Capitol City Plume - Documents (3 of 4)

Stephen Smith to: gary.gengel@lw.com 07/26/2011 03:16 PM

Attached are discussed documents:

CC Plume - RI.pdf

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REMEDIAL INVESTIGATION REPORT
CAPITOL CITY PLUME SITE
Montgomery, Montgomery County, Alabama

REMEDIAL INVESTIGATION REPORT

Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Prepared For The
U.S. Environmental Protection Agency, Region IV
Work Assignment 001-RICO-A4H7
BVSPC Project No. 48011

November 8, 2002

Prepared by
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1.0 Introduction

Black & Veatch Special Projects Corp. (Black & Veatch) was tasked by the U.S. Environmental Protection Agency (EPA), Waste Management Division, Region 4, to conduct a remedial investigation/feasibility study (RI/FS) with a human health risk assessment, for the Capitol City Plume site located in Montgomery, Montgomery County, Alabama. The RI/FS field investigation effort was performed under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). Black & Veatch prepared this document for EPA Region 4 under Contract Number 68-W-99-043, Work Assignment Number 001-RICO-A4H7 and in accordance with the objectives specified in the Statement of Work (SOW), dated July 19, 1999, (EPA, 1999a); Final Sampling and Analysis Plan and addendums submitted September 30, 1999, November 30, 2000, and February 4, 2002, (Black & Veatch, 1999; Black & Veatch, 2000a, Black & Veatch, 2002a); Work Plan revision request, dated October 13, 2000, (Black & Veatch, 2000b); and subsequent variance requests, dated January 16, 2001, (Black & Veatch, 2001a) and January 24, 2002, (Black & Veatch, 2002b).

1.1 Objectives

The overall purpose of this RI/FS was to gather data to complete an evaluation of the nature and extent of contamination within the Capitol City Plume site contributing to groundwater contamination in the site area. EPA will use the data collected in the RI and previous site investigations to develop an approach for site remediation that includes a feasability study (FS), a proposed plan, and a record of decision (ROD).

The following is a summary of the RI objectives established for the Capitol City Plume site:

- Consider the use of all relevant existing data during the RI and justify the need for additional data.

- Obtain current information on demographics and land use for properties located within the 30-city block site area.

- Identify community concerns associated with the RI/FS and the final remedy for the site through community interviews, public hearings and meetings, and fact sheets and summarize results.

- Determine natural or background, physical and chemical, and flow characteristics of groundwater in the site area.

- Determine the nature and extent of soil and groundwater contamination relative to local background conditions that may be attributable to facilities within the site.

- Determine the extent of human contact with potentially contaminated media.

- Collect and evaluate the additional data necessary to develop a baseline human health risk assessment.

- Collect data to develop a limited number of remedial action objectives that protect human health and the environment and satisfy pertinent applicable or relevant and appropriate requirements (ARARs).

- Collect data to identify and evaluate a limited number of potential remediation technologies.

- Provide post RI/FS support in the form of technical assistance to prepare the responsiveness summary, proposed plan, and ROD as requested.

1.2 Scope of Work

An RI/FS was scoped for the Capitol City Plume site under the Statement of Work issued to Black & Veatch on July 19, 1999 (EPA, 1999a). The objective of the RI/FS is to develop data necessary to support selection of an approach for site remediation and use the data to support a ROD for the site. The scope of work includes generating data to select a remedy to eliminate, reduce, or control risks to human health and the environment. Data collected was limited to what was necessary to characterize the site by identifying the types and concentration of hazardous wastes or hazardous constituent releases, the rate and direction at which the releases are migrating, and the distance over which releases have migrated. The RI/FS also included a risk assessment to determine whether site contaminants pose a current or potential risk to human health and the environment in the absence of any remedial action.

Field activities to address environmental concerns near the Capitol City Plume site included the installation of monitoring wells, collection of surface soil, subsurface soil, and groundwater samples, estimating of hydraulic conductivity using monitoring well slug tests, surveying of monitoring wells, and disposal of investigation-derived wastes (IDW). Section 3.0 of the RI report presents monitoring well and sample locations as well as a description of RI/FS fieldwork.

The overall scope of the RI/FS included generating data to close gaps in site characterization by identifying the type and concentration of hazardous wastes or hazardous constituent releases, the rate and direction at which releases are migrating, and the distance over which releases have migrated. The following specific activities were conducted during the RI:

- Obtain and review background materials relevant to assessing potential health and environmental hazards posed by the site.
- Obtain information on local water system wells and other area wells that may affect area water levels.
- Install monitoring wells and collect groundwater samples.
- Characterize site source areas.
- Determine the nature and extent of contamination.
- Prepare the RI report.
- Complete a human health risk assessment and determine both what is needed to complete an ecological risk assessment or whether one is necessary.

1.3 Report Organization

This RI report is an evaluation of data generated in RI/FS field investigations and file review to characterize the nature and extent of contaminants at the Capitol City Plume site and determine whether more data is needed. Section 1 introduces the objectives and scope of the Capitol City Plume RI report. Section 2 describes the site and summarizes site area characteristics and history. Section 3 summarizes field activities. Section 4 addresses the nature and extent of contamination of the study area. Section 5 addresses the fate and transport of site-attributable contaminants. Section 6 includes a human health risk assessment, and Section 7 summarizes the findings.

2.0 Site Description and Site History

2.1 Site Description

The Capitol City Plume site is an approximately 30-city block area located in downtown Montgomery, Montgomery County, Alabama. Figure 2-1 is a vicinity map showing the general site location. Figure 2-2 is a site layout map showing the site area in greater detail.

The Capitol City Plume site area was determined by groundwater contamination identified in downtown Montgomery. Groundwater contamination was initially identified through soil and groundwater contamination (tetrachloroethene) detected during construction of the Retirement Systems of Alabama (RSA) energy plant located at the corner of Monroe Street and McDonough Street (Figure 2-2). Tetrachloroethene (PCE) contamination was later detected in groundwater at Montgomery Water Works Well 9W, located at the corner of Court Street and Pollard Street. Well 9W was closed due to PCE contamination (ADEM, 1993a; ADEM, 1994a; ADEM, 1995). Benzene, toluene, ethyl benzene, and total xylenes (BTEX) were identified in soil gas during further investigation of the site area. An Alabama Department of Environmental Management soil gas survey identified a minimum of 12 soil gas plumes consisting of 6 PCE plumes and 6 BTEX plumes within the 30-city block area (ADEM, 1995; NERI, 1995).

PCE is a man-made compound primarily used for dry cleaning fabrics and textiles. It is also used as a metal cleaning agent and an additive in printing inks, adhesives, glues, sealants, and polishes. A historical review of Montgomery city directories noted 38 dry cleaning businesses operated in the site area from 1905 to 1985 (ADEM, 1995). BTEX is commonly used in automobile fuel and many other petroleum derived fuels and solvents. Although BTEX has widespread use, at least two BTEX plumes are though to have originated from leaking underground storage tanks (USTs), which may have been associated with automobile service stations (ADEM, 1995). Waste sources for the12 soil gas plumes were not completely identified during the ADEM study.

2.2 Regulatory History and Previous Investigations

In 1992, The CWA Group, Inc. (CWA) was retained by PH&J Architects, Inc., to conduct a Phase I Environmental Site Assessment of several properties located in the downtown area of Montgomery, Alabama, which were of interest to RSA. The purpose of the assessment was to identify potential releases resulting from past or present use of the properties identified

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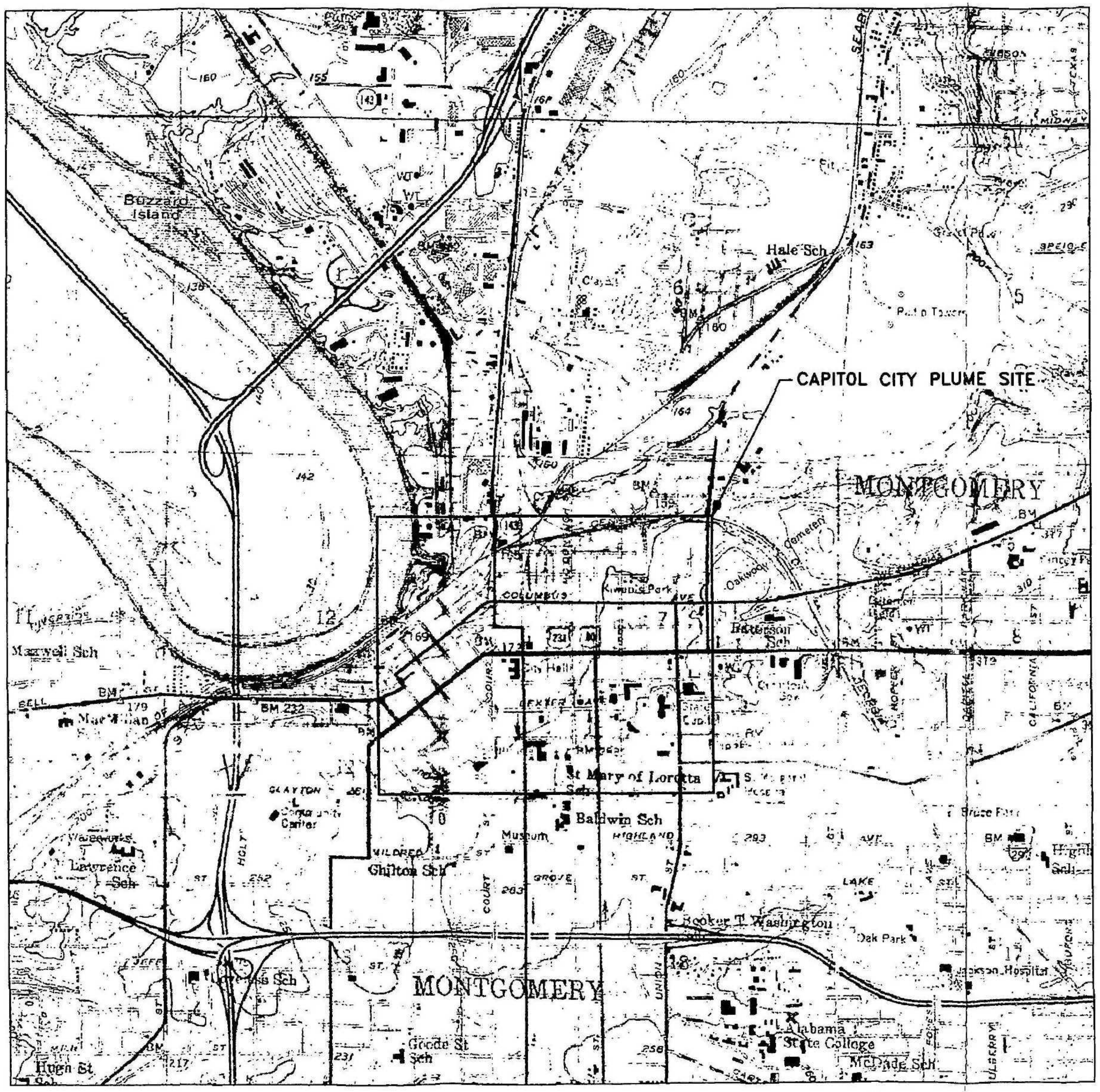
DRAFTERS INITIALS: ACM



N

0.67 0 0.67 MILES

SCALE: 1"= 0.67 MILES

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

SITE VICINITY MAP

FIGURE
2-1

CAD DWG NO: FIG2-1/4
DATE: 9-24-99
PLOT SCALE: 1"=0.2MILES

ORIGINAL DWG SIZE
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FILE: R:/48011/100

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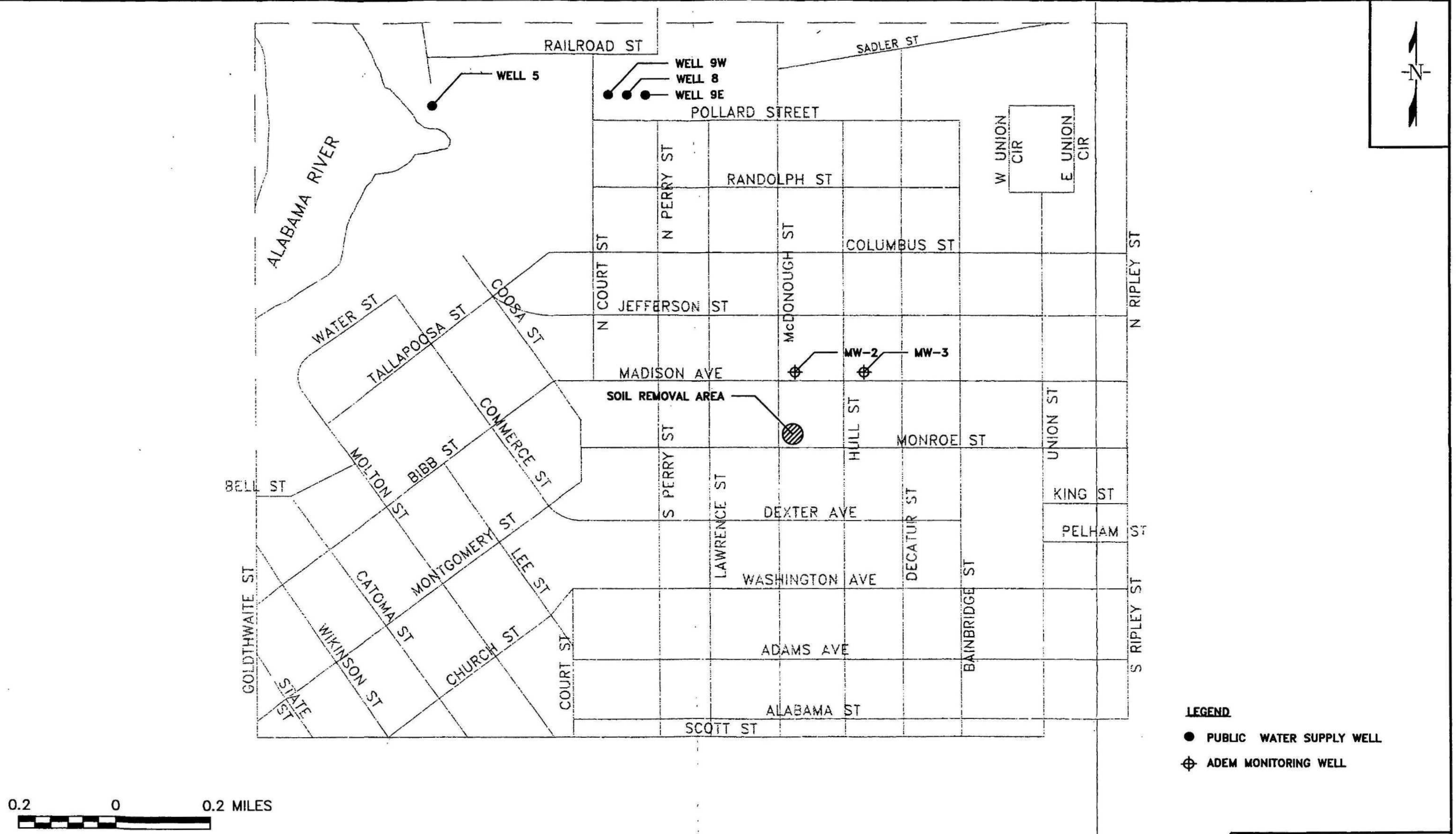

SCALE: 1"= 0.2 MILES

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

SITE LAYOUT MAP

FIGURE
2-2

and/or adjacent properties. The energy plant area and properties located within city blocks located west, southwest, and south of the energy plant were among the properties identified for environmental site assessment. No environmental concerns were identified for these properties on the local or state levels. The Madison Mini Mart, Inc., gasoline service station, located at 318 Madison Avenue, and the Madison Car Wash, Inc., (reported closed at the time of the assessment), located at 300 Madison Avenue between Hull and McDonough Streets, were identified as having USTs, but no violations or complaints were on file for these facilities.

During the Phase I inspection, four facilities were identified within the same block as the energy plant as having the potential for the presence of hazardous materials. These former facilities, their addresses, location within the block, and respective potential contaminants follow: 1) Madison Ave. Cleaners, 320/330 Madison Ave., northeast corner, solvents, other chemicals, metals; 2) Madison Auto Car Wash, 318 Madison Ave., north central portion of block, UST; 3) Gulf Service Station, 300 Madison Ave., northwest corner, UST and hydraulic lift; and 4) Swift and Co., 319 Monroe Ave., west central portion of block, UST. Dry cleaning facilities that potentially use solvents, other chemicals, and metals also are located in the northwest (1 facility) and southwest (1 facility) corners of the block east of the energy plant, in the southwest quadrant (2 facilities) of the block southwest of the energy plant, near the southeast corner of the block (1 facility) located south of the energy plant, and in the southern portion of the block (1 facility) located northwest of the block containing the energy plant. Ten other facilities located in blocks adjacent to the energy plant block that may contain USTs and/or hydraulic lifts include gasoline stations, auto repair shops, one parking lot/public transfer station, and one greenhouse, which potentially contains solvents, other chemicals, and metals. The Phase I Environmental Assessment report recommended that Phase II Environmental Assessments be conducted on sites where visual indications noted the potential for the existence of hazardous materials on or beneath the ground surface (CWA, 1992).

The contamination concern at the Capitol City Plume site was not discovered until construction of the RSA energy plant near the corner of Monroe Street and McDonough Street. In September 1993, ADEM's Special Projects group under the Alabama Hazardous Substance Cleanup Fund (AHSCF) received a report of contaminated soil from RSA officials. RSA reported an area of suspected PCE contamination had been discovered at a depth of 25 feet while excavating during construction of a basement for the RSA utility building. The reported soil contamination was estimated to be approximately 20 feet wide and 15 feet deep. On September 13 through 14, 1993, Mr. Stephen Maurer of ADEM conducted a site inspection of the RSA energy plant area. During the site inspection, it was determined that the nearby Davis Dry Cleaning establishment did not perform and had never performed dry cleaning at that location, according to its owner, Mr. Davis. Dry cleaning machine parts and chemicals were observed during the site inspection, but no indication was found of present or previous dry cleaning machine utility connections. The Degostin & Angelini Brothers Building, located at the southwest corner of Hull and Monroe Street and southeast of the RSI energy plant utility building excavation, had been torn down recently. A laboratory analysis of soil collected from the utility building excavation on September 9, 1993, 21.5 feet below ground level and 1 foot into the bank contained concentrations of 7,066 parts per billion (ppb) PCE; 1,037 ppb methylene chloride; and 255 ppb of 1,1,2-trichloroethane. The area of contamination had been taped off, and construction halted until a course of action could be determined. Mr. Maurer of ADEM collected three subsurface soil samples at approximately 25 feet below ground level from the utility building excavation. The contractor for the utility building excavation was advised to discontinue disposal of contaminated soil from the utility building excavation into the area 2 blocks down from Monroe Street until a course of action could be determined. On September 15, 1993, Mr. Maurer received a copy of the Phase I Preliminary Environmental Site Assessment report for the RSA properties conducted by the CWA Group, Inc., for PH&J Architects, Inc. (ADEM, 1993b; CWA, 1992).

Three subsurface soil samples, RSA-1, RSA-2, and RSA-3, collected by Mr. Maurer of ADEM and included in ADEM Phase I report analytical results, contained 3,989 parts per million (ppm); 7,268 ppm; and 7,843 ppm of PCE, respectively (ADEM, 1993a; ADEM, 1993b). Additional ADEM Phase I samples, consisting of 17 subsurface samples and 2 groundwater samples (both collected from monitoring well MW-1), were collected in October 1993 (ADEM, 1993a; ADEM, 1994a). Subsurface soil sample analytical results for PCE ranged from below detection limits (BDL) to 0.13 ppm in the soil and 536 to 607 ppb in groundwater (ADEM, 1993a). Sample locations and analytical results identified in the Phase I report are shown on Figure 2-3 and presented in Table 2-1.

On September 20, 1993, ADEM personnel met with Mr. Gilbert and Mr. Chesnut at the RSA energy plant site to determine a course of action with regards to the contaminated soil originating

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FILE: 48011.101

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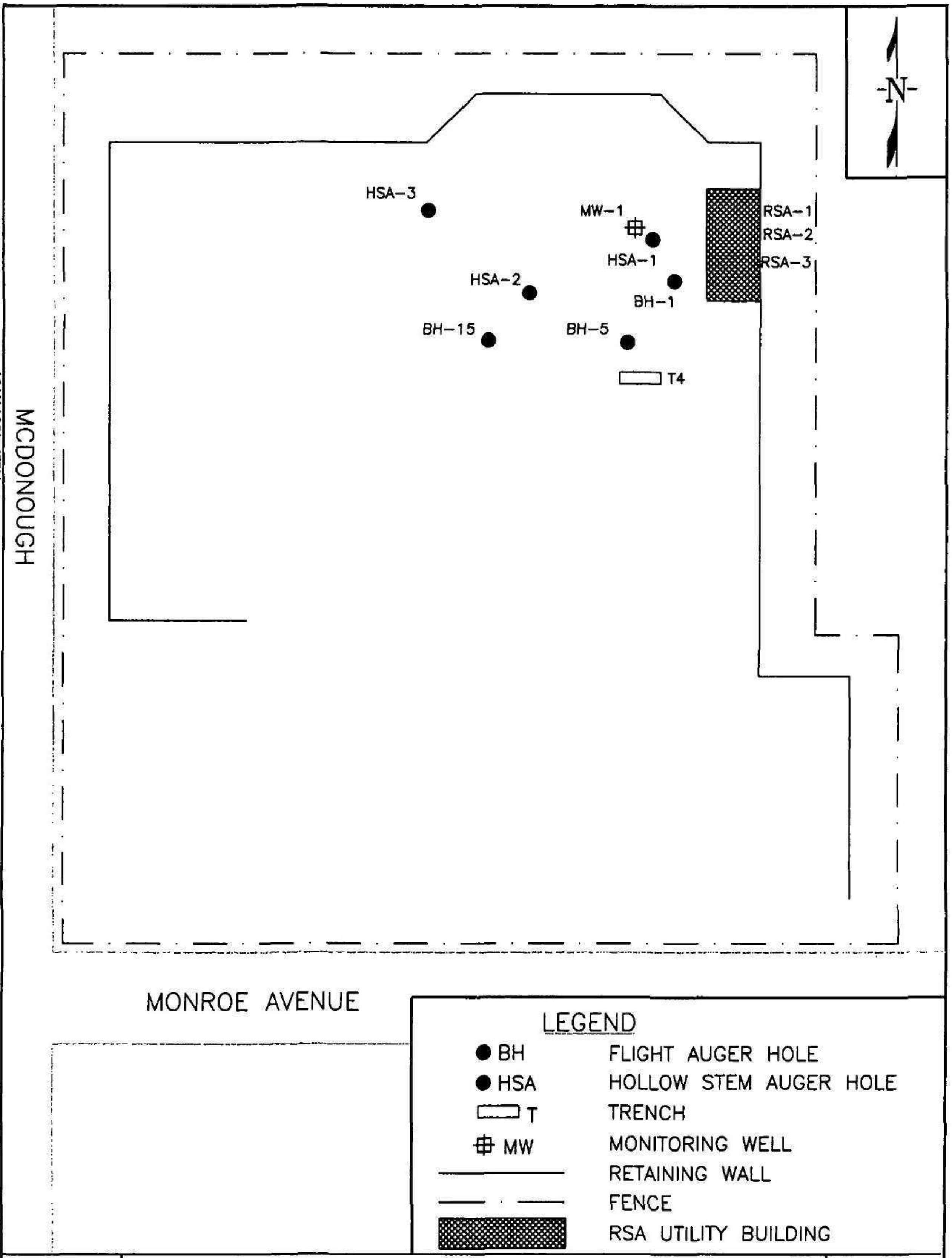

ADEM PHASE I SAMPLING LOCATIONS
CAPITOL CITY PLUME RSA ENERGY PLANT SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

FIGURE
2-3

Table 2-1
ADEM Phase I Investigation
Capitol City Plume
Montgomery, Montgomery County, Alabama

Sample Identification	Sample Location	Sample Date	Sample Matrix/Depth	Analytical Results
RSA-1	Utility Building	09/14/93	Soil/NA	PCE - 3989 ppm
RSA-2	Utility Building	09/14/93	Soil /NA	PCE - 7268 ppm
RSA-3	Utility Building	09/14/93	Soil/NA	PCE - 7843
RSA-1	BH-1	10/11/93	Soil/1.5 - 4 feet	BDL
RSA-2	BH-1	10/11/93	Soil/4 - 6.5 feet	BDL
TR-5	T4	10/15/93	Soil/0 - 4 feet	PCE - 0.06 ppm
TR-6	T4	10/15/93	Soil/0 - 4 feet	PCE - 0.13 ppm
HSA-1A	HSA-1	10/18/93	Soil/1.5 - 4 feet	BDL
HSA-1B	HSA-1	10/18/93	Soil/4 - 6.5 feet	PCE - 0.09 ppm
HSA-2A	HSA-2	10/18/93	Soil/1.5 - 4 feet	BDL
HSA-2B	HSA-2	10/18/93	Soil/4 - 6.5 feet	BDL
SP-2C	HSA-3	10/18/93	Soil/6.5 - 8 feet	BDL
HSA-3A	HSA-3	10/18/93	Soil/1.5 - 4 feet	BDL
HSA-3B	HSA-3	10/18/93	Soil/4 - 6.5 feet	BDL
AM	BH-15	10/22/93	Soil/Unknown	PCE - 0.02 ppm
AN	BH-1	10/22/93	Soil/Unknown	PCE - 0.01 ppm
AO	BH-5	10/22/93	Soil/Unknown	PCE - 0.02 ppm
WS-2	MW-1	10/15/93	Groundwater/Unknown	PCE - 536 ppb
WS-3	MW-1	10/15/93	Groundwater/Unknown	PCE - 607 ppb

Notes:
RSA - Retirement Systems of Alabama
PCE - tetrachloroethene
BH - flight auger hole
T - trench
MW - monitoring well
NA - not applicable
ppm - parts per million
BDL - below detection limit
HSA - hollow stem auger hole
ppb - parts per billion

from the energy plant site. Using a photoionization analyzer, ADEM personnel detected high levels of contamination at the utility building location sampled by Mr. Maurer of ADEM on September 14, 1993, and very low levels at the construction site, where some excavated soil had been stored. ADEM personnel offered Mr. Gilbert and Mr. Chestnut the option of wrapping the contaminated soil in plastic and storing it on a concrete slab or loading the soil directly onto trucks for immediate transport to an approved disposal facility (ADEM, 1993c). The soil was tentatively schedule for removal to the Chemical Waste Management Emille Landfill on October 9, 1993 (CTE, 1993); however, final disposition of the contaminated soil was not documented in the files reviewed.

In early October 1993, Rusty Kestle, a geologist with ADEM, recommended further testing be conducted in the RSA energy plant area. Mr. Kestle recommended soil samples from soil borings and water samples from borings that encountered the water table be collected. He also suggested that it might become necessary to install monitoring wells to determine the extent of groundwater contamination and to find the source, if widespread contamination is evident (ADEM, 1993d).

ADEM began a Phase II investigation in November 1993. The focus of the Phase II investigation was to attempt to identify sources and the extent of contamination in the RSA energy plant area. Initially, 25 soil samples were collected from five borings, and two unpurged monitoring well groundwater samples were collected from two borings completed as permanent monitoring wells within a 4-city block area in November and December 1993. Monitoring well MW-1 was abandoned; therefore, it was not available for Phase II sampling. According to file materials, monitoring well MW-4 was also installed during the Phase II investigation; however, it was not sampled until March 4, 1994. Monitoring wells MW-2, MW-3 and MW-4 were sampled on March 4, 1994, and again on June 13, 1994. Water levels were also collected during all three sampling dates. Additionally, Montgomery public well 9W was sampled on June 13, 1994. This well was sampled because file information discovered during the Phase II investigation indicated that 9W, located approximately 1.1 miles northwest of the RSA energy (or chiller) plant contained 7.1 ppb PCE in a sample collected April 4, 1991, and 21.0 ppb PCE in a sample collected May 14, 1992. Reportedly well 9W was closed because of the presence of PCE; however, the closure date was not in available file material (ADEM, 1994b). The ADEM Central Laboratory analyzed

Phase II soil and groundwater samples for PCE and other volatile organic compounds. Soil and groundwater results were reported in micrograms per gram (ug/g or ppm) and in micrograms per liter (ug/L or ppb), respectively.

In December 1994, 60 soil gas samples were collected as part of the ADEM Phase II investigation by ADEM subcontractor, Northeast Research Institute (NERI) (ADEM, 1995; NERI, 1995). Soil gas samples were analyzed for PCE and other volatile organic compounds using the PETREX method, which identifies compounds detected by ion counts that are reported relative response values.

All 25 Phase II soil sample analytical results were below detection limits of 0.025 and 0.050 ug/g. The June 13, 1994, purged well groundwater sample results for monitoring well MW2, located north of the chiller plant; monitoring well MW3, located northeast of the chiller plant; and monitoring well MW4, located east of the chiller plant; contained PCE concentrations of 113.0 ppb, 17.2 ppb, and 3.7 ppb, respectively. Montgomery public well 9W analytical results were below detection limits of 0.5 ug/L. Figure 2-4 indicates soil and groundwater sample locations. Tables 2-2 and 2-3 present soil sample and purged well groundwater sample analytical results, respectively. Table 2-3 presents monitoring well water levels recorded during groundwater sampling. File material construction details for these wells were inadequate; therefore this information is presented in this document. File material, however, did indicate a northwesterly groundwater flow direction from the chiller plant area toward the Alabama River (ADEM, 1994b). Twelve soil gas plumes consisting of 6 PCE plumes and 6 BTEX plumes were identified, based on results of the 60-sample PETREX soil gas survey. Potential PCE source areas were identified in city blocks bounded by Monroe Street to the south, McDonough Street to the west, Hull Street to the east, and Jefferson Street to the north.

The primary potential BTEX source area identified is located near city blocks bounded by Dexter Street to the south, Lawrence Street to the west, Hull Street to the east, and Madison Avenue to the north (NERI, 1995). Figures 2-5 and 2-6 present PCE soil gas plumes and BTEX soil gas plumes respectively (NERI, 1995).

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FILE: 48011.0101

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DATE: 07/30/02
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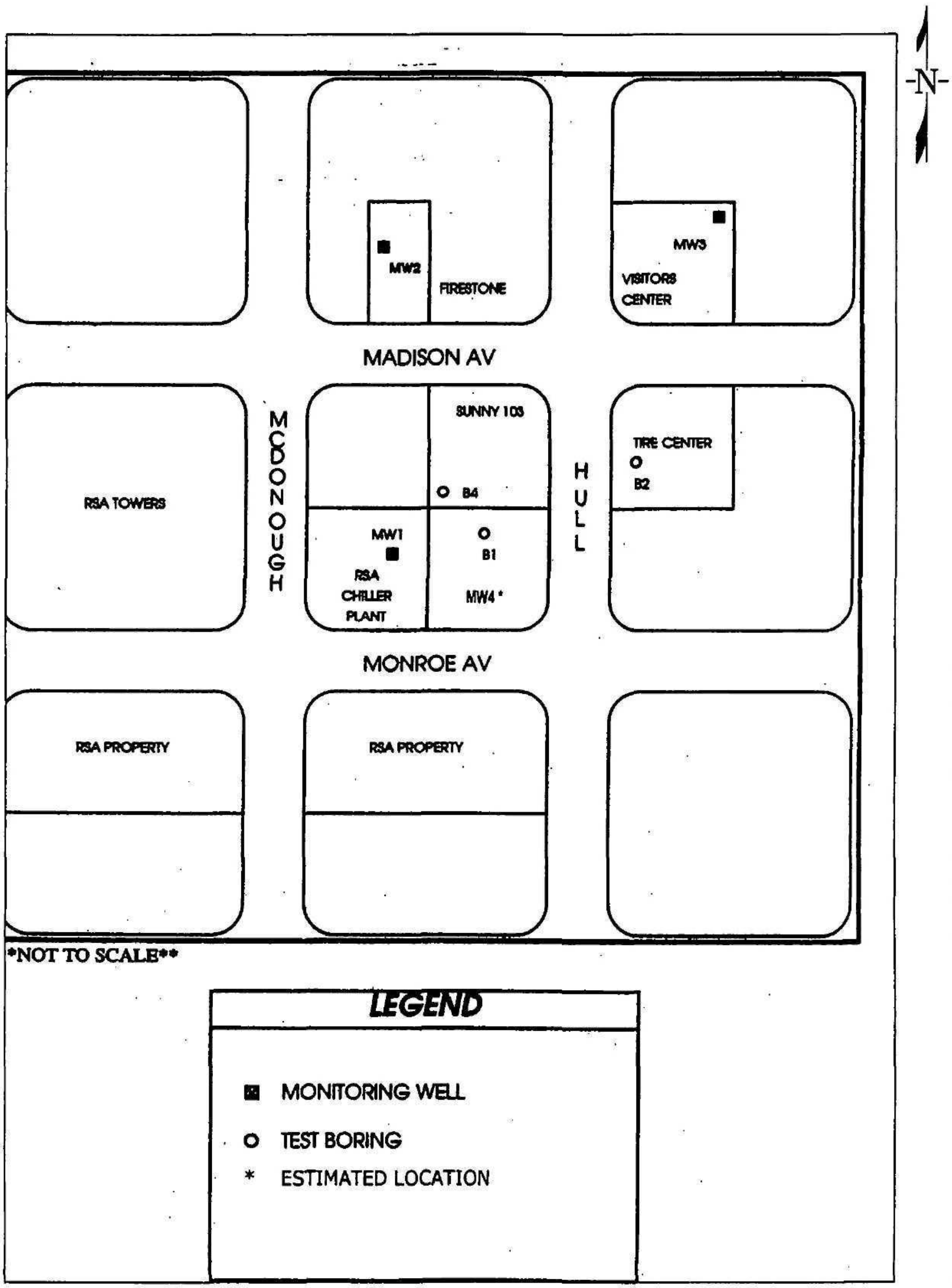

*NOT TO SCALE**

ADEM PHASE II, INVESTIGATION SAMPLING LOCATIONS
CAPITOL CITY PLUME RSA ENERGY PLANT SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

FIGURE
2-4

Table 2-2
ADEM Phase II Investigation
Soil Sample Analytical Results
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

BORING NO.	SAMPLE ID.	SAMPLE DEPTH	SAMPLE DATE	SAMPLE TIME	TETRACHLOROETHENE RESULTS
MW2	MW2-1	4'-6'	11-29-93	0930	BDL
MW2	MW2-2	11'-13'	11-29-93	0938	BDL
MW2	MW2-3	18'-20'	11-29-93	0955	BDL
MW2	MW2-4	25'-27'	11-29-93	1005	BDL
MW2	MW2-5	32'-34'	11-29-93	1012	BDL
MW3	MW3-1	4'-6'	11-30-93	0840	BDL
MW3	MW3-2	11'-13'	11-30-93	0846	BDL
MW3	MW3-3	18'-20'	11-30-93	0850	BDL
MW3	MW3-4	25'-27'	11-30-93	0910	BDL
MW3	MW3-5	32'-34'	11-30-93	0930	BDL
B1	B1-A	4'-6'	11-30-93	1350	BDL
B1	B1-B	11'-13'	11-30-93	1354	BDL
B1	B1-C	18'-20'	11-30-93	1357	BDL
B1	B1-D	25'-27'	11-30-93	1405	BDL
B1	B1-E	32'-34'	11-30-93	1415	BDL
B2	B2-A	4'-6'	12-1-93	0900	BDL
B2	B2-B	11'-13'	12-1-93	0907	BDL
B2	B2-C	18'-20'	12-1-93	0914	BDL
B2	B2-D	25'-27'	12-1-93	0921	BDL
B2	B2-E	32'-34'	12-1-93	0936	BDL
B4	B4-A	4'-6'	12-1-93	1035	BDL
B4	B4-B	11'-13'	12-1-93	1040	BDL
B4	B4-C	18'-20'	12-1-93	1045	BDL
B4	B4-D	25'-27'	12-1-93	1051	BDL
B4	B4-E	32'-34'	12-1-93	1100	BDL

NOTES:

MW	Monitoring Well
B	Soil Boring
BDL	Below Detection Limits

Table 2-3
ADEM Phase II Investigation
Groundwater Analytical Results/Water Levels
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Well Identification Number	Groundwater Analytical Results		Water Level Information	
	Tetrachloroethene (ppb) 3/4/1994	Tetrachloroethene (ppb) 6/13/1994	3/4/94 (feet btoc)	6/13/94 (feet btoc)
MW2	93.0	113.0	38.25	38.05
MW3	41.9	17.2	54.07	54.10
MW4	38.8	3.7	48.49	48.76
9W	NC	BDL	??	??

NOTES:

ppb	Parts per billion.
NC	Not collected.
BDL	Below Detection Limit.
btoc	Below top of casing.
??	Information not available.

