EPA 542-R-06-013
June 2006
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REMEDIATION SYSTEM EVALUATION (RSE)

57TH AND NORTH BROADWAY SITE
WICHITA, KANSAS

Report of the Remediation System Evaluation
Site Visit Conducted January 12, 2006

Final Report
June 2006

NOTICE

Work described herein was performed by GeoTrans, Inc. (GeoTrans) for the U.S. Environmental Protection Agency (U.S. E.P.A). Work conducted by GeoTrans, including preparation of this report, was performed under Dynamac Corporation Prime Contract No. 68-C-02-092. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

EXECUTIVE SUMMARY

A Remediation System Evaluation (RSE) involves a team of expert hydrogeologists and engineers, independent of the site, conducting a third-party evaluation of site operations. It is a broad evaluation that considers the goals of the remedy, site conceptual model, above-ground and subsurface performance, and site exit strategy. The evaluation includes reviewing site documents, visiting the site for up to 1.5 days, and compiling a report that includes recommendations to improve the system. Recommendations with cost and cost savings estimates are provided in the following four categories:

- Improvements in remedy effectiveness
- Reductions in operation and maintenance costs
- Technical improvements
- Gaining site closeout

The recommendations are intended to help the site team identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation by the RSE team, and represent the opinions of the RSE team. These recommendations do not constitute requirements for future action, but rather are provided for the consideration of all stakeholders.

The 57th and N. Broadway site is located in the northern region of the City of Wichita, Sedgewick County, Kansas. The site is located on the diagonal that runs from the extension of West 58th Street North and Broadway Avenue to the southwest and extends to approximately West 46th Street North and Armstrong Drive. The eastern boundary of the site is generally defined by Chisholm Creek (see Figure 1). The site includes approximately 180-acres of mixed industrial, commercial, and residential properties including a used oil re-refinery, trucking firms, municipal waste water treatment plant, an insurance impound lot, and a school bus facility. The 57th and N. Broadway site was first identified in 1983 as a result of local residents' concern about the quality of drinking water in the Wichita Heights area, located on the northern edge of the city of Wichita. Subsequent investigations between 1984 and 1994 identified volatile organic chemicals (VOCs) above the maximum contaminant level (MCL) in the ground water as well as contaminants in the soil and surface water. The primary constituents of concern include trichloroethene (TCE), tetrachloroethene (PCE), and vinyl chloride. The site was listed on the National Priorities List (NPL) on November 14, 1993.

From August 1990 to May 1992, USEPA performed a removal action at the site which supplied residents and businesses with bottled water until the installation of an alternative water supply line was completed in the spring of 1992. While completing the remedial investigation (RI) for Operable Unit 1 (OU1), contamination was identified in the residential Riverview area, which is located in the southwestern portion of the site. The Riverview area was designated as OU2. Remedial action started in June of 1998 by connecting the Riverview area residences to a public water supply. The remedy for the site was selected in two separate Records of Decision (ROD). The remedy in the June 5, 1998 ROD was to connect residents in the Riverview area (OU2) to a public water supply. The September 29, 1999 ROD identified remedies for site wide (OU1 and OU2) soil and ground water contamination. The soil remedy uses soil vapor extraction (SVE) and the ground water remedy uses ground water circulation wells, which use the density-driven circulation (DDC) technology to provide treatment via in-well air stripping.

The focus of the RSE is on the following remedial components:

- six DDC wells (DDC-1 to DDC-6) installed in the OU2 Riverview area
- 25 DDC wells (DDC-53-1 to DDC-53-25) in the OU1 area along 53rd Street
- eight SVE wells (SVE-1 to SVE-8) installed in the OU1 area at the Midland Refinery
- seven SVE wells (SVE-9 to SVE-15) installed in the OU1 area at the Wilko facility

The DDC wells and SVE systems have been in operation since 2002.

The observations and recommendations contained in this report are not intended to imply a deficiency in the work of either the system designers or operators but are offered as constructive suggestions in the best interest of the EPA, the public, and the facility. These recommendations have the obvious benefit of being formulated based upon operational data unavailable to the original designers.

Recommendations are provided in all four categories: effectiveness, cost reduction, technical improvement, and site closeout. The recommendations for improving system effectiveness include the following:

- perform additional source area characterization north and west of the western DDC wells along 53rd Street
- update State and owner of public supply well on site conditions and potential need for future wellhead treatment
- consider a change to pump and treat (P&T) to replace the <u>western</u> DDC wells along 53rd Street after source investigation is complete
- evaluate if the extent of the SVE system at Midland is adequate
- consider using air sparging to augment the existing SVE system at Midland
- continue monitoring sentinel wells between the main plume and the Bel Aire Wellfield
- evaluate and document the potential for vapor intrusion

Recommendations for cost reduction include the following:

- consider immediately taking the <u>eastern</u> 53rd Street DDC wells out of operation and eliminating associated DDC monitoring well sampling
- develop better tracking of routine & non-routine costs

The recommendations for technical improvement include the following:

- prepare an annual monitoring report and distribute it to site stakeholders
- improve site maps

- report detection levels for “non-detect” results

Recommendations for site closeout include the following:

- clarify and document the turnover date to State

- develop USEPA/KDHE consensus on terminating SVE at Wilko

A table summarizing the recommendations, including estimated costs and/or savings associated with those recommendations, is presented in Section 7.0 of this report.

PREFACE

This report was prepared as part of a project conducted by the United States Environmental Protection Agency (USEPA) Office of Superfund Remediation and Technology Innovation (OSRTI). The objective of this project is to conduct Remediation System Evaluations (RSEs) at selected pump and treat (P&T) systems that are jointly funded by USEPA and the associated State agency. The project contacts are as follows:

Organization	Key Contact	Contact Information
USEPA Office of Superfund Remediation and Technology Innovation (OSRTI)	Jennifer Hovis	1235 Jefferson Davis Hwy, 12th floor Arlington, VA 22202 Mail Code 5201G Phone: (703) 603-8888 hovis.jennifer@epa.gov
Dynamac Corporation (Contractor to USEPA)	Daniel F. Pope	Dynamac Corporation 3601 Oakridge Boulevard Ada, OK 74820 phone: (580) 436-5740 fax: (580) 436-6496 dpope@dynamac.com
GeoTrans, Inc. (Contractor to Dynamac)	Doug Sutton	GeoTrans, Inc. 2 Paragon Way Freehold, NJ 07728 Phone: (732) 409-0344 Fax: (732) 409-3020 dsutton@geotransinc.com

TABLE OF CONTENTS

Figures

1.0 INTRODUCTION

1.1 PURPOSE

During fiscal years 2000 and 2001 Remediation System Evaluations (RSEs) were conducted at 20 Fund-lead pump and treat (P&T) sites (i.e., those sites with pump and treat systems funded and managed by Superfund and the States). Due to the opportunities for system optimization that arose from those RSEs, USEPA OSRTI has incorporated RSEs into a larger post-construction complete strategy for Fund-lead remedies as documented in *OSWER Directive No. 9283.1-25, Action Plan for Ground Water Remedy Optimization*. OSRTI has since commissioned RSEs at additional Fund-lead sites with P&T systems. An independent USEPA contractor is conducting these RSEs, and representatives from USEPA OSRTI are participating as observers.

The RSE process was developed by the US Army Corps of Engineers (USACE) and is documented on the following website:

http://www.environmental.usace.army.mil/library/guide/rsechk/rsechk.html

An RSE involves a team of expert hydrogeologists and engineers, independent of the site, conducting a third-party evaluation of site operations. It is a broad evaluation that considers the goals of the remedy, site conceptual model, above-ground and subsurface performance, and site exit strategy. The evaluation includes reviewing site documents, visiting the site for up to 1.5 days, and compiling a report that includes recommendations to improve the system. Recommendations with cost and cost savings estimates are provided in the following four categories:

- Improvements in remedy effectiveness
- Reductions in operation and maintenance costs
- Technical improvements
- Gaining site closeout

The recommendations are intended to help the site team (the responsible party and the regulators) identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation by the RSE team, and represent the opinions of the RSE team. These recommendations do not constitute requirements for future action, but rather are provided for the consideration of all site stakeholders.

The 57th and N. Broadway site was selected by USEPA OSRTI based on a recommendation from the associated USEPA Region, the effectiveness of the remedy to protect human health and the environment, and the annual costs of operating the remedy. This report provides a brief background on the site and current operations, a summary of observations made during a site visit, and recommendations regarding the remedial approach. The cost impacts of the recommendations are also discussed.

1.2 TEAM COMPOSITION

The team conducting the RSE consisted of the following individuals:

Grady Konieczko, Environmental Scientist, GeoTrans, Inc.
Peter Rich, Civil and Environmental Engineer, GeoTrans, Inc.
Robert Greenwald, Hydrogeologist, GeoTrans, Inc.

The RSE team was also accompanied by the following observer:

Charles Sands from USEPA OSRTI

1.3 DOCUMENTS REVIEWED

AUTHOR	DATE	TITLE
Black & Veatch Special Projects Corp.	3/29/1998	Draft Focused Feasibility Study, 57th and North Broadway Site, Sedgewick County, Kansas
Black & Veatch Special Projects Corp.	7/1998	Residential Well Sampling Addendum 1 to Remedial Investigation Report, 57th and North Broadway Site, Sedgewick County, Kansas
Black & Veatch Special Projects Corp	8/1998	Remedial Investigation Report, 57th and North Broadway Site, Sedgewick County, Kansas
USEPA	9/1999	Record of Decision, 57th and North Broadway Site, Operable Unit 1, Wichita-Park City, Kansas
USEPA, Region VII	1/2004	Five-Year Review Report for 57th and North Broadway Site, Wichita-Park City Kansas
??	??	Conceptual Cross-Section provided by Ashley Allen of KDHE
USEPA	2/2006	Excel spreadsheets with historical water quality data at monitoring wells (through January 2006) and DDC observation well clusters (through February 2005)
USEPA	2/2006	Site map (PDF) provided by site RPM
USEPA	2/2006	Excel spreadsheet with water level data for June 2005 and January 2006
??	varies	Various documents pertaining to Midland Products SVE system such as “Area of Soil and Cap Fringe Contamination”, “Log for Boring #4”, “Lab Report for Product at MW-412, 11/03”.
??	10/13/05	Hardcopy of Powerpoint slides titled “57th and North Broadway Site, Wichita, Kansas: Density Driven Convection Soil Vapor Extraction at a Chlorinated Solvent Site”
??	8/2005	Various inspection notes and observations
EnviroTrac	2005	Various Monthly Status Reports for SVE systems at Midland and Wilko

1.4 PERSONS CONTACTED

The following individuals associated with the site were present for the visit:

Steve Kinser, Remedial Project Manager, USEPA Region VII
Ashley Allen, Project Manager, Kansas Department of Health and Environment (KDHE)
Leo Henning, Section Chief, KDHE
Raule Filardi, Black & Veatch
Genise Luecke, Black & Veatch

1.5 SITE LOCATION, HISTORY, AND CHARACTERISTICS

1.5.1 LOCATION

The 57th and N. Broadway site is located in the northern region of the City of Wichita, Sedgewick County, Kansas. The site is located on the diagonal that runs from the extension of West 58th Street North and Broadway Avenue to the southwest and extends to approximately West 46th Street North and Armstrong Drive. The eastern boundary of the site is generally defined by Chisholm Creek. The site layout is shown in Figure 1. The site includes approximately 180 acres of mixed industrial, commercial and residential properties including a used oil re-refinery, trucking firms, municipal waste water treatment plant, an insurance impound lot, and a school bus facility.

The 57th and N. Broadway site was first identified in 1983 as a result of local residents' concern about the quality of drinking water in the Wichita Heights area, located on the northern edge of the city of Wichita. Subsequent investigations between 1984 and 1994 identified volatile organic chemicals (VOCs) above the maximum contaminant level (MCL) in the ground water as well as contaminants in the soil and surface water. The primary constituents of concern include trichloroethene (TCE), tetrachloroethene (PCE), and vinyl chloride, with PCE representing the most significant concentration levels. The site was listed on the National Priorities List (NPL) on November 14, 1993.

