 1999	NMED-SOS completed a detailed investigation of DNAPL at the source area
January 2001	RI completed
June 2001	FS completed
September 27, 2001	ROD signed
December 2003	Final Remedial Design (RD) submitted
September 2004	Funding for RA awarded
May 12, 2005	RA contract awarded
July 26, 2005	RA construction began
January - December 2006	Changes to construction schedule – postponement of SEAR revision of ERD Field Test Plan completed
January 2, 2007	Approval of Revised Enhanced Reductive Dechlorination (ERD) Field Test Plan
March 2007 – January 2008	ERD field test performed
March 14, 2008	Explanation of Significant Difference signed – replace SEAR with ERD; soil vapor extraction replaced with soil removal, if needed
April 8, 2008	EPA and State perform pre-final inspection of the hotspot and biocurtain treatment systems
April 28, 2008	Operation begins - initial amendment injections to all four treatment systems
June 06, 2008	Preliminary Close Out Report signed for site construction completion
October 2008	2nd amendment dose added at all 4 treatment systems
April 2009	3rd amendment dose added at hotspot and biocurtain systems
August 2009	4th amendment dose added at hotspot and biocurtain systems, 3rd dose at Deep Zone
February 2006 – March 2009	NMED performs ground water monitoring events: February 2006, December 2006, October 2007, July 2008, March 2009
June 30, 2009	Operational and Functional determination approved

III. Background

A. Physical Characteristics

The Site consists of an approximately 58-acre, 260-foot deep ground water plume that extends approximately 0.75 miles from the source. The source of contamination has been identified as the former Norge Town Laundry and Dry Cleaners facility located at 113 North Railroad Avenue in the downtown area of Española, Rio Arriba County, New Mexico (see Figure A2-1 of

Attachment 2). The Site coordinates are Latitude 35°59’31” North, and Longitude 106°04’53” West which is located in Township 20N, Range 8E, Section 3. The facility was occupied and operated by various individuals as a dry cleaning business from 1970 until June 2007 when it ceased operations. The Site is located on fee lands within the City of Espanola and within the boundary of Santa Clara Pueblo. The ground water plume is located in the Northern Rio Grande Basin in the sole-source drinking water aquifer for the City of Española, Santa Clara Pueblo and individual water supply wells in the immediate area of the Site.

EPA proposed the Site for placement on the National Priority List (NPL) on July 30, 1998 and listing of the Site became final on January 19, 1999.

B. Land and Resource Use

The Site is located in an area that is a mix of residential, light industrial and commercial properties within the City of Española, Rio Arriba County, New Mexico. The Santa Clara Pueblo is located one mile to the south of Española. Both businesses and residences are located within the ground water plume boundaries.

Several buildings are situated above the ground water plume (see Attachment 2, Figure A2-1). The northernmost building on the Site is the Norge Town facility with an unpaved parking area surrounding it. South of the Norge Town facility are two office buildings, which are both surrounded by paved parking lots. A residence is located just east of the Norge Town facility. A community learning center with outdoor play area and a middle school area located one block to the east and south of the dry cleaner facility. The City plaza and residential area are west of the Site. To the north of the Site is a mostly residential area, with a community center with a swimming pool and library located a few blocks to the northwest of the Norge Town facility.

Further south over the existing ground water plume are several businesses and a residential neighborhood. Riparian woodlands, or bosque, and pasture areas are found to the east and south along the Rio Grande. The bosque is located within tribal boundaries of the Santa Clara Pueblo where the river is utilized for swimming and fishing. The adjacent bosque provides hunting of small game and gathering edible and medicinal plants.

The aquifer in this area is a sole source for drinking water for the City of Espanola and for the Santa Clara Pueblo. Each community has their own public water supply systems. As of January

2000, the population served by the City was estimated to be 8,700 persons (Molzen and Corbin & Associates, 2000). The Pueblo has a population of approximately 2,400 (Warren, 1998). As of a 1990 Census, approximately 78.4 percent of the population was connected to the municipal water system. Current trends in population growth reveal an estimated population within the City limits to grow from 11,908 people in the year 2000, to 13,657 people in the year 2050. Total ground water extracted by the City in 1998 was 428,129,000 gallons. The City of Española is currently preparing a Phase II Water System Master Plan, which will consider future growth and expansion of the water system service area. In addition to the two former City supply wells, eighteen private wells were identified within the 1,000-foot radius of the Site boundaries. Ten of these wells were sampled during the SSI between September and November 1991. One of the private irrigation wells was impacted with site contaminants. In addition, residences to the south of the Site, in the Guachupangue area, use private wells for their drinking water supply. In 1998 and 1999, twelve wells (ranging in depth from 50 to 240 feet bgs) in the northern portion of the area were sampled to determine if the community was affected by the plume. No site COC were found in any of the wells.

C. Initial Response

The ground water contamination was first discovered after tetrachloroethylene (PCE) and trichloroethylene (TCE) were detected in two municipal drinking water supply wells in 1989 by the New Mexico Environmental Improvement Division (now NMED). The wells were immediately taken off-line and have been permanently removed from the City's drinking water supply system. The NMEID/NMED performed a Preliminary Assessment and Screening Site Inspection between 1990 and 1992 in an effort to characterize the migration and exposure pathways and identify potential sources for the ground water contamination. During the Screening Site Inspection twelve private wells were sampled. Additional site investigations were performed between 1993 and 1996 to further determine the nature and extent of the ground water contamination. This included the installation of forty three direct push sampling locations and an investigation of the lint trap and soils located adjacent to the Norge Town Dry Cleaner facility. As a result of these investigations, the EPA added the North Railroad Avenue Plume site to the National Priorities List (NPL), qualifying the Site for remediation under CERCLA. Following the Site listing, the Remedial Investigation was completed in January 2001 and the Feasibility Study in June 2001.

D. Basis for Taking Action

The Site affects a sole source drinking water aquifer and public water supply for the City of Española and Santa Clara Pueblo which must be protected and kept from further contamination. The principle threat wastes at the Site are the residual DNAPL located in the source area and the shallow and deep zone dissolved phase ground water plumes.

Subsurface Contamination

The Site consists of a small area of soil contamination next to the dry cleaner facility and an extensive ground water plume containing chlorinated solvents including tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2 dichloroethene (cDCE), and trans-1,2 DCE (tDCE). Of these contaminants, PCE and to a lesser extent, its degradation product TCE, are the primary contaminants of concern COCs. The ground water contamination was first discovered after PCE and TCE were detected in two municipal drinking water supply wells in 1989 by the New Mexico Environmental Improvement Division (now NMED). The wells were taken off-line and have been removed from the City's drinking water supply system.

The NMED conducted several investigations between 1990 and 1998 to determine the source of the contamination. Based on soil and ground water samples collected across the Site, there are three known ground water zones underlying the Site which are defined by differences in the water levels in the zones, and are referred to in the RI as hydrostratigraphic units. These units are typically separated by clay layers; however, the clays are not present everywhere beneath the Site, and ground water flows between these units. All three units contain chlorinated solvents. The intermediate and deep zones have been further divided into two subunits (intermediate - I1 and I2, and deep – D1 and D2). Depth to ground water throughout most of the Site is approximately 6 feet below ground surface (bgs). Depth to water increases in the western area of the plume due to an increase in the surface topography and the vertical extent of contamination extends to a depth of 265 feet in certain areas. The shallow ground water contaminant plume extends approximately 3/4 of a mile (3700 feet) south/southeast of the Norge Town facility. The source area is located approximately 0.5 miles west of the Rio Grande and the shallow extent (approximately 6 to 32 feet bgs) of the dissolved-phase ground water plume abuts the Rio Grande at its downgradient extent to the southeast. The shallow aquifer is hydraulically connected to the Rio Grande and the plume historically extended to within 10 feet (TCE 1.6 µg/l, cDCE 7.4 µg/l) of the Rio Grande; however, no contamination has been detected in the river. The shallow aquifer consists of a coarse grained sand/gravel/cobble from approximately 6 to 20 feet bgs underlain by a 5 to 7 foot thick interbedded fine grained sand to clayey sand. The lithology below the shallow aquifer consists of thick sequences of silts and clays with the deep zone aquifers primarily consisting of 10 to 20 foot thick fine-grained sand and silty sand units. The intermediate zone contamination occurs from depths of approximately 55 to 130 feet bgs and the deep zone contamination occurs from approximately 155 to 200 feet bgs (D1 zone) and 225 to 265 feet bgs (D2 zone). Historical contaminant concentrations within the intermediate zone as high as 66 µg/L PCE and 26 µg/L TCE have been observed approximately 750 feet downgradient of the source area. Within the D1 and D2 zones, PCE contaminant concentrations as high as 1200 µg/L and 300 µg/L have been observed.

A source area investigation at the Norge Town facility indicated some minor soil contamination (soils above the water table) is found near the facility; however, most of the contaminant mass occurs as residual dense non-aqueous phase liquid (DNAPL) trapped between soil particles in the saturated zone between 10 to 20 ft bgs (further defined to approximately 27 ft bgs during the RA construction) and within an approximate 2000 square-foot area immediately east of the dry cleaner building. The DNAPL estimates are based on high dissolved phase concentrations recorded in the source area. DNAPL in physical form has not been observed despite extensive drilling and ground water extraction performed as part of the RA activities. Soil and ground water data collected does not indicate that PCE DNAPL penetrated the clayey silt layer underlying the Norge Town facility or migrated deeper within the aquifer as indicated by the nondetect sampling results from EWMW-4A which is screened below this clayey silt layer at a depth from 47.5 to 58.5 feet bgs. A maximum PCE soil concentration of 800,000 micrograms per kilogram (µg/kg) was reported at a depth of 12 ft bgs (DE&S, RI Report, 2001) and ground water samples as high as 81,000 ug/L (AMEC, FTP Results 2008) have been recorded in the source area. The mass of DNAPL in the source zone was calculated to be between 6 to 45 gallons or approximately 81 to 600 pounds based on results from soil sampling.

An estimated 280 million gallons of ground water has been contaminated. Based on plume dimensions and average concentrations, the dissolved-phase plume is estimated to contain approximately 275 pounds of PCE and its breakdown products (INTERA, 2003).

IV. Remedial Actions

A. Remedy Selection

The Record of Decision (ROD) for the Site was signed on September 27, 2001. The EPA determined that the remedial alternatives selected in the ROD are necessary to protect the public health or welfare or the environment from actual releases of hazardous substances into the environment, or from the substantial threat of such release. The remedy is also necessary to prevent further migration of the ground water plume from its current location.

The remedial action objectives (RAOs) and remedial goals (RGs) were developed specifying contaminants and media of concern, the potential exposure pathways and to establish acceptable exposure levels that are protective of human health and the environment. Based on the Human Health Risk Assessment, the primary medium of concern is the ground water. The RAOs identified in the ROD include:

- Prevent human ingestion, inhalation, or dermal contact of ground water containing Site related Contaminants of Concern (COCs) at concentrations that exceed their corresponding non-zero Maximum Contaminant Level Goals (MCLGs) or MCLs where their corresponding MCLGs are zero as established under the Safe Drinking Water Act (SDWA).

- Restore the ground water at the site such that concentrations of COCs and Contaminants of Potential Concern (COPCs) are less than the MCLs.

- Prevent residual-phase PCE, DNAPL, from causing concentrations of COCs in ground water to exceed their MCLs.

- Prevent the transport of COCs from ground water to surface water at concentrations that may exceed the Applicable or Relevant and Appropriate Requirements (ARARs) in the receiving surface water body.

The RGs for the COCs and COPCs in ground water and surface water are as follows:

- PCE, 5 ug/l;
- TCE, 5 ug/l;
- cis-1,2, DCE, 70 ug/l;

- trans- 1,2 DCE, 100 ug/l; and
- Vinyl chloride, 1.0 ug/l.

The COPCs are defined as PCE and TCE degradation products that have not been observed to exceed their respective MCLs but may occur as part of the treatment process.

The RAO and RG for PCE in soil are to prevent ground water from being impacted above MCLs through transport from the unsaturated zone soils at levels greater than 0.019 milligrams per kilogram PCE.

There were no RAOs or RG for air established in the ROD because the Baseline Human Health Risk Assessment determined the potential risk from indoor vapor intrusion was within an acceptable risk range to protect human health. To further support this determination the ROD recommended that additional evaluation and monitoring be performed as part of the site monitoring program.

The Site consists of one Operable Unit (OU) defined as the following areas; the source area soil and ground water, the shallow and deep zone "hotspots", and the downgradient and deep zone dissolved-phase ground water plumes. The remedy described in the ROD was intended to address the entire OU and consisted of five components (or phases) of treatment listed as follows:

1. In-situ treatment of saturated soils in the source area using surfactant or co-solvent treatment to remove residual DNAPL;
2. Enhanced in-situ bioremediation of hot spots to destroy chlorinated solvent compounds;
3. Enhanced in-situ bioremediation of the dissolved-phase plume;
4. Soil vapor extraction to treat unsaturated soils in the source area;
5. Monitoring of ground water quality to assess performance of the remedial action.

An Explanation of Significant Differences (ESD) was issued on March 12, 2008 to refine the treatment alternatives for the source area. This modification was required as a result of the geologic conditions encountered during the installation of the source area well and the results from the field pilot tests. The changes that were implemented as part of the ESD included:

- Elimination of operation of the Surfactant Enhanced Aquifer Remediation (SEAR) system in the source area. Geologic conditions, including significant dip of the clay unit as well as a less permeable fine grained sand layer observed during installation of the SEAR wells, were incompatible for implementation of SEAR.

- Alternative Source Area treatment - Use of bioremediation through Enhanced Reductive Dechlorination (ERD) in the source area. Pilot testing demonstrated that ERD was effective in treating the high concentration of PCE in the source area. The infrastructure including wells and conveyance piping was installed and could be converted for use in the ERD system.

- Elimination of SVE system for treating soil. During well installation, the delineated extent of soil contamination was greatly reduced. The PCE residual in the soil matrix was sampled and determined to be within acceptable soil screening levels. The limited area of affected soil will be addressed through excavation and disposal or in-situ ERD at a later date.

B. Remedy Implementation

As outlined below, the majority of this Five-Year Review period was spent in construction of the RA systems. The remedial design was completed in December 2003 by INTERA Inc., contractor to NMED. EPA funding for the Remedial Action (RA) was awarded in September 2004 and the RA construction was awarded to AMEC in June 2005. Construction of the four RA systems began in July 2005 and was completed in June 2008.

In January 2006, the construction schedule was revised due to the unforeseen geologic conditions encountered in the source area and work shifted to the ERD pilot test. The revised schedule caused an approximate two year delay in completion of the RA construction while the proposed pilot test was revised to incorporate a test cell within the DNAPL source area and additional engineering evaluation of the SEAR system was performed. The additional technical analysis included:

- Investigation of the hydrologic clay layer that was originally intended to capture the DNAPL released during the SEAR flood operation,
- Aquifer test on the lower fine grained sand unit,

- Re-evaluation of the original SEAR design to determine if other modifications could optimize the remedial plans.
- Modification of the original ERD pilot test criteria to include a test cell in the DNAPL source area to evaluate the effectiveness of treating the residual phase liquid or DNAPL through enhanced bioremediation.
- Nine-month long pilot test was initiated on May 1, 2007 and concluded on January 8, 2008.
- Results of the pilot test determined that emulsified vegetable oil could be used to remediate both the high concentration DNAPL source area and the dissolved phase portion of contaminant plume.

EPA issued an ESD (March 2008) to remove the surfactant/co-solvent treatment portion from the Site remedy. This decision was based on the technical limitations associated with the hydrogeologic conditions, the associated technical uncertainty, the increased cost associated with continuing with the original SEAR remedy and the positive results from the ERD pilot test.

The RA construction activities were performed according to specifications set forth in the remedial design along with some minor system modifications incorporated as a result of the pilot test. These modifications included incorporation of the SEAR system wells into the ERD system. NMED completed construction of the four ERD systems in April 2008. Major construction components and activities are summarized below.

B.1 Treatment system construction

The ERD systems are designed to include the injection of an electron donor solution (emulsified vegetable oil (EVO)) into the formation followed by recirculation through the extraction and injection wells to accelerate the distribution of the electron donor stock through the contaminated portion of the aquifer. The injection and extraction wells are installed over a grid pattern in the source area/hotspot system with one extraction well surrounded by four injection wells. The biocurtain is designed with alternating extraction and injection wells. Wells in both systems are installed on approximately 30 to 40 foot centers with tighter 10 foot spacing in the source area. Electron donor stock and other nutrients are metered into the injection lines with a chemical feed pump and mixed with extracted ground water. The amendment solution is then routed to a manifold used to split flow to injection wells. The system's instrumentation and controls have been designed for unmanned operation, and remote monitoring. Two 21 foot by 21 foot steel fabricated buildings were erected at the upgradient source area/hotspot and the downgradient biocurtain system. These buildings house the injection and extraction well manifold systems, amendment tanks and electrical and instrumentation systems.

Installation of the treatment system wells was completed between July 2005 and November 2005. Wells were installed using rotosonic drilling method incorporating two drill rigs and crews. A total of 73 shallow zone (generally <34 feet) wells totaling 2100 feet were installed in the source area (SEAR system), hotspot and biocurtain treatment systems. Seventeen (17) wells ranging from 70 to 270 feet deep totaling 3150 feet were installed in the deep zone treatment system. The injection and extraction wells were constructed using 4 inch ID schedule 40 PVC or stainless steel screens. Screens length varied according to depth of the clay aquitard and generally completed to just above the top of the water table.

Construction of the treatment system buildings and piping began in late August 2005 with most of the below grade piping and electrical lines installed to the treatment compounds by January 2006. Following postponement of the SEAR operations, final construction of the remaining manifold systems, piping, instrumentation and electrical terminations, other than modifications required for the ERD pilot test, were delayed until completion of the ERD field pilot test in January 2008.

Source Area and Hotspot System

The Source Area treatment system was designed to address an approximately 1,600-square foot area located southeast of the dry cleaner building. The majority of the below grade portion of the SEAR system was constructed prior to the determination to abandon implementation of the SEAR component. A total of nine extraction/injection wells, two hydraulic controls and six monitoring wells (nested completions) were installed as part of the proposed SEAR system. Injection wells were modified to include nested wells with screens in discrete upper and lower zones. The cancellation of SEAR application in the source area along with the demonstration of effective in-situ ERD in the source area during the field pilot test resulted in the decision to treat the source area using ERD. All 14 of the source area injection and extraction wells were integrated into the hot-spot ERD system. The 3 nested injection wells, 2 hydraulic control wells and 2 of the original extractions wells were plumbed as amendment injection wells, while the four corner extraction wells were incorporated as extraction wells in the hotspot system. Due to space limitations and in an effort to maximize the use of available funds the source area wells were plumbed to the existing injection and extraction manifolds and connected via headers shared with existing hotspot wells.

The Hotspot area includes the shallow (water table) aquifer from 5 to 30 feet bgs that extends from the source area to approximately Hunter Street and encompasses an area of 56,000-square feet. Construction of hotspot ERD treatment system included installation 19 injection wells, 14 extractions wells installed in a grid pattern, a treatment building, extraction/injection piping manifold for delivery of amendment to ground water and incorporation of SEAR wells. A total of 1150 feet of trenching and 6000 feet of 1 inch HDPE piping along with electrical and data lines were installed to connect the wells to the treatment building. See Attachment 2, Figure 2.

Biocurtain System

For purposes of treating the shallow dissolved-phase PCE, a "biocurtain" or, series of alternating injection and extraction wells, was installed at the approximate midpoint of the shallow aquifer plume approximately 1400 feet downgradient form the source area. The biocurtain is installed perpendicular to ground water flow and is designed to prevent further migration (or expansion) of the ground water plume. Construction of the 700 foot long biocurtain system includes 9 injection and 10 extractions wells, a treatment building, and extraction/injection piping and manifolds for delivery of amendment to ground water. A total of 700 feet of trench and 6700 feet of 1 inch HDPE piping and electrical wiring were installed to connect the wells to the treatment building. Monitoring wells were installed approximately 30 feet downgradient of the biocurtain in order to observe remediation progress. See Attachment 2, Figure 3.

Deep Zone System

The deep zone treatment system for the ground water plume included installation of 11 deep zone amendment injection wells, conversion of 4 existing wells for injection purposes and installation of several additional monitoring wells. Well construction for the deep zone wells was generally consistent with the design drawings. The deep zone injection system is designed as a mobile system consisting of a 3000 gallon tanker truck and a Dosatron® water-powered dosing pump that proportionally mixes the amendment (from an undiluted source) into water from a tanker truck. The truck is moved between individual wells for injection of the amendment.

C. Remediation System Operation and Maintenance

The Site is currently under Long Term Remedial Action (LTRA). Remediation system operations began on April 14, 2008 with initial shakedown testing and circulation of ground water within the treatment zones. The following subsections describe operations in the treatment zones.

C.1 Deep Zone Treatment

The deep zone treatment was initiated on April 28, 2008 when 168 gallons of emulsified vegetable oil (EVO) (Terrasystems SRS™ Substrate) combined with 6150 gallons of potable water was injected into seven of the deep zone wells. This injection was followed by 100 gallons of yeast-extract nutrient mixture (50 pounds JRW Yeast Fermentation Metabolite diluted in 100 gallons of water) and flushed with an additional 4900 gallons of potable water. The injections were made using a 2000 gallon tanker truck and Dosatron® liquid dispenser to meter in the EVO and nutrient mixtures which occurred over a 7 day period. Three of the wells received higher doses targeting a 5000 µg/l total organic carbon (TOC) concentration while the remaining four wells received lower doss targeting a 1000 µg/l TOC concentration. A second injection using half the original dose and fresh water flush was injected in October 2008. A third injection using ethyl lactate (EL) in place of EVO was performed August 2009. The EL was used due to its slight surfactant properties that were intended to help move the EVO and EL away from the injection wells. Approximately 81.25 gallons of EL and 7.14 gallons of nutrient concentrate diluted with 4350 gallons of water were injected during this event.

C.2 Source Area Treatment

The source area treatment was initiated on May 7, 2008 with the injection and recirculation of 275 gallons of EVO followed by 166 gallons of nutrient mix to the Source Area wells over a 5 day period. A total flow of between 12 and 16 gpm (3 to 4 gpm/well) was extracted and distributed among the 10 injection wells. EVO was added to the ground water at approximately 0.5 gpm flow rate with a targeted TOC concentration on 1000 µg/l across the treatment area. Recirculation continued until May 20, 2009, when the system was switched over to the Hotspot area. On October 16, 2008, a second dose (55 gallons of EVO) was injected followed by recirculation through October 27, 2008. On April 8, 2009, a third dose (100 gals. EVO and 4.5 gallons nutrient concentrate added to 200 gallons water) was injected to the 10 Source Area injection wells. Recirculation continued until April 29, 2009 when the system was switched over to the Hotspot treatment area. On August 14, 2009, a fourth dose of amendment, using 94 gallons of ethyl lactate and 2.85 gallons of nutrient concentrate, was injected to the 10 Source Area wells. Recirculation was performed until August 25, 2009.

C.3 Hot Spot Treatment

Treatment for the remainder of the Hotspot system was initiated on May 28, 2008. Approximately 1450 gallons of EVO followed by 400 gallons of nutrient mix was injected to the Hotspot system. Recirculation continued until June 25, 2008 when the system was shutdown due to biofouling and clogging of the lines (see discussion on modifications below). The system was restarted in late August 2008 and operated in a capture mode where ground water is extracted from the downgradient extent of the treatment wells along Hunter Street and reinjected at several locations throughout the plume. A second dose of EVO injection (410 gallons) was performed from October 27 through November 7, 2008 with recirculation continuing until November 26, 2008. The system was shutdown for cleaning and maintenance between December 2008 and April 2009. In May 2009, a third dose of EVO (733 gallons) and 250 gallons of nutrient mix (37 gallons nutrient concentrate) was injected throughout the hotspot area. In August 2009, a fourth dose of amendment, using 620 gallons of ethyl lactate and 10 gallons of nutrient concentrate mixed with 100 gallons of water, was injected throughout the Hotspot area. Following the injection, the system was operated in the capture flow recirculation pattern using the downgradient extraction wells located along Hunter Street and one Source Area well (SAE-3) at a total flow rate of 4 to 6 gpm. On the injection side, flows were directed to 5 to 7 wells distributed throughout the treatment area including wells in the Source Area.

C.4 Biocurtain System

Treatment at the downgradient Biocurtain system was initiated on May 13, 2008 with the injection and recirculation of 400 gallons of EVO amendment followed by 218 gallons of nutrient mix. Once the amendment injection was complete, the biocurtain is run in a continuous recirculation mode with an injection/extraction flow rate of 2 to 3 gpm per well. A second round of EVO injection (220 gallons) occurred on October 16, 2008 with recirculation through November 26, 2008. The system was shut down for cleaning and maintenance between November 26, 2008 and January 27, 2009. In April 2009, a third round of EVO injection (200 gallons) followed by 160 gallons of nutrient mixture(10 gallons of concentrate plus 150 gallons of water) injection was performed and followed by recirculation. In August 2009, a fourth round of amendment injection using 186.5 gallons of EL and 4.75 gallons of nutrient concentrate mixed with 100 gallons of water was performed. The system operated at less than full capacity through December 2009 due to several inoperable extraction pumps and continued biofouling issues which required shutdowns for cleaning and maintenance. The pumps were replaced in March 2010 and the system restarted. On March 23, 2010, a fifth round of amendment injection using 370 gallons of EVO and nutrient was performed.

C.5 System and Operational Modifications

Operation and maintenance activities are ongoing at the site as part of the LTRA phase. Based on current site conditions and observed TOC consumption rates, amendment injections will continue on a semi-annual bases at the Source Area and Biocurtain systems. Due to the decreased contaminant concentrations at the Hotspot, the amendment injections will be performed on an as needed basis in response to potential rebound of contamination observed as part of the site monitoring program. At the passive Deep Zone system, annual to biennial injections are scheduled.

The recirculation systems have required extensive maintenance to prevent biological fouling and clogging of the pumps, wells, and associated conveyance piping and manifolds. Soon after injection of the first dose in April 2008, the lines in the extraction and injection manifolds at the Hotspot area and Biocurtain started to become clogged due to biofouling and the flow rates through the manifold could not be maintained as designed. By the end of the first three months of operations most of the extraction wells and injection wells stopped flowing.

Modifications to the Source Area/Hotspot and downgradient Biocurtain systems involved replacing the Kates® flow controllers with gate valves and replacing the 50 micron strainer elements with 500 micron elements. The galvanized drop tube lines on the extraction pumps had shown signs of corrosion and were replaced with HDPE piping and quick connections. The new connections allow for easier access for pump maintenance and removal and assist in reducing maintenance costs by allowing for pumps to be removed by hand and cleaned when not in use.

Servicing of the lines and pumps included a high pressure jetting of the injection and extraction well screens, removal and cleaning of the pumps, and flushing the extraction/injection lines and manifold systems with an OxiClean® solution followed by fresh water purge to remove bacterial growth and clogging. The well rehabilitation and cleaning will be required prior to each round of amendment injections.

C.6 Operational and Performance Monitoring

Operational/system performance monitoring as well as overall plume monitoring has been performed at the Site. The RA contractor performed six ground water and system sampling events during the first eighteen months of LTRA to evaluate system performance in meeting the RAOs and RGs established in the ROD. The monitoring events occurred after approximately 60, 90 and 120 days of system operations as established in the contactors performance demonstration workplan and at the end of the first year LTRA operations and quarterly during the subsequent six months of LTRA. In addition, NMED has been conducting semi-annual to annual ground water monitoring throughout the plume since February 2006. As described in further detail in the Data Review section below, the ground water concentrations have decreased significantly within the areas of active treatment. Approximately ninety percent (90%) of the original mass from the Source Area/Hotspot has been destroyed. Complete reductive dechlorination has occurred in the majority of the shallow Source Area/Hotspot treatment area and up to 400 feet downgradient of the system based on the estimated volume released. Near complete PCE degradation has also been observed in the Deep Zone injection wells. However, to date, little affect from the injections has been observed in the monitoring wells located approximately 40 feet downgradient of the injections wells. As required in the ROD, semi-annual ground water monitoring will continue until the Site remedial goals are met.

C.7 Reporting

Details of the LTRA operations and maintenance activities listed above are reported in the quarterly technical memorandums and annual LTRA reports. The results of site-wide ground water monitoring are reported in NMED's semi-annual ground water monitoring reports.

C.8 Construction and LTRA O & M Costs

The costs discussed in this section reflect construction and LTRA contractor costs only in order to compare project costs with the ROD and remedial design estimates. It does not include NMED oversight costs which totaled approximately $550,000 over the five year period.

Table 2 provides a summary of the costs for each major component and a comparison of the actual costs with the ROD estimate of the project costs.

Table 2: Summary of Construction and O&M Costs

Cost Item	**ROD Estimate (2000 $$)**	**ROD Estimate (2005 $$)[1]**	**Actual Cost**
RA Capital Costs	$3,049,000	$4,276,380	$3,613,000
SEAR evaluation and ERD Pilot Test	Not Included	Not included	$ 730,000
RA LTRA Costs (per year)	$206,500	$290,000	1st Yr $510,000[(2)] 2nd Yr $506,400

Notes:
[1] ROD costs adjusted from 2000 dollar costs to 2005 dollar costs using 7% annual inflation rate
[2] First year LTRA based on system shakedown and modifications and 3 amendment injections.

The original cost estimate to implement the RA as presented in the ROD was $5.82 million dollars (net present worth for year 2000). This was broken out to include $3.0 million dollars for construction and $206,500 for annual Operations and Maintenance or LTRA. Updating the ROD estimate to 2005 net present worth using a 7% inflation rate increased the construction costs estimate to $4.28 million dollars and $290,000 for annual LTRA. The total capital construction cost including NMED's engineering oversight contactor was $3,613,000.

The estimated annual LTRA cost developed during the remedial design was $482,382 for operation of the three ERD systems for the first five years and $355,490 for operations of the Biocurtain and Deep Zone injections for years six through thirty. The current system configuration includes the addition of a fourth treatment area (Source Area). The first year LTRA included three amendment injections at a cost of $510,000. The second year LTRA costs were $506,400 for semi-annual amendment injections, semi-annual well rehabilitation and O&M. The second year cost also includes approximately $150,000 for the initial methane response and implementation of the SVE mitigation system. Subsequent years of LTRA costs are projected to be $340,000 based on the construction contractor's cost estimate for semi-annual amendment injections, semi-annual well rehabilitation and O&M. Operational costs are higher than the inflation updated ROD cost but are in line with the design estimates. The current costs are reflective of the significant increase in maintenance requirements associated with the biofouling issues and the methane response and mitigation. However, costs for operating the system should be reduced as portions of the treatment systems (Hotspot) are taken off-line. NMED has been performing the long term ground water monitoring program with Superfund Oversight Section staff and utilizing the EPA's contract laboratory program for sample analysis.

C.9 Progress since the Last Five-Year Review

This is the first five-year review. The remedial action activities began in June 2005 with the award of the RA contract. Physical construction of the RA remedy began on July 26, 2005.

V. Five-Year Review Process

A. Administrative Components

This five-year review has been conducted in accordance with the EPA's Comprehensive Five-Year Review Guidance, dated June 2001 (EPA, June 2001). The NRAP Five-Year Review team was led by Ms. Petra Sanchez, the EPA Region 6 RPM for the Site. Mr. Steve Jetter of the NMED assisted in the review as the representative for the support agency. In addition, Mr. Peter Guerra, the RA contractor provided technical support and analysis for the review. The Five Year Review included the following activities:

- Public notice was placed in local newspapers, the Rio Grande Sun and Santa Fe New Mexican
- Project documents listed in Attachment 1 were reviewed
- Interviews (Attachment 6) were conducted with representatives from the RA contractor (AMEC Earth and Environmental, Inc.), the City of Espanola, Santa Clara Pueblo Environmental Office, the site property owner and the local community
- Site Inspection performed on April 8 and 9, 2010

B. Community Involvement

The public notice announcing the commencement of the Five Year Review process was placed on December 17, 2009 in the Rio Grande Sun newspaper located in Espanola, New Mexico and in the Santa Fe New Mexican (reaching the greater Santa Fe area) on the same date.

Upon completion of the Five-Year Review and the availability of the Report at the information repositories, a community meeting will be held to present the results. A public notice will again be placed in the local newspapers and the report will be made available in the local repositories.

Other community involvement activities that have occurred throughout this five year review period.

- A Fact Sheet was distributed in June 2005 and two public meetings were held on June 29, 2005 at the Santa Clara Pueblo and in Española to announce the start of the RA construction.
- A public ground breaking ceremony was held on August 30, 2005 to announce the start of the RA constructions.
- An additional public ceremony was performed on October 8, 2008, to announce construction completion.
- The NMED project manager provided periodic updates to the Santa Clara Pueblo's Tribal Council and the Espanola City Council (May and June 2005 and again in April 2008.)
- EPA mailed Fact Sheets during the course of construction activities to update the public on progress at the site.
- NMED met with concerned citizens and provided project updates as requested throughout the remedial action process. NMED maintains communication and availability with property owners affected by the remedial action and apprised of site activities.
- Fact sheets, construction reports and semi-annual ground water monitoring reports were placed in the following information repositories maintained at this Site:

Espanola Public Library
314-A Onate Street
Espanola, NM 87532

Santa Clara Public Library
1 Kee Street
Santa Clara, NM 87532

Documents including this Five Year Review are available for review at the NMED office library and upon request and appointment with the Project Manager.

C. Document Review

This Five-Year Review consisted of a review of relevant documents including O&M records and monitoring data (see Attachment 1). The Remedial Action Objectives (RAOs) and Remedial Goals for ground water, surface water, and soil as listed in the September 2001 Record of Decision were reviewed. In addition, ARARs for the remedial action as contained in the ROD were reviewed.

D. Data Review

The data reviewed for this Five-Year Review included:

- A review of initial Site investigations, the RI/FS, ground water monitoring data and operational/performance monitoring of the treatment systems.
- For the majority of this Five-Year Review period the site was in the RA construction phase. Construction began in late July 2005 and was completed in April 2008 with the initial round of EVO amendment injection and recirculation.
- The Pilot tests performed in May 2007 helped to jumpstart the contamination reductions in the Source Area/Hotspot Area.
- The remedy performance was evaluated by reviewing the ground water monitoring and system performance monitoring. The system performance ground water monitoring includes sampling of select injection and extraction wells and monitoring wells located in the general vicinity of the treatment systems. The system performance monitoring covers the period through March 2010.
- In addition to the system performance monitoring, NMED performed six semi–annual to annual site wide ground water monitoring events. The last data evaluated for the Five Year Review was collected in October and November 2009.

Remediation progress is based on the conversion of PCE to its subsequent degradation products – TCE, cDCE, tDCE, VC and in reduction in concentrations for these COCs. The analysis focused on the status of current site conditions, data trends analysis, and progress toward meeting the ground water RAOs.

D.1 Historical Ground Water Conditions

An estimated 280 million gallons of ground water has been contaminated at the site. Based on plume dimensions and average concentrations, an estimated 275 pounds of PCE exists in the dissolved phase. In addition, residual PCE, in the form of a DNAPL in the Source Area constitute the principal threat waste at the Site. The pre-remedial action ground water plume conditions as highlighted in the NMED's *Semi-Annual Ground Water Sampling Report, September 2007* documenting the December 2006 sampling event included the following findings:

- Analytical results confirm the nature, extent, and magnitude of chlorinated solvent contamination in previously identified areas of the Site.

- Contamination existed in four water bearing zones; shallow, defined as less than 30 feet bgs; intermediate zone defined as 65 to 115 feet bgs; and two deep zones ranging from 170 to 200 feet bgs and 230 to 260 feet bgs.

- The downgradient extent of the plume, as defined by the 1 µg/L isopleth is fully delineated. (see plume delineation map Figure A2-1 in Attachment 2 and isoconcentration maps in Attachment 4).

- The contaminant plume in all four zones was stable in both lateral and vertical extent and concentrations.

- The shallow Source Area observed PCE concentrations of up to 81,000 µg/L in SMW-3D.

- PCE concentrations in the shallow Hotspot Area (between Source Area and Hunter Street to the south or 200 feet from the source) ground water monitoring wells ranged from 61 to 3100 µg/L and TCE ranged from 34 to 480 µg/L.

- The central portion of the shallow contaminant plume (between Hunter Street and Calle Chavez or up to 1000 feet from source) had PCE and TCE concentrations in ground water monitoring wells up to 230 µg/L (EX-13) and 110 µg/L (R-12(S1)) respectively.
- The downgradient area of the shallow contaminant plume (near the biocurtain system) had PCE concentrations of less than 11µg/L, TCE concentrations up to 27 µg/L, and cDCE concentrations up to 63 µg/L.

- The intermediate zone had PCE and TCE concentrations up to 49 µg/L and 22 µg/L, respectively and is concentrated along the Los Alamos Highway near the R-09 well cluster.

- The deep zone had concentrations of PCE between 100 and 750 µg/L in the D1 zone and between 46 and 170 µg/L in the D2 zone. TCE concentrations were less than 15 µg/L within these two zones.

D.2 Groundwater Cleanup Standards

For ground water remediation, the following standards were identified in the ROD as applicable or relevant and appropriate requirements (ARARs) for groundwater:

- MCLs per Federal Safe Drinking Water Act (SDWA)
- New Mexico Water Quality Control Commission Regulations, Part 3, Section 3-10 (NMWQCCR)

Table 3 lists the ground water contaminants of concern, maximum contaminant concentrations detected at the Site, and chemical-specific standards.

Table 3: Groundwater COCs, Maximum Concentrations, and Chemical-specific Standards

Contaminant	Maximum Contaminant Concentration (µg/L)	Chemical-specific Standards (µg/L)	Basis for Standard
PCE	81,000	5.0	MCL per SDWA
TCE	830	5.0	MCL per SDWA
cis-1,2 DCE	5600	70.0	MCL per SDWA
trans-1,2 DCE	82	100.0	MCL per SDWA
Vinyl Chloride	660	1.0	NMWQCC
Arsenic (1)	20.2	10	MCL per SWDA
Manganese (1)	8690	200	NMWQCC
Iron (1)	8070	1000	NMWQCC

Note (1): Dissolved metals are not listed in ROD as COC for the Site, but are listed as Federal or a State ARARs .

D.3 Source Area Remediation

The RAOs for ground water and principle threat waste in the ROD state;

> *"Prevent the residual-phase PCE, DNAPL, the principle threat waste at the Site, from causing concentrations of Contaminants of Concern in ground water to exceed the Maximum Contaminant Levels or Maximum Contaminant Level Goals;"*

Based on estimates developed during the RI/FS and the RD phases, an estimated 6 to 45 gallons (approximately 81 to 600 pounds) of DNAPL was determined to be present in ground water. This residual source was acting as a continual source of contamination by slowly dissolving into the ground water and creating the downgradient shallow and deep dissolved phase plumes. The DNAPL estimates were based on high concentrations of dissolved phase PCE observed in the Source Area. However, DNAPL in residual (or physical form) has not been observed despite extensive drilling and ground water extraction performed as part of the RA activities.