CAD DWG NO: FIG 2-5.DWG ORIGINAL DWG SIZE
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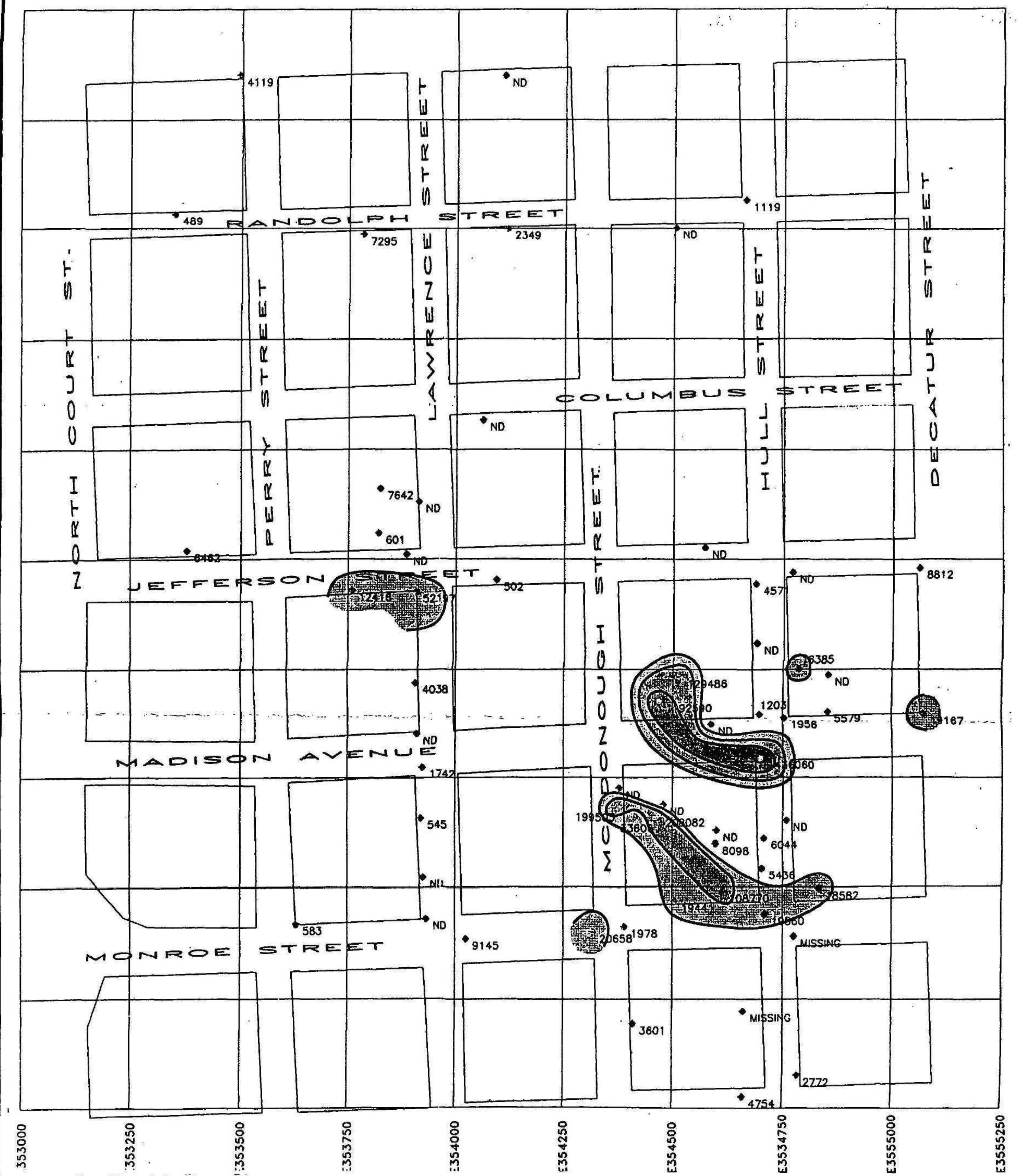
PLOT SCALE: 1=1
REVISED: 08-22-02 ACM



SCALE: 1"=40'±

LEGEND
RELATIVE RESPONSE VALUES

▩	≥ 1,000,000
▨	100,000-999,999
░	10,000-99,999

SOURCE: NORTHEAST RESEARCH INSTITUTE

PETREX RELATIVE RESPONSE TETRACHLOROETHENE PLUMES
CAPITOL CITY PLUME
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

FIGURE
2-5

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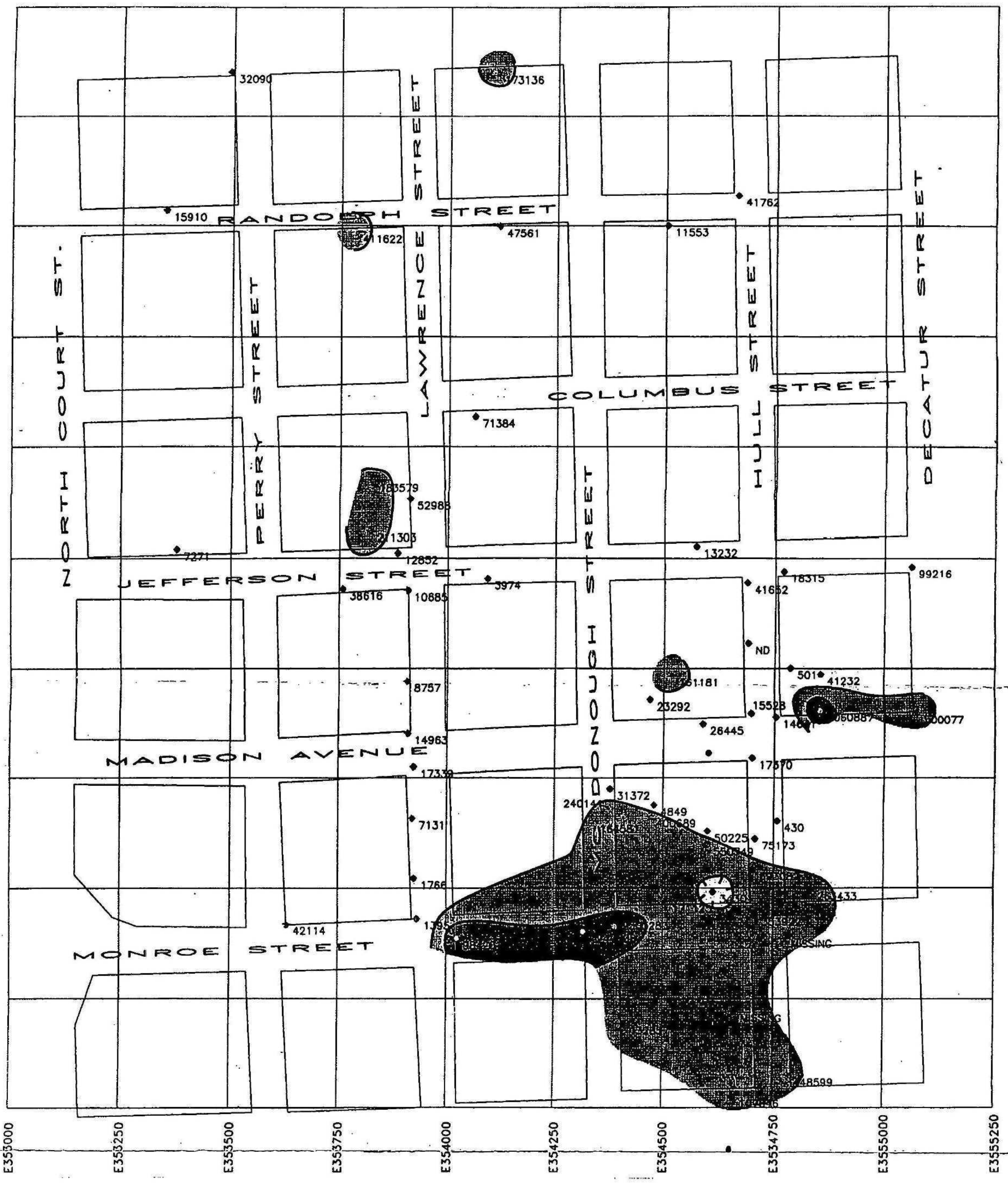
PLOT SCALE: 1=1
REVISED: 08-22-02 ACM



SCALE: 1"=40'±

LEGEND

RELATIVE RESPONSE VALUES

■	≥ 900,000
▨	100,000-899,999

SOURCE: NORTHEAST RESEARCH INSTITUTE

PETREX RELATIVE RESPONSE BTEX PLUMES
CAPITOL CITY PLUME
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

FIGURE 2-6

In April 1997, CH2M Hill submitted a wellhead protection plan to the Montgomery Water Works and Sanitary Sewer Board (MWWSSB). The plan indicated that much of the groundwater contamination reported in the ADEM investigation was located within the wellhead protection areas associated with wells in the North Well Field (CH2M Hill, 1997). CH2M Hill also had conducted a sewer study for the MWWSSB to determine whether the sewer system piping was acting as a distribution system for contaminant migration. This report concluded that the contamination was the result of releases of chlorinated organic solvents from adjacent land owners or from petroleum hydrocarbon storage tanks. Contamination does not appear to be transported through sewer piping or bedding materials (CH2M Hill, 1999).

On February 19, 2002, ADEM personnel collected six surface water samples from Cypress Creek, directly north of the 30-block area of the Capitol City Plume site. The sample location at the mouth of the stream, closest to the Alabama River contained PCE at 7.2 ug/L. Analysis of the other five surface water samples taken upstream in the creek did not show the presence of PCE or other volatile contaminants above detection limits.

2.3 Historical Source Areas

The purpose of defining the nature and extent of contamination within the Capitol City Plume site is to show attribution of contaminants historically used or associated with specific facilities within the 30-city block site to those detected in the nearby Montgomery municipal well 9W. Numerous former and/or existing facilities are within the Capitol City Plume site and may contribute to groundwater contamination, if not municipal well contamination. However, very little is known about whether and to what extent these facilities may be contributing to groundwater contamination. Additionally, the nature and extent of contamination within the Capitol City Plume site, which contributed to the groundwater contamination responsible for closure of the Montgomery municipal well 9W, has not been completely defined because of the unknown origin of similar contamination in several areas throughout the Capitol City Plume site. As previously mentioned, the use of BTEX and PCE for a variety of industrial purposes has limited efforts to identify sources of groundwater plumes.

3.0 Sampling Investigation

Field activities for the Capitol City Plume Site RI included collection of subsurface soil and groundwater samples March through May 2000, January 2001, and February 2002. Soil samples from each event were analyzed for target compound list/target analyte list (TCL/TAL) parameters, which include volatile compounds, semivolatile compounds, pesticides, polychlorinated biphenyls (PCBs), metals, and cyanide. Additionally, geotechnical analyses were performed on a sample taken from each boring for the 34 permanent and temporary monitoring wells for the following parameters: grain size distribution, Atterburg limits, moisture content, porosity, bulk density, and total organic carbon (TOC). Groundwater samples collected from permanent monitoring, temporary monitoring, public water wells, and industrial wells were analyzed for the same TCL/TAL parameters as soil samples, excluding four previously installed monitoring wells from the 2002 sampling event that were not submitted for organic analyses. Additional analyses included natural attenuation parameters, ammonia, TOC, methane/ethane/ethene, chloride, nitrite/nitrate, sulfate, and total alkalinity. In the 2002 sampling event, groundwater samples, except for industrial wells were also analyzed for dissolved metals and chromium speciation.

Times and dates of sample collection and corresponding sample identification numbers were recorded on appropriate traffic reports and chain of custody forms. Inorganic and organic sample analyses were performed under the Contract Laboratory Program (CLP) for routine analytical services (RAS) (EPA, 1999b). Inorganic analyses were performed by Sentinel, Inc., in Huntsville, Alabama; and Liberty Analytical Corporation in Cary, North Carolina. Organic analyses were performed by American Technical & Analytical Services in Maryland Heights, Missouri; Ceimic Corporation in Narragansett, Rhode Island; Liberty Analytical Corporation in Cary, North Carolina; PDP Analytical Services in The Woodlands, Texas; and the EPA Science and Ecosystem Support Division (SESD) laboratory in Athens, Georgia. TOC and geotechnical tests were performed by Kiber Environmental Services, Norcross, Georgia. Sample collection, sample preservation, and chain of custody procedures used during this investigation were in accordance with standard operating procedures specified in the EPA Region 4, Environmental Services Division, Environmental Investigations Standard Operating procedures and Quality Assurance Manual, May, 1996, (EISOPQAM) (EPA, 1997a). Groundwater samples were field tested for temperature, turbidity, pH, dissolved oxygen (DO), conductivity, and oxidation reduction potential (ORP). Quality assurance/quality control (QA/QC) samples were also collected. QA/QC samples included a trip blank (soil or water) for each shipment of volatile organic samples from each field event, preservative blanks (three prepared in 2000, two prepared in 2001, and one prepared in 2002), and a matrix duplicate for every 20 samples in each medium (soil and water). Table 3-1 shows sample codes, descriptions, locations, and sampling rationale; Figures 3-1 and 3-2 show sample locations.

3.1 Subsurface Soil Sampling

Soil samples were collected at regular intervals to total depth at each boring location for lithologic description. Excluding duplicates, 66 subsurface soil samples were collected for CLP analysis in association with the Capitol City Plume site. Samples were collected for CLP analysis from 29 borings in the vadose zone. During the first field event, one subsurface soil sample was collected at each of the borings and, if elevated organic compounds were detected by the organic vapor analyzer (OVA), additional subsurface samples were collected at the boring. Additionally, two borings were sampled continuously during the first mobilization (SB-1I and SB-5I). Samples were also collected for geotechnical analysis from the screened interval at most boring locations. Table 3-1 and Figures 3-1 and 3-2 address sample codes and descriptions for subsurface soil samples.

3.2 Groundwater Sampling

Sixteen permanent monitoring wells and 16 temporary monitoring wells were installed to characterize groundwater at the Capitol City Plume site. Twelve of the 16 permanent monitoring wells installed are cluster wells consisting of a shallow and an intermediate well. These wells measure the difference in hydraulic conductivities at different zones within the surficial aquifer, as well as variances in contaminant concentrations across zones. Each well cluster consists of a shallow well positioned at or near the water table and an intermediate well screened above the top of a clay layer at a depth of 102 to 239 feet bls across the site. Wells are screened with 10-foot well screens just below the water table. In addition, two industrial wells (IW-01 and IW-02), three public wells (PW-5, PW-8 and PW-9W), and two existing permanent monitoring wells (MW-2S and MW-3S) were sampled to help characterize the groundwater. Table 3-1 and Figures 3-1 and 3-2 show sample codes and descriptions.

Table 3-1
Sample Codes, Descriptions, Locations, and Rationale
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Sample Code	Description/Year	Location	Rationale
CC-MW-1S	Permanent Well, 2000 & 2001	116 McDonough Street	Source Well.
CC-MW-1I	Permanent Well, 2000 & 2001	116 McDonough Street	Source Well, vertical extent of contamination.
CC-MW-2S	Permanent Well, 2000 & 2001	Existing ADEM monitoring well, parking lot west of Firestone Tire, 300 Block of Madison Street.	Horizontal extent of contamination in shallow (Eutaw) aquifer.
CC-MW-3S	Permanent Well, 2000 & 2001	Existing ADEM monitoring well, 401 Madison Street, behind former visitors center.	Horizontal extent of contamination in shallow (Eutaw) aquifer.
CC-MW-4S	Permanent Well, 2000 - 2002	Northeast corner of intersection of Perry and Monroe Streets.	Side-gradient well west of source, horizontal extent of contamination
CC-MW-4I	Permanent Well, 2000 - 2002	Northeast corner of intersection of Perry and Monroe Streets.	Side-gradient well west of source area, vertical extent of contamination.
CC-MW-5I	Permanent Well, 2000 & 2001	Southeast corner of intersection Decatur and Madison Streets.	Source well, vertical extent of contamination
CC-MW-6S	Permanent Well, 2000 - 2002	Southeast corner of Jefferson and Bainbridge Streets.	Side gradient well northeast of source area, horizontal extent of contamination.
CC-MW-7S	Permanent Well, 2000 & 2001	Northeast of intersection of Madison and Lawrence Streets.	Downgradient well north of source area, horizontal extent of contamination.
CC-MW-7I	Permanent Well, 2000 & 2001	Northeast of intersection of Madison and Lawrence Streets.	Downgradient well north of source area, vertical extent of contamination
CC-MW-8S	Permanent Well, 2000 & 2001	Northeast of intersection of Lawrence and Columbus Streets.	Downgradient well north of source area, horizontal extent of contamination.
CC-MW-8I	Permanent Well, 2000 & 2001	Northeast of intersection of Lawrence and Columbus Streets.	Downgradient well north of source area, vertical extent of contamination.
CC-MW-9S	Permanent Well, 2000 & 2001	Northeast of intersection of Washington and Lawrence Streets.	Side gradient well, southwest of source area, horizontal extent of contamination.

Table 3-1 (Continued)
Sample Codes, Descriptions, Locations, and Rationale
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Sample Code	Description/Year	Location	Rationale
CC-MW-10S	Permanent Well, 2000 & 2001	Northwest of intersection of Washington and Decatur Streets.	Upgradient well, southeast of source area, horizontal control.
CC-MW-11S	Permanent Well, 2000 - 2002	Southeast of intersection Adams and Union Streets.	Upgradient well, southeast of source area, horizontal control.
CC-MW-11I	Permanent Well, 2000 & 2001	Southeast of intersection Adams and Union Streets.	Upgradient well, southeast of source area, vertical control.
CC-MW-12S	Permanent Well, 2002	Permanent well cluster at CC-TW-13.	Confirmation of CC-TW-13 sample during the phase 2 sampling event.
CC-MW-12I	Permanent Well, 2002	Permanent well cluster at CC-TW-13.	Confirmation of CC-TW-13 for the vertical extent of contamination in the intermediate aquifer.
CC-PW-5	Permanent Well, 2000 & 2001	North of Pollard Street.	Downgradient of source area, vertical extent of contamination
CC-PW-8	Permanent Well, 2000 & 2001	North of Pollard Street.	Downgradient of source area, vertical extent of contamination
CC-PW-9W	Permanent Well, 2000 & 2001	North of Pollard Street.	Downgradient of source area, vertical extent of contamination
CC-IW-01	Industrial Well, 2002	520 North Court Street	Determine quality of industrial water.
CC-IW-02	Industrial Well, 2002	301 Columbus Street	Determine quality of industrial water.
CC-TW-01	Temporary Well, 2001	Just north and east of well cluster CC-MW-01	Horizontal extent of contamination in shallow aquifer.

Table 3-1 (Continued)
Sample Codes, Descriptions, Locations, and Rationale
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Sample Code	Description/Year	Location	Rationale
CC-TW-02	Temporary Well, 2001	Just east of well cluster CC-MW-01	Horizontal extent of contamination in shallow aquifer.
CC-TW-03	Temporary Well, 2001	Just south and east of well CC-MW-05I	Horizontal extent of contamination in shallow aquifer.
CC-TW-03	Temporary Well, 2001	Just south and east of well CC-MW-05I	Horizontal extent of contamination in shallow aquifer.
CC-TW-04	Temporary Well, 2001	Just south and west of well CC-MW-10S	Upgradient well, southeast of source area, horizontal control.
CC-TW-05	Temporary Well, 2001	West of well cluster CC-MW-07	Downgradient well north of source area, horizontal extent of contamination.
CC-TW-06	Temporary Well, 2001	West of N Court Street	Horizontal extent of contamination in shallow aquifer.
CC-TW-07	Temporary Well, 2001	North and west of well cluster CC-MW-08	Downgradient well north of source area, horizontal extent of contamination.
CC-TW-08	Temporary Well, 2001	North and west of well cluster CC-MW-08	Downgradient well north of source area, horizontal extent of contamination.
CC-TW-09	Temporary Well, 2001	North of well cluster CC-MW-08	Downgradient well north of source area, horizontal extent of contamination.
CC-TW-10	Temporary Well, 2001	North and east of well cluster CC-MW-08	Downgradient well north of source area, horizontal extent of contamination.
CC-TW-11	Temporary Well, 2001	North of well CC-MW-09W	Side gradient well, southwest of source area, horizontal extent of contamination.
CC-TW-12	Temporary Well, 2001	Just east of well CC-MW-09E	Horizontal extent of contamination in shallow aquifer.
CC-TW-13	Temporary Well, 2001	East of well CC-MW-09E	Horizontal extent of contamination in shallow aquifer.
CC-TW-14	Temporary Well, 2002	620 McDonough Street.	Horizontal extent of contamination in shallow aquifer.

Table 3-1 (Continued)
Sample Codes, Descriptions, Locations, and Rationale
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Sample Code	Description	Location	Rationale
CC-TW-15	Temporary Well, 2002	701 McDonough Street, west of building.	Horizontal extent of contamination in shallow aquifer.
CC-TW-16	Temporary Well, 2002	West of intersect of Pollard Street and N. Court Street, immediately west of railroad track.	Horizontal extent of contamination in shallow aquifer.
CC-SB-1I	Subsurface Soil, 2000	Boring of MW-1I at 14 distinct depth intervals	Vertical extent of contamination at source.
CC-SB-4I	Subsurface Soil, 2000	Boring of MW-4I at 2 distinct depth intervals	Vertical extent of contamination, side-gradient to source.
CC-SB-5I	Subsurface Soil, 2000	Boring of MW-5I at 16 distinct depth intervals	Vertical extent of contamination at source.
CC-SB-6S	Subsurface Soil, 2000	Boring of MW-6S at 1 depth interval	Horizontal extent of contamination.
CC-SB-7I	Subsurface Soil, 2000	Boring of MW-7I at 2 distinct depth intervals	Vertical extent of contamination, downgradient of source.
CC-SB-8S	Subsurface Soil, 2000	Boring of MW-8S at 1 depth interval	Horizontal extent of contamination., downgradient of source.
CC-SB-8I	Subsurface Soil, 2000	Boring of MW-8I at 2 distinct depth intervals	Vertical extent of contamination, downgradient of source.
CC-SB-9S	Subsurface Soil, 2000	Boring of MW-9S at 1 depth interval	Horizontal extent of contamination, side-gradient to source.
CC-SB-10S	Subsurface Soil, 2000	Boring of MW-10S at 1 depth interval	Horizontal control.
CC-SB-11S	Subsurface Soil, 2000	Boring of MW-11S at 2 distinct depth intervals	Horizontal control.
CC-SB-11I	Subsurface Soil, 2000	Boring of MW-11I at 5 distinct depth intervals	Vertical control.
CC-SB-12S	Subsurface Soil, 2002	Boring of MW-12S at 1 depth interval	Confirmation of CC-SB-13 sample during the phase 2 sampling event.

Table 3-1 (Continued)
Sample Codes, Descriptions, Locations, and Rationale
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Sample Code	Description	Location	Rationale
CC-SB-12I	Subsurface Soil, 2002	Boring of MW-12I at 1 depth interval	Confirmation of CC-SB-13 sample during the phase 2 sampling event
CC-SB-01	Subsurface Soil, 2001	Boring of TW-01 at 1 depth interval	Horizontal extent of contamination.
CC-SB-02	Subsurface Soil, 2001	Boring of TW-02 at 1 depth interval	Horizontal extent of contamination.
CC-SB-03	Subsurface Soil, 2001	Boring of TW-03 at 1 depth interval	Horizontal extent of contamination.
CC-SB-04	Subsurface Soil, 2001	Boring of TW-04 at 1 depth interval	Horizontal control.
CC-SB-05	Subsurface Soil, 2001	Boring of TW-05 at 1 depth interval	Horizontal extent of contamination, downgradient of source.
CC-SB-06	Subsurface Soil, 2001	Boring of TW-06 at 1 depth interval	Horizontal extent of contamination.
CC-SB-07	Subsurface Soil, 2001	Boring of TW-07 at 1 depth interval	Horizontal extent of contamination, downgradient of source.
CC-SB-08	Subsurface Soil, 2001	Boring of TW-08 at 1 depth interval	Horizontal extent of contamination, downgradient of source.
CC-SB-09	Subsurface Soil, 2001	Boring of TW-09 at 1 depth interval	Horizontal extent of contamination, downgradient of source.
CC-SB-10	Subsurface Soil, 2001	Boring of TW-10 at 1 depth interval	Horizontal extent of contamination, downgradient of source.
CC-SB-11	Subsurface Soil, 2001	Boring of TW-11 at 1 depth interval	Horizontal extent of contamination, side-gradient to source.
CC-SB-12	Subsurface Soil, 2001	Boring of TW-12 at 1 depth interval	Horizontal extent of contamination.
CC-SB-13	Subsurface Soil, 2001	Boring of TW-13 at 1 depth interval	Horizontal extent of contamination.

Table 3-1 (Continued)
Sample Codes, Descriptions, Locations, and Rationale
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

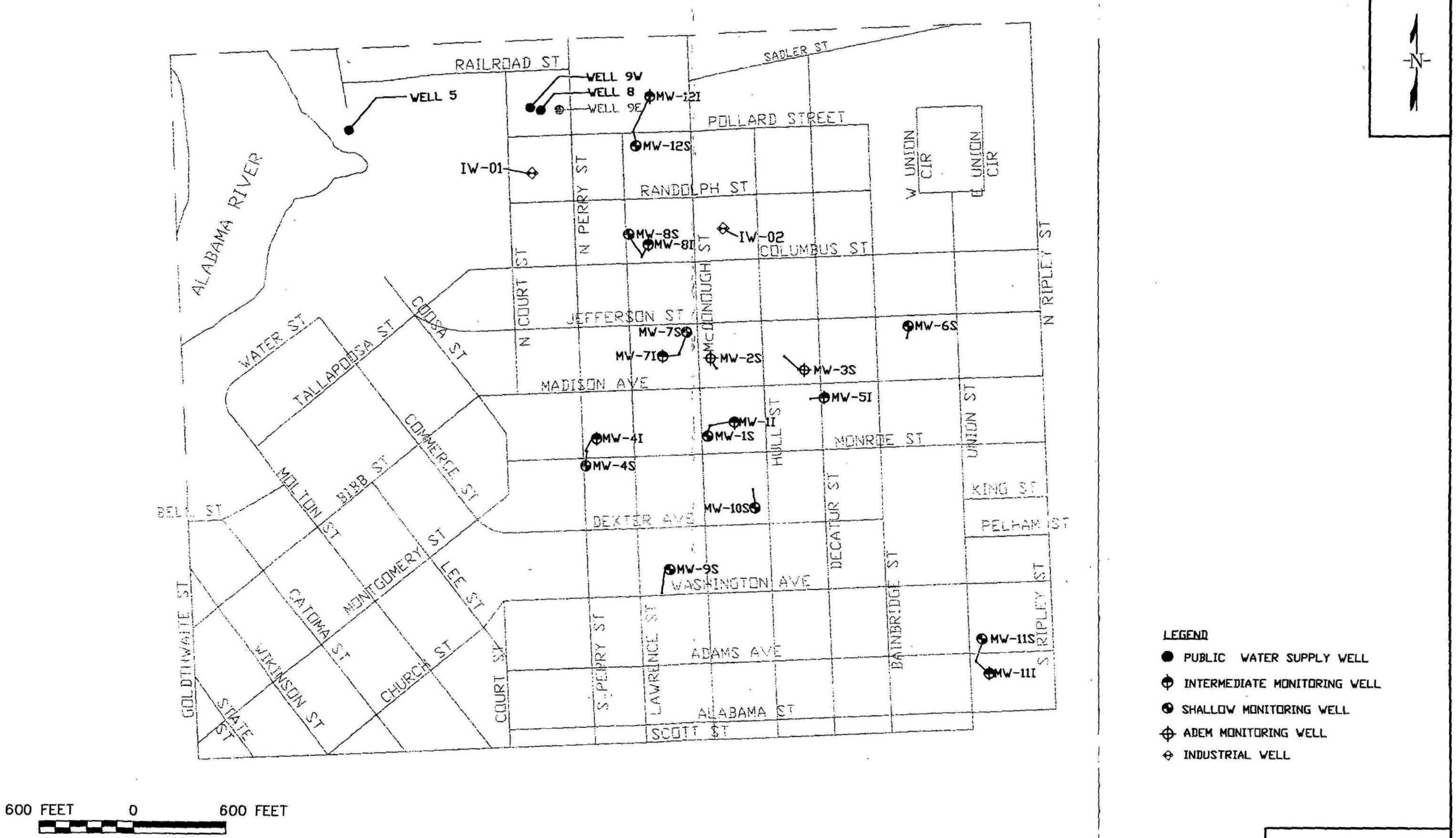
Sample Code	Description	Location	Rationale
CC-SB-14	Subsurface Soil, 2002	Boring of TW-14 at 1 depth interval	Horizontal extent of contamination.
CC-SB-15	Subsurface Soil, 2002	Boring of TW-15 at 1 depth interval	Horizontal extent of contamination.
CC-SB-16	Subsurface Soil, 2002	Boring of TW-16 at 1 depth interval	Horizontal extent of contamination.

NOTES:

Subsurface soil samples CC-SB-12S, CC-SB-12I, CC-SB-14, CC-SB-15, and CC-SB-16 were originally named MW-12S, MW-12I, TW-14, TW-15, and TW-16, respectively, in the third Data Evaluation Report (Black & Veatch, 2002). The change in this RI Report is to eliminate potential confusion with the permanent and temporary wells from which these borings were taken.

CAD DWG NO: monitoring wells fig ORIGINAL DWG SIZE
DATE: 09-24-99 ARW 11 x 17
PLOT SCALE: 1"=600' LOCATION: R:\48011\109\CAD

MOST R REVISION
REVISION DATE: 08-20-02
DRAFTERS INITIALS: ACM



SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

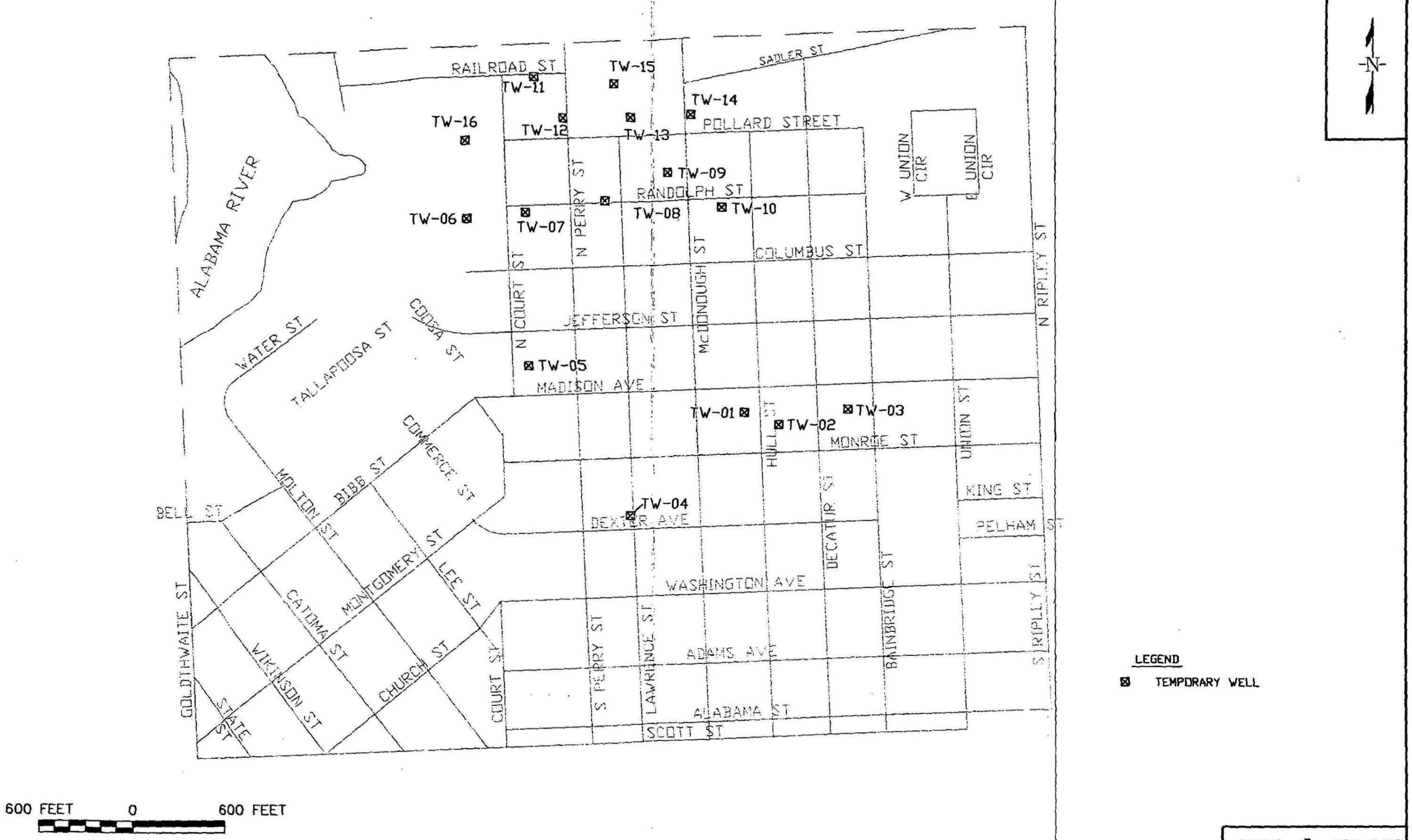
PERMANENT WELL LOCATION MAP

FIGURE 3-1

CAD DWG NO: MW_FIGS
DATE: 08-24-99 ARW
PLOT SCALE: 1:1056

ORIGINAL DWG SIZE
11 x 17
LOCATION: R:\48011\109\CAD

MOST R[illegible] REVISION
REVISION DATE: 08-22-02
DRAFTERS INITIALS: ACM



SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

TEMPORARY WELL LOCATION MAP

FIGURE
3-2

3.3 Methodology

All laboratory analyses and laboratory quality assurance procedures used during this investigation were in accordance with standard procedures and protocols specified in the Analytical Support Branch's Laboratory Operations and Quality Control Manual; United States Environmental Protection Agency Region 4, Environmental Services Division, October 1990; or existing United States Environmental Protection Agency standard procedures and protocols for the CLP. All samples for TCL/TAL parameters were submitted to CLP laboratories, as appropriate, at the time of sampling. All CLP analyses for the three Capitol City Plume Site RI investigation phases produced data acceptable for its intended purpose.

3.3.1 Subsurface Soil Sampling Procedures

During the first field event, subsurface soil samples were collected from borings made by a Rotasonic drill rig. Subsurface soil samples obtained during the second event were collected above the water table from a Geoprobe 4-foot Macrocore© sampler using a 2-foot by 3-inch stainless steel split spoon and during the third event using the hollow stem auger method. The VOC sample was collected first, directly from the boring core using an EnCore™ sampler. The remainder of the sample was transferred by a stainless steel spoon to a 2-quart or equivalent glass or stainless steel bowl. The remainder of the sample was thoroughly mixed in the bowl with the stainless steel spoon and placed in appropriate containers for analysis.

3.3.2 Groundwater Sampling Procedures

Monitoring wells were sampled almost immediately after well development with allowances for the aquifer to stabilize and the wells to be properly purged of stagnant water. After unlocking the well and removing the well cap, the ambient air and air in the well was monitored using a flame ionization detector (FID) to detect the presence of organic vapors. FID readings were recorded in the field logbook. Plastic sheeting was placed around the well to keep equipment from coming in contact with ground surface. A decontaminated electric water level indicator was then placed into the well to measure the depth of the static water level. Measurements were taken to the nearest 0.01 foot and from a reference notch etched at the top of the casing. The volume of the well casing was then calculated. Depth measurements and volume calculations were recorded in the field logbook.

A decontaminated Grundfos© 220V variable speed pump was used to purge the wells in a way that minimized turbidity. During well purging, field parameters (temperature, turbidity, pH, dissolved oxygen, specific conductance, and oxidation reduction potential) were measured and recorded. Purging was terminated when a minimum of three casing volumes was withdrawn and field parameter readings stabilized (pH readings within 0.1 units, temperature within 0.5 degrees Celsius, specific conductance within three percent, and turbidity at or below 10 nephelometric units) or upon evacuating five casing volumes from each well. Water from well purging activities was containerized. Appendix A provides the final field parameters for groundwater samples.

A disposable Teflon™ bailer was used to retrieve the sample from the well. Care was taken when filling the sample jars by accessing the ball check valve at the end of the bailer. The fraction of the sample for metals analysis was collected first. The methane/ethane/ethene, and volatile organic compound jars were filled last by tipping the bailer and slowly filling until the head space was eliminated, and no air bubbles were present. Each portion of the sample was properly preserved upon collection. The time of sampling was recorded in the field logbook. Temperature, turbidity, pH, dissolved oxygen, ORP, and conductivity measurements were measured when each groundwater sample was collected.

The temporary monitoring wells installed during the second field event using the Direct Push Technology (DPT) were purged and sampled directly using a check valve on the end of a Teflon™ tube. During the third field event, stainless steel temporary monitoring wells were installed, and the wells were purged with a Grundfos pump and sampled with a Teflon™ bailer. Samples were not collected during either field event until the minimum purge volume was removed; temperature, pH, and conductivity had stabilized; and the turbidity was at or below 10 nephelometric units. The time of sampling was recorded in the field logbook, and the sample was then distributed to appropriate sample containers. Temperature, turbidity, pH, and conductivity measurements were measured as each groundwater sample was collected. Each sample portion was properly preserved.

3.3.3 Groundwater Level Measurements

Groundwater level measurements were recorded using a Solinst water level indicator at each of the permanent monitoring wells and temporary monitoring wells during the field effort and within a time frame of twenty-four hours. Section 4 shows groundwater elevations.

3.4 Analytical Data Quality and Data Qualifiers

All analytical data generated by the three field efforts were subjected to data validation and a quality assurance review as described in the EPA, Region 4, SESD evaluation guidelines. In tables presented in this RI, some concentrations of organic and inorganic analytes have been assigned a "J" qualifier, which indicates the qualitative analysis is acceptable, but the quantitative value is an estimate. Other analytes have been assigned an "N" qualifier, indicating they were detected based on presumptive evidence of their presence. This means the compound is only tentatively identified, and its detection cannot be a positive indication of its presence. Some sample results have a "U" qualifier, which indicates that the contaminant was analyzed for, but not detected above the sample quantitation limit (SQL) for that sample. The reported number is the laboratory derived sample quantitation limit for the compound or element in that sample. At times, miscellaneous organic compounds that do not appear on the target compound list are reported with a data set. These compounds are assigned a "JN" qualifier, indicating they are tentatively identified at estimated quantities. Because these compounds are not routinely analyzed for, background levels or SQL levels are not generally available for comparison. Other analyte sample results have been assigned an "R" qualifier, which indicates the data is considered to be rejected and will not be used. The "R" qualifier denotes the failure of quality control criteria such that it can not be determined whether the analyte is present or absent from the sample. Appendix B provides complete analytical packages, along with the data usability report. Groundwater samples containing concentrations of contaminants greater than the EPA Drinking Water Standards and Health Advisories, Primary Maximum Contaminant Levels (MCL) and EPA Region 9 Preliminary Remediation Goals (PRG) are considered to be elevated. Subsurface soil samples containing concentrations of contaminants greater than the EPA Region 4 Preliminary Remediation Goals (PRG) are considered to be elevated.

Water trip blanks (TB-01, -02) from the 2000 field event, (CC-TB-01, -02, -03) from the 2001 field event, and (CC-TB-01, -05) from the 2002 field event were included in the groundwater samples analyzed for the Capitol City Plume Site. No detectable constituents were found in the water trip blanks. Three soil trip blanks (TB-01, -03, -04) from the 2000 field event were included in the soil samples analyzed. Soil trip blank CC-TB-01 was found to contain trichloroethene (TCE) at 9 micrograms per kilogram (ug/kg) and trichlorofluoromethane at 4J ug/kg. Two field blanks (CC-FB-01, -02) from the 2001 field event were included in the groundwater samples analyzed for volatile organics, semivolatile organics, pesticides/PCBs, and inorganics. Calcium was detected in CC-FB-02 at 53J micrograms per liter (ug/L). Preservative blanks (CC-PB-01, -02, 03) from the 2000 field event, (CC-PB-01, -02) from the 2001 field event, and (CC-PB-01) from the 2002 field event were also included in the water samples analyzed. Iron was detected in CC-PB-01 from the 2000 field event at 23 micrograms per liter (ug/L). Sodium was detected in CC-PB-02 from the 2001 field event at 1,900J ug/L. No detectable constituents were found in remaining preservative blanks.

3.5 Monitoring Well Installation

Borings for permanent well and permanent well clusters MW-01 to MW-11, excluding MW-02 and MW-03 which were previously installed by the State, were completed in March through May 2000 using the Rotasonic 4-inch core barrel with a 6-inch override drive casing method. The 4-inch core barrel is advanced in 10-foot intervals, followed by the 6-inch override casing to an equal depth, at which point the 4-inch core barrel is removed for sample description. Borings for temporary monitoring wells TW-01 through TW-13 were completed in January 2001 using the Direct Push Technology (DPT) method. Borings for permanent monitoring wells MW12S and MW12I, and temporary monitoring wells TW-14 through TW-16 were completed in February 2002 using the nominal 4.25 inch inner diameter (I.D.) hollow stem auger method for a pilot hole and for collecting 2-foot split spoon subsurface soil samples every 5 feet. Once at the predetermined depth, the boring was reamed with 6.25-inch I.D. hollow stem augers to provide an approximate 2-inch annular space between the outside of the well casing and the inside wall of the auger to facilitate placement of well materials. Each well installation was performed in accordance with procedures outlined in the field sampling plan for their respective investigations.