From August 1990 to May 1992, USEPA performed a removal action at the site which supplied residents and businesses with bottled water until the installation of an alternative water supply line was completed in the spring of 1992. While completing the Remedial Investigation (RI) for Operable Unit 1 (OU1), contamination was identified in the residential Riverview area, which is located in the southwestern portion of the site. The Riverview area was designated as OU2. Remedial action started in June of 1998 by connecting the Riverview area residences to a public water supply. The remedy for the site was selected in two separate Records of Decision (ROD). The remedy in the June 5, 1998 ROD was to connect residents in the Riverview area (OU2) to a public water supply. The September 29, 1999 ROD identified remedies for site wide (OU1 and OU2) soil and ground water contamination. The remedies include two soil vapor extraction (SVE) systems plus two groups of ground water circulation wells, which use the density-driven circulation (DDC) technology to provide treatment via in-well air stripping.

This RSE pertains to the site wide soil and ground water remedies (i.e., the two SVE systems and the two groups of DDC wells).

1.5.2 POTENTIAL SOURCES

The presumed source of the ground water contamination that is addressed by the remedy is from several facilities located near 57th and N. Broadway. The Midland Refining Company (Midland) complied with an administrative order issued by the State of Kansas and completed investigation of the ground water around their facility in July 1985. A notice of liability and two orders, (an Emergency Administrative

Order and a Finding of Imminent and Substantial Endangerment to the Health of Humans under Section 1431 of the Safe Drinking Water Act (SDWA) from USEPA, were issued to four parties located near 57th and N. Broadway: Coastal Refining and Marketing Inc., Farmland Industries, Inc., Wilko Paint, Inc. (Wilko), and Midland. Due to potential delays as a result of legal negotiations, USEPA withdrew the SDWA orders to the four parties. In June of 1994 USEPA issued a Unilateral Administrative Order under CERCLA to Midland and Wilko. Midland and Wilko complied with the order and performed sampling of the drinking water wells downgradient of the known contamination and provided hook-ups to public water for residences with contaminated water.

Midland is considered to be the more significant of these two source areas. There is disagreement between USEPA and KDHE as to whether or not Wilko remains a potential future source. USEPA suggests that SVE sampling data do not indicate contaminants associated with the ground water plume. KDHE indicates there is little or no ground water monitoring data available from the area and would prefer to see such data prior to making a determination about the potential for Wilko to be a continuing source.

Free product has been observed and is recovered at the Midland Refinery. A sample of the free product collected from MW-412 at Midland in November 2003 contained the types of contaminants observed in the ground water plume (such as PCE, TCE, and daughter products). Although Midland is located upgradient of the plume and plume contaminants are present at Midland, there is uncertainty regarding Midland being the only remaining significant potential source. It was suggested during the site visit that the wood composting facility located just north of 53rd Street (near the western portion of the DDC barrier system) could potentially be an additional source. These uncertainties are discussed in more detail in Section 1.5.5 of this RSE report (Description of Ground Water Plume).

1.5.3 HYDROGEOLOGIC SETTING

As defined in the OU1 ROD issued by the EPA, the geology in the area of Wichita consists primarily of sedimentary rock overlain by alluvium, colluvium, and loess. The site lies within the eastern portion of the Arkansas River flood plain and terrace complex. According to the ROD, beneath the topsoil lies a brown to light brown layer of silty clay and silt approximately 10 to 15 feet thick. The clayey zone is continuous across the site and has a low plasticity. The clayey zone grades into a fine to coarse grained sand zone near the water table. The sand zone may contain significant amounts of silt in the upper 10 feet of the sand zone. The sand grades into coarser sand toward the bottom of the alluvium where the sand may contain more gravel. The sandy zone is approximately 30 feet thick and lies unconformably on the blue to gray shale of the Wellington Formation. The shale is blocky to finely laminated and can appear as clay where it is weathered.

As summarized in the OU1 ROD, the depth to ground water ranges from 8 to 20 feet below ground surface (bgs). Ground-water occurs in the alluvial aquifer, the principal aquifer at the site. The alluvial aquifer is an unconfined system that flows to the south-southwest at a gradient of approximately 0.001 feet/foot. The RSE team constructed a water level map from the January 2006 water level data (see Figure 2) provided by USEPA after the site visit. The hydraulic conductivity at the site is reported in the OU1 ROD to range from 50 feet/day to 400 feet/day, based on historic pump test data, and the ground water velocity is reported to range from 0.51 feet/day to 1.6 feet/day.

1.5.4 POTENTIAL RECEPTORS

The site includes established residential neighborhoods as well as commercial, municipal, and industrial properties. Several ground water sampling events between 1984 and 1994 determined that approximately 50 drinking water supply wells were contaminated with COCs. Residences and business in the vicinity of the 57th and N. Broadway were connected to a public water supply system in 1992. In addition, residential well sampling was conducted in the Riverview area in December 1998 to determine the nature and extent of ground water contamination (57 of 108 identified locations were sampled). Based on the sampling results, it was determined that 25 homes were exposed to ground water containing COCs in excess of maximum contaminant levels (MCLs). The residents in the Riverview area were connected to a public water supply in 1998.

There are two public water supply wellfields located within a three mile radius of the site. The Bel Aire wellfield, located cross-gradient of the site, has reportedly increased pumping rates by a factor of five to six compared with the pumping rate during the ground water modeling conducted during the RI. The Park City Well Field includes an additional public supply well (name not provided to the RSE team) approximately 1,500 feet down gradient from sentinel well EPA-2 (see Figure 1). This water supply well is located immediately downgradient of the ground water plume. Sentinel well EPA-2 (located upgradient of this water supply well) began showing an increase in PCE concentrations in 2004, though concentrations remain below MCLs. Sentinel well EPA-1 is located approximately 600 feet downgradient (and perhaps slightly cross-gradient) of sentinel well EPA-2 and has generally been non-detect (ND) for PCE, although PCE at 1.4 ug/l was recently observed at EPA-1 in January 2006. Illustrations of concentration trends at EPA-2 and EPA-1 are presented below.