Historical samples from EWMW-4B along with baseline sampling that at the start of the ERD field pilot test performed in January 2007 indicated that the more than 98% of the chloroethene mass was in the form of PCE. The January 2007 baseline PCE concentrations ranged from 8250 µg/L in the shallow portion (zero to 20 feet below ground surface (bgs)) of the Source Area and 63,500 µg/L in the deeper zone (20 to 25 feet bgs). A more detailed description of the baseline and results is provided in the Field Test Plan Results Report (AMEC, 2008). Since the start of full-scale operations in April 2008, the following observations can be made:

- The total average VOC concentrations measured in micromolar (uM) equivalence has decreased from an average high of 168 uM in August 2008 to 106 µM in March 2009.
- The percent molar concentrations changed to approximately 40% PCE, 8% TCE and 50% DCE isomers in July 2008 after the pilot test and initiation of full scale operations.
- By the end of the first year operations in March 2009, PCE accounted for only 4% of the detectable VOCs with DCE isomers (~38%) and vinyl chloride (VC) (~57%) accounting for the majority of the detectable VOCs.
- The shallower monitoring wells completed in the coarse grained material tend to contain lower concentrations than the deeper wells which are completed in the tighter, fine grained material, with the two shallow wells sampled, SMW-3S and SMW-6S, in March 2009 having total VOC concentrations of 0.21 and 0.071 µM, respectively. These same

two wells (SMW-3S and SMW-6S) had total VOC concentrations in July 2008 of 76 and 7.2 µM, respectively.

- Of the deep wells, total VOC concentrations decreased from an average of 270 µM in August 2008 to 177 µM by March 2009. Total VOC concentrations in SMW-3D decreased from 254 µM to 68 µM, despite low levels of TOC present.
- The levels of PCE and daughter products in the shallow wells (less than 20 ft bgs) were below the MCL for each compound, while PCE concentrations in the deep wells (20 to 30 ft) have decreased from an average concentration of 14,500 µg/L in July 2008 to 1050 µg/L in March 2009.
- The highest PCE, TCE, cDCE, tDCE, and vinyl chloride (VC) concentrations detected at the Source Area in August 2008 were 24,000 µg/L, 3,700 µg/L, 7,000 µg/L, 84 µg/L, and 150 µg/L, respectively. In March 2009, the highest PCE, TCE, cDCE, tDCE, and VC concentrations detected at the Source Area were 1,900 µg/L, 360 µg/L, 4,100 µg/L, 67 µg/L, and 17,000 µg/L, respectively.
- An additional round of comprehensive sampling at 14 Source Area wells occurred in October 2009. The data trends continue to exhibit a decreasing trend. These results indicate the highest concentrations occur in the deeper portion of the shallow zone where the highest PCE, TCE, cDCE, tDCE and VC concentrations were 350 µg/L, 320 µg/L, 5,600 µg/L, 290 µg/L and 11,000 µg/L, respectively.

The significant decreasing trends in concentrations and contaminant mass indicate that the ERD treatment system is effective in removing the suspected DNAPL source. In addition, high concentrations of dissolved ethene, and its increasing trend, indicates that complete reductive dechlorination is occurring within the Source Area. Performance monitoring results at the Source Area are depicted in the time-series plots for wells SMW-3D (Figure 1) and EWMW-4B (Figure 2) below.

Figure 1: SMW-3D Time Series Plot

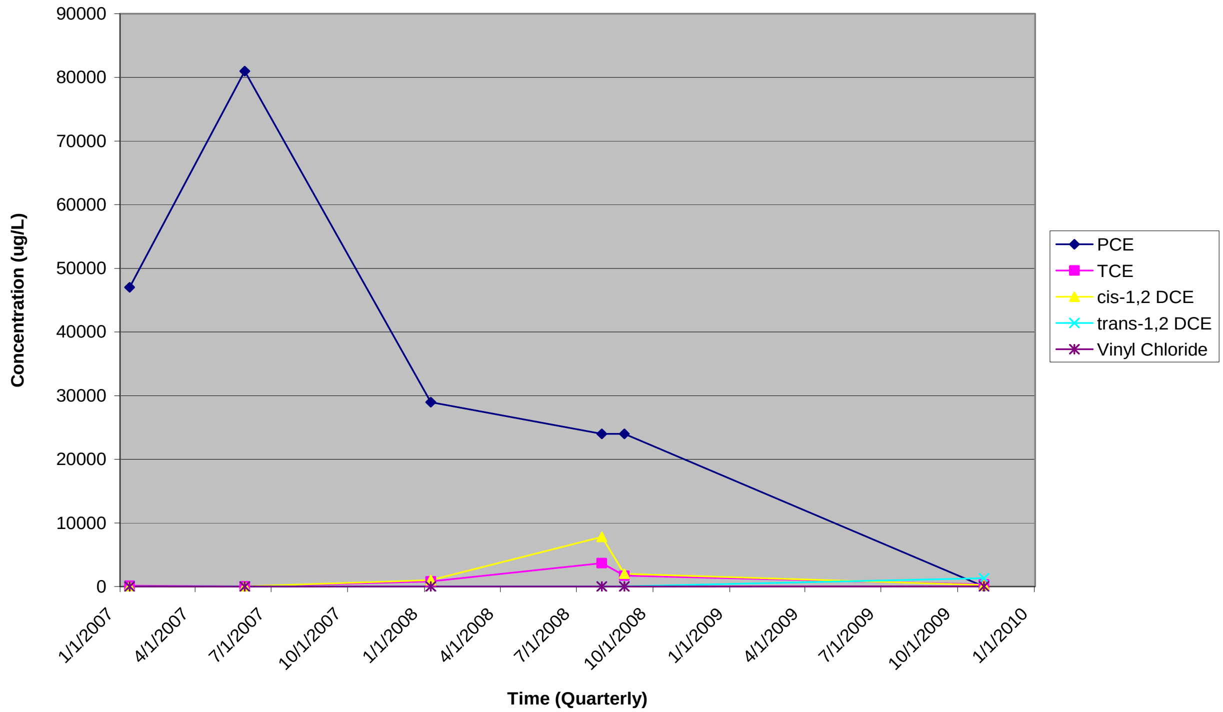
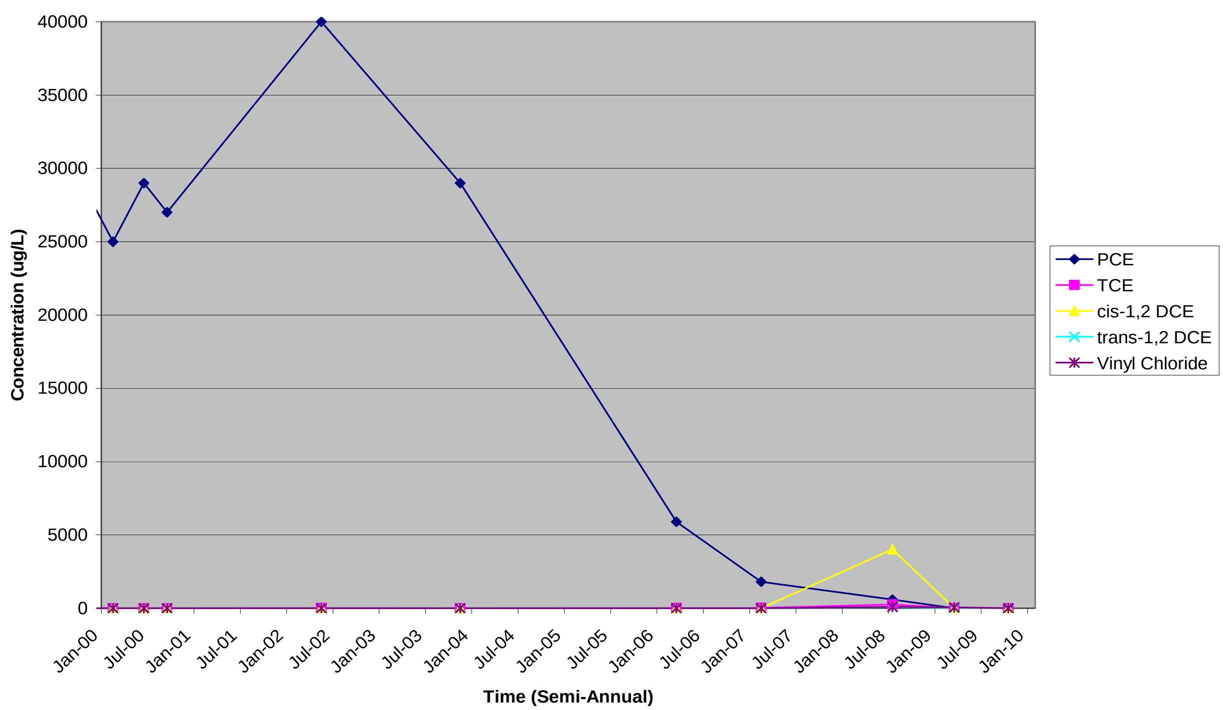


Figure 2: EWMW-4B Time Series Plot



D.4 Dissolved Phase Ground Water Plume

Additional RAOs for ground water in the ROD are;

> *“ Prevent human ingestion or inhalation of ground water containing Safe Drinking Water Act Maximum Contaminant Levels (MCLs) of these Contaminants of Concern when the Maximum Contaminant Level Goals are zero;*
>
> *Restore the ground water at the Site such that it contains concentrations of Contaminants of Concern less than the Maximum Contaminant Levels (MCLs) or non-zero Maximum Contaminant Level Goals, as applicable;*
>
> *Prevent the transport of Contaminants of Concern from ground water to surface water in concentrations that may results in exceedances of the Applicable or Relevant and Appropriate Requirements (ARARs) in the receiving surface water body.”*

Hot Spot Remediation

The sampling results and discussions presented below are discussed relative to the initiation of full-scale operations. However, prior to full-scale operations, the ERD pilot test was performed within the Source/Hotspot area. As a result of the pilot test, the baseline for full-scale operations were significantly lower than the original ground water concentrations observed at the beginning of this Five Year Review. The results from the Hotspot sampling performed during the 2 years of LTRA are summarized below:

- The average molar concentration of total VOCs has decreased from 20.1 µM in January 2008 following completion of the ERD pilot test to 7.4 µM in August 2008 and to 1.5 µM in March 2009. See Attachment 4 for isoconcentration time series plots.
- Based on molar concentrations, approximately 98% of the VOC was PCE prior to pilot testing and full-scale operations. By July 2008, the molar concentrations were approximately 2% PCE with DCE isomers (~73%) and VC (~24%) accounting for most of the VOC mass. By March 2009, DCE isomers (~17%) and VC (~82%) accounted for the majority of the detectable VOCs.
- In addition, PCE and TCE were below MCLs in all seven (7) of the hotspot well sampled. DCE isomers were detected in all wells at concentrations below their respective MCLs. VC was detected in 4 of the 7 Hotspot extraction wells, with one being below the MCL and the maximum concentration of VC detected in HSE-5 at 23 µg/L.

- Additional comprehensive sampling of twenty two (22) of the Hotspot extraction and injection wells in October 2009 continue to show a decreasing trend with PCE, TCE, cDCE and tDCE below their respective MCLs. VC was detected above the remediation goal of 1.0 µg/L in 5 of the 22 wells at a maximum concentration of 3.8µg/L. Although VC has been generated through the dechlorination process it does show a decreasing trend over time.

In addition to the positive ERD occurring within the active treatment zone, contaminant reductions have also been observed over 400 feet downgradient of the Hotspot treatment system as outlined below:

- Historical PCE concentrations in the four downgradient wells since 1999 has averaged 185 µg/L, TCE 60 µg/L, DCE isomers less than 10 µg/L and VC below detection limits.
- After one year of treatment, only one well, EX-17, had a detectable concentration of PCE at 4.0 µg/L, which is below the MCL. TCE was detected in 3 of the 4 downgradient monitoring wells with only one, R-25, having a concentration higher than the MCL at 12 µg/L. DCE isomers were detected below their respective MCLs with the exception of EX-17 which had a cDCE concentration of 120 µg/L. VC was detected in all 4 wells at an average concentration of 215 µg/L, with a minimum of 150 µg/L and a maximum of 290 µg/L.
- Additional sampling of these wells in October/November 2009 indicates that the VC has decreased to less than 25µg/L and that the remaining COCs are below their respective MCLs at all four wells.
- VC has been generated through the dechlorination process but shows a decreasing trend over time. Elevated ethene concentrations as well as decreasing levels of VC demonstrate that complete dechlorination is occurring downgradient of the Hotspot even with low levels of TOC.

Performance monitoring results at the Hotspot area are depicted by time-series plots for wells R-25 and EX-13 which are presented as Figures 3 and 4, respectively. Historical ground water analytical results for wells in the Hotspot area are presented in Table A5-1 of Attachment 5. In addition, Figure A4-6 of Attachment 4 presents a series of images showing the changes in the plume of dissolved VOCs and ethene across the Source Area and Hotspot treatment area.

Figure 3: R-25 (S2) Time Series Plot

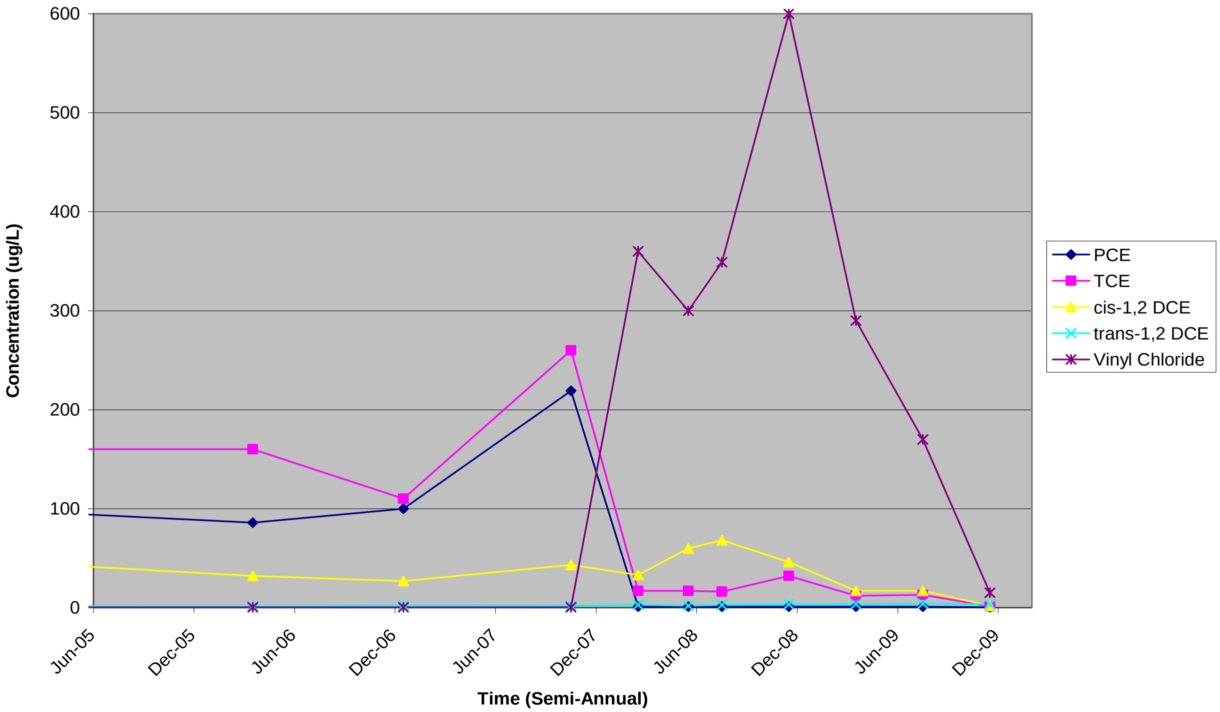
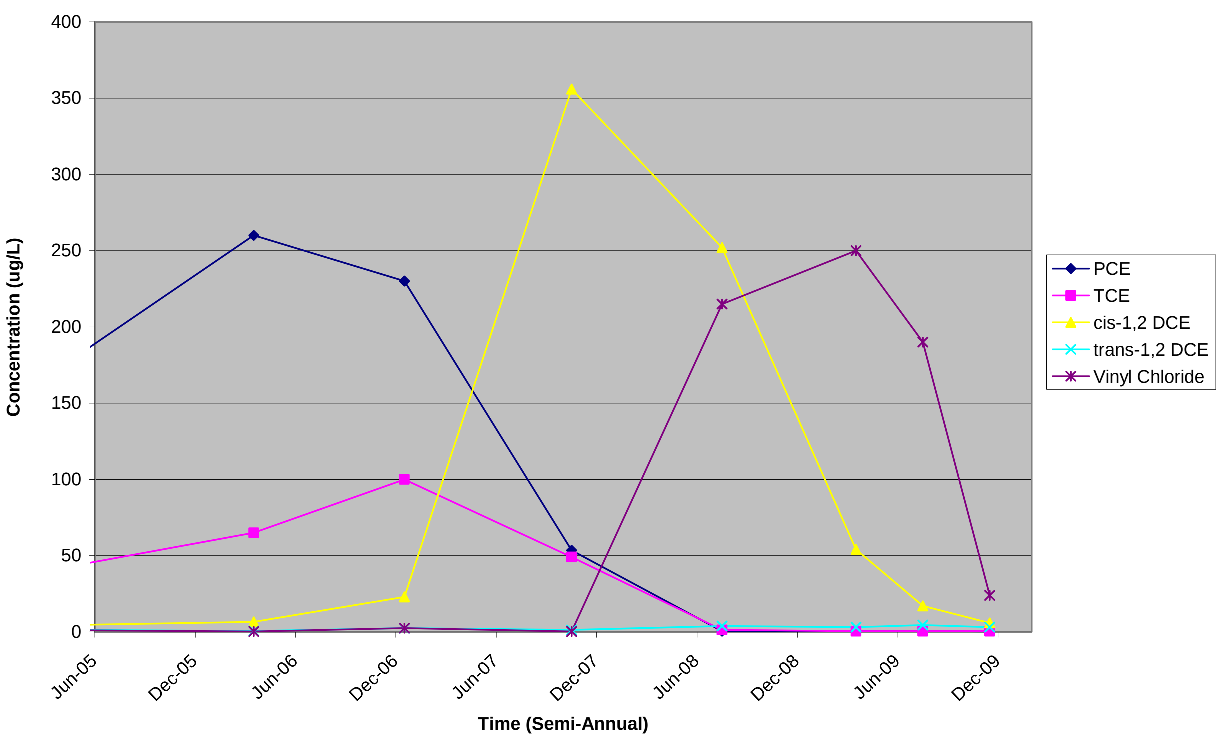


Figure 4: EX-13 Time Series Plot



Downgradient BioCurtain Area

The results from system operations monitoring at the downgradient biocurtain are summarized below:

- In July 2008, approximately 9% of the detectable VOCs were PCE based on molar concentrations. TCE (~27%) and DCE isomers (~64%) accounted for the remaining VOC mass. VC was not detected in any of the samples.
- In March 2009, PCE accounted for ~6% of the detectable VOCs. TCE (~18%), DCE isomers (~62%), and VC (~14%) accounted for the rest of the detectable VOCs.
- March 2009 was the first sampling event that had detectable levels of VC indicating that reductive dechlorination was occurring.
- In March 2009, the levels of PCE and TCE were below the MCL in 6 of the 7 wells sampled, DCE isomers were below MCLs in all 7 wells sampled, and VC was detected above MCL in 5 of the 7 wells sampled.
- The highest concentration of PCE, TCE, cDCE, tDCE and VC detected at the biocurtain in the 7 wells sampled in March 2009 were 9.5 µg/L, 25 µg/L, 17 µg/L, 10 µg/L, and 5.2 µg/L, respectively.
- In October 2009, PCE was below the MCL in 10 of the 11 wells sampled, TCE in 9 of 11 wells, cDCE and tDCE in all 11 wells. VC was detected in 8 of 11 wells. The highest concentrations of PCE, TCE, cDCE, tDCE, and VC detected were 5.6 µg/L, 14 µg/L, 35 µg/L, 32 µg/L and 16 µg/L.
- Ethene samples were collected in November 2008 and March 2009. Ethene concentrations in November 2008 were an average of 0.033 µg/L. The concentrations increased slightly to an average of 0.047 µg/L in March 2009. The low concentrations of dissolved ethene are most likely a result of low concentrations of contaminant and the fact that VC was not being produced in detectable quantities until March 2009 and not as a result of incomplete dechlorination.

Performance monitoring results at the Biocurtain area are depicted by time-series plots for wells BC-4 and R-04, and downgradient wells R-05 and RPD-2 which are presented as Figures 5, 6, 7, and 8, respectively. Historical ground water analytical results for wells in the Biocurtain area are presented in Table A5-1 of Attachment 5.

Figure 5: BC-4 Time Series Plot

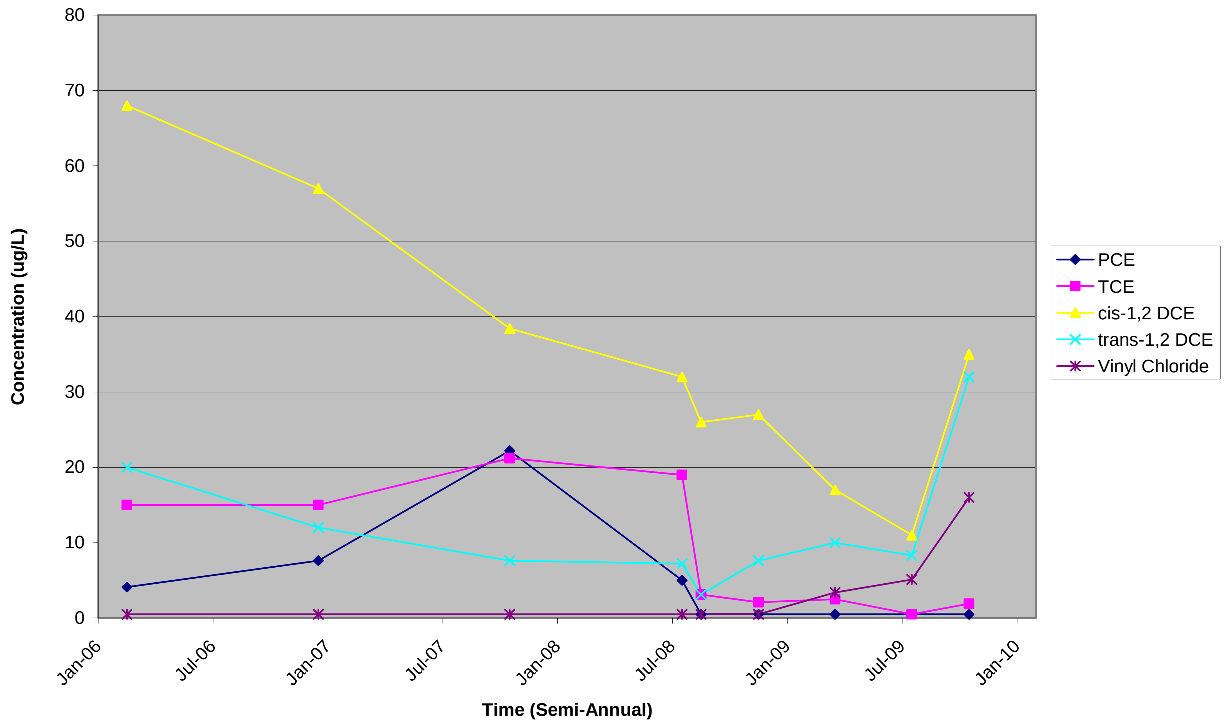


Figure 6: R-04(S2) Time Series Plot

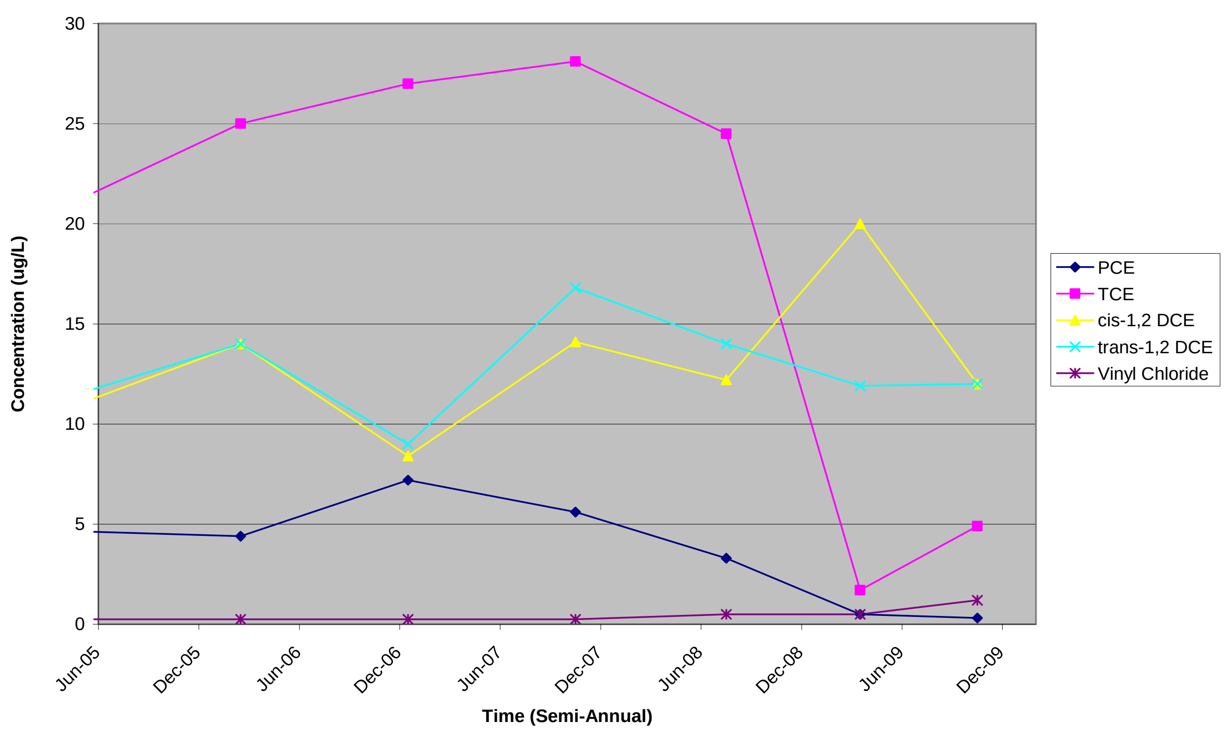


Figure 7: R-05(S2) Time Series Plot

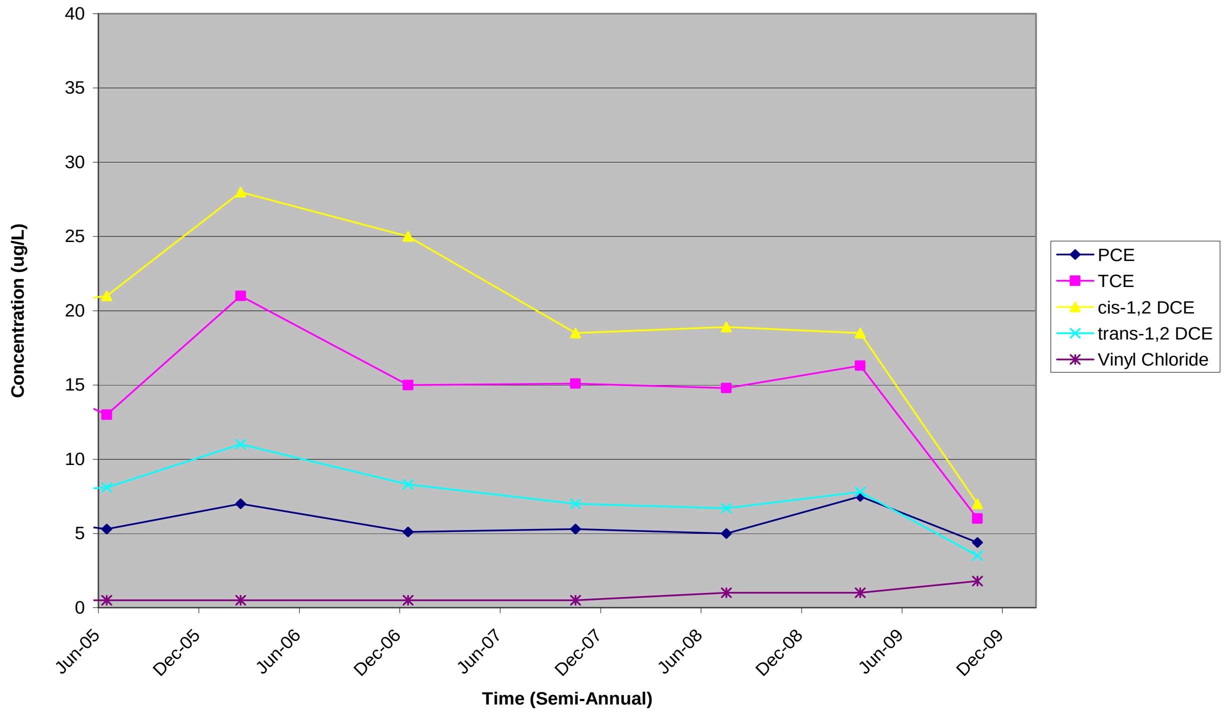
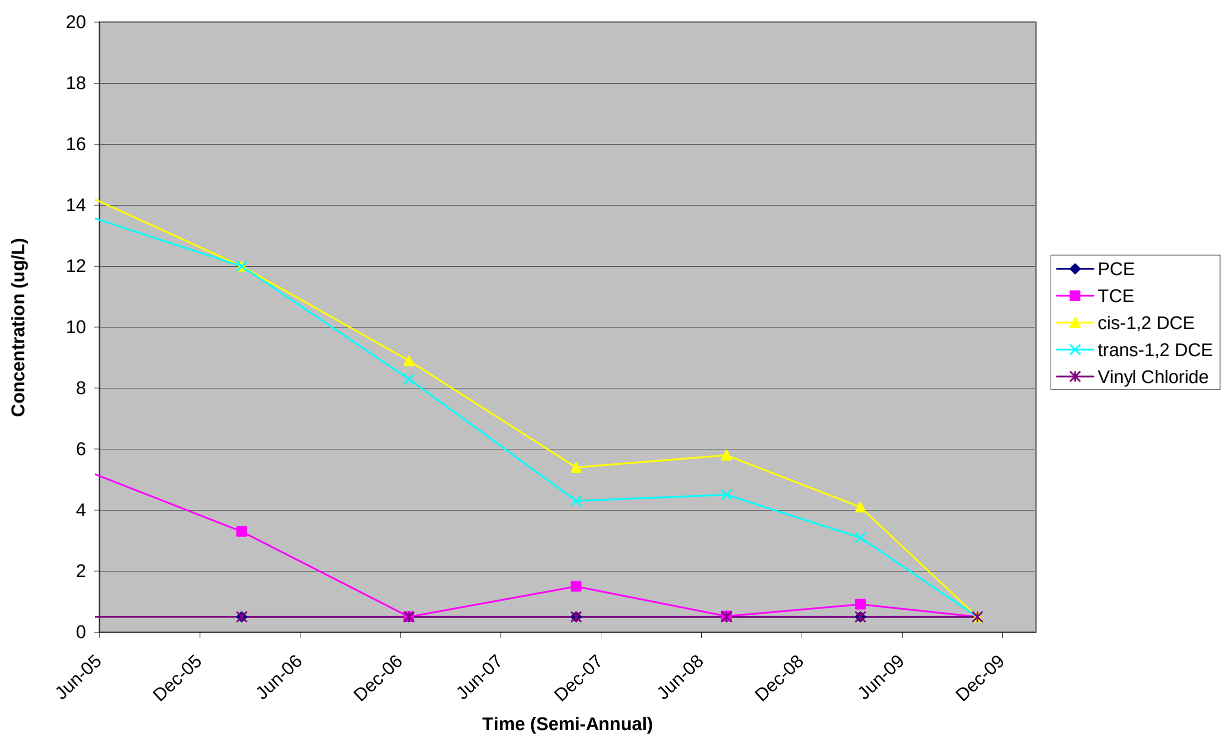


Figure 8: RPD-2 Time Series Plot



Deep Zone – Performance Monitoring Results

The results from system performance monitoring at the Deep Zone are summarized below:

- Historical concentration data from the Deep Zone wells indicate that approximately 97% of the detectable VOCs is in the form of PCE. See Attachment 4, Figure A4-5.
- Based on molar concentrations; approximately 35% of the detectable VOCs at the injection wells in July 2008 (following the initial injections) were in the form PCE. TCE (~18%), DCE isomers (~34%), and VC (~13%) accounted for the rest of the VOC mass.
- In November 2008, PCE accounted for approximately 30% of the detectable VOCs, TCE ~5% and DCE isomers for ~63% of the mass. VC accounted for only ~2% of the detectable VOCs.
- In November 2008, PCE was not detected in 6 of the 7 injection wells. TCE was detected in 4 of the 7 injection wells with the highest concentration of 27 µg/L detected in DI-2(D2). DCE isomers were detected in 4 wells with most of the detected concentrations below their respective MCLs, though R-21 had a concentration of 440 µg/L. VC was detected in 4 of the 7 injection wells, with R-21 being above the MCL at 7.7 µg/L.
- In October/November 2009, results continue to show reduced concentrations in the injection wells. PCE was detected in 2 of the 7 injection wells with the highest concentration 69 µg/L. TCE and VC were detected in one well each at 14 µg/L and 25 µg/L, respectively. Ethene samples collected from the Deep Zone injection and monitoring wells had an average concentration of 0.054 µg/L with a minimum of 0.012 µg/L and a maximum of 0.13 µg/L in November 2008. The highest levels of ethene were seen in DI-2(D2) and R-21, two injection wells that had detectable levels of VC. This indicates that complete dechlorination is occurring, but not as quickly as seen in other treatment areas.

Due to the passive nature of the treatment technology in the Deep Zone aquifer, reductions in contaminant concentrations have not been observed in monitoring wells located approximately 40 feet downgradient of the injection wells as discussed below:

- All of the Deep Zone monitoring wells sampled in March 2009 had detectable levels of PCE with only one, DM-2(I1) being below the MCL.
- The highest concentration was in M-09 at 659 µg/L. TCE was in all 13 monitoring wells with the highest concentration in M-09 at 22.6 µg/L.
- DCE isomers were detected in most wells at concentrations less than 5 µg/L.

- VC was not detected in any of the monitoring wells.
- The most recent samples collected in October/November 2009 continue to show similar PCE results with wells DM-1(I1) and DM-2(I1) below the MCL. The highest PCE and TCE concentration were detected in M-09 at 498 µg/L and 53.5 µg/L, respectively. The DCE isomers were below 10 µg/L and VC was not detected in any of the Deep Zone monitoring wells.

Performance monitoring results for the Deep Zone are depicted by time-series plots for wells M-09, D-09(D1), and R-09(D2) which are presented as Figures 9, 10, and 11, respectively.

Figure 9: M-09 Time Series Plot

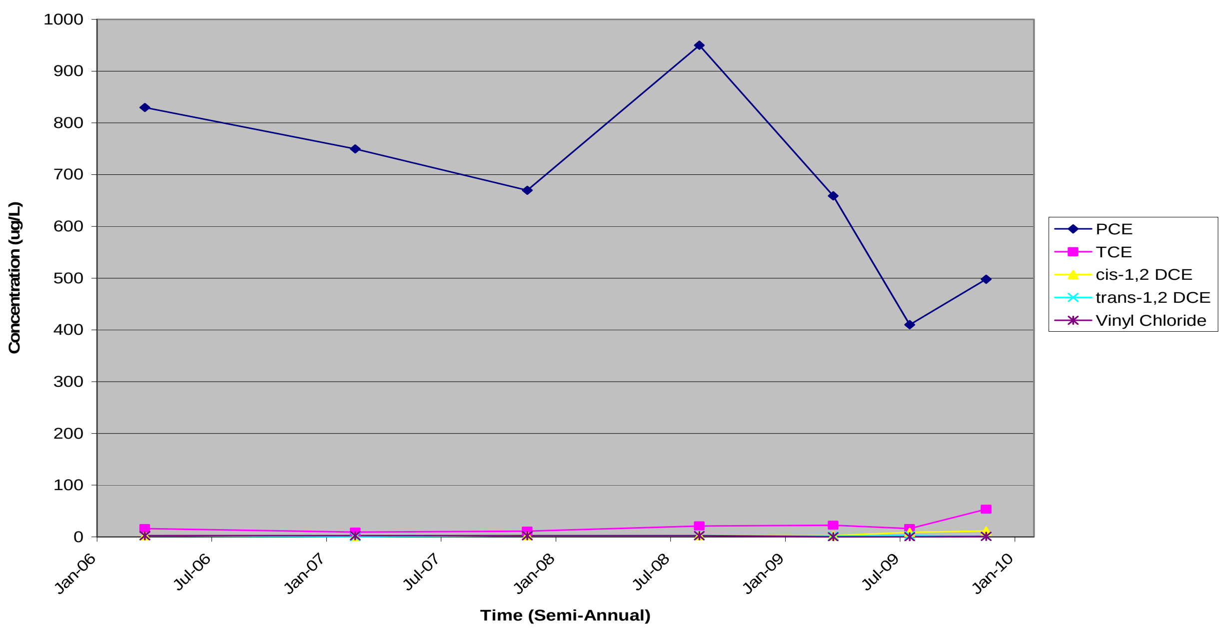


Figure 10: R-09(D1) Time Series Plot

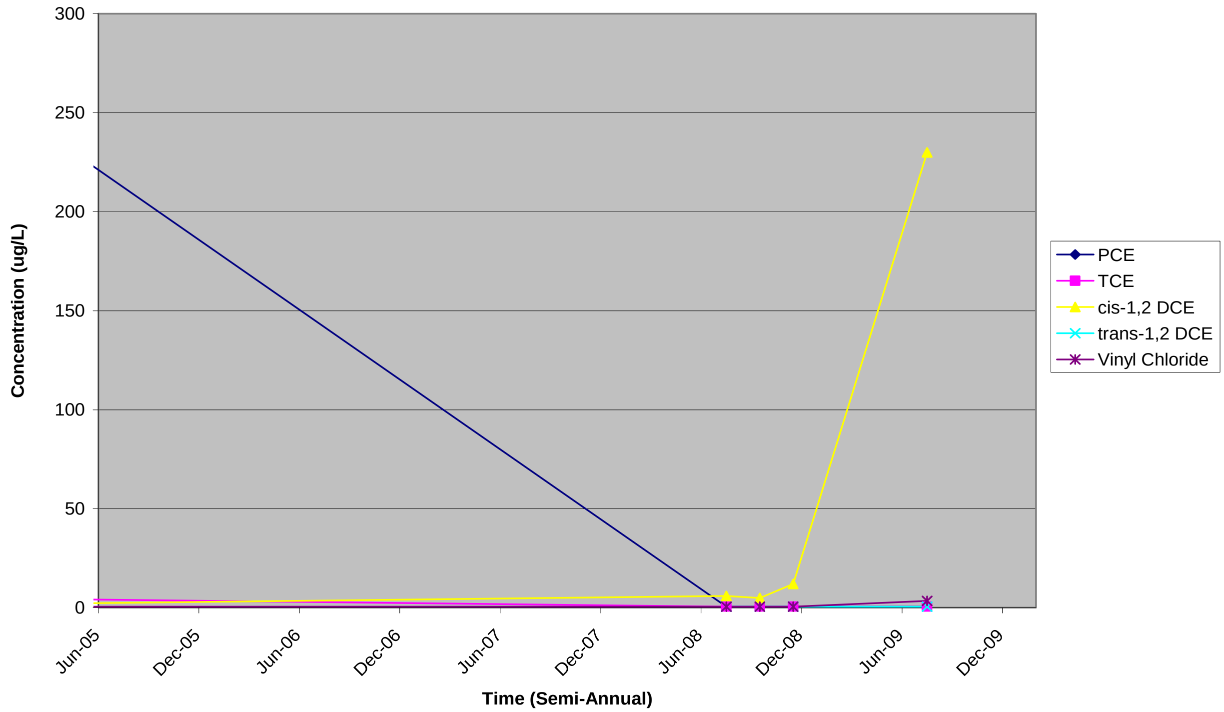
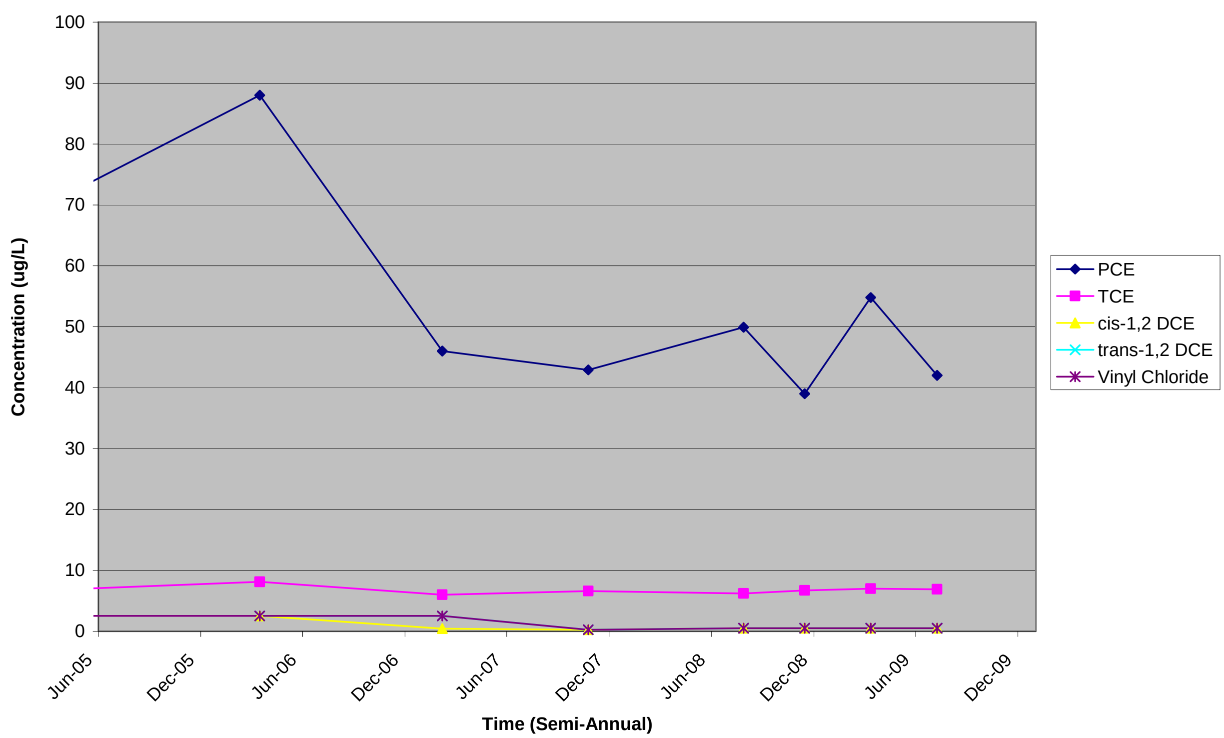


Figure 11: R-09(D2) Time Series Plot



D.5 Ground Water Monitoring Summary

Based on hydraulic conductivity estimates developed during the RI and refined during the RA Pilot Test the ground water velocity is estimated at 330 ft/year. This estimated ground water velocity has been verified by the downgradient contaminant reductions observed during the first two years of the ERD treatment operations. Groundwater potentiometric maps of the shallow, intermediate, and deep zone aquifers for the March 2009 semi-annual ground water monitoring event are presented in Attachment 3.