Each of the six permanent monitoring well clusters consist of a shallow well that ranges between 38 and 128 feet below land surface and an intermediate well that ranges between 104 and 239 feet below land surface. Single monitoring wells have depths ranging from 72 feet to 159 feet. Well depth was determined by aquifer thickness and designed to serve as an indication of possible contamination at depths ranging from the upper surficial zone, to the lower surficial zone above a confining clay located approximately 102 to 239 feet below land surface. Wells were installed with 10-foot schedule 5 Type 304 stainless steel well screens with the tops of the screens located at approximately 30 feet and 228 feet below land surface, or approximately 5 feet and 103 feet below the water table interface. Temporary monitoring wells TW-14 through TW-16 were also installed with 10-foot stainless steel well screens with the tops of the screens located approximately 30 feet below land surface, or 5 feet below the water table interface.

During drilling, subsurface soil samples were collected to total depth of the boring for stratigraphic interpretation of the site specific geology. Appendix C presents boring logs and well installation diagrams. Upon completion of monitoring well borings, clean silica sand was poured through the augers or an override core barrel to form a minimal 1-foot sand base at the bottom of the borehole. Decontaminated, 2-inch stainless steel well screen and riser pipe was then installed through the augers. Appropriately sized, prewashed silica sand was installed at each well as filter material to a level approximately 2 feet above the top of screen and a minimum of 12 inches under the bottom of the well plug. One-eighth-inch diameter bentonite pellets were placed above the sand pack to a thickness of approximately 2 feet. Where a surface casing was necessary, the boring was widened to 10 inches and a nominal 6-inch seamless or welded black steel pipe in accordance with ASTM standards was set in place. The pipe was then grouted in place with PureGold 30% high solids bentonite grout with greater than 10.2 lbs/gallon mixture. The remaining annular space above the bentonite pellets was grouted to within 2 feet of the surface with a PureGold bentonite slurry using tremie pipe. All temporary monitoring well casings were removed and grouted following groundwater sampling. Permanent monitoring wells were sealed to ground surface with concrete and completed with a 3-foot by 3-foot by 6-inch thick concrete surface pad constructed to slope away from the protective casing. A flush mount protective steel cover and a locking well cap were installed at each well.

3.6 Slug Testing

Variable head (slug) tests were conducted in each new well installed to estimate hydraulic conductivity of the strata in which the wells are screened. Before initiating a slug test, a static water level measurement was recorded at each well. Slug tests were conducted as follows: a closed end PVC pipe (slug) was lowered into the well to displace the water column from the static water level. The displaced water rose within the well, and receded with time. This phase is termed a falling-head slug test. After the initial static water level was reestablished, the slug was withdrawn from the well. The water level dropped initially and then rose toward the static water level. This phase is termed a rising-head slug test. The rate at which the static water level is reestablished is a function of the transmissivity of the strata near the well screen. The variation of the displaced column of water was monitored with a submerged pressure transducer (situated 1 foot to 2 feet above the bottom of the well) and recorded using a data logger. Both falling-head and rising-head slug tests were conducted in each well. Only data from the rising head tests were used to estimate hydraulic conductivity to avoid error associated with groundwater mounding around the well screen, which is typical of shallow wells where the screen crosses the water table.

4.0 Nature and Extent of Contamination

This section discusses the nature and extent of contamination at the Capital City Plume Site. The analyses presented are based primarily on results of chemical analyses performed on soil and groundwater collected during the RI field mobilizations. Analytical results from subsurface soil samples collected during the RI are compared to EPA Region 9 preliminary remediation goals (PRGs) for industrial soils. Groundwater analytical results are compared to the National Primary Drinking Water Standard maximum contaminant levels (MCLs) as provided by the EPA (EPA, 1996a) and the EPA Region 9 PRGs for tap water (EPA, 1999b). The MCL is the permissible concentration of a particular analyte in potable water supplied by a municipal water system. Groundwater and soil samples containing concentrations of contaminants that are equal to or exceed the appropriate regulatory standards or screening values are considered to be elevated. Appendix B provides the complete laboratory analytical results for the RI sampling events.

4.1 Soil

4.1.1 Soil Sampling Locations

Excluding duplicates, 66 biased subsurface soil samples were collected for CLP analysis for the Capitol City Plume site from 29 locations. During the first field event, one subsurface soil sample was collected at each boring and, if elevated organic compounds were detected by the OVA, additional subsurface samples were collected at the boring. Additionally, two borings were sampled continuously during the first mobilization (SB-1I and SB-5I). For the second and third mobilizations, samples were collected from 13 DPT and 5 hollow stem auger borings, respectively. No surface soil samples were collected during RI field efforts. Table 3-1 presents sample codes, descriptions, locations, and rationale; Figures 3-1 and 3-2 illustrate subsurface soil sample locations (collocated with monitoring well locations).

4.1.2 Soil Analytical Results

Analysis of subsurface soil results for RI sampling events indicates very little organic contamination and only one contaminant above EPA Region 9 PRGs. Sample SB-16, taken from the boring for temporary monitoring well TW-16 during the third sampling event, was more the four times the PRG (290 ug/kg) for benzo(a)pyrene with a detection of 1,300 J ug/kg. Tables 4-1 through 4-3 present organic analytical results for subsurface soil samples.

3 10 0030

Table 4-1
Subsurface Soil Organic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	SB-11 (8-9 ft.)	SB-11 (25-26 ft.)	SB-11 (31-32 ft.)	SB-11 (41-42 ft.)	SB-11 (55-56 ft.)	SB-11 (61-62 ft.)	SB-11 (71-72 ft.)	SB-11 (83-34 ft.)
Volatile Organics (ug/kg)									
Acetone	620,000								
Methylene Chloride	21,000	20J	19J	21J	26J	33J	36J	31J	
Toluene	52,000								
Trichloroethene	61,000								
Trichlorofluoromethane	200,000								
1,1,2-Trichloro-1,1,2-trifluoroethane	560,000								
Miscellaneous Volatile Organics (ug/kg)									
Carbon dioxide	NE				810JN				
5,6-Dic-benzene-1,2,3,4-d4-	NE								
Fluorobenzene	NE								
Hexamethylcyclotrisiloxane	NE								
Isopropyl alcohol	NE			15JN		14JN			
Octamethylcyclotetrasiloxane	NE								
2-[Trimethyls benzoic acid	NE			19JN			11JN		
Unknown siloxane/#	NE								
Unidentifed Compound/#	NE		12J/2				10J		
Laboratory artifacts/#	NE								
Semi-Volatile Organics (ug/kg)									
Acetophenone	160								
Bis(2-ethylhexyl)phthlate	180,000								
Miscellaneous Semi-Volatile Organics (ug/kg)									
1,2-Benzenedicaroxylic acid	NE								
1-Decene	NE								
2,5-Dimethyl furan	NE								
N,N-Dimethyl-formamide	610,000								
Dioctadecyl pyhosphonic acid	NE	180JN							
Dodecanoic acid	NE								
1-Ethyl-2,3-dimethyl benzene	NE								
1-Ethyl-2,4-dimethyl benzene	NE								
2-Ethyl-1,3-dimethyl benzene	NE								
-Ethyl-1,2-dimethyl benzene	NE								
1-Hexacosanol	NE								
2,5-Hexanedione	NE								
4-Hydroxy-4-met-2-pentanone	NE								
1-Methyl-2-(1-methyl)benzene	NE								
1-Methyl-3-(1-methyl)benzene	NE								
1-Methyl-4-(1-methyl)benzene	NE								
4-Methyl-3-penten-2-one	NE								
9-Octadecanamide, (z)	NE								
Octadecane, -chloro- (2 isomers)	NE								
2-Fluoro-4-nitrophenol	NE								
2-Fluoro-6-nitrophenol	NE								
1,2,4,5-Tetramethyl benzene	NE								
1,2,3-Trimethyl benzene	NE								
1,2,4-Trimethyl benzene	5,200								
Unknown amide	NE								
Unknown hydrocarbon	NE								
Unknown phthlates	NE								
Unknown Compound/#	NE	750J	1,100J/7	1,100J/6	1,600J/6	2,000J/9	1,300J/5	900J/3	1,500J/5
Pesticides (ug/L)									
Aldrin	150		0.64J	1.8U	2.0U	2.2U	2.2U	2.0U	2.0U
Beta-BHC	2100								
Gamma-BHC	2900		0.79J	1.8U	2.0U	2.2U	2.2U	2.0U	2.0U
Dieldrin	150		1.7J	3.5U	3.8U	4.2U	4.2U	4.0U	3.9U
4,4'-DDT	12,000	1.1JN	1.5J	3.5U	3.8U	4.2U	4.2U	4.0U	3.9U
Endrin	26,000		1.8J	3.5U	3.8U	4.2U	4.2U	4.0U	3.9U
Heptachlor	550		1.1J	1.8U	2.0U	2.2U	2.2U	2.0U	2.0U

NOTES:

1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 29, 1999.
NE	Not established.
ug/kg	micrograms per kilogram
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
MW	Monitoring well
PW	Pubic water supply well.
	Shading indicates a value equal to or greater than the EPA Region IX regulatory value indicated for that analyte.

Table 4-1
Subsurface Soil Organic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	SB-1I (91-92 ft)	SB-1I (101-102 ft.)	SB-1I (112-113 ft.)	SB-1I (122-123 ft.)	SB-1ID (122-123 ft.)	SB-1I (131-132 ft.)	SB-1I (140-141 ft.)	SB-4I (25-26 ft.)
Volatile Organics (ug/kg)									
Acetone	620,000					14	12U	12U	10U
Methylene Chloride	21,000	50J	29J	28U	22U	27J	20U	24U	10U
Toluene	52,000								
Trichloroethene	61,000								
Trichlorofluoromethane	200,000								
1,1,2-Trichloro-1,1,2-trifluoroethane	560,000	2J							10U
Miscellaneous Volatile Organics (ug/kg)									
Carbon dioxide	NE								
5,6-Dic-benzene-1,2,3,4-d4-	NE								
Fluorobenzene	NE								
Hexamethylcyclotrisiloxane	NE								11J
Isopropyl alcohol	NE								
Octamethylcyclotetrasiloxane	NE								
2-[Trimethyls benzoic acid	NE				7JN				
Unknown siloxane/#	NE								
Unidentifed Compound/#	NE					9J			18J/2
Laboratory artifacts/#	NE								180J/3
Semi-Volatile Organics (ug/kg)									
Acetophenone	160					41J		44J	340U
Bis(2-ethylhexyl)phthlate	180,000								
Miscellaneous Semi-Volatile Organics (ug/kg)									
1,2-Benzenedicaroxylic acid	NE						87JN		
1-Decene	NE								96JN
2,5-Dimethyl furan	NE								210JN
N,N-Dimethyl-formamide	610,000								
Dioctadecyl pyhosphonic acid	NE	96JN							
Dodecanoic acid	NE	96JN							
1-Ethyl-2,3-dimethyl benzene	NE						98JN		
1-Ethyl-2,4-dimethyl benzene	NE		95JN	92JN		83JN		94JN	
2-Ethyl-1,3-dimethyl benzene	NE			84JN	86JN	92JN		96JN	
4-Ethyl-1,2-dimethyl benzene	NE			92JN	87JN				
1-Hexacosanol	NE								
2,5-Hexanedione	NE						82JN		120JN
4-Hydroxy-4-met-2-pentanone	NE								7,800JN
1-Methyl-2-(1-methyl)benzene	NE		92JN		79JN	85JN	83JN		
1-Methyl-3-(1-methyl)benzene	NE								
1-Methyl-4-(1-methyl)benzene	NE		92JN				100JN		
4-Methyl-3-penten-2-one	NE								14,000JN
9-Octadecanamide, (z)	NE								
Octadecane, -chloro- (2 isomers)	NE								
2-Fluoro-4-nitrophenol	NE	88JN					89J		
2-Fluoro-6-nitrophenol	NE	84JN							
1,2,4,5-Tetramethyl benzene	NE			86JN	86JN			84JN	
1,2,3-Trimethyl benzene	NE		85JN						
1,2,4-Trimethyl benzene	5,200						83JN		
Unknown amide	NE								370J
Unknown hydrocarbon	NE								240J
Unknown phthlates	NE								
Unknown Compound/#	NE	1,600J/7	1,600J/5	1,400J/6	1,200J/4	890J/4	1,500J/8	2,100JN	1,400J/3
Pesticides (ug/L)									
Aldrin	150	2.0U	2.0U	2.0U	2.0U	2.0U	2.1U	2.1U	1.7U
Beta-BHC	2100								1.7U
Gamma-BHC	2900	2.0U	2.0U	2.0U	2.0U	2.0U	2.1U	2.1U	1.7U
Dieldrin	150	4.0U	3.9U	3.9U	3.9U	3.9U	4.1U	4.1U	3.3U
4,4'-DDT	12,000	4.0U	3.9U	3.9U	3.9U	3.9U	4.1U	4.1U	3.3U
Endrin	26,000	4.0U	3.9U	3.9U	3.9U	3.9U	4.1U	4.1U	3.3U
Heptachlor	550	2.0U	2.0U	2.0U	2.0U	2.0U	2.1U	2.1U	1.7U

NOTES:

1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 29, 1999.
NE	Not established.
ug/kg	micrograms per kilogram
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
MW	Monitoring well
PW	Pubic water supply well.

Shading indicates a value equal to or greater than the EPA Region IX regulatory value indicated for that analyte.

Table 4-1
Subsurface Soil Organic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs	SB-4F (137-139 ft)	SB-5I (8-10 ft.)	SB-5I (24-26 ft. bls)	SB-5I (28-30 ft bls)	SB-5I (45-47 ft bls)	SB-5I (55-57 ft bls)	SB-5ID (55-57 ft bls)	SB-5I (59-61 ft bls)
Volatile Organics (ug/kg)									
Acetone	620,000	14U	11U	12U	12U	12U	11U	11U	12U
Methylene Chloride	21,000	14U	11U	12U	12U	12U	11U	11U	12U
Toluene	52,000								
Trichloroethene	61,000								
Trichlorofluoromethane	200,000								
1,1,2-Trichloro-1,1,2-trifluoroethane	560,000	14U	11U	12U	12U	12U	11U	11U	12U
Miscellaneous Volatile Organics (ug/kg)									
Carbon dioxide	NE								
5,6-Dic-benzene-1,2,3,4-d4-	NE								
Fluorobenzene	NE								
Hexamethylcyclotrisiloxane	NE			7J	7J	9J	11J	12J	
Isopropyl alcohol	NE								
Octamethylcyclotetrasiloxane	NE								
2-[Trimethyls benzoic acid	NE								
Unknown siloxane/#	NE								
Unidentifed Compound/#	NE								
Laboratory artifacts/#	NE		450J/4	140J/3	130J/3	190J/3	330J/3	330J/3	220J/4
Semi-Volatile Organics (ug/kg)									
Acetophenone	160	460U	350U	390U	390U	380U	360U	360U	390U
Bis(2-ethylhexyl)phthlate	180,000						1,800J	360UJ	390U
Miscellaneous Semi-Volatile Organics (ug/kg)									
1,2-Benzenedicaroxylic acid	NE								
1-Decene	NE								
2,5-Dimethyl furan	NE								
N,N-Dimethyl-formamide	610,000								
Dioctadecyl pyhosphonic acid	NE								
Dodecanoic acid	NE								
1-Ethyl-2,3-dimethyl benzene	NE								
1-Ethyl-2,4-dimethyl benzene	NE								
2-Ethyl-1,3-dimethyl benzene	NE								
-Ethyl-1,2-dimethyl benzene	NE								
1-Hexacosanol	NE								
2,5-Hexanedione	NE								
4-Hydroxy-4-met-2-pentanone	NE								
1-Methyl-2-(1-methyl)benzene	NE								
1-Methyl-3-(1-methyl)benzene	NE								
1-Methyl-4-(1-methyl)benzene	NE								
4-Methyl-3-penten-2-one	NE								
9-Octadecanamide, (z)	NE								
Octadecane, -chloro- (2 isomers)	NE								
2-Fluoro-4-nitrophenol	NE								
2-Fluoro-6-nitrophenol	NE								
1,2,4,5-Tetramethyl benzene	NE								
1,2,3-Trimethyl benzene	NE								
1,2,4-Trimethyl benzene	5,200								
Unknown amide	NE								
Unknown hydrocarbon	NE								
Unknown phthlates	NE							170J/2	
Unknown Compound/#	NE	810J/2	420J	1,400J/3	8,800J/14	980J/3	930J/3	860J/2	860J/3
Pesticides (ug/L)									
Aldrin	150	2.4U	1.8U	2.0U	2.0U	2.0U	1.8U	2.0U	2.0U
Beta-BHC	2100	2.6	1.8U	2.0U	2.0U	2.0U	1.8U	2.0U	2.0U
Gamma-BHC	2900	2.4U	1.8U	2.0U	2.0U	20.U	1.8U	2.0U	2.0U
Dieldrin	150	4.6U	3.5U	3.9U	3.9U	3.8U	3.6U	3.9U	4.0U
4,4'-DDT	12,000	4.6U	3.5U	3.9U	3.9U	3.8U	4.2N	3.9U	4.0U
Endrin	26,000	4.6U	3.5U	3.9U	3.9U	3.8U	3.6U	3.9U	4.0U
Heptachlor	550	2.4U	1.8U	2.0U	0.30J	2.0U	1.8U	2.0U	0.21J

NOTES:

1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 29, 1999.
NE	Not established.
ug/kg	micrograms per kilogram
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
MW	Monitoring well
PW	Pubic water supply well.

Shading indicates a value equal to or greater than the EPA Region IX regulatory value indicated for that analyte.

Table 4-1
Subsurface Soil Organic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs	SB-5I (74-76 ft bls)	SB-5I (78-80 ft bls)	SB-5I (95-97 ft bls)	SB-5I (105-107 ft)	SB-5I (109-111 ft)	SB-5I (125-127 ft)	SB-5I (129-131 ft)	SB-5I (142-144 ft)
Volatile Organics (ug/kg)									
Acetone	620,000	12U	12U	12U	12U	12U	12U	12U	12U
Methylene Chloride	21,000	12U	12U	12U	12U	12U	12U	12U	12U
Toluene	52,000								
Trichloroethene	61,000								
Trichlorofluoromethane	200,000								
1,1,2-Trichloro-1,1,2-trifluoroethane	560,000	12U	12U	12U	12U	12U	12U	12U	12U
Miscellaneous Volatile Organics (ug/kg)									
Carbon dioxide	NE								
5,6-Dic-benzene-1,2,3,4-d4-	NE								
Fluorobenzene	NE								
Hexamethylcyclotrisiloxane	NE	10J							
Isopropyl alcohol	NE								
Octamethylcyclotetrasiloxane	NE								
2-[Trimethyls benzoic acid	NE								
Unknown siloxane/#	NE								
Unidentifed Compound/#	NE								
Laboratory artifacts/#	NE	210J/3	210J/4	210J/4	200J/4	370J/4	230J/4	200J/4	240J/4
Semi-Volatile Organics (ug/kg)									
Acetophenone	160	400U	400U	410U	400U	410U	410U	410U	400U
Bis(2-ethylhexyl)phthlate	180,000	400U	460	410U	400U	410U	410U	410U	400U
Miscellaneous Semi-Volatile Organics (ug/kg)									
1,2-Benzenedicaroxylic acid	NE								
1-Decene	NE								
2,5-Dimethyl furan	NE								
N,N-Dimethyl-formamide	610,000								
Dioctadecyl pyhosphonic acid	NE								
Dodecanoic acid	NE								
1-Ethyl-2,3-dimethyl benzene	NE								
1-Ethyl-2,4-dimethyl benzene	NE								
2-Ethyl-1,3-dimethyl benzene	NE								
4-Ethyl-1,2-dimethyl benzene	NE								
1-Hexacosanol	NE								
2,5-Hexanedione	NE								
4-Hydroxy-4-met-2-pentanone	NE								
1-Methyl-2-(1-methyl)benzene	NE								
1-Methyl-3-(1-methyl)benzene	NE								
1-Methyl-4-(1-methyl)benzene	NE								
4-Methyl-3-penten-2-one	NE								
9-Octadecanamide, (z)	NE								
Octadecane, -chloro- (2 isomers)	NE								
2-Fluoro-4-nitrophenol	NE								
2-Fluoro-6-nitrophenol	NE								
1,2,4,5-Tetramethyl benzene	NE								
1,2,3-Trimethyl benzene	NE								
1,2,4-Trimethyl benzene	5,200								
Unknown amide	NE								
Unknown hydrocarbon	NE								
Unknown phthlates	NE	1,600J/3							
Unknown Compound/#	NE	840J/3		920J/2	910J/2	870J2	930J/2	870J/2	920J/2
Pesticides (ug/L)									
Aldrin	150	1.8U	2.1U	2.1U	2.1U	2.1U	2.1U	2.1U	2.0U
Beta-BHC	2100	1.8U				2.1U	2.3	2.1U	2.0U
Gamma-BHC	2900	1.8U	2.1U	2.1U	2.1U	2.1U	2.1U	2.1U	2.0U
Dieldrin	150	3.6U	4.0U	4.1U	4.0U	4.1U	4.1U	4.1U	4.0U
4,4'-DDT	12,000	3.6U	4.0U	4.1U	4.0U	4.1U	4.1U	4.1U	4.0U
Endrin	26,000	3.6U	4.0U	4.1U	4.0U	4.1U	4.1U	4.1U	4.0U
Heptachlor	550	1.8	2.1U	2.1U	2.1U	2.1U	2.1U	2.1U	2.0U

NOTES:

1 U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 29, 1999.
NE Not established.
ug/kg micrograms per kilogram
J Estimated value.
U The analyte was analyzed for, but was not detected above the reporting limit.
R QC indicates that data unusable, compound may or may not be present.
N Presumptive evidence of presence of material.
MW Monitoring well
PW Pubic water supply well.
Shading indicates a value equal to or greater than the EPA Region IX regulatory value indicated for that analyte.

Table 4-1
Subsurface Soil Organic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs	SB-5I (155-157 ft)	SB-5I (160-162 ft)	SB-6S (25-27 ft)	SB-6S (65-67 ft)	SB-7I (53-55 ft)	SB-7ID (53-55 ft)	SB-7I (127-129 ft)	SB-8I (30-31 ft)
Volatile Organics (ug/kg)									
Acetone	620,000	11U	13U	11U	11U	13U	13U	13U	19
Methylene Chloride	21,000	11U	17UJ	11U	11U	13U	13U	13U	25J
Toluene	52,000		2J	11U	11U	13U	13U	13U	11U
Trichloroethene	61,000								
Trichlorofluoromethane	200,000								
1,1,2-Trichloro-1,1,2-trifluoroethane	560,000	11U	13U	11U	11U	13U	13U	13U	11U
Miscellaneous Volatile Organics (ug/kg)									
Carbon dioxide	NE								
5,6-Dic-benzene-1,2,3,4-d4-	NE		7NJ						
Fluorobenzene	NE		7NJ						
Hexamethylcyclotrisiloxane	NE					150J	8J	7J	
Isopropyl alcohol	NE								
Octamethylcyclotetrasiloxane	NE		99J						
2-[Trimethyls benzoic acid	NE								10J
Unknown siloxane/#	NE								
Unidentifed Compound/#	NE			15J/2	13J/2				
Laboratory artifacts/#	NE	190J/4	210J/3			150J/3	170J/3	240J/3	
Semi-Volatile Organics (ug/kg)									
Acetophenone	160	380U	420U	380U	360U	420U	430U	420U	46J
Bis(2-ethylhexyl)phthlate	180,000	380U	420U	380U	360U	420U	430U	420U	370U
Miscellaneous Semi-Volatile Organics (ug/kg)									
1,2-Benzenedicaroxylic acid	NE								
1-Decene	NE								
2,5-Dimethyl furan	NE			530JN	210JN				
N,N-Dimethyl-formamide	610,000			78JN					
Dioctadecyl pyhosphonic acid	NE								
Dodecanoic acid	NE								
1-Ethyl-2,3-dimethyl benzene	NE								
1-Ethyl-2,4-dimethyl benzene	NE								78JN
2-Ethyl-1,3-dimethyl benzene	NE								86JN
4-Ethyl-1,2-dimethyl benzene	NE								
1-Hexacosanol	NE		110NJ						
2,5-Hexanedione	NE			110JN	120JN				78JN
4-Hydroxy-4-met-2-pentanone	NE			7,700JN	4,700JN				
1-Methyl-2-(1-methyl)benzene	NE								
1-Methyl-3-(1-methyl)benzene	NE								83JN
1-Methyl-4-(1-methyl)benzene	NE								
4-Methyl-3-penten-2-one	NE			16,000JN	8,200JN				
9-Octadecanamide, (z)	NE				100JN				120JN
Octadecane, -chloro- (2 isomers)	NE								
2-Fluoro-4-nitrophenol	NE								
2-Fluoro-6-nitrophenol	NE								
1,2,4,5-Tetramethyl benzene	NE								
1,2,3-Trimethyl benzene	NE								
1,2,4-Trimethyl benzene	5,200								80JN
Unknown amide	NE		550J						
Unknown hydrocarbon	NE								
Unknown phthlates	NE								
Unknown Compound/#	NE	900J/2		1,800J/5	690J/3	1,200J/2	430J/2	250J	
Pesticides (ug/L)									
Aldrin	150	2.0U	2.2U	1.9U	1.8U	2.2U	2.2U	2.2U	2.2U
Beta-BHC	2100	2.0U	2.2U	1.9U	1.8U	2.2U	2.2U	2.2U	
Gamma-BHC	2900	2.0U	2.2U	1.9U	1.8U	2.2U	2.2U	2.2U	2.2U
Dieldrin	150	3.8U	4.2U	3.7U	3.5U	4.2U	4.3U	4.2U	4.3U
4,4'-DDT	12,000	3.8U	4.2U	3.7U	3.5U	4.2U	4.3U	4.2U	4.3U
Endrin	26,000	3.8U	4.2U	3.7U	3.5U	4.2U	4.3U	4.2U	4.3U
Heptachlor	550	2.0U	2.2U	1.9U	1.8U	2.2U	2.2U	2.2U	2.2U

NOTES:

1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 29, 1999.
NE	Not established.
ug/kg	micrograms per kilogram
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
MW	Monitoring well
PW	Pubic water supply well.

Shading indicates a value equal to or greater than the EPA Region IX regulatory value indicated for that analyte.

Table 4-1
Subsurface Soil Organic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs	SB-8ID (30-31 ft)	SB-8I (39-40 ft)	SB-8I (118-119 ft)	SB-9S (58-59 ft)	SB-10S (58-59 ft)	SB-11S (15-16 ft)	SB-11S (33-35 ft)	SB-11I (74-75 ft)
Volatile Organics (ug/kg)									
Acetone	620,000	11	12U	13U	12U	12U	20UJ	16UJ	16U
Methylene Chloride	21,000	11U	24J	20U	27J	12U	12UJ	10UJ	11U
Toluene	52,000	11U	12U	13U	12U	12U	12UJ	10UJ	11U
Trichloroethene	61,000						2J	10U	11U
Trichlorofluoromethane	200,000							2J	11U
1,1,2-Trichloro-1,1,2-trifluoroethane	560,000	11U	12U	13U	12U	12U	12UJ	10U	11U
Miscellaneous Volatile Organics (ug/kg)									
Carbon dioxide	NE								
5,6-Dic-benzene-1,2,3,4-d4-	NE								
Fluorobenzene	NE								
Hexamethylcyclotrisiloxane	NE								
Isopropyl alcohol	NE								
Octamethylcyclotetrasiloxane	NE								
2-[Trimethyls benzoic acid	NE	10JN							
Unknown siloxane/#	NE					13J			90J
Unidentifed Compound/#	NE								
Laboratory artifacts/#	NE	6J							
Semi-Volatile Organics (ug/kg)									
Acetophenone	160	46J	380U	46J	400U	420U	380U	340U	350U
Bis(2-ethylhexyl)phthlate	180,000	370U	380U	430J	400U	420U	380U	340U	350U
Miscellaneous Semi-Volatile Organics (ug/kg)									
1,2-Benzenedicaroxylic acid	NE								
1-Decene	NE								
2,5-Dimethyl furan	NE								
N,N-Dimethyl-formamide	610,000								
Dioctadecyl pyhosphonic acid	NE								
Dodecanoic acid	NE								
1-Ethyl-2,3-dimethyl benzene	NE			88JN					
1-Ethyl-2,4-dimethyl benzene	NE	86JN							
2-Ethyl-1,3-dimethyl benzene	NE								
4-Ethyl-1,2-dimethyl benzene	NE								
1-Hexacosanol	NE								
2,5-Hexanedione	NE								
4-Hydroxy-4-met-2-pentanone	NE					10,000J			10,000J
1-Methyl-2-(1-methyl)benzene	NE	78JN							
1-Methyl-3-(1-methyl)benzene	NE								
1-Methyl-4-(1-methyl)benzene	NE	76JN		94JN	81JN				
4-Methyl-3-penten-2-one	NE								
9-Octadecanamide, (z)	NE	150JN							
Octadecane, -chloro- (2 isomers)	NE						310JN		
2-Fluoro-4-nitrophenol	NE								
2-Fluoro-6-nitrophenol	NE								
1,2,4,5-Tetramethyl benzene	NE	84JN							
1,2,3-Trimethyl benzene	NE								
1,2,4-Trimethyl benzene	5,200								
Unknown amide	NE						83J	150J	
Unknown hydrocarbon	NE								
Unknown phthlates	NE								
Unknown Compound/#	NE	1,300J/7	1,100J/5	1,100J/4	860JN/4	530J/2	740J/2	320J/2	1,700J/3
Pesticides (ug/L)									
Aldrin	150	1.9U	2.0U	1.9U	2.0U	2.1U	2.0U	1.8U	1.8U
Beta-BHC	2100					2.1U	2.0U	1.8U	1.8U
Gamma-BHC	2900	1.9U	2.0U	1.9U	2.0U	2.1U	2.0U	1.8U	1.8U
Dieldrin	150	3.7U	3.8U	3.7U	4.0U	4.2U	3.8U	3.4U	3.4U
4,4'-DDT	12,000	3.7U	3.8U	3.7U	4.0U	4.2U	3.8U	3.4U	3.4U
Endrin	26,000	3.7U	3.8U	3.7U	4.0U	4.2U	3.8U	3.4U	3.4U
Heptachlor	550	1.9U	2.0U	1.9U	2.0U	2.1U	2.0U	1.8U	1.8U

NOTES:

1 U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 29, 1999.

NE Not established.

ug/kg micrograms per kilogram

J Estimated value.

U The analyte was analyzed for, but was not detected above the reporting limit.

R QC indicates that data unusable, compound may or may not be present.

N Presumptive evidence of presence of material.

MW Monitoring well

PW Pubic water supply well.

Shading indicates a value equal to or greater than the EPA Region IX regulatory value indicated for that analyte.

Table 4-1
Subsurface Soil Organic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs	SB-111 (99-100 ft)	SB-111 (139-140 ft)	SB-111 (180-181 ft)	SB-111 (237-238 ft)
Volatile Organics (ug/kg)					
Acetone	620,000	11U	14U	11U	33U
Methylene Chloride	21,000	12J	14	16J	24J
Toluene	52,000	11U	11U	11U	12U
Trichloroethene	61,000	11U	11U	11U	12U
Trichlorofluoromethane	200,000	11U	11U	11U	12U
1,1,2-Trichloro-1,1,2-trifluoroethane	560,000	11U	11U	11U	12U
Miscellaneous Volatile Organics (ug/kg)					
Carbon dioxide	NE				
5,6-Dic-benzene-1,2,3,4-d4-	NE				
Fluorobenzene	NE				
Hexamethylcyclotrisiloxane	NE				
Isopropyl alcohol	NE				
Octamethylcyclotetrasiloxane	NE				
2-[Trimethyls benzoic acid	NE				
Unknown siloxane/#	NE	88J	67J	41J/3	26J/2
Unidentifed Compound/#	NE		9J		
Laboratory artifacts/#	NE				
Semi-Volatile Organics (ug/kg)					
Acetophenone	160	380U	380U	380U	420U
Bis(2-ethylhexyl)phthlate	180,000	380U	380U	380U	420U
Miscellaneous Semi-Volatile Organics (ug/kg)					
1,2-Benzenedicaroxylic acid	NE				
1-Decene	NE				
2,5-Dimethyl furan	NE				
N,N-Dimethyl-formamide	610,000				
Dioctadecyl pyhosphonic acid	NE				
Dodecanoic acid	NE				
1-Ethyl-2,3-dimethyl benzene	NE				
1-Ethyl-2,4-dimethyl benzene	NE				
2-Ethyl-1,3-dimethyl benzene	NE				
4-Ethyl-1,2-dimethyl benzene	NE				
1-Hexacosanol	NE				
2,5-Hexanedione	NE				
4-Hydroxy-4-met-2-pentanone	NE	12,000J	13,000J	11,000J	7,500J
1-Methyl-2-(1-methyl)benzene	NE				
1-Methyl-3-(1-methyl)benzene	NE				
1-Methyl-4-(1-methyl)benzene	NE				
4-Methyl-3-penten-2-one	NE				
9-Octadecanamide, (z)	NE				
Octadecane, -chloro- (2 isomers)	NE				
2-Fluoro-4-nitrophenol	NE				
2-Fluoro-6-nitrophenol	NE				
1,2,4,5-Tetramethyl benzene	NE				
1,2,3-Trimethyl benzene	NE				
1,2,4-Trimethyl benzene	5,200				
Unknown amide	NE				
Unknown hydrocarbon	NE				
Unknown phthlates	NE				
Unknown Compound/#	NE	420J/1	930J/3	420J	1,400J/3
Pesticides (ug/L)					
Aldrin	150	2.0U	1.9U	1.9U	2.1U
Beta-BHC	2100	2.0U	1.9U	1.9U	2.1U
Gamma-BHC	2900	2.0U	1.9U	1.9U	2.1U
Dieldrin	150	3.8U	3.8U	3.7U	4.2U
4,4'-DDT	12,000	3.8U	3.8U	3.7U	4.2U
Endrin	26,000	3.8U	3.8U	3.7U	4.2U
Heptachlor	550	2.0U	1.9U	1.9U	2.1U

NOTES:

1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 29, 1999.
NE	Not established.
ug/kg	micrograms per kilogram
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
MW	Monitoring well
PW	Pubic water supply well.

Shading indicates a value equal to or greater than the EPA Region IX regulatory value indicated for that analyte.

Tab
Subsurface Soil Organic Analytical Summary - Field Event 2 (January, 2001)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	SB-01	SB-02	SB-03	SB-04	SB-05	SB-06	SB-07	SB-08	SB-08D	SB-09	SB-10	SB-11	SB-12	SB-13	SB-13D
Volatile Organics (ug/kg)																
Acetone	620,000	11U	15	13U	13	11U	11U	12UJ	12U	12U	35	20	14	17	11UJ	11U
Benzene	1,500	11U	13U	13U	12U	11U	11U	12U	12U	12U	3J	11U	13U	15U	11U	11U
Carbon Disulfide	72,000	11U	13U	13U	12U	11U	11U	12U	12U	12U	13U	11U	13U	3J	11U	11U
Methylene Chloride	21,000	11U	13U	13U	12U	11U	11U	12U	12U	12U	13U	11U	13U	15U	11U	11U
Methyl Ethyl Ketone	2,800,000	11U	13U	13U	12U	11U	11U	12UJ	12U	12U	19	11U	13U	15U	11UJ	11U
Toluene	52,000	11U	13U	13U	12U	11U	11U	12U	12U	12U	2J	11U	13U	2J	11U	11U
Trichloroethene	61,000	11U	13U	13U	12U	11U	11U	12U	12U	12U	13U	11U	13U	15U	11U	11U
Trichlorofluoromethane	200,000	11U	13U	13U	12U	11U	11U	12U	12U	12U	13U	11U	13U	15U	11U	11U
1,1,2-Trichloro-1,1,2-trifluoroethane	560,000	11U	13U	13U	12U	11U	11U	12U	12U	12U	13U	11U	13U	15U	11U	11U
Miscellaneous Volatile Organics (ug/kg)																
Carbon dioxide	NE															
Octamethylcyclotetrasiloxane	NE				8J				7J							
5,6-Dic-benzene-1,2,3,4-d4-	NE															
Fluorobenzene	NE															
Hexamethylcyclotrisiloxane	NE															
Isopropyl alcohol	NE															
2-[Trimethyls benzoic acid	NE															
Unknown alcohol	NE														8JN	
Unknown siloxane/#	NE															
Unidentifed Compound/#	NE															
Laboratory artifacts/#	NE	23J/2	92J/3	21J/1	43J/2	11J/1	190J/2		37J/2	23J/2		27J/2	21J/1	260J/3		140J/2
Semi-Volatile Organics (ug/kg)																
Anthracene	10,000,000	350U	420U	420U	410U	350U	350U	380U	390U	400U	410U	360U	69J	500U	380U	380U
Benzo(a)anthracene	2,900	350U	420U	420U	410U	350U	350U	380U	390U	400U	410U	360U	200J	500U	380U	380U
Benzo(b)fluoranthene	2,900	350U	420U	420U	410U	350U	350U	380U	390U	400U	410U	360U	250J	500U	380U	380U
Benzo(k)fluoranthene	29,000	350U	420U	420U	410U	350U	350U	380U	390U	400U	410U	360U	110J	500U	380U	380U
Benzo(ghi)perylene	NE	350U	420U	420U	410U	350U	350U	380U	390U	400U	410U	360U	68J	500U	380U	380U
Benzo(a)pyrene	290	350U	420U	420U	410U	350U	350U	380U	390U	400U	410U	360U	170J	500U	380U	380U
Chrysene	290,000	350U	420U	420U	410U	350U	350U	380U	390U	400U	410U	360U	200J	500U	380U	380U
Fluoranthene	3,000,000	350U	420U	420U	410U	350U	350U	380U	390U	400U	410U	360U	460	500U	380U	380U
Indeno(1,2,3-cd)pyrene	2,900	350U	420U	420U	410U	350U	350U	380U	390U	400U	410U	360U	110J	500U	380U	380U
Phenanthrene	NE	350U	420U	420U	410U	350U	350U	380U	390U	400U	410U	360U	280J	500U	380U	380U
Pyrene	5,400,000	350U	420U	420U	410U	350U	350U	380U	390U	400U	410U	360U	460	500U	380U	380U
Miscellaneous Semi-Volatile Organics (ug/kg)																
1,2-Benzenedicaroxylic acid	NE															
Benzo(k)fluoranthene	29,000												110NJ			
Bis(2-ethyl)hexanedoic acid	NE									86NJ						
1-Decene	NE															
Deca 1H-cycloprop[e]azulene	NE													730NJ		
2,5-Dimethyl furan	NE															
N,N-Dimethyl-formamide	610,000															
Dioctadecyl pyhosphonic acid	NE															
1-Ethyl-2,3-dimethyl benzene	NE															
1-Ethyl-2,4-dimethyl benzene	NE															

Table 4-2
Subsurface Soil Organic Analytical Summary - Field Event 2 (January, 2001)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	SB-01	SB-02	SB-03	SB-04	SB-05	SB-06	SB-07	SB-08	SB-08D	SB-09	SB-10	SB-11	SB-12	SB-13	SB-13D
Miscellaneous Semi-Volatile Organics (ug/kg) - (Continued)																
2-Ethyl-1,3-dimethyl benzene	NE															
4-Ethyl-1,2-dimethyl benzene	NE															
1-Hexacosanol	NE															
Hexadecyl-oxirane isomers	NE															
2,5-Hexanedione	NE															
4-Hydroxy-4-met-2-pentanone	NE															
1-Methyl-2-(1-methyl)benzene	NE															
1-Methyl-3-(1-methyl)benzene	NE															
1-Methyl-4-(1-methyl)benzene	NE															
4-Methyl-3-penten-2-one	NE															
9-Octadecanamide, (z)	NE															
Octadecane, -chloro- (2 isomers)	NE															
2,3,4,9 (1H)=Phenanthrene	NE													180NJ		
2-Fluoro-4-nitrophenol	NE															
2-Fluoro-6-nitrophenol	NE															
1,2,4,5-Tetramethyl benzene	NE															
Tetramethylphenathrene	NE													240JN		
1,2,3-Trimethyl benzene	NE															
1,2,4-Trimethyl benzene	5,200															
Unknown alcohol	NE											95JN				
Unknown amide	NE															
Unknown hydrocarbon	NE															
Unknown phthlates	NE											2600J/12				
Unknown Compound/#	NE	1200J/2	1400J/2	1500J/2	1300J/2	1500J/2	1100J/2	670J/2	1300J/3	1900J/5	1600J/J	1200J/4	1700J/4	13000J/27	1300J/4	1200J/3
Pesticides (ug/kg)																
Alpha Chlordane /2	1,100	1.8U	2.2U	2.2U	2.1U	1.8U	1.8U	2.0U	2.0U	2.1U	2.1U	1.8U	2.2U	2.4J	2.0U	1.9U
Dieldrin	150	3.5U	4.2U	4.2U	4.1U	3.5U	3.5U	3.8U	3.8U	4.0U	4.1U	3.6U	4.3U	2.8J	3.8U	3.8U
PCB-1254 (Aroclor 1254)	100	35U	42U	42U	41U	35U	35U	2.8J	4.5J	40U	2.9J	3.0J	43U	50U	38U	38U

NOTES:

mg/kg	milligrams per kilogram
NE	Not established.
1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 29, 1999.
SB	Subsurface soil sample
D	SB-11D is a duplicate of SB-11; SB-51D is a duplicate of SB-51; SB-71D is a duplicate of SB-71; SB-8SD is a duplicate of SB-8S.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
	Shading indicates a value equal to or greater than the EPA Region IX regulatory value indicated for that analyte.