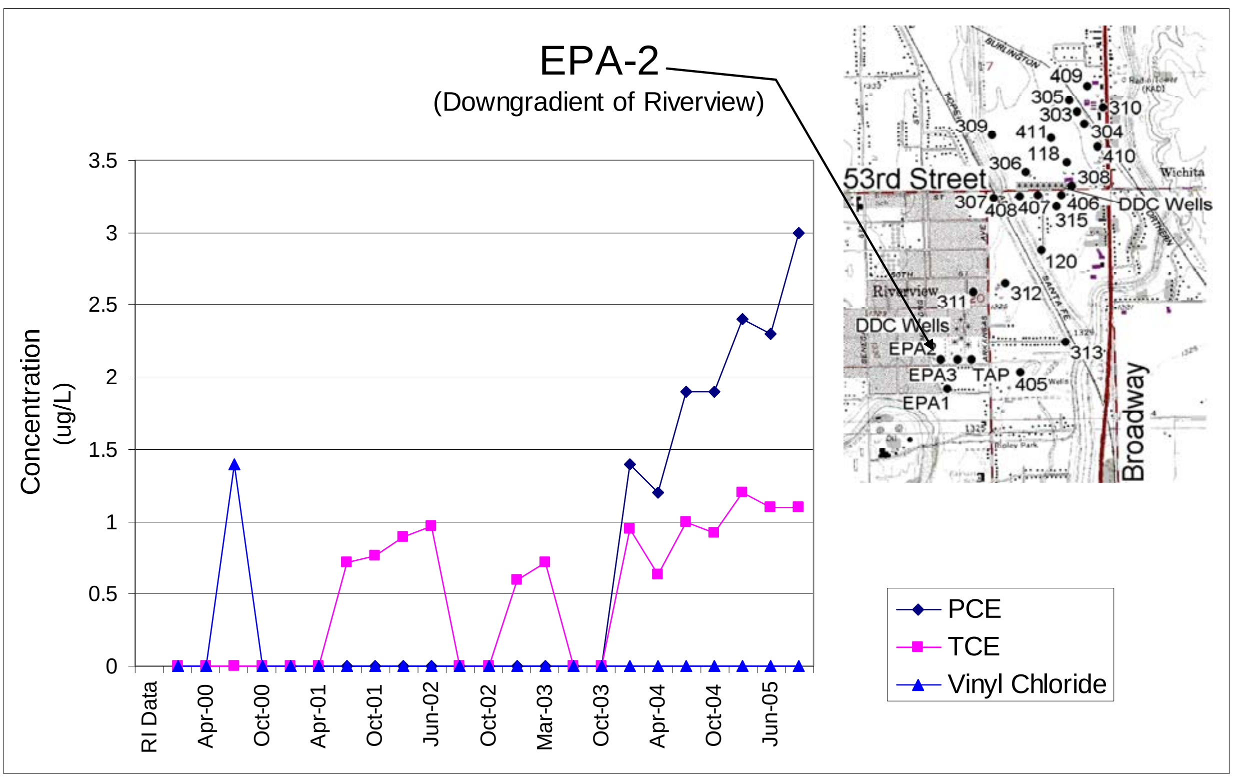


illustration from spreadsheet provided by site RPM

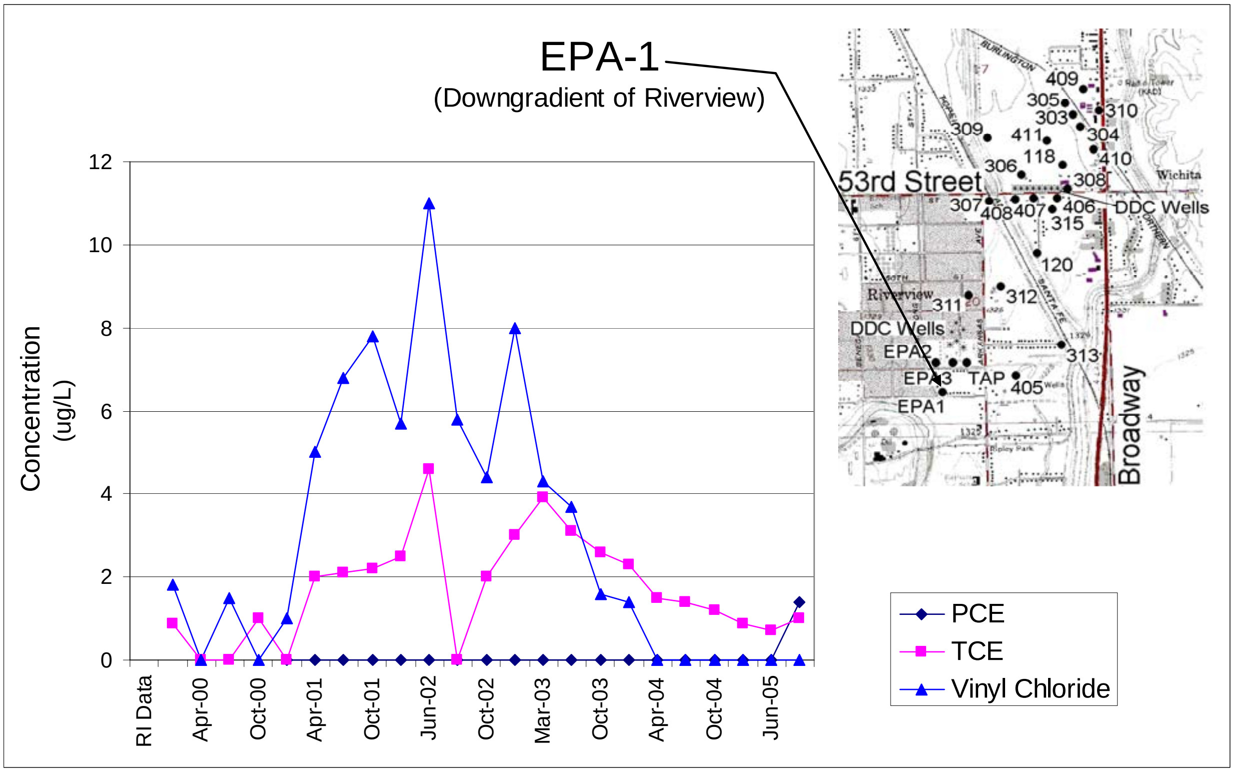


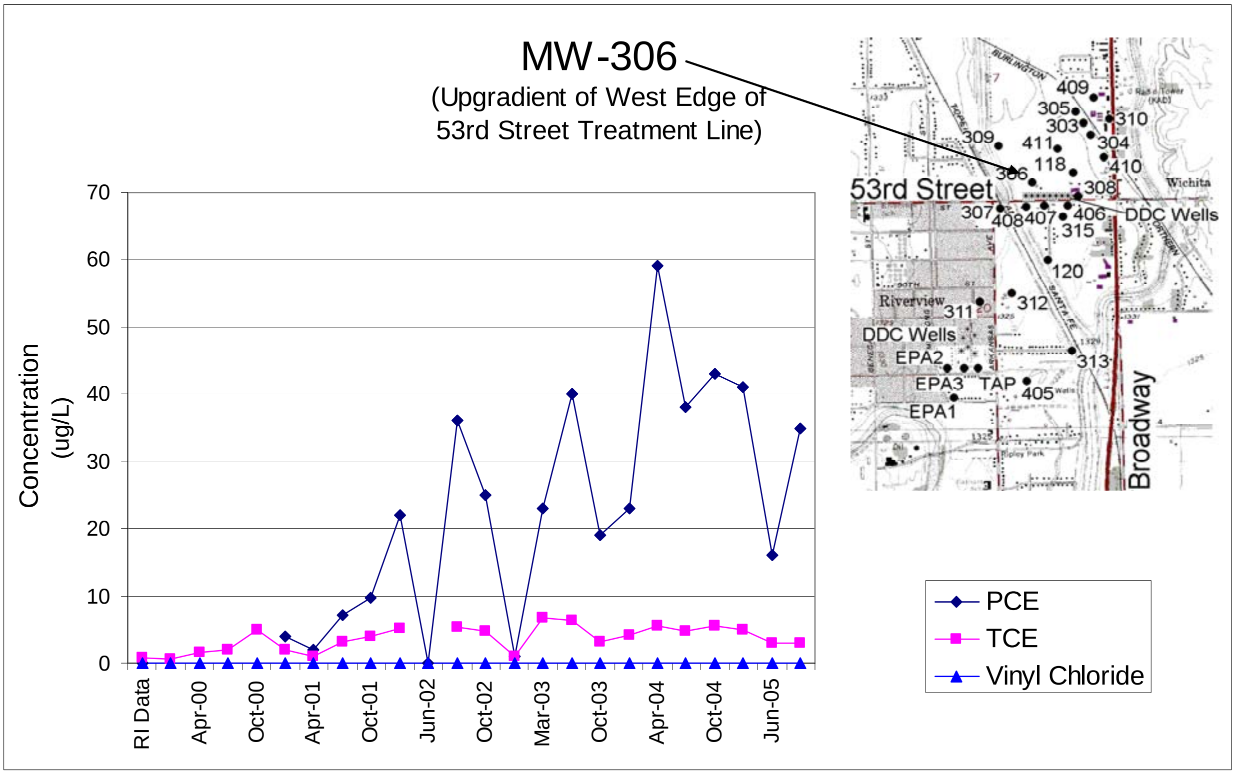
**illustration from spreadsheet provided by site RPM*

1.5.5 DESCRIPTION OF GROUND WATER PLUME

The contaminants of concern at the 57th and N. Broadway site include PCE, TCE, 1,1-Dichloroethene (1,1-DCE), 1,2-Dichloroethene (1,2-DCE), and vinyl chloride. In addition, 1,1-Dichloroethane (1,1-DCA) has also been detected in ground water samples. The ground water plume has migrated from the northeast (near 57th and N. Broadway) to the southwest (Riverview area).

During the RSE site visit it was suggested by the Site team that the ground water plume has historically been split into a northern plume and a southern plume; the Chisholm Creek floodway is located in the division of the two plumes. It is speculated that the split in the plume was the result of a flooding event that took place in 1993. However, the RSE team notes that there are no monitoring wells between MW-408 and MW-311, making these types of interpretations difficult.

The site ground water plume is generally defined as PCE concentrations above MCLs. Relatively high PCE concentrations are observed in monitoring wells located along the western edge of the plume such as MW-306 and MW-408, and concentrations have been increasing at MW-311 which is located further downgradient. Concentration histories at these wells are illustrated below.



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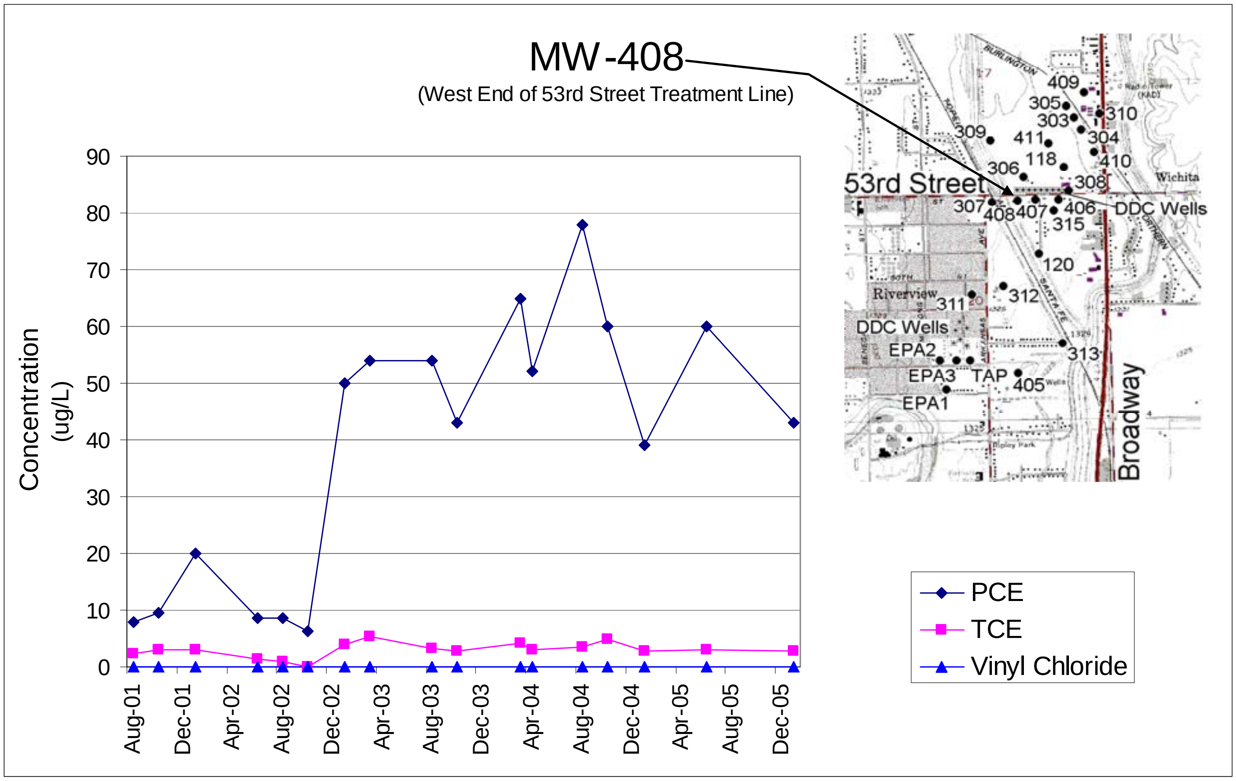

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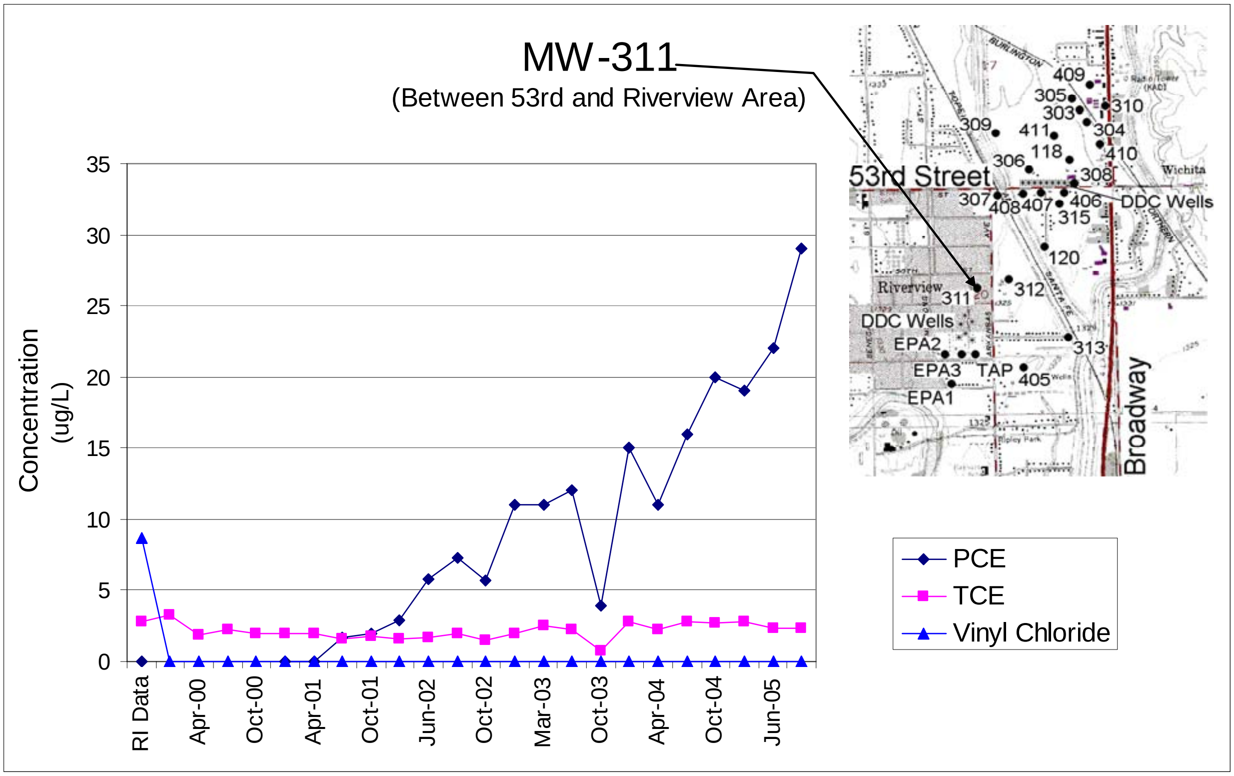


illustration from spreadsheet provided by site RPM

Similarly PCE concentrations greater than 50 ug/l have also been observed in the deep observation wells of the western-most DDC wells (DDC-53-22D to DDC-53-25D). The concentration history associated with the western-most DDC well is provided below.