Isoconcentration contour maps provided in Attachment 4 illustrate the contaminant distribution prior to ERD treatment ground water conditions in March 2006, near end of ERD pilot test in October 2007, and remediation performance monitoring trends from July 2008 and November 2009 sampling events. The ground water monitoring results indicate that the ground water remediation process is proceeding as expected and demonstrates decreasing trends in contaminant mass over time. A clear decreasing trend in PCE concentrations has been established since initiation of the ERD field pilot test was performed between March 2007 and January 2008, and subsequent ERD amendment injections beginning in April 2008. As part of the ERD process, concentrations of TCE and the daughter products, cDCE and VC, had initially increased after ERD treatment and are now decreasing in the central portion of the plume as well as the Source Area.

D.6 Surface Water

The RAO for surface water in the ROD stated:

"Prevent the degradation of surface water by ensuring that the concentrations of ground water Contaminants of Concern and Contaminants of Potential Concern are in compliance with applicable surface water standards";

Both current surface water standards for the ground water Contaminants of Potential Concern listed in the Water Quality Code for the Pueblo of Santa Clara and proposed standards were identified in the ROD with those in effect as fully promulgated and enforceable when the remedial design was completed would be used.

Previous investigations had not identified COC in surface water samples or sediment samples collected from the Rio Grande, the Santa Clara ditch or the Guachupangue Arroyo. During this Five Year Review no surface water sampling was performed. Instead, NMED has relied on ground water samples collected from three wells, (R-16(S2), RDP-3 and RPD-4) which were installed along the west bank of the Rio Grande to determine if contamination is reaching the river. As indicated by isoconcentration contour maps that depict the extent of PCE and TCE plumes in October 2006 (see Attachments A4-1 and A4-2), these contaminants have not been detected in these wells above the surface water RGs. Ground water monitoring results for the downgradient wells adjacent to the Rio Grande are presented in Table 4.

Table 4: Groundwater Monitoring Results for Downgradient Wells adjacent to the Rio Grande

Well Number	Contaminant	February 2006	December 2006	October 2007	July 2008	March 2009	October 2009
R-16(S2)	PCE	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5
	TCE	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5
RDP-3	PCE	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5
	TCE	<0.5	<0.5	1.6	<1.0	<1.0	<0.5
RPD-4	PCE	<0.5	<0.5	<0.5	<1.0	<1.0	<0.5
	TCE	0.12 LJ	0.04 LJ	<0.5	<1.0	<1.0	<0.5

Notes:
Not detected recorded as less than (<) the laboratory reporting limit
LJ qualifier denotes low estimated concentration below the analytical method detection limit
All concentrations are in micrograms per liter (µg/L); maximum contaminant level (MCL) for PCE & TCE is 5 µg/L

D.7 Soil Contamination

Previous soil investigations did not identify surface soil contamination above the EPA Region 6 screening values for direct contact and therefore were not found to pose a health risk. However, a subsurface soil RAO was established for protection of ground water. The RAO for soil in the ROD stated:

"Prevent the ground water from being impacted above the Maximum Contaminant Levels through the transport of Contaminants of Concern from the unsaturated zone soils at levels greater than 0.019 milligrams per kilogram for PCE."

The remediation goal for PCE contaminated soil was calculated using the *EPA's Soil Screening Guidance: User Guide* and was set at a level such that if remediation goals are met ground water cannot become impacted above their respective MCLs through migration from the soils. The intent of this RAO and RG is to meet the ARAR requirements of 20.6.2 NMAC § 4103.

Soil contamination was identified in the shallow vadose zone during the installation of the source area wells at concentrations ranging from non-detect to 0.70 mg/kg from nine sampling locations. Although the levels were above the Site RAO, the concentrations and extent were not considered high enough to warrant the installation of the soil vapor treatment system identified in the ROD. EPA issued an Explanation of Significant Differences in March 2008 to remove the SVE treatment alternative. Instead, existing soil contamination will be excavated or treated through ERD.

The follow-on soil remediation strategy was not implemented during this Five-Year Review period. The soil removal will be performed after completion of the ground water remedy due to interference from the treatment system's infrastructure.

D.8 Air Monitoring

The ROD did not identify RAOs or RGs for indoor air at the Site due to the lack of measured indoor air levels above risk based screening levels. A total of seven air samples, consisting of indoor and outdoor air samples, were collected as part of the RI of the Site. Six of these samples were collected over the contaminated ground water plume and one sample was collected outside the boundary of the plume. All of the indoor air samples were below the established risk based levels. One sample collected outside of the Norge Town Dry cleaner facility had a PCE concentration of 0.98 milligrams per cubic meter (mg/m^3)resulting in a cancer risk of 2.2 x 10-6. The ROD did recommend that air quality continue to be assessed during remediation of the Site.

As a result of the remediation activities and the resulting changes to the ground water contamination chemistry beneath the site, NMED and the EPA determined that potential indoor air impacts to buildings located near the Hotspot treatment area should be reassessed. As part of the assessment, the remedial goals for indoor air were established using EPA's Draft Vapor Intrusion Guidance (EPA 2002). The RG corresponds to a $1x10^{-6}$ cancer risk level based on residential land use. The resulting site RGs for PCE and VC are 0.81 $\mu g/m^3$ and 0.28 $\mu g/m^3$ respectively.

Both PCE and VC have been detected above the site RGs within two of the buildings at the Site. Indoor air samples were collected at two nearby commercial buildings on September 3, 2008 and four indoor air samples collected at three commercial buildings on March 18, 2009 and again in September 2009. PCE was detected at concentrations between 0.38 $\mu g/m^3$ and 1.5 $\mu g/m^3$ and VC was detected at concentrations between 0.40 $\mu g/m^3$ and 3.8 $\mu g/m^3$. cDCE was detected in one sample at 0.72 $\mu g/m^3$ during the first sampling event. The air monitoring data summaries are included in Attachment 5.

The current levels observed are within the 1×10^{-4} and 1×10^{-6} risk range established by the EPA as protective of human health. In addition, the ground water concentrations beneath the buildings have been reduced to levels that will no longer act as a source for the indoor air contamination. Based on the observed reduction in ground water concentrations and the likelihood that the indoor air issue will be a short term issue, NMED and EPA established a tiered action approach based on risk-based metrics to evaluate site conditions and determine when additional action is required. Tier 1 action level corresponds to a target cancer risk of 1x10-6 and requires no action. Tier 2 action level corresponds to a target cancer risk between 1x10-6 and 1x10-4 and requires additional monitoring and evaluation. The Tier 3 action level corresponds to a target cancer risk greater than 1×10^{-4} and requires an evaluation for taking action to address the exceedance such as installing a vapor intrusion mitigation system.

D.9 Institutional Control & Residential Well Monitoring

The RAO for ground water in the ROD states:

> *" Prevent human ingestion, inhalation, or dermal contact of ground water that contain Site related Contaminants of Concern at concentrations which exceed the corresponding non-zero Maximum Contaminant Level Goals (MCLGs) established under the Safe Drinking Water Act;"*

In order to meet this RAO the selected remedy included the institutional controls to eliminate installation of water supply wells within the site boundaries and to perform semi-annual sampling of residential wells in vicinity of the Site.

Two City of Española drinking water supply wells were removed from service in 1992. In addition, the New Mexico Office of State Engineer which oversees ground water appropriations for the State has issued a moratorium on installing new wells. NMED contacted the Office of the State Engineer to validate the existence of the well moratorium and found it to be in place.

NMED has not established a comprehensive monitoring program for conducting private/residential well sampling during this five year review period. Currently, only one private which historically has had detections of contaminants and one public supply well located approximately 1 mile downgradient of the extent of the plume are monitored. The private well is used for irrigation only and the public supply well is no longer in use as a public supply source. The stability of the existing contaminant plume indicates that it is not advancing toward any currently used private supply wells.

E. Site Inspection

Ms. Petra Sanchez of the EPA Region 6 and Mr. Steve Jetter of NMED conducted a Site inspection on April 7, 2010.

Inspection of the shallow injection system, including the treatment building compounds, piping manifolds and controllers at the source area and biocurtain treatment buildings was performed. All treatment system performance wells and ground water monitoring wells were found to be locked and secured and in good condition. Specific observations are noted in the site inspection checklist provided in Attachment 6. In addition, five interviews were conducted and the interview records are also provided in Attachment 6.

VI. Technical Assessment

The Five-Year Review must determine whether the Site remedy is protective of human health and the environment. The EPA guidance provides three questions that are used to organize and evaluate data and information and ensure that all relevant issues are considered when determining the protectiveness of a remedy. These questions are addressed in the following sections.

Question A - Is the remedy functioning as intended by the ROD?

Remedial Action Performance

The ground water remedy was implemented and operated as specified in the ROD and subsequent ESD which replaced the surfactant treatment with ERD treatment in the source area.

The shallow ERD recirculation systems have been effective in at reducing the suspected DNAPL source and dissolved phase COCs in the shallow hotspot area located near the Norge Town Dry Cleaner facility. The ERD treatment systems using extraction/injection and recirculation is an efficient method of delivering amendment to the treatment zones and offer a safe and effective means to reduce the chlorinated ethane-based aquifer contamination at the site. The chosen amendment formulation (EVO) has demonstrated that sustainable treatment levels can be maintained over time and that complete reductive dechlorination is occurring both within and downgradient of the treatment systems.

Operation of the shallow ERD treatment systems has reduced contaminant concentrations within all three treatment areas. Within the source area, initial PCE concentrations ranging from 8250 µg/L to 63,500 µg/L have decreased to less than 400 µg/L over the first eighteen months of operation. PCE degradation products, TCE, cDCE, tDCE and VC, while initially increasing in concentrations have demonstrated a decreasing trend over the course of treatment operations. These daughter products, particularly cDCE (ranging 1300 to 5600 µg/L) and VC (ranging from 530 to 11,000 µg/L) remain within the Source Area. Based on these concentration reductions, the vast majority of the DNAPL source has been removed from the Site. Within the Hotspot treatment area, concentrations for all COCs have decreased to below the RGs except for VC. The VC concentrations in the Hotspot treatment area are less than 5 µg/L.

The downgradient Biocurtain system has also been effective in reducing the dissolved phase COCs and preventing the continued migration (expansion) of the ground water plume. PCE and TCE concentrations have been reduced from approximately 30 µg/L each to less than 6 µg/L and 14 µg/L respectively while VC has increased from less than 1 µg/L to 16 µg/L. However, as has been observed in the Hotspot, the current VC levels should decrease over time as the PCE/TCE concentrations are reduced.

Treatment of the Deep Zone has been less successful due to the significantly fewer network of injection wells and the reliance on natural ground water flow for the amendment distribution rather than active recirculation. Significant reductions to complete reductive dechlorination has been observed in the individual injection wells but these results have not been observed at monitoring wells located within 40 feet of the injection wells.

Isoconcentration maps for the shallow and deep zones are provided in Attachment 4.

System Operations/O&M:

The operations include procedures and schedules for inspection and maintenance of the remediation systems. Activities include data collection and inspections to facilitate preventive maintenance and to ensure that the system continues to operate with minimum problems. Difficulties that occurred during operations have been addressed and resolved in a timely manner.

Specific observations and mid-course corrections relating to remediation system operations that were identified during this five year review period include:

- Residue and biofouling created by the injection and recirculation of EVO causes clogging in well screens, transmission lines and the extraction pumps. Several extraction pumps, particularly at the biocutain, have failed due to the biofouling and had to be replaced.

- A maintenance schedule that includes flushing of transmission lines and extraction pumps with an oxidizing detergent and tap water following recirculation or prior to additional amendment injections has been implemented to control biofouling. Injection wells require surging and redevelopment prior to additional amendment injection. The established method for redevelopment of the wells include swabbing and bailing the wells, followed by a high pressure water jet to remove the biofouling of the well screens.

- Despite the upgrades to the injection well seals, injected liquids can breach the surface at injection wells. Due to the short vertical distance from the floor of the well vaults to the top of the injection well screen, mounded injectate has been observed within the well vaults following amendment injections. Lowering the flow rates to the injection wells has decreased the chance of surface breaches.

In February 2010, elevated methane levels were discovered in the well vaults associated with the Source Area/Hotspot treatment system. Emergency response measures were taken to determine whether the methane was entering area buildings at levels that would be of concern. The results of the initial and subsequent monitoring proved that there were no elevated levels or immediate threat to human health in the buildings. The elevated methane levels were confined to the subsurface soils and well vaults which are secured from entry to the public.

Additional actions were taken to identify the source which was determined to result from the biological processes associated with the ERD treatment method. NMED developed a contingency plan for the removal of the methane gas. The plan includes installation of a soil vapor extraction system to remove the methane gas from the subsurface and a monitoring program to ensure protection of building occupants and worker safety. The monitoring program also includes monitoring of subsurface soils and well vaults. Operation of the SVE system was started in April 2010.

The costs associated with implementation of the remedy have generally been within the estimated ranges developed in the ROD and remedial design. The cost for construction of the remedy was $4.34 million including the conversion from surfactant treatment to ERD in the source area and the ERD pilot test. The estimated annual LTRA cost developed during the remedial design was $482,382 for operation of the three ERD treatment systems for the first five years. The first year LTRA cost was $510,000. The second year LTRA costs were $506,400 for semi-annual amendment injections, semi-annual well rehabilitation and O&M. The second year cost also includes approximately $150,000 for the initial methane response and implementation of the SVE mitigation system. Subsequent years of LTRA costs are projected to be $340,000 based on the construction contractor’s cost estimate for semi-annual amendment injections, semi-annual well rehabilitation and O&M.

System Optimization:

As discussed in Section IV.A, the cancellation of the SEAR application in the source area along with the demonstrated effectiveness ERD treatment has saved significant costs while not significantly increasing the overall remediation timeframe. The current monitoring well network provides sufficient data to assess both the remedial progress within the treatment zones and the overall plume dynamics.

Opportunities to optimize the existing remedy may be explored during the next five year review. These may include substituting the continuous recirculation currently used with a shorter recirculation periods during which the amendment injections occur. Also, expansion or a modified approach to the Deep Zone ERD treatment system may be required to effectively treat the deep aquifer.

Implementation of Institutional Controls and Other Measures:

Temporary institutional controls that restrict installation of new domestic supply wells within the site boundaries have been implemented and maintained by the New Mexico Office of the State Engineer. This is a temporary order that was instituted until the RGs for the site are met. The remediation treatment facility buildings at the Site are fenced and secured to prevent unauthorized entry. The injection and extraction well vaults are secured with locks as are the well casings on the monitoring wells.

Question B - Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards

Federal or State standards for the COCs identified in the ROD have not been revised during this Five-Year Review period. However, the SDWA standard for arsenic was reduced from 50 µg/L to 10µg/L and has become a concern as discussed below.

Changes in Exposure Pathways

There have been no changes to land use at the Site and the surrounding area which is expected to remain zoned as residential and commercial property. There have been no drinking water supply wells installed near the site.

The indoor air exposure pathway which was not identified as a potential risk during the RI became a potential exposure route during this Five-Year Review timeframe for both COCs and methane gas produced from the ERD treatment method. The receptors include the workers and children at three buildings located near the Source Area. Both PCE and VC have been detected above the human health risk based level of 1 x 10^{-6} based on a residential land use scenario which has been used to establish other RGs for the site. As a result, NMED and EPA established a tiered action approach as outlined in the table below to evaluate site conditions and determine when additional action is required. Methane has not been detected in Site structures above the established actionable threshold of ten percent (10%) of the Lower Explosive Limit (LEL).

	Action	Action Levels (ug/m3)				Reference Action Levels	Notes
		PCE	TCE	cDCE	VC		
Tier 1	No further action is warranted to evaluate potential concentrations in indoor air	<0.81	<0.022	<0.35	<0.28	EPA 2002	Action level based on target cancer risk of 1x10-6 or noncancer hazard quotient (HQ) of <1.
Tier 2	Perform additional sampling to establish concentration and trends and evaluate need for sampling at other nearby structures.	0.81 – 81	0.022 – 2.2	0.35 – 35	0.28 – 28	EPA 2002	Action levels corresponding to target cancer risk between 1x10-6 and 1x10-4. For noncancer risk, levels correspond to HQ between 1 and 3.
Tier 3	Evaluate the need for mitigation measures at the structure such as sealing of cracks, soil vapor extraction or installation of sub-slab depressurization systems	>81	>2.2	>35	>28	EPA 2002	Action level corresponds to a target cancer risk of greater than 1x10-4 and HQ >3.
CPL	Evaluate the need for temporary relocation of occupants from a structure	1,360	11,000	800	1,300	ATSDR 2007	Action level based on Agency for Toxic Substances and Disease Registry minimal risk level for 14 day exposure. They are set below levels that, based on current information, might cause adverse health effects in most sensitive people

Additional contaminants have been identified in the ground water. Changes in the ground water geochemistry as a result of the treatment technology have increased the dissolved metal concentrations for three metals above their respective MCLs or Site ARARs. Current arsenic levels within the treatment zones have increased to as high as 20 µg/L and exceed the SWDA standard of 10µg/L. In addition, other dissolved metals, notably iron and manganese, which are action-specific ARARs under the NMWQCC regulations have increased above their respective NMWQCC standards of 1000 and 200 µg/L, respectively. To ensure the long term protectiveness of the ground water remedy as a potential drinking water source, and before the ground water is returned to its beneficial use, it may be necessary at some future date to address these metal exceedances.

Changes in Toxicity and Risk Assessment Methods

Toxicological information for the COCs on which the MCLs were established has not changed since the original risk assessment was performed and therefore the levels are considered protective of human health and the environment.

Expected Progress Towards Meeting RAOs

The remedy is effectively addressing the contaminants of concern as intended. Progress toward meeting RAOs and RGs is progressing at a more expedited rate than originally anticipated. However, the increase in dissolved metals, particularly arsenic, due to the nature of the current remedy may require modification to the overall remedial system at some future date.

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

METHANE ISSUE

In February 2010, elevated methane levels were discovered in the well vaults in the Source/Hotspot treatment area. An immediate response to the situation was taken to evaluate whether the methane gas was entering area buildings, and at levels that would harm human receptors. The actionable level established for occupied buildings was set at 10% of the lower explosive limit (LEL). The results of the initial and subsequent monitoring demonstrated that there were no elevated levels entering the buildings or creating an eminent threat to human health inside the buildings. The elevated methane levels were determined to be confined to the subsurface soils and well vaults, which are secured from entry to the public.

Additional actions were taken to identify the source of the methane gas production. The evaluation determined the gas resulted from the biological processes associated with the ERD treatment method. NMED developed a contingency plan for the removal of the methane gas. The plan includes installation of a soil vapor extraction system to remove the methane gas and a monitoring program to ensure protection of building occupants. The monitoring program also includes monitoring of subsurface soils and well vaults to determine if/when additional SVE operations will be required. Operation of the SVE system was started in April 2010.

The City of Española is planning a downtown revitalization effort which will take place over parts of the ground water plume. Land use is not expected to change with the implementation of these activities. Therefore, the protectiveness of the remedy should remain intact. However, these efforts will likely include construction of new buildings which may require implementation of construction and worker safety precautions to limit exposure to the subsurface ground water. In addition, these buildings may require indoor air monitoring.

Technical Assessment Summary

Responses to questions A, B, and C of the Technical Assessment were based on the review of technical documents, the ROD, annual LTRA and ground water monitoring reports and other material generated for the Site. The remedy is functioning as intended by the ROD and subsequent ESD modification.

The RAO for prevention of human ingestion of the ground water has been met through the use of the temporary institutional control on drilling of water wells within the Site boundaries. However, this RAO as it relates to inhalation of the COCs through the indoor air pathway has not been met. Continued reductions in ground water concentrations in the area of the affected buildings and compliance with the ground water RAO is expected to eliminate the indoor air exposure pathway.

Although the RAO for restoring ground water has not been met, both the DNAPL source and the dissolved phase contaminant concentrations have been reduced significantly. The downgradient biocurtain system has reduced contaminant concentrations and is preventing additional migration of the plume and is therefore protective of surface water.

VII. Issues

The following issues have been identified during the first five-year review:

Table 5 - Issues

Issues	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1. Elevated methane levels which could present an explosive hazard were discovered in well vaults and in the soil within the Source Area/Hotspot treatment area	N	Y
2. Indoor air impacts of PCE and VC have been identified at three commercial buildings located near the source area. The impacts are above the established remedial action goals which are based on residential land use and a 1 x 10-6 risk level. However, it is anticipated that these impacts will be relatively short lived given the substantial contaminant reductions that have been obtained during the initial 24 months of operations.	N	Y
3. Mechanical and plumbing issues associated clogging/biofouling and corrosion of the extraction pumps and associated piping is an ongoing maintenance issue. The intensive maintenance requirements have increased the O & M costs for the project.	N	N
4. The Deep Zone ERD system as it is presently designed relies on passive flow through the deep zone portion of the plume. To date, contaminant reductions associated with the ERD treatment have not been observed in monitoring wells located within 40 feet of the injection wells. The remedy will have to either be modified to expedite the remedial delivery system, or a longer time frame might be required until RAOs are met and the aquifer can return to its beneficial use.	N	N
5. The Deep Zone plume may require additional characterization for purposes of more efficient targeting of treatment and amendment injections. Except for the southeast portion of the plume, there is approximately 600 feet distance between the contaminated wells and nondetect wells.	N	Y
6. The intermediate Deep Zone treatment wells (DI-1(I1) and DI-2(I1)) no longer serve their intended purpose for treating the higher concentration zone. Ground water data from the wells and nearby monitoring wells indicate that the contamination is much lower (PCE less than 3 times	N	Y

Issues	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
the MCL). These well locations may be outside the highest concentration area or above the highest concentration zone.		
7. There are currently no monitoring wells immediately upgradient of the biocurtain to determine when the system can be shut down. Therefore additional monitoring wells might be needed in the shallow aquifer between the hotspot and biocurtain systems.	N	Y
8. The creation of anaerobic conditions associated with the injection of the carbon source amendment has caused other primary SWDA standards for arsenic and NMWQCC standard for manganese and iron to increase above background levels and exceed standards. A treatment alternative for dealing with the increase in dissolved metal that exceed ARARs should be investigated.	N	Y
9. A number of highway and downtown redevelopment projects have been impacted through delays by perceived issues associated with the NRAP Superfund Site.	N	N

No other technical issues of the remedy, or the implementation of the remedy, were noted during the five-year review. Any difficulties observed during routine inspections and monitoring of the system were immediately addressed and corrected, as needed.

VIII. Recommendations and Follow-up Actions

Based on the review of the data collected during the first five years of remedial actions (as discussed in Section V.D, the following issues were identified and follow-up actions are recommended. The numbering system corresponds to that presented in Issues Table above.

Table 6 - Recommendations

Recommendations	Responsible Party	Milestone Date
General - Routine system operations should continue at the Site, particularly at the Source Area, Biocurtain, and Deep Zone. Continue monitoring of the Hotspot area to determine if additional amendment injections are warranted.	NMED	Continuous
1. NMED has initiated a temporary soil vapor extraction unit to remove the accumulated methane from the subsurface soil and well vaults. A monitoring program has also been established to ensure protection of the building occupants and monitor the subsurface soils.	NMED, EPA, City, NMDOT	Continuous
2. An indoor air monitoring program and metrics for taking additional remedial actions has been established. Plans toward mitigating the indoor vapors will be developed in anticipation of any further exceedances.	NMED, EPA	Continuous
3. a. Continue evaluating design changes to the manifold that minimize flow restrictions including limiting valves, regulators, and meters. b. A plan for servicing or replacing pumps will be implemented. c. Evaluate changing operation from continuous recirculation to circulation during amendment injections only.	NMED	December 2010
4. NMED is currently evaluating whether the removal of the shallow aquifer source at the dry cleaner will have a positive impact on the Deep Zone aquifers. Presently, there is insufficient data to determine the long term ROI from the current injection grid. Either more injections points, higher volume of fresh water flush to increase the ROI, or a recirculation system should be evaluated.	NMED	December 2010
5. At least three additional D1 and D2 zone wells should be installed to better define the deep zone plume. One well would be installed between the R-10 and M-20 wells. Two wells would be installed in the western part of the plaza west between the current injection wells locations and R-17 and R-18.	NMED	TBD

Recommendations	Responsible Party	Milestone Date
6. NMED is currently evaluating whether the removal of the shallow aquifer source at the dry cleaner will have a positive impact on the deep zone aquifers. In the interim, additional amendment injections at intermediate well locations will be halted. The deeper intermediate zone (70 to 120 feet bgs) will be evaluated to determine if the contamination exists at depth in this area. New amendment injections wells will be installed around the R-09 well cluster to address the intermediate zone contamination at this location.	NMED	TBD
7. Install up to 4 new monitoring wells between Paseo de Onate Street and the Biocurtain system in order to monitor progress upgradient of the biocurtain.	NMED	TBD
8. Exceedances of dissolved metals will need to be addressed at some future date. Technical options should be considered to resolve this issue but should not be implemented until the chlorinated solvent contamination has met the RGs. Solutions should be available prior to an expansion of the deep zone injection pattern.	NMED	TBD
9. NMED and the EPA are committed to working with the City to resolve any issues that may arise, particularly related to any highway projects or downtown revitalization.	NMED	December 2010
10. An amendment to the ROD should be considered to establish RGs for indoor air and to add dissolved metals to the list of ground water COCs.	EPA	TBD

IX. Protectiveness Statements

The EPA has determined that the remedial alternatives selected in the ROD are necessary to protect the public health or welfare or the environment from actual releases of hazardous substances into the environment. The Site affects a public water supply for the City of Española and Santa Clara Pueblo and restricts the beneficial use of the aquifer. The remedy is necessary to prevent further risks to human health and the environment and is necessary to prevent further expansion of the ground water plume from its current location.

The ERD ground water remedy is expected to continue progressing towards meeting the remedial goals set out in the ROD and in protecting human health and the environment. The ground water remedy is operating and functioning in accordance with the design and associated modifications and optimization and has significantly reduced COC concentrations. However, hazardous substances remain in ground water at the Site at concentration levels that are above health-based levels that allow for unlimited use of the ground water and unlimited exposure to the ground water.

The temporary moratorium (in place until remedial goals are met) on private well drilling within the affected plume boundaries, (serving as an institutional control) at the site is serving its intended purpose in protecting human health. The drilling restriction continues to be enforced by the New Mexico Office of the State Engineer.

The indoor air concentrations for the COCs are within the 1 x 10^{-4} and 1 x 10^{-6} risk range established by the EPA as protective of human health. Indoor air concentration of methane is also below the 10% LEL level and is currently protective of human health. Due to the newly discovered occurrence of methane, continued monitoring will be conducted to ensure levels remain protective.

Because there is no surface soil or surface water impacts of concern and the remedial actions for the subsurface media are protective of human health and the environment, the remedy for the Site as a whole is protective of both human health and the environment.

X. Next Review

Remedial actions that result in hazardous substances, pollutants, or contaminants remaining at the Site above that allowed for unrestricted use and exposure, require EPA to conduct a review of the Site every five years. Because ground water contaminants are still present above the Site RGs and MCLs, the EPA will continue to perform Five-Year Reviews. The next review will be conducted within five years of the completion of this First Five-Year Review. The completion date is the date of the signature shown on the signature cover attached to the front of this report.

ATTACHMENT 1
Documents Reviewed

NRAP Site Documents Reviewed

"Record of Decision," North Railroad Avenue Plume Superfund Site, Española, New Mexico, issued by U. S. Environmental Protection Agency, Region 6, September 27, 2001.

"Remedial Action Report," North Railroad Avenue Plume Superfund Site, Española, New Mexico, CERCLIS #NMD986670156**,** prepared by Duke Engineering Services, for New Mexico Environment Department, Ground Water Quality Bureau, Superfund Oversight Section and U.S. Environmental Protection Agency Region VI, March 2001.

"Feasibility Study Report," North Railroad Avenue Plume Superfund Site, Española, New Mexico, CERCLIS #NMD986670156**,** prepared by Duke Engineering Services, for New Mexico Environment Department, Ground Water Quality Bureau, Superfund Oversight Section and U.S. Environmental Protection Agency Region VI, June 2001.

"Semi-Annual Ground Water Sampling Report," North Railroad Avenue Plume Superfund Site, Española, New Mexico, CERCLIS #NMD986670156**,** prepared by the New Mexico Environment Department, Ground Water Quality Bureau, Superfund Oversight Section, September 2007.

"Semi-Annual Ground Water Sampling Report," North Railroad Avenue Plume Superfund Site, Española, New Mexico, CERCLIS #NMD986670156**,** prepared by the New Mexico Environment Department, Ground Water Quality Bureau, Superfund Oversight Section, May 2008.

"Semi-Annual Ground Water Sampling Report," North Railroad Avenue Plume Superfund Site, Española, New Mexico, CERCLIS #NMD986670156**,** prepared by the New Mexico Environment Department, Ground Water Quality Bureau, Superfund Oversight Section, April 2009.

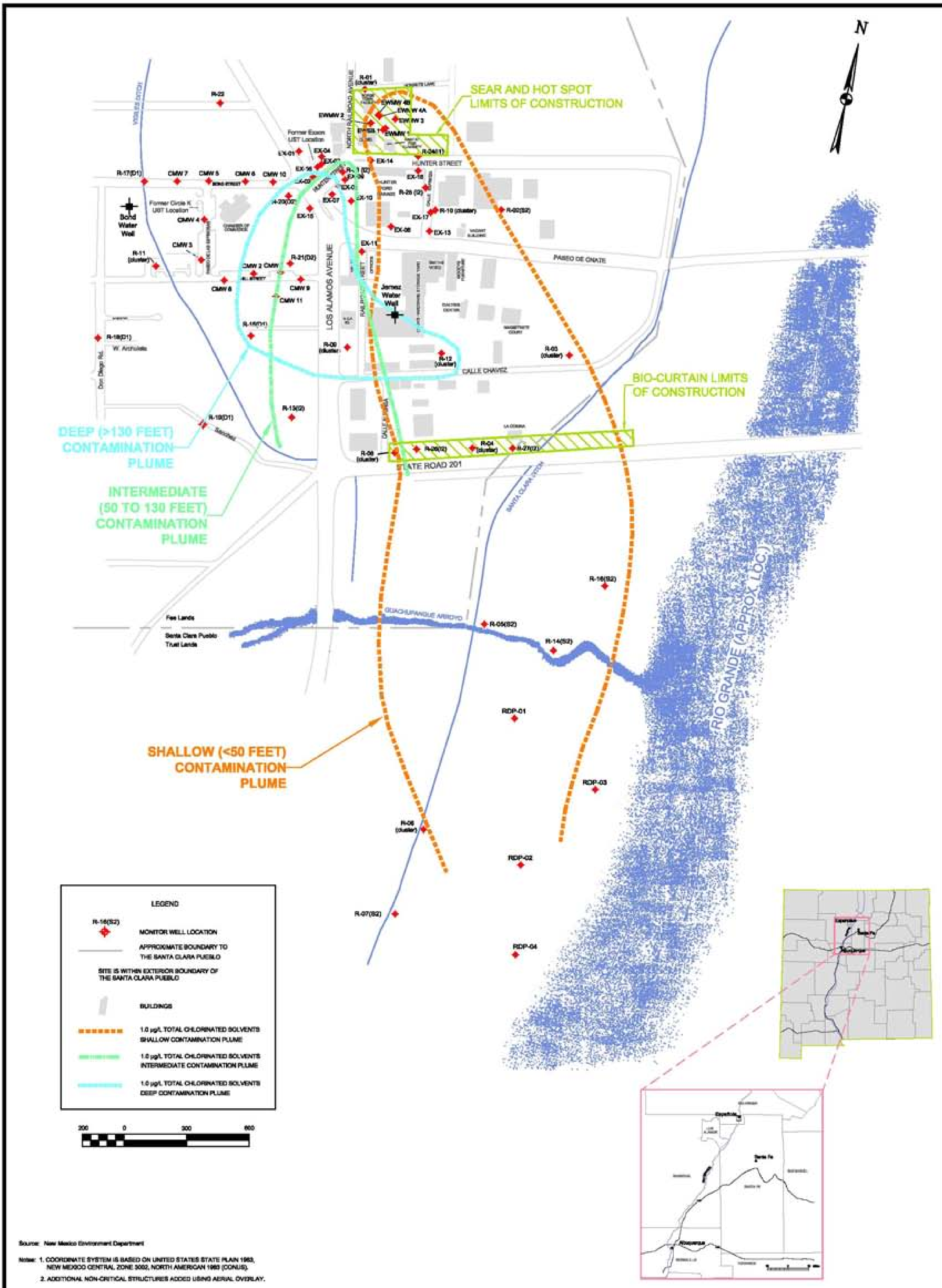
"Semi-Annual Ground Water Sampling Report," North Railroad Avenue Plume Superfund Site, Española, New Mexico, CERCLIS #NMD986670156**,** prepared by the New Mexico Environment Department, Ground Water Quality Bureau, Superfund Oversight Section, September 2009.

"Draft-Final Interim Remedial Action Report," North Railroad Avenue Plume Superfund Site, Española, New Mexico, EPA CERCLIS ID Number - NMD986670156**,** prepared by the New Mexico Environment Department, Ground Water Quality Bureau, Superfund Oversight Section, October 2009.

"Remedial Action Construction As-Built Report," North Railroad Avenue Plume, NPL #NMD986670165, prepared by INTERA Inc., for the New Mexico Environment Department, Superfund Oversight Section, December 2009.

"First Year Long Term Remedial Action Report," North Railroad Avenue Plume Superfund Site, Española, New Mexico, NPL #NMD986670156**,** prepared by AMEC Earth & Environmental, Inc. for the New Mexico Environment Department, Superfund Oversight Section and U.S. EPA Region 6, December 2009.

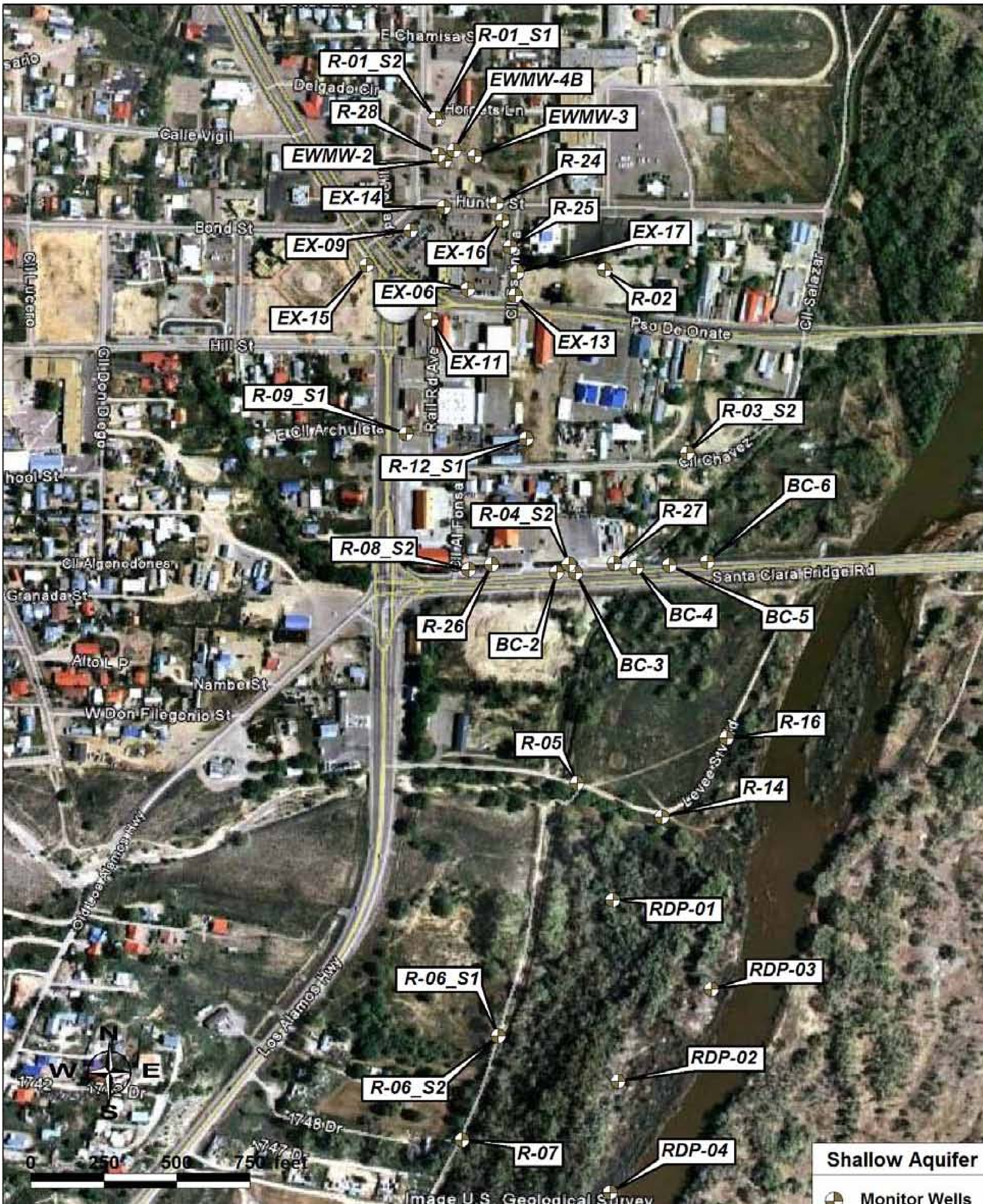
ATTACHMENT 2
Site Maps and Plans



NEW MEXICO ENVIRONMENT DEPARTMENT

North Railroad Avenue Plume Site
Española, New Mexico

INTERA INC.