Table 4-3
Subsurface Soil Organic Analytical Summary - Field Event 3 (February, 2002)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	SB-12S	SB-12I	SB-14	SB-15	SB-16
Volatile Organics (ug/kg)						
Acetone	620,000	1,400UJ	NA	49UJ	63UJ	2,000J
Benzene	1,500	1.7U	NA	1.3UJ	1.0UJ	2.8J
Carbon Disulfide	72,000	1.7UJ	NA	1.3UJ	1.0UJ	2.5J
Toluene	52,000	1.7UJ	NA	1.3UJ	1.0UJ	1.6J
Semi-Volatile Organics (ug/kg)						
Benzo(a)anthracene	2,900	6,700U	NA	6,600U	6,100U	1,500J
Benzo(b)fluoranthene	2,900	6,700U	NA	6,600U	6,100U	1,700J
Benzo(ghi)perylene	NE	6,700U	NA	6,600U	6,100U	1,200J
Benzo(a)pyrene	290	6,700U	NA	6,600U	6,100U	1,300J
Chrysene	290,000	6,700U	NA	6,600U	6,100U	1,600J
Fluoranthene	3,000,000	6,700U	NA	6,600U	6,100U	3,000J
Indeno(1,2,3-cd)pyrene	2,900	6,700U	NA	6,600U	6,100U	950J
Phenanthrene	NE	6,700U	NA	6,600U	6,100U	3,000J
[illegible]enol	22,000	6,700U	NA	6,600U	6,100U	3,000J
[illegible]yrene	5,400,000	6,700U	NA	6,600U	6,100U	3,100J

NOTES:

ug/kg	micrograms per kilogram
NE	Not established.
NA	Not analyzed.
MW	Monitoring well.
TW	Temporary well.
1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 22, 2000.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.

Shading indicates a value equal to or greater than the EPA Region IX regulatory value indicated for that analyte.

SB-12S and SB-12I were collected immediately above the water table at monitoring wells MW-12S and MW-12I, respectively. These subsurface soil samples were originally named MW-12S and MW-12I in the third Data Evaluation Report (Black & Veatch, 2002)

SB-14, SB-15 and SB-16 were collected immediately above the water table at temporaray wells TW-14, TW-15, and TW-16, respectively. These subsurface soil samples were originally named TW-14, TW-15 and TW-16 in the third Data Evaluation Report (Black & Veatch, 2002)

Several subsurface soil samples had elevated levels of inorganic contamination. Aluminum, arsenic, chromium, iron, and lead were detected in subsurface samples above Region 9 PRGs for industrial soil. Iron is the most widespread of the inorganic contaminants with eight samples containing concentrations greater than or equal to the 10,000 mg/kg PRG for industrial soils. These samples were collected from SB-4I (137-139 feet bls), SB-5I (24-26 feet bls), SB-8I (118-119 feet bls), and SB-11S (15-16 feet bls) during the first sampling event; SB-02, SB-07, and SB09 during the second sampling event; and SB-16 during the third sampling event. Elevated arsenic concentrations were detected in three samples and ranged from 3.6 mg/kg (SB-11S) to 26 mg/kg (SB-16). Aluminum, chromium, and lead were each detected above Region 9 industrial PRGs in only one sample. Tables 4-4 through 4-6 present inorganic analyte results for subsurface soil samples.

4.1.3 Soil Conclusions

Very little soils contamination is present in the Capitol City Plume site area. Except for benzo(a)pyrene in one sample (SB-16), no organic contamination was detected at elevated levels in the RI samples. Inorganic contamination was detected at elevated levels in more samples; however, except for sample SB-16, the contamination levels rarely exceeded twice the PRG. SB-16 was contaminated by arsenic, iron, and lead at 10, 5, and 30 times the respective PRGs. RI sampling results do not provide strong evidence for a soil source area that continues to contribute to groundwater contamination.

4.2 Groundwater

4.2.1 Hydrogeologic Setting

4.2.1.1 Regional Topography and Surface Drainage. Montgomery is located in the northern part of the Coastal Plain Physiographic Province of Alabama (SCS, 1957).

4.2.1.2 Site Topography and Surface Drainage. Topography in the investigation area is largely controlled by the nearby Alabama River (Jones Bluff Lake) and associated flood plain (USGS, 1981). The site is located within the 100-year flood plain in an area with elevations ranging approximately 160 to 260 feet above mean sea level (USGS 1981; FEMA, 1992). Surveyed monitoring well locations on site range in elevation from approximately 275 feet amsl at monitoring well cluster MW-11 located at the southeast edge of the site to 158 feet amsl at temporary

Tabl

Subsurface Soil Inorganic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	SB-1I (8-9 ft.)	SB-1I (25-26 ft.)	SB-1I (31-32 ft.)	SB-1I (41-42 ft.)	SB-1I (55-56 ft.)	SB-1I (61-62 ft.)	SB-1I (71-72 ft.)	SB-1I (83-34 ft.)	SB-1I (91-92 ft)
Inorganics (mg/kg)										
Aluminum	10,000	4400	2900	2200	1700	4800	5000	2300	2400	1800
Antimony	82	0.48UJ	0.43UJ	0.43UJ	0.46UJ	0.56UJ	0.50UJ	0.47UJ	0.50UJ	0.51UJ
Arsenic	2.7	.052U	0.47U	0.47U	0.51U	0.61U	0.55U	0.51U	0.55U	0.56U
Barium	10,000	13	8.8	11	34	22	39	20	14	12
Beryllium	220	0.11	0.15	0.40	0.24	0.45	0.39	0.25	0.25	0.16
Cadmium	81	0.04U	0.04U	0.04U	0.04U	0.05U	0.05U	0.04U	0.05U	0.05U
Calcium	NE	470J	81J	44J	190J	510J	700J	210J	280J	290J
Chromium	64	6.7	8.1	7.5	1.5U	43	3.8	2.4	2.6	1.6U
Cobalt	10,000	0.13U	1.5	2.7	0.41	1.3	1.3	0.42	0.55	0.96
Copper	7,600	1.6U	3.6U	3.5U	0.93U	1.1U	1.1U	0.62U	0.74U	4.7U
Iron	10,000	3700	6900	6400	2000	4400	3900	3100	2700	1900
Lead	75	3.3	1.7	1.7	1.3	1.9	2.1	1.5	1.5	4.7
Magnesium	NE	220	260	310	190	640	660	240	260	190
Manganese	3200	5.6J	38J	64J	41J	88J	110J	48J	50J	170J
Mercury, total	61	0.06U	0.05U	0.05J	0.05U	0.07U	0.06U	0.05U	0.06U	0.06U
Nickel	4100	1.2	1.6	2.0	1.2	2.4	2.3	1.4	1.4	1.4
Potassium	NE	180	190	260	180	690	580	290	310	240
Selenium	3.9	0.50U	0.45U	0.45U	0.49	0.58U	0.52U	0.49U	0.64U	0.53U
Silver	3.9	0.14U	0.12U	0.12U	0.13U	0.16U	0.14U	0.13U	0.14U	0.14U
Sodium	NE	150U	180U	160U	180U	200U	190U	170U	180U	170U
Thallium	NE	0.72U	1.0U	1.2U	0.71U	0.85U	0.76U	0.71U	0.76U	0.78U
Vanadium	1400	10	12	9.8	2.2	5.8	5.4	2.7	3.1	2.1
Zinc	10000	4.2U	7.1	9.2	4.3U	8.3	8.0	5.2	4.2U	24
Cyanide	3.5	0.05U	0.05U	0.05U	0.05U	0.06U	0.06U	0.05U	0.05	0.06U

NOTES:

mg/kg	milligrams per kilogram
NE	Not established.
1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 22, 2000.
SB	Subsurface soil sample
D	SB-1ID is a duplicate of SB-1I; SB-5ID is a duplicate of SB-5I; SB-71D is a duplicate of SB-71; SB-8SD is a duplicate of SB-8S;
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
	Shading indicates a value equal to or greater than the EPA Region IX PRG indicated for that analyte.

Table 4-4
Subsurface Soil Inorganic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	SB-1I (101-102 ft.)	SB-1I (112-113 ft.)	SB-1I (122-123 ft.)	SB-1ID (122-123 ft.)	SB-1I (131-132 ft.)	SB-1I (140-141 ft.)	SB-4I (25-26 ft.)	SB-4I (137-139 ft)	SB-5I (8-10 ft.)
Inorganics (mg/kg)										
Aluminum	10,000	2100	2200	1800	1800	2100	2100	1500	8900	5000
Antimony	82	0.46UJ	0.47UJ	0.49UJ	0.48UJ	0.52UJ	0.50UJ	0.53UJ	0.74UJ	0.56UJ
Arsenic	2.7	0.50U	0.51U	0.53U	0.53U	0.57U	0.55U	0.71U	2.1U	1.1
Barium	10,000	16	16	15	15	27	16	4.4	59	42
Beryllium	220	0.22	0.26	0.17	0.17	0.18	0.39	0.18U	0.97U	0.67U
Cadmium	81	0.04U	0.04U	0.05U	0.05U	0.05U	0.05U	0.04U	0.09U	0.07U
Calcium	NE	520J	470J	340J	340J	710J	910J	94	7600J	540J
Chromium	64	1.9U	2.4	2.6	2.0U	2.6	2.8	5.6	13	3.2
Cobalt	10,000	0.5	0.45U	0.50	0.60	1.2	0.99	2.2	7.6	1.9
Copper	7,600	0.74U	0.92U	0.88U	0.72U	0.89U	1.1U	2.2U	13	6.2
Iron	10,000	2200	2200	2200	2000	2700	6200	4400	14,000	7900
Lead	75	1.6	1.3	1.3	1.3J	2.1	1.8	1.3J	10	5.9
Magnesium	NE	290	230	210	200	370	460	210	3900	310
Manganese	3200	55J	47J	68J	88J	270J	200J	45J	72	380
Mercury, total	61	0.05U	0.06U	0.05U	0.06U	0.06U	0.05U	0.05U	0.07U	0.05U
Nickel	4100	0.81	0.73U	0.77U	0.71	3.6	0.55	1.2	18	1.7
Potassium	NE	340	290	310	280	420	580	220	3100	540
Selenium	3.9	0.48U	0.49U	0.51U	0.78U	0.55U	0.52U	0.47U	0.86U	0.52U
Silver	3.9	0.13U	0.13U	0.14U	0.14U	0.15U	0.14U	0.12U	0.20U	0.15U
Sodium	NE	130U	150U	160U	1700	180U	140U	170U	76U	58U
Thallium	NE	0.70U	0.72U	0.74U	0.73U	0.80U	1.4U	0.61U	1.0UJ	0.76UJ
Vanadium	1400	2.3	3.2	2.3	2.2	3.0	3.4	5.7	12	9.2
Zinc	10000	3.9U	4.3U	2.9U	2.9U	5.7	4.3U	4.4	59J	28J
Cyanide	3.5	0.05U	0.05U	0.05U	0.05U	0.06U	0.06U	0.10U	0.12U	0.16U

NOTES:

mg/kg	milligrams per kilogram
NE	Not established.
1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 22, 2000.
SB	Subsurface soil sample
D	SB-1ID is a duplicate of SB-1I; SB-5ID is a duplicate of SB-5I; SB-7ID is a duplicate of SB-7I; SB-8SD is a duplicate of SB-8S;
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
	Shading indicates a value equal to or greater than the EPA Region IX PRG indicated for that analyte.

Table [illegible]

Subsurface Soil Inorganic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	SB-5I (24-26 ft. bls)	SB-5I (28-30 ft bls)	SB-5I (45-47 ft bls)	SB-5I (55-57 ft bls)	SB-5ID (55-57 ft bls)	SB-5I (59-61 ft bls)	SB-5I (74-76 ft bls)	SB-5I (78-80 ft bls)	SB-5I (95-97 ft bls)
Inorganics (mg/kg)										
Aluminum	10,000	5000	3400	4300	1800	1700	2200	3100	3400	1500
Antimony	82	0.61UJ	0.61UJ	0.62UJ	0.56UJ	0.56UJ	0.60UJ	0.63UJ	0.89UJ	1.6UJ
Arsenic	2.7	8.7	0.45U	0.45U	0.7	0.58U	0.44U	0.46U	0.70U	0.97U
Barium	10,000	21	20	27	92	8.8	25	20	15	18
Beryllium	220	0.56U	0.38U	0.57U	0.49U	0.48U	0.51U	0.36U	0.29U	0.21U
Cadmium	81	0.07U	0.07U	0.07U	0.06U	0.07U	0.07U	0.07U	0.26U	0.26U
Calcium	NE	640J	650J	570J	170J	140J	540J	460J	75U	72U
Chromium	64	4.1	4	12	6.1	6.1	3.9	1.1	3.0	2.4
Cobalt	10,000	3.1	0.19U	4.1	1.9	1.7	0.35	0.24U	0.58	1.3U
Copper	7,600	2.2	1.8	8.9	11	3.6	3.2	2.5	0.99U	1.3U
Iron	10,000	14,000	6600	7900	7600	7200	4700	1900	2200	3900
Lead	75	3.1	4.1	3.5	1.9	2.7	1.7	2.1	1.8	1.4
Magnesium	NE	530	450	700	200	190	320	330	300J	160J
Manganese	3200	160	23	84	63	64	71	79	39	180
Mercury, total	61	0.06U	0.06U	0.06U	0.06U	0.05U	0.06U	0.06U	0.06U	0.06U
Nickel	4100	1.4	0.21U	2.1	1.4	1.2	1.2	0.92	1.4U	4.0U
Potassium	NE	650	470	720	240	240	330	440	550	270
Selenium	3.9	0.52U	0.52U	0.53U	0.49U	0.48U	0.64U	0.53U	0.62U	0.60U
Silver	3.9	0.16U	0.17U	0.17U	0.15U	0.15U	0.16U	0.17U	0.46U	0.81U
Sodium	NE	63U	63U	64U	57U	58U	62U	65U	250U	240U
Thallium	NE	0.82UJ	0.83UJ	0.84UJ	0.75UJ	0.76UJ	0.81UJ	0.85UJ	1.1U	1.0U
Vanadium	1400	9.2	7	24	9.4	9.0	4.2	1.6	3.5	3.8
Zinc	10000	11J	6.9J	20J	13J	9.6J	37J	9.5J	7.1	6.7
Cyanide	3.5	0.14U	0.09U	0.15U	0.10U	0.09U	0.11U	0.10U	0.16UJ	0.12UJ

NOTES:

mg/kg	milligrams per kilogram
NE	Not established.
1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 22, 2000.
SB	Subsurface soil sample
D	SB-11D is a duplicate of SB-11; SB-5ID is a duplicate of SB-5I; SB-7ID is a duplicate of SB-7I; SB-8SD is a duplicate of SB-8S;
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
	Shading indicates a value equal to or greater than the EPA Region IX PRG indicated for that analyte.

Table 4-4
Subsurface Soil Inorganic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	SB-5I (105-107 ft)	SB-5I (109-111 ft)	SB-5I (125-127 ft)	SB-5I (129-131 ft)	SB-5I (142-144 ft)	SB-5I (155-157 ft)	SB-5I (160-162 ft)	SB-6S (25-27 ft)	SB-6S (65-67 ft)
Inorganics (mg/kg)										
Aluminum	10,000	1600	2700	2900	1800	1400	1500	2000	4500	2200
Antimony	82	0.89UJ	1.0UJ	1.0UJ	0.90UJ	.88UJ	0.84UJ	0.94UJ	0.59UJ	0.57UJ
Arsenic	2.7	1.5	0.73U	0.78U	0.71U	0.69U	0.69U	0.82U	1.3U	0.88U
Barium	10,000	13	20	28	19	9.1	22	18	21	20
Beryllium	220	0.19	0.3	0.35	0.24	0.14	0.17	0.28	0.24U	0.29U
Cadmium	81	0.27U	0.28U	0.28U	0.27U	0.26U	0.26U	0.28U	0.04U	0.04U
Calcium	NE	75U	78U	78U	76U	74U	74U	820	520	190
Chromium	64	1.7U	3.3	3.0	1.7U	1.4U	1.8U	2.0U	4.6	3.2
Cobalt	10,000	0.55U	1.2	1.2U	0.56U	0.55U	1.1	0.58U	3.2	3.2
Copper	7,600	1.7	1.1	1.0UJ	0.73U	0.72U	1.0	0.96U	1.8U	1.0U
Iron	10,000	2000	2600	3300	1800	1500	1800	3700	7700	4200
Lead	75	1.1J	1.4	1.2	1.1	0.65U	3.4	1.2J	3.2J	2.8J
Magnesium	NE	180J	300J	340J	190J	200J	220J	500J	440	200
Manganese	3200	38	82	79	37	29	230	37	230J	210J
Mercury, total	61	0.06U	0.06U	0.06U	0.06U	0.06U	0.06U	0.06U	0.06U	0.06U
Nickel	4100	0.68U	1.4U	1.5U	0.63U	0.50U	1.6U	0.96U	1.6	2.2
Potassium	NE	280	480	520	340	370	380	630	360	220
Selenium	3.9	0.63U	0.66U	0.65U	0.63U	0.62U	0.62U	0.66U	0.75U	0.51U
Silver	3.9	0.46U	0.48U	0.72U	0.46U	0.45U	0.46U	0.48U	0.14U	0.13U
Sodium	NE	250U	260U	260U	250U	250U	250U	260U	220U	200U
Thallium	NE	1.1U	1.7U	1.1U	1.1U	1.1U	1.1U	1.1U	0.68U	0.66U
Vanadium	1400	2.5	3.4	4.2	2.1	1.7	1.9	2.4	11	5
Zinc	10000	3.7	5.6	5.0	3.3	5.3	4.8	6.9	6.3	3.7
Cyanide	3.5	0.08UJ	0.09UJ	0.08UJ	0.07UJ	0.08UJ	0.10J	0.11UJ	0.04U	0.05U

NOTES:

mg/kg milligrams per kilogram
NE Not established.
1 U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil, PRGs, November 22, 2000.
SB Subsurface soil sample
D SB-1ID is a duplicate of SB-1I; SB-5ID is a duplicate of SB-5I; SB-7ID is a duplicate of SB-7I; SB-8SD is a duplicate of SB-8S;
J Estimated value.
U The analyte was analyzed for, but was not detected above the reporting limit.
R QC indicates that data unusable, compound may or may not be present.
N Presumptive evidence of presence of material.
Shading indicates a value equal to or greater than the EPA Region IX PRG indicated for that analyte.

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Subsurface Soil Inorganic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	SB-7I (53-55 ft)	SB-7ID (53-55 ft)	SB-7I (127-129 ft)	SB-8S (30-31 ft)	SB-8SD (30-31 ft)	SB-8S (39-40 ft)	SB-8I (118-119 ft)	SB-9S (58-59 ft)	SB-10S (58-59 ft)
Inorganics (mg/kg)										
Aluminum	10,000	4600	4900	2800	1400	1500	3200	2400	2700	9700
Antimony	82	0.65UJ	0.65UJ	0.64UJ	0.46UJ	0.47UJ	0.49UJ	0.52UJ	0.50UJ	0.55UJ
Arsenic	2.7	0.48U	0.48U	0.47U	0.50U	0.51U	0.53U	0.98U	0.55U	0.60U
Barium	10,000	35	42	21	8.3	6.2	21	100	19	64
Beryllium	220	0.50U	0.53U	0.56U	0.13	0.14	0.29	0.44	0.21	0.94U
Cadmium	81	0.08U	0.08U	0.07U	0.04U	0.04U	0.05U	0.25U	0.05U	0.05U
Calcium	NE	900J	830J	1700J	14J	13J	300J	780J	320J	2100
Chromium	64	5.8	6.4	2.5	4.8	5.9	2.4	3.7	1.9U	6.4
Cobalt	10,000	1.5	1.5	0.20U	2.2	2.2	0.98	1.7	0.72	2.6
Copper	7,600	3.8	8.5	9.5	1.9U	2.2U	0.60U	1.4U	1.0U	2.1
Iron	10,000	4500	4900	7000	4100	4600	3700	12,000	2400	7600
Lead	75	2.5	2.7	2.2	2.1	1.8	2.1	2.2	1.6J	3.7J
Magnesium	NE	680	740	670	79	87	260	470	250	1500
Manganese	3200	180	180	86	90J	82J	360J	640J	110J	100J
Mercury, total	61	0.06U	0.06U	0.06U	0.06U	0.05U	0.06U	0.05U	0.05U	0.06U
Nickel	4100	2.7	2.9	0.61	0.96	1.2	2.1	1.4	1.2	4.1
Potassium	NE	910	1100	1000	92	100	280	590	170	1100
Selenium	3.9	0.55U	0.6	0.54U	0.50U	0.49U	0.51U	0.62U	0.53U	0.57U
Silver	3.9	0.18U	0.18U	0.17U	0.13U	0.13U	0.14U	0.15U	0.14U	0.16U
Sodium	NE	67U	67U	65U	160U	180U	180U	190U	180U	270U
Thallium	NE	0.88UJ	0.88UJ	0.86UJ	0.69U	0.71U	0.74U	2.3U	0.77U	0.90U
Vanadium	1400	3.9	4.7	2.6	5.0	5.1	4.0	4.4	3.2	9.8U
Zinc	10000	16J	14J	12J	6.7	4.0U	4.7	6.9	3.6U	20
Cyanide	3.5	0.11U	0.09U	0.15U	0.05U	0.27U	0.05U	0.06U	0.08U	0.06U

NOTES:

mg/kg	milligrams per kilogram
NE	Not established.
1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 22, 2000.
SB	Subsurface soil sample
D	SB-1ID is a duplicate of SB-1I; SB-5ID is a duplicate of SB-5I; SB-7ID is a duplicate of SB-7I; SB-8SD is a duplicate of SB-8S;
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
	Shading indicates a value equal to or greater than the EPA Region IX PRG indicated for that analyte.

Table 4-4
Subsurface Soil Inorganic Analytical Summary - Field Event 1 (March, 2000)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	*SB-11S* (15-16 ft)	*SB-11S* (33-35 ft)	*SB-11I* (74-75 ft)	*SB-11I* (99-100 ft)	*SB-11I* (139-140 ft)	*SB-11I* (180-181 ft)	*SB-11I* (237-238 ft)
Inorganics (mg/kg)								
Aluminum	10,000	9500	2900	2800	6800	3400	1700	2700
Antimony	82	12UJ	11UJ	0.44UJ	0.47UJ	0.47UJ	0.44UJ	0.51UJ
Arsenic	2.7	**3.6**	0.41U	0.49U	0.51U	0.51U	0.49U	1.0U
Barium	10,000	29	8.7	14	74	46	41	29
Beryllium	220	0.80U	0.50U	0.31U	0.74U	0.31	0.27U	0.60U
Cadmium	81	0.94U	0.86U	0.04U	0.04U	0.04U	0.04U	0.05U
Calcium	NE	360	10U	220	700	510	190	1300
Chromium	64	**140**	3.3	5.0	4.8	2.6	4.1	3.7
Cobalt	10,000	4.0UJ	2.7UR	1.1	1.9	4.6	0.85	1.4
Copper	7,600	2.2U	1.1U	0.85	0.86	0.68	0.75	1.0
Iron	10,000	**16,000**	3000	4200	6400	3600	2100	**10,000**
Lead	75	6.8J	1.6J	1.9J	4.2J	2.3J	1.7J	1.6J
Magnesium	NE	430	220	340	770	460	150	680
Manganese	3200	76J	61J	56J	450J	200J	460J	290J
Mercury, total	61	0.08U	0.05U	0.05U	0.05U	0.04U	0.05U	0.05U
Nickel	4100	7.2U	6.6U	1.2	2.7	2.7	1.8	1.0
Potassium	NE	520	540	630	740	370	280	850
Selenium	3.9	0.60U	0.55U	0.47U	0.49U	0.49U	0.47U	0.53U
Silver	3.9	1.2	1.1U	0.13U	0.13U	0.13U	0.13U	0.14U
Sodium	NE	16	7.2	140U	130U	180U	150U	220U
Thallium	NE	0.48U	0.44U	0.68U	0.73U	0.71U	0.68U	1.8U
Vanadium	1400	28	4.3	3.9U	7.4U	4.5U	2.2U	5.0U
Zinc	10000	13	5.7	3.5	9.3	6.8	3.1	6.0
Cyanide	3.5	0.11U	0.11U	0.05U	0.05U	0.05U	0.05U	0.06U

NOTES:

mg/kg	milligrams per kilogram
NE	Not established.
1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 22, 2000.
SB	Subsurface soil sample
D	*SB-1ID* is a duplicate of *SB-1I*; *SB-5ID* is a duplicate of *SB-5I*; *SB-71D is a duplicate of SB-71*; SB-8SD is a duplicate of SB-8S;
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
	Shading indicates a value equal to or greater than the EPA Region IX PRG indicated for that analyte.

Table 4-5
Subsurface Soil Inorganic Analytical Summary - Field Event 2 (January, 2001)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	SB-01	SB-02	SB-03	SB-04	SB-05	SB-06	SB-07	SB-08	SB-08D	SB-09	SB-10	SB-11	SB-12	SB-13	SB-13D
Inorganics (mg/kg)																
Aluminum	10,000	1,500	6100	8,100	4,800	1,600	330J	5,200J	820J	960J	5,300J	1,400J	6,100J	**11,000J**	4,200J	4,300J
Arsenic	2.7	1.1	1.1U	1.0U	1.0U	0.88U	0.89U	1.1U	1.0U	1.0U	1.0U	0.83U	1.2J	1.2U	0.95U	0.92U
Barium	10,000	6.7J	26J	29J	19J	7.0J	3.1	63	8.1	10	34	7.7	57	140	39	72
Cadmium	81	0.13U	0.16U	0.15U	0.15U	0.26U	0.13U	0.16U	0.14U	0.15U	0.15U	0.12U	0.16U	0.18U	0.14U	0.13U
Calcium	NE	61	390	470	660	15	26	260	110	140	480	20	3,300	1,200	440	1,700
Chromium	64	11	13	14	4.1	7.2	3.4J	7.0J	8.3J	6.8J	14J	15J	12J	26J	14J	14J
Cobalt	10,000	2.1	4.3	4.9	2.1	4.2	0.66	11	1.2	1.3	9.1	1.4	2.9	3.3	5.2	4.1
Copper	7,600	3.1UJ	8.9J	8.2J	1.6UJ	3.2UJ	0.58UJ	3.8UJ	1.0UJ	1.3UJ	6.1UJ	3.0UJ	10J	17J	4.6UJ	5.8J
Iron	10,000	5,600	**11,000**	7,900	6,300	4,900	1,800	**10,000**	4,700	4,900	**11,000**	5,100	6,500	3,200	700	9,900
Lead	75	1.3	4.1	4.1	2	1.1J	0.75J	4.6J	2.4J	4.3J	5.2J	1.8J	18J	16J	4J	21J
Magnesium	NE	150	880	980	700	120	30UJ	710J	88J	100J	540J	140J	900J	620J	610J	840J
Manganese	3,200	73	85	91	110	62	59	570	85	100	190	34	94	9.9	110	96
Mercury, total	61	0.05U	0.22	0.05U	0.05U	0.04U	0.04U	0.06U	0.06U	0.05U	0.06U	0.05U	0.09U	0.18	0.06U	0.06U
Nickel	4,100	1.6	4.6	4.7	3.1	1.4	0.53J	4.9J	0.93J	1.1J	3.8J	1.5J	3.3J	7.8J	4.1J	3.4J
Potassium	NE	130	640	770	550	120	28J	510J	110J	130J	400J	150J	320J	370J	390J	360J
Vanadium	1,400	8.3U	29	26	6.3U	6.6U	1.8	15	5	4.9	19	6.9	16	24	14	13
Zinc	10,000	11	17	15	11	4.6	1.6J	19J	4.5J	6.1J	20J	4.6J	19J	22J	17J	15J

NOTES:

mg/kg milligrams per kilogram
NE Not established.
1 U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 22, 2000.
SB Subsurface soil sample
D SB-8D is a duplicate of SB-8; SB-13D is a duplicate of SB-13
J Estimated value.
U The analyte was analyzed for, but was not detected above the reporting limit.
R QC indicates that data unusable, compound may or may not be present.
N Presumptive evidence of presence of material.
Shading indicates a value equal to or greater than the EPA Region IX regulatory value indicated for that analyte.

Table 4-6
Subsurface Soil Inorganic Analytical Summary - Field Event 3 (February, 2002)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Region IX PRGs[1]	SB-12S	SB-12I	SB-14	SB-15	SB-16
Inorganics (mg/kg)						
Aluminum	10,000	NA	NA	4,000	3,900	8,000
Antimony	82	NA	NA	0.72UJ	0.72UJ	10J
Arsenic	2.7	NA	NA	0.60U	1.1	26
Barium	10,000	NA	NA	34	16	1,000
Cadmium	81	NA	NA	0.09U	0.10U	3.3
Calcium	NE	NA	NA	500	310	34000
Chromium	64	NA	NA	8.2	10	33
Cobalt	10,000	NA	NA	3.8	1.7	7.5
Copper	7,600	NA	NA	4.2U	4.7U	480
Iron	10,000	NA	NA	5,400	5,500	53,000
Lead	75	NA	NA	3.5	3.8	2500
Magnesium	NE	NA	NA	640	260	3,100
Manganese	3,200	NA	NA	20	4.6	740
Mercury, total	61	NA	NA	0.06U	0.60U	0.29
Nickel	4,100	NA	NA	4.7	2.8	37
Potassium	NE	NA	NA	490	280	1,300
Sodium	NE	NA	NA	660	620	1,400
Vanadium	1,400	NA	NA	11	10.0	17
Zinc	10,000	NA	NA	21	17	1,900

NOTES:

mg/kg	milligrams per kilogram
NA	Not analyzed
NE	Not established.
MW	Monitoring well.
TW	Temporary well.
1	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Industrial Soil PRGs, November 22, 2000.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.

Shading indicates a value equal to or greater than the EPA Region IX regulatory value indicated for that analyte.

SB-12S and SB-12I were collected immediately above the water table at monitoring wells MW-12S and MW-12I, respectively. These subsurface soil samples were originally named MW-12S and MW-12I in the third Data Evaluation Report (Black & Veatch, 2002)

SB-14, SB-15 and SB-16 were collected immediately above the water table at temporaray wells TW-14, TW-15, and TW-16, respectively. These subsurface soil samples were originally named TW-14, TW-15 and TW-16 in the third Data Evaluation Report (Black & Veatch, 2002) monitoring well TW-16, located near the Alabama River at the northwest portion of the site. The Alabama River is located within 2,000 feet west of the site, with banks approximately 100 feet above mean sea level (USGS, 1981). Surface soils in the area are of the Amite-Cahaba soil series, which typically are level to sloping well drained soils consisting primarily of silty and sandy clay loam (USDA, 1960).

4.2.1.3 Regional Geology. Geologic formations beneath the area are comprised of approximately 810 to 880 feet of Upper Cretaceous and younger sedimentary deposits resting on a pre-Cretaceous crystalline rock basement complex(USGS, 1981; USGS 1963). The crystalline basement rocks, comprised primarily of schist, gneiss, granite, quartzite and marble, slope (down) southeastward at approximately 60 to 100 feet per mile (or approximately one foot for every 53 to 88 linear feet) (USGS, 1963). A nonconformity exists between pre-Cretaceous basement rocks and overlying Upper Cretaceous age deposits (USGS, 1963).

In the Montgomery area, geological formations that rest on pre-Cretaceous basement rocks are, in descending order: Terrace deposits, the Eutaw formation, Gordo formation, and Coker formation (USGS, 1963).

Terrace deposits in the area are Quaternary in age and typically consist of pale yellowish-orange medium to coarse grained ferruginous quartzose sand, dark reddish-brown sandy clay, and lenses of well-rounded gravel, ranging in size from pebbles to cobbles, with pebble size being dominant (USGS, 1963). Terrace deposits are remnants of a series of former river channels from the ancestral Alabama River (USGS, 1963). These channels were successively abandoned as lower channels were formed, creating plains sloping downward toward the Alabama River (USGS, 1963). In Montgomery County, Terrace deposits rest unconformably on Upper Cretaceous deposits and range from 10 to 100 feet in thickness (USGS, 1963). These deposits are present at or near land surface in a belt approximately 6 to 8 miles wide that roughly parallels the Alabama River (USGS, 1963). In the investigation area, Terrace deposits overlay sediments of the Eutaw formation (USGS, 1963).

The Eutaw formation is of Upper Cretaceous age and described as consisting of upper and lower zones of marine sands separated by marine clay (USGS, 1987). Sediments of the Eutaw formation are primarily greenish-gray unconsolidated micaceous, glauconitic, and fossiliferous sand interbedded with micaceous and glauconitic clay and sandy clay (USGS, 1963). Upper portions of the Eutaw formation also contain light gray to white thin (6 to 12 inch thick) beds of calcareous-cemented quartzose sandstone that is also galuconitic and fossiliferous (USGS, 1963). The thickness of the Eutaw formation may be up to 400 feet in some areas and crops out in the City of Montgomery (USGS, 1963). In Montgomery County, the Eutaw formation lies unconformably on the Gordo formation and dips southward at approximately 40 to 65 feet per mile (or one foot of dip for every 81 to 132 linear feet) (USGS, 1963).

The Gordo formation is also Upper Cretaceous in age and primarily consists of yellowish-orange ferruginous quartzose sand interbedded with reddish-brown to pale reddish-purple sandy clay (USGS, 1963). Beds consisting primarily of clay are present in the upper and lower portions of the formation (USGS, 1963). Beds consisting primarily of sand separate these clay beds. These sandy portions of the Gordo formation are typically 40 to 100 feet in thickness (USGS, 1963). The total thickness of the Gordo formation is approximately 200 feet in the study area (CH2M Hill, 1997). In the Montgomery area, the base of the Gordo formation consists of a thin bed of quartz gravel (USGS, 1963), and the top of the Gordo formation ranges from approximately 30 to 400 feet below land surface (USGS, 1963; USGS, 1981). The Gordo formation rests unconformably upon the Coker formation (USGS, 1963).

The Coker formation is of Upper Cretaceous age and comprised of poorly consolidated beds of clay, sand, and gravel (USGS, 1963). The Coker formation generally ranges from 360 to 600 feet in thickness in the area (USGS, 1963). The upper 300 to 400 feet of the formation is typically a light greenish-gray glauconitic micaceous quartzose sand thinly laminated with greenish-gray micaceous clay (USGS, 1963). The upper portion of this formation is also fossiliferous and contains lignite and hard calcareous sandstone (USGS, 1963). The lower portion of the formation (the lower 150 feet) consists of arkosic sand (pale yellowish-orange) interbedded with reddish-brown, pale red-purple, or pale green sandy clay (USGS, 1963). The Coker formation rests upon the pre-Cretaceous crystalline rocks (USGS, 1963). The Coker formation and the overlying Gordo formation constitute the Tuscaloosa Group (USGS, 1987).

Locally, the geology is typical of the surrounding area with Terrace deposits resting on Upper Cretaceous age sedimentary deposits (the Eutaw formation, Gordo formation, and Coker formation) which, in turn, are on pre-Cretaceous crystalline rocks (CH2M Hill, 1997; USGS, 1963). Table 4-7 summarizes geological and hydrogeological units.

According to a nearby boring log (located approximately 1,200 feet northwest from the suspected source area), Terrace deposit thickness is approximately 67 feet, consisting of about 22 feet of sandy clay on 45 feet of medium to very coarse rounded quartzose sand and rounded pebble sized gravel deposits (CH2M HILL, 1997). Geotechnical testing reflects similar lithologic descriptions at an adjacent (west) property; however, an onsite driller's log (for MW4) suggests a local clay and silt layer from approximately 35 to at least 50 feet bls (CTE, 1992; ADEM, 1995).

The Eutaw formation in the study area is significantly thinner than in some other areas in the Montgomery area; likely the result of erosion by the ancestral Alabama River (CH2M HILL, 1997; USGS, 1963). As a result, the upper sandy zone and clay zone of the Eutaw formation are not present (USGS, 1987). In the study area, the Eutaw formation is comprised of approximately 65 feet of deposits, consisting primarily of sand (CH2M HILL, 1997).