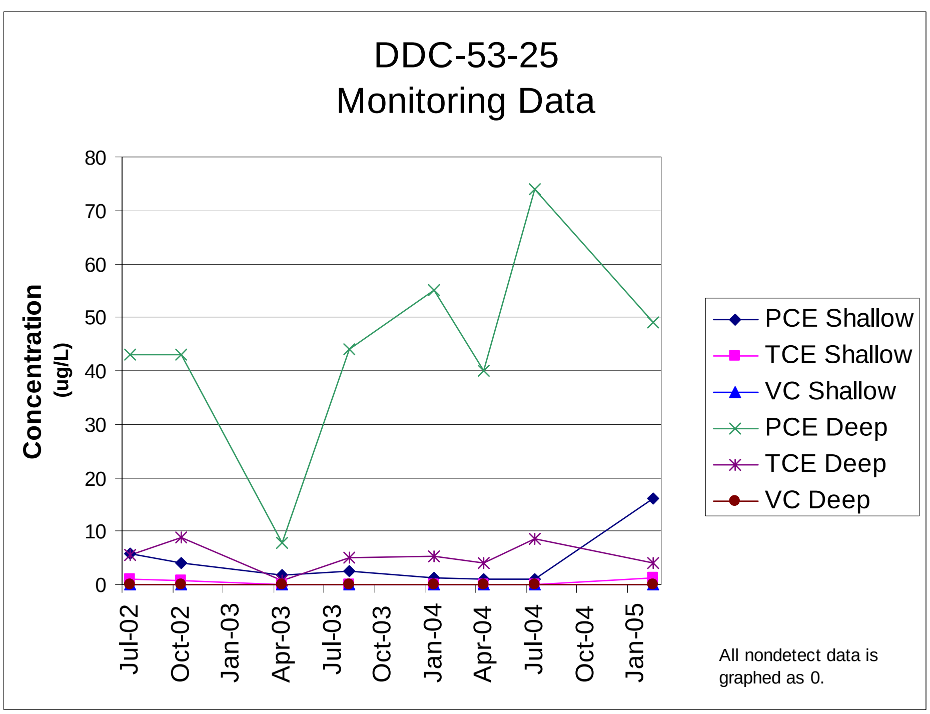


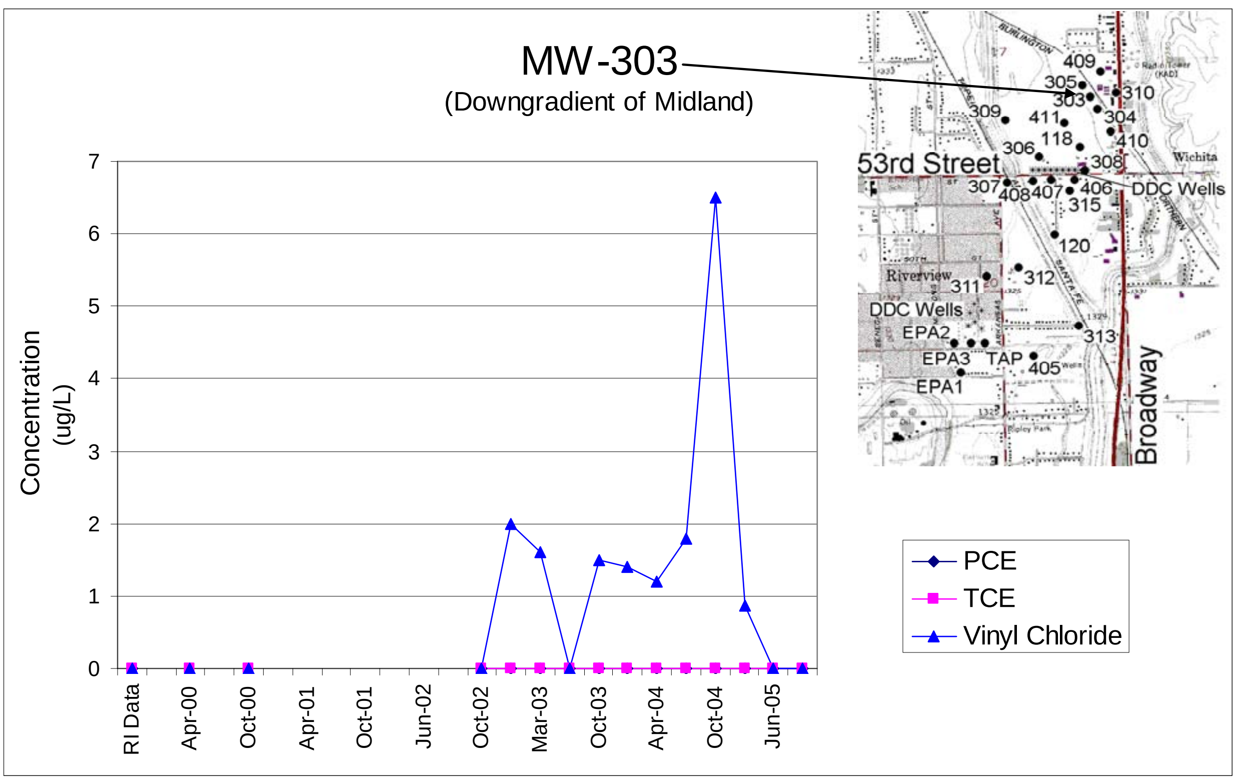
illustration from spreadsheet provided by site RPM

Note that shallow concentrations near active DDC wells may be lower than deeper concentrations due to discharge of treated water in the shallow interval.

Lower VOC concentrations have been consistently measured at the observation wells adjacent to the eastern DDC wells along 53rd Street. Between wells DDC-1 and DDC-15, VOCs are generally below MCLs or just above MCLs (such as PCE or TCE concentrations between 5 and 10 ug/l). From DDC-16 to DDC-19 VOC concentrations are slightly higher, and between DDC-20 and DDC-25 concentrations are noticeably higher (PCE concentrations generally 20 to 80 ug/l).

Free product has been observed and is recovered at the Midland Refinery, located upgradient of the 53rd street DDC system. A sample of the free product collected from MW-412 at Midland in November 2003 contained the types of contaminants observed in the ground water plume (such as PCE, TCE, and daughter products). Although Midland is located upgradient of the plume and plume contaminants are present at Midland, there is uncertainty regarding Midland being the only remaining significant potential source. For instance, significant daughter products are not observed in the vicinity of 53rd street, potentially indicating a "fresher" source near 53rd street. However, the presence of daughter products at Midland could also be due to co-metabolism provided by fuel hydrocarbon impacts.

Another uncertainty regarding Midland being the only significant remaining source is that there are relatively "clean" wells between Midland and the remediation system, such as MW-303, MW-304, and MW-411. Concentration histories for these wells are illustrated below.



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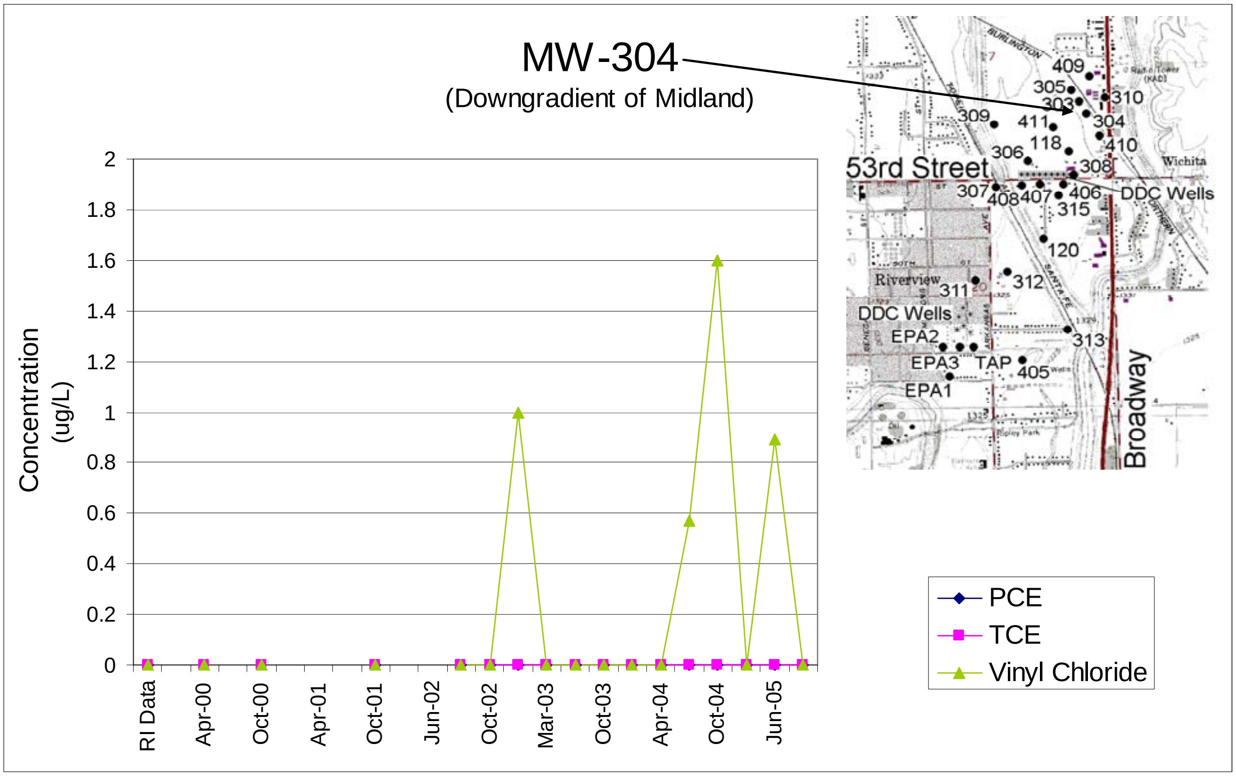

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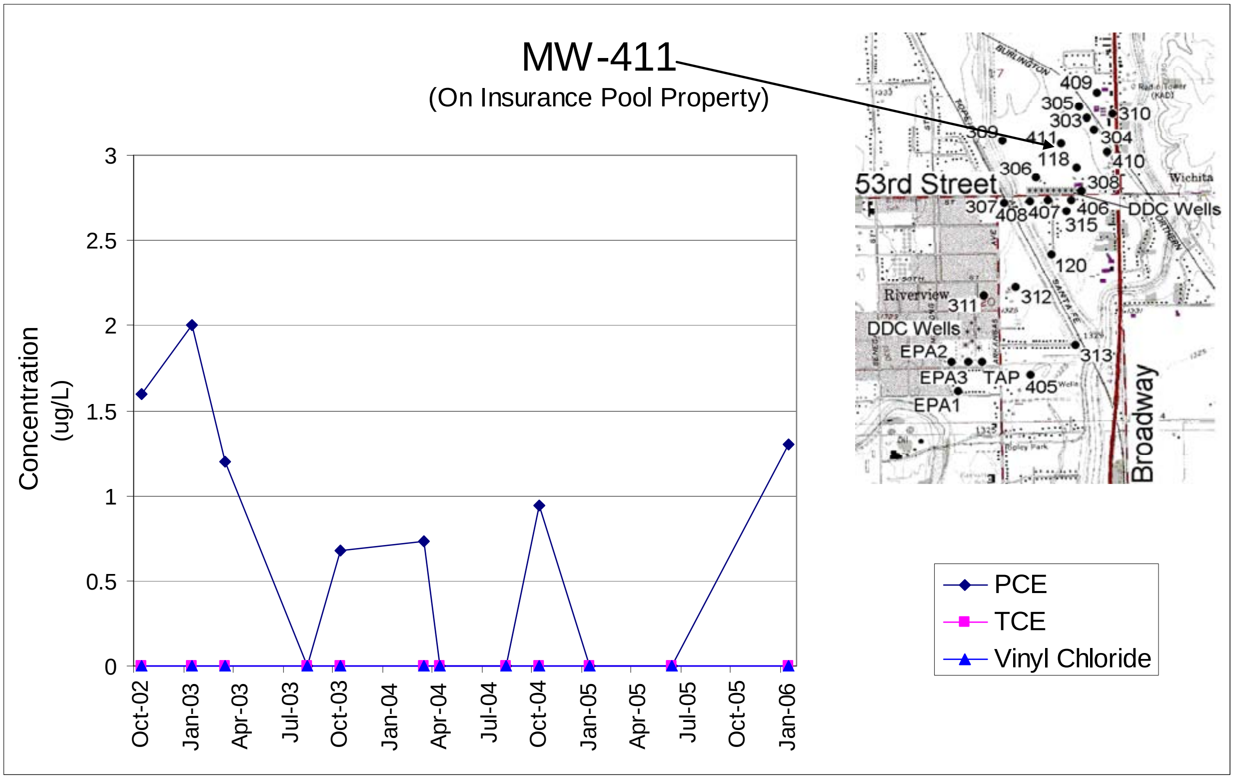
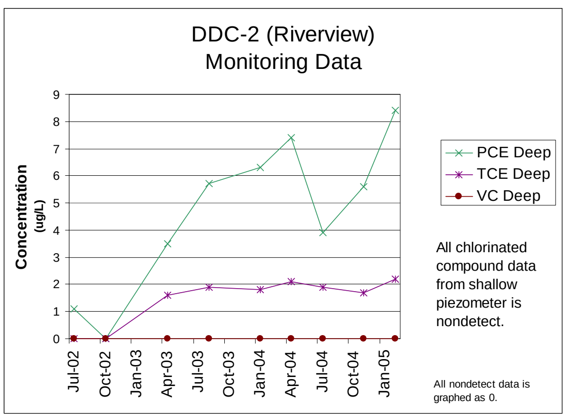


illustration from spreadsheet provided by site RPM

However, the RSE team notes that these relatively "clean" wells might not show impacts due to their screen interval (i.e., they might be screened above or below the contamination), but not enough information has been provided to the RSE team to establish this conclusion. A conceptual illustration was provided by KDHE to highlight this point, but a vertical scale indicating actual well screen elevations was not included, and more detailed evaluation would be required.