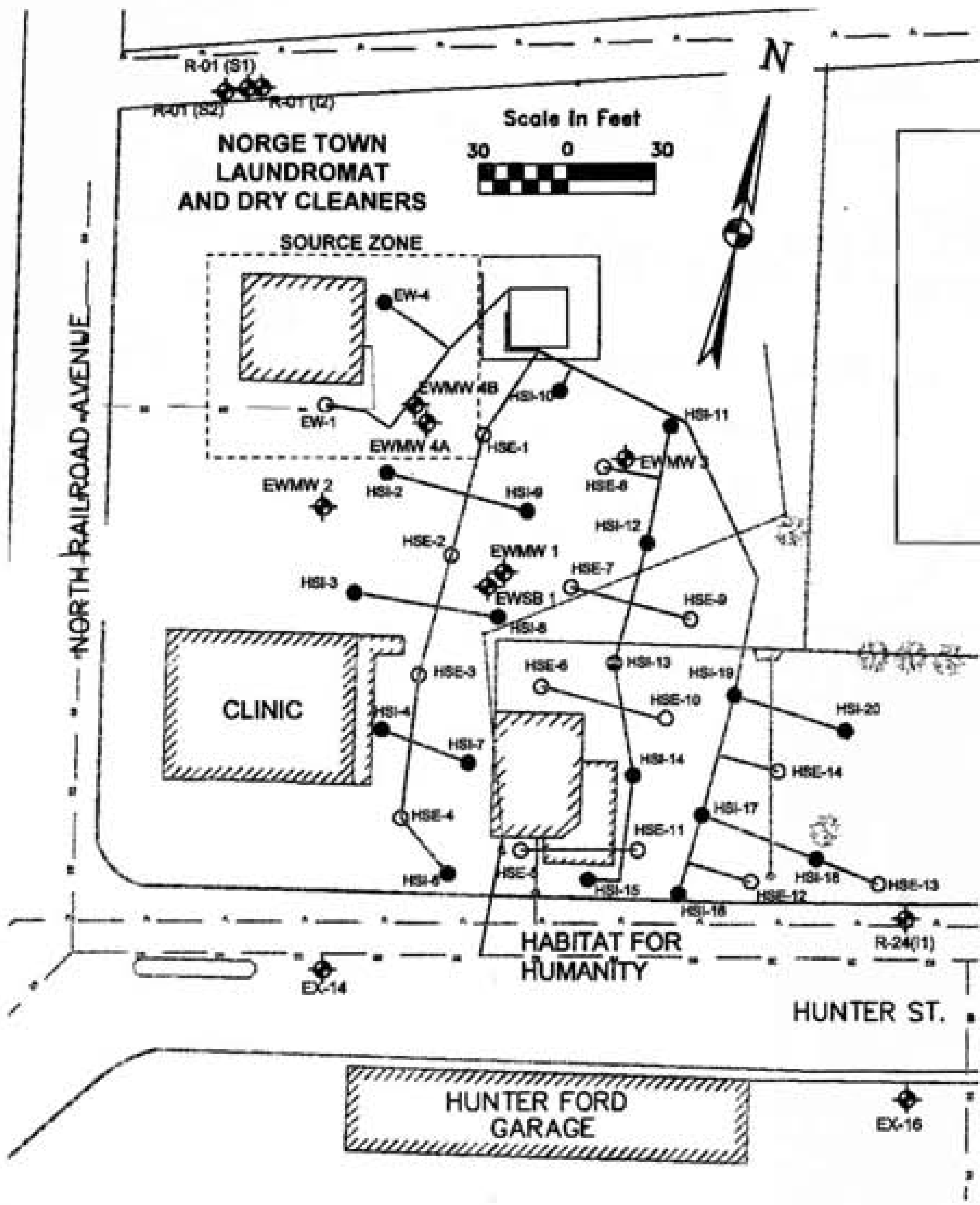
Attachment: A2-2
Location of Shallow Monitor Wells

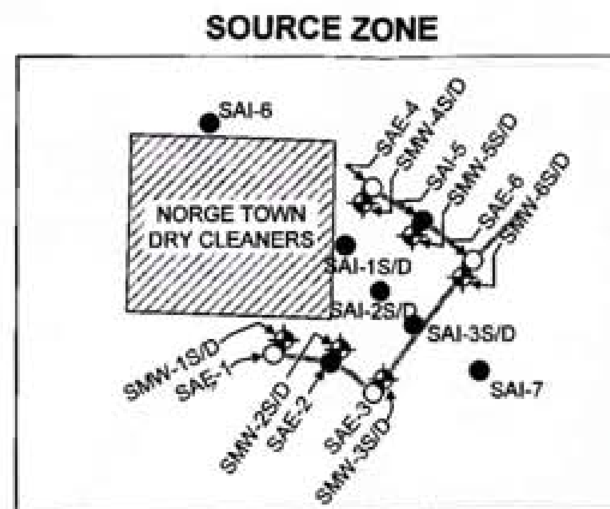
New Mexico Environment Department
North Railroad Avenue Plume
Espanola, New Mexico

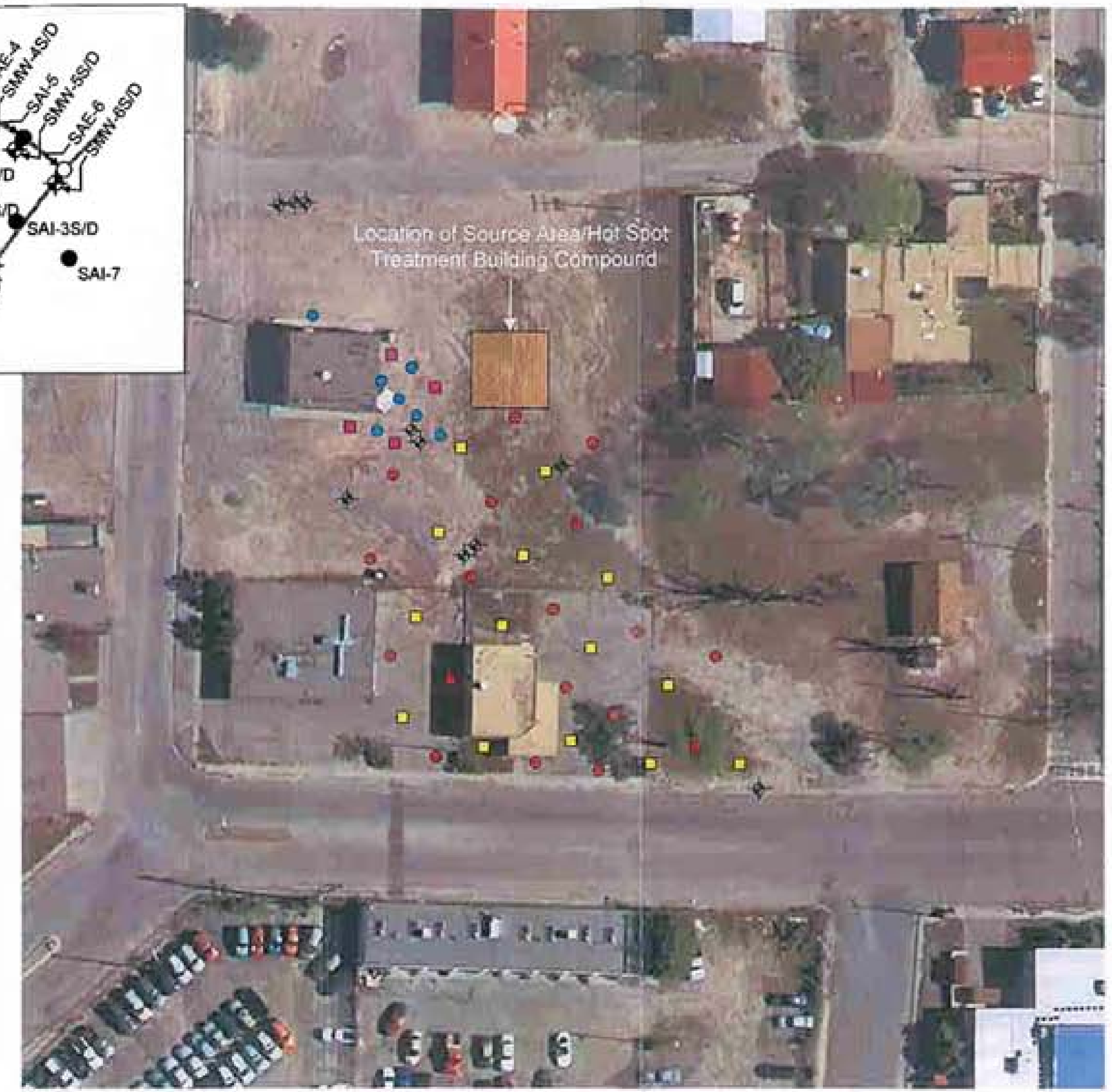
Attachment: A2-3 Location of Intermediate Monitor Wells		New Mexico Environment Department North Railroad Avenue Plume Espanola, New Mexico

Attachment: A2-4
Location of Deep Monitor Wells

New Mexico Environment Department
North Railroad Avenue Plume
Espanola, New Mexico







- Source Area Injection Well
- Source Area Extraction Well
- Hot Spot Injection Well
- Hot Spot Extraction Well

NOTES:

1. Figure above from Drawing *C-4: HOT-SPOT BIOREMEDIATION: PLAN AND PIPING LAYOUT* revised March 2006 provided by INTERA, Inc..
2. Aerial photograph at right from April 2004 copied from http://maps.google.com/maps.

amec

SOURCE AREA AND HOT SPOT BIOREMEDIATION WELLS AND SYSTEM LAYOUT

NORTH RAILROAD AVENUE PLUME SUPERFUND SITE – FIRST YEAR LTRA REPORT
USEPA ID No: NMD986670156 SITE ID: 0604299

FIGURE No.: 2

22 December 2009

- Bio Curtain Injection Well
- Bio Curtain Extraction Well

NOTES:

1. Figure above from Drawing *C-7: BIO-CURTAIN: STATE ROAD 102 PLAN AND PIPING LAYOUT* revised January 2006 provided by INTERA, Inc..
2. Aerial photograph at right from April 2004 copied from http://maps.google.com/maps.

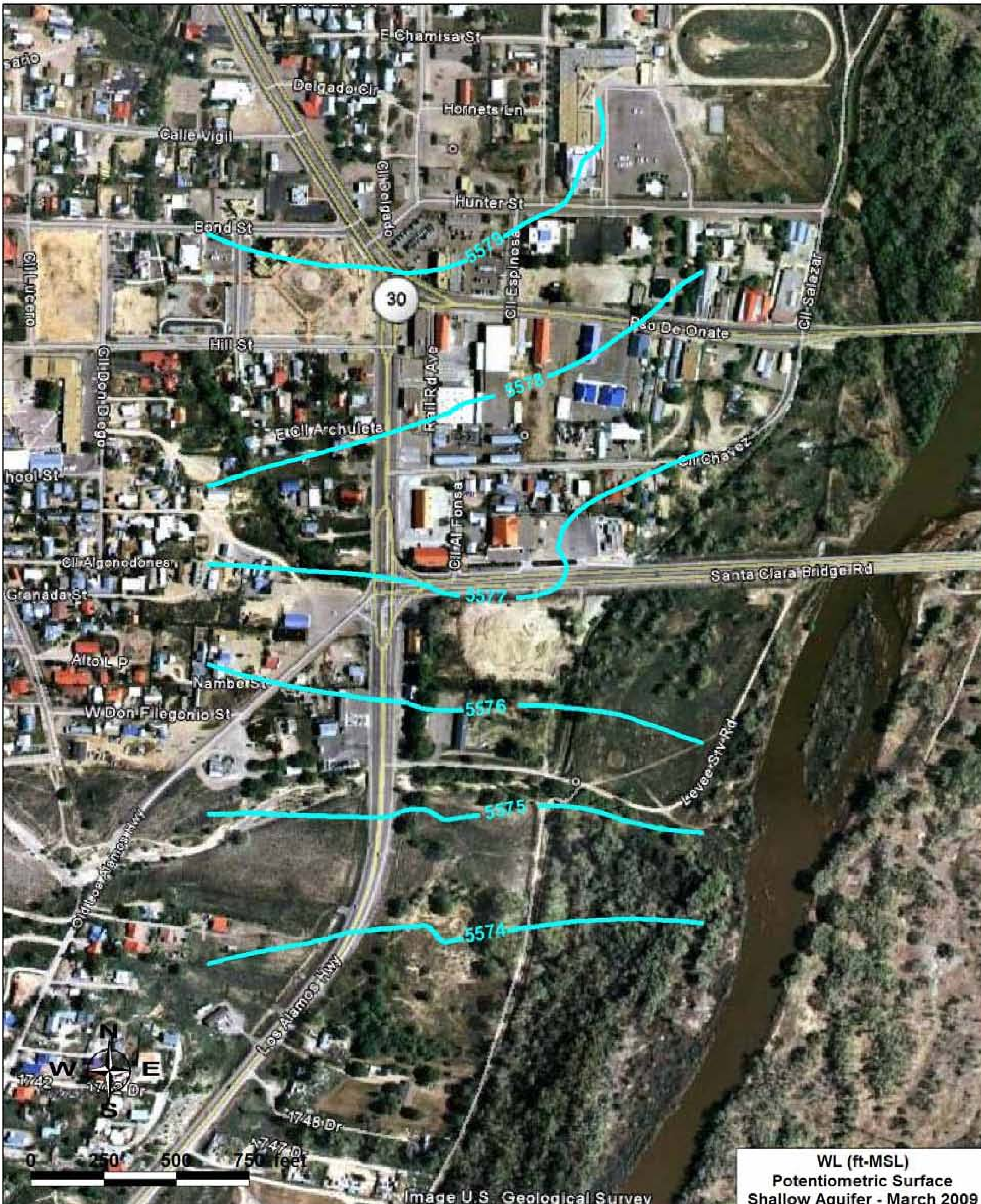
BIO CURTAIN BIOREMEDIATION WELLS AND SYSTEM LAYOUT

NORTH RAILROAD AVENUE PLUME SUPERFUND SITE – FIRST YEAR LTRA REPORT
USEPA ID No: NMD986670156 SITE ID: 0604299

FIGURE No.: 3

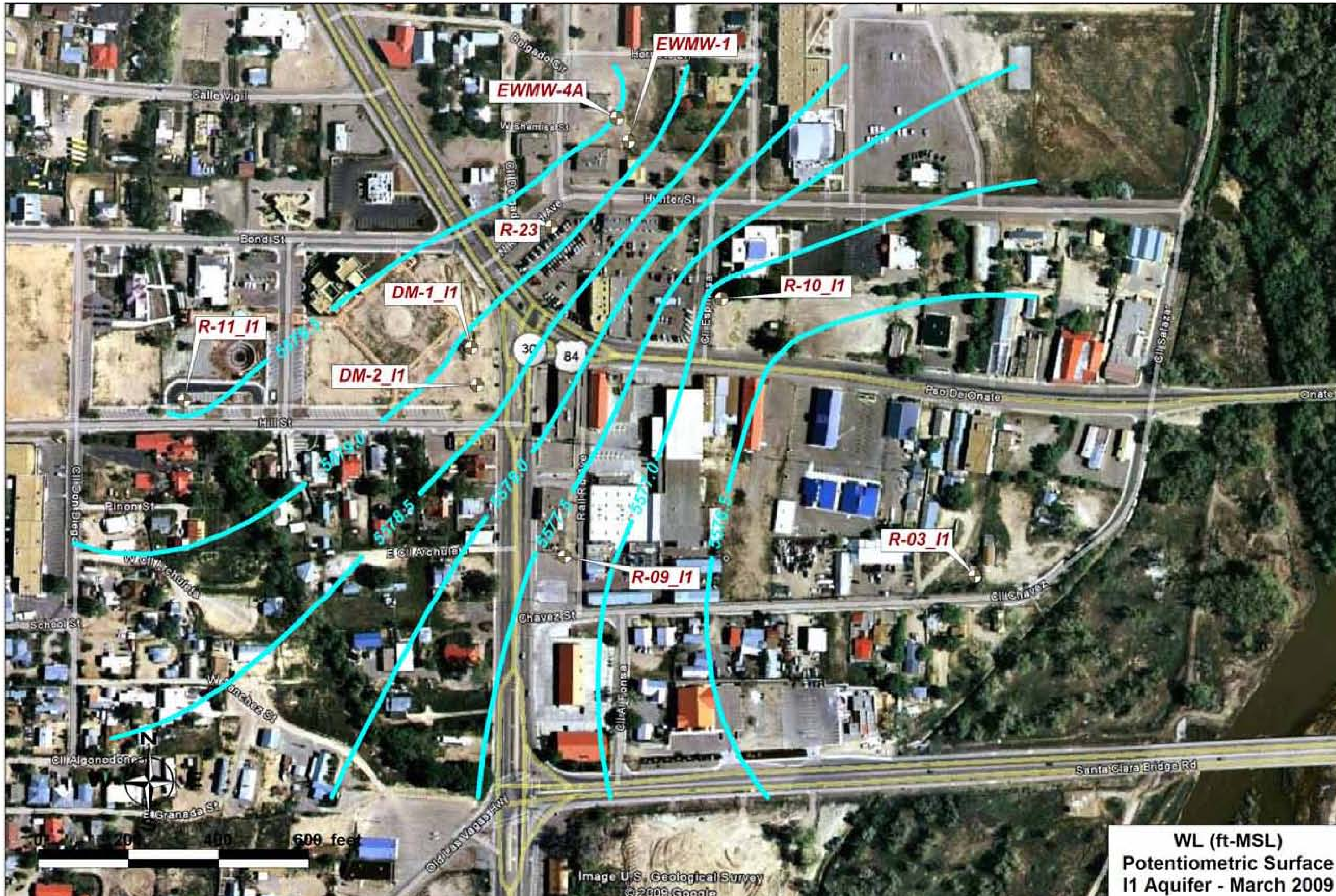
22 December 2009

ATTACHMENT 3
Ground Water Potentiometric Maps



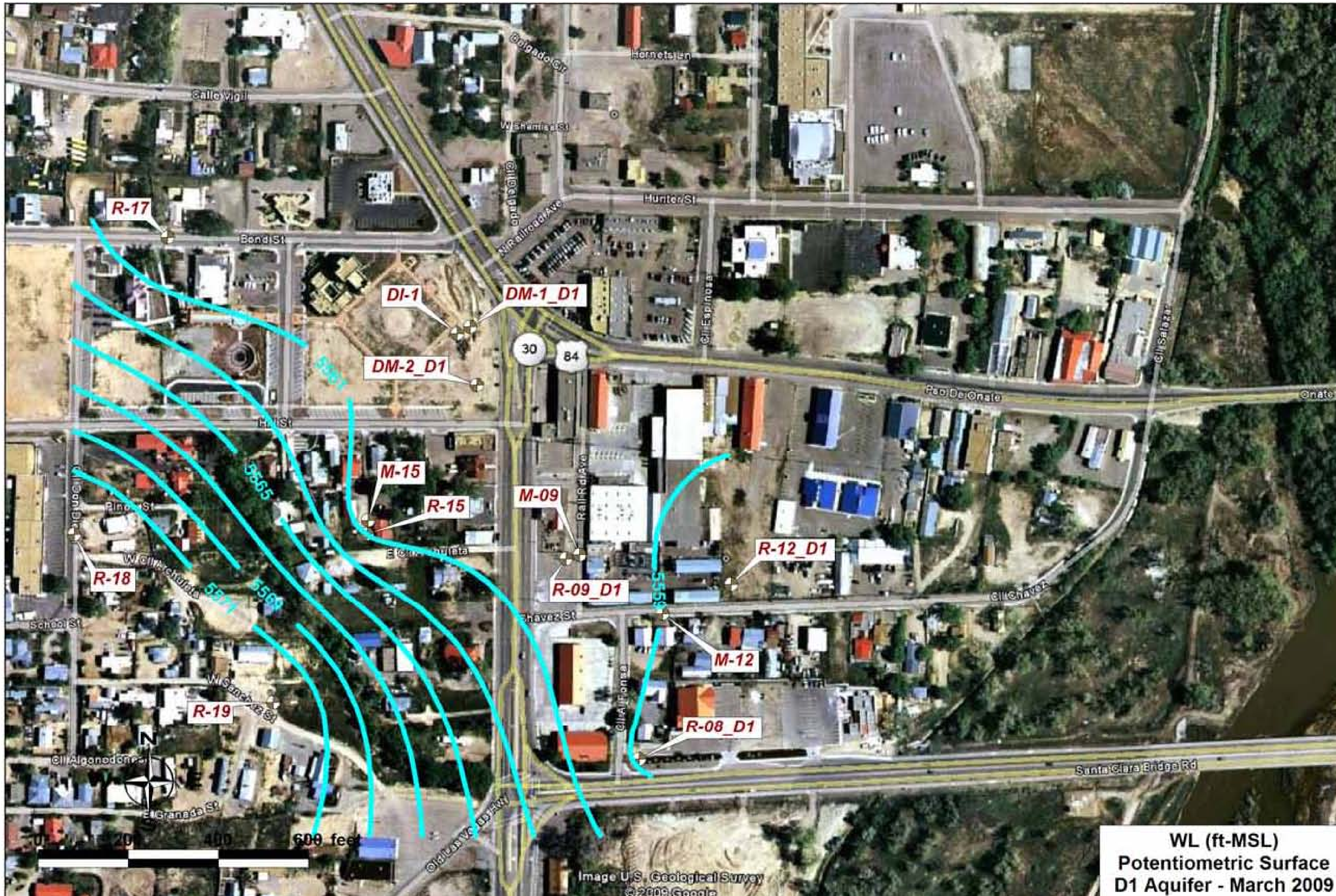
Attachment: A3-1
Potentiometric Surface Contour Map
Shallow Aquifer - March 2009

New Mexico Environment Department
North Railroad Avenue Plume
Espanola, New Mexico



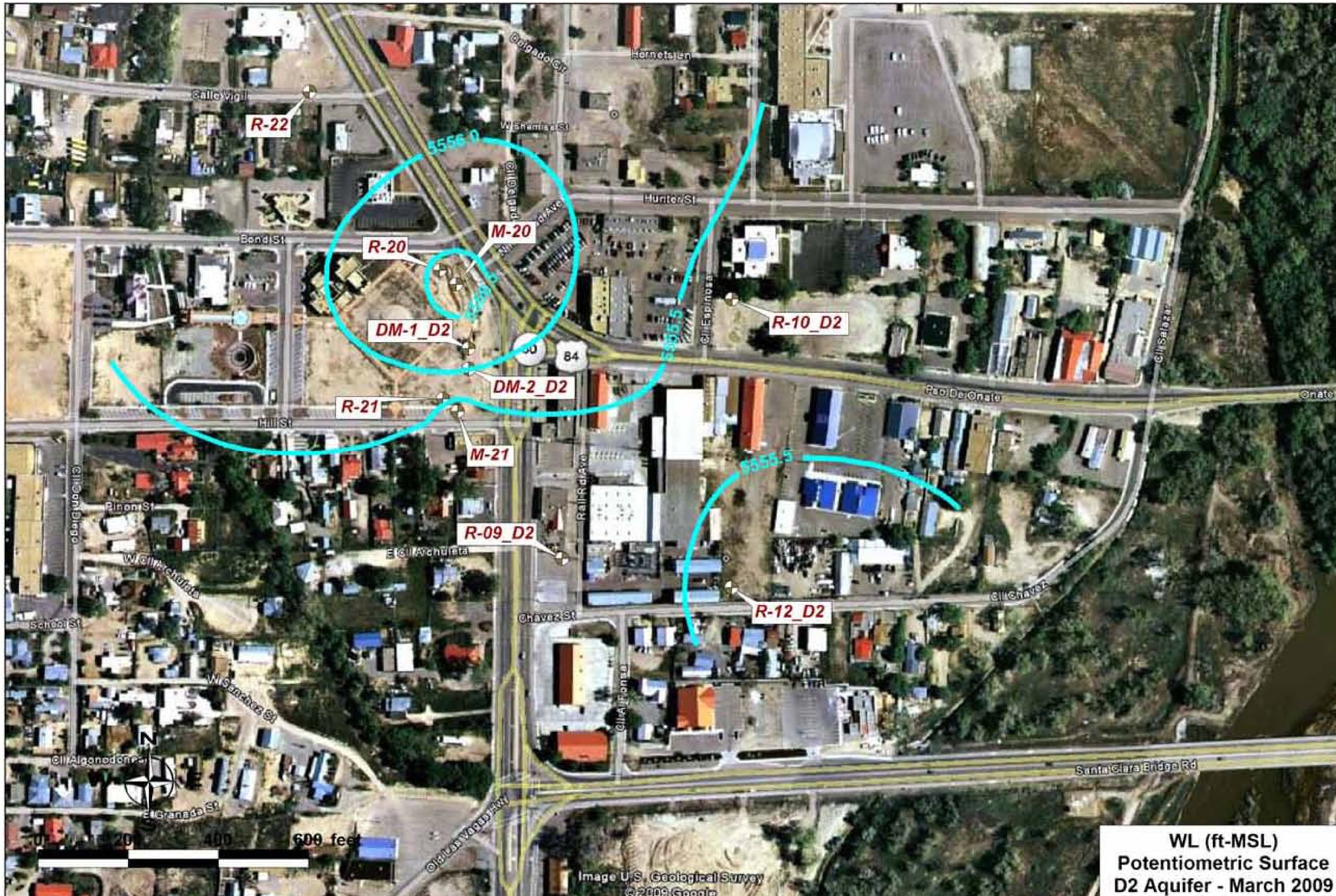
Attachment: A3-2
Potentiometric Surface Contour Map
Intermediate (I1) Aquifer - March 2009

New Mexico Environment Department
North Railroad Avenue Plume
Espanola, New Mexico



Attachment: A3-3
Potentiometric Surface Contour Map
Deep (D1) Aquifer - March 2009

New Mexico Environment Department
North Railroad Avenue Plume
Espanola, New Mexico



Attachment: A3-4 Potentiometric Surface Contour Map Deep (D2) Aquifer - March 2009		New Mexico Environment Department North Railroad Avenue Plume Espanola, New Mexico

ATTACHMENT 4
Isoconcentration Contour Maps

Figure A4-1: Shallow Aquifer PCE Concentration Map March 2006 – November 2009

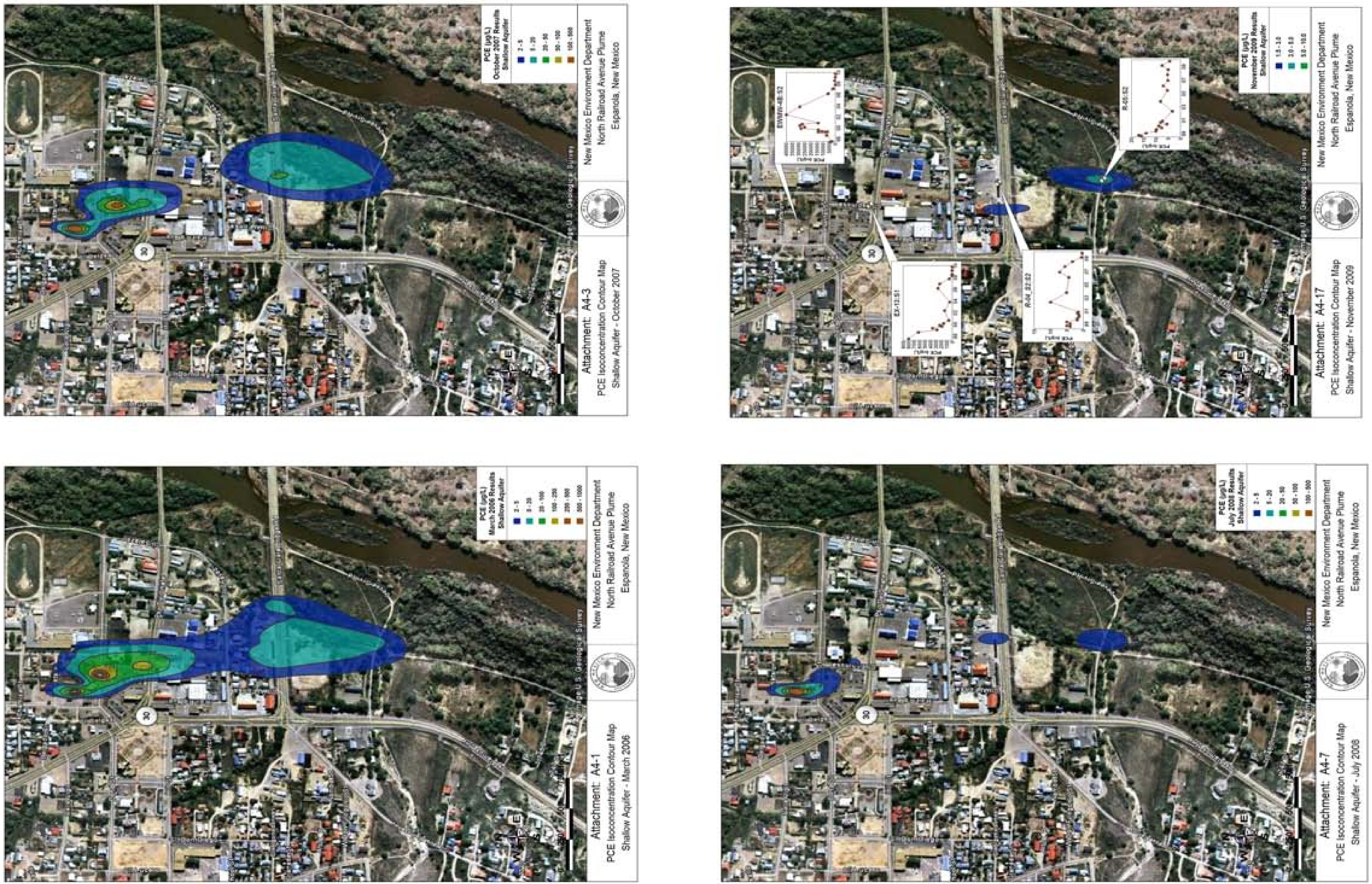


Figure A4-2: Shallow Aquifer TCE Concentration Map
March 2006 – November 2009

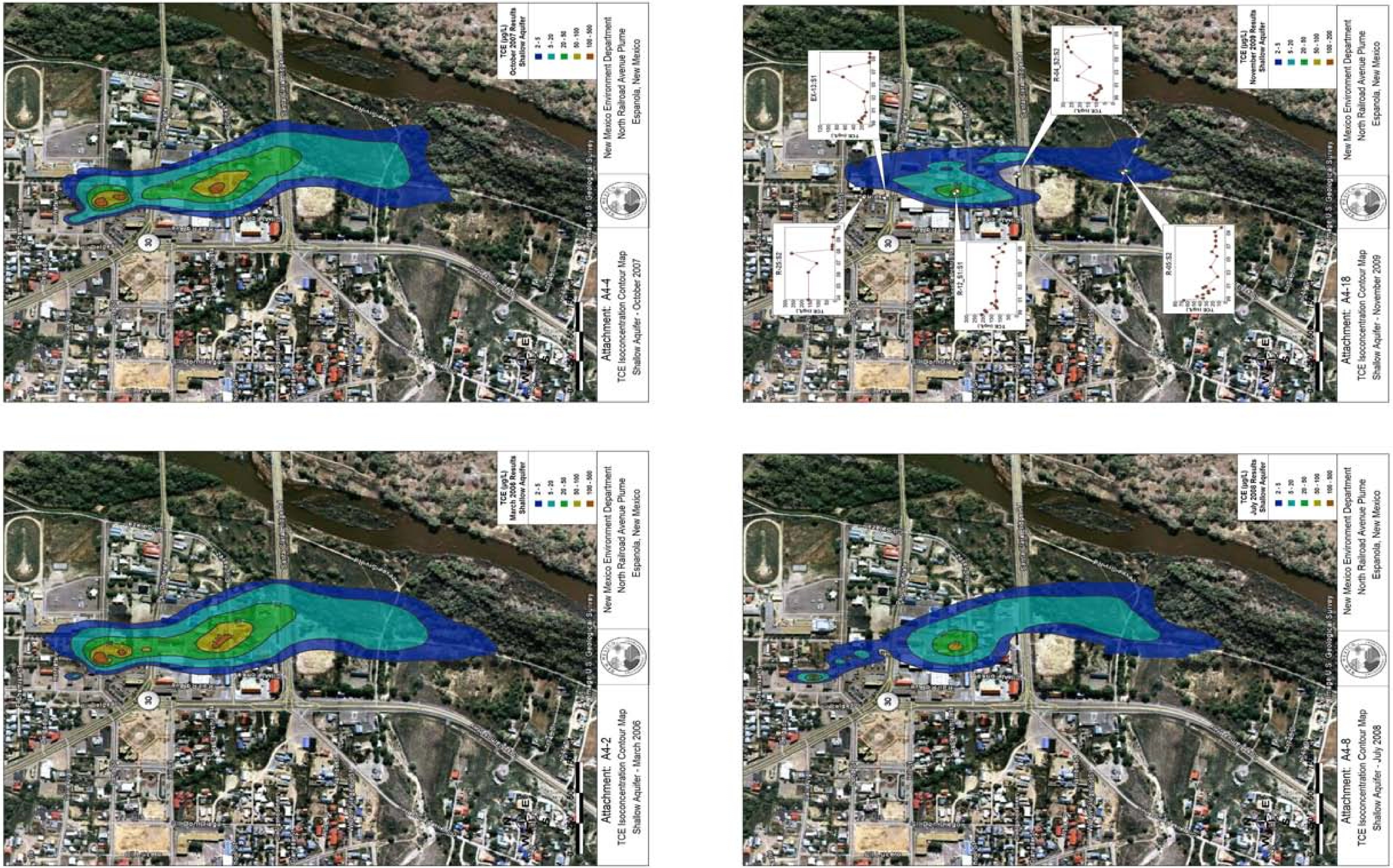


Figure A4-3: Shallow Aquifer DCE Concentration Map
March 2006 – November 2009

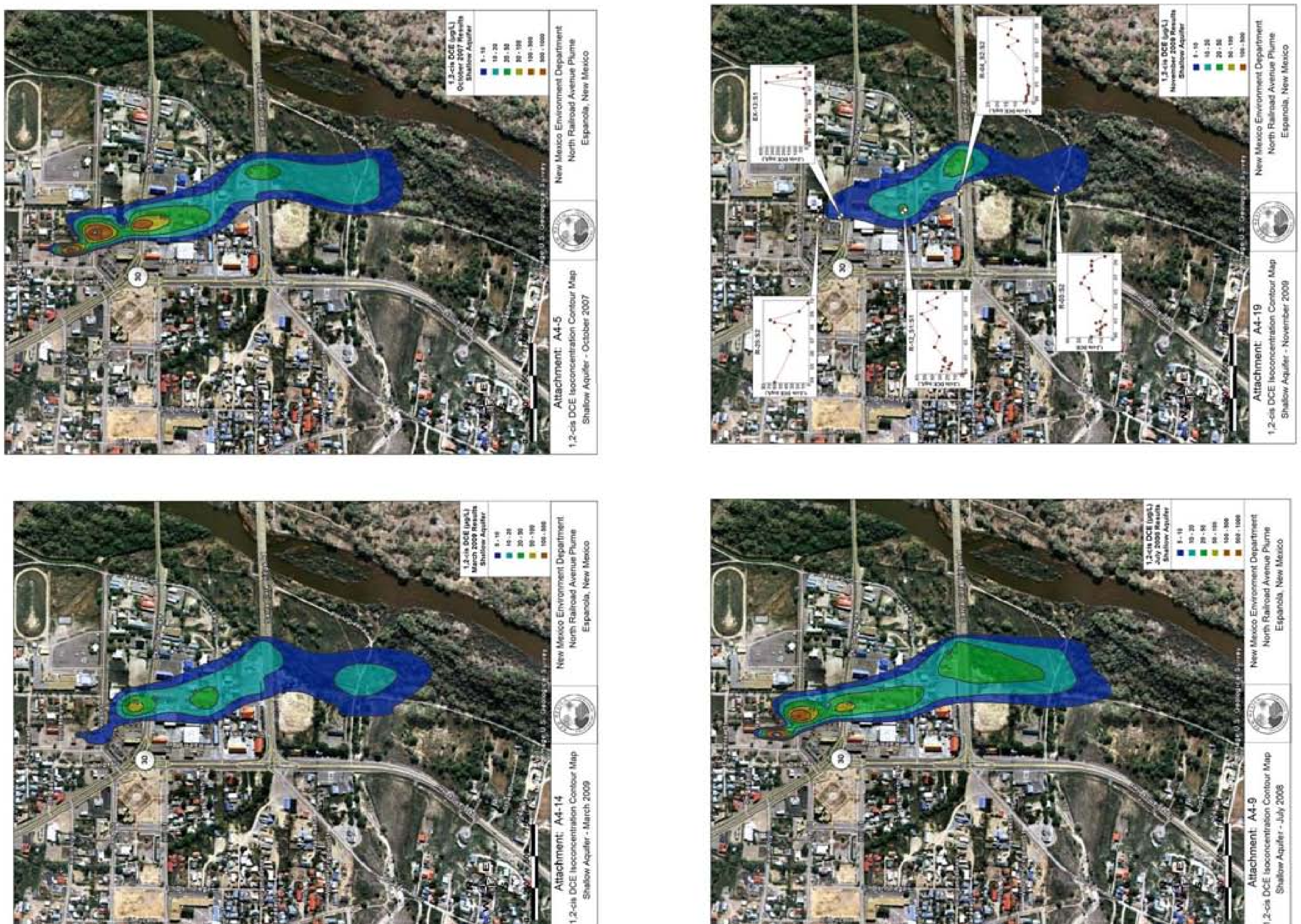
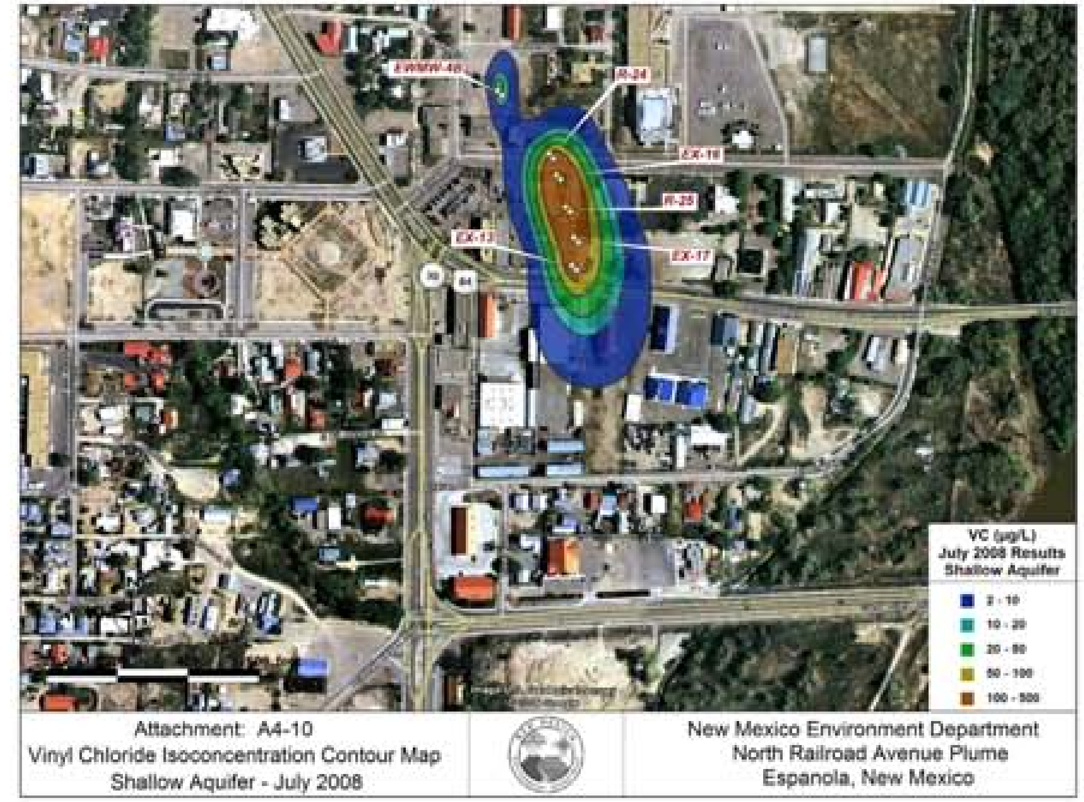
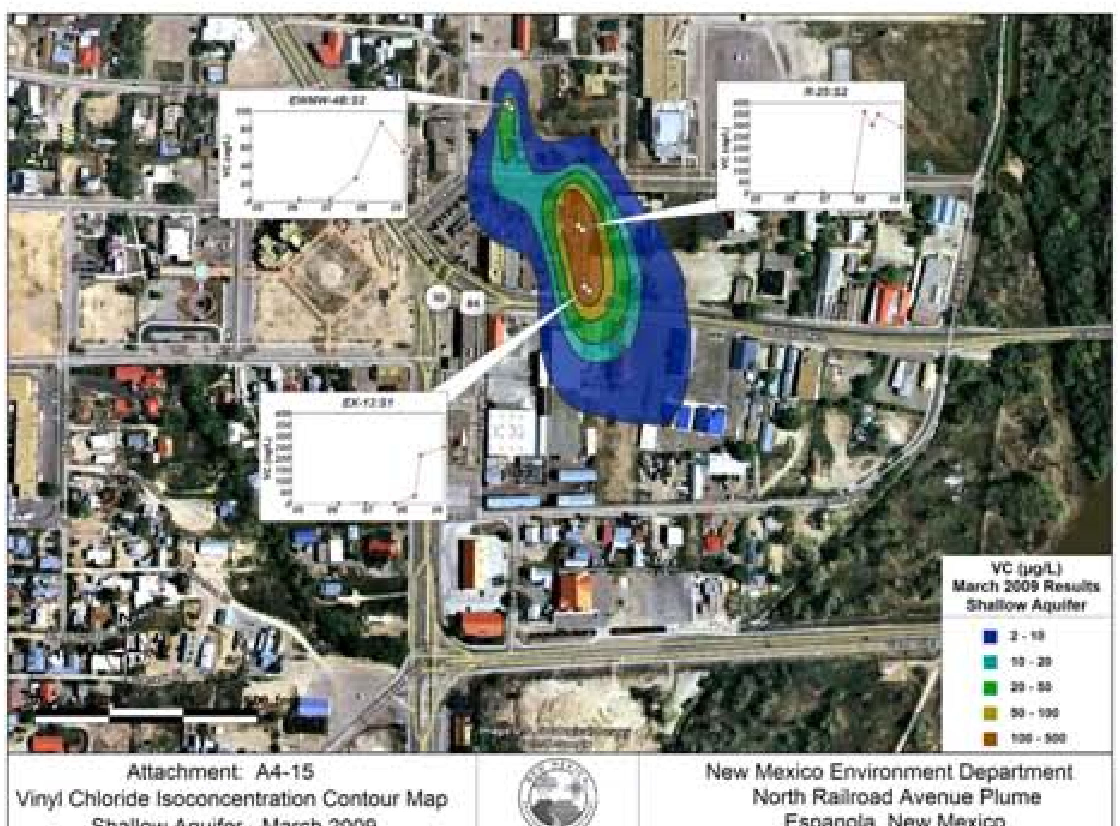