The Eutaw formation is on approximately 37 feet of sandy clay that constitutes the upper portion of the Gordo formation (CH2M HILL, 1997; USGS, 1993). The remainder of the Gordo formation is comprised of approximately 165 feet of deposits consisting, primarily of sands (CH2M HILL, 1997). The Gordo formation is on approximately 37 feet of sandy clay, which constitutes the upper portion of the Coker formation (CH2M HILL, 1997). Beneath this sandy clay are two permeable portions of the Coker formations, both comprised primarily of sand. The upper sand zone is approximately 160 feet thick in the study area and is on a clay layer that is approximately 32 feet thick (CH2M HILL, 1997). The thickness of the lower sandy zone is undetermined beneath the study area because available boring logs did not penetrate the full thickness of the Coker formation (CH2M HILL, 1997).

4.2.1.4 Site-Specific Hydrogeology. Locally, three commonly used aquifers are beneath the study area: the Eutaw (shallow) aquifer, the Gordo aquifer, and the Coker aquifer

Table 4-7
Generalized Summary of Hydrogeologic Units for the Area Around Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Location		Hydrogeologic Unit	Stratum	Top of Stratum Depth (in feet)	(Bottom of Stratum) Cumulative Depth (in feet)	Reference(s)
At the suspected source area and the surrounding area.	Quaternary Age Deposits	Shallow aquifer	Surficial Deposits: Augsta Series Soils, Cahaba Series Soils, and Terrace Escarpment Soils.	0	> 8'*	USDA, 1960, General Soil Map, Sheet 11, Soil Legend, pp. 45, 49, 74.
Onsite Monitoring Well Boring MW4***		Conf. zone	Terrace Deposits: ~22' of sandy clay resting upon ~45' of pebble size gravel** < Local Confining Zone (MW4)***	~8'*	~67'	ADEM 1995 (Well #4)
Nearby Municipal Well Boring**	Upper Cretaceous Age Deposits	Shallow aquifer	Eutaw formation ~65 feet consisting primarily of sand	~67'	~132'	CH2M HILL p. 2-1, Figure 2-1, Figure 2-4, Table 2-2, Well #8.
		Conf. zone	Gordo formation Upper Portion ~37' consisting primarily of sandy clay	~132'	~169'*	
		Gordo aquifer	Gordo formation Lower Portion ~165' consisting primarily of sand	~169'	~334'	
		Conf. zone	Coker formation Upper Portion ~37' consisting primarily of sandy clay.	~334'	~371'	
		Coker aquifer	Coker formation Upper Sandy Zone ~160' consisting primarily of sand	~371'	~531'	
		Conf. zone	Coker formation Clay Layer ~32' consisting primarily of clay	~531'	~563'	
		Coker aquifer	Coker formation Lower Sand Zone >160 feet consisting primarily of sand	~563'	>723'	
	pre-Cretaceous Rocks	■	Basement rock complex.	Undetermined		

* Soil survey information does not describe any of these soils below a depth of 8 feet; however, some soils may be greater than 8 feet.

** Data is from Municipal well #8 that is approximately 1,200 feet northwest of the site.

*** A Clay and Silt zone is present locally in suspected source area (> 15 feet thick).

ft - feet	ft^2 - square feet
cm - centimeters	d - day
s - second	~ - approximately
Conf. - Confining	

⁘	deposits consisting primarily of sand, utilized as water supply aquifer
▤	deposits consisting largely of clay and sandy clay.
■	crystalline rocks (not considered a major aquifer in the study area).

Hydrogeologic Units are not illustrated to scale.

(USGS, 1987). Each aquifer is used for municipal water supplies in the Montgomery area (USGS, 1987). Figure 4-1 is a generalized geologic map and Figure 4-2 is a generalized diagram illustrating hydrogeologic units beneath the study area.

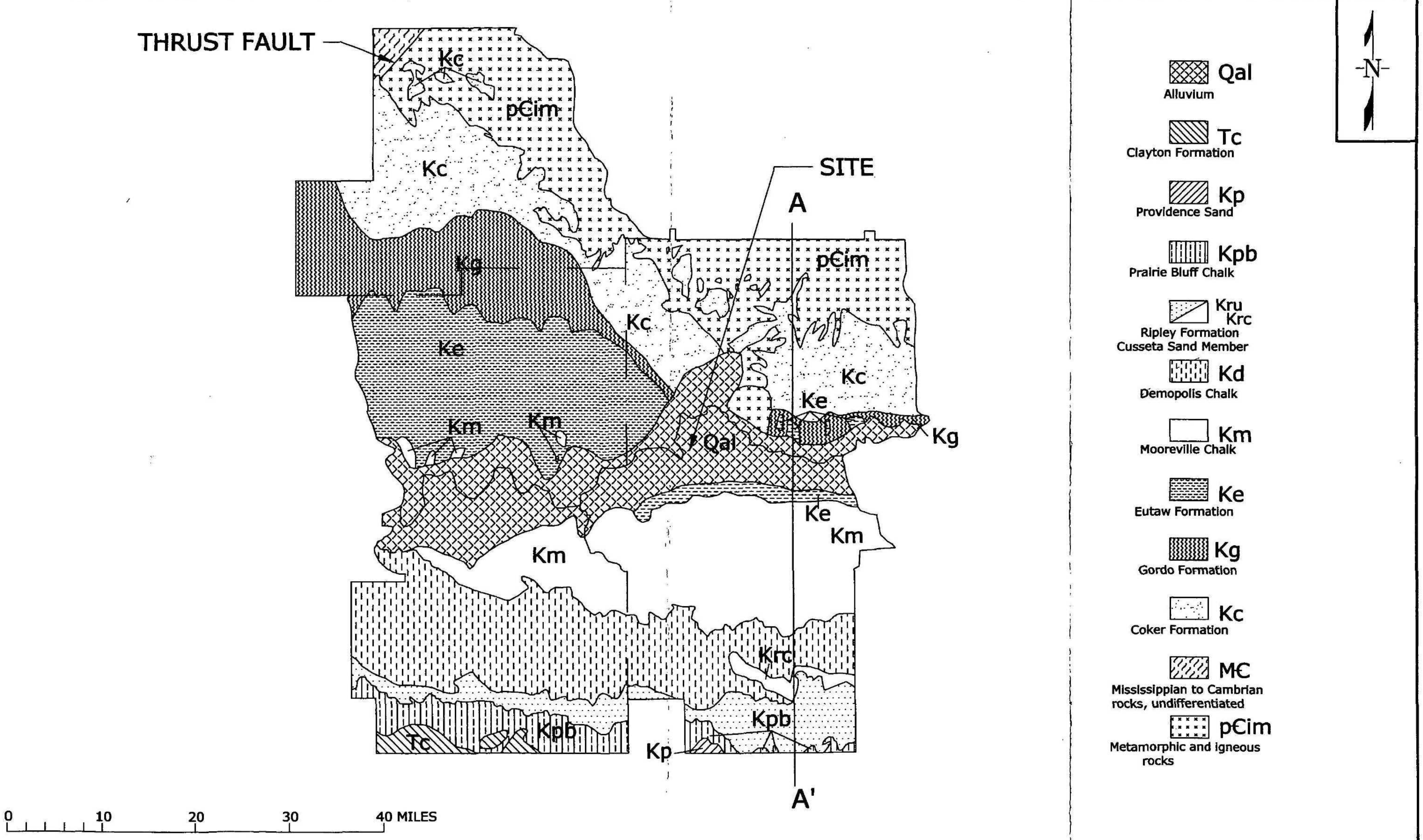
Terrace deposits combined with the lower sandy zone of the Eutaw formation comprise the Eutaw aquifer or shallow aquifer (CH2M HILL, 1997). Groundwater in the study area is typically encountered from approximately 30 to 45 feet bls in the shallow aquifer (CTE, 1992; CH2M HILL, 1997). The shallow aquifer exists under both unconfined and confined conditions in the Montgomery area (CTE, 1992; CH2M HILL, 1997). Available information does not indicate whether the shallow aquifer is confined in the study area; however, boring logs from an adjacent property indicate the Eutaw aquifer is unconfined (CTE, 1992; CH2M HILL, 1997). A boring (MW4) indicates a localized silt and clay low permeability zone may exist from approximately 35 to at least 50 feet BLS (ADEM, 1995). The saturated thickness of the shallow aquifer beneath the study area is expected to be approximately 90 to 100 feet, with the local groundwater flow westward toward Jones Bluff Lake (CH2M Hill, 1997; CTE, 1992; USGS, 1987). A groundwater divide within the shallow aquifer may be present on the north, east, and south sides of the study area (CH2M HILL, 1997). This divide, if present, is believed to reflect topographic highs. It has not been determined whether the divide is based on measured groundwater levels (CH2M HILL, 1997). Pumping of the shallow aquifer has created a cone of depression west of the study area; however, this does not appear to influence groundwater flow in the shallow aquifer near the study area (USGS, 1987; CH2M HILL, 1997). Aquifer tests conducted on the Eutaw aquifer in the Montgomery West Well field indicate an average transmissivity of 28,000 gallons per day per foot; however, calculations for wells in the Montgomery North Well field (9E and 9W) indicate lower transmissivity values of 11,700 gallons per day per foot (USGS, 1963; CH2M HILL, 1997).

Information pertaining to hydrogeological unit thicknesses below the Eutaw aquifer were interpolated from City Well #8, which is approximately 1,200 feet northwest of the suspected source area (CH2M HILL, 1997). The approximate 37-foot thick sandy clay layer at the top of the Gordo formation forms a low permeability unit that separates the shallow aquifer from the Gordo aquifer. The permeable portions of the Gordo formation are approximately 165 feet thick beneath the study area forming the Gordo aquifer (CH2M HILL, 1997). Groundwater flow in the

MOST REVISION
REVISION DATE: 9-23-99
DRAFTERS INITIALS: ARW

ORIGINAL DWG SIZE
11 x 17
FILE: 48011.0100

CAD DWG NO: FIG2-1
DATE: 9-23-99
PLOT SCALE: 1"=40'



MODIFIED FROM USGS WRI REPORT 86–4360

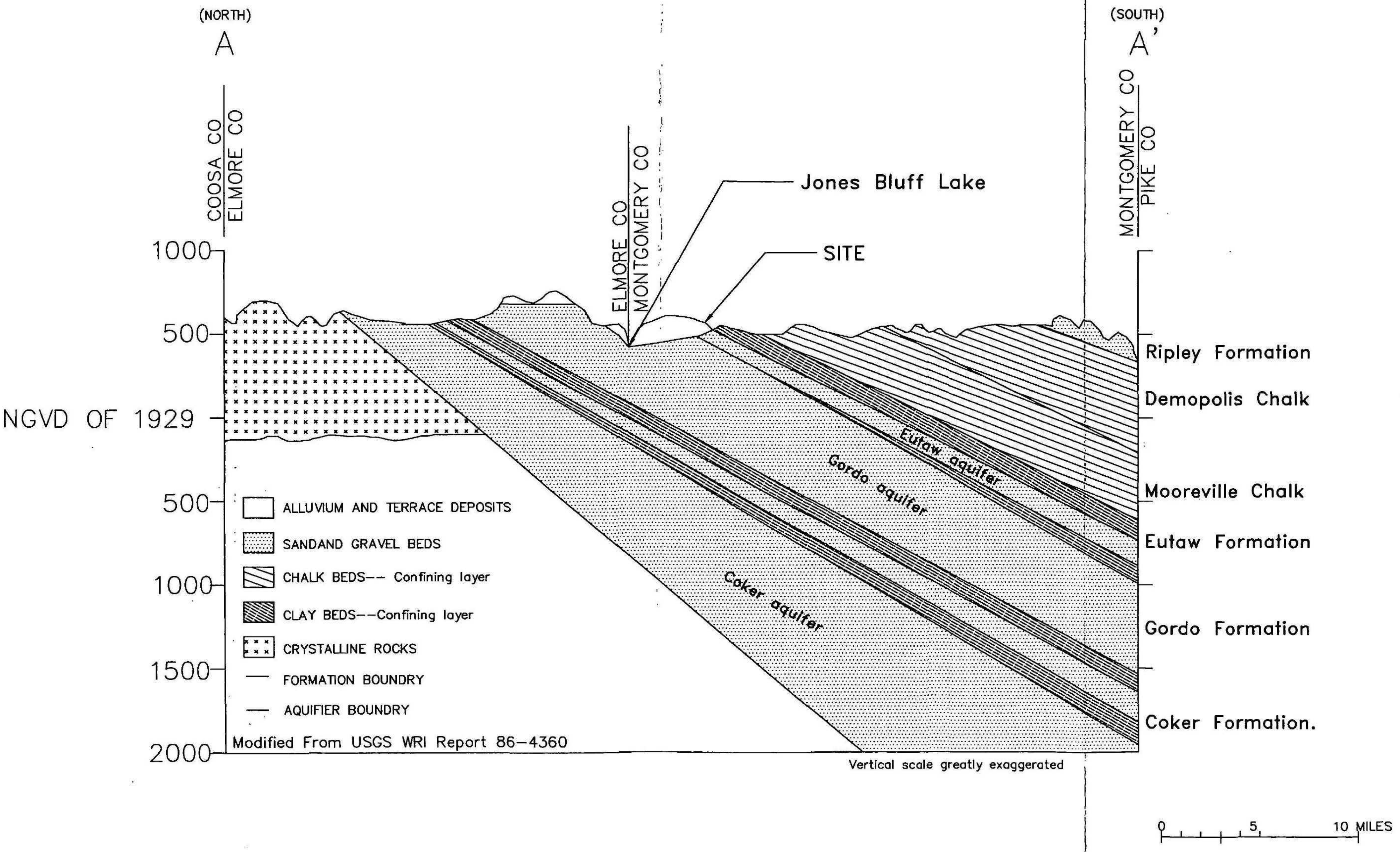
GENERALIZED GEOLOGIC MAP OF THE STUDY AREA

FIGURE
4–1

CAD DWG NO: FIG2-2
DATE: 9-23-99
PLOT SCALE: 1"=5MILES

ORIGINAL DWG SIZE
11 x 17
FILE: 48011.0100

MOST [illegible] REVISION
REVISION DATE: 9-23-99
DRAFTERS INITIALS: ARW



APPROXIMATE LOCATION OF THE CAPITOL CITY PLUME SITE IN RELATION TO GENERALIZED HYDROGEOLOGICAL UNITS

FIGURE
4-2

Gordo aquifer is northwest (CH2M HILL, 1997). Local pumping of the Gordo aquifer has created a cone of depression in both the western and northern well field areas (USGS, 1987).

The Gordo aquifer is on an approximately 37-foot thick sandy clay layer that separates the Gordo aquifer from the permeable portions of the Coker formation (CH2M HILL, 1997). Two permeable portions of the Coker formations comprise the Coker aquifer. These are separated by a clay-confining layer, which is approximately 30 feet thick in area (CH2M HILL, 1997). The upper permeable layer is approximately 160 feet thick; the lower unit thickness beneath the study area is undetermined because available boring logs did not penetrate its full thickness (CH2M HILL, 1997). Regionally, groundwater flow in the Coker aquifer is southeast (USGS, 1987). Groundwater flow in the Coker aquifer appears to be southerly in the Montgomery area, with a possible slight eastern component (CH2M HILL, 1997).

Site-specific geologic and hydrogeologic information was obtained during completion of groundwater monitoring wells as described in Subsection 3.5. Appendix C presents boring logs that include detailed descriptions of subsurface materials encountered during drilling activities. Materials encountered from the surface to total depth in onsite borings include sand, sandy silt, silty sand, silt, silty clay, and clay. Appendix D presents geotechnical sample analysis results; Figure 4-3 presents a map view of site geologic cross sections; and Figures 4-4 and 4-5 illustrate a cross section of subsurface site geology.

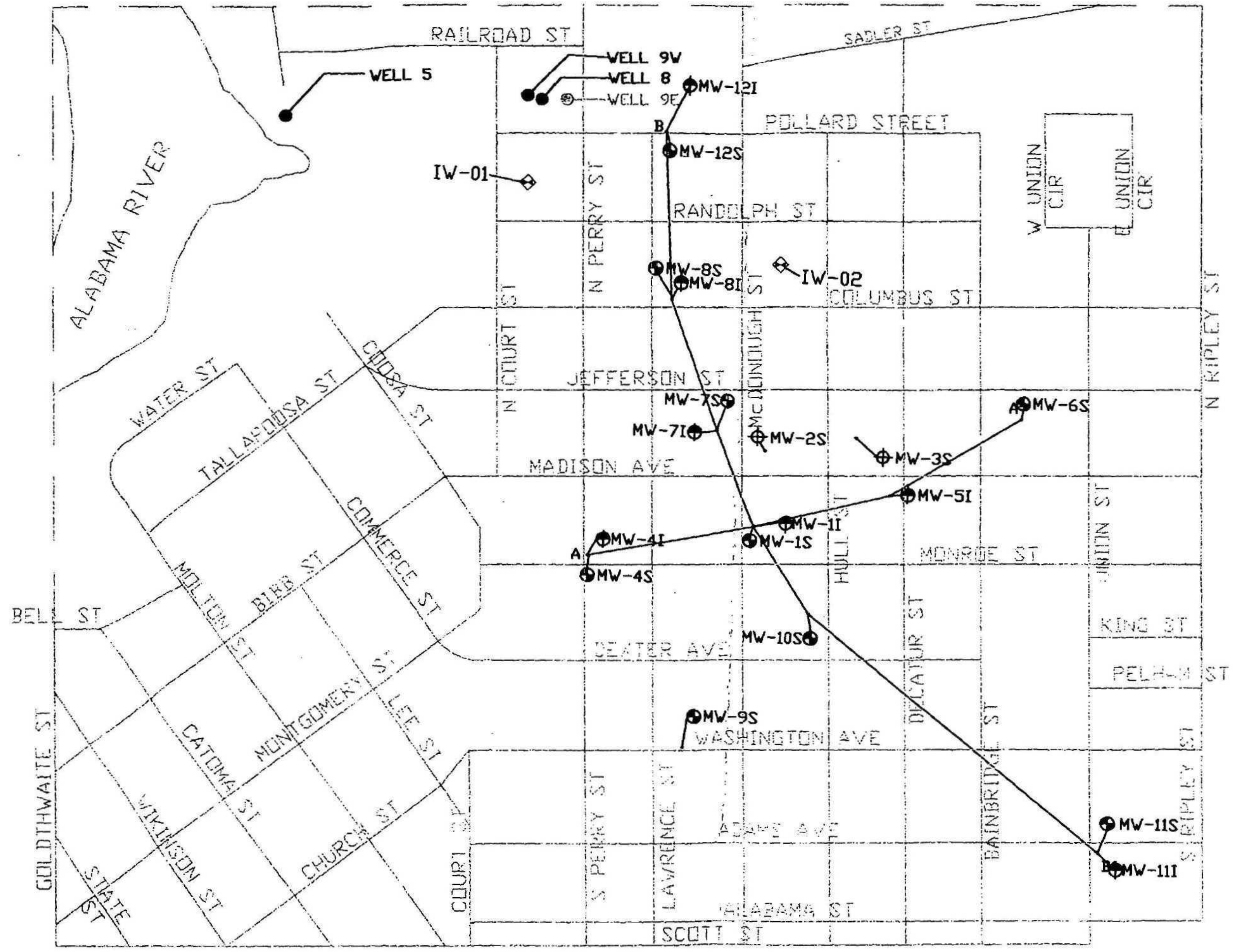
In general, three zones of lithofacies were identified beneath the Capitol City Plume site. These include, in descending order, a surficial layer consisting primarily of silty or clayey sand; an intermediate zone consisting of sand and trace gravel; and a deep zone of clay, silt, and clayey sand with an undetermined local thickness. The vertical limit of site-specific lithology is approximately 247 feet bls at MW11I.

The upper zone encountered varied in sand, silty sand, and clayey sand layers, ranging from approximately 13 to 44 feet bls at locations MW-08I and MW-05I. This zone was encountered in all borings, except for TW-16 beside the railroad tracks where fill consisting of slag, glass, metal, and pottery chips was encountered until approximately 35 feet bls.

CAD DWG NO: RI_BASEMAP
DATE: 08-24-99 ARW
PLOT SCALE: 1:1056

ORIGINAL DWG SIZE
11 x 17
LOCATION: R:\48011\109\CAD

MOST REVISION
REVISION DATE: 08-20-02
DRAFTERS INITIALS: ACM



600 FEET 0 600 FEET

LEGEND

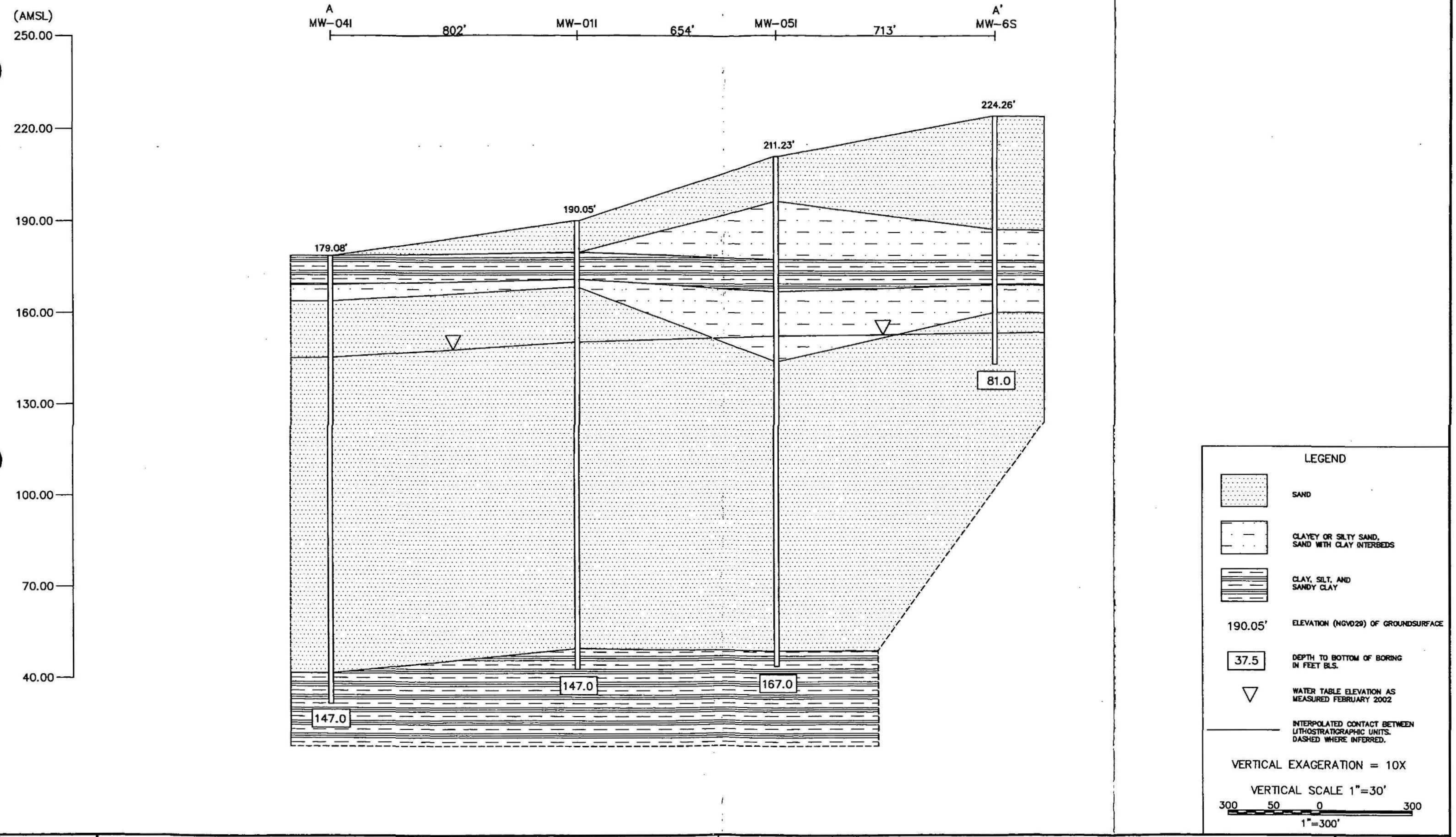
- ● PUBLIC WATER SUPPLY WELL
- ⊕ INTERMEDIATE MONITORING WELL
- ● SHALLOW MONITORING WELL
- ⊕ ADEM MONITORING WELL
- ◇ INDUSTRIAL WELL
- A—A' GEOLOGIC CROSS-SECTION

SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

GEOLOGIC CROSS-SECTION MAP

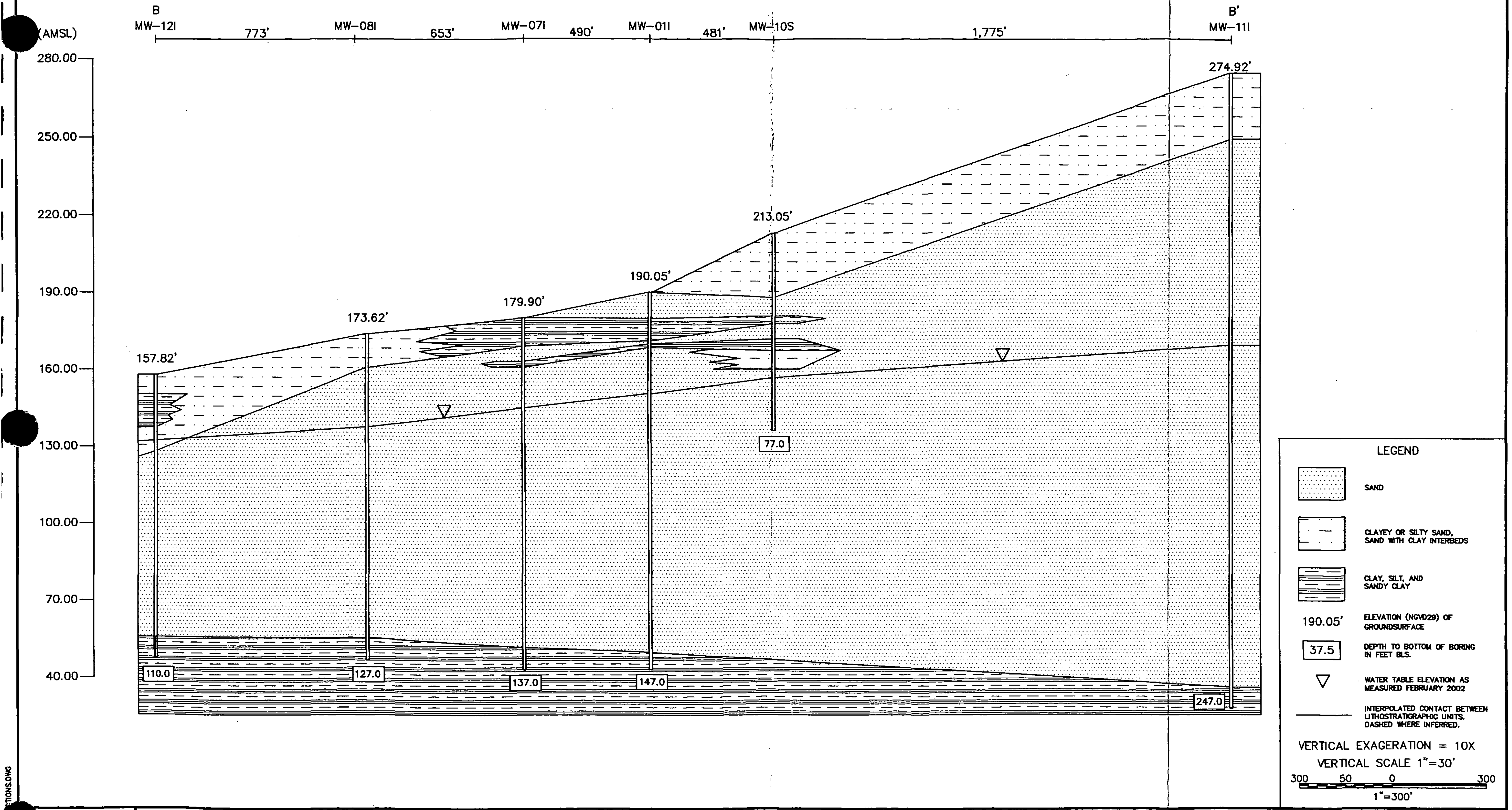
FIGURE
4-3



CAPITOL CITY PLUME SITE
MONTGOMERY, ALABAMA

GEOLOGIC CROSS SECTION A-A'

FIGURE 4-4



CAPITOL CITY PLUME SITE
MONTGOMERY, ALABAMA

GEOLOGIC CROSS SECTION B-B'

FIGURE 4-5

The unit underlying the surficial silty- to clayey sand layer consists of medium- to coarse-grained sand and trace pebble-sized gravel. This unit varies in thickness across the site. The boring log for monitoring well MW-12I indicates this intermediate sand layer has a thickness of approximately 60 feet, and the boring log for monitoring well MW-11I indicates its thickness is approximately 180 feet.

The deep unit of clay, silt, and clayey sand underlying the intermediate sand layer has not been penetrated more than 12 feet. Information from other investigations in the area suggest this clay layer ranges from approximately 40 to 46 feet in thickness (CH2M HILL, 1997).

Site-specific hydrogeologic information was obtained after completion of permanent groundwater monitoring wells during the Phase I and Phase III RI field efforts. All monitoring wells were completed within the surficial aquifer. Table 4-8 presents monitoring well construction details and the surveyed coordinates; Figures 3-1 and 3-2 present monitoring well locations.

During monitoring well installation, depth to groundwater ranged from approximately 25 to 127 feet bls at each well at the Capitol City Plume site. Surface topography is the most prominent feature controlling local groundwater flow direction in the surficial aquifer. Table 4-9 presents a set of water table elevations measured at permanent monitoring wells during a 24-hour period, ending on February 16, 2002. Using this data, groundwater within the surficial aquifer was estimated to flow to the northwest in both the shallow and deep zones of the surficial aquifer, as illustrated on Figures 4-4 and 4-5. On February 15, 2002, the estimated hydraulic gradient for the shallow wells at the Capitol City Plume site were measured in a range from 1.4×10^{-2} to 8.3×10^{-3} feet of hydraulic head per foot distance. The estimated hydraulic gradient for deep wells at the Capitol City Plume Site (as measured February 15, 2002) ranges from 1.3×10^{-2} to 7.9×10^{-3} feet of hydraulic head per foot distance. Groundwater elevations indicate that hydrostatic pressure in surficial and intermediate wells of each well cluster were generally the same, with the exception of MW-01S and MW-01I, MW-12S and MW-12I, and MW-04S and MW-04I. Monitoring well cluster MW-01S and MW-01I showed a downward-flowing vertical groundwater gradient of approximately 0.67 feet, and wells MW-12S and MW-12I showed a upward-flowing vertical gradient of approximately 0.34 foot. Monitoring well cluster MW-04S and MW-04I had the largest gradient of approximately 1.52 feet and was downward-flowing.

Table 4-8
Construction Details for Monitoring Wells
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Monitoring Well	Installation Date	Well Casing Diameter (inches)	Northing (Y) (feet)	Easting (X) (feet)	Total Depth of Well (feet bls)*	Sandpack Interval (feet bls)*	Screened Interval (feet bls)*	Elevation Top of Casing (feet amsl)	Height of Casing Above Pad (feet)
MW-01S	4/16/2000	2	683943.95	510596.75	51.96	19-57	11.27-21	189.37	-0.25
MW-01I	4/16/2000	2	683944.63	510601.89	141.76	128-147	130-139.71	190	-0.05
MW-02S	11/29/1993	2	684303.83	510637.81	59.87	37-60**	40-60**	188.59	0.06
MW-03S	11/30/1993	2	684381.71	511066.14	59.32	37-60**	40-60**	206.18	-0.31
MW-04S	3/18/2000	2	683780.11	509822.92	38.75	25-40	27-36.7	178.72	-0.34
MW-04I	3/18/2000	2	683783.23	509815.87	136.96	121.85-138	125.22-134.92	178.9	-0.18
MW-05I	4/4/2000	2	684113.92	511233.31	159.37	143.6-167	147.6-157.32	210.98	-0.25
MW-06S	3/18/2000	2	684495.16	511836.27	79.76	66-81	68-77.72	224.26	-0.33
MW-07S	3/16/2000	2	684401.46	510402.04	96.71	82.96-97	84.96-94.67	179.65	-0.26
MW-07I	4/2/2000	2	684392.88	510402.76	128.85	113.85-130	117.11-126.81	179.76	-0.14
MW-08S	4/18/2000	2	685008.22	510169.10	51.77	37-53	40-49.71	173.46	-0.23
MW-08I	4/18/2000	2	685003.15	510168.99	119.73	106-127	108-117.7	173.42	-0.2
MW-09S	4/14/2000	2	682890.15	510287.11	71.76	57-73	60-69.71	213.41	-0.29
MW-10S	4/10/2000	2	683543.56	510867.66	71.91	58-77	60.16-69.87	212.67	-0.38
MW-11S	3/8/2000	2	682464.39	512268.98	128.49	114-129	116.71-126.44	274.92	-0.25
MW-11I	4/13/2000	2	682455.68	512269.61	239.76	226-247	228-237.72	274.74	-0.18
MW-12S	2/7/2002	2	685782.50	510116.69	41.88	22.8-43.2	29.37-38.95	157.58	-0.12
MW-12I	2/12/2002	2	685786.15	510111.71	104.69	84.5-110	92.18-101.85	157.82	-0.15

NOTES:

Monitoring wells MW-02 and MW-03 were installed by another contractor during a previous investigation.

bls below land surface

amsl above mean sea level

* Measurements for bls are based on ground surface datum used upon installation of monitoring well.

** Measurements approximated from well diagrams generated during a previous investigation.

Table 4-9
Water Table Elevations as Measured February 2002
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Monitoring Well	Elevation Top of Casing (feet NGVD29)	Elevation of Well Pad (feet NGVD29)	Water Table Elevation as Measured 5/12/2000	Water Table Elevation as Measured 1/17/2001	Water Table Elevation as Measured 2/16/2002	Depth to Water (feet btoc) 2/16/2002	Water Level (feet bls) 2/16/2002
MW-01S	189.37	189.62	152.12	150.41	151.09	38.28	38.53
MW-01I	190.00	190.05	151.56	150.19	150.42	39.58	39.63
MW-02S	188.59	188.53	149.35	147.57	147.81	40.78	40.72
MW-03S	206.18	206.49	151.20	149.43	149.68	56.50	56.81
MW-04S	178.72	179.06	148.59	147.07	147.02	31.70	32.04
MW-04I	178.9	179.08	147.32	146.14	145.50	33.40	33.58
MW-05I	210.98	211.23	153.79	152.39	152.48	58.50	58.75
MW-06S	224.26	224.59	155.47	153.80	153.46	70.80	71.13
MW-07S	179.65	179.91	145.53	144.22	144.65	35.00	35.26
MW-07I	179.76	179.90	145.75	144.21	144.76	35.00	35.14
MW-08S	173.46	173.69	137.27	136.21	137.20	36.26	36.49
MW-08I	173.42	173.62	137.33	136.27	137.15	36.27	36.47
MW-09S	213.41	213.70	160.42	159.29	159.17	54.24	54.53
MW-10S	212.67	213.05	157.65	156.49	156.33	56.34	56.72
MW-11S	274.92	275.17	171.23	169.70	169.12	105.80	106.05
MW-11I	274.74	274.92	171.45	169.45	169.26	105.48	105.66
MW-12S	157.58	157.70	NA	NA	131.98	25.60	25.72
MW-12I	157.82	157.97	NA	NA	132.32	25.50	25.65

NOTES:

Monitoring wells MW-02 and MW-03 were instaled by another contractor during a previous investigation.

N/A	Not Applicable due to well installation at a later date.
bls	below land surface
btoc	below top of well casing
NGVD29	National Geodetic Vertical Datum of 1929.

Slug tests were performed in monitoring wells installed during the Phase I RI, as well as in monitoring wells TW-12I and TW-12S during the Phase III RI. Rising and falling head tests were conducted in each well. Rising head test data are preferred when calculating hydraulic conductivity from slug tests because when introducing the slug into the monitoring well for a falling head test, the risk of excessive splash and disturbing the transducer cables increases significantly. Rising head tests also allow a fairly instantaneous removal of a known volume from the monitoring well. Except for MW-1I, MW-7S, MW-7I, and MW-11S, in which falling head tests were used, data from rising head tests were used to calculate hydraulic conductivities at the Capitol City Plume site. Upon completion of the field effort, data acquired during slug testing were downloaded into Aqtesolv to estimate hydraulic conductivity (K) of the screened strata and prepare slug test plots. Hydraulic conductivities indicate sediments in which intermediate wells are screened are, in general, much less permeable than sediment in which shallow wells are screened. Therefore, the geometric mean of hydraulic conductivity was calculated twice: once for the wells screened within the upper portion of the surficial aquifer, and a second time for the wells screened at lower depths. These calculations were completed to characterize flow within both portions of the aquifer because the two zones differ in types of sediment encountered and estimated hydraulic conductivities. The surficial layer consists primarily of silty or clayey sand, and the intermediate zone consists primarily of sand and trace gravel. The geometric mean of the hydraulic conductivity estimated for monitoring wells screened within the upper portion of the surficial aquifer at Capitol City Plume site is 4.45×10^{-3} ft/min. The geometric mean of the hydraulic conductivity estimated for the monitoring wells screened within the lower portion of the surficial aquifer is 2.48×10^{-3} ft/min. Table 4-10 presents hydraulic conductivities estimated from slug tests.

The estimated average horizontal flow velocity for the upper portion of the surficial aquifer is 95 feet/year, while deeper within the aquifer, the estimated average flow velocity is 91.6 feet/year. Table 4-11 presents a summary of calculations of the average horizontal flow velocity for both upper and deeper portions of the surficial aquifer, as well as calculations for minimum and maximum anticipated horizontal flow velocities.