Due to these uncertainties, it was suggested during the site visit that the relatively new wood composting facility located just north of 53rd Street (near the western portion of the DDC barrier system) could potentially be an additional source. This was previously vacant land. There was general agreement that additional source area characterization is likely merited.

Further downgradient, in the Riverview Area, VOC concentrations in ground water are lower than they are in the area near 53rd Street, but have been increasing. An illustration of concentration history at MW-311 (located upgradient of the Riverview Area DDC wells) was presented earlier, and it indicates that PCE concentrations at MW-311 have been steadily rising from ND in 2001 to nearly 30 ug/l in January 2006. The deep observation wells adjacent to several of the Riverview area DDC wells have also shown increasing PCE concentrations over the past three years. For example, illustrations of concentration trends for DDC-2 and DDC-5 are presented below.



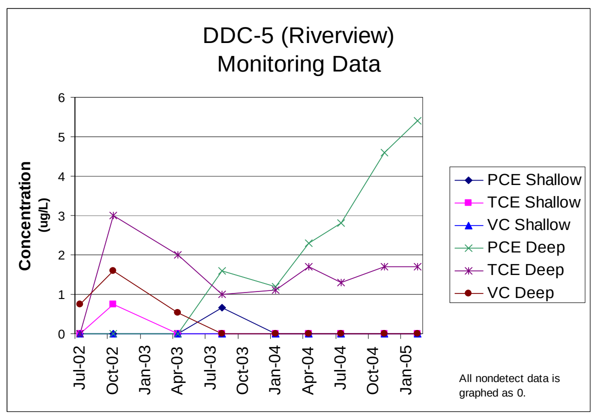


**illustration from spreadsheet provided by site RPM*

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

The remedial system construction was completed in 2002, and operation began in 2002. The remedial system consists of the following:

- six DDC wells (DDC-1 to DDC-6) installed in the OU2 Riverview area
- 25 DDC wells (DDC-53-1 to DDC-53-25) in the OU1 area along 53rd Street
- eight SVE wells (SVE-1 to SVE-8) installed in the OU1 area at the Midland Refinery
- seven SVE wells (SVE-9 to SVE-15) installed in the OU1 area at the Wilko facility

Oil, containing aromatic and chlorinated compounds, is present in SVE-4 and SVE-5 at the Midland facility, and product removal pumps have been installed in these wells to collect light non-aqueous phase liquid (LNAPL) along the water table and in the soil pore space.

2.2 GROUND WATER REMEDIATION SYSTEM: 53RD STREET AND RIVERVIEW

Each in-situ DDC well consists of a vertical well that is screened at two depths, a shallow screened interval in the vadose zone and a deep screened interval in the saturated zone. The shallow screened intervals range from approximately 2 feet bgs to approximately 1 foot above the water table. The deep screened intervals range from approximately 32 feet to 50 feet bgs. Pressurized air (7 pounds per square inch) is injected into the well at 10 cubic feet per minute (by a dedicated compressor for each DDC well) below the water table as diffuse bubbles. The lower density aerated water rises in the well and flows out of the well at the shallow screened interval, into the unsaturated zone. Contaminated ground water is drawn into the well at the deeper screened interval to replace the water that has exited through the shallow interval. This system creates a hydraulic circulation of ground water, and the ground water is never brought above the surface. Conceptually, the air bubbles strip the volatile organic compounds (VOCs) from the contaminated ground water within the well. When the contaminant laden bubbles reach the water surface within the well, the contaminant laden air is vented to the atmosphere. Two monitoring wells are located adjacent to each DDC well. The shallow monitoring well has a 10-foot screened interval that begins approximately 10 to 16 feet bgs and the deep monitoring well has a 10-foot screened interval that begins approximately 30 to 38 feet bgs.

It was noted during the RSE site visit that the design of the DDC wells does not allow for measurement of water flow or vapor concentrations within the wells. Coupled with steady to increasing concentration trends at and/or immediately downgradient of some of the DDC wells, there is some question regarding the effectiveness of the DDC wells in providing a treatment zone.

Another issue discussed during the RSE site visit is that the 53rd Street line of DDC wells cannot be extended to the west due to physical limitations.

2.3 SVE SYSTEM: MIDLAND AND WILKO

SVE is an in-situ remedial technology that applies a vacuum to the vapors in the vadose zone near the source of contamination to physically remove contaminant mass. Extracted subsurface vapors from the systems at this site are discharged directly to the atmosphere.

The July-August 2005 Monthly Report prepared by EnviroTrac states that mass removal from the Wilko facility system since system start-up in 1992 through August 2005 has been 792 lbs of VOCs. The mass removal has been reduced to less than a pound of VOCs removed during the months of July and August 2005. The site team is nearing system shut-off at the Wilko facility. Only a minor ketone issue reportedly remains, but KDHE is concerned that ground water concentrations at Wilko have not been sufficiently evaluated.

The July-August 2005 Monthly Report prepared by EnviroTrac states that mass removal from the Midland facility since system start-up in 1992 through August 2005 has been approximately 1154 lbs of VOCs. Oil floating on the water table, containing aromatic and chlorinated compounds, is present in SVE-4 and SVE-5 at the Midland facility; product removal pumps have been installed in these wells to collect free product that is collecting in these SVE wells. Oil was formerly removed from SVE-4 and SVE-5 by weekly hand bailing events with the SVE system turned off. As of August 2005, SVE-5 was yielding 2.5 to 3.25 gallons of LNAPL per week. Since that time, product removal pumps have been installed in SVE-4 and SVE-5 and cycle on and off three times a day to remove LNAPL from the wells. The LNAPL recovery is collected in 55-gallon drums on the order of approximately 10 to 12 gallons, per well, each month.

2.4 MONITORING PROGRAM

The monitoring program consists of the following:

- Ground water monitoring at monitoring wells (VOCs)
- Ground water monitoring at observation wells (shallow and deep) adjacent to the DDC wells (VOCs)
- Air monitoring at the SVE systems (VOCs)
- Water level measurements

Based on water quality data spreadsheets provided to the RSE team, the ground water monitoring program at monitoring wells consisted of quarterly sampling; however, the October 2005 event was missed. Each sampling event appears to include 25 sampling locations (including one residential well tap). Water levels are presumably collected at the ground water monitoring wells during each ground water monitoring event. The RSE team was provided with water level data for the June 2005 and January 2006 events.

For the sampling at observation wells (shallow and deep) adjacent to DDC wells, sampling has been quarterly. This sampling at the DDC wells is performed independent of the other ground water monitoring. The site team is considering a reduction in the frequency of the DDC observation well sampling (to semi-annual and perhaps annual), particularly at the non-functioning wells.

Formal ground water monitoring reports are not compiled or distributed. However, the site RPM does compile data from the monitoring wells and DDC observation wells in spreadsheets, which are distributed to the stakeholders. There is monthly sampling and status reporting for the SVE systems.

3.0 SYSTEM OBJECTIVES, PERFORMANCE AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The remedial action objectives are specified in the OU1 ROD as follows:

- Prevent ingestion, inhalation, or direct contact with ground water having vinyl chloride, PCE, TCE, or 1,1-DCE at concentrations in excess of current federal and state regulatory drinking water standards. Current regulatory drinking water standards include MCLs, which are maximum permissible levels as established by the Safe Drinking Water Act (SDWA), [42 U.S. C.§ 300(f) et seg.] for a contaminant in water that is delivered to any user of a public water system.

- Prevent further migration of contaminants to prevent degradation of natural resources and the potential contamination of additional water supply wells.

- Treat soils above health based levels to prevent direct contact or subsequent contamination of ground water.

The ROD provided an initial estimate of 10 years for total remedy duration.

The cleanup standards for the site ground water are MCLs. Cleanup standards for specific site contaminants are provided in the following table.

Contaminant of Concern	Cleanup Criteria (MCL) (μg/L)
1,1-Dichloroethane	NA
1,1-Dichloroethene	7
Cis-1,2-Dichloroethene	70
Tetrachloroethene	5
Trichloroethene	5
Vinyl chloride	2

NA indicates no value is available
MCL = Maximum Contaminant Level

For soil, it was indicated during the RSE site visit that the state of Kansas has two criteria, one pertaining to exposure and one pertaining to potential impacts to ground water. However, these criteria, and their applicability to this site, were not clarified further during the RSE site visit. In the OU1 ROD it indicates that SVE will treat soils to reduce the risk range to between 10^{-4} to 10^{-6} and reduce the Hazard Index below 1. With respect to treated vapor, the OU1 ROD states that “due to the low volume of contaminants that will be extracted contaminants will be able to be released to the atmosphere.”

4.0 FINDINGS AND OBSERVATIONS FROM THE RSE SITE VISIT

4.1 FINDINGS

The observations provided below are not intended to imply a deficiency in the work of the system designers, system operators, or site managers but are offered as constructive suggestions in the best interest of USEPA and the public. These observations obviously have the benefit of being formulated based upon operational data unavailable to the original designers. Furthermore, it is likely that site conditions and general knowledge of ground water remediation have changed over time.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 WATER LEVELS

Site wide static water level measurements are collected but are not formally reported in tables or water level maps. However, previous investigations have consistently determined that ground water flow is generally in the southwest direction. The RSE team constructed a water level map from the January 2006 water level data provided by USEPA after the site visit. This map is presented in Figure 2. It is consistent with ground water flow to the southwest.

4.2.2 CAPTURE ZONES

The ground water remedy system at the 57th and N. Broadway site was designed and placed in accessible locations to intersect the chlorinated VOC plume migrating southwest. However, it is difficult to establish the actual treatment zone of the DDC wells. PCE concentrations at key monitoring wells downgradient of the DDC wells in both areas (53rd Street and Riverview Area) call into question their effectiveness with respect to containment. For instance, concentrations are increasing at MW-408 (downgradient of the 53rd Street system) and at well EPA-2 (downgradient of the Riverview Area system). Also, as mentioned earlier, the ground water plume very likely extends west of the line of DDC wells along 53rd Street. Finally, there is a capture issue related to system down-time. Based on a chart provided to the RSE team illustrating the number of DDC wells operating by month (periodically observed from 8/02 to 7/04) there were less than 10 of the 31 DDC wells operating in 12 of the 15 observation events. Because the DDC wells do not provide a treatment zone when they are not operating, it is likely that the actual treatment zone is not as comprehensive as intended.

The six SVE wells at Wilko are spaced within 20 feet of each other in a small area while the eight SVE wells at Midland are spaced at approximately 100 foot centers and spread out across the large site based on direct-push sampling results. Observation wells are present at both sites to monitor vacuum influence between wells. A December 2004-January 2005 O&M status report by the site contractor indicates that observation wells at both sites show influence indicating the actual radius of influence exceeds the design radius of influence (15 feet at Wilko, not specified at Midland), which would indicate that the capture zone of the systems equals or exceeds the design.