Figure A4-4: Shallow Aquifer VC Concentration Map: October 2007 – November 2009





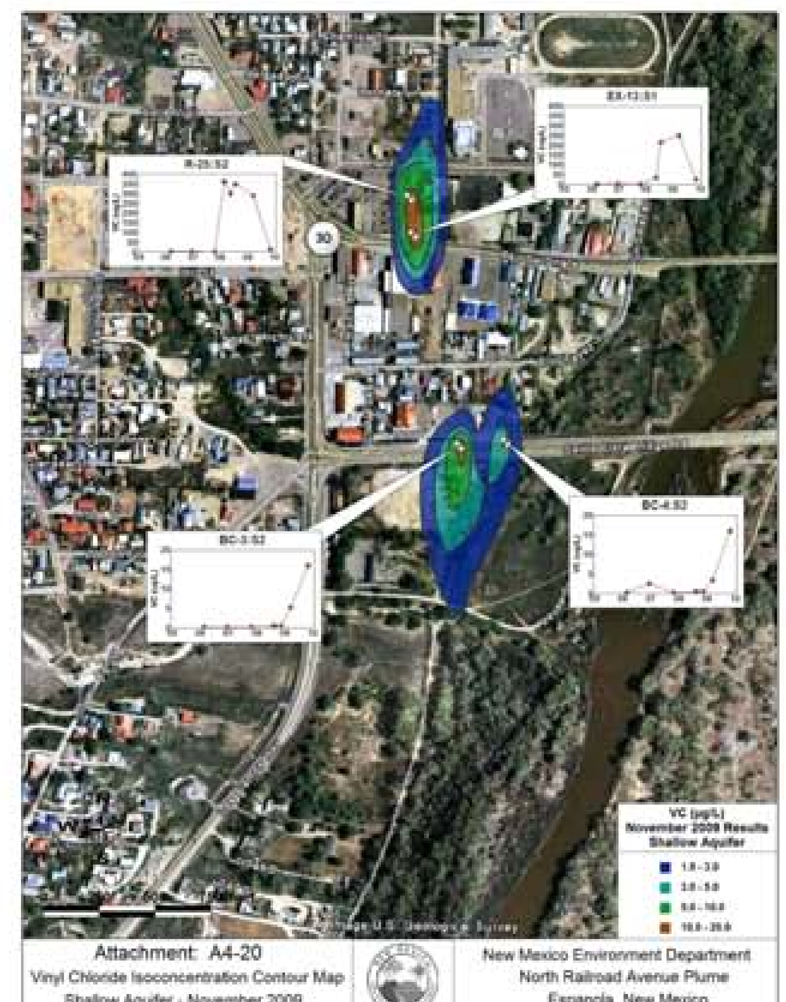
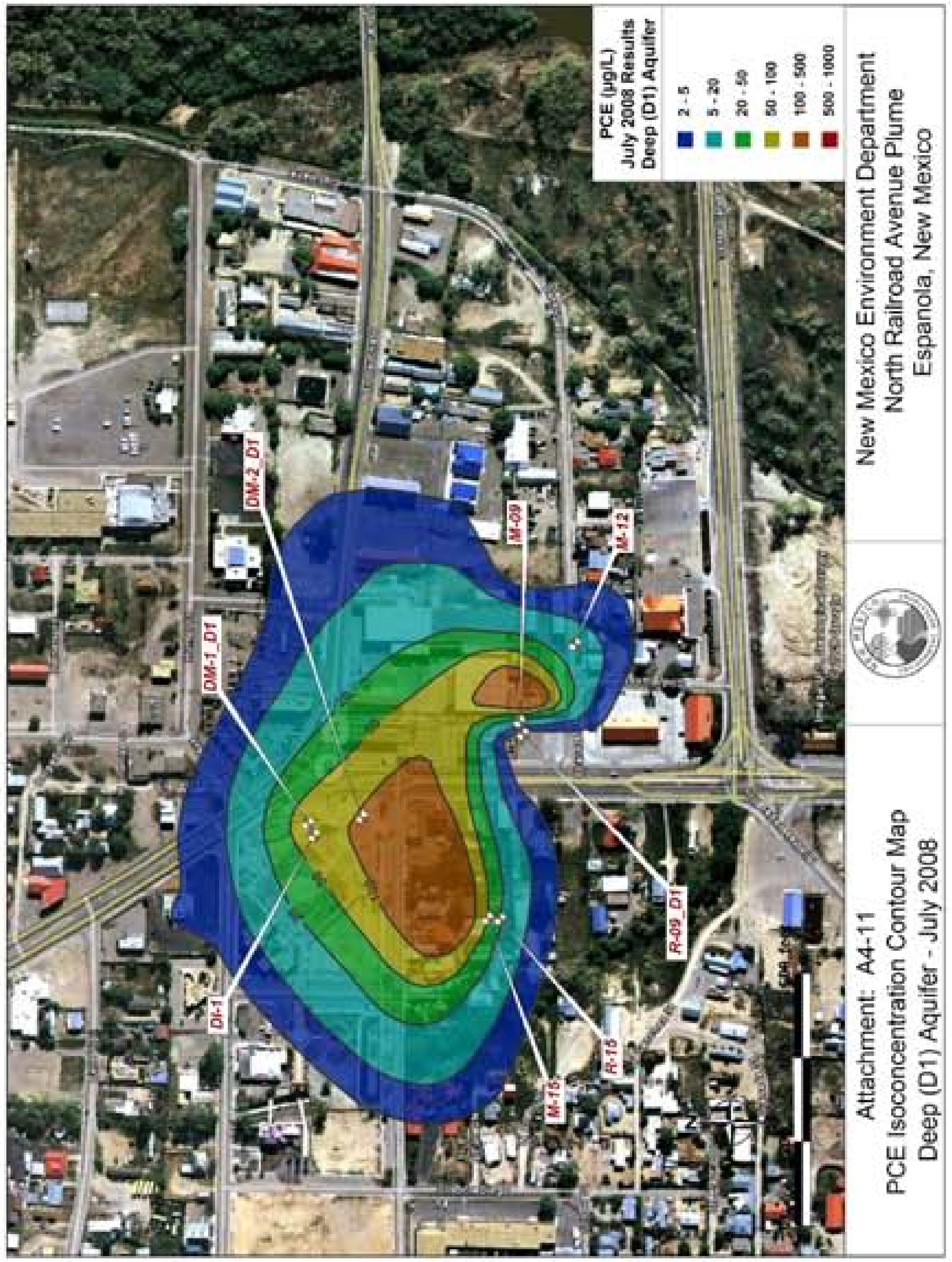
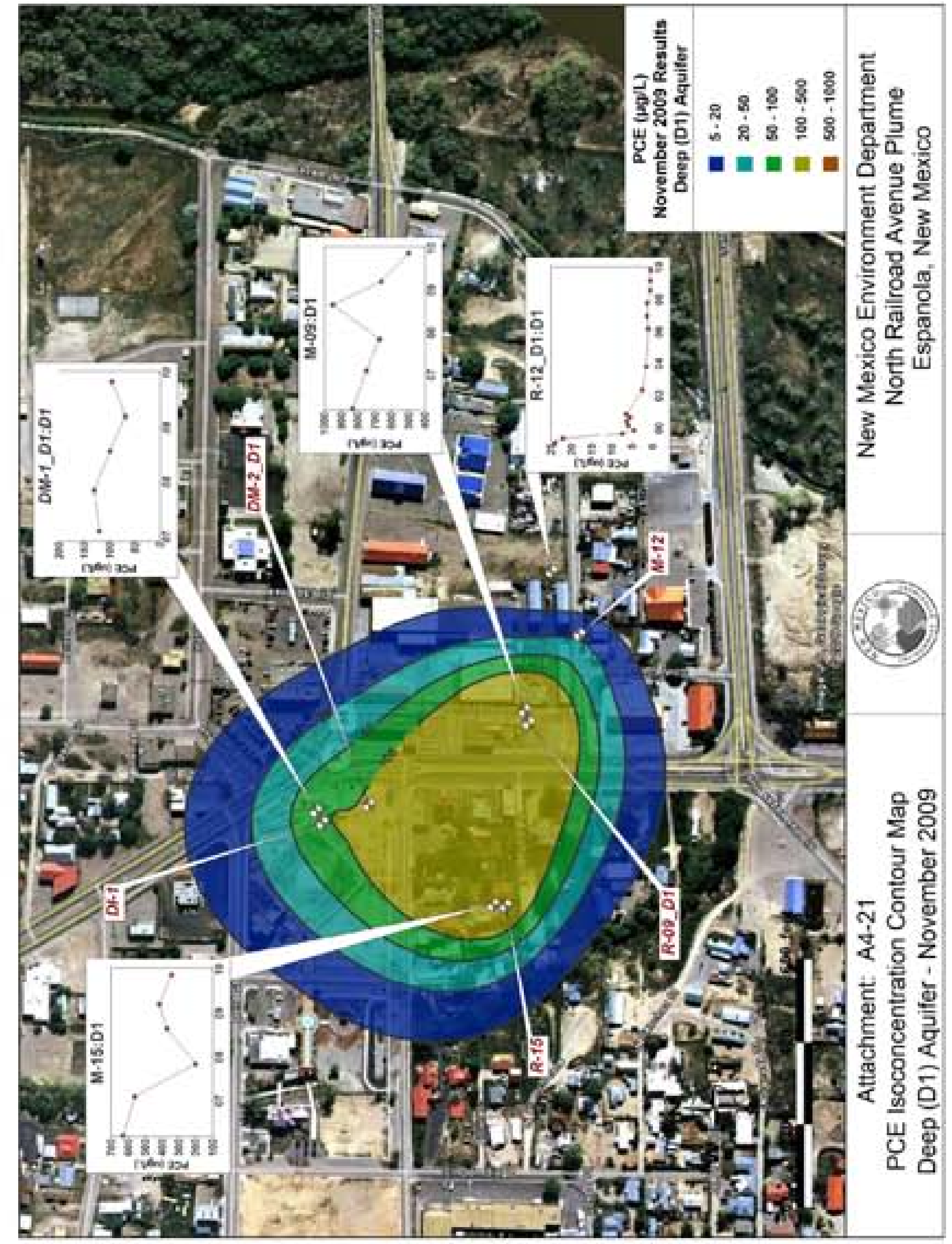
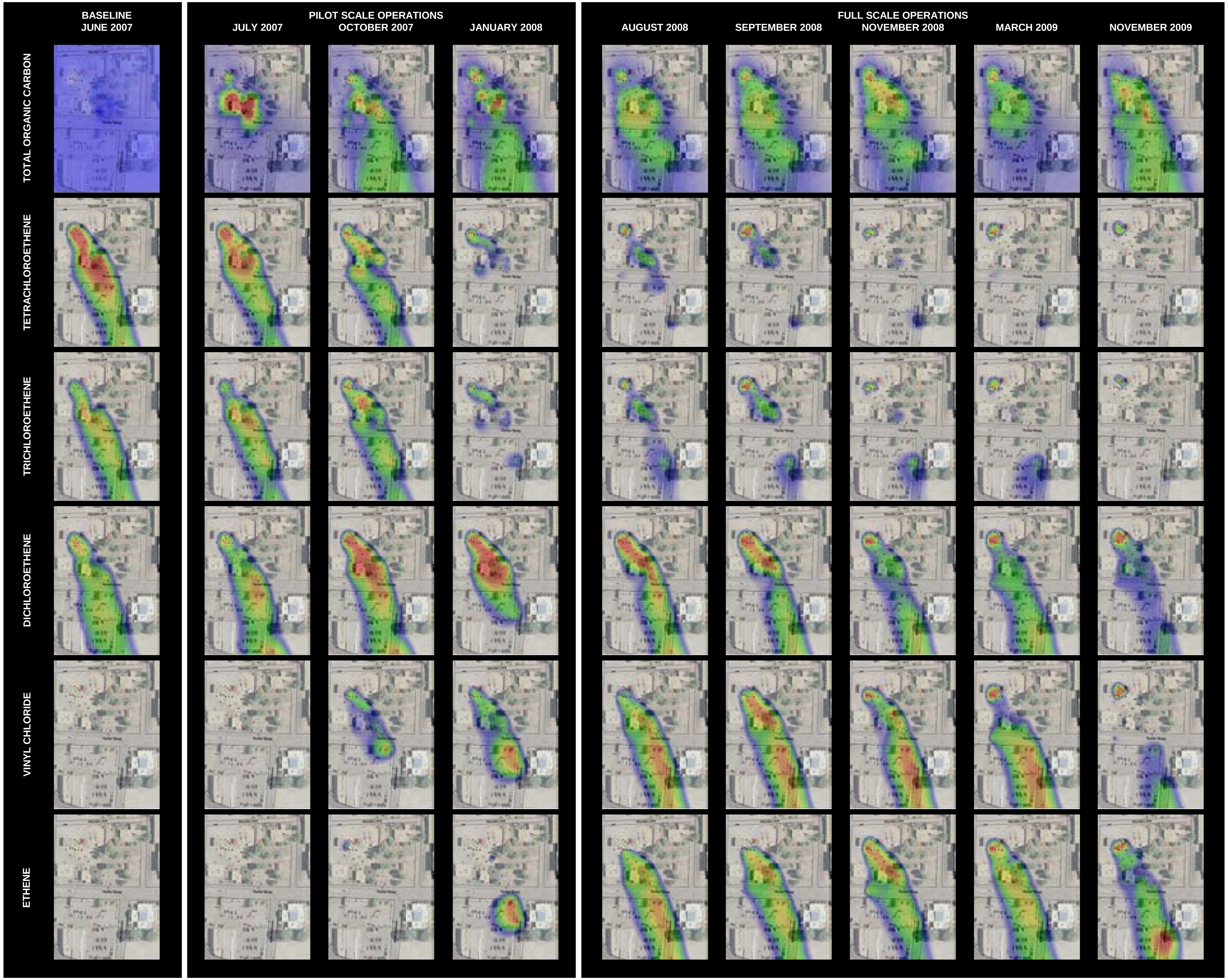
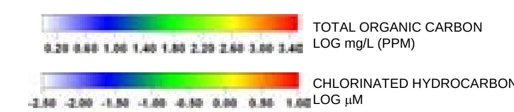


Figure A4-5: Deep (D1) Aquifer PCE Map: July 2008 – November 2009









NOTES:

1. Refer to Attachment 2 Figure 2 for detailed/labeled wells base map
2. Bioamendment was added during two separate events during pilot –scale test: June 2007 and October 2007
3. Bioamendment injections occurred at following times during full-scale operations: May 2008, November 2008, April 2009 and August 2009

Source Area/Hotspot
Reductive Dechlorination
Time-Series Plot

Figure A4-6

ATTACHMENT 5
Sampling Data Results Summaries

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
EWMW-1		6/16/1997	ND	ND	ND	ND	
EWMW-1		7/21/1997	ND	ND	ND	ND	
EWMW-1		8/19/1998	ND	ND	ND	ND	ND
EWMW-1		5/12/1999	ND	ND	ND	ND	ND
EWMW-1		8/23/1999	ND	ND	ND	ND	ND
EWMW-1		11/11/1999	ND	ND	ND	ND	ND
EWMW-1		2/24/2000	ND	ND	ND	ND	ND
EWMW-1		5/15/2002	ND	ND	ND	ND	ND
EWMW-1		10/30/2003	ND	ND	ND	ND	ND
EWMW-1	NS	2/20/2006					
EWMW-2		6/16/1997	2.6	0.9 J	ND	ND	
EWMW-2		7/21/1997	19	0.9 J	ND	ND	
EWMW-2		12/9/1997	2	ND	ND	ND	
EWMW-2		8/19/1998	20	0.4 J	ND	ND	ND
EWMW-2		2/2/1999	2	ND	ND	ND	ND
EWMW-2		5/18/1999	3 J	ND	ND	ND	ND
EWMW-2		8/26/1999	5.91	ND	ND	ND	ND
EWMW-2		11/17/1999	2.3	ND	ND	ND	ND
EWMW-2		2/25/2000	2.5	ND	ND	ND	ND
EWMW-2		9/7/2000	2.2	ND	ND	ND	ND
EWMW-2		5/14/2002	3.9	ND	ND	ND	ND
EWMW-2		10/30/2003	3.3	ND	ND	ND	ND
EWMW-2	F2028	2/20/2006	3.5	0.23 LJ	<0.5	<0.5	<0.5
EWMW-2	F2AP0	12/11/2006	4.6	0.26 LJ	<0.5	<0.5	<0.5
EWMW-2 (Dup)	F2AP1	12/11/2006	4.1	0.22 LJ	<0.5	<0.5	<0.5
EWMW-2		10/17/2007	78.7	2.2	3.5	<0.5	<0.5
EWMW-2		7/15/2008	158.0	1.9	210.0	3.1	1.3
EWMW-2		3/16/2009	1.2	9.6	17.7	24.0	24.2
EWMW-2		10/26/2009	<0.5	<0.5	<0.5	6.3	<0.5
EWMW-3		6/15/1997	1	ND	ND	ND	
EWMW-3		7/22/1997	2	ND	ND	ND	
EWMW-3		8/19/1998	ND	ND	ND	ND	ND
EWMW-3		5/12/1999	3	ND	ND	ND	ND
EWMW-3		8/26/1999	ND	ND	ND	ND	ND
EWMW-3		11/17/1999	ND	ND	ND	ND	ND
EWMW-3		2/25/2000	3.2	ND	ND	ND	ND
EWMW-3		5/15/2002	3.2	ND	ND	ND	ND
EWMW-3		10/30/2003	3.9	ND	ND	ND	ND
EWMW-3	F2029	2/20/2006	<0.5	<0.5	<0.5	<0.5	<0.5
EWMW-3	F2AP2	12/11/2007	<0.5	<0./5	<0.5	<0.5	<0.5
EWMW-3		10/17/2007	1.2	4.6	31.6	0.6	<0.5
EWMW-3		3/17/2009	<1.0	<1.0	<1.0	5.0	<1.0
EWMW-3		10/26/2009	<0.5	<0.5	<0.5	2.0	<0.5
EWMW-4A		6/16/1997	ND	ND	ND	ND	
EWMW-4A		7/21/1997	ND	ND	ND	ND	
EWMW-4A		8/19/1998	ND	ND	ND	ND	ND
EWMW-4A		5/12/1999	ND	ND	ND	ND	ND
EWMW-4A		8/23/1999	ND	ND	ND	ND	ND
EWMW-4A		11/11/1999	ND	ND	ND	ND	ND
EWMW-4A		2/24/2000	ND	ND	ND	ND	ND
EWMW-4A		5/15/2002	ND	ND	ND	ND	ND
EWMW-4A		10/31/2003	ND	ND	ND	ND	ND
EWMW-4A	F2030	2/20/2006	<0.5	<0.5	<0.5	<0.5	<0.5
EWMW-4A	F2AP3	12/11/2006	<0.5	<0.5	<0.5	<0.5	<0.5

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
EWMW-4A		10/17/2007	<0.5	<0.5	<0.5	<0.5	<0.5
EWMW-4A		7/16/2008	<1.0	<1.0	<1.0	<1.0	<1.0
EWMW-4A		3/9/2009	<1.0	<1.0	<1.0	<1.0	<1.0
EWMW-4A		10/28/2009	<0.5	<0.5	<0.5	<0.5	<0.5
EWMW-4B		6/16/1997	4400	ND	ND	ND	
EWMW-4B		7/23/1997	2700	5 J			
EWMW-4B		8/27/1998	7000	15 J			ND
EWMW-4B		4/13/1999	14000	4.9			
EWMW-4B		4/14/1999	8000	4.9			
EWMW-4B		4/15/1999	6500	2.7			
EWMW-4B		5/17/1999	11000	ND	ND	ND	ND
EWMW-4B		8/30/1999	13900	7.11	ND	ND	ND
EWMW-4B		11/19/1999	28000	ND	ND	ND	ND
EWMW-4B		2/23/2000	25000	ND	ND	ND	ND
EWMW-4B		6/7/2000	29000	ND	ND	ND	ND
EWMW-4B		9/6/2000	27000	ND	ND	ND	ND
EWMW-4B		11/16/2000	14000	ND	ND	ND	ND
EWMW-4B		5/17/2002	40000	12	ND	ND	ND
EWMW-4B		11/4/2003	29000	ND	ND	ND	ND
EWMW-4B	F20H7	3/16/2006	5900.0	20.0	<5.0	<5.0	<5.0
EWMW-4B	F2DK8	2/6/2007	1800.0	32.0	3.0 LJ	<5.0	<5.0
EWMW-4B		10/31/2007	8.3	13.0	5600.0	82.0	26.0
EWMW-4B		7/24/2008	585.0	251.0	4020.0	75.0	87.3
EWMW-4B		3/17/2009	<1.0	<1.0	12.8	15.1	54.7
EWMW-4B Dup	R-32	3/17/2009	<1.0	1.6	15.7	15.1	53.5
EWMW-4B		10/28/2009	<0.5	<0.5	0.31LJ	7.7	<0.5
EX-01		11/13/1991	ND	ND	ND	ND	
EX-01		4/5/1995	ND	ND	ND	ND	
EX-02		4/5/1995	ND	ND	ND	ND	
EX-02		12/9/1997	ND	ND	ND	ND	
EX-02		8/18/1998	ND	ND	ND	ND	ND
EX-03		4/5/1995	ND	ND	ND	ND	
EX-04		11/13/1991	ND	ND	ND	ND	
EX-05		4/5/1995	ND	ND	ND	ND	
EX-06		4/5/1995	ND	ND	ND	ND	
EX-06		12/9/1997	ND	ND	ND	ND	
EX-06		8/18/1998	ND	ND	ND	ND	ND
EX-06		5/12/1999	ND	ND	ND	ND	ND
EX-06		8/24/1999	ND	ND	ND	ND	ND
EX-06		11/17/1999	ND	ND	ND	ND	ND
EX-06		2/24/2000	ND	ND	ND	ND	ND
EX-06		9/6/2000	ND	ND	ND	ND	ND
EX-06		5/15/2002	ND	ND	ND	ND	ND
EX-06		10/27/2003	ND	ND	ND	ND	ND
EX-06	F20H8	3/6/2006	<0.5	<0.5	1.0	0.3	<0.5
EX-06	F2AP4	12/14/2006	<0.5	<0.5	1.8	0.5	<0.5
EX-06		10/17/2007	<0.5	<0.5	0.8	<0.5	<0.5
EX-06		7/15/2008	<1.0	<1.0	<1.0	<1.0	<1.0
EX-06		3/10/2009	<1.0	<1.0	<1.0	<1.0	<1.0
EX-06		10/28/2009	<0.5	<0.5	0.59	0.14LJ	<0.5
EX-07		4/5/1995	ND	ND	ND	ND	
EX-07		2/1/1999	ND	ND	ND	ND	ND
EX-08		4/5/1995	ND	ND	ND	ND	

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
EX-08		9/2/1998	ND	6 J			ND
EX-09		4/5/1995	ND	ND	ND	ND	
EX-09		2/1/1999	ND	ND	ND	ND	ND
EX-09		5/12/1999	ND	ND	ND	ND	ND
EX-09		8/23/1999	ND	ND	ND	ND	ND
EX-09		11/11/1999	ND	ND	ND	ND	ND
EX-09		2/24/2000	ND	ND	ND	ND	ND
EX-09		5/15/2002	ND	ND	ND	ND	ND
EX-09	F20H9	3/8/2006	<5.0	<5.0	<5.0	<5.0	<5.0
EX-09	F2B16	1/18/2007	<0.5	<0.5	<0.5	<0.5	<0.5
EX-09		10/28/2009	<0.5	<0.5	0.44LJ	<0.5	<0.5
EX-10		4/5/1995	ND	ND	ND	ND	
EX-10		8/18/1998	ND	ND	ND	ND	ND
EX-10		2/24/2000	ND	ND	ND	ND	
EX-10		5/15/2002	ND	ND	ND	ND	ND
EX-10		10/27/2003	ND	ND	ND	ND	ND
EX-11		4/5/1995	ND	ND	3.4	ND	
EX-11		12/9/1997	ND	ND	ND	ND	
EX-11		8/18/1998	ND	ND	ND	ND	ND
EX-11		5/12/1999	ND	ND	ND	ND	ND
EX-11		8/27/1999	ND	ND	ND	ND	ND
EX-11		11/17/1999	ND	ND	ND	ND	ND
EX-11		2/25/2000	ND	ND	ND	ND	ND
EX-11		5/16/2002	ND	ND	ND	ND	ND
EX-11		10/27/2003	ND	ND	ND	ND	ND
EX-11	F20J0	3/7/2006	<0.5	<0.5	<0.5	<0.5	<0.5
EX-12		2/15/1995	1210	52			
EX-12		4/5/1995	1400	0	ND	ND	
EX-12		6/7/1995	891	45		ND	
EX-12		3/27/1996	160.6	36.8			
EX-13		4/5/1995	1200	ND	2.1	ND	
EX-13		6/7/1995	ND	ND		ND	
EX-13		9/29/1995	964	45		ND	
EX-13		12/15/1995	1070	46			
EX-13		3/27/1996	630 J	56			
EX-13		7/23/1997	800	81			
EX-13		8/25/1998	620	44 J			ND
EX-13		2/1/1999	280	22 J	ND	ND	ND
EX-13		5/12/1999	360	27	ND	ND	ND
EX-13		8/25/1999	190	19	3.01	ND	ND
EX-13		11/15/1999	230	19	ND	ND	ND
EX-13		2/23/2000	160	13	ND	ND	ND
EX-13		9/8/2000	63	10	ND	ND	ND
EX-13		5/16/2002	140	15	2.6	ND	ND
EX-13		10/27/2003	43	6.7	1.1	ND	ND
EX-13	F20J1	3/6/2006	260.0	65.0	6.6	0.6	<0.5
EX-13	F2AP5	12/12/2006	230.0	100.0	23.0	<5	<5
EX-13		10/18/2007	53.5	49.0	356.0	1.3	<0.5
EX-13		5/13/2008	<5.0	2.0J	7.0	<5.0	34.0
EX-13		7/16/2008	<1.0	1.3	252.0	3.9	215.0
EX-13		3/17/2009	<1.0	1.0	54.0	3.1	250.0
EX-13		7/8/2009	<1.0	<1.0	17.0	4.4	190.0
EX-13		11/2/2009	<0.5	0.41 LJ	5.9	3.2	24.0

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
EX-14		4/5/1995	14	0.3	ND	ND	
EX-14		7/23/1997	6 J	ND			
EX-14		8/18/1998	11	0.4 J	ND	ND	ND
EX-14		1/29/1999	4	ND	ND	ND	ND
EX-14	F2AX0	12/14/2006	1.7	0.15 LJ	<0.5	<0.5	<0.5
EX-14		10/17/2007	1.3	<0.5	<0.5	<0.5	<0.5
EX-14		7/15/2008	2.4	<1.0	<1.0	<1.0	<1.0
EX-14		3/9/2009	1.8	<1.0	8.6	<1.0	17.3
EX-14		11/3/2009	2.3	0.39 LJ	1.4	0.24 LJ	2.3
EX-15		4/5/1995	ND	ND	ND	ND	
EX-15		12/9/1997	ND	ND	ND	ND	
EX-15		9/1/1998	ND	ND			ND
EX-15		1/28/1999	ND	ND	ND	ND	ND
EX-15	F20J2	3/8/2006	<0.5	<0.5	<0.5	<0.5	<0.5
EX-16		6/7/1995	474	34		ND	
EX-16		9/29/1995	229	15		6	
EX-16		12/15/1995	607	37			
EX-16		8/27/1998	130	19			ND
EX-16		1/28/1999	360	35 J	ND	ND	ND
EX-16		5/12/1999	400	31	12	ND	ND
EX-16		8/25/1999	163	17.5	6.89	4.71	ND
EX-16		11/15/1999	340	35	11	ND	ND
EX-16		2/24/2000	190	37	ND	ND	
EX-16		9/8/2000	150	29	ND	ND	ND
EX-16		5/16/2002	480	52	14	ND	ND
EX-16		10/27/2003	370	100	7.4	ND	ND
EX-16	F20J4	3/6/2006	150.0	32.0	9.9	<5.0	<5
EX_16	F2AP6	12/12/2006	750.0	150.0	10.0	<5	<5
EX-16		10/18/2007	52.1	48.4	406.0	6.7	192.0
EX-16		1/11/2008	<2.0	<2.0	7.4	3.1	660.0
EX-16		2/21/2008	<1.0	<1.0	7.4	1.8	500.0
EX-16		5/13/2008	<5.0	<5.0	160.0	<1.0	140.0
EX-16		7/31/2008	11.0	1.1	410.0	2.2	470.0
EX-16		8/28/2008	<1	<1	57.0	2.5	460.0
EX-16		11/19/2008	<10	<10	35.0	<10	490.0
EX-16		3/17/2009	<1.0	<1.0	4.9	2.5	170.0
EX-16		11/3/2009	<0.5	<0.5	0.42 LJ	2.8	7.5
EX-17		6/7/1995	419	36		ND	
EX-17		9/29/1995	139	13		ND	
EX-17		12/15/1995	170	20			
EX-17		9/2/1998	85 J	10			ND
EX-17		2/1/1999	170	19	9 J	ND	ND
EX-17		5/12/1999	260	25	12	0.6 LJ	ND
EX-17		8/25/1999	89.8	10.3	3.98	ND	ND
EX-17		11/15/1999	140	19	6.8	ND	ND
EX-17		2/24/2000	60	8.5	ND	ND	ND
EX-17		5/16/2002	56	5.9	3.2	ND	ND
EX-17	F20J5	3/6/2006	95.0	35.0	8.2	<5.0	<5.0
EX-17 Dup	F20J6	3/6/2006	64.0	23.0	5.4	<5.0	<5.0
EX-17	F2AP7	112/12/2006	80.0	36.0	10.0	0.82 LJ	<5
EX-17		10/18/2007	9.3	4.9	3.0	<0.5	<0.5
EX-17		2/21/2008	<1.0	<1.0	<1.0	<1.0	<1.0
EX-17		5/13/2008	<5	<5	2 J	<5	19.0

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
EX-17		7/16/2008	4.9	3.4	32.0	1.0	143.0
EX-17		11/19/2008	5.1	3.8	130.0	3.3	310.0
EX-17		3/17/2009	4.0	2.8	120.0	1.9	150.0
EX-17		7/8/2009	2.9	2.0	35.0	2.0	66.0
EX-17		11/2/2009	1.9	1.0	9.4	0.95	11.0
R-01(I2)		8/24/1998	ND	ND	ND	ND	ND
R-01(I2)		1/28/1999	1	ND	ND	ND	ND
R-01(I2)		5/10/1999	0.6 J	ND	ND	ND	ND
R-01(I2)		8/24/1999	ND	ND	ND	ND	ND
R-01(I2)		11/12/1999	ND	ND	ND	ND	ND
R-01(I2)		2/21/2000	ND	ND	ND	ND	ND
R-01(I2)		5/15/2002	ND	ND	ND	ND	ND
R-01(I2)		10/30/2003	ND	ND	ND	ND	ND
R-01(I2)	F20J7	3/7/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-01(I2)	F2AP8	12/11/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-01(I2)		10/26/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-01(S1)		8/24/1998	ND	ND	ND	ND	ND
R-01(S2)		8/24/1998	ND	ND	ND	ND	ND
R-01(S2)		1/28/1999	ND	ND	ND	ND	ND
R-01(S2)		5/10/1999	ND	ND	ND	ND	ND
R-01(S2)		8/24/1999	ND	ND	ND	ND	ND
R-01(S2)		11/12/1999	ND	ND	ND	ND	ND
R-01(S2)		2/21/2000	ND	ND	ND	ND	ND
R-01(S2)		5/15/2002	ND	ND	ND	ND	ND
R-01(S2)		10/27/2003	ND	ND	ND	ND	ND
R-01(S2)	F2031	2/20/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-01(S2)	F2AP9	12/11/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-01(S2)		10/17/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-01(S2)		7/15/2008	<1.0	<1.0	<1.0	<1.0	<1.0
R-01(S2)		3/10/2009	<1.0	<1.0	<1.0	<1.0	<1.0
R-01(S2)		11/17/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-02(S2)		8/18/1998	ND	ND	ND	ND	ND
R-02(S2)		5/11/1999	ND	ND	ND	ND	ND
R-02(S2)		8/27/1999	ND	ND	ND	ND	ND
R-02(S2)		11/12/1999	ND	ND	ND	ND	ND
R-02(S2)		2/24/2000	ND	ND	ND	ND	
R-02(S2)		5/16/2002	ND	ND	ND	ND	ND
R-02(S2)		10/28/2003	ND	ND	ND	ND	ND
R-02(S2)		3/6/2006	NS	NS	NS	NS	NS
R-03(I1)		1/29/1999	ND	ND	ND	ND	ND
R-03(I1)		5/11/1999	ND	ND	ND	ND	ND
R-03(I1)		8/25/1999	ND	ND	ND	ND	ND
R-03(I1)		11/12/1999	ND	ND	ND	ND	ND
R-03(I1)		2/25/2000	ND	ND	ND	ND	ND
R-03(I1)		5/14/2002	ND	ND	ND	ND	ND
R-03(I1)		10/29/2003	ND	ND	ND	ND	ND
R-03(I1)	F20K0	3/7/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-03(I1)	F2AQ0	12/14/2006	<0.5 UJ	<0.5 UJ	<0.5	<0.5	<0.5
R-03(I1)		10/29/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-03(I2)		9/2/1998	0.5 J	ND	ND	ND	ND
R-03(I2)		1/29/1999	ND	ND	ND	ND	ND