Velocities were calculated based on the hydraulic conductivity values found in Table 4-10, calculated minimum and maximum hydraulic gradients based on flow data on Figures 4-6 and 4-7, and assumed effective porosities for the silty sand and clayey sand surficial aquifer sediments of 25

Table 4-10
Slug Test Results
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Monitoring Well	Depth of Well (feet bls)*	Screened Interval (feet bls)*	Depth to Water[(1)] (feet btoc)	Hydraulic Conductivity[(2)] (ft/min)	Hydraulic Conductivity (cm/s)
CC-MW-1S	51.96	40.69-50.42	37.25	8.35E-03	4.24E-03
CC-MW-1I	141.76	130.00-139.71	38.44	3.01E-03	1.53E-03
CC-MW-4S	38.75	27.00-36.70	30.13	3.12E-03	1.59E-03
CC-MW-4I	136.96	125.22-134.92	31.58	8.09E-04	4.11E-04
CC-MW-5I	159.37	147.60-157.32	57.19	6.14E-03	3.12E-03
CC-MW-6S	79.76	68.00-77.72	68.29	4.81E-03	2.44E-03
CC-MW-7S	96.71	84.96-94.67	34.12	8.17E-04	4.15E-04
CC-MW-7I	128.85	117.11-126.81	34.01	8.62E-03	4.38E-03
CC-MW-8S	51.77	40.00-49.71	36.19	6.56E-03	3.33E-03
CC-MW-8I	119.73	108.00-117.70	36.09	3.21E-03	1.63E-03
CC-MW-9S	71.76	60.00-69.71	52.99	1.60E-03	8.14E-04
CC-MW-10S	71.91	60.16-69.87	55.02	4.10E-03	2.08E-03
CC-MW-11S	128.49	116.71-126.33	103.69	2.16E-03	1.10E-03
CC-MW-11I	239.76	228.00-237.72	103.29	5.51E-04	2.80E-04
CC-MW-12S	41.88	29.37 - 38.95	25.6	7.23E-02	3.67E-02
CC-MW-12I	104.69	92.18 - 101.85	25.5	2.56E-03	1.30E-03

NOTES:

bls	below land surface
btoc	below top of well casing
ft/min	feet per minute
cm/s	centimeters per second
*	Measurements for bls are based on ground surface datum used upon installation of monitoring well for wells installed from March to May, 2000 as part of the RI/FS.
1	At the time of the slug test.
2	Slug test data analyzed using Bower, 1989; Bower and Rice, 1975. Cooper, Bredehoeft, Papadopulos (1967)

$$K_{gm} = \boxed{\frac{\exp(\ln k1+\ln k2+....\ln kn)}{n}}$$

where

kn = hydraulic conductivity value n.
ln = natural log.
n = number of hydraulic conductivity values being averaged.
exp = inverse natural log.

Table 4-11
Groundwater Velocity Calculation Summary
Capitol City Plume, Montgomery, Alabama

Hydraulic Conductivity (K)		Hydraulic Gradient (i)[1]		Assumed Effective Porosity (n)[2,3]	min/year	Calculated Horizontal Groundwater Velocity (V_h)[4]
Shallow Wells						
High	7.22×10^{-3}	High	1.38×10^{-2}	25 %	525,600	2094
Low	8.16×10^{-4}	Low	8.33×10^{-3}	25 %	525,600	14.29
g.m.	4.45×10^{-3}	Median	1.12×10^{-2}	25 %	525,600	104
Deep Wells						
High	8.62×10^{-3}	High	1.28×10^{-2}	25 %	525,600	231
Low	5.51×10^{-4}	Low	7.93×10^{-3}	25 %	525,600	9.1
g.m.	2.48×10^{-3}	Median	1.17×10^{-2}	25 %	525,600	61

Notes:

1. Estimated from water levels measured on February 15, 2002.
2. Value listed is a percentage.
3. Effective porosity has been assumed to be the lowest value in the range of total porosity per matrix in <u>Groundwater</u>, Freeze and Cheery, 1979. A significant underestimate or overestimate of "n" when the actual effective porosity is near 10 to 20% or less, will greatly effect the resulting V_h; however, if the effective porosity is higher, any underestimate or overestimate will be less significant to the resulting V_h.
4. Darcy's Equation: $V_h = Ki/n$

Where

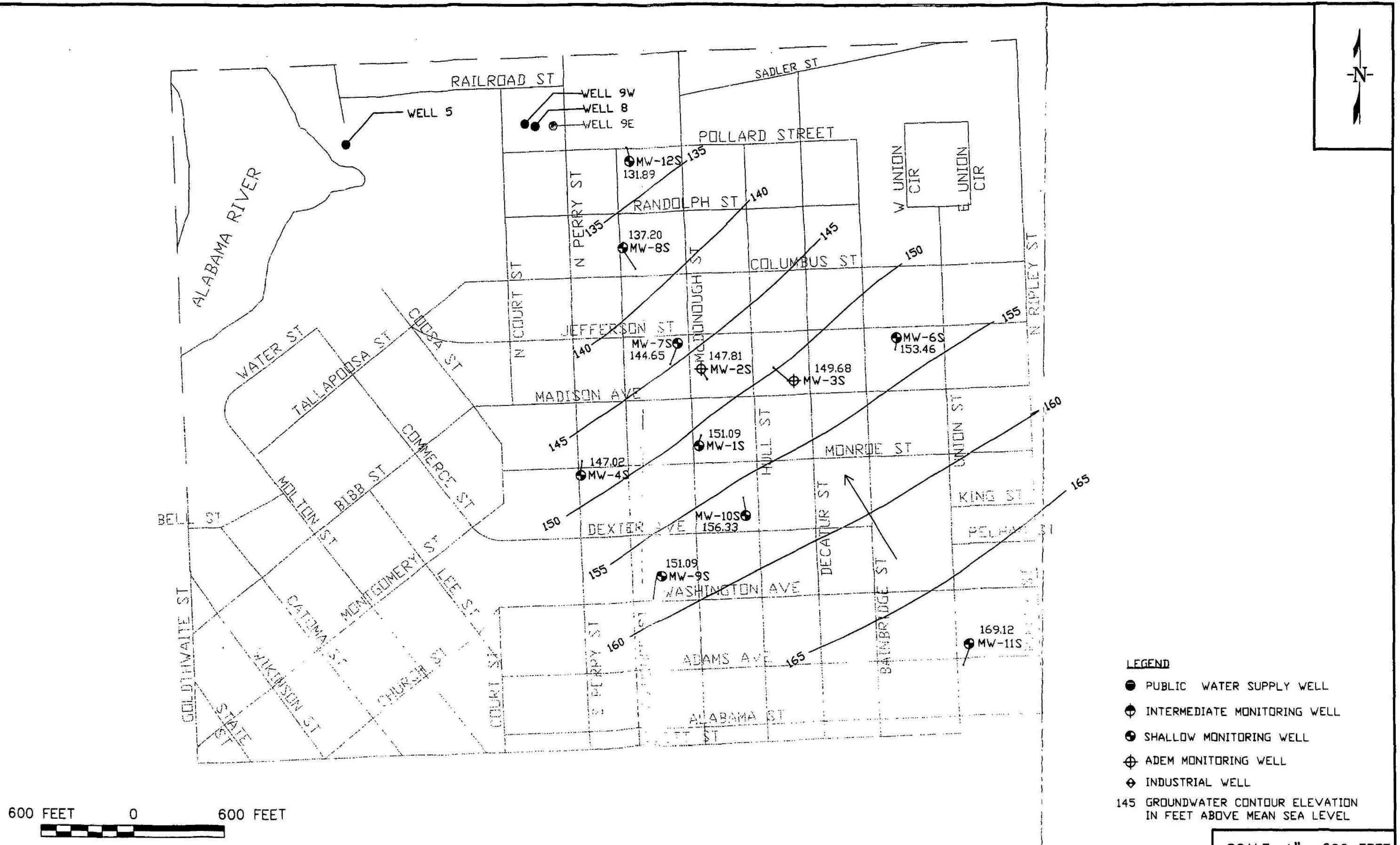
V_h = horizontal groundwater velocity, measured in foot/year
K = estimated hydraulic conductivity, measure in foot/minute
I = estimated hydraulic gradient, measured in feet/foot
N = assumed effective porosity of subsurface materials

g.m. geometric mean

CAD DWG NO: RI_BASEMAP
DATE: 09-24-99 ARW
PLOT SCALE: 1:1056

ORIGINAL DWG SIZE
11 x 17
LOCATION: R:\48011\109\CAD

MOST RECENT REVISION
REVISION DATE: 06-20-02
DRAFTERS INITIALS: ACM



LEGEND
- ● PUBLIC WATER SUPPLY WELL
- ⊕ INTERMEDIATE MONITORING WELL
- ● SHALLOW MONITORING WELL
- ⊕ ADEM MONITORING WELL
- ◈ INDUSTRIAL WELL
- 145 GROUNDWATER CONTOUR ELEVATION IN FEET ABOVE MEAN SEA LEVEL

SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

POTENTIOMETRIC SURFACE/SHALLOW WELLS
FEBRUARY 2002

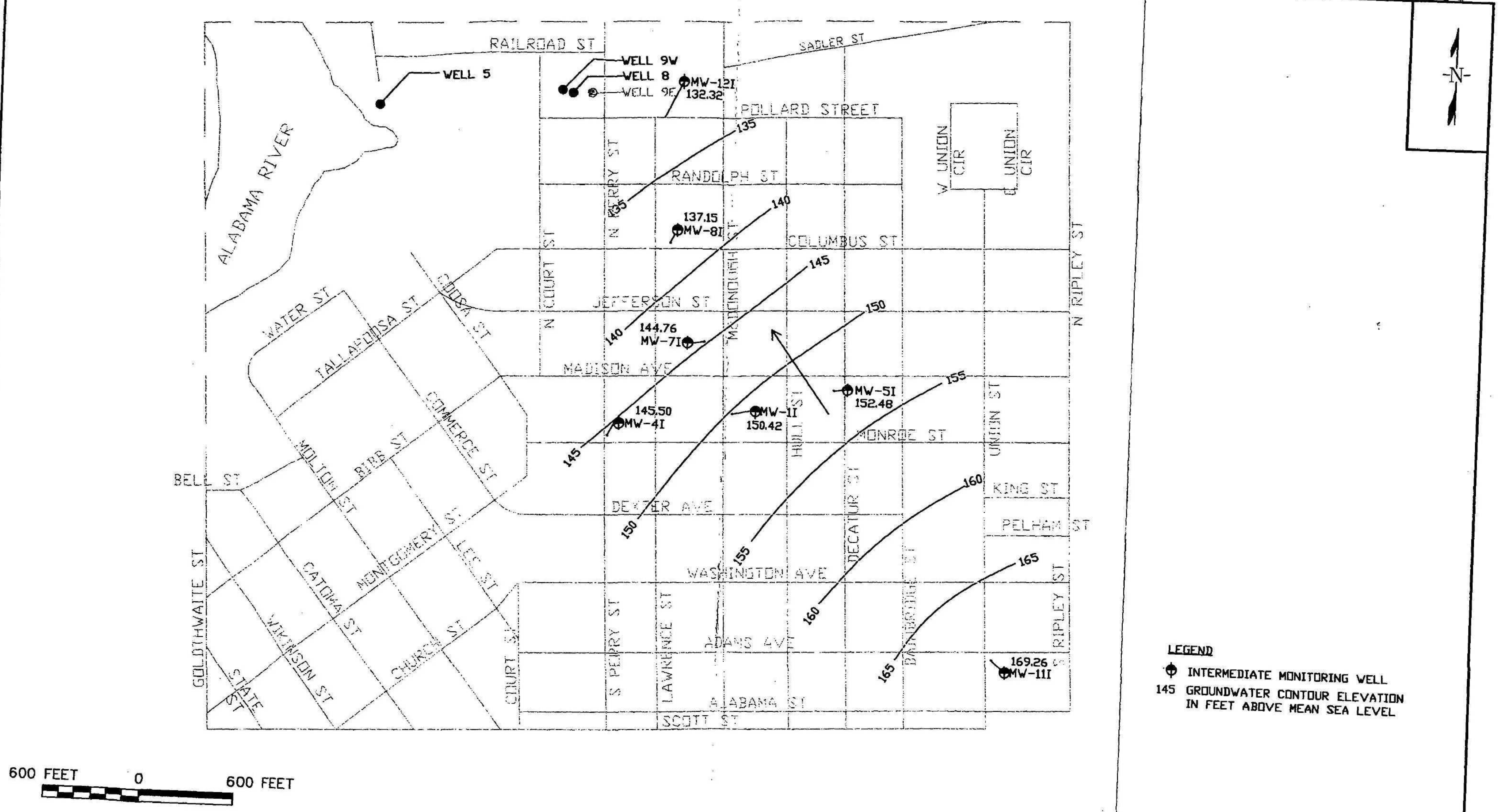
FIGURE
4-6

3 10 0058

MOST REVISION
REVISION DATE: 08-20-02
DRAFTERS INITIALS: ACM

ORIGINAL DWG SIZE
11 x 17
LOCATION: R:\48011\109\CAD

CAD DWG NO: RL_BASEMAP
DATE: 09-24-99 ARW
PLOT SCALE: 1:1056



SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

POTENTIOMETRIC SURFACE/INTERMEDIATE WELLS
FEBRUARY 2002

FIGURE
4-7

percent (Freeze and Cherry, 1979). Table 4-11 presents hydraulic conductivities estimated from slug tests; Appendix E presents slug test plots.

The estimated hydraulic conductivity was calculated based on the equation by Bouwer and Rice (1976), used in the Aqtesolv software:

$$Q = 2 \Pi K L \frac{y}{Ln\ (R_e / r_w)}$$

and

$$dy/dt = - \frac{Q}{\Pi r_c^2}$$

where

Q = *flow into well*
K = *hydraulic conductivity*
L = *intake length*
y = *drawdown in well*
R_e = *effective radius of the borehole*
r_w = *radius of borehole*
dy/dt = *rate of rise in well*
r_c = *radius of well casing.*

The horizontal groundwater velocity (V_h) was calculated using the following form of Darcy's equation:

$$V_h = Ki/n$$

where

K = ***estimated hydraulic conductivity***
i = ***estimated hydraulic gradient***
n = ***assumed effective porosity of subsurface materials.***

4.2.2 Groundwater Sampling Locations

A total of 14 permanent monitoring wells were installed and sampled during the Phase I RI. These wells, along with three City wells, were sampled to identify the boundaries of the groundwater plume. During the Phase II RI, temporary monitoring wells TW-01 through TW-13 were installed by DPT and sampled with a discreet sampler. During the Phase III RI, two permanent monitoring wells and three temporary wells were installed by hollow stem auger method. These five wells were sampled along with industrial wells IW-01 and IW-02. Previously installed monitoring wells MW-4S, MW-4I, MW-6S, and MW-11S were sampled for inorganic analysis only during the final sampling event. Table 3-1 presents sample codes, descriptions, locations, and rationale; Figures 3-1 and 3-2 illustrate temporary and permanent groundwater sample locations, respectively.

4.2.3 Groundwater Analytical Results

Inorganic and organic sample analyses of groundwater samples were performed under the CLP RAS. The CLP RAS parameter groups and accepted analytical methods include volatile organic compounds [Modified EPA Method 624 - groundwater; semivolatile organic compounds (Modified EPA Method 625)]; pesticides/PCBs (Modified EPA Method 608); metals (Modified EPA Method 200 series); and cyanide (Modified EPA Method 335.4) (EPA, 1999c; EPA,1999d). Several groundwater samples were also analyzed for natural attenuation properties, including non-CLP methods for ammonia [Methods of Chemical Analysis of Water and Waste (MCAWW) Method 350.1]; chloride (MCAWW Method 325.3); dissolved (DOC) and total organic carbon (TOC) (MCAWW Method 415.1); methane/ethane/ethene (SESD method); nitrate (MCAWW Method 352.1); sulfate (MCAWW Method 375.4); and total alkalinity (MCAWW Method 310.1) (EPA, 1983). In the 2002 sampling event, all groundwater samples, except for the industrial wells also were analyzed for dissolved metals (Modified EPA Method 335.4), cyanide (Modified EPA Method 335.4), and chromium speciation [SM 3500 Cr-D (EPA Prep. Method 3060A)] (EPA, 1999c).

Three volatile organic compounds were detected above MCLs and/or PRGs in all sampling events: benzene (2000: MW-11S; 2001: MW-11S, TW-05, TW-08, TW-09; 2002: MW-12I); chloroform (2000: MW-5I, MW-11I; 2001: MW-1S, MW-4S, MW-11S; 2002: MW-12I, TW-14, TW-15, TW-16); and tetrachloroethene (PCE) (2000: MW-2S, MW-3S, MW-4S,

MW-8S; 2001: MW-1S, MW-2S, MW-3S, MW-4S, MW-5I, MW-8S, TW-01, TW-02, TW-05, TW-07, TW-08, TW-13; 2002: MW-12S, MW-12I, TW-14, TW-16, IW-02). Five volatile organic compounds were detected above MCLs and/or PRGs in two sampling events: 1,2-dichloroethane (2000: MW-11S; 2001: MW-11S); 1,1-dichloroethene (2000: MW-8S; 2001: MW-8S, TW-01); cis-1,2-dichloroethene (2000: MW-4S; 2001: MW-4S); trichloroethene (TCE) (2000: MW-3S, MW-4S; 2001: MW-3S, MW-4S, MW-9S, TW-01, TW-06, TW-07); and 1,2,4-trimethylbenzene (2000: MW-11S; 2001: TW-09, TW-11). Nine other volatile organic compounds were detected at elevated levels in only one of the sampling events.

Only one semivolatile organic compound, bis(2-ethylhexyl)phthalate, was detected at elevated levels in all sampling events. Bis(2-ethylhexyl)phthalate was detected above the MCL and PRG in 2000 (MW-7S), 2001 (MW-1S, MW-1I, MW-11S, MW-11I, TW-01), and 2002 (MW-12S). Three other semivolatile organic compounds were detected at elevated levels in only one of the sampling events. The following two pesticides were detected above MCLs and/or PRGs in the first two sampling events: dieldrin (2000: MW-9S; 2001: MW-2S, MW-9S, TW-03, TW-04, TW-09) and heptachlor epoxide (2000: MW-2S, MW-7S, MW-10S; 2001: MW-2S, MW-4S, TW-03, TW-06). Two other pesticides, beta-BHC and alpha-chlordane, were detected at levels above PRGs in the second sampling event. No pesticides were detected in last sampling event. PCBs were only detected in the temporary well samples from the second sampling event; none were at elevated levels. Analyses of groundwater samples collected from public wells (PW-5, PW-8, PW-9W) did not detect any organic contaminants at elevated levels in the two sampling events in which these wells were sampled.

Ten inorganic compounds were detected above MCLs and/or PRGs in all sampling events: aluminum (2000: 4 wells; 2001: 15 wells; 2002: 6 wells), antimony (2000: 3 wells; 2001: 1 well; 2002: 1 well), arsenic (2000: 1 well; 2001: 5 wells; 2002: 4 wells), barium (2000: 1 well, 2001: 8 wells; 2002: 3 wells), beryllium (2000: 1 well; 2001: 1 well; 2002: 1 well); chromium (2000: 11 wells; 2001: 27 wells; 2002: 8 wells), iron (2000: 13 wells; 2001: 22 wells; 2002: 9 wells), lead (2000: 2 wells; 2001: 5 wells; 2002: 4 wells), manganase (2000: 14 wells; 2001: 22 wells; 2002: 8 wells), and nickel (2000: 3 wells; 2001: 11 wells; 2002: 4 wells). Four inorganic compounds were detected above MCLs and/or PRGs in two sampling events: copper (2000: 1

well; 2002: 2 wells), thallium (2001: 3 wells; 2002: 2 wells), vanadium (2001: 5 wells; 2002: 3 wells), and zinc (2001: 1 well; 2002: 4 wells). Cadmium was detected at levels above the MCL and PRG in seven wells during the second sampling event. Only one contaminant was detected at an elevated level in a public well (PW5). In 2000, PW5 exceeded the PRG for antimony, but did not exceed the MCL.

Tables 4-12 through 4-14 summarize groundwater organic analytical results for RI field mobilizations and Tables 4-15 through 4-17 show groundwater inorganic analytical results for these mobilizations. Figures 4-8 and 4-9 depict elevated concentrations of organic contaminants in shallow and intermediate wells, respectively. Figures 4-10 and 4-11 present inorganic analyses for shallow and intermediate wells, respectively.

Nine organic compounds and pesticides were detected above MCLs; however, most of these contaminants were not elevated in a significant number of samples. Ethylbenzene, 1,1-dichloroethene, and toluene exceeded MCLs in only one sample, and 1,2-dichloroethane and heptachlor epoxide were only detected above MCLs in two samples. The remaining four contaminants, PCE, TCE, benzene, and bis(2-ethylhexyl)phthalate, were detected at elevated concentrations in at least three wells.

PCE contamination was detected above the MCL in the most wells, ranging from an elevated concentration of 5J to 340 ug/L. From the data for the 13 shallow wells, two plumes of contamination are evident: a northwestern plume that encompasses wells MW-8S, MW-12S, TW-7, TW-8, TW-13, TW-14, and TW-16, and a plume that encompasses wells MW-1S, MW-2S, MW-3S, MW-4S, TW-02, and TW-05. Figure 4-12 presents an isoconcentration map of the PCE contamination in shallow wells. Two wells that were elevated above the PCE MCL in the events in which they were sampled were likewise above the TCE MCL in those events. Wells MW-3S and MW-4S were the most contaminated wells for TCE and indicate separate hotspots of TCE contamination at the site. Temporary wells TW-06 and TW-07 define another plume along the western side of the site. Elevated concentrations of TCE ranged from 6J to 13 ug/L. Figure 4-13 presents the isoconcentration map for TCE contamination in shallow wells.

Tab[illegible]2
Groundwater Organic Analytical Summary - Field Event 1 (May, 2000)
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-1S	MW-1I	MW-2S	MW-3S	MW-4S	MW-4I	MW-5I	MW-6S
Volatile Organics (ug/L)										
Acetone	NE	61	10UJ	10U	10U	10U	10U	57	10U	10U
Benzene	5	0.41	10U	10U	10U	10U	10U	10U	10U	10U
Chloroform	NE	0.16	10U	10U	10U	10U	10U	10U	**11**	10U
Cyclohexane	NE	NE	10U	10U	10U	10U	10U	10U	10U	10U
Ethyl benzene	700	130	10U	10U	10U	10U	10U	10U	10U	10U
1,2-Dichloroethane	5	0.12	10U	10U	10U	10U	10U	10U	10U	10U
1,1-Dichloroethene	7	0.046	10UJ	10U	10U	10U	10U	10U	10U	10U
Cis-1,2-Dichloroethene	70	6.1	10U	10U	10U	10U	**11**	10U	10U	10U
Methyl acetate	NE	610	10U	10U	10U	10U	10U	10U	10U	10U
Methylcyclohexane	NE	520	10UJ	10U	10U	10U	10U	10U	10U	10U
Tetrachloroethene	5	1.1	10U	10U	**37**	**21J**	**55**	10U	10U	10U
Trichloroethene	5	1.6	10U	10U	10U	**18J**	**10**	10U	10U	10U
Xylenes, total	10,000	140	10U	10U	10U	10U	10U	10U	10U	10U
Miscellaneous Volatile Organics (ug/L)										
Butane	NE	NE								
Cyclopentane	NE	NE								
Diisopropyl ether	NE	NE								
1-Ethyl-2-methyl-benzene	NE	NE								
Isopropyl alcohol	NE	NE					6NJ			
2-Methyl butane (2 isomers)	NE	NE								
Methyl-cyclopentane	NE	NE								
2-Methyl-2-heptanol	NE	NE								
2-Methyl-2-hexanol	NE	NE								
2-Methyl-2-pentanol	NE	NE								
2-Methyl-3-pentanol	NE	NE								
Pentane	NE	NE								
1,2,3-Trimethyl-benzene	NE	NE								
1,2,4-Trimethyl-benzene	NE	1.2								
1,3,5-Trimethyl-benzene	NE	1.2								
Unidentified Compounds/#	NE	NE								

Table 4-12
Groundwater Organic Analytical Summary - Field Event 1 (May, 2000)
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-7S	MW-7I	MW-8S	MW-8I	MW-9S	MW-10S	MW-11S	MW-11I	PW-5	PW-8	PW-9W
Volatile Organics (ug/L)													
Acetone	NE	61	21J	10J	10UJ	10UJ	25J	10U	10UJ	10UJ	10U	10UJ	10UJ
Benzene	5	0.41	10U	10UJ	10UJ	10U	10UJ	10U	**490J**	10U	10U	10U	10U
Chloroform	NE	0.16	10U	10UJ	10UJ	10U	10UJ	10U	10U	**11**	10U	10U	10U
Cyclohexane	NE	NE	10U	10UJ	10UJ	10U	10UJ	10U	40	10U	10U	10U	10U
Ethyl benzene	700	130	10U	10UJ	10UJ	10U	10UJ	10U	41	10U	10U	10U	10U
1,2-Dichloroethane	5	0.12	10U	10UJ	10UJ	10U	10UJ	10U	**31**	10U	10U	10U	10U
1,1-Dichloroethene	7	0.046	10U	10UJ	**4J**	10U	10UJ	10U	10UJ	10UJ	10U	10UJ	10UJ
Cis-1,2-Dichloroethene	70	6.1	10U	10UJ	10UJ	10U	10UJ	10U	10U	10U	10U	10U	10U
Methyl acetate	NE	610	10U	10UJ	10UJ	10U	10UJ	10U	44	10U	10U	10U	10U
Methylcyclohexane	NE	520	10U	10UJ	10UJ	10U	10UJ	10U	7J	10UJ	10U	10UJ	10UJ
Tetrachloroethene	5	1.1	10U	10UJ	**85J**	10U	10UJ	10U	10U	10U	10U	10U	10U
Trichloroethene	5	1.6	10U	10UJ	1J	10U	10UJ	10U	10U	10U	10U	10U	10U
Xylenes, total	10,000	140	10U	10UJ	10UJ	10U	10UJ	10U	33	10U	10U	10U	10U
Miscellaneous Volatile Organics (ug/L)													
Butane	NE	NE							13NJ				
Cyclopentane	NE	NE							13NJ				
Diisopropyl ether	NE	NE							11NJ				
1-Ethyl-2-methyl-benzene	NE	NE							7NJ				
Isopropyl alcohol	NE	NE											
2-Methyl butane (2 isomers)	NE	NE							26JN				
Methyl-cyclopentane	NE	NE							23NJ				
2-Methyl-2-heptanol	NE	NE							9NJ				
2-Methyl-2-hexanol	NE	NE							6NJ				
2-Methyl-2-pentanol	NE	NE							16NJ				
2-Methyl-3-pentanol	NE	NE							8NJ				
Pentane	NE	NE							24NJ				
1,2,3-Trimethyl-benzene	NE	NE							10NJ				
1,2,4-Trimethyl-benzene	NE	1.2							**11NJ**				
1,3,5-Trimethyl-benzene	NE	1.2							**6NJ**				
Unidentified Compounds/#	NE	NE							5J				

Tabl[illegible]2
Groundwater Organic Analytical Summary - Field Event 1 (May, 2000)
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-1S	MW-1I	MW-2S	MW-3S	MW-4S	MW-4I	MW-5I	MW-6S
Semi-Volatile Organics (ug/L)										
Caprolactam	NE	18,000	10UJ	1J	2J	10U	10U	10UJ	10U	10U
Bis(2-ethylhexyl)phthalate	6	4.8	22UJ	10U	10U	10U	35U	41UJ	10U	10U
Phenol	NE	2,200	10UJ	10U	10U	10U	10U	10UJ	10U	10U
Miscellaneous Semi-Volatile Organics (ug/L)										
2-Butoxy-ethanol	NE	NE	3J							
Benzyl alcohol	NE	11,000								
2-(2-Butoxyethoxy)-ethanol	NE	NE				3JN			2JN	3JN
Butyl ester butanoic acid	NE	NE								
4,4-Butylidenebis[2]phenol	NE	NE		8JN	2JN				10JN	
tert-Butyl-2-pyrazolin-5-0-	NE	NE								
2-Butyltetrahydrofuran	NE	NE								
2-Butoxyethanol	NE	NE								
Cycloeicosane	NE	NE								
Decameth cyclopentasiloxane	NE	NE								
2,3-Dimethyl-2-nitrobutane	NE	NE	3NJ							
3,3-Dimethyl-butanamide	NE	NE								
2,3-Dimethyl-2,3-butanediol	NE	NE								
1,3-Dimethyl cyclohexanol	NE	NE								
1,2-Dimethylcyclopentanol	NE	NE								
1,3-Dimethyl cyclopentanol	NE	NE								
7,9-Di-tert-butyl-1-oxasprio	NE	NE								
1-Docosene	NE	NE	3NJ							
Dodecanoic acid	NE	NE							2JN	
1-Eicosonal	NE	NE								
2-(2-Ethoxyethoxy)-ethanol	NE	NE					3J			
2-Heptene	NE	NE	3NJ							
Hexadecanoic acid	NE	NE							3JN	
1-Hexadecanol	NE	NE								
N-Hexadecanoic acid	NE	NE	5J							
Hexanoic acid	NE	NE						2NJ		
Lauric anhydride	NE	NE								
1-Methylcyclohexanol	NE	NE								
2-Methyl-2-heptanol	NE	NE								
2-Methyl-4-heptanol	NE	NE								
Methyl heptanol isomer	NE	NE								
2-[2-(2-Methoxyetho ethanol	NE	NE								
2-Methyl-2-pentanol	NE	NE								
1-Methyl-2-pyrrolidinone	NE	NE								
Nonanoic acid	NE	NE		5JN						
Octadecanal	NE	NE								
Ocathydro-2-2'-bi-2h-pyran	NE	NE								
Octanoic acid	NE	NE								
(E)-9-Octadeconoic acid	NE	NE								
Oleic acid	NE	NE		6JN					4JN	
Tetradecanoic acid	NE	NE								
Trinonanoin	NE	NE								
Unidentified Compounds/#	NE	NE	95J/3	520J/6	1300J/17	22J/3	5J/2	6J/1	210J/4	960J/20

Table 4-12
Groundwater Organic Analytical Summary - Field Event 1 (May, 2000)
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-7S	MW-7I	MW-8S	MW-8I	MW-9S	MW-10S	MW-11S	MW-11I	PW-5	PW-8	PW-9W
Semi-Volatile Organics (ug/L)													
Caprolactam	NE	18,000	10U	11U	10U	10U	10U	10U	3000	10UJ	10U	10U	10U
Bis(2-ethylhexyl)phthalate	6	4.8	11	11U	10U	10U	10U	10U	36U	29UJ	14U	64U	17U
Phenol	NE	2,200	10U	11U	10U	10U	10U	10U	10	10U	10U	10U	10U
Miscellaneous Semi-Volatile Organics (ug/L)													
2-Butoxy-ethanol													
Benzyl alcohol	NE	11,000					3JN	2JN					
2-(2-Butoxyethoxy)-ethanol	NE	NE					7JN	7JN					
Butyl ester butanoic acid	NE	NE						5JN					
4,4-Butylidenebis[2]phenol	NE	NE	10JN					5JN	12NJ	3NJ			
tert-Butyl-2-pyrazolin-5-0-	NE	NE							22NJ				
2-Butyltetrahydrofuran	NE	NE							8NJ				
2-Butoxyethanol	NE	NE											3J
Cycloeicosane	NE	NE									4NJ		
Decameth cyclopentasiloxane	NE	NE											2J
2,3-Dimethyl-2-nitrobutane	NE	NE											
3,3-Dimethyl-butanamide	NE	NE							19NJ				
2,3-Dimethyl-2,3-butanediol	NE	NE							13NJ				
1,3-Dimethyl cyclohexanol	NE	NE							8NJ				
1,2-Dimethylcyclopentanol	NE	NE							110NJ				
1,3-Dimethyl cyclopentanol	NE	NE							400NJ				
7,9-Di-tert-butyl-1-oxasprio	NE	NE								4NJ			
1-Docosene	NE	NE											
Dodecanoic acid	NE	NE		9JN									
1-Eicosonal	NE	NE								3NJ			3NJ
2-(2-Ethoxyethoxy)-ethanol	NE	NE									2J		
2-Heptene	NE	NE											
Hexadecanoic acid	NE	NE						4JN					
1-Hexadecanol	NE	NE							6NJ				
N-Hexadecanoic acid	NE	NE							10J		3J		5J
Hexanoic acid	NE	NE								7NJ	2J		2J
Lauric anhydride	NE	NE								4NJ			
1-Methylcyclohexanol	NE	NE							100NJ				
2-Methyl-2-heptanol	NE	NE							27NJ				
2-Methyl-4-heptanol	NE	NE							6NJ				
Methyl heptanol isomer	NE	NE							28NJ				
2-[2-(2-Methoxyetho ethanol	NE	NE							8NJ				
2-Methyl-2-pentanol	NE	NE							32NJ				
1-Methyl-2-pyrrolidinone	*NE*	*NE*	*2JN*										
Nonanoic acid	NE	NE	2JN							15NJ			
Octadecanal	NE	NE						3JN					
Ocathydro-2-2'-bi-2h-pyran	NE	NE							24NJ				
Octanoic acid	NE	NE				3JN		6JN					
(E)-9-Octadeconoic acid	NE	NE								15NJ			
Oleic acid	NE	NE	3JN										
Tetradecanoic acid	NE	NE								2NJ			
Trinonanoin	NE	NE	110JN										
Unidentified Compounds/#	NE	NE	20J/2	6J/1	180J/7	[illegible]	17J/3	660J/23	160J/7	130J/2		3J/1	2J/1

Tabl

Groundwater Organic Analytical Summary - Field Event 1 (May, 2000)

Capitol City Plume

Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-1S	MW-1I	MW-2S	MW-3S	MW-4S	MW-4I	MW-5I	MW-6S
Pesticides (ug/L)										
gamma-BHC	0.2	0.052	0.050UJ	0.050UJ	0.050UJ	0.050U	0.050U	0.050UJ	0.050UR	0.050U
alpha-Chlordane	2	0.19	0.050UJ	0.050UJ	0.050UJ	0.050U	0.050U	0.050UJ	0.050UR	0.050U
gamma-Chlordane	2	0.19	0.011 N	0.050UJ	0.050UJ	0.050U	0.050U	0.050UJ	0.050UR	0.050U
Dieldrin	NE	0.0042	0.10UJ	0.10UJ	0.10UJ	0.10U	0.10U	0.10UJ	0.10UR	0.005U
Endrin ketone	NE	NE	0.10UJ	0.10UJ	0.10UJ	0.10U	0.10U	0.10UJ	0.10UR	0.10U
Heptachlor epoxide	0.2	0.0074	0.050UJ	0.050UJ	**0.27J**	0.050U	0.050U	0.050UJ	0.050UR	0.050U

NOTES:

1	U.S Environmental Protection Agency Drinking Water Standards and Health Advisories, Primary Maximum Contaminant Levels (MCLs),
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 29, 1999
NE	Not established.
ug/L	micrograms per liter.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present
N	Presumptive evidence of presence of material.
MW	Monitoring well
PW	Pubic water supply well.
Shading	indicates a value greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Table 4-12
Groundwater Organic Analytical Summary - Field Event 1 (May, 2000)
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-7S	MW-7I	MW-8S	MW-8I	MW-9S	MW-10S	MW-11S	MW-11I	PW-5	PW-8	PW-9W
Pesticides (ug/L)													
gamma-BHC	0.2	0.052	0.050U	0.050UJ	0.050U	0.050UJ	0.039J	0.050U	0.050U	0.050UJ	0.050U	0.050U	0.050U
alpha-Chlordane	2	0.19	0.050U	0.050UJ	0.005U	0.050UJ	0.010JN	0.050U	0.050U	0.050UJ	0.050U	0.050U	0.050U
gamma-Chlordane	2	0.19	0.050U	0.050UJ	0.050U	0.005UJ	0.006JN	0.050U	0.050U	0.050UJ	0.050U	0.050U	0.050U
Dieldrin	NE	0.0042	0.10U	0.10UJ	0.10U	0.10UJ	**0.19J**	0.10U	0.10U	0.10UJ	0.10U	0.10U	0.10U
Endrin ketone	NE	NE	0.10U	0.10UJ	0.10U	0.10UJ	0.029J	0.10U	0.10U	0.10UJ	0.10U	0.10U	0.10U
Heptachlor epoxide	0.2	0.0074	**0.020J**	0.050UJ	0.050U	0.050UJ	0.050UJ	**0.008J**	0.050U	0.050UJ	0.050U	0.050U	0.050U

NOTES:

1 U.S. Environmental Protection Agency Drinking Water Standards and Health Advisories, Primary Maximum Contaminant Levels (MCLs).
2 U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 29, 1999.
NE Not established.
ug/L micrograms per liter.
J Estimated value.
U The analyte was analyzed for, but was not detected above the reporting limit.
R QC indicates that data unusable, compound may or may not be present.
N Presumptive evidence of presence of material.
MW Monitoring well
PW Pubic water supply well.
Shading indicates a value greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Tab
Groundwater Organic Analytical Summary - Field Event 2 (January, 2001)
Temporary Wells
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	TW-1	TW-2	TW-3	TW-4	TW-5	TW-6	TW-7	TW-8	TW-08D	TW-09	TW-10	TW-11	TW-12	TW-13	TW-13D
Volatile Organics (ug/L)																	
Acetone	NE	61	10U	10U	10U	10U	10U	10U	10U	10U	10U	500U	10U	10U	10U	20U	20U
Benzene	5	0.35	10U	10U	10U	10U	150	10U	10U	3J	3J	4500	10U	10U	10U	20U	20U
Chloroform	NE	0.16	10U	10U	10U	10U	10U	10U	10U	10U	10U	500U	10U	10U	10U	20U	20U
Cyclohexane	NE	3,500	10U	10U	10U	10U	62	10U	10U	10U	10UJ	80J	10U	10U	10U	20UJ	20UJ
1,1-Dichloroethene	7	0.046	10	10U	10U	10U	10U	10U	10U	10U	10UJ	500UJ	10U	10UJ	10UJ	20UJ	20UJ
1,2-Dichloroethane	*5*	*0.12*	*10U*	*10U*	*10U*	*10U*	*10U*	*10U*	*10U*	*10U*	*10U*	*500U*	*10U*	*10U*	*10U*	*20U*	*20U*
Ethylbenzene	700	130	10U	10U	10U	10U	10U	10U	10U	10U	10U	780	10U	58	10U	20U	20U
Isopropylbenzene	NE	NE	10U	10U	10U	10U	5J	10U	10U	10U	10U	500U	10U	39	10UJ	20U	20U
Methylcyclohexane	NE	520	10U	10U	10U	10U	28	10U	10U	10U	10U	500U	10U	94	10U	20U	20U
Tetrachloroethene	5	1.1	2J	26	10U	10U	5J	10U	39	39	31	500U	10U	10U	10U	340	300
Toluene	1,000	72	10U	10U	10U	10U	10U	10U	10U	10U	10U	3800	10U	10U	10U	20U	20U
Trichloroethene	5	1.6	2J	10U	10U	10U	1J	7J	6J	10U	10U	500U	10U	10U	10U	20U	20U
Trichlorofluoromethane	NE	130	10U	10U	10U	2J	10U	10U	10U	10U	10U	500U	10U	10U	10U	20U	20U
Xylenes, total	10,000	140	10U	10U	10U	10U	33	10U	10U	10U	10U	2300	10U	22	10U	20U	20U
Miscellaneous Volatile Organics (ug/L)																	
1,3-Diethyl benzene (2 isomers)	NE	NE												380JN			
2,3-Dihydro-4-methyl H-indene (2 isomers)	NE	NE												290JN			
1-Ethyl-2,3-dimethyl benzene	NE	NE												140NJ			
1-Ethyl-2,4-dimethyl benzene	NE	NE															
1-Ethyl-2-methyl benzene	NE	NE					11NJ							45NJ			
1-Ethyl-3-methyl benzene	NE	NE										460NJ					
2-Methyl-1-butenyl benzene	NE	NE												51NJ			
1-Methyl-3-(1-methyl) benzene	NE	NE					6NJ										
1-Methyl-4-(1-methyl) benzene	NE	NE					6NJ										
1-Methyl-2-(2-propene) benzene	NE	NE												140NJ			
4-Methyl-2-pentene, (E)	NE	NE												42NJ			
Octamethylcyclotetrasiloxane	NE	NE	10J		8J			29NJ			21J	1000J					60J
Propylbenzene	NE	0.61												170NJ			
1,2,4,5-Tetramethyl benzene	NE	NE												150NJ			
1,2,3-Trimethylbenzene	NE	NE										710NJ					
1,2,4-Trimethylbenzene (2 isomers)	NE	1.2												470JN			
1,2,3-Trimethylcyclopentene	NE	NE												69NJ			
Brominated hydrocarbon	NE	NE												160JN			
Substituted benzenes/#	NE	NE										290NJ		580JN/4			
Substituted phenol	NE	NE												71NJ			
Laboratory Artifacts/#	NE	NE	15J/1	8J	8J	14J/2	10J/1	43J/2	36J/3	35J/3	19J/2	1000J/2	13J/2		21J/2	160J/2	67J/2
Unknown Alkene	NE	NE												60JN			
Unidentified Compounds/#	NE	NE					46J/3							1700J/7			
Semi-Volatile Organics (ug/L)																	
1,1-Biphenyl	NE	30	10U	10U	10U	10U	10U	10U	10U	10U	10U	1J	10U	30U	10U	10U	10U
Bis(2-ethylhexyl)phthalate	6	4.8	20	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	30U	10U	10U	10U
Caprolactam	NE	1,800	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	30U	10U	10U	10U
2-Methylnaphthalene	NE	NE	10U	10U	10U	10U	8J	10U	10U	10U	10U	52	10U	85	10U	10U	10U
2-Methylphenol	NE	180	10U	10U	10U	10U	10U	10U	10U	10U	10U	13	10U	30U	10U	10U	10U
(3-and/or 4-)Methylphenol	NE	18	10U	10U	10U	10U	10U	10U	10U	10U	10U	19	10U	30U	10U	10U	10U
Naphthalene	NE	0.62	10U	10U	10U	10U	34	10U	10U	10U	10U	230	10U	21J	10U	10U	10U
Phenanthrene	NE	NE	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	3J	10U	10U	10U
Phenol	NE	2,200	10U	10U	10U	10U	3J	10U	10U	10U	10U	50	10U	30U	10U	10U	10U