4.2.3 CONTAMINANT LEVELS

A detailed discussion of concentration trends in the subsurface was presented in Section 1.5.5 of this RSE report. The reader is referred to that section to avoid repetition.

4.2.4 LNAPL Recovery

Oil containing aromatic and chlorinated solvents, was formerly removed from SVE-4 and SVE-5 by weekly hand bailing events with the SVE system turned off. As of August 2005, SVE-5 was yielding 2.5 to 3.25 gallons of LNAPL per week. Since that time, product removal pumps have been installed in SVE-4 and SVE-5 and cycle on three times a day to remove LNAPL from the wells. The LNAPL recovery is collected in 55-gallon drums on the order of approximately 10 to 12 gallons, per well, each month. The 5-year review indicated further product removal was planned for MW-412 at Midland.

4.3 COMPONENT PERFORMANCE

4.3.1 DDC SYSTEMS: 53RD STREET AND RIVERVIEW

It was noted during the RSE site visit that the design of the DDC wells does not allow for measurement of water flow or vapor concentrations within the wells. Coupled with steady to increasing concentration trends at and/or immediately downgradient of DDC wells, there is some question regarding the effectiveness of the DDC wells to prevent contaminant migration near MW-306 and MW-408 (along the western portion of the 53rd Street line of DDC wells). Another issue discussed during the RSE site visit is that the 53rd Street line of DDC wells cannot be extended to the west (where concentrations are highest) due to physical limitations.

Design problems and ongoing maintenance issues have also caused significant downtime. An apparent design flaw in the system resulted in inadequate air exchange between the exterior and interior of the equipment housing. Consequently, increased temperatures in the equipment housing triggered the automatic shut-down of the system compressors, causing the unit to cycle on and off as the temperature fluctuated. Additional venting has solved the problems. The site team identified the need to replace the carbon blades (vanes) in the compressor unit every three to five thousand operating hours. In addition, fouling of the in-situ wells has significantly impacted the effectiveness to treat contaminated ground water. An acid wash was used to clean the wells; this process was completed once during a five year period and is considered part of the routine maintenance for the system.

4.3.2 SVE SYSTEM: MIDLAND REFINERY

The in-situ SVE system located at the Midland facility is in full operation. Mass removal rates have declined significantly since initial operation, and between February 2005 and August 2005 mass removal rate was on the order of 5 pounds per month. During construction an oil product was encountered. Previously, LNAPL was hand bailed on a weekly basis. Recently, product removal pumps have been installed in SVE-4 and SVE-5 and cycle on three times a day to remove LNAPL from the wells. Approximately 10 to 12 gallons of LNAPL is removed from each well per month. LNAPL is stored in 55-gallon drums. USEPA is currently evaluating the need to install additional LNAPL extraction wells, including a recovery system at MW-412. The State questions whether the coverage of the SVE system at Midland is appropriate to address the extent of soil contamination at the site, but the system does appear to be operating as designed.

4.3.3 SVE SYSTEM: WILKO PAINT

The SVE system located at the Wilko facility is in full operation and is functioning as expected. No significant problems have been encountered. Mass removal rates have declined significantly since operation began, and as of August 2005 the mass removal rate was down to less than one pound per month. USEPA believes this system is no longer necessary for the remedy. The State would like to see additional ground water sampling results prior to making that determination.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF ANNUAL COSTS

The construction of the DDC systems were completed in Spring 2002 and construction of the SVE systems was completed in August 2002. The following table provides the best estimate of annual O&M costs that can be discerned by the RSE team for both DDC systems and both SVE systems. At the time of the RSE, five of the 15 eastern DDC wells along 53rd Street were not in operation and were not likely going to be placed back into operation by the site. Therefore, future annual costs might be lower than those reported below.

ROUTINE ITEMS

Item Description	Estimated Cost
Labor: Project management (no substantial reporting)	$126,000*
Labor: DDC operator	$50,000**
Labor: Ground water sampling	$46,000**
SVE operation (include labor, utilities, monitoring, etc.)	$56,000
Utilities: DDC Electricity	$30,000
Discharge or disposal costs (Midland site oil)	$2,000
Analytical costs	$0***
Other (parts – carbon vanes, routine maintenance, etc.)	$50,000
Total Estimated Cost	**~$370,000**

* *approximately 100 hours per month at approximately $80/hr assumed loaded rate, plus $2,500/month for travel and other direct costs*

** *a total of $96,000 was provided for site labor, which includes operator labor and ground water sampling labor. The individual estimates of $50,000 and $46,000 are by the RSE team assuming approximately 3 person days for each sampling event at monitoring wells and 10 person days for each DDC monitoring event*

*** *USEPA laboratory, no charge to project*

NON-ROUTINE ITEMS

Item Description	Estimated Cost
Acid wash for DDC wells	$170,000*
DDC well exhaust retrofits	$700 per well**

* *Done once in five years*

** *Already have done DDC-1 to DDC-6, considering doing DDC-53-1, and DDC-53-14 to DDC-53-25*

The above costs are based on discussion during the RSE site visit, plus a summary of nine-month costs provided by USEPA. However, the nine-month costs provided by USEPA were not categorized in the format listed above, and the RSE team has attempted to assign costs appropriately based on the information provided. Also, it is not clear if mark-ups of subcontractors are included in the project management costs listed above.

4.4.1 UTILITIES

The primary utility expenditure is for electricity associated with the DDC wells, approximately $30,000 per year when all units are in operation, due to the large number of motors associated with the system. It should be noted that, much of the time, many units have not been operating. Electricity for the SVE systems is included in the SVE operation costs.

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

Non-utility consumables include acid wash (non-routine), carbon vanes, and oil disposal costs. The carbon vanes are the primary cost in this category; the acid wash has been performed once in a five year time frame. The carbon vanes (seven carbon vanes for each of the 31 DDC units) are replaced approximately every 200 days of operation. At an estimated unit cost of $128 each (provided by the site team), the total cost is estimated to be approximately $50,000 per year ($900 per system × 31 systems × 1.7 events per year). Labor for this activity appears to be included in the cost of the DDC operator.

Costs for disposal of oil are estimated at $6 per gallon at about 288 gallons per year for an estimated cost of approximately $2,000 per year.

4.4.3 LABOR

There are several components of labor at this site:

- Project Management – This appears to be the role of Black and Veatch. They provide overall project management plus subcontractor oversight. They do not appear to have responsibility for reporting of ground water monitoring, because formal ground water monitoring reports are not prepared. Costs provided by USEPA indicate an average of 100 hours per month. Also, ODCs and travel of approximately $2,500 per month are indicated. Assuming average loaded labor rate of $80 per hour, this would translate to a total cost of $10,500 month (including travel and ODCs) for a total of approximately $126,000 per year.

- DDC operator (including sampling) – This is estimated by USEPA at approximately $8,000 per month, or $96,000 per year. This includes monthly visits by GSI, labor for carbon vane replacements, ground water sampling at DDC wells (two people for five days per 62-sample event) and ground water sampling at monitoring wells (one person for three days per 25-sample event). Assuming four events per year for DDC-well sampling and two events per year for monitor well sampling, the ground water sampling component would require approximately 46 person days per year, or approximately $46,000 per year assuming that each person day requires approximately $1,000 of cost (including labor, travel, and equipment). Thus, it can be assumed that the remaining approximately $50,000 per year is required for non-sampling tasks.

Again, these costs are estimated by the RSE team based on the information provided.

4.4.4 CHEMICAL ANALYSIS

The annual sampling is analyzed at USEPA laboratory; therefore, analytical costs are not billed to the project.

4.5 RECURRING PROBLEMS OR ISSUES

Operational problems of the DDC system have caused a large amount of downtime. Based on a chart provided to the RSE team illustrating number of DDC wells operating by month (periodically observed from 8/02 to 7/04) there were less than 10 of the 31 DDC wells operating in 12 of the 15 observation events. DDC units were shutting down due to high temperatures. This issue has been addressed by regularly replacing carbon vanes and improving ventilation through the housing for each compressor. Some of the DDC wells have also been removed from operation where ground water concentrations are below standards. Additional problems with the blowers have been identified. Additional exhaust retrofits have been conducted for the Riverview DDC wells and some of the 53rd Street DDC wells.

Also, it was noted during the RSE site tour that neighbors in the Riverview Area complain about noise from the DDC well exhaust retrofit. Some noise was noted by the RSE team, but it did not seem excessive during business hours when the RSE site visit was conducted.

4.6 REGULATORY COMPLIANCE

There appears to be some disagreement between USEPA and KDHE regarding the date of system turnover to the State. According to information provided by USEPA, the turnover date is either in 2012 or 2013, depending on interpretation.

4.7 TREATMENT PROCESS EXCURSIONS AND UPSETS, ACCIDENTAL CONTAMINANT/REAGENT RELEASES

The site team reports that there have not been any uncontrolled releases of contaminants or reagents.

4.8 SAFETY RECORD

The site team reports no health and safety incidents.

5.0 EFFECTIVENESS OF THE SYSTEM TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

5.1 GROUND WATER

The current plume near 53rd Street appears to extend west of the line of existing DDC wells, and physical limitations prevent additional DDC wells to the west. Monitoring well MW-408, located just downgradient of the western section of DDC wells, has consistently shown PCE concentrations greater than 40 ug/l. The problems associated with operation of the current system have also resulted in significant downtime. Thus, the effectiveness of the DDC wells to provide containment in the area of 53rd Street is questionable. Furthermore, additional source areas, other than Midland and Wilko, are possible. The site team appears to agree that additional source area characterization is appropriate.

Although the residences in the Riverview area are connected to public water service, the increases in concentration at MW-311, Riverview Area DDC observation wells, and EPA-2 are of concern because they indicate that the plume (albeit at relatively low concentrations of VOCs) is potentially migrating toward the PWS well located approximately 1500 feet downgradient of EPA-2.

5.2 SURFACE WATER

Given the relatively low levels of VOCs associated with this site, no impacts to surface water would be anticipated.

5.3 AIR

Annual reports do not list specific limits allowed for discharge from the SVE systems to the atmosphere, but the RSE team presumes the current mass removal rates indicated in the monthly EnviroTrac reports (less than 1 pound per month from Wilko and approximately 5 pounds per month from Midland) are below these limits. Similarly, discharge of vapors from the DDC wells would be expected to be quite low. Assuming circulation of 10 gpm through a DDC well and nearly complete treatment of 40 ug/L in the circulating water yields less than 2 pounds per year of VOCs released to the atmosphere.

Soil vapor concentrations for chlorinated VOCs at the Midland property were as high as 3,500 parts per billion by volume during 2005.

5.4 SOIL

Surface soils at the site are being addressed by SVE systems at the Midland and Wilko facilities. The State questions whether the areal extent of the SVE system at Midland is appropriate to address the extent of soil contamination at the site.

5.5 WETLANDS AND SEDIMENTS

Wetlands were not addressed by the RSE team, but no impacts to wetlands are expected.

6.0 RECOMMENDATIONS

Cost estimates provided herein have levels of certainty comparable to those done for CERCLA Feasibility Studies (-30%/+50%), and these cost estimates have been prepared in a manner consistent with EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, July, 2000.

6.1 RECOMMENDATIONS TO IMPROVE EFFECTIVENESS

6.1.1 PERFORM ADDITIONAL SOURCE AREA CHARACTERIZATION

There seems to be general agreement among the site team that additional source area characterization is appropriate north and west of the western extent of the DDC wells along 53rd Street. One approach discussed during the RSE site visit would be a line of direct-push samples (at multiple depths) oriented northwest from the western DDC wells (such as near DDC-53-23) to beyond MW-306. This would help establish plume width. Then, the center of that plume could be traced back to the northeast (again, at multiple depths) to establish if Midland is the ultimate source, or if there is another source between Midland and 53rd Street. It was noted during the RSE site visit that there have been access issues to property north of 53rd Street in the past, and the State suggests that USEPA should use their authority to gain access and do this direct-push study. The RSE team agrees with that approach.