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
R-03(I2)	F20K1	3/7/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-03(I2)	F2AQ1	12/14/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-03(S2)		8/18/1998	0.5 J	4	0.7 J	ND	ND
R-03(S2)		1/29/1999	0.5 J	3	ND	ND	ND
R-03(S2)		5/11/1999	ND	3	ND	ND	ND
R-03(S2)		8/25/1999	ND	1.54	ND	ND	ND
R-03(S2)		11/12/1999	ND	1.6	ND	ND	ND
R-03(S2)		2/24/2000	ND	1.6	ND	ND	
R-03(S2)		9/6/2000	ND	1.5	ND	ND	ND
R-03(S2)		5/16/2002	ND	1.2	ND	ND	ND
R-03(S2)		10/27/2003	ND	1.4	ND	ND	ND
R-03(S2)	F20J9	3/7/2006	<0.5	0.9	<0.5	<0.5	<0.5
R-03(S2)	F2AQ2	12/14/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-03(S2)		3/10/2009	<1.0	<1.0	<1.0	<1.0	<1.0
R-03(S2)		10/29/2009	<0.5	0.46 LJ	0.16 LJ	<0.5	<0.5
R-04(I2)		8/27/1998	62	ND	ND	ND	ND
R-04(I2)		10/14/1998	ND	ND	ND	ND	ND
R-04(I2)		1/27/1999	ND	ND	ND	ND	ND
R-04(I2)		5/11/1999	ND	ND	ND	ND	ND
R-04(I2)		8/26/1999	ND	ND	ND	ND	ND
R-04(I2)		11/13/1999	ND	ND	ND	ND	ND
R-04(I2)		2/24/2000	ND	ND	ND	ND	ND
R-04(I2)		9/7/2000	ND	ND	ND	ND	ND
R-04(I2)		5/14/2002	ND	ND	ND	ND	ND
R-04(I2)		10/29/2003	ND	ND	ND	ND	ND
R-04(I2)	F2033	2/22/2006	<0.5	0.9	<0.5	<0.5	<0.5
R-04(I2)	F2AQ3	12/12/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-04(I2)		10/18/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-04(I2)		7/17/2008	<1.0	<1.0	<1.0	<1.0	<1.0
R-04(I2)		3/9/2009	<1.0	<1.0	<1.0	<1.0	<1.0
R-04(I2)	F3B96	10/29/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-04(S2)		8/27/1998	4	10	4	1	ND
R-04(S2)		10/15/1998	5	12	4	0.9 J	ND
R-04(S2)		1/27/1999	4	12	4	1	ND
R-04(S2)		5/11/1999	5	14	4	1	ND
R-04(S2)		8/26/1999	1.79	10.7	2.85	1.11	ND
R-04(S2)		11/13/1999	1.9	9.1	2.6	1.2	ND
R-04(S2)		2/24/2000	1.3	8.7	2.6	1.5	
R-04(S2)		6/7/2000	1.3	7.2	2.7	1.8	ND
R-04(S2)		9/7/2000	1.8	7.6	2.2	1.8	ND
R-04(S2)		11/15/2000	1.5	7.9	3.1	2.3	ND
R-04(S2)		5/13/2002	10	21	4.3	4.1	ND
R-04(S2)		10/27/2003	5.1	14	5.3	6.8	ND
R-04(S2)	F2032	2/22/2006	4.4	25.0	14.0	14.0	<0.5
R-04(S2)	F2AQ4	12/11/2006	7.2	27.0	8.4	9.0	<0.5
R-04(S2)		10/17/2007	5.6	28.1	14.1	16.8	<0.5
R-04(S2)		7/17/2008	3.3	24.5	12.2	14.0	<1.0
R-04(S2)		3/9/2009	<1.0	1.7	20.0	11.9	<1.0
R-04(S2) Dup	R-30L	3/9/2009	<1.0	1.7	21.1	12.6	<1.0
R-04(S2)	F3B95	10/29/2009	0.31LJ	4.9	12.0	12.0	1.2
R-04(S2)Dup	R-50	10/29/2009	0.33LJ	5.3	13.0	13.0	1.2
R-05(S2)		8/26/1998	16	67	19	7	ND
R-05(S2)		10/14/1998	17	66	19	7	ND

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
R-05(S2)		2/1/1999	14	35	11	4	ND
R-05(S2)		5/18/1999	10	45	11	6	ND
R-05(S2)		8/24/1999	9.82	35.4	14.1	4.66	ND
R-05(S2)		11/16/1999	7.6	26	11	3.7	ND
R-05(S2)		2/29/2000	8.8	27	9.4	4.2	ND
R-05(S2)		6/6/2000	5.5	18	6.5	3	ND
R-05(S2)		9/5/2000	8.1	35	15	6	ND
R-05(S2)		11/17/2000	7.4	31	11	4.9	ND
R-05(S2)		5/13/2002	3.3	12	6.6	2.9	ND
R-05(S2)		10/28/2003	8.1	23	18	6.6	ND
R-05(S2)		6/23/2005	5.3	13.0	21.0	8.1	<5.0
R-05(S2) Dup		6/23/2005	5.4	14.0	21.0	8.1	<5.0
R-05(S2)	F2034	2/22/2006	7.0	21.0	28.0	11.0	<0.5
R-05(S2) Dup	F2035	2/22/2006	7.1	22.0	29.0	11.0	<0.5
R-05(S2)	F2AX6	12/18/2006	5.1	15.0	25.0	8.3	<5
R-05(S2)		10/23/2007	5.3	15.1	18.5	7.0	<0.5
R-05(S2)A Dup		10/23/2007	4.6	12.9	14.1	5.7	<0.5
R-05(S2)		7/21/2008	5.0	14.8	18.9	6.7	<1.0
R-05(S2)A Dup		7/21/2008	5.0	15.2	19.5	6.7	<1.0
R-05(S2)		3/11/2009	7.5	16.3	18.5	7.8	<1.0
R-05(S2)		10/27/2009	4.4	6.0	7.0	3.5	1.8
R-06(S1)		2/1/1999	ND	ND	ND	ND	ND
R-06(S2)		8/26/1998	ND	ND	ND	ND	ND
R-06(S2)		2/1/1999	ND	ND	ND	ND	ND
R-06(S2)		5/18/1999	ND	0.6 J	ND	ND	ND
R-06(S2)		8/24/1999	ND	ND	ND	ND	ND
R-06(S2)		11/16/1999	ND	ND	ND	ND	ND
R-06(S2)		2/22/2000	ND	ND	ND	ND	ND
R-06(S2)		9/5/2000	ND	ND	ND	ND	ND
R-06(S2)		5/13/2002	ND	ND	ND	ND	ND
R-06(S2)		10/28/2003	ND	ND	ND	ND	ND
R-06(S2)	F2036	2/22/2006	0.45 LJ	2.1	1.6	0.5	<0.5
R-06(S2)	F2AQ6	12/18/2006	0.43 LJ	1.7 J	14 J	0.41 LJ	<0.5 UR
R-06(S2)		10/23/2007	<0.5	1.8	1.7	0.6	<0.5
R-06(S2)		7/21/2008	<1.0	2.5	2.7	<1.0	<1.0
R-06(S2)		3/11/2009	<1.0	1.1	<1.0	<1.0	<1.0
R-06(S2)		10/27/2009	4.4	1.1	0.48LJ	<0.5	<0.5
R-07(S2)		8/26/1998	ND	ND	ND	ND	ND
R-07(S2)		5/18/1999	ND	ND	ND	ND	ND
R-07(S2)		8/24/1999	ND	ND	ND	ND	ND
R-07(S2)		11/16/1999	ND	ND	ND	ND	ND
R-07(S2)		2/22/2000	ND	ND	ND	ND	ND
R-07(S2)		5/13/2002	ND	ND	ND	ND	ND
R-07(S2)		10/28/2003	ND	ND	ND	ND	ND
R-07(S2)	F2037	2/22/2006	<0.5	0.18 LJ	<0.5	<0.5	<0.5
R-07(S2)	F2AQ7	12/18/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-07(S2)		10/27/2009	0.32LJ	<0.5	<0.5	<0.5	<0.5
R-08(D1)		1/27/1999	ND	ND	ND	ND	ND
R-08(D1)		5/17/1999	8	ND	ND	ND	ND
R-08(D1)		8/25/1999	ND	ND	ND	ND	ND
R-08(D1)		11/15/1999	ND	ND	ND	ND	ND
R-08(D1)		2/24/2000	ND	ND	ND	ND	ND
R-08(D1)		5/16/2002	ND	ND	ND	ND	ND
R-08(D1)		10/28/2003	ND	ND	ND	ND	ND

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
R-08(D1)	F2040	2/21/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-08(D1)	F2AQ8	12/13/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-08(D1)		10/27/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-08(I2)		8/25/1998	1.8	2.7	0.9 J	ND	ND
R-08(I2)		1/27/1999	2	3	0.6 J	ND	ND
R-08(I2)		5/18/1999	2 J	2 J	0.6 LJ	ND	ND
R-08(I2)		8/26/1999	ND	2.6	ND	ND	ND
R-08(I2)		11/15/1999	1.2	2.2	ND	ND	ND
R-08(I2)		2/24/2000	2.4	2.5	ND	ND	ND
R-08(I2)		5/16/2002	ND	1.1	ND	ND	ND
R-08(I2)		11/3/2003	1.1	1.3	ND	ND	ND
R-08(I2)	F2039	2/21/2006	1.4	0.47 LJ	0.20 LJ	<0.5	<0.5
R-08(I2)	F2AQ9	12/13/2006	2.1	2.8	0.6	0.12 LJ	<0.5
R-08(I2)		10/17/2007	1.8	3.1	0.6	<0.5	<0.5
R-08(I2)		7/17/2008	1.9	3.2	<1.0	<1.0	<1.0
R-08(I2)		3/10/2009	2.6	3.7	<1.0	<1.0	<1.0
R-08(I2)		10/29/2009	3.1	4.5	0.87	0.2 LJ	<0.5
R-08(S2)		8/18/1998	ND	ND	0.3 J	ND	ND
R-08(S2)		1/27/1999	ND	ND	ND	ND	ND
R-08(S2)		5/18/1999	ND	ND	ND	ND	ND
R-08(S2)		8/25/1999	ND	ND	ND	ND	ND
R-08(S2)		11/13/1999	ND	ND	ND	ND	ND
R-08(S2)		2/25/2000	ND	ND	ND	ND	ND
R-08(S2)		5/13/2002	ND	ND	ND	ND	ND
R-08(S2)		10/27/2003	ND	ND	ND	ND	ND
R-08(S2)	F2038	2/21/2006	0.16 LJ	0.16LJ	0.23 LJ	<.05	<0.5
R-08(S2)	2AR0	12/13/2006	<0.5	0.15 LJ	0.22 LJ	<0.5	<0.5
R-08(S2)		10/17/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-08(S2)		7/17/2008	<1.0	<1.0	<1.0	<1.0	<1.0
R-08(S2)		3/10/2009	<1.0	<1.0	<1.0	<1.0	<1.0
R-08(S2)		10/27/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-09(D1)		9/2/1998	260	ND	ND	ND	ND
R-09(D1)		1/28/1999	290 J	ND	ND	ND	ND
R-09(D1)		5/17/1999	260	ND	ND	ND	ND
R-09(D1)		8/30/1999	106	3.5	ND	ND	ND
R-09(D1)		11/13/1999	120	ND	ND	ND	ND
R-09(D1)		2/28/2000	190	ND	ND	ND	ND
R-09(D1)		6/8/2000	140	ND	ND	ND	ND
R-09(D1)		9/8/2000	130	ND	ND	ND	ND
R-09(D1)		11/16/2000	97	ND	ND	ND	ND
R-09(D1)		5/17/2002	170	4.7	ND	ND	ND
R-09(D1)		11/3/2003	330	5.8	ND	ND	ND
R-09(D1)		7/25/2008	<1.0	<1.0	5.9	<1.0	<1.0
R-09(D1)		9/3/2008	<1.0	<1.0	4.9	<1.0	<1.0
R-09(D1)		11/11/2008	<1.0	<1.0	12.0	<1.0	<1.0
R-09(D1)		7/10/2009	<1.0	<1.0	230.0	<1.0	3.4
M-09	F20K8	3/16/2006	830.0	16.0	<5.0	<5.0	<5.0
M-09	F2DK9	2/5/2007	750.0	9.2	0.61 LJ	0.57 LJ	<5.0
M-09	F2GL7	11/5/2007	670.0	11LJ	<25	<25	<25
M-09(170') PDB	F2GL8	11/5/2007	71.0	6.7	<5	<5	<5
M-09(178') PDB	F2GL9	11/5/2007	260.0	15.0	<5	<5	<5
M-09(185') PDB	F2GK0	11/5/2007	310.0	13.0	<5	<5	<5
M-09		8/27/2008	950.0	21.0	<5	<5	<5

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
M-09		3/18/2009	659.0	22.6	2.4	1.7	<1.0
M-09		7/9/2009	410.0	16.0	8.9	3.0	<1.0
M-09		11/18/2009	498.0	53.5	11.4	<2.5	<2.5
M-09(178') PDB		11/18/2009	16.4	4.3	5.3	<0.5	<0.5
R-09(D2)		8/26/1998	89	6	ND	ND	ND
R-09(D2)		1/28/1999	47 J	5	ND	ND	ND
R-09(D2)		5/18/1999	58	5	ND	ND	ND
R-09(D2)		8/31/1999	20.5	3.53	ND	ND	ND
R-09(D2)		11/14/1999	45	5	ND	ND	ND
R-09(D2)		11/16/1999	52	6	ND	ND	ND
R-09(D2)		11/17/1999	49	6.2	ND	ND	ND
R-09(D2)		2/28/2000	26	3.6	ND	ND	ND
R-09(D2)		6/9/2000	40	5.5	ND	ND	ND
R-09(D2)		9/8/2000	39	5	ND	ND	ND
R-09(D2)		5/16/2002	46	4.8	ND	ND	ND
R-09(D2)		10/31/2003	47	5	ND	ND	ND
R-09(D2)	F20K6	3/16/2006	88.0	8.1	<5.0	<5.0	<5.0
R-09(D2)	F2DL5	2/5/2007	46.0	6.0	0.42 LJ	<5.0	<5.0
R-09(D2)		10/24/2007	42.9	6.6	<0.5	<0.5	<0.5
R-09(D2)		7/28/2008	49.9	6.2	<1.0	<1.0	<1.0
R-09(D2)		11/14/2008	39.0	6.7	<1.0	<1.0	<1.0
R-09(D2)		3/12/2009	54.8	7.0	<1.0	<1.0	<1.0
R-09(D2)		7/9/2009	42.0	6.9	<1.0	<1.0	<1.0
R-09(D3)		1/26/1999	0.8 J	0.6 J	ND	ND	ND
R-09(D3)		5/13/1999	ND	ND	ND	ND	ND
R-09(D3)		8/26/1999	ND	ND	ND	ND	ND
R-09(D3)		11/22/1999	ND	ND	ND	ND	ND
R-09(D3)		2/28/2000	ND	ND	ND	ND	ND
R-09(D3)		5/16/2002	ND	ND	ND	ND	ND
R-09(D3)		10/28/2003	ND	ND	ND	ND	ND
R-09(D3)	F20K7	3/14/2006	0.42 LJ	<0.5	<0.5	<0.50	<0.5
R-09(D3)	F2B21	1/18/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-09(D3)		11/16/2009	0.6	<0.5	<0.5	<0.5	<0.5
R-09(I1)		8/20/1998	13	13	2	ND	ND
R-09(I1)		1/26/1999	15	14	2	ND	ND
R-09(I1)		5/13/1999	16	13	2	ND	ND
R-09(I1)		8/30/1999	6.63	10.5	1.48	ND	ND
R-09(I1)		11/11/1999	8	12	1.6	ND	ND
R-09(I1)		2/25/2000	8.3	10	1.5	ND	ND
R-09(I1)		5/15/2002	20	12	2.1	ND	ND
R-09(I1)		10/30/2003	23	12	2.1	ND	ND
R-09(I1)	F20K3	3/7/2006	26.0	15.0	2.8	0.4	<0.5
R-09(I1) Dup	F20K4	3/7/2006	24.0	13.0	2.2	0.3	<0.5
R-09(I1)*	Pinnacle	8/29/2007	27.0	14.0	2.7	<1.0	<1.0
R-09(I1)		10/22/2007	33.9	15.1	2.6	<0.5	<0.5
R-09(I1)		7/21/2008	49.6	15.5	2.6	<1.0	<1.0
R-09(I1)		3/18/2009	55.5	15.7	2.3	<1.0	<1.0
R-09(I1)		11/3/2009	65.0	12.0	2.2	0.3 LJ	<0.5
R-09(I2)		11/2/1992	56	19			
R-09(I2)		7/22/1997	66	24	0.8 J	ND	
R-09(I2)		7/23/1997	56	19	0.9 J	ND	
R-09(I2)		9/2/1998	44	20	ND	ND	ND
R-09(I2)		1/26/1999	63	24	1	ND	ND

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
R-09(I2)		5/18/1999	57	23	ND	ND	ND
R-09(I2)		8/27/1999	27.7	18.9	ND	ND	ND
R-09(I2)		11/12/1999	12	9	ND	ND	ND
R-09(I2)		2/25/2000	42	23	1	ND	ND
R-09(I2)		6/8/2000	33	24	ND	ND	ND
R-09(I2)		9/7/2000	44	22	1.1	ND	ND
R-09(I2)		11/16/2000	30	19	ND	ND	ND
R-09(I2)		11/17/2000	31	5.6	ND	ND	ND
R-09(I2)		5/17/2002	58	24	1.2	ND	ND
R-09(I2)		10/30/2003	56	24	1.2	ND	ND
R-09(I2)	F20K5	3/9/2006	48.0	25.0	2.3 LJ	<5.0	<5.0
R-09(I2)	F2DL4	2/6/2007	49.0	22.0	1.5 LJ	0.27 LJ	<5.0
R-09(I2)	F2GJ5	11/5/2007	43.0	22.0	<5.0	<5.0	<5.0
R-09(I2) PDB	F2GJ6	11/5/2007	16.0	20.0	<5.0	<5.0	<5.0
R-09(I2)		7/24/2008	62.0	26.7	1.8	<1.0	<1.0
R-09(I2)		3/12/2009	55.0	24.1	1.7	<1.0	<1.0
R-09(I2)		11/3/2009	41.0	18.0	1.3	<0.5	<0.5
R-09(S1)		11/2/1992	3 J	1 J	1.3	ND	
R-09(S1)		7/22/1997	0.5 J	ND	ND	ND	
R-09(S1)		8/20/1998	ND	ND	ND	ND	ND
R-09(S1)		5/13/1999	0.6 J	ND	ND	ND	ND
R-09(S1)		8/27/1999	ND	ND	ND	ND	ND
R-09(S1)		11/10/1999	ND	ND	ND	ND	ND
R-09(S1)		2/25/2000	ND	ND	ND	ND	ND
R-09(S1)		5/17/2002	ND	ND	ND	ND	ND
R-09(S1)		10/27/2003	ND	ND	ND	ND	ND
R-09(S1)	NS	3/6/2006					
R-09(S1)*	Pinnacle	8/29/2007	<1.0	<1.0	<1.0	<1.0	<1.0
R-09(S1)		11/5/2009	0.31 LJ	0.42 LJ	0.36 LJ	<0.5	<0.5
R-10(D2)		8/25/1998	ND	ND	ND	ND	ND
R-10(D2)		5/12/1999	ND	ND	ND	ND	ND
R-10(D2)		8/25/1999	ND	ND	ND	ND	ND
R-10(D2)		11/13/1999	ND	ND	ND	ND	ND
R-10(D2)		2/23/2000	ND	ND	ND	ND	ND
R-10(D2)		5/14/2002	ND	ND	ND	ND	ND
R-10(D2)		10/27/2003	ND	ND	ND	ND	ND
R-10(D2)	F20L1	3/6/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-10(D2)	F2AR1	12/12/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-10(D2)		10/30/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-10(I1)		8/24/1998	ND	ND	ND	ND	ND
R-10(I1)		5/12/1999	ND	ND	ND	ND	ND
R-10(I1)		8/25/1999	ND	ND	ND	ND	ND
R-10(I1)		11/13/1999	ND	ND	ND	ND	ND
R-10(I1)		9/7/2000	ND	ND	ND	ND	ND
R-10(I1)		5/14/2002	ND	ND	ND	ND	ND
R-10(I1)		10/31/2003	ND	ND	ND	ND	ND
R-10(I1)	F20K9	3/6/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-10(I1)	F2AR2	12/12/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-10(I1)		11/2/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-10(I2)		8/24/1998	ND	ND	ND	ND	ND
R-10(I2)		5/12/1999	ND	ND	ND	ND	ND
R-10(I2)		8/25/1999	ND	ND	ND	ND	ND
R-10(I2)		11/13/1999	ND	ND	ND	ND	ND

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
R-10(I2)		2/23/2000	ND	ND	ND	ND	ND
R-10(I2)		2/24/2000	ND	ND	ND	ND	ND
R-10(I2)		5/14/2002	ND	ND	ND	ND	ND
R-10(I2)		10/27/2003	ND	ND	ND	ND	ND
R-10(I2)	F20L0	3/6/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-10(I2)	F2AR3	12/12/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-10(I2)		11/2/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-11(I1)		8/20/1998	ND	ND	ND	ND	ND
R-11(I1)		5/14/2002	ND	ND	ND	ND	ND
R-11(I1)		10/29/2003	ND	ND	ND	ND	ND
R-11(I1)	NS	2/21/2006					
R-11(I1)	F2B23	1/17/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-11(I2)		8/20/1998	ND	ND	ND	ND	ND
R-11(I2)		5/14/2002	ND	ND	ND	ND	ND
R-11(I2)		10/29/2003	ND	ND	ND	ND	ND
R-11(I2)	NS	2/21/2006					
R-11(I2)	F2B24	1/17/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-11(I2)		11/4/2009	0.71	<0.5	<0.5	<0.5	<0.5
R-12(D1)		1/29/1999	24	19	2	0.7 J	ND
R-12(D1)		5/11/1999	22	18	2	0.7 LJ	ND
R-12(D1)		8/27/1999	7.38	10.9	1.22	ND	ND
R-12(D1)		11/15/1999	4.5	6.5	ND	ND	ND
R-12(D1)		2/25/2000	5.9	7.8	ND	ND	ND
R-12(D1)		6/8/2000	6.3	7.4	ND	ND	ND
R-12(D1)		9/7/2000	5.5	6.2	ND	ND	ND
R-12(D1)		11/16/2000	6.4	5.6	ND	ND	ND
R-12(D1)		5/15/2002	2.5	2.9	ND	ND	ND
R-12(D1)		10/30/2003	1.5	2.7	ND	ND	ND
R-12(D1)	F20L5	3/6/2006	1.0	2.9	0.8	0.7	<0.5
R-12(D1)	F2B26	12/18/2006	1.3	3.4	0.8	0.9	<0.5
R-12(D1)		10/18/2007	1.2	3.2	0.7	0.9	<0.5
R-12(D1)		7/23/2008	<1.0	3.1	<1.0	1.1	<1.0
R-12(D1)		3/10/2009	<1.0	2.0	<1.0	1.2	<1.0
R-12(D1)		11/3/2009	0.41 LJ	1.3	0.64	0.98	<0.5
M-12	NS	3/16/2006	NS	NS	NS	NS	NS
M-12	F2B28	1/22/2007	21.0	17.0	1.3	<0.5	<0.5
M-12		10/22/2007	31.2	16.8	2.5	<0.5	<0.5
M-12		7/17/2008	26.6	14.4	2.4	<1.0	<1.0
M-12		3/11/2009	31.9	15.7	1.7	<1.0	<1.0
M-12		11/4/2009	20.0	12.0	1.5	0.32 LJ	<0.5
R-12(D2)		9/1/1998	ND	ND	ND	ND	ND
R-12(D2)		5/11/1999	ND	ND	ND	ND	ND
R-12(D2)		8/24/1999	ND	ND	ND	ND	ND
R-12(D2)		11/12/1999	ND	ND	ND	ND	ND
R-12(D2)		2/23/2000	ND	ND	ND	ND	ND
R-12(D2)		9/6/2000	ND	ND	ND	ND	ND
R-12(D2)		5/15/2002	ND	ND	ND	ND	ND
R-12(D2)		10/31/2003	ND	ND	ND	ND	ND
R-12(D2)	F20L6	3/14/2006	0.8	<0.5	<0.5	<0.5	<0.5
R-12(D2)	F2B27	1/18/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-12(D2)		10/22/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-12(D2)		7/23/2008	<1.0	<1.0	<1.0	<1.0	<1.0

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
R-12(D2)		3/10/2009	<1.0	<1.0	<1.0	<1.0	<1.0
R-12(D2)		11/3/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-12(I1)		10/30/2003	ND	ND	ND	ND	ND
R-12(I1)		3/10/2009	<1.0	<1.0	<1.0	<1.0	<1.0
R-12(I1)		11/3/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-12(I2)		11/2/1992	3 J	1 J			
R-12(I2)		7/22/1997	ND	ND	ND	ND	
R-12(I2)		9/1/1998	ND	ND	ND	ND	ND
R-12(I2)		5/12/1999	ND	ND	ND	ND	ND
R-12(I2)		8/25/1999	ND	ND	ND	ND	ND
R-12(I2)		11/15/1999	ND	ND	ND	ND	ND
R-12(I2)		2/23/2000	ND	ND	ND	ND	ND
R-12(I2)		5/15/2002	ND	ND	ND	ND	ND
R-12(I2)		10/31/2003	ND	ND	ND	ND	ND
R-12(I2)	F2042	2/22/2006	0.13 LJ	0.47 LJ	1.7	1.3	<0.5
R-12(I2)	F2B25	1/17/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-12(I2)		10/18/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-12(I2)		7/16/2008	<1.0	<1.0	<1.0	<1.0	<1.0
R-12(I2)		11/3/2009	<0.5	0.53	1.0	3.4	<0.5
R-12(S1)		11/2/1992	120	96	6.7	ND	
R-12(S1)		7/22/1997	2 J	270 J	ND	ND	
R-12(S1)		12/9/1997	ND	220	32	17	
R-12(S1)		9/1/1998	ND	210			ND
R-12(S1)		1/29/1999	ND	180	28	15 J	ND
R-12(S1)		5/11/1999	ND	190	18	13	ND
R-12(S1)		8/24/1999	ND	117	25.8	19.9	ND
R-12(S1)		11/12/1999	ND	120	17	12	ND
R-12(S1)		2/23/2000	ND	130	15	12	ND
R-12(S1)		6/7/2000	ND	150	23	24	ND
R-12(S1)		9/7/2000	ND	120	25	26	ND
R-12(S1)		11/15/2000	ND	120	23	22	ND
R-12(S1)		5/17/2002	ND	130	37	36	ND
R-12(S1)		10/27/2003	ND	120	31	26	ND
R-12(S1)	F2041	2/20/2006	<5	120.0	46.0	33.0	<5
R-12(S1)	F2AR6	12/12/2006	<5	110.0	54.0	41.0	<5
R-12(S1)		10/18/2007	0.5	143.0	35.1	21.0	<0.5
R-12(S1)		7/16/2008	1.4	80.5	46.3	36.4	<1.0
R-12(S1)		3/12/2009	<1.0	106.0	33.8	21.8	<1.0
R-12(S1)		11/3/2009	<0.5	68.0	23	16.0	<0.5
R-13(I2)		9/2/1998	5	1	ND	ND	ND
R-13(I2)		1/29/1999	7	2	ND	ND	ND
R-13(I2)		5/17/1999	16	3	ND	ND	ND
R-13(I2)		8/26/1999	5.01	2.35	ND	ND	ND
R-13(I2)		11/15/1999	4.4	1.8	ND	ND	ND
R-13(I2)		2/25/2000	4.8	1.7	ND	ND	ND
R-13(I2)		6/8/2000	4.9	1.6	ND	ND	ND
R-13(I2)		9/7/2000	4.9	1.3	ND	ND	ND
R-13(I2)		11/16/2000	5.5	1.1	ND	ND	ND
R-13(I2)		5/15/2002	11	2.5	ND	ND	ND
R-13(I2)		11/3/2003	17	4.6	ND	ND	ND
R-13(I2)	F20J8	3/9/2006	19.0	6.7	0.7	<0.5	<0.5
R-13(I2)	F2AX3	12/18/2006	19.0	6.9	0.7	0.1 LJ	<0.5
R-13(I2)		10/22/2007	24.7	9.1	0.9	<0.5	<0.5

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
R-13(I2)		7/23/2008	25.1	7.6	<1.0	<1.0	<1.0
R-13(I2)		3/11/2009	29.2	7.6	<1.0	<1.0	<1.0
R-13(I2)		11/16/2009	30.4	8.7	1.1	<0.5	<0.5
R-14(S2)		2/1/1999	3	14	9	4	ND
R-14(S2)		5/18/1999	2	14	8	6	ND
R-14(S2)		8/24/1999	ND	4.23	3.97	3.14	ND
R-14(S2)		11/16/1999	ND	5.1	4.2	2.9	ND
R-14(S2)		2/29/2000	2.4	13	8.8	5	ND
R-14(S2)		9/5/2000	ND	6.7	6.6	4.9	ND
R-14(S2)		5/13/2002	ND	3.4	4.1	2.4	ND
R-14(S2)		10/28/2003	ND	4.9	8.9	5	ND
R-14(S2)		6/23/2005	<1.0	<1.0	2.9	2.1	
R-14(S2)	F2045	2/22/2006	0.25 LJ	1.7	2.7	1.8	<0.5
R-14(S2)	F2AR7	2/18/2006	0.28 LJ	1.6	3.6	2.1	<0.5
R-14(S2)		10/23/2007	1.0	4.6	10.6	4.2	<0.5
R-14(S2)		7/21/2008	<1.0	3.4	7.8	2.9	<1.0
R-14(S2)		3/11/2009	<1.0	1.4	4.4	2.6	<1.0
R-14(S2)		10/27/2009	0.66	2.5	9.2	3.3	<0.5
R-15(D1)		1/27/1999	560	ND	0.8 J	0.9 J	ND
R-15(D1)		5/17/1999	630	9 LJ	ND	ND	ND
R-15(D1)		8/31/1999	73.7	2.48	ND	ND	ND
R-15(D1)		2/23/2000	350	8.3	1	ND	ND
R-15(D1)		6/7/2000	78	2	ND	ND	ND
R-15(D1)		9/6/2000	66	1.5	ND	ND	ND
R-15(D1)		11/16/2000	90	2.3	ND	ND	ND
R-15(D1)		5/14/2002	970	14	ND	ND	ND
R-15(D1)		11/4/2003	1200	17	ND	ND	ND
R-15(D1)		6/24/2005	110.0	2.6	<1.0	<1.0	<5.0
R-15(D1)		7/28/2008	20.0	1.9	<1.0	<1.0	<1.0
R-15(D1)		11/11/2008	4.3	2.2	46.0	<1.0	1.2
R-15(D1)		7/10/2009	40.0	4.7	210.0	<1.0	1.3
M-15	F20L7	3/16/2006	630.0	15.0	<5.0	<5.0	<5.0
M-15	F2DL0	2/5/2007	560.0	8.4	0.30 LJ	<5.0	<5.0
M-15	F2GK1	11/6/2007	200.0	3.8LJ	<5	<5	<5
M-15		8/27/2008	370.0	7.5	<2.0	<2.0	<2.0
M-15		3/18/2009	416.0	8.9	<1.0	<1.0	<1.0
M-15		11/18/2009	343.0	8.5	<0.5	<0.5	<0.5
R-16(S2)		11/16/1999	ND	ND	ND	ND	ND
R-16(S2)		2/29/2000	ND	ND	ND	ND	ND
R-16(S2)		6/6/2000	ND	ND	ND	ND	ND
R-16(S2)		9/5/2000	ND	ND	ND	ND	ND
R-16(S2)		11/17/2000	ND	ND	ND	ND	ND
R-16(S2)		5/13/2002	ND	ND	ND	ND	ND
R-16(S2)		10/28/2003	ND	ND	ND	ND	ND
R-16(S2)	F2046	2/22/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-16(S2)	F2AR8	12/18/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-16(S2)		10/23/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-16(S2)		7/21/2008	<1.0	<1.0	<1.0	<1.0	<1.0
R-16(S2)		3/11/2009	<1.0	<1.0	<1.0	<1.0	<1.0
R-16(S2)		10/27/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-17(D1)		11/19/1999	ND	ND	ND	ND	ND
R-17(D1)		2/22/2000	ND	ND	ND	ND	ND

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
R-17(D1)		6/7/2000	ND	ND	ND	ND	ND
R-17(D1)		9/7/2000	ND	ND	ND	ND	ND
R-17(D1)		11/15/2000	ND	ND	ND	ND	ND
R-17(D1)		5/13/2002	ND	ND	ND	ND	ND
R-17(D1)		10/29/2003	ND	ND	ND	ND	ND
R-17(D1)	F20L8	3/7/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-17(D1)	F2B30	1/17/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-17(D1)		10/27/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-18(D1)		12/7/1999	2	ND	ND	ND	ND
R-18(D1)		2/22/2000	ND	ND	ND	ND	ND
R-18(D1)		6/6/2000	ND	ND	ND	ND	ND
R-18(D1)		9/6/2000	ND	ND	ND	ND	ND
R-18(D1)		11/15/2000	ND	ND	ND	ND	ND
R-18(D1)		5/13/2002	ND	ND	ND	ND	ND
R-18(D1)		10/30/2003	ND	ND	ND	ND	ND
R-18(D1)	F20L9	3/7/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-18(D1)	F2B31	1/117/2007	<0.5	<0.5	<0.5	<0.5	<0.5
R-18(D1)		10/26/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-19(D1)		12/7/1999	3	ND	ND	ND	ND
R-19(D1)		2/22/2000	ND	ND	ND	ND	ND
R-19(D1)		6/6/2000	ND	ND	ND	ND	ND
R-19(D1)		9/5/2000	ND	ND	ND	ND	ND
R-19(D1)		11/15/2000	ND	ND	ND	ND	ND
R-19(D1)		5/13/2002	ND	ND	ND	ND	ND
R-19(D1)		10/29/2003	ND	ND	ND	ND	ND
R-19(D1)	F20M0	3/6/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-19(D1)		12/06 Event	NS	NS	NS	NS	NS
R-19(D1)		10/26/2009	0.12 LJ	<0.5	<0.5	<0.5	<0.5
R-20		5/14/2002	140	7.6	ND	ND	ND
R-20		11/3/2003	120	6.5	ND	ND	ND
R-20		11/17/2009	85.4	4.3	<0.5	<0.5	<0.5
M-20	F20M1	3/9/2006	140.0	6.9	<5.0	<5.0	<5.0
M-20	F2DL1	2/7/2007	120.0	7.3	0.45 LJ	0.28 LJ	<5.0
M-20 (Dup)	F2DL2	2/7/2007	120.0	7.3	0.37 LJ	0.2 LJ	<5.0
M-20 (lab split)	Pinnacle	2/7/2007	120.0	7.9	<1.0	<1.0	<5.0
M-20	F2GK2	11/6/2007	120.0	14.0	<5	<5	<5
M-20(205') PDB	F2GK3	11/6/2007	85.0	130.0	<5	<5	<5
M-20(212') PDB	F2GK4	11/6/2007	63.0	15.0	<5	<5	<5
M-20(220') PDB	F2GK5	11/6/2007	45.0	12.0	<5	<5	<5
M-20		7/28/008	129.0	11.6	<1.0	<1.0	<1.0
M-20		3/17/2009	122.0	9.8	<1.0	<1.0	<1.0
M-20 Dup	R-31	3/17/2009	114.0	8.7	<1.0	<1.0	<1.0
M-20		7/9/2009	97.0	5.6	<1.0	<1.0	<1.0
M-20		11/18/2009	113.0	5.5	0.5	<0.5	<0.5
R-21		5/14/2002	110	1.9	ND	ND	ND
R-21		11/4/2003	520	7	ND	ND	ND
R-21		6/23/2005	590.0	11.0	<1.0	<1.0	<5.0
R-21	F2DL6	2/6/2007	530.0	10.0	0.34 LJ	<5.0	<5.0
R-21 (lab split)	Pinnacle	2/6/2007	500.0	12.0	<1.0	<1.0	<5.0
R-21	F2GK7	11/7/2007	630.0	15.0	<5.0	<5.0	<5.0
R-21		7/28/2008	<1.0	2.1	2.5	<1.0	<1.0
R-21		9/4/2008	2.5	1.3	340.0	<1.0	1.5

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
R-21		11/12/2008	<5.0	5.1	440.0	<5.0	7.7
R-21		7/10/2009	<1.0	2.0	190.0	<1.0	7.1
M-21	F20M2	3/9/2006	5.2	<5	<5	<5	<5
M-21 Dup	F20M3	3/9/2006	9.3	<5	<5	<5	<5
M-21	F2DL3	2/6/2007	22.0	0.34 LJ	<5.0	<5.0	<5.0
M-21	F2GK6	11/7/2007	5.7	<5.0	<5.0	<5.0	<5.0
M-21		3/16/2009	3.6	<1.0	<1.0	<1.0	<1.0
M-21		11/5/2009	1.9	1.1	<0.5	<0.5	<0.5
R-22		5/14/2002	ND	ND	ND	ND	ND
R-22		10/29/2003	ND	ND	ND	ND	ND
R-22	F20M4	3/9/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-22	F2A4	12/14/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-22		10/28/2009	<0.5	<0.5	<0.5	<0.5	<0.5
R-23(I2)		10/30/2003	8.1	ND	ND	ND	ND
R-23(I2)		6/22/2005	4.5	<1.0	<1.0	<1.0	<5.0
R-23(I2)	F20M5	3/7/2006	<0.5	<0.5	<0.5	<0.5	<0.5
R-23(I2)		12/06 Event	NS	NS	NS	NS	NS
R-23(I1)		3/10/2009	5.7	<1.0	<1.0	<1.0	<1.0
R-23(I1)		11/3/2009	5.1	0.53	<0.5	<0.5	<0.5
R-24(I1)		10/27/2003	2000	390	5.9	ND	ND
R-24(I1)		6/23/2005	1900.0	190.0	22.0	<1.0	<5.0
R-24(I1)	F20M6	3/6/2006	3000.0	830.0	14.0	<5.0	<5.0
R-24(S2)	F2AS1	12/12/2006	2800.0	210.0	6.7	<5	<5
R-24(S2) Dup	F2AS2	12/12/2006	3000.0	220.0	5.5	<5	<5
R-24(S2)	F2GK8	11/5/2007	17LJ	450.0	1800.0	<20	<20
R-24(S2) PDB	F2GK9	11/5/2007	82LJ	1700.0	2300.0	<100	<100
R-24(S2)		7/16/2008	3.6	12.1	871.0	6.7	152.0
R-24(S2)		3/17/2009	<1.0	<1.0	3.2	3.9	11.5
R-24(S2)		11/2/2009	<0.5	0.23 LJ	0.81	2.3	1.5
R-25(I2)		10/27/2003	110	160	60	1.6	ND
R-25(I2)	F20M7	3/6/2006	86.0	160.0	32.0	1.7	<5.0
R-25(S2)	F2AS3	12/12/2006	100.0	110.0	27.0	2.4 LJ	<5
R-25(S2)		10/18/2007	219.0	260.0	43.2	1.9	<0.5
R-25(S2)A Dup		10/18/2007	170.0	217.0	42.8	1.9	<0.5
R-25(S2)		2/21/2008	1.0	17.0	33.0	3.0	360.0
R-25(S2)		5/13/2008	1.0J	17.0	60.0	2.0 J	300.0
R-25(S2)		7/16/2008	<1.0	16.1	68.0	2.7	349.0
R-25(S2)A Dup		7/16/2008	<1.0	15.9	54.8	2.2	438.0
R-25(S2)		11/19/2008	1.0	32.0	46.0	3.4	600.0
R-25(S2)		3/17/2009	<1.0	12.0	17.0	3.7	290.0
R-25(S2)		7/8/2009	<1.0	13.0	17.0	4.1	170.0
R-25(S2)		11/2/2009	<0.5	1.3	1.9	3.4	15.0
R-26(I2)		10/28/2003	ND	1.3	1.5	ND	ND
R-26(I2)	F20M8	3/7/2006	3.1	3.5	0.9	0.2	<0.5
R-26(S2)	F2AS4	12/14/2006	2.7	4.5	1.9	1.2	<0.5
R-26(S2)		7/23/2008	<1.0	1.1	<1.0	<1.0	<1.0
R-26(S2)		3/16/2009	<1.0	<1.0	<1.0	<1.0	<1.0
R-26(S2)	F3BD2	10/29/2009	3.3	2.8	0.7	0.13LJ	<0.5
R-27(I2)		10/27/2003	8	23	16	7.1	ND
R-27(I2)		6/22/2005	<1.0	14.0	27.0	8.8	<5.0