Table 4-13
Groundwater Organic Analytical Summary - Field Event 2 (January, 2001)
Temporary Wells
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	TW-1	TW-2	TW-3	TW-4	TW-5	TW-6	TW-7	TW-8	TW-08D	TW-09	TW-10	TW-11	TW-12	TW-13	TW-13D
Miscellaneous Semi-Volatile Organics (ug/L)																	
Benzo[c]thiophene	NE	NE															
Cyclopropylbenzene	NE	NE										14NJ					
1,2-Diethylbenzene	NE	NE												14NJ			
1,3-Diethyl benzene	NE	NE					3NJ							110NJ			
2,3-Dihydro-4-methyl 1H-indene	NE	NE										42NJ		55NJ			
2,3-Dihydro-1-methylindene	NE	NE												76NJ			
1,1-Dimethylpropylbenzene	NE	NE												14NJ			
1,4-Dimethyl-2-(1-methyl)benzene	NE	NE												39NJ			
1,3-Dimethylnaphthalene	NE	NE												19NJ			
2,6-Dimethylnaphthalene	NE	NE												16NJ			
1-(2,5-Dimethylphe ethanone	NE	NE					2NJ										
1-Ethyl-1,3-dimethylbenzene	NE	NE					18NJ										
1-Ethyl-2,3-dimethylbenzene	NE	NE					6NJ					29NJ		110NJ			
1-Ethyl -2,4-dimethylbenzene	NE	NE												88NJ			
1-Ethyl-2-methyl benzene	NE	NE										240NJ		100NJ			
2-Ethyl-1,4-dimethylbenzene	NE	NE										42NJ		240NJ			
2-Etheneyl-1,4-dimethylbenzene	NE	NE										87NJ					
Indane	NE	NE										170NJ					
4-Iodomesitylene	NE	NE					3NJ										
(1-Methylethyl)benzene	NE	NE												32NJ			
1-Methylnaphthalene	NE	NE					10NJ					32NJ					
2-Methylnaphthalene	NE	NE												23NJ			
1-Methyl-3-(1-methyl)benzene	NE	NE										26NJ					
1-Methylpropylbenzene	NE	NE												33NJ			
1-Methyl-2-propylbenzene	NE	NE										14NJ					
1-Methyl-3-propylbenzene	NE	NE										34NJ					
(2-Methylpropyl)benzene	NE	NE												24NJ			
Pentamethylbenzene	NE	NE												16NJ			
1-Propenylbenzene	NE	NE					6NJ							140NJ			
1,2-Propadienylbenzene	NE	NE										26NJ					
Sulfur, Mol (S8)	NE	NE												120NJ			
1,2,4,5-Tetramethyl benzene (2 isomers)	NE	NE					30JN					63NJ		140JN			
1,2,3-Trimethylbenzene (2 isomers)	NE	NE												450NJ			
1,2,4-Trimethylbenzene	NE	12										120NJ					
Trimethylbenzene	NE	NE					7JN										
2,4,6-Trimethylbenzoic acid	NE	NE					7NJ										
Substituted benzenes/#	NE	NE					5JN/2					68J/1		140NJ/3			
Unknown Alcohol	NE	NE					24J					27JN					
Unidentified Compounds/#	NE	NE	8J/2	7J/2			180J/16		4J/1	3J/1		300J/9		43J/3	2J/1	8J/2	9J/2

Tab

Groundwater Organic Analytical Summary - Field Event 2 (January, 2001)
Temporary Wells
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	TW-1	TW-2	TW-3	TW-4	TW-5	TW-6	TW-7	TW-8	TW-08D	TW-09	TW-10	TW-11	TW-12	TW-13	TW-13D
Pesticides (ug/L)																	
beta-BHC	NE	0.037	0.050U	0.050U	0.050U	**0.051**	0.37U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
gamma-BHC	0.2	0.052	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
alpha-Chlordane	2	0.19	0.050U	0.050U	**0.27N**	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
gamma-Chlordane	2	0.19	0.050U	0.050U	0.18	0.012JN	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
4,4'-DDD	NE	0.28	0.10U	0.10U	0.10U	0.10U	0.042JN	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
4,4'-DDT	NE	0.20	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.019JN	0.10U	0.10U	0.10U	0.10U	0.10U
Dieldrin	NE	0.0042	0.10U	0.10U	**0.21**	**0.045J**	0.10U	0.10U	0.10U	0.10U	0.10U	**0.025JN**	0.10U	0.10U	0.10U	0.10U	0.10U
Endrin ketone	NE	NE	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
Endosulfan II (beta)	NE	NE	0.10UJ	0.10UJ	0.025JN	0.10UJ	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
Heptachlor epoxide	0.2	0.0074	0.050U	0.050U	**0.23N**	0.050U	0.050U	**0.009J**	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U

NOTES:

1	U.S. Environmental Protection Agency Drinking Water Standards and Health Advisories, Primary Maximum Contaminant Levels (MCLs).
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 1, 2000.
NE	Not established.
ug/L	micrograms per liter.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit
R	QC indicates that data unusable, compound may or may not be present
N	Presumptive evidence of presence of material.
TW	Temporary monitoring well
Shading	indicates a value equal to or greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Table 4-13
Groundwater Organic Analytical Summary - Field Event 2 (January, 2001)
Existing Wells
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-1S	MW-1I	MW-2S	MW-3S	MW-4S	MW-4I	MW-5I
Volatile Organics (ug/L)									
Benzene	5	0.41	10U	10U	10U	10U	10U	10U	10U
Chloroform	NE	0.16	**8J**	10U	10U	10U	**2J**	10U	10U
Cyclohexane	NE	NE	10U	10U	10U	10U	10U	10U	10U
1,2-Dichloroethane	5	0.12	10U	10U	10U	10U	10U	10U	10U
1,1-Dichloroethene	7	0.046	10U	10U	10UJ	10UJ	10UJ	10UJ	10U
Cis-1,2-Dichloroethene	70	6.1	10U	10U	10U	10U	**8J**	10U	10U
Tetrachloroethene	5	1.1	**6J**	10U	**44**	**22**	**85**	10U	**5J**
Trichloroethene	5	1.6	10U	10U	10U	**13**	**10**	10U	10U
Xylenes, total	10,000	140	10U	10U	10U	10U	10U	10U	10U
Miscellaneous Volatile Organics (ug/L)									
Octamethylcyclotetrasiloxane	NE	NE						10J	
Branched alkenes/#	NE	NE							
Laboratory artifacts/#	NE	NE			13J/2	14J/2	22J/2	11J/1	
Unidentified Compounds/#	NE	NE							
Semi-Volatile Organics (ug/L)									
Bis(2-ethylhexyl)phthalate	6	4.8	**17J**	**600J**	10U	10U	10U	10U	10UJ
Caprolactam	NE	1,800	10UJ	10UJ	10U	10U	2J	13	10UJ
Diethyl Phthalate	NE	2,900	10UJ	10UJ	10U	10U	10U	10U	10UJ
2,4-Dimethylphenol	NE	730	10UJ	10UJ	10UJ	10UJ	10UJ	10UJ	10UJ
Miscellaneous Semi-Volatile Organics (ug/L)									
4,4'-Burylidenebis{2 phenol	NE	NE							
Bubryl tetradecanoate	NE	.NE							
Decamethylcyclopentasiloxane	NE	NE							3J
Dodecemthylcyclohexasiloxane	NE	NE							
1-Methanol-cyclohexanol	NE	NE							
3-Methyl-3-heptanol	NE	NE							
9-Octadecenamide, (Z)-	NE	NE							
Unknowns/#	NE	NE		3J/1	4J			23J/6	
Unknown Amides/#	NE	NE				5JN		4JN	
Unknown (BC)	NE	NE				5J	5J		
Unknown Phthalate	NE	NE		5J					
Unknown Siloxanes/#	NE	NE							
Pesticides (ug/L)									
gamma-Chlordane	2	0.19	0.050UJ	0.050UJ	0.009J	0.050U	0.014JN	0.050UJ	0.050UJ
Dieldrin	NE	0.0042	0.10UJ	0.10UJ	**0.033J**	0.10U	0.10UJ	0.10UJ	0.10UJ
Endrin	2	11	0.010UJ	0.010UJ	0.10UJ	0.10U	0.010UJ	0.010UJ	0.010UJ
Heptachlor epoxide	0.2	0.0074	0.050UJ	0.050UJ	**0.035J**	0.050U	**0.023JN**	0.050UJ	0.050UJ

NOTES:

1	U.S. Environmental Protection Agency Drinking Water Standards and Health Advisories, Primary Maximum Contaminant Levels (MCLs),
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 22, 2000.
NE	Not established.
ug/L	micrograms per liter.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
MW	Monitoring well
PW	Pubic water supply well.
Shading	indicates a value equal to or greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Table 4-13
Groundwater Organic Analytical Summary - Field Event 2 (January, 2001)
Existing Wells
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-6S	MW-7S	MW-7I	MW-8S	MW-8I	MW-9S
Volatile Organics (ug/L)								
Benzene	5	0.41	10U	10U	10U	10U	10U	10U
Chloroform	NE	0.16	10U	10U	10U	10U	10U	10U
Cyclohexane	NE	NE	10U	10U	10U	10U	10U	10U
1,2-Dichloroethane	5	0.12	10U	10U	10U	10U	10U	10U
1,1-Dichloroethene	7	0.046	10UJ	10U	10U	6J	10UJ	10U
Cis-1,2-Dichloroethene	70	6.1	10U	10U	10U	10U	10U	10U
Tetrachloroethene	5	1.1	10U	10U	10U	26	10U	10U
Trichloroethene	5	1.6	10U	10U	10U	10U	10U	2J
Xylenes, total	10,000	140	10U	10U	10U	10U	10U	10U
Miscellaneous Volatile Organics (ug/L)								
Octamethylcyclotetrasiloxane	NE	NE				8J		
Branched alkenes/#	NE	NE						
Laboratory artifacts/#	NE	NE	28J/2			9J/1	22J/2	
Unidentified Compounds/#	NE	NE						
Semi-Volatile Organics (ug/L)								
Bis(2-ethylhexyl)phthalate	6	4.8	10U	10U	10UJ	10U	10U	10U
Caprolactam	NE	1,800	30	3J	10UJ	23	13	10U
Diethyl Phthalate	NE	2,900	10U	10UJ	10UJ	10U	10U	10U
2,4-Dimethylphenol	NE	730	10UJ	10UJ	10UJ	10UJ	10UJ	10U
Miscellaneous Semi-Volatile Organics (ug/L)								
4,4'-Butylidenebis[2 phenol	NE	NE						
Bubtyl tetradecanoate	NE	NE			3NJ			
Decamethylcyclopentasiloxane	NE	NE						
Dodecemthylcyclohexasiloxane	NE	NE			3NJ			
1-Methanol-cyclohexanol	NE	NE						
3-Methyl-3-heptanol	NE	NE						
9-Octadecenamide, (Z)-	NE	NE					5NJ	
Unknowns/#	NE	NE	43J/5		2J	30J/5	43J	2J/1
Unknown Amides/#	NE	NE	3JN/1	3J		12JN/2	3JN/1	3J/1
Unknown (BC)	NE	NE						
Unknown Phthalate	NE	NE						
Unknown Siloxanes/#	NE	NE			100J/12			
Pesticides (ug/L)								
gamma-Chlordane	2	0.19	0.050U	0.050UJ	0.050UJ	0.050U	0.050UJ	0.050UJ
Dieldrin	NE	0.0042	0.10U	0.10UJ	0.10UJ	0.10U	0.10UJ	0.38J
Endrin	2	11	0.010U	0.010UJ	0.010UJ	0.010U	0.010UJ	0.10UJ
Heptachlor epoxide	0.2	0.0074	0.050U	0.050UJ	0.050UJ	0.050U	0.050UJ	0.050UJ

NOTES:

1	U.S. Environmental Protection Agency Drinking Water Standards and Health Advisories, Primary Maximum Contaminant Levels (MCLs),
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 22, 2000.
NE	Not established.
ug/L	micrograms per liter.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
MW	Monitoring well
PW	Pubic water supply well.
Shading	indicates a value greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Table 4-13
Groundwater Organic Analytical Summary - Field Event 2 (January, 2001)
Existing Wells
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-10S	MW-11S	MW-11I	PW-5	PW-8	PW-9W
Volatile Organics (ug/L)								
Benzene	5	0.41	10UJ	290	10U	10U	10UJ	10U
Chloroform	NE	0.16	10UJ	2J	10U	10U	10UJ	10U
Cyclohexane	NE	NE	10UJ	22	10U	10U	10UJ	10U
1,2-Dichloroethane	5	0.12	10UJ	27	10U	10U	10UJ	10U
1,1-Dichloroethene	7	0.046	10UJ	20U	10U	10U	10UJ	10U
Cis-1,2-Dichloroethene	70	6.1	10UJ	20U	10U	10U	10UJ	10U
Tetrachloroethene	5	1.1	10UJ	20U	10U	10U	10UJ	10U
Trichloroethene	5	1.6	10UJ	20U	10U	10U	10UJ	10U
Xylenes, total	10,000	140	10UJ	17J	10U	10U	10UJ	10U
Miscellaneous Volatile Organics (ug/L)								
Octamethylcyclotetrasiloxane	NE	NE						
Branched alkenes/#	NE	NE		29JN/2				
Laboratory artifacts/#	NE	NE						
Unidentified Compounds/#	NE	NE	370J	150J/4				
Semi-Volatile Organics (ug/L)								
Bis(2-ethylhexyl)phthalate	6	4.8	10U	13	38	10U	10U	10U
Caprolactam	NE	1,800	10U	10U	10U	10U	10U	10U
Diethyl Phthalate	NE	2,900	10U	1J	10U	10U	10U	10U
2,4-Dimethylphenol	NE	730	10U	1J	10U	10U	10U	10U
Miscellaneous Semi-Volatile Organics (ug/L)								
4,4'-Butylidenebis[2 phenol	NE	NE		6NJ				
Bubtyl tetradecanoate	NE	NE						
Decamethylcyclopentasiloxane	NE	NE						
Dodecemthylcyclohexasiloxane	NE	NE						
1-Methanol-cyclohexanol	NE	NE		64NJ				
3-Methyl-3-heptanol	NE	NE		8NJ				
9-Octadecenamide, (Z)-	NE	NE						
Unknowns/#	NE	NE		38J/5				
Unknown Amides/#	NE	NE	5J/1	3J/1	3J/1			
Unknown (BC)	NE	NE						
Unknown Phthalate	NE	NE						
Unknown Siloxanes/#	NE	NE				4J/1		4J/1
Pesticides (ug/L)								
gamma-Chlordane	2	0.19	0.050UJ	0.050U	0.050U	0.050U	0.050U	0.050UJ
Dieldrin	NE	0.0042	0.10UJ	0.10U	0.10U	0.10U	0.10U	0.10UJ
Endrin	2	11	0.10UJ	0.10UJ	0.12J	0.010U	0.010U	0.010UJ
Heptachlor epoxide	0.2	0.0074	0.050UJ	0.050U	0.050U	0.050U	0.050U	0.050UJ

NOTES:

1	U.S. Environmental Protection Agency Drinking Water Standards and Health Advisories, Primary Maximum Contaminant Levels (MCLs).
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 22, 2000.
NE	Not established
ug/L	micrograms per liter.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
MW	Monitoring well
PW	Pubic water supply well.
Shading	indicates a value greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Tab

Groundwater Organic Analytical Summary - Field Event 3 (February, 2002)
Permanent and Temporary Wells
Capitol City Plume
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	TW-14	TW-15	TW-16	MW-12S	MW-12I	IW-01	IW-02
Volatile Organics (ug/L)									
Acetone	NE	61	25U	63UJ	25UJ	50.0U	25U	25.0U	38
Benzene	5	0.35	1.0UJ	1.0UJ	1.0UJ	2.0U	**2.8**	1.0U	1.0U
Bromodichloromethane	NE	0.18	**4.2**	**0.62J**	**1.1J**	2.0U	**3**	1.0U	1.0U
Chloroform	NE	0.16	**19**	**13**	**8.5J**	2.0U	**33**	1.0U	1.0U
Dibromochloromethane	NE	0.13	**0.60J**	1.0U	1.0UJ	2.0U	1.0U	1.0U	1.0U
Cis-1,2-Dichloroethene	100	NE	1.0UJ	1.0UJ	1.0UJ	1.0AJ	1.0U	1.0U	2.7
Methel Ethyl Ketone	NE	190	25U	13UJ	25.0U	50.0U	25U	25.0U	**2,600J**
Methyl T-Butyl Ether	5	1.1	**1.9**	1.0UJ	1.0UJ	**4.7A**	1.0U	1.0U	1.0U
Tetrachloroethene	5	0.43	**29**	1.0UJ	**24J**	**240**	**1.8**	1.0U	**4.9**
Trichloroethene	5	1.6	1.0UJ	1.0UJ	0.52J	2.0U	1.0U	1.0U	1.2
Miscellaneous Volatile Organics (ug/L)									
Cyclohexanone	NE	18,000							20JN
Isopropanol	NE	NE		10JN					
Tetrahydrofuran	NE	8.8							**400JN**
Semi-Volatile Organics (ug/L)									
Benzo(B)Fluoranthene	NE	0.092	10U	10U	**1.2J**	10U	10U	10U	10U
Bis(2-ethylhexyl)phthalate	6	4.8	10U	10U	10U	**18**	10U	10U	10U
Chrysene	NE	9.2	10U	10U	1.1J	10U	10U	10U	10U
Fluoranthene	NE	150	10U	10U	2.3J	10U	10U	10U	10U
Phenanthrene	NE	NE	10U	10U	2.6J	10U	10U	10U	10U
Pyrene	NE	NE	10U	10U	2.3J	10U	10U	10U	10U
Phenol	NE	2,200	10U	10U	10U	1.7J	1.5J	10U	10U
Miscellaneous Semi-Volatile Organics (ug/L)									
Drometrizole	NE	NE					20JN		

NOTES:

1	U.S. Environmental Protection Agency Drinking Water Standards and Health Advisories, Primary Maximum Contaminant Levels (MCLs).
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 1, 2000.
NE	Not established.
ug/L	micrograms per liter.
A	Average value.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
R	QC indicates that data unusable, compound may or may not be present.
N	Presumptive evidence of presence of material.
IW	Industrial Well
MW	Permenant monitoring well
TW	Temporary monitoring well

Shading indicates a value equal to or greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Tabl[illegible]5
Groundwater Inorganic Analytical Summary - Field Event 1 (May, 2000)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-1S	MW-1I	MW-2S	MW-3S	MW-4S	MW-4I	MW-5I
Inorganics (ug/L)									
Aluminum	NE	3,600	1,400	1,900J	2,200J	500J	1,200	1,200	**130,000J**
Antimony	6	1.5	4.4U	2.9U	2.6U	2.6U	4.4U	4.4U	2.6U
Arsenic	50	0.045	4.5U	3.0U	1.9U	2.0U	3.0U	6.2U	**18**
Barium	2,000	260	96	42	80	63	89	72	**270**
Beryllium	4	7.3	0.82	0.20	0.40	0.20	0.40	1.2	**6.3**
Cadmium	5	1.8	0.30U	0.30U	0.30U	0.80U	0.30U	0.30U	3.4U
Calcium	NE	NE	14,000	5,800	11,000	13,000	3,100	19,000	21,000
Chromium	100	11	8.0	**15**	7.1U	3.9U	6.6	**13**	**110**
Cobalt	NE	220	3.1	2.3U	1.0U	3.4U	1.3U	1.3U	6.8U
Copper	1,300	140	45	22U	4.0U	4.5U	11U	17U	62U
Iron	NE	1,100	**2,200**	**1,800**	**2,800**	920	**1,800**	**7,500**	**49,000**
Lead	15	NE	6.2	2.6U	1.8U	2.0	1.8U	9.7	**32J**
Magnesium	NE	NE	5,800	950	4,900	5,400	1,200	2,600	21,000
Manganese	NE	88	**300**	**100**	42	**120**	72	**340**	**1,000**
Mercury, total	2	1.1	0.10U	0.10U	0.23	0.10U	0.12U	0.15U	0.10U
Nickel	NE	73	18U	27UJ	5.5UJ	5.0UJ	14U	27U	70J
Potassium	NE	NE	3,100	2,000J	7,300J	4,400J	6,100	2,600	6,400J
Selenium	50	18	4.3	2.2U	2.3J	2.2U	3.7U	4.4U	4.2UJ
Silver	*NE*	*18*	*4.1UJ*	*1.0U*	*0.70U*	*0.70U*	*2.1UJ*	*1.8UJ*	*3.0U*
Sodium	NE	NE	17,000	16,000	24,000	21,000	34,000	31,000	79,000
Thallium	2	0.24	5.9U	3.5U	3.5U	3.5U	6.1UJ	6.1UJ	3.5U
Vanadium	NE	26	4.1	2.6U	4.4U	2.0U	2.9	4.1	46U
Zinc	NE	1,100	82	67U	16U	16U	30U	86	200
Cyanide	200	0.62	10U	10U	10U	10U	10U	10U	10U

NOTES:

1	U.S. Environmental Protection Agency Drinking Water Regulations and Health Advisories, Primary Maximum Contaminant Levels (MCLs), October 1996.
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 22, 2000.
NE	Not established.
ug/L	micrograms per liter.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
MW	Monitoring well
PW	Pubic water supply well.
Shading	indicates a value greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Table 4-15
Groundwater Inorganic Analytical Summary - Field Event 1 (May, 2000)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-6S	MW-7S	MW-7I	MW-8S	MW-8I	MW-9S	MW-10S
Inorganics (ug/L)									
Aluminum	NE	3,600	**5,000J**	380J	700J	210UJ	**4,600J**	1,400J	**5,800J**
Antimony	6	1.5	**3.7**	**3.4**	2.6U	2.6U	2.6U	2.6U	4.0U
Arsenic	50	0.045	1.9U	1.9U	1.9U	1.9U	1.9U	1.9U	3.0U
Barium	2,000	260	76	230	61	100	52	150	99
Beryllium	4	7.3	0.50	0.20U	0.10U	0.20U	0.6	0.2	0.6
Cadmium	5	1.8	0.30U	0.70U	0.40U	0.70U	0.30U	0.60U	0.30U
Calcium	NE	NE	16,000	23,000	4,200	15,000	6,900	11,000	11,000
Chromium	100	11	**100**	**21**	**38**	**11**	**20**	**82**	**60**
Cobalt	NE	220	5.4U	2.8U	1.8U	5.8U	2.1U	3.8U	11U
Copper	1,300	140	69U	100U	29U	24U	26U	74U	79U
Iron	NE	1,100	**6,200**	570	**1,500**	480	**4,500**	**1,900**	**6,100**
Lead	15	NE	4.7	5.7J	2.3	1.8U	6.8	4.3	**15**
Magnesium	NE	NE	4,500	4,900	640	4,600	1,400	4,300	4,100
Manganese	NE	88	**720**	**400**	**320**	**490**	**260**	**300**	**280**
Mercury, total	2	1.1	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
Nickel	NE	73	**100J**	29UJ	37UJ	20UJ	31UJ	**85J**	65J
Potassium	NE	NE	4,200J	4,800J	1,700J	6,100J	1,900J	3,500J	3,200J
Selenium	50	18	2.2U	2.2U	2.2U	2.2U	2.2U	2.2U	3.5UJ
Silver	NE	18	1.2U	1.2U	1.4U	0.70U	0.70U	1.2U	1.8U
Sodium	NE	NE	25,000	18,000	14,000	23,000	28,000	12,000	25,000
Thallium	2	0.24	3.5U	3.5U	3.5U	3.5U	3.5U	3.5U	3.5U
Vanadium	NE	26	6.6U	1.2U	1.5U	0.80U	4.3U	1.8U	8.7U
Zinc	NE	1,100	93U	78U	35U	31U	100U	91U	120U
Cyanide	200	0.62	10U	10U	10U	10U	10U	10U	10U

NOTES:

1	U.S. Environmental Protection Agency Drinking Water Regulations and Health Advisories, Primary Maximum Contaminant Levels (MCLs), October 1996.
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 22, 2000.
NE	Not established.
ug/L	micrograms per liter.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
MW	Monitoring well
PW	Pubic water supply well.
Shading	indicates a value greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Tabl[illegible]5

Groundwater Inorganic Analytical Summary - Field Event 1 (May, 2000)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-11S	MW-11I	PW-5	PW-8	PW-9W
Inorganics (ug/L)							
Aluminum	NE	3,600	1,600	760	26U	22U	13U
Antimony	6	1.5	4.4U	4.4U	4.4	4.4U	4.4U
Arsenic	50	0.045	6.5U	4.5U	4.0U	3.2U	3.1U
Barium	2,000	260	92	19	20	7.1	76
Beryllium	4	7.3	0.78	0.38	0.10U	0.10U	0.10U
Cadmium	5	1.8	0.30U	0.61U	0.30U	0.30U	0.30U
Calcium	NE	NE	39,000	3,300	6,500	2,400	5,400
Chromium	100	11	24	7.4	0.70U	0.70U	0.92
Cobalt	NE	220	5.1	1.3U	1.3U	1.3U	1.3U
Copper	1,300	140	540	88	6.9U	4.6U	6.7U
Iron	NE	1,100	5,200	2,600	22U	30	76
Lead	15	NE	2.9	5.8J	1.8U	1.8U	1.8U
Magnesium	NE	NE	5,900	970	580	240	1,600
Manganese	NE	88	1,200	130	8.7U	5.0U	2.7U
Mercury, total	2	1.1	0.10U	0.13U	0.10U	0.10U	0.10U
Nickel	NE	73	210	53	0.60U	0.60U	1.2U
Potassium	NE	NE	4,400	1,000	1,200	780	1,900
Selenium	50	18	3.7U	3.7U	3.7U	3.7U	3.7U
Silver	NE	18	3.2UJ	3.2UJ	2.0UJ	2.7UJ	2.6UJ
Sodium	NE	NE	25,000	56,000	66,000	68,000	7,900
Thallium	2	0.24	5.9U	5.9U	5.9U	5.9U	5.9U
Vanadium	NE	26	3.5	1.70	1.0U	1.0U	1.0U
Zinc	NE	1,100	160	130	19U	22U	28U
Cyanide	200	0.62	10U	10U	10U	10U	10U

NOTES:

1 U.S. Environmental Protection Agency Drinking Water Regulations and Health Advisories, Primary Maximum Contaminant Levels (MCLs), October 1996.

2 U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 22, 2000.

NE	Not established.
ug/L	micrograms per liter.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
MW	Monitoring well
PW	Pubic water supply well.
Shading	indicates a value greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Tabl[illegible]6
Groundwater Inorganic Analytical Summary - Field Event 2 (January, 2001)
Existing Wells
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-1S	MW-1I	MW-2S	MW-3S	MW-4S	MW-4I	MW-5I	MW-6S	MW-7S	MW-7I
Inorganics (ug/L)												
Aluminum	NE	3,600	**9,100**	860	**11,000J**	130UJ	2,600J	**23,000J**	270	**3,900J**	70U	91U
Arsenic	50	0.045	4.2U	4.2U	4.2U	4.2U	4.2U	**6.2**	4.2U	4.2U	4.2U	4.2U
Barium	2,000	260	190	34	140	70	**280**	**260**	55	**270**	29	230
Cadmium	5	1.8	0.60U	1.1	0.60U	0.60U	0.60U	**8.6**	**1.8**	0.65	1.2	**4.2**
Calcium	NE	NE	13,000J	4,800J	13,000	13,000	5,700	31,000	5,000J	13,000	3,400J	22,000J
Chromium	100	11	**31**	4.1	**19**	**23**	**73**	**85**	**22**	**81**	**16**	**13**
Cobalt	NE	220	1.2	0.94U	1.9	2.8	1.4U	4.8	2.6	2.6	0.70U	1.1U
Copper	1,300	140	13U	12U	5	2.2	5	53	12U	15	9.9U	9.4U
Iron	NE	1,100	**9,400**	590	**14,000**	230	**5,200**	**23,000**	480	**5,100**	**2,200**	240
Lead	15	NE	7.9	2.6	6	1.7U	3.5	**47**	1.9U	2.7	1.7U	1.8U
Magnesium	NE	NE	6,900	650	6,100	4,900	2,800	7,100	660	4,800	450	4500
Manganese	NE	88	**120**	50	**180**	**240**	63	**740**	**100**	73	**340**	39
Mercury, total	2	NE	0.17U	0.12U	0.94J	0.10U	0.11UJ	0.31J	0.11U	0.10U	0.11U	0.11U
Nickel	NE	73	22	9.4	9.1	27	37	69	21	48	16	30
Potassium	NE	NE	5,000	1,500	4,700J	8,500J	12,000J	4,900J	1,800	4,000J	1,500	4,300
Sodium	NE	NE	18,000J	7,700J	21,000J	890,000J	41,000J	22,000	6,700J	22,000J	9,300J	16,000J
Vanadium	NE	26	9.2	0.70U	18	0.77U	5.2	21	0.70U	6.9	0.70U	0.70U
Zinc	NE	1,100	32	8.9	30	35	15	100	12	33	8.7	92

NOTES:

1	U.S. Environmental Protection Agency Drinking Water Regulations and Health Advisories, Primary Maximum Contaminant Levels (MCLs), October 1996.
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 22, 2000.
NE	Not established.
ug/L	micrograms per liter.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
MW	Monitoring well
PW	Pubic water supply well.
Shading	indicates a value equal to or greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Table 4-16
Groundwater Inorganic Analytical Summary - Field Event 2 (January, 2001)
Existing Wells
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	MW-8S	MW-8I	MW-9S	MW-10S	MW-11S	MW-11I	PW-5	PW-8	PW-9W
Inorganics (ug/L)											
Aluminum	NE	3,600	780J	320J	550	240	1,400	**30,000**	22U	15U	15U
Arsenic	50	0.045	4.2U	4.2U	4.2U	4.2U	4.2U	**14**	4.2U	4.2U	4.2U
Barium	2,000	260	84	28	220	55	**2200**	**1300**	25	9.6	84
Cadmium	5	1.8	**1.9**	**32**	**3.4**	0.60U	1.7	**1.8**	0.60U	0.60U	0.60U
Calcium	NE	NE	12,000	3,500	9,100J	8,100J	12,000J	32,000J	6,600J	2,500J	5,300J
Chromium	100	11	**30**	**26**	**64**	3.7	**600**	**46**	0.50U	0.50U	1.2
Cobalt	NE	220	2.2	0.81	1.0U	0.70U	6.0	8.4	0.70U	0.70U	0.70U
Copper	1,300	140	8.2	15	46	1.1U	100	85	0.70U	0.70U	1.6U
Iron	NE	1,100	**1,500**	670	940	200	**5,000**	**27,000**	14U	14U	14U
Lead	15	NE	2.5	2	3.8	1.7U	4.0	**86**	1.7U	1.7U	1.7U
Magnesium	NE	NE	4,000	410	4,100	3,400	4,100	8,300	640	280	1,500
Manganese	NE	88	64	57	**88**	11U	**570**	**1400**	11	6.5U	2.2U
Mercury, total	2	NE	0.10U	0.10U	0.11U	0.11U	0.13U	0.17U	0.10U	0.13U	0.13U
Nickel	NE	73	49	33	**79**	3.1	**360**	57	1.3U	1.3U	2
Potassium	NE	NE	4,800J	1,200J	3,000	2,400	2,800	7,300	1,400	1,000	2,300
Sodium	NE	NE	22,000	4,800J	13,000J	28,000J	20,000J	27,000J	84,000J	87,000J	9,000J
Vanadium	NE	26	2	0.87U	0.70U	0.70U	5.0	18	0.70U	0.70U	0.70U
Zinc	NE	1,100	11	13	38	1.7	33	160	1.8	1.1U	2.6

NOTES:

1	U.S. Environmental Protection Agency Drinking Water Regulations and Health Advisories, Primary Maximum Contaminant Levels (MCLs), October 1996.
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 22, 2000.
NE	Not established.
ug/L	micrograms per liter.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
MW	Monitoring well
PW	Pubic water supply well.
Shading	indicates a value greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Table [illegible]6
Groundwater Inorganic Analytical Summary - Field Event 2 (January, 2001)
Temporary Wells
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	TW-1	TW-2	TW-3	TW-4	TW-5	TW-6	TW-7	TW-8
Inorganics (ug/L)										
Aluminum	NE	3,600	2500J	**14000J**	**10000J**	**13000J**	**4600J**	3,100J	**4,800J**	2,400J
Antimony	6	1.5	2.5U	2.5U	2.5U	2.5U	2.5U	2.5U	2.5U	2.5U
Arsenic	50	0.045	4.2U	**11**	4.2U	4.2U	4.2U	4.2U	4.2U	4.2U
Barium	2,000	260	180	150	130	110	52	130	220	**320**
Beryllium	4	7.3	0.57U	4.5U	1.2U	1.8U	0.85U	0.71U	0.95U	0.73U
Calcium	NE	NE	10,000	13,000	8,200	4,600	7,300	17,000	14,000	21,000
Chromium	100	11	**66**	**1200**	**180**	**240**	**130**	**220**	**180**	**120**
Cobalt	NE	220	18	30	11	13	5.1	9	15	5.8
Copper	1,300	140	11U	120	25U	21U	5.7U	9.5	13	7.6
Iron	NE	1,100	**8,200**	**81,000**	**24,000**	**34,000**	**8,000**	**9,200**	**14,000**	**9,300**
Lead	15	NE	2.6U	**16**	7.2	6.8	2.2	6.4	4.6	4.1
Magnesium	NE	NE	4,100	6,400	4,600	3,200	4,100	42,000	4,500	5,600
Manganese	NE	88	**950**	**1000**	**240**	**700**	**480**	**1,800**	**810**	**450**
Mercury, total	2	1.1	0.10U	0.10U	0.25	0.10U	0.10U	0.14UJ	0.10U	0.10U
Nickel	NE	73	48	**600**	**120**	**120**	**83**	**120**	**99**	68
Potassium	NE	NE	2,900	5200	3300	7,100	4,400	5,600J	5,000J	4,700J
Selenium	50	18	4.8U	4.8U	4.8U	4.8U	4.8U	4.87U	4.8U	4.8U
Sodium	NE	NE	14000J	26000J	16000J	25000J	34000J	24,000J	23,000J	18,000J
Thallium	2	0.24	6.2U	10U	6.2U	6.2U	6.2U	6.2U	6.2U	6.2U
Vanadium	NE	26	9.7U	**94**	**65**	37U	7.4U	11	16	11
Zinc	NE	1,100	99	**1,400**	200	80	44	26	120	79

NOTES:

1	U.S. Environmental Protection Agency Drinking Water Regulations and Health Advisories, Primary Maximum Contaminant Levels (MCLs), October 1996.
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 22, 2000.
NE	Not established.
ug/L	micrograms per liter.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
TW	Temporary monitoring well
Shading	indicates a value equal to or greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Table 4-16
Groundwater Inorganic Analytical Summary - Field Event 2 (January, 2001)
Temporary Wells
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	TW-8D	TW-9	TW-10	TW-11	TW-12	TW-13	TW-13D
Inorganics (ug/L)									
Aluminum	NE	3,600	**4,200J**	**16,000J**	**4,600J**	**13,000J**	1,800J	**14,000J**	**9,800J**
Antimony	6	1.5	2.5U	2.5U	2.5U	2.5U	2.5U	**4.1**	**2.8**
Arsenic	50	0.045	4.2U	**13JN**	4.2U	4.2U	4.2U	**14**	**18**
Barium	2,000	260	**320**	**510**	200	**340**	100	230	180
Beryllium	4	7.3	0.89U	2.2U	1.0U	4.5U	1.4U	**8.3**	**8**
Calcium	NE	NE	22,000	55,000	14,000	24,000	9,400	13,000	14,000
Chromium	100	11	**130**	**370**	**110**	**230**	**29**	**210**	**170**
Cobalt	NE	220	7.7	24	2.1	12	17	27	24
Copper	1,300	140	9.8	37	10	47	8.1	22	17
Iron	NE	1,100	**14,000**	**89,000**	**8,300**	**100,000**	**14,000**	**150,000**	**150,000**
Lead	15	NE	6.2	**29**	2.3	**88**	2.7	12	8.3
Magnesium	NE	NE	5,800	19,000	4,400	19,000	3,600	5,000	4,700
Manganese	NE	88	**570**	**14,000**	**180**	**1,300**	**330**	**1,200**	**1,100**
Mercury, total	2	1.1	0.10UJ	0.16UJ	0.10U	0.17UJ	0.10U	0.014UJ	0.14UJ
Nickel	NE	73	63	**170**	72	**110**	19	**84**	**75**
Potassium	NE	NE	4,800J	9,300J	4,700J	8,200J	3,000J	5,000J	4,600J
Selenium	50	18	4.8U	4.8U	5.1	6.4	4.8U	8.7	9.3
Sodium	NE	NE	18,000J	33,000J	20,000J	60,000J	11,000J	63,000J	32,000J
Thallium	2	0.24	6.2U	**11**	6.2U	**11**	6.2U	**21**	**20**
Vanadium	NE	26	18	**96**	7.2	**43**	15	**83**	**75**
Zinc	NE	1,100	98	130	170	210	200	140	120

NOTES:

1	U.S. Environmental Protection Agency Drinking Water Regulations and Health Advisories, Primary Maximum Contaminant Levels (MCLs), October 1996.
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 22, 2000.
NE	Not established.
ug/L	micrograms per liter.
J	Estimated value.
U	The analyte was analyzed for, but was not detected above the reporting limit.
TW	Temporary monitoring well
Shading	indicates a value greater than Federal or EPA Region IX regulatory values indicated for that analyte.