The RSE team also suggests the need for the following items associated with this additional investigation:

- Prior to performing the direct-push work, well construction details (including screen intervals for existing data measurement points) should be used to prepare a cross-sectional figure down the heart of the plume (from NE to Southwest), with an accurate vertical scale and current VOC concentrations. This figure should illustrate sampling intervals and associated concentration results with depth. Based on this preliminary work, it should be determined if additional direct-push work (above and beyond that recommended above) might help clarify the locations of potential sources.

- A formal report presenting the results of the additional source characterization should be prepared in a timely manner. The report should include the data results, accurate maps, and a detailed text discussion of the updated site conceptual model (which should include an updated cross-sectional analysis such as described above) incorporating previous data and the newly collected data.

The direct-push work can be conducted using a dynamic work plan consistent with the TRIAD approach. The site team could opt for using several one day events sending samples to an off-site laboratory for rush analysis or in one continuous event using a mobile laboratory. If the turn-around time from USEPA lab is too slow for sampling analysis in the first option, private labs can be used (they typically offer 1-3 day turn around time for less than $150 per VOC sample). Assuming a total of five days of direct-push (i.e., multiple one-day events), up to 40 VOC samples, and ultimate installation of perhaps up to three additional monitoring wells, total cost for this investigation (including analysis and reporting) might be on the order of $100,000 to $150,000.

6.1.2 Update State and Owner of Public Supply Well on Site Conditions and Potential Need for Future Wellhead Treatment

While even the highest plume concentrations in the Riverview Area are relatively low, impacts to the newly installed downgradient public water supply well could potentially occur within several years. Recent concentration increases at MW-311 to nearly 30 ug/L PCE are of particular concern. Although site conditions and the potential for future impacts to this supply well were reportedly communicated to the State and well owner before the supply well was installed/activated, the RSE team believes it would be prudent for EPA to routinely update the State and the owner of the supply well regarding site conditions and the potential need for future wellhead treatment.

6.1.3 Consider Change to P&T After Source Investigation (53^{RD} Street)

Once the source is better characterized, a potential change to pump and treat (P&T) in the area near 53^{rd} Street is recommended, unless it is determined that the source can be aggressively remediated in a timely manner. This would replace the operation of the DDC wells near 53^{rd} Street. Given that the DDC system cannot be extended west of its present extent, and the effectiveness of the DDC wells to provide containment is questionable, P&T would provide for a more protective remedy with greater assurance of containment.

A preliminary analysis can be conducted to approximate the required pumping rate. The following equation is used to estimate flow through an impacted area assumed to be 1,000 feet wide:

$$Q = KAi$$

Where:

Q = flow rate through the cross-sectional area A
K = hydraulic conductivity (assume varies from 50 to 400 ft/d)
$A = w \times b$
w = plume width (assume 1,000 feet)
b = aquifer saturated thickness (assume 30 feet)
i = hydraulic gradient (assume 0.001)

Based on these assumptions, estimated flow through a plume width of 1,000 feet would be approximately 1,500 to 12,000 cubic feet per day, which equates to approximately 8 to 60 gpm. Even if the plume width is double, and a safety factor of 2 is applied, the required pumping would range from approximately 32 to 240 gpm. This could likely be achieved by one or two extraction wells.

Consideration of a P&T system assumes the following:

- recommendation 6.2.1 is implemented (i.e., immediately eliminate the eastern 15 DDC wells along 53^{rd} Street)
- the results of recommendations 6.1.1 (source investigation) identify a new source northeast of 53^{rd} Street
- P&T in place of the remaining DDC wells will increase effectiveness of the remedy

A feasibility study for P&T might cost approximately $30,000.

It is likely that replacing the remaining 10 DDC locations along 53rd Street with a P&T system would require capital costs, but then be close to cost-neutral on an annual basis. A pumping system with one or two extraction wells, with simple carbon treatment and discharge to the floodway, could likely be constructed for $300,000, and would likely require less than $60,000 per year to operate. Assuming 200 gpm with influent VOC concentrations of 40 ug/l, this would include annual carbon costs on the order of $7,500 per year and electricity costs on the order of $1,000 per year. Removing the remaining 10 DDC wells along 53rd Street from operation would reduce sampling costs, carbon vane costs, etc. System maintenance costs would generally be much lower. It is likely the cost of operating the P&T system would be similar to operating the remaining 10 DDC wells, but without the need for the acid cleaning every several years. This cost comparison should be performed in a more detailed manner when preparing the P&T Feasibility Study recommended above.

During the RSE site visit, it was mentioned that discharge of treated water from a P&T system to the floodway could have permitting issues, but the RSE team believes these issues (if present) can be overcome, particularly if KDHE agrees that P&T is a more protective long-term approach.

6.1.4 EVALUATE IF EXTENT OF SVE SYSTEM AT MIDLAND IS ADEQUATE

It is recommended that USEPA and KDHE meet to clearly document and review the extent of the SVE system at Midland versus the known extent of the impacts. Consensus should be reached as to whether or not the extent of the SVE system at Midland is adequate. This evaluation might require $10,000 for analysis and meetings.

6.1.5 CONSIDER USING AIR SPARGING WITH EXISTING SVE SYSTEM AT MIDLAND

Assuming that the main source of continuing ground water impact is located at the Midland facility, the site team should consider using air sparging to augment the existing SVE system. Although this may decrease anaerobic biodegradation, the benefits of increased mass removal would be beneficial to the overall effectiveness of the system. The site team should also consider vapor treatment in conjunction with air sparging, since a relatively high vapor mass may be released.

The cost of adding air sparging to Midland would be on the order of $100,000 and might cost an additional $25,000 per year to operate.

6.1.6 CONTINUE MONITORING SENTINEL WELLS FOR BEL AIRE WELL FIELD

It was noted during the RSE site visit that the Bel Aire Wellfield pumps significantly more water than was assumed when the current remedy was designed. The RSE team believes that the relatively low VOC concentrations in the plume, coupled with the high hydraulic conductivities in the aquifer, make potential impacts to the side-gradient Bel Aire Wellfield unlikely. Nevertheless, continued monitoring of wells between the main portion of the plume and the Bel Aire Wellfield (MW-120, MW-312, MW-313, MW-405) would be prudent. This is already performed, and therefore will not increase costs.

6.1.7 EVALUATE/DOCUMENT POTENTIAL FOR VAPOR INTRUSION

The potential for vapor intrusion to residences and/or businesses was not discussed during the RSE meeting. Although VOC concentrations in ground water are low, and in most areas the highest concentrations appear to be deep rather than shallow, the potential for vapor intrusion should be evaluated (particularly near the source area) in a screening-level approach and documented. This preliminary screening evaluation will likely only require comparison of VOC concentrations in shallow ground water to screening values, simple Johnson-Ettinger modeling, and/or comparison to similar sites. Note that documentation of clean shallow ground water over impacted deeper ground water might suffice. The

RSE team is not suggesting by making this recommendation that it believes vapor intrusions will be a serious issue at this site. Rather, we are suggesting that it is appropriate to perform a screening level evaluation to hopefully conclude that it is not a concern, and then to document that evaluation. The work should require $10,000 or less.

6.2 RECOMMENDATIONS TO REDUCE COSTS

6.2.1 CONSIDER IMMEDIATELY TAKING THE EASTERN 53RD STREET DDC WELLS OUT OF OPERATION

As discussed in Section 1.5.5, lower VOC concentrations have been consistently measured at the observation wells adjacent to the eastern DDC wells along 53rd Street. Between wells DDC-53-1 and DDC-53-15, VOCs are generally below or just above MCLs (such as PCE or TCE concentrations between 5 and 10 ug/l). In the short-term, it is recommended that consideration be given to no longer operating the eastern DDC wells (DDC-53-1 to DDC-53-15) along 53rd Street and to continue monitoring concentrations semi-annually at a small number of those wells. The site team reported that five of these DDC wells (DDC-53-6, DDC-53-7, DDC-53-9, DDC-53-10, and DDC-53-11) were not operational at the time of the RSE and that the site team was considering leaving them out of operation due to the low VOC concentrations in the area. If the site team were to move forward with this decision and discontinue operation at the remaining 10 eastern DDC wells, the following benefits would apply:

- There would be reduced monitoring because quarterly sampling at 30 locations (2 depths at 15 wells) would be replaced by semi-annual sampling at perhaps 6 locations (2 depths at 3 locations). This would reduce the sampling labor requirements for DDC well locations from 5 days per event to perhaps 3 days per event for 2 people, saving 16 man days per year in sampling labor (approximately $16,000 per year).

- There would be reduced need to replace carbon vanes at 15 wells (versus 31 DDC wells in current system), which would save approximately $25,000 per year in cost for the vanes and likely an additional $10,000 savings in labor, for a total savings of approximately $35,000 per year.

- There would be reduced electricity by removing 15 of the 31 existing DDC wells, cutting electrical costs by up to $15,000 per year.

These savings add up to approximately $66,000 per year. It would also lead to less maintenance, less reporting, and lower costs in the future for acid wash treatments should they once again be performed. Factoring in these items, cost savings should be even greater.

6.2.2 DEVELOP BETTER TRACKING OF ROUTINE & NON-ROUTINE COSTS

As discussed in Section 4.4, the costs at this site are not clearly summarized or broken out in a meaningful way to track costs. It is recommended that costs be tracked using categories such as those listed in Section 4.4, with some sub-categories as appropriate for clarity. Non-routine costs should be separated from routine costs. Also, services provided by the prime contractor should be better identified and compared to project management costs that do not result from markups of subcontractors.

There should be no cost associated with implementing this recommendation. It is possible that other cost-savings opportunities will become clear when costs are tracked more clearly, but those potential savings cannot be quantified at this point.

6.3 Recommendations for Technical Improvement

6.3.1 Prepare and Distribute Annual Monitoring Reports

Currently USEPA maintains excellent Excel spreadsheets of water quality and water levels data, and produces informal maps. It is highly recommended that more formal reports be prepared on an annual basis, and then be shared with all site stakeholders. These reports should likely be prepared by the primary contractor (currently Black and Veatch) and should include monitoring data, accurate site maps, well-construction details, water levels maps, detailed descriptions of the current remedy system operation and effectiveness, and an updated site conceptual model that includes a cross-sectional evaluation of plume depth over space related to monitoring well screens. Additional annual cost of $15,000 per year for the first year is assumed and $8,000 per year thereafter is assumed. It is quite possible these costs can be absorbed within the current project management budget, but that is not assumed herein.

6.3.2 Improve Site Maps

At the time of the RSE site visit there were no formal maps available that comprehensively show all site features. Most maps provided to the RSE site team do not include significant site features such as:

- Locations/names of public supply wells
- Extent of SVE system versus impacted area at Midland
- MW-412 at Midland

It also appears that many locations are estimated. For instance, MW-408 appears south of the DDC wells on some maps, and southwest of the DDC wells on other figures. Locations should be surveyed or ground-truthed. No extra costs are assumed for implementing this recommendation (included in costs for Recommendation 6.3.1).

6.3.3 Report Detection Levels for "Non-Detect" Results

Data tables report non-detect values as "ND". This does not indicate the detection limit. It is recommended in the future that the detection level be indicated (e.g., "<1.0" or "ND(1.0)")

6.4 Considerations for Gaining Site Close Out

6.4.1 Clarify/Document Turnover Date to State

There appears to be some disagreement between USEPA and KDHE regarding the date of system turnover to the State. According to information provided by USEPA, the turnover date is either in 2012 or 2013, depending on interpretation. This should be clarified and documented. This should not require additional funding.

6.4.2 Develop USEPA/KDHE Consensus on Terminating SVE at Wilko

The SVE system at Wilko reportedly shows little or no site-related contaminants in vapors, and removes negligible mass. KDHE has indicated concerns regarding the adequacy of ground water investigation at Wilko. During the RSE site visit Black and Veatch discussed direct-push sampling done there. In addition, MW-410 is located in the vicinity, and shows no impacts. It is recommended that previous ground water investigations and available monitoring data be formally documented, and then be reviewed jointly by USEPA and KDHE, so that a consensus on terminating SVE at Wilko (or at least a plan for doing so) can be developed and documented. This should require less than $10,000. Assuming the SVE system at Wilko can be shut down, annual savings of approximately $15,000 per year are likely.