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
R-27(I2)	F20M9	3/7/2006	5.0	31.0	20.0	9.3	<0.5
R-27(I2) Dup	F20N0	3/7/2006	4.6	24.0	23.0	11.0	<0.5
R-27 (S2)	F2AS5	12/13/2006	1.7	22.0	22.0	14.0	<0.5
R-27(S2)	F2GL0	11/6/2007	6.0	31.0	19.0	9.7	<0.5
R-27(S2) PDB	F2GL1	11/6/2007	13.0	41.0	11.0	4.4	<0.5
R-27(S2)		7/23/2008	1.0	19.4	36.1	12.5	<1.0
R-27(S2)		3/12/2009	<1.0	5.5	16.4	13.3	7.2
R-27(S2)		11/17/2009	1.9	17.3	29.0	12.5	0.6
R-28(S2)		7/15/2008	<1.0	<1.0	<1.0	<1.0	<1.0
R-28(S2)		3/10/2009	2.3	<1.0	<1.0	<1.0	<1.0
R-28(S2)		11/17/2009	0.8	<0.5	<0.5	<0.5	<0.5
RDP-01(S1)		2/2/1999	0.9 J	4	19	12	ND
RDP-01(S1)		5/13/1999	2	8	12	6	ND
RDP-01(S1)		8/24/1999	ND	4.92	8.3	5	ND
RDP-01(S1)		11/16/1999	1.1	7.3	11	6.3	ND
RDP-01(S1)		2/29/2000	ND	2.1	11	7.4	ND
RDP-01(S1)		6/6/2000	1.3	9.4	11	5.8	ND
RDP-01(S1)		9/5/2000	ND	3.6	5.6	4.1	ND
RDP-01(S1)		11/17/2000	ND	3.5	4.8	3.3	ND
RDP-1		5/13/2002	1	6.2	15	10	ND
RDP-1		10/28/2003	ND	2.8	7.2	3.7	ND
RDP-1	F2048	2/22/2006	<0.5	1.6	12.0	6.7	<0.5
RDP-1	F2AS6	12/18/2006	0.1 LJ	1.3	9.8	5.1	<0.5
RDP-1		10/23/2007	<0.5	0.8	4.3	2.2	<0.5
RDP-1		7/21/2008	<1.0	<1.0	3.1	1.6	<1.0
RDP-1		3/11/2009	<1.0	1.4	8.9	3.9	<1.0
RPD-1		10/27/2009	<0.5	0.65	2.5	0.81	<0.5
RDP-02(S1)		2/2/1999	ND	5	15	14	ND
RDP-02(S1)		5/13/1999	ND	10	20	15	ND
RDP-02(S1)		8/24/1999	ND	7.27	9.36	7.1	ND
RDP-02(S1)		11/16/1999	ND	1.4	8.7	7.9	ND
RDP-02(S1)		2/22/2000	ND	ND	12	6.4	ND
RDP-02(S1)		6/6/2000	ND	9.3	19	17	ND
RDP-02(S1)		9/5/2000	ND	3.3	12	12	ND
RDP-02(S1)		11/17/2000	ND	ND	8.9	8.3	ND
RDP-2		10/28/2003	ND	1.5	5.4	4.3	ND
RDP-2	F2049	2/22/2006	<0.5	0.5	5.8	4.5	<0.5
RDP-2	F2AS7	12/18/2006	<0.5	0.9	4.1	3.1	<0.5
RDP-2		10/23/2007	<0.5	<0.5	<0.5	<0.5	<0.5
RDP-2#		7/21/2008	<1.0	<1.0	3.4	2.2	<1.0
RDP-2		3/11/2009	<1.0	<1.0	7.6	5.2	<1.0
RPD-2		10/27/2009	<0.5	0.64	6.1	3.2	<0.5
RDP-03(S1)		2/2/1999	ND	ND	0.7 J	ND	ND
RDP-03(S1)		5/13/1999	ND	ND	1	0.8 LJ	ND
RDP-03(S1)		8/24/1999	ND	ND	ND	ND	ND
RDP-03(S1)		11/16/1999	ND	ND	ND	ND	ND
RDP-03(S1)		2/22/2000	ND	ND	ND	ND	ND
RDP-03(S1)		9/5/2000	ND	ND	ND	ND	ND
RDP-3		5/13/2002	ND	ND	ND	ND	ND
RDP-3		10/28/2003	ND	ND	ND	ND	ND
RDP-3	F2050	2/22/2006	<0.5	<0.5	<0.5	<0.5	<0.5
RDP-3	F2AS8	12/18/2006	<0.5	<0.5	<0.5	<0.5	<0.5
RDP-3		10/23/2007	<0.5	1.6	7.4	4.9	<0.5

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
RDP-3#		7/21/2008	<1.0	<1.0	<1.0	<1.0	<1.0
RDP-3		3/11/2009	<1.0	<1.0	<1.0	<1.0	<1.0
RPD-3		10/27/2009	<0.5	<0.5	<0.5	<0.5	<0.5
RDP-04		11/17/1999	ND	ND	2	2	ND
RDP-04		2/29/2000	ND	ND	11	9.9	ND
RDP-04		6/6/2000	ND	ND	1.4	1.1	ND
RDP-04		9/5/2000	ND	ND	ND	ND	ND
RDP-04		5/13/2002	ND	ND	3.5	3	ND
RDP-04		10/28/2003	ND	ND	ND	ND	ND
RDP-4	F2051	2/22/2006	<0.5	0.12 LJ	4.5	3.3	<0.5
RDP-4	F2AS9	12/18/2006	<0.5	0.04 LJ	2.2	1.7	<0.5
RDP-4		10/23/2007	<0.5	<0.5	0.8	0.6	<0.5
RDP-4		7/21/2008	<1.0	<1.0	<1.0	<1.0	<1.0
RDP-4		3/11/2009	<1.0	<1.0	4.3	3.0	<1.0
RPD-4		10/27/2009	<0.5	<0.5	1.6	0.95	<0.5
BC-2	F2059	2/21/2006	14.0	12.0	3.4 J	2.1 J	<0.5
BC-2	F2AT0	12/13/2006	9.6	7.4	1.8	1.0	<0.5
BC-2		10/22/2007	4.9	5.6	1.6	0.6	<0.5
BC-2		7/30/2008	<1.0	<1.0	9.8	1.2	<1.0
BC-2		8/28/2008	<1.0	<1.0	25.0	4.7	<1.0
BC-2		11/13/2008	<1.0	<1.0	22.0	6.2	<1.0
BC-2		3/12/2009	<1.0	1.9	10.2	7.4	1.4
BC-2		7/7/2009	<1.0	<1.0	4.6	8.0	4.7
BC-2	F3BD3	10/29/2009	<0.5	<0.5	0.4 LJ	2.9	3.7
BC-3	F2060	2/21/2006	10.0	21.0	12.0	9.0	<0.5
BC-3	F2AT1	12/13/2006	11 J	18 J	7.7	5.0	<0.5
BC-3		10/23/2007	30.4	28.7	6.8	4.4	<0.5
BC-3		7/30/2008	11.0	20.0	8.0	4.8	<1.0
BC-3		8/28/2008	<1.0	<1.0	27.0	4.8	<1.0
BC-3		11/13/2008	<1.0	<1.0	24.0	5.8	<1.0
BC-3		3/16/2009	<1.0	2.0	6.8	5.8	5.2
BC-3		7/7/2009	<1.0	<1.0	1.5	7.5	9.3
BC-3	F3BD4	10/29/2009	<0.5	0.16 LJ	2.0	11.0	16.0
BC-4	F2061	2/22/2006	4.1	15.0	68.0	20.0	<0.5
BC-4	F2AT2	12/12/2006	7.6	15.0	57.0	12.0	<5
BC-4 Dup	F2AT3	12/12/2006	8.1	17.0	63.0	13.0	<5
BC-4		10/23/2007	22.2	21.2	38.4	7.6	<0.5
BC-4		7/30/2008	5.0	19.0	32.0	7.2	<1.0
BC-4		8/28/2008	<1.0	3.1	26.0	3.1	<1.0
BC-4		11/13/2008	<1.0	2.1	27.0	7.6	<1.0
BC-4		3/16/2009	<1.0	2.5	17.0	10.0	3.4
BC-4		7/7/2009	<1.0	<1.0	11.0	8.3	5.1
BC-4	F3BD5	10/29/2009	0.48 LJ	1.9	35.0	32.0	16.0
BC-5	F2062	2/22/2006	8.6	13.0	8.9	2.8	0.12 LJ
BC-5	F2AT4	12/18/2006	3.5	5.4	5.4	1.7	<0.5
BC-5		10/23/2007	3.2	5.6	6.9	1.8	<0.5
BC-5		7/30/2008	<1.0	5.6	15.0	3.8	<1.0
BC-5		8/28/2008	<1.0	1.2	23.0	4.7	<1.0
BC-5		11/13/2008	<1.0	<1.0	21.0	5.7	<1.0
BC-5		3/11/2009	<1.0	2.1	14.0	8.1	2.5
BC-5	F3BB3	10/27/2009	<0.5	0.39 LJ	19.0	7.1	<0.5
BC-5 Dup	R-40	10/27/2009	<0.5	0.45 LJ	19.0	7.9	<0.5

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
BC-6	F2063	2/22/2006	<0.5	0.18 LJ	0.24 LJ	<0.5	<0.5
BC-6		12/06 Event	NS	NS	NS	NS	NS
BC-6		7/30/2008	<1.0	<1.0	<1.0	<1.0	<1.0
BC-6		8/28/2008	<1.0	<1.0	<1.0	<1.0	<1.0
BC-6		11/13/2008	<1.0	<1.0	<1.0	<1.0	<1.0
BC-6		3/16/2009	<1.0	<1.0	<1.0	<1.0	<1.0
BC-6		7/7/2009	<1.0	1.6	<1.0	<1.0	<1.0
BC-6	F3BB4	10/27/2009	<0.5	0.69	0.59	0.072 LJ	<0.5
DI-1(D1)	F2GL3	11/8/2007	100.0	5.6	<5.0	<5.0	<5.0
DI-1(D1)	Pinnacle	11/8/2007	68.0 C2	5.6	<1.0	<1.0	<1.0
DI-1 (D1) - 35'	Pinnacle	3/15/2006	11.0	2.6	<1.0	<1.0	<1.0
DI-1 (D1)- 35'		1/22/2007	NS	NS	NS	NS	NS
DI-1 (D1)- 35'	Pinnacle	11/8/2007	<1.0	<1.0	23.0	<1.0	<5.0
DI-1 (D1) - 175'	Pinnacle	3/15/2006	72.0	4.8	<1.0	<1.0	<1.0
DI-1 (D1)- 175'	Pinnacle	1/22/2007	93.0	4.9	<1.0	<1.0	<5.0
DI-1 (D1)- 175'	Pinnacle	11/8/2007	43 C2	4.7	<1.0	<1.0	<5.0
DI-1 (D1) - 182'	Pinnacle	3/15/2006	63.0	4.1	<1.0	<1.0	<1.0
DI-1 (D1) - 182'	Pinnacle	1/22/2007	100.0	5.0	<1.0	<1.0	<5.0
DI-1 (D1) - 182'	Pinnacle	11/8/2007	42 C2	4.7	<1.0	<1.0	<5.0
DI-1 (D1) - 188'	Pinnacle	3/15/2006	54.0	4.4	<1.0	<1.0	<1.0
DI-1 (D1) - 188'	Pinnacle	1/22/2007	98.0	5.1	<1.0	<1.0	<5.0
DI-1 (D1) - 188'	Pinnacle	11/8/2007	29 C2	4.8	<1.0	<1.0	<5.0
DM-1 (I1)	F20N1	3/8/2006	11.0	1.0	0.2	<0.5	<0.5
DM-1 (I1)	F2B37	1/22/2007	13.0	1.6	0.8	0.8	<0.5
DM-1 (I1)		10/23/2007	12.1	1.6	1.4	1.0	<0.5
DM-1 (I1)		7/21/2008	5.5	<1.0	1.0	<1.0	<1.0
DM-1 (I1)		11/10/2008	12.0	1.3	1.3	<1.0	<1.0
DM-1 (I1)		7/8/2009	11.0	4.3	1.7	1.0	<1.0
DM-1 (I1)		11/4/2009	2.4	1.9	3.6	2.6	<0.5
DM-1 (D1)	F20N2	3/8/2006	230.0	8.3	<5.0	<5.0	<5.0
DM-1 (D1)	F2DK0	2/7/2007	120.0	8.0	<5.0	<5.0	<5.0
DM-1 (D1) Dup	F2DK1	2/7/2007	110.0	7.5	<5.0	<5.0	<5.0
DM-1(D1)	F2GL2	11/8/2007	130J	8.2	<5.0	<5.0	<5.0
DM-1(D1)		7/28/2008	99.1	7.8	<1.0	<1.0	<1.0
DM-1(D1)		3/17/2009	68.5	8.0	1.1	3.7	<1.0
DM-1(D1)		11/5/2009	95.0	5.2	0.68	2.20	<0.5
DM-1(D2)	F2GL8	11/8/2007	91.0	5.9	<5.0	<5.0	<5.0
DM-1(D2)A	F2GM3 Dup	11/8/2007	91.0	6.2	<5.0	<5.0	<5.0
DM-1(D2)		11/7/2008	62.0	4.3	<1.0	<1.0	<1.0
DM-1(D2)		7/8/2009	71.0	4.3	<1.0	<1.0	<1.0
DM-1(D2)		11/4/2009	58.0	4.0	0.34 LJ	0.15 LJ	<0.5
DM-1(D2) - 228'	Pinnacle	3/15/2006	53.0	5.7	<1.0	<1.0	<1.0
DM-1(D2) - 240'	Pinnacle	3/15/2006	56.0	4.5	<1.0	<1.0	<1.0
DM-1(D2)-240'	F2DK3	2/7/2007	76.0	4.3 LJ	0.31 LJ	<5.0	<5.0
DM-1(D2)-240'	F2GM0	11/8/2007	98.0	6.3	<5.0	<5.0	<5.0

Table A5-1
North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results
Concentrations ug/L

Sample Location	Lab ID#	Date Sampled	PCE	TCE	1,2-cis DCE	1,2-trans DCE	VC
DM-1(D2) - 247'	Pinnacle	3/15/2006	54.0	4.6	<1.0	<1.0	<1.0
DM-1(D2) - 247'	Pinnacle	2/7/2007	79.0	4.6	<1.0	<1.0	<5.0
DM-1(D2) - 247'	F2GM1	11/8/2007	91.0	5.6	<5.0	<5.0	<5.0
DM-1(D2) - 257'	Pinnacle	3/15/2006	57.0	4.2	<1.0	<1.0	<1.0
DM-1(D2) - 257'	F2DK5	2/7/2007	78.0	4.3 LJ	0.31 LJ	<5.0	<5.0
DM-1(D2) - 257'	F2GM2	11/8/2007	87.0	5.5	<5.0	<5.0	<5.0
DM-2 (I1)	F20N4	3/8/2006	2.6	1.0	1.0	0.3	<0.5
DM-2 (I1)	F2B40	1/22/2007	1.2	0.6	0.6	<0.5	<0.5
DM-2 (I1) Dup	F2B41	1/22/2007	1.3	0.6	0.7	<0.5	<0.5
DM-2(I1)		10/24/2007	1.1	<0.5	0.6	<0.5	<0.5
DM-2(I1)A Dup		10/24/2007	1.1	<0.5	0.6	<0.5	<0.5
DM-2(I1)		7/21/2008	1.0	<1.0	<1.0	<1.0	<1.0
DM-2(I1)		11/10/2008	1.2	<1.0	<1.0	<1.0	<1.0
DM-2(I1)		11/4/2009	1.7	0.46	0.4 LJ	0.22 LJ	<0.5
DM-2 (D1)	F20N5	3/15/2006	190.0	8.1	<5.0	<5.0	<5.0
DM-2 (D1) Split	Pinnacle	3/15/2006	120.0	5.2	<1.0	<1.0	<1.0
DM-2 (D1)	F2DK6	2/7/2007	80.0	5.3	1.0 LJ	1.9 LJ	<5.0
DM-2(D1)		8/28/2008	130.0	4.1	<1.0	<1.0	<1.0
DM-2(D1)		11/25/2008	72.0	4.3	<1.0	<1.0	<1.0
DM-2(D1)		7/9/2009	66.0	5.4	<1.0	<1.0	<1.0
DM-2(D1)		11/17/2009	102.0	6.5	0.8	1.4	<0.5
DM-2 (D2)	F20N6	3/8/2006	160J	8.8J	0.5	0.2	<0.5
DM-2 (D2)	F2DK9	2/7/2007	170.0	13.0	1.9 LJ	5.7	<5.0
DM-2 (D2)		10/24/2007	160.0	17.9	2.9	7.5	<0.5
DM-2(D2)		8/26/2008	190.0	12.0	<2.0	2.0	<2.0
DM-2(D2)		11/10/2008	300.0	16.0	<1.0	<1.0	<1.0
DM-2(D2)		7/7/2009	140.0	7.7	<1.0	1.1	<1.0
DM-2(D2)		11/17/2009	177.0	7.0	0.6	1.0	<0.5
DM-2(D2) Dup	R-54	11/17/2009	173.0	7.2	0.7	1.1	<0.5
Cook Estate		10/14/1998	56.0	24.0	6.0	2.0	
Cook Estate		11/23/2003	26.0	59.0	13.0	5.5	<1.0
Cook Estate	F20P7	3/14/2006	16.0	15.0	7.8	19.0	<0.5
Cook Estate		3/16/2009	74.2	40.2	4.7	2.6	<1.0
Cook Estate		11/5/2009	1.1	1.3	<0.5	<0.5	<0.5
SCTW-2	F20P5	3/15/2006	<0.5	<0.5	<0.5	<0.5	<0.5
SCTW-2	F2B03	1/17/2007	<0.5	<0.5	<0.5	<0.5	<0.5
SCTW-2		7/21/2008	<1.0	<1.0	<1.0	<1.0	<1.0
SCTW-2		3/11/2009	<1.0	<1.0	<1.0	<1.0	<1.0
SCTW-2		11/1/2009	NS	NS	NS	NS	NS

Legend
1,2-cis DCE-1,2-cis Dichlroethene
1,2-trans DCE-1,2-trans Dichlroethene
PCE- Tetrachloroethne
TCE - Trichloroethene
VC - Vinyl Chloride
NS - Not Sampled
ND - Not detected above laboratroy quantitation limits
J - Estimated value
LJ - Estimated value - Reported concentration below contract required quantitation limit value

Table A5-2 - North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results - Dissolved Metals

Sample Location	Lab ID#	Date Sampled	**Fe** (ug/l)	**Mn** (ug/l)	**As** (ug/l)
MCLs			1000.0	200.0	10.0
Shallow Aquifer					
R-01(S2)	0710023-06	10/17/2007	25.0 U	**668**	3.0 U
Shallow Background well	0807026-04	7/16/2008	25.0U	**594**	6.8U
	0903024-11	3/10/2009	25.0 U	**37.5**	2.0 U
		10/26/2009	100 U	**752**	10 U
EWMW-2	0807026-01	7/15/2008	25.0U	**702**	6.8U
	0903040-09	3/16/2009	**8070**	**4,490**	**13.0**
		10/26/2009	**41,400**	**8,690**	**19.7 J**
R-24-(S2)	0711006-03	11/05/2007	836	**1860**	**12.0**
	0807026-05	7/16/2008	**2740**	**2160**	9.8
	0903040-05	3/17/2009	**4850**	**3290**	9.4
		11/2/2009	**5020**	**3430**	**10.1**
R-25(S2)	0710026-10	10/18/2007	271	**348**	3.0 U
	0807026-06	7/16/2008	**1740**	**1620**	**13.5**
	0807026-07	7/16/2008	**1740**	**1610**	**13.5**
		11/2/2009	**2100**	**2790**	**20.2**
EX-13	0710026-06	10/18/2007	77.6	**773**	6.9
	0807026-03	7/16/2008	**1910**	**1390**	**13.4**
		11/2/2009	**1140**	**1730**	**11.2**
R-04(S2)	0710023-07	10/17/2007	114	**707**	3.0 U
	0807032-04	7/17/2008	25U	**371**	6.8U
	0903024-14	3/9/2009	**1250**	**2950**	7.5
		10/29/2009	**1440**	**1950**	10 U
BC-2	0710031-01	10/22/2007	25.0 U	**1160**	3.0 U
	0903029-01	3/12/2009	**1610**	**3220**	**12.8**
		10/29/2009	787	**2970**	10 U
BC-5	0710039-09	10/23/2007	47.3	**1150**	3.0 U
	0903029-08	3/11/2009	**2440**	**1730**	**10.4**
		10/27/2009	**3490**	**3790**	**11.7 UC**
R-05(S2)	0710039-11	10/23/2007	36.5	**922**	3.0 U
		7/21/2008	25.0U	**971**	6.8U
	0903029-10	3/11/2009	26.5	**1180**	2.0 U
		10/27/2009	292	**1020**	10 U
Intermediate Aquifer					
EWMW-4A	0710023-03	10/17/2007	36.4	51.9	3.0 U
	0807026-02	7/16/2008	25.0U	58.3	6.8U
	0903024-12	3/9/2009	25.0 U	63.6	2.0 U
		10/28/2009	100 U	60.9	10 U
R-04(I2)	0710026-01	10/18/2007	63.7	2.0	3.0 U
	0807032-05	7/17/2008	32.4	5.0U	6.8U
	0903024-13	3/9/2009	61.4	5.0 U	2.0 U

Table A5-2 - North Railroad Avenue Plume, Summary of Historical Ground Water Analytical Results - Dissolved Metals

Sample Location	Lab ID#	Date Sampled	**Fe** (ug/l)	**Mn** (ug/l)	**As** (ug/l)
		10/29/2009	100 U	15 U	10 U
DM-1(I1)	0710039-10	10/23/2007	41.6	128	3.0 U
	0807033-01	7/21/2008	26.2	104	6.8U
		11/4/2009	1700	**1220**	4.5
Deep aquifer					
M-12	0710031-02	10/22/2007	25.0 U	2.6	3.0 U
	0807032-02	7/17/2008	25.0U	5.0U	6.8U
	0903029-09	3/11/2009	25.0 U	5.0 U	2.0 U
		11/4/2009	25.0 U	5.0 U	0.4 U
M-15	0903047-02	3/18/2009	25.0 U	11	5.0
		11/18/2009	25.0 U	10	3.9
M-20	0711006-02	11/06/2007	25.0 U	54.8	6.8 U
		3/17/2009	25.0 U	52.4	2.0 U
		11/18/2009	25.0 U	52.4	0.4 U
M-09	0711006-01	11/05/2007	290	21.2	6.8 U
	0903047-01	3/18/2009	88.4	47.3	3.3
		11/18/2009	161	160	0.4 U
R-09(D2)	0903029-02	3/12/2009	25.0 U	5.0 U	2.0 U
		11/3/2009	25.0 U	5.0 U	0.4 U
DM-2(D2)	0710039-06	10/24/2007	25.0U	28.1	3.0U
		11/17/2009	32.7	22	0.4 U
DM-1(D1)		3/17/2009	25.0U	9.9	2.0U
		11/5/2009	25.0 U	7.3	0.4 U

Legend

Fe - Iron

Mn - Manganese

As - Arsenic

U - Not detected above the specified laboratory quantitation/reporting limits

ATTACHMENT 6
Site Inspection Checklist and Interview Records

Site Inspection Checklist

I. SITE INFORMATION	
Site name: North Railroad Avenue Plume	**Date of inspection: April 7, 2010**
Location and Region: Espanola, NM **EPA Region 6**	**EPA ID: NMD986670156**
Agency, office, or company leading the five-year review: New Mexico Environment Department	**Weather/temperature: Sunny Warm**

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☐ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls
- ☒ Other_____Ground water remediation is combination of P&T and containment. The system is a bioremediation or ERD using ground water recirculation system in Source/Hotspot Area and downgradient biocurtain to maintain c ontainment.________________________

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Peter Guerra (Name) Amec Project Manager (Title) 4/7/2010 (Date)
   Interviewed ☒ at site ☐ at office ☐ by phone Phone no. ____________
   Problems, suggestions; ☒ Report attached ____________________________

2. **O&M staff** ____________ (Name) ____________ (Title) ____________ (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. ____________
   Problems, suggestions; ☐ Report attached ____________________________

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency City of Espanola
Contact Ben Ortega — Public Works Director — 4/8/10 — ______

Name	Title	Date	Phone no.
Ben Ortega	Public Works Director	4/8/10	

Problems; suggestions; ☒ Report attached ______

Agency ______
Contact ______

Name	Title	Date	Phone no.

Problems; suggestions; ☐ Report attached ______

Agency ______
Contact ______

Name	Title	Date	Phone no.

Problems; suggestions; ☐ Report attached ______

Agency ______
Contact ______

Name	Title	Date	Phone no.

Problems; suggestions; ☐ Report attached ______

4. **Other interviews** (optional) ☒ Report attached.

Mrs. Garcia, Property Owner

Eric Quintana, Downtown Action Team member

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☒ O&M manual	☐ Readily available	☒ Up to date	☐ N/A
☒ As-built drawings	☐ Readily available	☒ Up to date	☐ N/A
☐ Maintenance logs	☐ Readily available	☐ Up to date	☐ N/A

Remarks ______Documents are maintained in NMED Project Manger office in Santa Fe and at AMECs office is Albuquerque______

2.	**Site-Specific Health and Safety Plan** ☐ Readily available ☐ Up to date ☐ N/A ☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☐ N/A Remarks___The sitewide HASP was developed for the RA construction phase and need to be updated to better reflect the operational aspect and ERD treatment. The HASP was updated in March 2010 to cover worder safety for the methane issue and SVE operations.
3.	**O&M and OSHA Training Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks_________Maintained at AMECs office in Albuquerque
4.	**Permits and Service Agreements** ☐ Air discharge permit ☐ Readily available ☐ Up to date ☒ N/A ☐ Effluent discharge ☐ Readily available ☐ Up to date ☒ N/A ☐ Waste disposal, POTW ☐ Readily available ☐ Up to date ☒ N/A ☒ Other permits____OSE ☐ Readily available ☐ Up to date ☐ N/A Remarks_____The Office of the State Engineer (OSE) permit is currently being modified to include the ERD treatment system requirments. Waste water disposal to the Espanola POTW occurs only during the rehab of wells which occurs on a semi-annual basis. The typical volume is 10K to 12K gallons is stored on site in frac tanks. Following analysis and acceptance by the POTW, the water is discharge at the dry cleaner facility sewer connection.
5.	**Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks
6.	**Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks
7.	**Groundwater Monitoring Records** ☒ Readily available ☐ Up to date ☐ N/A Remarks________AMEC performs system O&M monitoring records. NMED performs and maintains compliance monitoring records
8.	**Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A Remarks
9.	**Discharge Compliance Records** ☐ Air ☐ Readily available ☐ Up to date ☒ N/A ☐ Water (effluent) ☐ Readily available ☐ Up to date ☒ N/A Remarks
10.	**Daily Access/Security Logs** ☒ Readily available ☐ Up to date ☐ N/A Remarks___The only portions of the Site with restricted access are the two treatment facilities which are fenced and secured with locks. Access is limited to NMED, AMEC and Santa Clara Pueblo Office of Environment staff.____Typically personnel are on-site once a week to check on conditions.

IV. O&M COSTS

1. **O&M Organization**

☒ State in-house ☒ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other

2. **O&M Cost Records**

☒ Readily available ☐ Up to date
☐ Funding mechanism/agreement in place

Original construction cost estimate - $3,837,072 based on 2003 Remedial Design (RD)
Original annual O&M cost estimate- $482,000 based on 2003 RD ☐ Breakdown attached

Total annual cost by year for review period if available

From (Date)	To (Date)	Total cost	
July 1, 2005	June 30, 2006	$2,520,253	☐ Breakdown attached
July 1, 2006	June 30, 2007	$1,221,773	☐ Breakdown attached
July 1, 2007	June 30, 2008	$958,560	☐ Breakdown attached
July 1, 2008	June 30, 2009	$460,008	☐ Breakdown attached
July 1, 2009	April 13, 2010	$406,347	☐ Breakdown attached

TOTAL 5 YEAR COST - $5,566,943

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: There were significant increase in the amount of maintenance and system upkeep due to biofouling and plugging of various components in the injection/extraction manifolds and extractions wells. The extraction/injection manifolds were modified to remove or replace components that restricted flow (particularly flow controllers) which were replaced with gate valves. In addition, the extraction well piping was reconfigured to allow for easier removal and cleaning of the extraction pumps. There has also been incompatibility issues (corrosion) of the galvanized steel used for extraction well drop tubes and parts of the manifold which have required unscheduled maintenance and repairs. The overall cost for the increased site O&M due to increase in site visits and maintenance has not been evaluated. However, the initial cost to replace and upgrade the system was ~$111,000. An additional $37,500 was spent to evaluate ways to best address and prevent the biofouling issue.

Another unanticipated issue and expense was the discovery of biogenic gas (primarily methane) build up within the subsurface soils and well vaults that required immediate response actions to remove the methane. Apprximately $150,000 was spent on investigating and mitigating through install of soil vapor drive point wells and operation of a soil vapor extraction system

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A
A. Fencing

1.	**Fencing damaged** ☒ Location shown on site map ☒ Gates secured ☐ N/A Remarks ___Fencing is limited to areas around the SA/Hosptot treatment building and the downgradient biocurtain treatment building
B. Other Access Restrictions	
1.	**Signs and other security measures** ☐ Location shown on site map ☒ N/A Remarks__________

C. Institutional Controls (ICs)	
1.	**Implementation and enforcement** Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A Type of monitoring (*e.g.*, self-reporting, drive by) ___NA___ Frequency ________ Responsible party/agency ___New Mexico Office of State Engineer maintains the temporary prohibition for permitting of domestic supply wells. Contact __Bruce Richardson__ Northern Rio Grande Manager 3/2/2010 (505)827-6120 Name Title Date Phone no. Reporting is up-to-date ☐ Yes ☐ No ☒ N/A Reports are verified by the lead agency ☐ Yes ☐ No ☐ N/A Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☒ N/A Violations have been reported ☐ Yes ☐ No ☒ N/A Other problems or suggestions: ☐ Report attached ___On March 2, 2010, Steve Jetter with NMED confirmed with Bruce Richardson with the OSE that the restriction on ground water appropriation on new domestic well permits is in place with the OSE.
2.	**Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A Remarks__________
D. General	

1.	**Vandalism/trespassing** ☐ Location shown on site map ☐ No vandalism evident Remarks The Biocurtain treatment building and frac tanks have been graffitied. The graffiti has been removed from the building. The frac tanks were removed from the site.
2.	**Land use changes on site** ☐ N/A Remarks The dry cleaner facility closed in 2007. Plans to use the building as a retail shop are pending.
3.	**Land use changes off site** ☐ N/A Remarks There have been no significant land use changes within the ground water plume boundary. Land use remains commercial/light industrial and residential. The City of Espanola has plans to build a Railroad Museum near the Deep Zone injection wells
	VI. GENERAL SITE CONDITIONS
A. Roads	☐ Applicable ☒ N/A
1.	**Roads damaged** ☐ Location shown on site map ☐ Roads adequate ☐ N/A Remarks

B. Other Site Conditions	
	Remarks
	VII. LANDFILL COVERS ☐ Applicable ☒ N/A
A. Landfill Surface	
1.	**Settlement** (Low spots) ☐ Location shown on site map ☐ Settlement not evident Areal extent Depth Remarks
2.	**Cracks** ☐ Location shown on site map ☐ Cracking not evident Lengths Widths Depths Remarks

3.	**Erosion** Areal extent______________ Remarks____	☐ Location shown on site map Depth___________	☐ Erosion not evident
4.	**Holes** Areal extent______________ Remarks____	☐ Location shown on site map Depth___________	☐ Holes not evident
5.	**Vegetative Cover** ☐ Grass ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks____	☐ Cover properly established	☐ No signs of stress
6.	**Alternative Cover (armored rock, concrete, etc.)** Remarks____	☐ N/A	
7.	**Bulges** Areal extent______________ Remarks____	☐ Location shown on site map Height___________	☐ Bulges not evident
8.	**Wet Areas/Water Damage** ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade Remarks____	☐ Wet areas/water damage not evident ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map	 Areal extent____________ Areal extent____________ Areal extent____________ Areal extent____________
9.	**Slope Instability** ☐ Slides Areal extent______________ Remarks____	☐ Location shown on site map	☐ No evidence of slope instability
B.	**Benches** ☐ Applicable ☒ N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)		
1.	**Flows Bypass Bench** Remarks____	☐ Location shown on site map	☐ N/A or okay
2.	**Bench Breached** Remarks____	☐ Location shown on site map	☐ N/A or okay
3.	**Bench Overtopped** Remarks____	☐ Location shown on site map	☐ N/A or okay

C. Letdown Channels ☐ Applicable ☑ N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)	
1.	**Settlement** ☐ Location shown on site map ☐ No evidence of settlement Areal extent__________ Depth__________ Remarks__________
2.	**Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation Material type__________ Areal extent__________ Remarks__________
3.	**Erosion** ☐ Location shown on site map ☐ No evidence of erosion Areal extent__________ Depth__________ Remarks__________

4.	**Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting Areal extent__________ Depth__________ Remarks__________
5.	**Obstructions** Type__________ ☐ No obstructions ☐ Location shown on site map Areal extent__________ Size__________ Remarks__________
6.	**Excessive Vegetative Growth** Type__________ ☐ No evidence of excessive growth ☐ Vegetation in channels does not obstruct flow ☐ Location shown on site map Areal extent__________ Remarks__________
D. Cover Penetrations ☐ Applicable ☒ N/A	
1.	**Gas Vents** ☐ Active ☐ Passive ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks__________
2.	**Gas Monitoring Probes** ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks__________

3.	**Monitoring Wells** (within surface area of landfill) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks______			
4.	**Leachate Extraction Wells** ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks______			
5.	**Settlement Monuments**	☐ Located	☐ Routinely surveyed	☐ N/A
	Remarks______			

E. Gas Collection and Treatment		☐ Applicable	☒ N/A
1.	**Gas Treatment Facilities** ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse ☐ Good condition ☐ Needs Maintenance Remarks______		
2.	**Gas Collection Wells, Manifolds and Piping** ☐ Good condition ☐ Needs Maintenance Remarks______		
3.	**Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) ☐ Good condition ☐ Needs Maintenance ☐ N/A Remarks______		
F. Cover Drainage Layer		☐ Applicable	☒ N/A
1.	**Outlet Pipes Inspected** Remarks______	☐ Functioning	☐ N/A
2.	**Outlet Rock Inspected** Remarks______	☐ Functioning	☐ N/A
G. Detention/Sedimentation Ponds		☐ Applicable	☒ N/A
1.	**Siltation** Areal extent______ Depth______ ☐ Siltation not evident Remarks______		☐ N/A

2.	**Erosion** Areal extent________ Depth________ ☒ Erosion not evident Remarks________
3.	**Outlet Works** ☐ Functioning ☐ N/A Remarks________
4.	**Dam** ☐ Functioning ☐ N/A Remarks________

H. Retaining Walls	☐ Applicable ☒ N/A
1.	**Deformations** ☐ Location shown on site map ☐ Deformation not evident Horizontal displacement________ Vertical displacement________ Rotational displacement________ Remarks________
2.	**Degradation** ☐ Location shown on site map ☐ Degradation not evident Remarks________
I. Perimeter Ditches/Off-Site Discharge	☐ Applicable ☒ N/A
1.	**Siltation** ☐ Location shown on site map ☐ Siltation not evident Areal extent________ Depth________ Remarks________
2.	**Vegetative Growth** ☐ Location shown on site map ☐ N/A ☐ Vegetation does not impede flow Areal extent________ Type________ Remarks________
3.	**Erosion** ☐ Location shown on site map ☐ Erosion not evident Areal extent________ Depth________ Remarks________
4.	**Discharge Structure** ☐ Functioning ☐ N/A Remarks________

VIII. VERTICAL BARRIER WALLS	☐ Applicable ☒ N/A
1.	**Settlement** ☐ Location shown on site map ☐ Settlement not evident Areal extent________ Depth________ Remarks________

2.	**Performance Monitoring** Type of monitoring________ ☐ Performance not monitored Frequency________ ☐ Evidence of breaching Head differential________ Remarks________

C. Treatment System ☐ Applicable ☐ N/A	
1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☒ Bioremediation ☐ Air stripping ☐ Carbon adsorbers ☐ Filters________ ☒ Additive (*e.g.*, chelation agent, flocculent) Emulsified Vegetable Oil amendment and nutrient mix ☐ Others________ ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☐ Sampling/maintenance log displayed and up to date Records currently at Amec office ☑ Equipment properly identified ☐ Quantity of groundwater treated annually Treatment is in-situ volume not calculated ☐ Quantity of surface water treated annually________ Remarks The treatment system is currently in good condition however, maintenance is ongoing. There has been evidence of corrosion of the galvanized steel components and periodic failure of extraction pumps. 10 of the pumps were recently replaced.
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks________
3.	**Tanks, Vaults, Storage Vessels** ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks There is no seconday contaminment on the tanks. Tanks are only used to store nonhazardous vegetable oil for short periods (typically less than 7 days) during the amendment injections. The Oil/Water separator no longer used.
4.	**Discharge Structure and Appurtenances** ☒ N/A ☐ Good condition ☐ Needs Maintenance Remarks________
5.	**Treatment Building**(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☑ Chemicals and equipment properly stored Remarks________

6.	**Monitoring Wells** (pump and treatment remedy) ☒ Properly secured/locked ☐ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks__________

D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☐ N/A Remarks__________

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The shallow ground remedy is designed to reduce concentrations to below MCLs in the source area and hotspot while the biocurtain is designed to prevent further migration of the plume by treating and reducing the concentrations as it passes through the biocurtain. The remedy has been effective in reducing concentrations from >1000 times the MCLs to <10 times the MCLs across most of the treatment zone. The remedy has also been effective in reducing ground water concentrations up to 600 feet downgradient of both treatment systems. Although the system has been effective in reducing concentrations it has required a significant amount of modifications and maintenance to keep it operational. The passive Deep Zone treatment which relies on natural ground water flow to disperse the EVO amendment has been less effective.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

O & M procedures have been implemented to address the biofouling and up keep of the system. These procedures are constantly being reviewed and modified as needed.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

1. The systems have required a significant amount of upgrades and repairs. In particular, corrosion issues have been a concern on the down well pumps and connections along with the manifolds. This is not an issue with the underground portion of the lines which are constructed with HDPE. A number of pumps have failed and required replacement. In addition, the biofouling issues require significant labor and cost to maintain design flows. This is not expected to be an issue in the Source/Hotspot system as the RGs should be met within a couple years. However, these could become an issue at the biocurtain where the system is expected to operate for a longer period.

2. The reduced ground water conditions created with the addition of the EVO amendment has resulted in the dissolution of metals above primary and secondary ARAR standards. Of particularly concern is arsenic, iron, and manganese.