7.0 SUMMARY

The observations and recommendations contained in this report are not intended to imply a deficiency in the work of either the system designers or operators, but are offered as constructive suggestions in the best interest of USEPA and the public. These recommendations have the obvious benefit of being formulated based upon operational data unavailable to the original designers.

Recommendations are provided in all four categories: effectiveness, cost reduction, technical improvement, and site closeout. The recommendation for effectiveness initially focuses on additional source area characterization. It is also recommended that a contingency plan be developed for potential wellhead treatment at the Park City public well located downgradient of EPA-2. Once the source is better characterized, evaluating the feasibility of a change to P&T to replace the western DDC wells along 53rd Street is recommended, unless it is determined that the source can be aggressively remediated in a timely manner. Several other effectiveness recommendations are made with respect to the SVE systems, continued sentinel monitoring with respect to the Bel Aire Wellfield, and performing and documenting a preliminary screening evaluation of the potential for vapor intrusion. With respect to potential cost reduction, it is recommended that consideration be given to immediately eliminating operation of the eastern DDC wells along 53rd Street and associated ground water monitoring. It is also recommended that system costs be more clearly tracked. Several recommendations for technical improvement are included, which generally pertain to improved reporting. With respect to site closeout, it is recommended that the turnover date to the State be clarified and documented; in addition, data regarding the conditions at Wilko be compiled and documented so that consensus between USEPA and KDHE can be reached for terminating that SVE system.

Table 7-1 summarizes the costs and cost savings associated with each recommendation in Sections 6.1 through 6.4. Both capital and annual costs are presented. Also presented is the expected change in life-cycle costs over a 10-year period for each recommendation both with discounting (i.e., net present value) and without it.

Table 7-1. Cost Summary Table

Recommendation	Reason	Additional Capital Costs ($)	Estimated Change in Annual Costs ($/yr)	Estimated Change in Life-cycle Costs ($) Undiscounted*	Estimated Change in Life-cycle Costs ($) Discounted**
6.1.1 Perform additional source area characterization	Effectiveness	$125,000	$0	$125,000	$1,013,000
6.1.2 Consider contingent well head treatment at the PWS well downgradient of EPA-2	Effectiveness	$10,000	$0	$10,000	$8,100
6.1.3 Consider change to P&T after source investigation (53rd Street)	Effectiveness	$30,000 + $300,000(1)	$0(2)	$30,000 + $300,000(1)	$243,000 + $2,430,000(1)
6.1.4 Evaluate if extent of SVE system at Midland is adequate	Effectiveness	$10,000	$0	$10,000	$8,100
6.1.5 Consider using air sparging with existing SVE system at Midland	Effectiveness	$100,000	$25,000	$350,000	$303,000
6.1.6 Continue monitoring sentinel wells for Bel Aire Wellfield	Effectiveness	$0	$0	$0	$0
6.1.7 Evaluate/document potential for vapor intrusion	Effectiveness	$10,000	$0	$10,000	$8,100
6.2.1 Consider immediately taking the eastern 53rd street DDC wells out of operation	Cost Reduction	$0	($66,000)	($660,000)	($535,000)
6.2.2 Develop better tracking of routine & non-routine costs	Cost Reduction	Not quantified	Not quantified	Not quantified	Not quantified
6.3.1 Prepare and distribute an annual monitoring report	Technical Improvement	$15,000	$8,000	$95,000	$80,000
6.3.2 Improve site maps	Technical Improvement	$0	$0	$0	$0
6.3.3 Report detection levels for “non-detect” results	Technical Improvement	$0	$0	$0	$0
6.4.1 Clarify/document turnover date to state	Site Closeout	$0	$0	$0	$0
6.4.2 Develop USEPA/KDHE consensus on terminating SVE at Wilko	Site Closeout	$10,000	($15,000)	($140,000)	($112,000)

Costs in parenthesis imply cost reduction
** Assumes 10 years of operation with discount rate of 0% (i.e., no discounting)*
*** Assumes 10 years operation with a discount rate of 5% and no discounting in the first year*

(1) Only incurred if P&T is implemented
(2) Assumes 6.2.1 will also be implemented

FIGURES

Source: Base map provided by Steven Kinser. Additional features superimposed by RSE team.

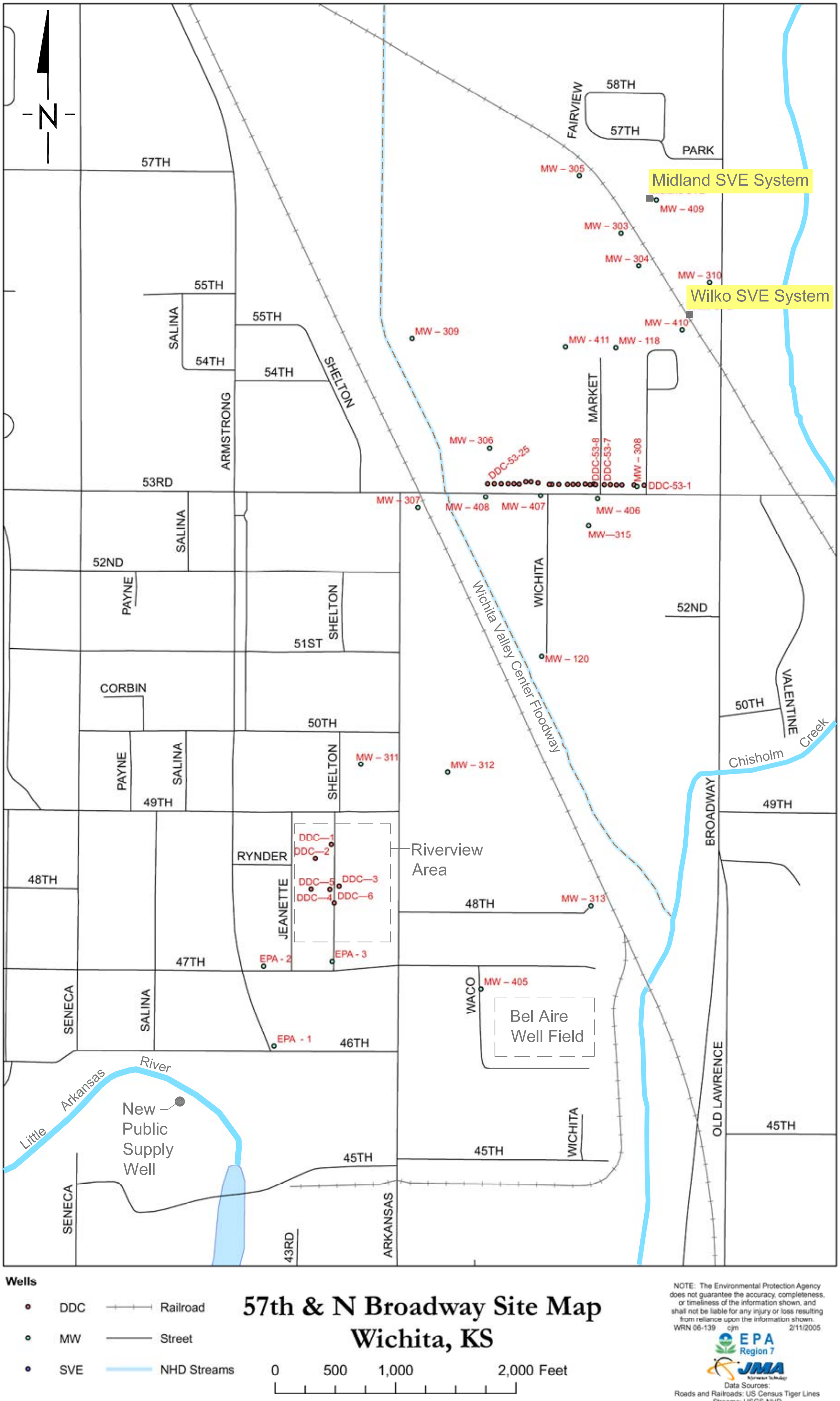


Figure 1 Site Map

Source: Base map provided by Steven Kinser. Additional features superimposed by RSE team.

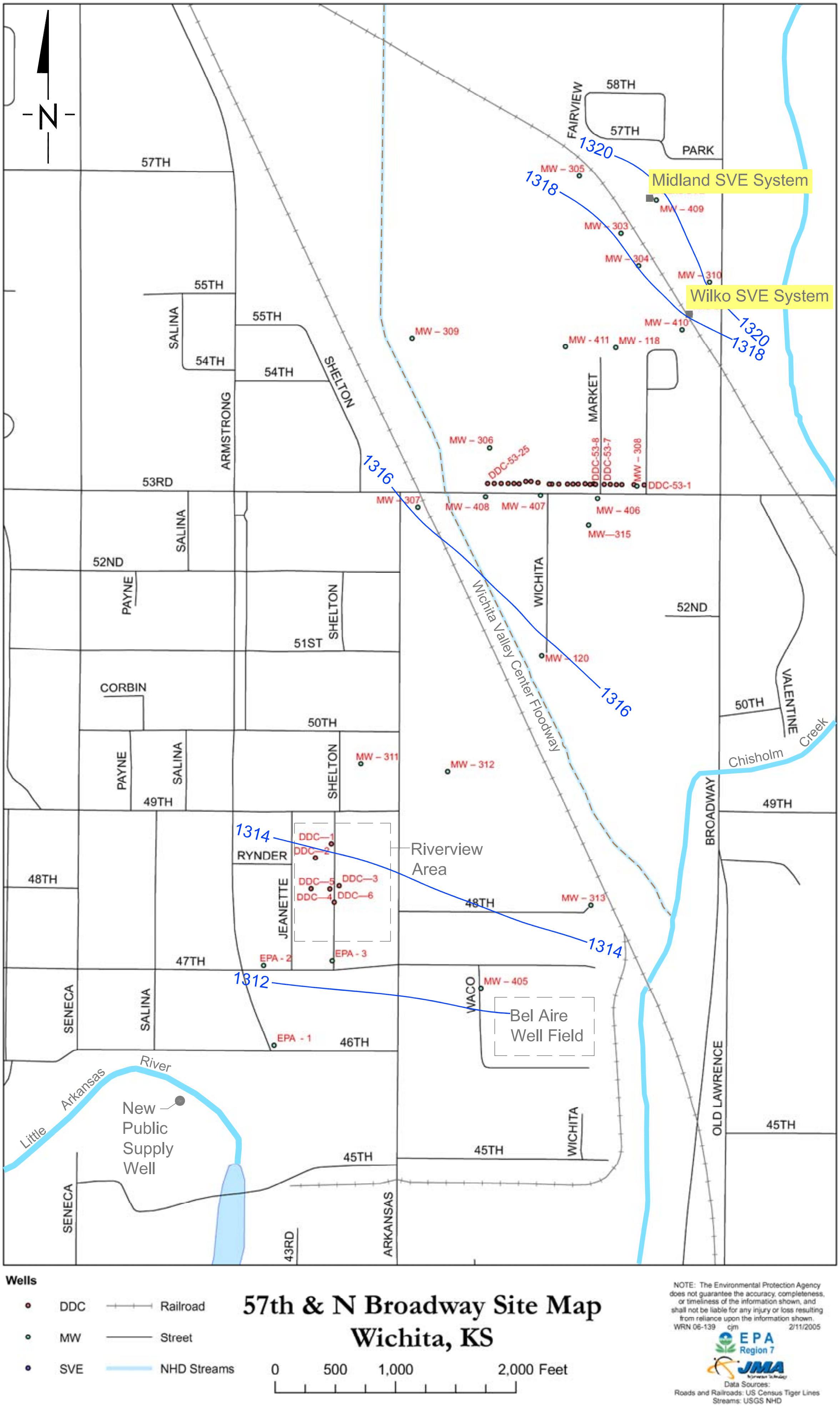


Figure 2 Groundwater Contours - January 2006