3. A more aggressive system may be required to effectively treat the Deep Zone.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

NEW MEXICO
ENVIRONMENT DEPARTMENT

Ground Water Quality Bureau

1190 St. Francis Drive, P.O. Box 5469
Santa Fe, New Mexico 87502
Phone (505) 827-2900 Fax (505) 827-2965
www.nmenv.state.nm.us

BILL RICHARDSON
Governor
DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

March 12, 2010

The Honorable Alice Lucero
Mayor of Española
405 Paseo de Oñate
Española, NM 87532

RE: Participation in EPA's Five Year Review for the North Railroad Avenue Plume Superfund Site, Española, New Mexico

Dear Mayor Lucero:

The New Mexico Environment Department and the US EPA Region 6 are performing a Five Year Review on the remediation activities at the North Railroad Avenue Plume Superfund Site. The EPA is required to perform a 5 year review at all NPL sites undergoing Remedial Action in order to ensure that the site remedy is protective of human health and the environment and is consistent with the Record of Decision. As part of the review we are soliciting input from stakeholders on the activities performed at the site.

Please find attached a list of questions we would like you to answer and return in the enclosed envelop. We would also like to follow up with an in-person interview some time in late March.

Congratulations on your recent election. I look forward to meeting you and working with you and your staff on this project. If you have any questions, please contact me at (505) 827-0072 or by e-mail at steve.jetter@state.nm.us.

Sincerely,

Steve Jetter
Project Manager
Superfund Oversight Section

Attachment: Questionnaire

Cc w/attachment: Ben Ortega, Public Works Director, City of Espanola

Cc w/o attachment: Petra Sanchez, RPM, USEPA Region 6
Dana Bahar, Manager, Superfund Oversight Section, NMED
NRAP correspondence file
SOS read file

INTERVIEW RECORD

Site Name: North Railroad Avenue Plume	**EPA ID No.: NMD986670156**	
Subject: First Five Year Review	**Time: 10:30 am**	**Date: 4/8/2010**
Type: Visit **Location of Visit:** Española City Hall		

Contact Made By:

Name: Petra Sanchez	**Title: Remedial Project Manager**	**Organization: EPA Region 6**
Name: Steve Jetter	**Title: Project Manager**	**Organization: NMED**

Individual Contacted:

Name: Mr. Ben Ortega	**Title:** Public Works Director	**Organization:** City of Espanola

Telephone No: (505) 747-6066 **Fax No:** (505) 747-6084 **E-Mail Address:** bortega@espanolanm.gov	**Street Address:** 405 N. Paseo de Oñate **City, State, Zip:** Española, NM 87532

Summary Of Conversation

Question 1 - What is your overall impression of the project? (General sentiment)

Mr. Ortega's overall impression is that the site has had a severe impact and need to be cleaned up and remediated as soon as possible.

Question 2 - What effects have the site operations had on the surrounding community?

Mr. Ortega stressed that the effect of having a Superfund site in downtown Española has restricted downtown redevelopment including improvements to roads, buildings and other structures that requiring any minor excavation of soils. Of particular importance was the loss (delay) of a utility and highway project designed to realign a dangerous intersection at Paseo de Onate and the Los Alamos Highway. This project was scaled back to only surface improvements and street lights.

Question 3 - Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

Mr. Ortega is concerned that the community is not well informed. He suggested a need for a community presentation or city council presentation to provide information on the clean up activities and progress and timeline for completion.

Question 4 - Are you aware of any complaints, incidents or activities at the Site such as vandalism, trespassing, or emergency response from local authorities? If so, please provide details.

Mr. Ortega is not aware of any complaints or incidents that have occurred at the site.

Question 5 - Do you feel well informed about the Site's activities and progress?

Mr. Ortega just recently, July 2009, joined the City government and has no history on the site other than a briefing and site tour that Mr. Jetter provided.in January 2010. He is now becoming informed on the clean up matters.

Question 6 - Do you have any comments, questions, or recommendations regarding the Site's management or operations?

Mr. Ortega would like regularly scheduled updates on a quarterly basis and to develop a program for public dissemination of information on the Superfund project.

NEW MEXICO
ENVIRONMENT DEPARTMENT

Ground Water Quality Bureau

1190 St. Francis Drive, P.O. Box 5469
Santa Fe, New Mexico 87502
Phone (505) 827-2900 Fax (505) 827-2965
www.nmenv.state.nm.us

BILL RICHARDSON
Governor
DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

March 12, 2010

The Honorable Walter Dasheno
Governor
Pueblo of Santa Clara
P.O. Box 580
Espanola, NM 87532

RE: Participation in EPA's Five Year Review for the North Railroad Avenue Plume Superfund Site, Española, New Mexico

Dear Governor Dasheno:

The New Mexico Environment Department and the US EPA Region 6 are performing a Five Year Review on the remediation activities at the North Railroad Avenue Plume Superfund Site. The EPA is required to perform a 5 year review at all NPL sites undergoing Remedial Action in order to ensure that site remedy is protective of human health and the environment and is consistent with the Record of Decision. As part of the review we are soliciting input from stakeholders on the activities performed at the site.

Please find attached a list of questions we would like you or your staff to answer and return in the enclosed envelop. We would also like to follow up with an in-person interview some time in late March.

If you have any questions, please contact me at (505) 827-0072 or by e-mail at steve.jetter@state.nm.us.

Sincerely,

Steve Jetter
Project Manager
Superfund Oversight Section

Attachment: Questionnaire

Cc w/attachment: Dino Chavarria, Santa Clara Pueblo, OEA

Cc w/o attachment: Petra Sanchez, RPM, USEPA Region 6
Dana Bahar, Manager, Superfund Oversight Section, NMED
NRAP correspondence file

INTERVIEW RECORD

Site Name: North Railroad Avenue Plume		**EPA ID No.: NMD986670156**	
Subject: First Five Year Review		**Time: 1:00pm**	**Date: 4/8/2010**
Type: Visit **Location of Visit:** Santa Clara Pueblo Office of Environmental Affairs			

Contact Made By:

Name: Petra Sanchez	**Title: Remedial Project Manager**	**Organization: EPA Region 6**
Name: Steve Jetter	**Title: Project Manager**	**Organization: NMED**

Individual Contacted:

Name: Mr. Dino Chavarria	**Title:**	**Organization:** Santa Clara Pueblo Office of Environmental Affairs
Telephone No: (505) 753-7326 **Fax No:** (505) 753-8988 **E-Mail Address:** dinoc@santaclarapueblo.org	**Street Address:** P.O. Box 580 **City, State, Zip:** Española, NM 87532	

Summary Of Conversation

Question 1 - What is your overall impression of the project? (General sentiment)

Mr. Chavarria's impression is that the Site remediation has been successfully implemented and will have an overall positive impact, both short term and long term, on other environmental issues and concerns for the Pueblo and surrounding community.

The remedy construction both on and off the Pueblo's land took into account the Pueblo's concerns.

Question 2 - What effects have the site operations had on the surrounding community?

Mr. Chavarria indicated that overall there have been no significant effects from site operations on the Pueblo. The fact that the Superfund site exists has increased the Pueblo community's knowledge of the Superfund process. The Pueblo's staff has used information from the site to inform citizens in newsletters and educate people on the dangers on the misuse and improper disposal of chemicals.

Question 3 - Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

Mr. Chavarria stated that some citizens have had questions and concerns about using the Rio

Grande for traditional uses. The Pueblo also had concerns early on with the biofouling issue and the inconsistent operations of the treatment systems and how it might affect the overall treatment progress. The Pueblo's concerns were addressed promptly by NMED.

Question 4 - Are you aware of any complaints, incidents or activities at the Site such as vandalism, trespassing, or emergency response from local authorities? If so, please provide details.

Mr. Chavarria knows of no emergency response actions from local authorities that have occurred at the biocurtain treatment compound located on Pueblo land. The biocurtain treatment building has been vandalized twice with graffiti, once during construction and again during operations. The Pueblo was unhappy with the amount of time it took for NMED to address and remove the 2nd episode.

Mr. Chavarria also brought up the issue of the gentleman who has claimed ownership of the land around the biocurtain building and who has been on site at least once while NMED staff was performing sampling. Mr. Chavarria's concern is that this individual may approach workers at the site and cause an incident or act in a threatening manner.

Question 5 - Do you feel well informed about the Site's activities and progress?

Mr. Chavarria stated that his office is kept informed about the site activities and progress. The OEA office and the Governor receive regular updates from NMED and NMED provides analytical results from wells located on the Pueblo prior to official report submittals. NMED also provides all published reports to the Santa Clara Pueblo's library which allow citizens to review the site information.

Although NMED provides notification to the Pueblo before major sampling events that occur on the Pueblo, NMED has been less informative when it come to access for routine maintenance visits to the biocurtain compound. Mr. Chavarria suggested that weekly or monthly e-mail communications occur to documents planned visits. This would be more inline wit the Memorandum of Agreement between the NMED and the Pueblo.

Question 6 - Do you have any comments, questions, or recommendations regarding the Site's management or operations?

Mr. Chavarria is pleased with the progress that has occurred both at the source area and at the biocurtain and that the remedy is proving successful in treating the ground water contamination. Mr. Chavarria thinks the Site has improved government to government interaction and can be used as a model for the Federal and State governments in working with the tribal governments in getting these types of projects completed. The Superfund MOA has allowed this to happen and is being used to develop a larger MOA to address all aspects of Pueblo and State government interactions.

The project has increased the Pueblo's knowledge of the Superfund program.

NEW MEXICO
ENVIRONMENT DEPARTMENT

Ground Water Quality Bureau

1190 St. Francis Drive, P.O. Box 5469
Santa Fe, New Mexico 87502
Phone (505) 827-2900 Fax (505) 827-2965
www.nmenv.state.nm.us

BILL RICHARDSON
Governor
DIANE DENISH
Lieutenant Governor

RON CURRY
Secretary

March 15, 2010

Rebecca Garcia
c/o Estate of Delfina Archuleta
1223 S. Orchard Drive
Española, NM 87532

RE: Participation in EPA's Five Year Review for the North Railroad Avenue Plume Superfund Site, Española, New Mexico

Dear Ms. Garcia:

The New Mexico Environment Department and the US EPA Region 6 are performing a Five Year Review on the remediation activities at the North Railroad Avenue Plume Superfund Site. The EPA is required to perform a 5 year review at all NPL sites undergoing Remedial Action in order to ensure that site remedy is protective of human health and the environment and is consistent with the Record of Decision. As part of the review we are soliciting input from stakeholders and landowners on the activities performed at the site.

Please find attached a list of questions we would like you to answer and return in the enclosed envelop. We would also like to follow up with an in person interview some time in late March.

If you have any questions, please contact me at (505) 827-0072 or by e-mail at steve.jetter@state.nm.us.

Sincerely,

Steve Jetter
Project Manager
Superfund Oversight Section

Attachment: Questionnaire

Cc w/o attachment: Petra Sanchez, RPM, USEPA Region 6
Dana Bahar, Manager, Superfund Oversight Section, NMED
NRAP correspondence file
SOS read file

INTERVIEW RECORD

Site Name: North Railroad Avenue Plume	**EPA ID No.: NMD986670156**	
Subject: First Five Year Review	**Time: 2:00 pm**	**Date: 4/7/2010**
Type: Visit **Location of Visit:**		

Contact Made By:

Name: Petra Sanchez	**Title: Remedial Project Manager**	**Organization: EPA Region 6**
Name: Steve Jetter	**Title: Project Manager**	**Organization: NMED**

Individual Contacted:

Name: Mrs. Rebecca Garcia	**Title: Trustee for Archuleta Estate - Norge Town Property Owner**	**Organization:**
Telephone No: (505)753-6008 **Fax No:** **E-Mail Address:**	**Street Address:** 1223 S. Orchard Drive **City, State, Zip:** Española, NM 87532	

Summary Of Conversation

Question 1 - What is your overall impression of the project? (General sentiment)

Mrs. Garcia believes the clean up is progressing at a good pace. She is hopeful that it will be completed in a couple of years.

Question 2 - What effects have the site operations had on the surrounding community?

Based on Mrs. Garcia's account, she does not believe there has been a negative affect on the area.

Question 3 - Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

Mrs. Garcia is not aware of any major concerns from the community. The one concern she has is on how long it will take to complete.

Question 4 - Are you aware of any complaints, incidents or activities at the Site such as vandalism, trespassing, or emergency response from local authorities? If so, please provide details.

Mrs. Garcia is not aware of any complaints or incidents that have occurred at the site.

Question 5 - Do you feel well informed about the Site's activities and progress?

Mrs. Garcia states that she is kept well informed on the project. She receives copies of all reports and is updated on current and future planned activities on a regular basis

Question 6 - Do you have any comments, questions, or recommendations regarding the Site's management or operations?

Mrs. Garcia is hopes that the clean up will be completed soon so she can put the property to other uses.

INTERVIEW RECORD

Site Name: North Railroad Avenue Plume Superfund Site	**EPA ID No.:**	
Subject: First Five-year Review Report	**Time:** 10:40 hrs	**Date:** 4/5/10
Type: ☐ Telephone ☑ Visit ☐ Other **Location of Visit:**		

Contact Made By:

Name: Mr. Steve Jetter	**Title:** Project Manager	**Organization:** NMED

Individual Contacted:

Name: Peter Guerra	**Title:** Project Manager	**Organization:** AMEC Earth & Environmental, Inc.

Telephone No: 505.821.1801 **Fax No:** 505.821.7371 **E-Mail Address:** peter.guerra@amec.com	**Street Address:** 8519 Jefferson NE **City, State, Zip:** Albuquerque, NM 87113

Summary Of Conversation

1. What is your overall impression of the project? (general sentiment)

Considering that the NRAP project is one operable unit, it has been both complex and successful. The RA is markedly different from the RD considering the execution of the ESD; however, aspects of the RA closely resemble the original design concepts. The flexibility of the stakeholders in the project has permitted the RA to be implemented using cutting-edge technologies and to limit costs associated with more complete redesign and reconstruction. To this end a balance between the perfect approach and making due has been struck on this project. With some key decisions made between the NMED, EPA and operators the project has been an overall success to date. However, some unexpected consequences have caused additional exposure and safety risks as well as additional costs during the operation of the full scale system. Included in these unexpected consequences are the buildup of chloroethenes in buildings above and adjacent to the source area treatment zone and the accumulation of biogenic gasses (especially methane) in the shallow vadose zone. The experience related to both these unexpected consequences reveals an obligatory step in the RD phase. The obligatory RD step consists of assessing the potential for accumulation of both choroethene and biogenic gasses in the vadose zone and other exposure pathways (e.g. basements) and a contingency plan for monitoring and abatement/removal of those gasses should they approach unsafe or potentially explosive levels. At the NRAP site, components to effectively manage/abate the accumulation of these gasses could have been incorporated into the system construction and the operations and monitoring program.

2. Is the remedy functioning as expected? How well is the remedy performing?

The remedy is functioning as expected. The treatment within the Source Area and Hot Spot has been the most aggressive. As such, we have seen greater than 95 percent of the contaminant mass biodegraded in these areas. The majority of the remaining mass resides within the source area and evidence of strong reductive dechlorination continues to be observed through chemical as well as biological (proteomic and genomic) analysis results. The biocurtain system has also been routinely and thoroughly treated with bioamendment and nutrient. Due to the pre-existing, favorably aerobic conditions and high Darcy flow, generating a reduced environment at the biocurtain has been challenging. Some evidence of reducing environment has been observed. Possible augmentation of the biocurtain with source area/hot spot groundwater may be an economical and efficient way to bring site-specific chloroethene-reducing bacterium consortia (and DNA) to the biocurtain. The deep zone has been partially treated. Bioamendment/nutrient has not been added at all DZ injection wells. A similar approach to augmentation might be considered in the DZ, where chloroethene-reducing bacterium consortia could be in injected using groundwater collected from the source area/hot spot.

3. What is the current status of the ground water remediation? What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

As discussed above, greater than 95 percent reduction in dissolved-phase chloroethene contaminants mass has been observed at the source area and hot spot portions of the site. Moreover, monitoring data supports that adsorbed phase (and possibly liquid phase, if present) chloroethene contaminants have been desorbed/dissolved through increased amendment solubility and/or bacterial production of localized surfactants; then successfully biodegraded. As such and with follow-on monitoring of the source area and hot spot portions of the site, additional bioamendment may not be required; or, if required may be in very discrete, recalcitrant portions of the site. Some reductive dechlorination has been observed around and downgradient of the biocurtain system. Continued bioamendment/nutrient addition at the biocurtain is probably required to maintain and enhance the conditions for effective reductive dechlorination. At the DZ, reduction of chloroethene contamination has been observed at injection wells that have received bioamendment/nutrient. No conclusive reductive dechlorination has been observed at DZ monitoring wells.

4. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

There is not a continuous, physical on-site O&M presence, per se. Failsafe and notification systems are built into the operations at the site as part of the Site Control and Data Acquisition (SCADA) systems. Additionally, during system operations the site is visited at a minimum of twice per week to check and record flows and service/clean system components. AMEC works in concert with the NMED to increase site visits and inspect the systems for defects and or leaks.

5. Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

The most significant changes to the O&M requirements include the following:

1. Routine cleaning of the manifold and underground transmission lines and extraction pumps is needed to maintain recirculation flow and limit clogging due to biofoul;
2. Injection wells require routine rehabilitation by swab/bail and high-pressure/low-flow water jetting to remove biofoul build-up on the well screens and filter pack;
3. Corrosion pitting and ultimate leaks in galvanized steel portions of the manifold require routine inspection and replacement; and
4. The build-up of biogenic gasses generated from the addition of bioamendment and nutrients in the shallow vadose zone requires monitoring associated with potentially unsafe working conditions as well as potential unsafe conditions for the public.

The requirement for routine transmission line, extraction pump, and injection well screen cleaning and rehabilitation although not specifically detailed in the RD is not an entirely unforeseen necessity. Although other possible means for filtration and/or biofoul treatment could have been part of the original design, the requirement for line and well cleaning/rehabilitation would have eventually been realized. At this juncture and in part due to the great success at growing a hardy and effective subsurface consortia for reductive dechlorination, injection well rehabilitation and pump/line cleaning operations is a biannual effort. The effort results in a functional, albeit continuously clogging, system.

The corrosion pitting observed in galvanized steel fittings is a result of the specific reactivity of the reduced groundwater and subsequent repairs should be made using SCH80 PVC. Otherwise, continued replacement of the galvanized steel parts will be required.

The buildup of biogenic gasses; especially methane, in the subsurface was first observed during a routine inspection performed by local utility personnel. The levels of methane observed were unexpected. Although the requirement to inspect for these biogenic gasses and to abate their presence do not promote the effectiveness for the remedy when considering the reduction of dissolved chloroethenes; the accumulated methane posses a potential threat to site workers and public health and safety. Conservative calculations estimate that approximately half the organic carbon added as vegetable oil, ethyl lactate, and whey has been converted to methane resulting in concentrated layer of methane directly over the water table. Currently efforts are underway to remove the cloud of biogenic gasses from the hot-spot and source area vadose zone.

6. Have there been unexpected O&M difficulties or costs at the site since start-up or in the last five years? If so, please give details.

Prior to the start of full-scale operations, system modifications identified during the pilot scale operations or Field Test Plan (FTP) implementation and incorporation of the source area (SA) wells into the hot-spot manifold system were completed. These modifications were not part of the original RD and included revision of the system manifolds, upgrading of the injection well plugs with a thicker bentonite seal and grout cap, completion of the hot box for the SA system transmission line wall penetrations in the north wall of the hot-spot (HS) and SA building, installation of new, progressive-cavity amendment pumps at both treatment buildings, transfer and installation of two amendment tanks from the HS to the biocurtain (BC) building, installation of a new discharge pump for the DNAPL separator at the HS, upgrades to the SCADA programming for both systems, installation of Digital Subscriber Line (DSL) internet connections at the HS and BC buildings, and construction of a metering device for administering amendment to the deep zone (DZ) wells.

As part of the field activities, AMEC brought a subcontractor with drill rig to the site in order to redevelop the injection wells used during the FTP (IW-2S, IW-2D, HSI-8, HSI-14, and HSI-19). The rig was also used to pull pumps that required servicing. The pumps serviced were the ones associated with the FTP, which had become fouled. The associated extraction and injection lines had also become clogged following their use during the pilot test.

Soon after injection of the first dose in April 2008, the lines in the extraction and injection manifolds started to become clogged due to biofouling and flow could not be maintained as designed. Flow was directed to and from whichever wells were not clogged. By the end of the 1st quarter of operations flow was limited to and from a handful of wells. The most problematic pieces of equipment were the Kates® flow controllers and the fine (50 micron) strainer elements that in some cases clogged within minutes of starting flow. In May and June 2008 the Kates flow controllers and fine strainers were replaced with gate valves and courser (500 micron) strainers.

Based on review of performance and maintenance of the pumps used during the pilot test, submersible, down-well pumps and the associated underground discharge line were clogging, especially when stagnant liquids remained in the line following shutdown. The configuration did not allow for the discharge lines to be flushed following operation and prior to shutdown, and the submersible pumps could not be readily removed as they were hung in the well off 20+ foot long galvanized steel 1-inch diameter pipe. In this, as-designed configuration, to remove the extraction pumps hoisting-type equipment (drill rig/fork truck/etc.) was required. In addition, at several extraction wells, corrosion and pitting to the point of pipe fracture of these galvanized steel discharge lines had been observed. During July 2008, the wellhead and drop tube assemblies at each of the extraction wells were upgraded to allow for hand removal of the pumps and purging of the discharge lines. The rigid pipe connection from the discharge line entry point in the vault to the wellhead flange remained as originally installed. The galvanized steel drop tube assembly were replaced primarily with HDPE pipe and stainless-steel connectors.

Following the upgrade to extraction well drop tubes, extraction pump and extraction/injection line cleaning activities were performed. Pumps and extraction lines were cleaned and purged by pulling the pump from the well, and putting it in a drum located at ground surface. The HDPE drop tubes were disconnected and a reusable flexible line was connected to the pump and discharge line entering the vault. The pump was then used to flow first a mixture of Oxiclean® and tap water and then tap water through the underground discharge line. The flow was returned to the drum using a hose connected to the discharge port on the Amiad® strainer located in the treatment building at the extraction well manifold branch. Using this method the pumps and transmission lines were simultaneously cleaned and cleaning- and rinsing- liquids were minimized and contained. Cleaning and purging liquids were collected in the DNAPL separator. Additionally, the injection manifold and injection well flow lines were cleaned and purged. This was accomplished by connecting the tap-water source to the manifold trunk line and feeding concentrated soapy water into the flow stream using the amendment/nutrient delivery system. Approximately 20 gallons of soapy water followed by 20-gallons of clean tap-water was flowed through each injection well manifold branch and flow line and collected at the wellhead for disposal.

In early December 2008, a majority of the HS extraction wells were serviced through the removal, inspection/cleaning of the pumps and flushing the extraction lines and manifold systems with an OxiClean® solution followed by fresh water to remove bacterial growth and clogging. A small leak was detected during flushing on the HS extraction manifold branch located where the PVC flow meter body is threaded into the galvanized steel union. A leak on the BC injection manifold branch was also detected during this time. This BC injection leak was also located where the plastic flow meter body threads into the galvanized steel union. Two-part epoxy was used to seal the leaks on both branches.

Solutions to reduction of clogging and liberation of flow from the extraction side of the side of the system gave rise to clogging issues at injection wells. To find a solution for rehabilitation of injection wells tests were performed during February 2009. Ten HS/SA injection wells were tested for their degree of clogging/biofoul. From this test six injection wells were selected for rehabilitation testing using mechanical and chemical methods. The test results indicated that swabbing and bailing followed by high-pressure/low-volume water jetting was the most efficient method of cleaning the injection well screens. The wells that were jetted showed an increased flow rate without a corresponding build up of pressure at the wellhead. This method was also a more straightforward and safer procedure for rig operators to perform than the other treatment options. The rehab testing also determined that clogging of the injection lines played a significant role in reducing flows on the injection side of the system. The test results indicated that ethyl lactate was more effective for unclogging the transmission lines when compared with an acetic acid treatment.

During March 2009 injection well rehabilitation activities at the HS/SA and BC were implemented. Concurrent with injection well rehab, extraction pump and extraction/injection line cleaning activities were performed. During extraction well cleaning operations injection well transmission lines were used for return flow during pump cleaning operations. By this method injection well transmission lines could be cleaned simultaneously with extraction pump/transmission line and manifold cleaning. Additionally, cleaning and develop fluids were disposed of through the local POTW. The recovered liquids were sampled for the presence of contaminants of concern prior to disposal. No COCs above POTW disposal requirements were detected and the recovered liquids were disposed of through the local POTW. As a regular system maintenance plan and based on the success of the extraction pump/transmission line cleaning and the injection well rehabilitation; it was determined that prior to bioamendment/nutrient addition, well cleaning/rehab would be required.

In January 2010 an assessment considering repairs of existing pumps versus replacement with less expensive, comparable pumps was performed. The results of this assessment showed that the costs for new replacement pumps is less expensive than servicing existing damaged pumps. As such, damaged extraction pumps at biocurtain wells and source area wells were replaced in March 2010. Existing Grunfros extraction pumps were replaced with new Dayton pumps. Additionally, the motor starters in the biocurtain extraction well control panel were replaced with higher amperage motor starters to help abate damage caused by repeated switching. The existing 6.3 Amp motor starters were replaced with 16 Amp motor starters.

In February 2010, It was determined that the flow pressure regulators placed on the upstream side of the extraction manifold branches were generating excessive backpressure and clogging. Routine cleaning of the coarse strainer as well as adjusting the regulators to a full open position assisited in alleviating some of this clogging and damage to the extraction pumps. However, the regulators continued to provide excess backpressure and in March 2010 the flow regulators were removed and replaced with a straight section of pipe.

In July 2009, it was observed that the CPU fans in the touch panel PCs at the HS and BC buildings had burnt out, causing the PCs to freeze due to over heating. A temporary solution was implemented by removing the back of the PC case and directing a small fan to provide air flow. New, more robust cooling fans will be required.

Indoor air impacts have been identified at three commercial buildings located near the source area. The impacts are above the established remedial action goals which are based on residential land use and a 1 x 10-6 risk level. However, it is anticipated that these impacts will be short-lived given the substantial contaminant reductions that have been obtained during the initial 18 months of operations. The indoor air quality is routinely monitored.

7. Are you aware of any events, incidents or activities at the Site such as vandalism, trespassing, or emergency responses by your company or local authorities? If so, please give details.

During continued recirculation of the SA and HS systems, five injection wells, one in the SA and four in the HS, developed breaches to the surface causing the well vaults to fill with injected groundwater. The wells that developed breaches were SAI-5 in the SA and HSI-9, HSI-10, HSI-12 and HSI-13 in the HS. It is apparent that the wells were clogged due to biofouling and the injected liquids mounded at the well and breached through the floor of the vault. Other wells throughout the site showed increased pressures and reduced flows, which was also apparently due to biofouling. The breach at SAI-5 was detected on October 3, 2008. The breach at the HS injection wells were detected as follows: HSI-10 on November 7, 2008, HSI-12 on November 10, 2008, HSI-9 on December 8, 2008, and HSI-13 on May 15, 2009. On June 5, HSI-8 was shut down because a slow leak in the transmission line connection at the wellhead and liquids had partly filled the vault. Flow to the wells with breaches was immediately stopped upon detection of the breaches and spilled liquids were returned to the system for reinjection.

On February 17, 2010 the New Mexico Environment Department (NMED) was informed by the local natural gas utility provider that high levels (50%+ of the Lower Explosive Limit (LEL)) of explosive biogenic gas were detected in several of the SA/HS well vaults. AMEC, under direction from NMED, went to the site that day and checked the vaults with an O2/LEL/CO meter and a photoionization detector (PID). Five of the vaults and a water meter handhold located near SAI-2 were checked using the meters. Volatile organic compounds (VOCs) were not detected using the PID. Explosive gas was detected and ranged between 0% and 42% of the LEL, at an average of 16.3% of the LEL. Following the initial visit, a GEM 2000 Plus Landfill Gas Monitor was brought to the site to measure methane, carbon dioxide, hydrogen sulfide and other biogenic gas levels in the site-area well vaults, wells and area buildings. Biogenic gas levels were monitored in these areas between February 23, 2010 and April 9, 2010. Additionally, a soil gas survey using and direct-push drill rig was conducted on March 10, 2010 and ambient air sampling of site-area buildings using Summa® canisters was conducted on February 24, 2010.

Currently and since April 2010, a SVE pilot test has been set-up and is under operation to remove the accumulated biogenic gasses. The SVE pilot test was designed and installed as a hybrid with the existing system and new components. Existing underground transmission lines and the HS/SA manifold have been used with existing wells and new shallow SVE well-points to provide a SVE well network for biogenic gas extraction. This SVE well network has been connected to an IC Engine SVE system powered off the extracted biogases and supplemental natural gas.

8. Do you have any comments, suggestions, or recommendations regarding the project?

Aspects of this project are both examples of "how to" and "what to avoid". As such, the NRAP project provides future designers and operators with valuable insights and recommendations. The results with respect to remedial goals have been stellar; massive COC reduction occurred rapidly. The upfront pilot test as part of RA instead of RD was critical to the success of the project. This approach realizes a flaw in the CERCLA RD/RA process that the time lag between ROD, RD and RA often time limits selected remedies to older technologies. The monitoring program is robust and provides for a myriad of data by quantity and type. These data provide the operator with assurances and direction concerning where and when to apply treatment. Lessons learned at NRAP consist of the following:

- Use of Rotosonic drilling method allowed for better definition of site geology. This was particularly useful in defining the less permeable fine sand layer and underlying clay aquitard at the bottom of the shallow aquifer treatment zone. Better geologic interpretation was also required for the deep zone wells where the water bearing zones consist of fine sands and clayey sand lenses.
- Use of Rotosonic drilling method generated significantly less drill cuttings and IDW waste.
- Several injection wells breached caused releases of amendment and contaminated water to the ground surface. This was likely due to the design and installations of well screens across the air/water interface. Injection wells planned in similar settings (shallow water table and highly permeable vadose zone) should be constructed with completely submerged screens and seals. Extending the top of the screen section and bentonite seal below the water table will force injected liquids into the aquifer limiting the possibility of injectate breach at the wellhead.
- Biofouling and subsequent clogging of piping and wells is inherent in this type of treatment. Engineering design criteria should include minimizing flow restrictions including limiting valves, regulators, and meters, and maximizing the diameter of transmission piping.
- The extraction and injection systems are contiguous. Basically the NRAP systems consist of pumping groundwater from a grid of extraction wells, pushing the extracted liquids through a network of underground piping to an aboveground extraction manifold where it is combined in a larger pipe. From this trunk-line pipe the water is pushed to the injection manifold where it is distributed through a network of underground piping to the grid of

injection wells. Nutrients and bioamendments are added to the injection system by direct feed into the trunk-line pipe connecting the extraction and injection manifolds. Removal of clogging agents such as sediments, precipitates, and amorphous solids common and potentially deleterious to a biological system of this nature is difficult with this design. Additionally, the confluence of flows at the extraction manifold combined with heterogeneous clogging across the system results in "competition" between the in-well extraction pumps. During full-scale, continuous operations the clogging occurs quicker in lines with less headloss/restriction. This results in flow increasing to the remaining lines. Where clogging is then again hastened, and so on. This process perpetuates until lines are fully clogged or surface breaches occur (see above). To avoid these pitfalls, individual extraction wells should freely discharge to a surge tank of sufficient capacity so that flow and pressure from one extraction well does not affect the flow and pressure desired from another. This surge tank could also act to remove solids through settlement. Delivery of the extracted water to the injection system should be provided by a single pump which draws off the surge tank, from above a sediment line. Single, large filtration or flocculation systems can be positioned between the surge tank and injection manifold to remove and manage potentially deleterious/clogging agents. Bioamandments and nutrients should be added to the system using an eductor powered off the discharge of this injection system pump.

- Areas with high PCE concentrations will produce high VC concentrations. Due to its low adsorption, higher solubility, and high Henry's Constant, VC may mobilized away from the original treatment zone and will readily volatilize and move into the vadose zone. This should be anticipated and accounted for in the design and operation of the treatment systems. Following the observed downgradient movement following the pilot study, a capture mode pumping strategy was developed to prevent the downgradient migration of VC at the site. Vapor intrusion pathways should be evaluated and monitored during system operations.
- VC should rapidly degrade as it migrates to more aerobic ground water conditions that exist outside of the treatment areas.
- The creation of anaerobic conditions associated with the injection of a carbon source will likely cause secondary water quality standards (Mn, Fe, As) to be exceeded. Monitored Natural Attenuation of inorganic byproducts generated from enhanced anaerobic bioremediation should be considered during the FS and ROD creation. At NRAP, MNA may be a viable approach to assuring that inorganic byproducts do not pose unacceptable risk to the public.
- The generation of potentially harmful and/or explosive levels of biogenic gasses and the requirement to abate these accumulations was not part of the RD. Based on the biogenic-gas findings at NRAP, during the CERCLA FS and ROD stages the potential impact and costs associated with abatement of biogenic gas generation as well as contingency planning for biogenic gas abatement during the RD phase should be considered.
- Both proteomic- and genomic-based analyses were utilized during the pilot- and full-scale operations. Samples for both analyses were harvested similarly, using a filter to trap cells in groundwater extracted from wells. This method is subject to a significant sampling bias.

The cells captured within the flow of groundwater do not fully represent the biofilm adhered to the soil.

- Genomic- and proteomic-analyses were used to quantify the total biomass, as well as to measure the diversity of bacteria within the consortia. Results of these analyses proved useful in assessing the affect of the three bioamanedments used during the pilot test. Having results from two types of analyses was also useful in establishing a sense of the accuracy and reliability of the results.
- Genomic-based analyses were also used to identify and quantify specific bacteria and genes within the consortia. Using genetic-based analyses to detect and quantify genes that express chloroethene-reducing enzymes (PCE-reductase, TCE-reductase, cDCE-reductase, and VC-reductase) was unreliable, with poor repeatability between same and subsequent sampling events. Genetic-testing results for the detection and quantification of bacterium genus was more useful and repeatable. *Dehalobacter* and *dehalococcoides* genera were detected in groundwater retentate trapped on the filters with regular consistency. Additionally, *dehalococcoides* were observed to increase in population proportional to the degradation of cDCE and VC. These results provided positive assurance that reductive dechlorination was occurring under well understood and documented pathways.

BERNARD HODES GROUP
220 East 42nd Street, 15th Floor, New York, NY 10017

PROOF OF INSERTION

IN69789

Client: CH2MHILL
Publication: RIO GRANDE SUN
Insertion Dates: Thu, Dec 17, 2009

69789

North Railroad Avenue Plume Superfund Site Public Notice

U.S. EPA Region 6 Begins Five-Year Review of Site Remedy

December 2009

The U.S. Environmental Protection Agency Region 6 (EPA) has begun a five-year review of the remedy for the North Railroad Avenue Plume Superfund Site located Rio Arriba County, New Mexico. The review will evaluate if the remedy continues to protect public health and the environment.

The New Mexico Environment Department (NMED), the state lead on the Remedial Action at the site, is currently implementing Enhanced In-Situ Bioremediation treatment. The well installation phase of the remedy was completed November 2005. The two treatment buildings have been erected for the source area and bio-curtain along U.S. Highway 84/285, and in the deep zone near the Plaza de Espanola area. The remedy includes the following activities:

- Enhanced In-Situ Bioremediation in the Source Zone (Dense Non-aqueous Phase Liquids, or DNAPL), and at areas with high concentrations of tetrachloroethene, also called (PCE) (or Hot Spots);
- Enhanced In-Situ Bioremediation of the Dissolved-Phase Plume;
- Semi-Annual Ground Water Quality Monitoring (to assess performance of the remedial actions)

The site is located in Espanola, Rio Arriba County, New Mexico, within the exterior boundary of the Santa Clara Indian Reservation. The Santa Clara Pueblo is located one mile south of the site. The site is located within the central business district of the town of Espanola. This central district includes service businesses, light industrial activities, as well as residential properties, and subsistence farming land.

Results of the five-year review will be made available to the public at the following information repository:

Espanola Public Library
313 N Paseo De Onate
Espanola, NM 87532-2638

Information about the North Railroad Avenue Plume Superfund Site also is available on the internet at www.epa.gov/region6/superfund. For more information about North Railroad Avenue Plume Superfund site contact Petra Sanchez at 214.665.6686 or 1.800.533.3508 (toll free) or by email at sanchez.petra@epa.gov.

Para información en español, comunicarse con la Agencia de Protección del Medio Ambiente de los EEUU (la EPA) al número de teléfono 1-800-533-3508 (llamada gratis).

BERNARD HODES GROUP
220 East 42nd Street, 15th Floor, New York, NY 10017

PROOF OF INSERTION **IN69791**

Client: CH2MHILL
Publication: SANTA FE NEW MEXICAN
Insertion Dates: Thu, Dec 17, 2009

69791

North Railroad Avenue Plume Superfund Site Public Notice

U.S. EPA Region 6 Begins Five-Year Review of Site Remedy

December 2009

The U.S. Environmental Protection Agency Region 6 (EPA) has begun a five-year review of the remedy for the North Railroad Avenue Plume Superfund Site located Rio Arriba County, New Mexico. The review will evaluate if the remedy continues to protect public health and the environment.

The New Mexico Environment Department (NMED), the state lead on the Remedial Action at the site, is currently implementing Enhanced In-Situ Bioremediation treatment. The well installation phase of the remedy was completed November 2005. The two treatment buildings have been erected for the source area and bio-curtain along U.S. Highway 84/285, and in the deep zone near the Plaza de Espanola area. The remedy includes the following activities:

- Enhanced In-Situ Bioremediation in the Source Zone (Dense Non-aqueous Phase Liquids, or DNAPL), and at areas with high concentrations of tetrachloroethene, also called (PCE) (or Hot Spots);
- Enhanced In-Situ Bioremediation of the Dissolved-Phase Plume;
- Semi-Annual Ground Water Quality Monitoring (to assess performance of the remedial actions)

The site is located in Espanola, Rio Arriba County, New Mexico, within the exterior boundary of the Santa Clara Indian Reservation. The Santa Clara Pueblo is located one mile south of the site. The site is located within the central business district of the town of Espanola. This central district includes service businesses, light industrial activities, as well as residential properties, and subsistence farming land.

Results of the five-year review will be made available to the public at the following information repository:

Espanola Public Library
313 N Paseo De Onate
Espanola, NM 87532-2638

Information about the North Railroad Avenue Plume Superfund Site also is available on the internet at www.epa.gov/region6/superfund. For more information about North Railroad Avenue Plume Superfund site contact Petra Sanchez at 214.665.6686 or 1.800.533.3508 (toll free) or by email at sanchez.petra@epa.gov.

Para información en español, comunicarse con la Agencia de Protección del Medio Ambiente de los EEUU (la EPA) al número de teléfono 1-800-533-3508 (llamada gratis).

First Five-Year Review Report

North Railroad Avenue Plume Superfund Site
Española, Rio Arriba County, New Mexico

June 2010

Prepared by:

U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue
Dallas, Texas 75202

Concurred by: _______________ 6/15/10
Petra Sanchez, U.S. EPA — Date
Remedial Project Manager, 6 SF-RL

Concurred by: _______________ 6/11/10
Don Williams, U.S. EPA — Date
Deputy Assistant Director, 6 SF-R

Concurred by: _______________ 6/22/10
Barbara Nann, U.S. EPA — Date
Office of Regional Counsel 6 RC-S

Concurred by: _______________ 6/29/10
Charles Faultry U..S. EPA — Date
Chief, Louisiana/New Mexico Branch, 6SF-R

Concurred by: _______________ 07/02/10
Mark A. Peycke, U.S. EPA — Date
Office of Regional Counsel, 6 RC-S

Concurred by: _______________ 7/14/10
Pamela Phillips, U.S. EPA — Date
Deputy Director, Superfund Division, 6 SF

Approved by: Pamela Phillips, Acting — 7/14/10
Samuel Coleman, P.E. — Date
Director, Superfund Division
U.S. EPA Region 6