Table [illegible]17
Groundwater Inorganic Analytical Summary - Field Event 3 (February, 2002)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	TW-14	TW-15	TW-16	MW-4S	MW-4I	MW-6S	MW-11S	MW-12S	MW-12I	IW-01	IW-02
Inorganics (ug/L)													
Aluminum	NE	3,600	**11,000J**	**96,000J**	**23,000**	520J	**15,000J**	**7,100J**	1,400J	**6,600J**	3,000J	120UJ	140UJ
Aluminum (Dissolved)	NE	3,600	400J	160J	89J	100J	300J	110J	78U	97J	500J	NA	NA
Antimony	6	1.5	3.1U	3.1U	3.1U	3.1U	3.1U	3.1U	3.1U	3.1U	3.1U	3.1U	3.1U
Antimony (Dissolved)	6	1.5	3.1U	3.1U	3.1U	3.1U	**5.5**	6.1R	3.1U	3.1U	3.1U	NA	NA
Arsenic	50	0.045	4.1R	**36**	**22**	2.6U	**10**	2.9R	3.3R	**4.7**	6.0R	2.6U	2.8R
Arsenic (Dissolved)	50	0.045	2.6U	2.6U	4.4R	2.6U	**8.1**	2.6U	2.6U	2.6U	5.7R	NA	NA
Barium	2,000	260	140	**640**	**440**	170	95	**330**	480	180	35	35	77
Barium (Dissolved)	2,000	260	40	33	80	150	3.7U	63	140	120	16	NA	NA
Beryllium	4	7.3	1.6U	**13**	1.4U	0.43U	1.5U	1.1U	0.29U	0.96U	0.25U	0.20U	0.58U
Beryllium (Dissolved)	4	7.3	0.48U	0.37U	0.2U	0.52U	0.20U	0.48U	0.26U	0.41U	0.20U	NA	NA
Calcium	NE	NE	14,000	20,000	26,000	5,700	18,000	14,000	16,000	21,000	40,000	4,400	12,000
Calcium (Dissolved)	NE	NE	11,000	8,300	23,000	7,000	9,000	13,000	12,000	17,000	36,000	NA	NA
Chromium	100	11	**29**	**270**	**73**	5.3R	**27**	**79**	**97**	**1,100**	**400**	1.0U	7.7
Chromium (Dissolved)	100	11	1.3R	1.0U	1.0U	1.0U	1.0R	1	3.7R	1.0U	**64**	NA	NA
Chromium, hexavalent	100	11	10U	10U	10UJ	50UJ	65UJ	26U	10UJ	10U	10U	NA	NA
Cobalt	NE	220	15	140	16	1.3U	2.7	2.3	3.5	23	6.8	1.3U	1.3U
Cobalt (Dissolved)	NE	220	6	19	2.9	1.3U	1.3	1.3U	1.3U	1.3U	1.3U	NA	NA
Copper	1,300	140	40	130	**160**	1.2U	22	19	76	98	56	**1,600**	33
Copper (Dissolved)	1,300	140	17.0	1.2U	1.5	3	5.5	1.2U	13	4.1R	21	NA	NA
Iron	NE	1,100	**11,000**	**160,000**	**51,000**	450	**8,100**	**6,600**	**2,700**	**16,000**	**3,600**	240	**34,000**
Iron (Dissolved)	NE	1,100	290	100	**2,300**	12U	100	**1,500**	380	12U	250	NA	NA
Lead	15	NE	11	**100**	**320**	1.9U	**18**	2	1.9U	9.9	3.7	1.9U	**34**
Lead (Dissolved)	15	NE	1.9U	1.9R	1.9U	1.9U	1.9U	1.9U	1.9U	1.9U	1.9U	NA	NA
Magnesium	NE	NE	4,200	9,500	7,100	2,500	4,500	5,400	6,200	5,300	1,100	650	2,600
Magnesium (Dissolved)	NE	NE	2,500	2,700	5,500	3,100	1,500	4,800	4,900	4,500	210U	NA	NA
Manganese	NE	88	**380**	**6,900**	**3,500**	49	**390**	73	**1,000**	**470**	**90**	24	**120**
Manganese (Dissolved)	NE	88	**130**	**1,400**	**3,300**	44	**140**	63	**710**	**94**	6.4U	NA	NA
Mercury, total	2	1.1	0.10U	0.37	0.4	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
Mercury, total (Dissolved)	2	1.1	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	NA	NA

Table 4-17
Groundwater Inorganic Analytical Summary - Field Event 3 (February, 2002)
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Federal MCL[1]	Region IX PRGs[2]	TW-14	TW-15	TW-16	MW-4S	MW-4I	MW-6S	MW-11S	MW-12S	MW-12I	IW-01	IW-02
Inorganics (ug/L) (continued)													
Nickel	NE	73	27	**160**	**190**	2.7R	24	57	66	**740**	**310**	3.2	2.9
Nickel (Dissolved)	NE	73	12	44	32	2.6U	5	19	14	11R	41	NA	NA
Potassium	NE	NE	3,800	7,300	11,000	12,000	5,000	4,900	3,300	5,700	6,600	1,900	3,700
Potassium (Dissolved)	NE	NE	3,300J	3,000J	10,000J	13,000J	4,300J	4,300J	3,000J	5,000J	6,700	NA	NA
Selenium	50	18	2.5U	4.3	2.5U	5.6	2.5U	2.5U	2.5U	3.9R	3.7	2.5U	2.5U
Selenium (Dissolved)	50	18	2.5U	2.6R	2.5U	4.7R	2.5U	2.5U	2.5U	3.8J	4.6J	NA	NA
Sodium	NE	NE	18,000	16,000	16,000	50,000	69,000	21,000	18,000	20,000	110,000	5,900	13,000
Sodium (Dissolved)	NE	NE	17,000J	13,000J	15,000J	50,000J	66,000J	22,000J	18,000J	20,000J	110,000	NA	NA
Thallium	2	0.24	4.4U	**8.0J**	**4.6**	4.3U	4.3U	4.3U	5.3R	4.3U	4.3U	4.3U	4.3U
Thallium (Dissolved)	2	0.24	4.3U	4.3U	4.3U	4.3U	4.3U	4.3U	4.3U	4.3U	4.3U	NA	NA
Vanadium	NE	26	18	**220**	**70**	1.5U	14	9.4	3.0R	22	**37**	1.5U	2.8R
Vanadium (Dissolved)	NE	26	1.5U	1.5U	1.5U	1.5U	4	1.5U	1.5U	1.5U	**33**	NA	NA
Zinc	NE	180	100	**460**	**460**	9.5	74	68	42	65	160	**820**	**1,500**
Zinc (Dissolved)	NE	180	47	72	46	6.9	7.2	44	32	23	5.2	NA	NA

NOTES:

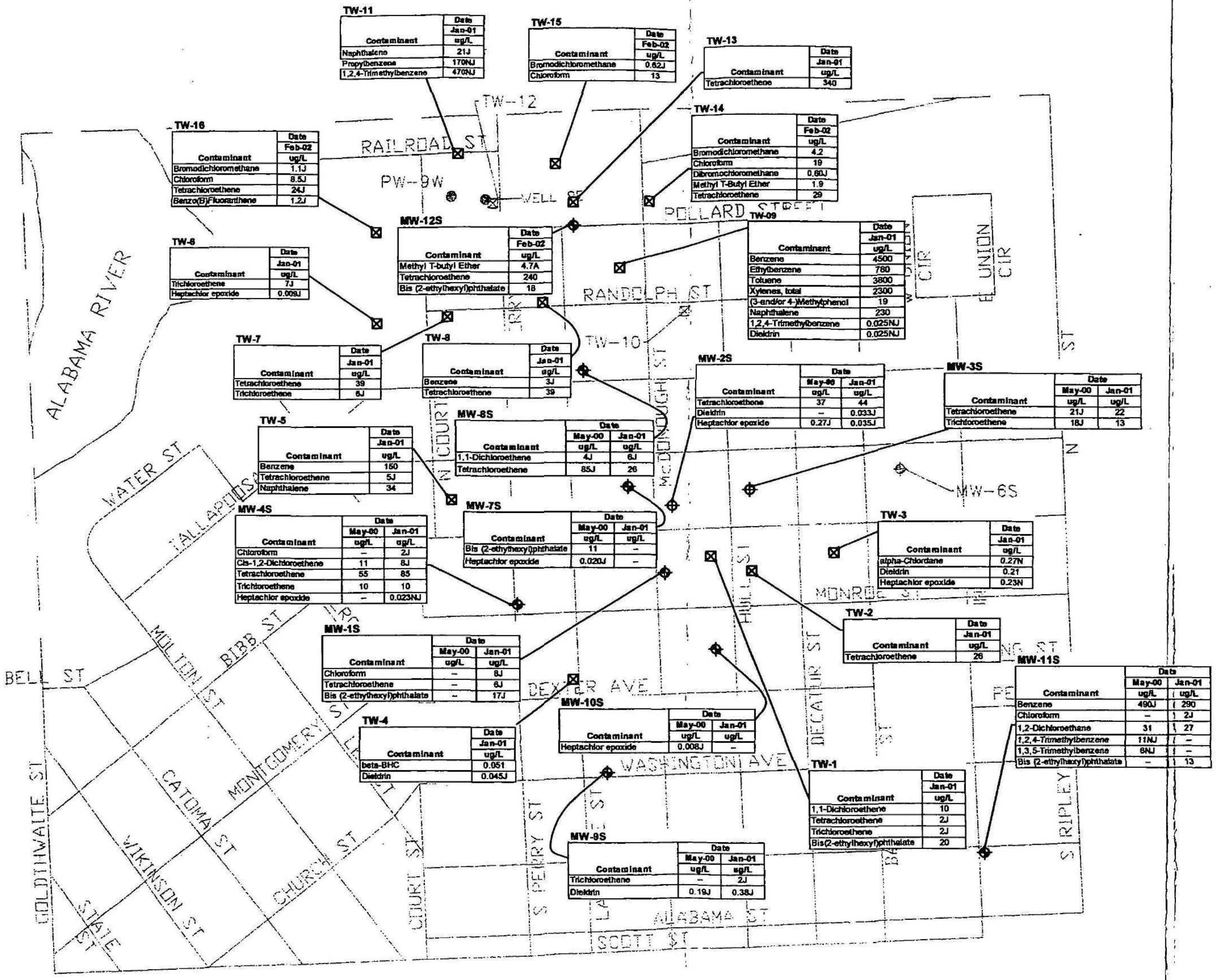
1	U.S. Environmental Protection Agency Drinking Water Regulations and Health Advisories, Primary Maximum Contaminant Levels (MCLs), October 1996.
2	U.S. Environmental Protection Agency Region IX Preliminary Remedial Goals (PRGs) Table, Tap Water PRGs, November 22, 2000.
NE	Not established
NA	Not analyzed
ug/L	micrograms per liter
J	Estimated value
R	Indicates that data is unusable
U	The analyte was analyzed for, but was not detected above the reporting limit
IW	Industrial Well
MW	Permenant monitoring well
TW	Temporary monitoring well
Shading	indicates a value greater than Federal or EPA Region IX regulatory values indicated for that analyte.

3 10 0073

CAD DWG NO: Org_GW_Spider
DATE: 08-21-02 ACM
PLOT SCALE: 1:600

ORIGINAL DWG SIZE
11 x 17
LOCATION: R:\46011\109\CAD

MOST RECENT REVISION
REVISION DATE: 08-22-02
DRAFTERS INITIALS: ACM



TW-11

Contaminant	Date Jan-01 ug/L
Naphthalene	21J
Propylbenzene	170NJ
1,2,4-Trimethylbenzene	470NJ

TW-15

Contaminant	Date Feb-02 ug/L
Bromodichloromethane	0.62J
Chloroform	13

TW-13

Contaminant	Date Jan-01 ug/L
Tetrachloroethene	340

TW-16

Contaminant	Date Feb-02 ug/L
Bromodichloromethane	1.1J
Chloroform	8.5J
Tetrachloroethene	24J
Benzo(B)Fluoranthene	1.2J

TW-14

Contaminant	Date Feb-02 ug/L
Bromodichloromethane	4.2
Chloroform	19
Dibromochloromethane	0.60J
Methyl T-Butyl Ether	1.9
Tetrachloroethene	29

TW-6

Contaminant	Date Jan-01 ug/L
Trichloroethene	7J
Heptachlor epoxide	0.009J

MW-12S

Contaminant	Date Feb-02 ug/L
Methyl T-butyl Ether	4.7A
Tetrachloroethene	240
Bis (2-ethylhexyl)phthalate	18

TW-09

Contaminant	Date Jan-01 ug/L
Benzene	4500
Ethylbenzene	780
Toluene	3800
Xylenes, total	2300
(3-and/or 4-)Methylphenol	19
Naphthalene	230
1,2,4-Trimethylbenzene	0.025NJ
Dieldrin	0.025NJ

TW-7

Contaminant	Date Jan-01 ug/L
Tetrachloroethene	39
Trichloroethene	6J

TW-8

Contaminant	Date Jan-01 ug/L
Benzene	3J
Tetrachloroethene	39

MW-2S

Contaminant	Date May-00 ug/L	Date Jan-01 ug/L
Tetrachloroethene	37	44
Dieldrin	–	0.033J
Heptachlor epoxide	0.27J	0.035J

MW-3S

Contaminant	Date May-00 ug/L	Date Jan-01 ug/L
Tetrachloroethene	21J	22
Trichloroethene	18J	13

TW-5

Contaminant	Date Jan-01 ug/L
Benzene	150
Tetrachloroethene	5J
Naphthalene	34

MW-8S

Contaminant	Date May-00 ug/L	Date Jan-01 ug/L
1,1-Dichloroethene	4J	6J
Tetrachloroethene	85J	26

MW-4S

Contaminant	Date May-00 ug/L	Date Jan-01 ug/L
Chloroform	–	2J
Cis-1,2-Dichloroethene	11	8J
Tetrachloroethene	55	85
Trichloroethene	10	10
Heptachlor epoxide	–	0.023NJ

MW-7S

Contaminant	Date May-00 ug/L	Date Jan-01 ug/L
Bis (2-ethylhexyl)phthalate	11	–
Heptachlor epoxide	0.020J	–

TW-3

Contaminant	Date Jan-01 ug/L
alpha-Chlordane	0.27N
Dieldrin	0.21
Heptachlor epoxide	0.23N

TW-2

Contaminant	Date Jan-01 ug/L
Tetrachloroethene	26

MW-1S

Contaminant	Date May-00 ug/L	Date Jan-01 ug/L
Chloroform	–	8J
Tetrachloroethene	–	6J
Bis (2-ethylhexyl)phthalate	–	17J

MW-11S

Contaminant	Date May-00 ug/L	Date Jan-01 ug/L
Benzene	490J	290
Chloroform	–	2J
1,2-Dichloroethane	31	27
1,2,4-Trimethylbenzene	11NJ	–
1,3,5-Trimethylbenzene	6NJ	–
Bis (2-ethylhexyl)phthalate	–	13

MW-10S

Contaminant	Date May-00 ug/L	Date Jan-01 ug/L
Heptachlor epoxide	0.008J	–

TW-4

Contaminant	Date Jan-01 ug/L
beta-BHC	0.051
Dieldrin	0.045J

TW-1

Contaminant	Date Jan-01 ug/L
1,1-Dichloroethene	10
Tetrachloroethene	2J
Trichloroethene	2J
Bis(2-ethylhexyl)phthalate	20

MW-9S

Contaminant	Date May-00 ug/L	Date Jan-01 ug/L
Trichloroethene	–	2J
Dieldrin	0.19J	0.38J

LEGEND

ug/L MICROGRAMS PER LITER

J ESTIMATED VALUE

N PRESUMPTIVE EVIDENCE OF PRESENCE OF MATERIAL

⊕ MW ADEM MONITORING WELL

⊕ MW SHALLOW MONITORING WELL

☒ TW TEMPORARY WELL

● PW PUBLIC SUPPLY WELL

(–) INDICATES A NON-DETECT CONCENTRATION.

FOR SAMPLES WITH DUPLICATES, THE HIGHEST CONCENTRATION DETECTED IS SHOWN.

VALUES SHOWN ARE TOTAL CONCENTRATIONS.

SCALE: 1"= 600 FEET

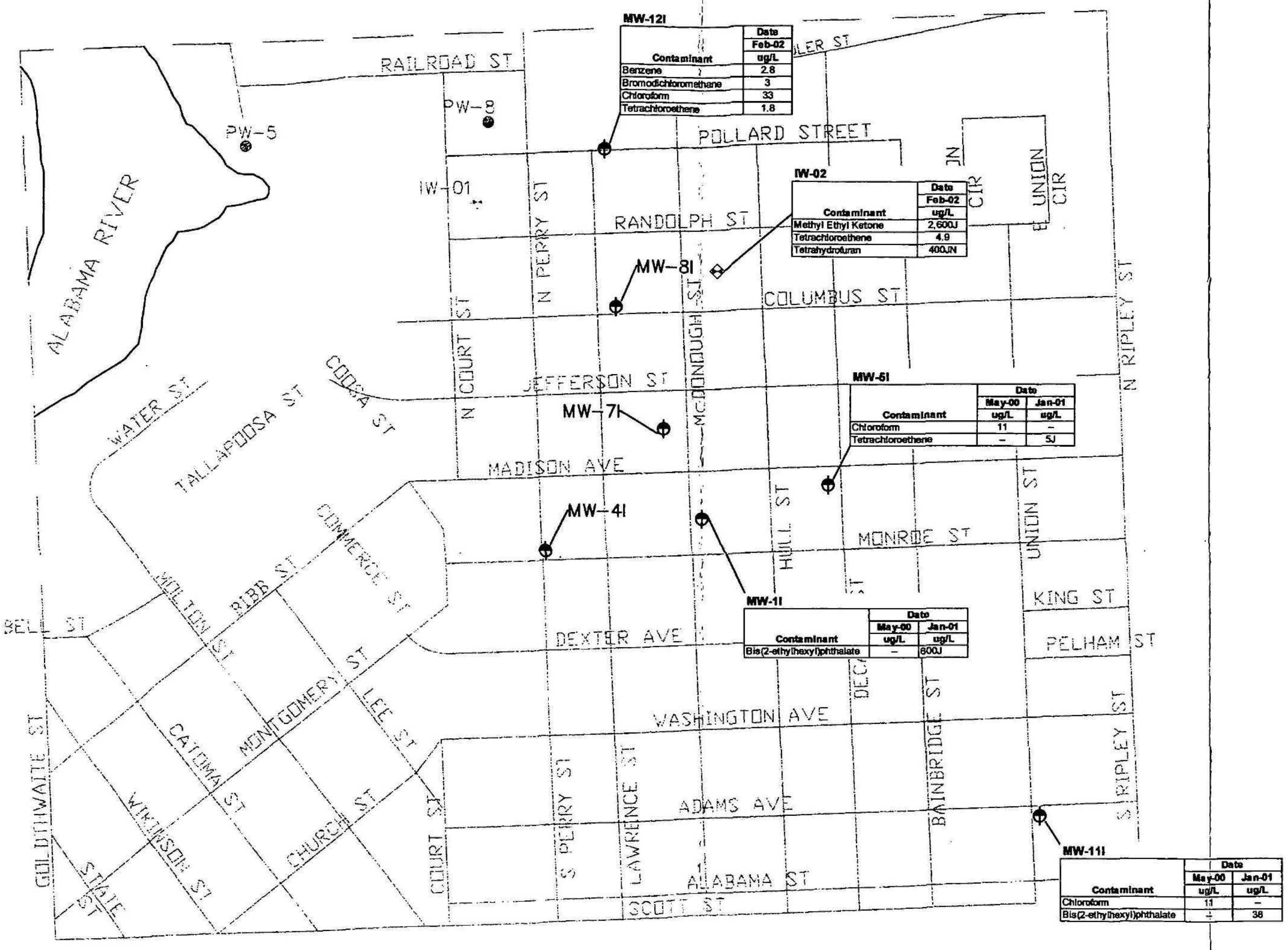
CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

CONCENTRATIONS OF ELEVATED ORGANIC CONTAMINANTS IN
GROUNDWATER OVER TIME – SHALLOW WELLS

FIGURE
4–8

CAD DWG NO: Org_GW_Spider_Int ORIGINAL DWG SIZE
DATE: 08-20-02 ACM 11 x 17
PLOT SCALE: 1:600 LOCATION: R:\48011\109\CAD

MOST [illegible]T REVISION
REVISION DATE: 08-22-02
DRAFTERS INITIALS: ACM



MW-12I

Contaminant	Date Feb-02 ug/L
Benzene	2.8
Bromodichloromethane	3
Chloroform	33
Tetrachloroethene	1.8

IW-02

Contaminant	Date Feb-02 ug/L
Methyl Ethyl Ketone	2,600J
Tetrachloroethene	4.9
Tetrahydrofuran	400JN

MW-6I

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Chloroform	11	–
Tetrachloroethene	–	5J

MW-1I

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Bis(2-ethylhexyl)phthalate	–	600J

MW-11I

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Chloroform	11	–
Bis(2-ethylhexyl)phthalate	–	38

LEGEND

ug/L MICROGRAMS PER LITER

J ESTIMATED VALUE

◈ INDUSTRIAL WELL

⊕ INTERMEDIATE MONITORING WELL

(–) INDICATES A NON–DETECT CONCENTRATION.

FOR SAMPLES WITH DUPLICATES, THE HIGHEST CONCENTRATION DETECTED IS SHOWN.

VALUES SHOWN ARE TOTAL CONCENTRATIONS.

THE DEPTH OF THE SCREENED INTERVAL OF IW–01 AND IW–02 IS UNKNOWN. THE WELLS MAY OR MAY NOT BE "INTERMEDIATE" WELLS.

SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

CONCENTRATIONS OF ELEVATED ORGANIC CONTAMINANTS IN GROUNDWATER OVER TIME – INTERMEDIATE WELLS

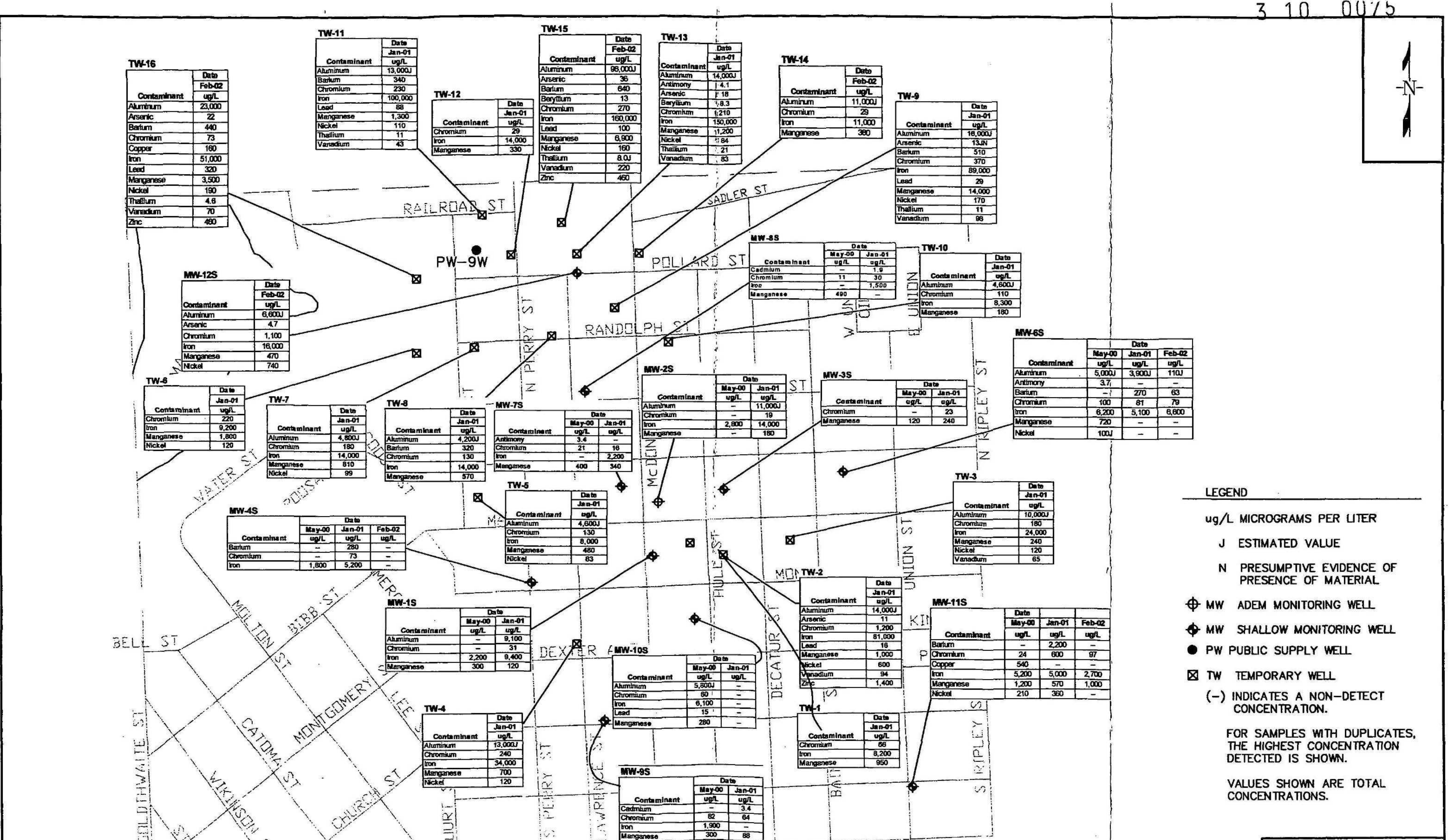
FIGURE
4–9

3 10 0075

CAD DWG NO: Inorg_GW_Spider
DATE: 08-21-02 ACM
PLOT SCALE: 1:600

ORIGINAL DWG SIZE
11 x 17
LOCATION: R:\48011\109\CAD

MOST [illegible] REVISION
[illegible]TE: 08-22-02
DRAFTERS INITIALS: ACM



TW-16

Contaminant	Date Feb-02 ug/L
Aluminum	23,000
Arsenic	22
Barium	440
Chromium	73
Copper	160
Iron	51,000
Lead	320
Manganese	3,500
Nickel	190
Thallium	4.6
Vanadium	70
Zinc	460

TW-11

Contaminant	Date Jan-01 ug/L
Aluminum	13,000J
Barium	340
Chromium	230
Iron	100,000
Lead	88
Manganese	1,300
Nickel	110
Thallium	11
Vanadium	43

TW-12

Contaminant	Date Jan-01 ug/L
Chromium	29
Iron	14,000
Manganese	330

TW-15

Contaminant	Date Feb-02 ug/L
Aluminum	96,000J
Arsenic	36
Barium	640
Beryllium	13
Chromium	270
Iron	160,000
Lead	100
Manganese	6,900
Nickel	160
Thallium	8.0J
Vanadium	220
Zinc	460

TW-13

Contaminant	Date Jan-01 ug/L
Aluminum	14,000J
Antimony	4.1
Arsenic	18
Beryllium	8.3
Chromium	210
Iron	150,000
Manganese	1,200
Nickel	84
Thallium	21
Vanadium	83

TW-14

Contaminant	Date Feb-02 ug/L
Aluminum	11,000J
Chromium	29
Iron	11,000
Manganese	380

TW-9

Contaminant	Date Jan-01 ug/L
Aluminum	16,000J
Arsenic	13JN
Barium	510
Chromium	370
Iron	89,000
Lead	29
Manganese	14,000
Nickel	170
Thallium	11
Vanadium	96

MW-12S

Contaminant	Date Feb-02 ug/L
Aluminum	6,600J
Arsenic	4.7
Chromium	1,100
Iron	16,000
Manganese	470
Nickel	740

MW-8S

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Cadmium	–	1.9
Chromium	11	30
Iron	–	1,500
Manganese	490	–

TW-10

Contaminant	Date Jan-01 ug/L
Aluminum	4,600J
Chromium	110
Iron	8,300
Manganese	180

TW-6

Contaminant	Date Jan-01 ug/L
Chromium	220
Iron	9,200
Manganese	1,800
Nickel	120

TW-7

Contaminant	Date Jan-01 ug/L
Aluminum	4,800J
Chromium	180
Iron	14,000
Manganese	810
Nickel	99

TW-8

Contaminant	Date Jan-01 ug/L
Aluminum	4,200J
Barium	320
Chromium	130
Iron	14,000
Manganese	570

MW-7S

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Antimony	3.4	–
Chromium	21	16
Iron	–	2,200
Manganese	400	340

MW-2S

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Aluminum	–	11,000J
Chromium	–	19
Iron	2,800	14,000
Manganese	–	180

MW-3S

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Chromium	–	23
Manganese	120	240

MW-6S

Contaminant	Date May-00 ug/L	 Jan-01 ug/L	 Feb-02 ug/L
Aluminum	5,000J	3,900J	110J
Antimony	3.7	–	–
Barium	–	270	63
Chromium	100	81	79
Iron	6,200	5,100	6,600
Manganese	720	–	–
Nickel	100J	–	–

TW-5

Contaminant	Date Jan-01 ug/L
Aluminum	4,600J
Chromium	130
Iron	8,000
Manganese	480
Nickel	83

MW-4S

Contaminant	Date May-00 ug/L	 Jan-01 ug/L	 Feb-02 ug/L
Barium	–	280	–
Chromium	–	73	–
Iron	1,800	5,200	–

TW-3

Contaminant	Date Jan-01 ug/L
Aluminum	10,000J
Chromium	180
Iron	24,000
Manganese	240
Nickel	120
Vanadium	65

TW-2

Contaminant	Date Jan-01 ug/L
Aluminum	14,000J
Arsenic	11
Chromium	1,200
Iron	81,000
Lead	16
Manganese	1,000
Nickel	600
Vanadium	94
Zinc	1,400

MW-11S

Contaminant	Date May-00 ug/L	 Jan-01 ug/L	 Feb-02 ug/L
Barium	–	2,200	–
Chromium	24	600	97
Copper	540	–	–
Iron	5,200	5,000	2,700
Manganese	1,200	570	1,000
Nickel	210	360	–

MW-1S

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Aluminum	–	9,100
Chromium	–	31
Iron	2,200	9,400
Manganese	300	120

MW-10S

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Aluminum	5,800J	–
Chromium	60	–
Iron	6,100	–
Lead	15	–
Manganese	280	–

TW-4

Contaminant	Date Jan-01 ug/L
Aluminum	13,000J
Chromium	240
Iron	34,000
Manganese	700
Nickel	120

MW-9S

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Cadmium	–	3.4
Chromium	82	64
Iron	1,900	–
Manganese	300	88
Nickel	85J	79

TW-1

Contaminant	Date Jan-01 ug/L
Chromium	66
Iron	8,200
Manganese	950

LEGEND

ug/L MICROGRAMS PER LITER
J ESTIMATED VALUE
N PRESUMPTIVE EVIDENCE OF PRESENCE OF MATERIAL
⊕ MW ADEM MONITORING WELL
⊕ MW SHALLOW MONITORING WELL
● PW PUBLIC SUPPLY WELL
☒ TW TEMPORARY WELL
(–) INDICATES A NON-DETECT CONCENTRATION.

FOR SAMPLES WITH DUPLICATES, THE HIGHEST CONCENTRATION DETECTED IS SHOWN.

VALUES SHOWN ARE TOTAL CONCENTRATIONS.

SCALE: 1"= 600 FEET

BV

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

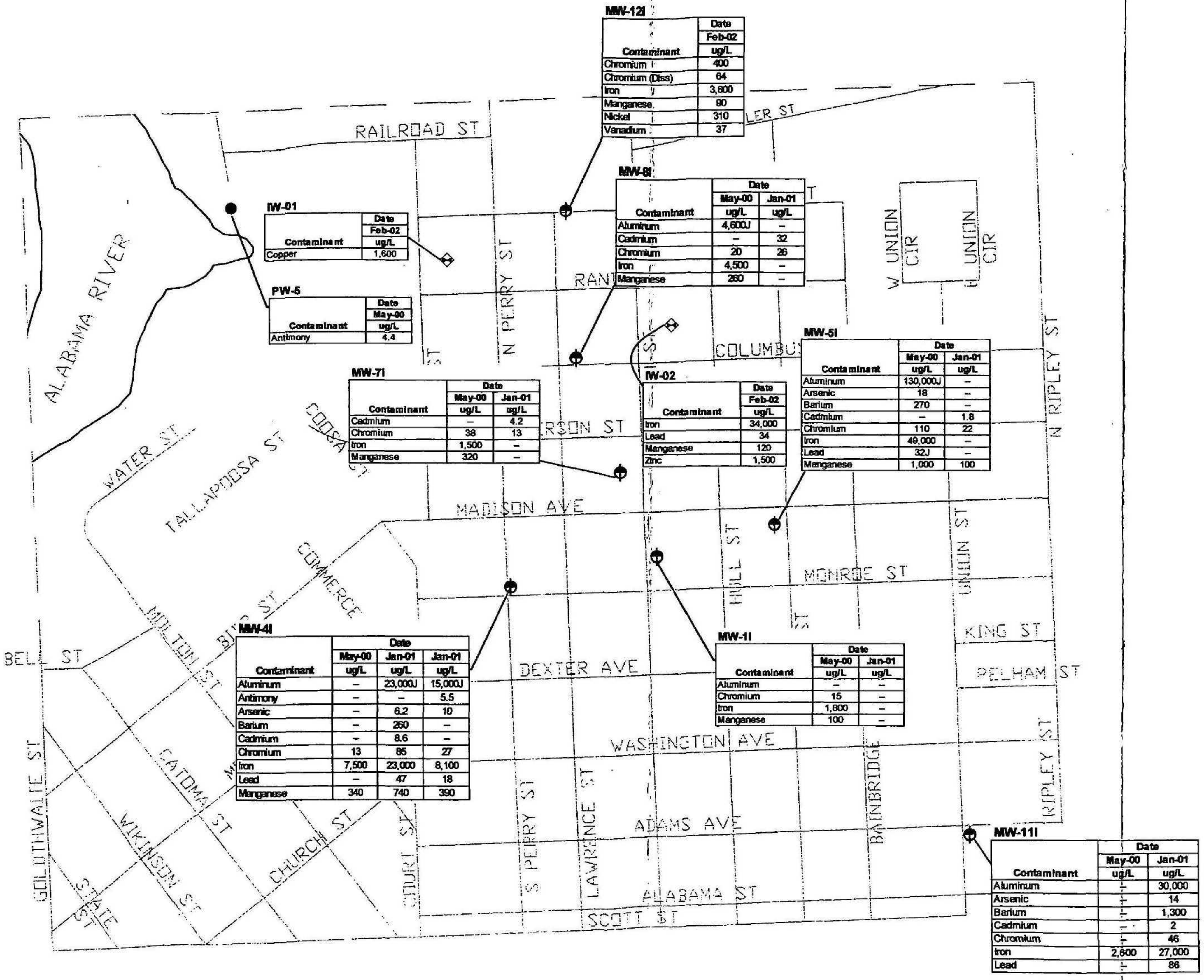
CONCENTRATIONS OF ELEVATED INORGANIC CONTAMINANTS IN GROUNDWATER OVER TIME – SHALLOW WELLS

FIGURE 4-10

3 10 0076

MOST RECENT REVISION
REVISION DATE: 08-15-02
DRAFTERS INITIALS: ACM

CAD DWG NO: Inorg_GW_Spider_Int ORIGINAL DWG SIZE
DATE: 08-22-02 ACM 11 x 17
PLOT SCALE: 1:600 LOCATION: R:\46011\109\CAD



MW-12I

Contaminant	Date Feb-02 ug/L
Chromium	400
Chromium (Diss)	64
Iron	3,600
Manganese	90
Nickel	310
Vanadium	37

IW-01

Contaminant	Date Feb-02 ug/L
Copper	1,600

MW-8I

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Aluminum	4,600J	–
Cadmium	–	32
Chromium	20	26
Iron	4,500	–
Manganese	260	–

PW-5

Contaminant	Date May-00 ug/L
Antimony	4.4

MW-7I

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Cadmium	–	4.2
Chromium	38	13
Iron	1,500	–
Manganese	320	–

IW-02

Contaminant	Date Feb-02 ug/L
Iron	34,000
Lead	34
Manganese	120
Zinc	1,500

MW-5I

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Aluminum	130,000J	–
Arsenic	18	–
Barium	270	–
Cadmium	–	1.8
Chromium	110	22
Iron	49,000	–
Lead	32J	–
Manganese	1,000	100

MW-4I

Contaminant	Date May-00 ug/L	 Jan-01 ug/L	 Jan-01 ug/L
Aluminum	–	23,000J	15,000J
Antimony	–	–	5.5
Arsenic	–	6.2	10
Barium	–	260	–
Cadmium	–	8.6	–
Chromium	13	85	27
Iron	7,500	23,000	8,100
Lead	–	47	18
Manganese	340	740	390

MW-1I

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Aluminum	–	–
Chromium	15	–
Iron	1,600	–
Manganese	100	–

MW-11I

Contaminant	Date May-00 ug/L	 Jan-01 ug/L
Aluminum	–	30,000
Arsenic	–	14
Barium	–	1,300
Cadmium	–	2
Chromium	–	46
Iron	2,600	27,000
Lead	–	86

LEGEND

ug/L MICROGRAMS PER LITER

J ESTIMATED VALUE

◈ IW INDUSTRIAL WELL

⦶ MW INTERMEDIATE MONITORING WELL

(–) INDICATES A NON-DETECT CONCENTRATION.

FOR SAMPLES WITH DUPLICATES, THE HIGHEST CONCENTRATION DETECTED IS SHOWN.

VALUES SHOWN ARE TOTAL CONCENTRATIONS.

THE DEPTH OF THE SCREENED INTERVAL OF IW-01 AND IW-02 IS UNKNOWN. THE WELLS MAY OR MAY NOT BE "INTERMEDIATE" WELLS.

SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

CONCENTRATIONS OF ELEVATED INORGANIC CONTAMINANTS IN GROUNDWATER OVER TIME – INTERMEDIATE WELLS

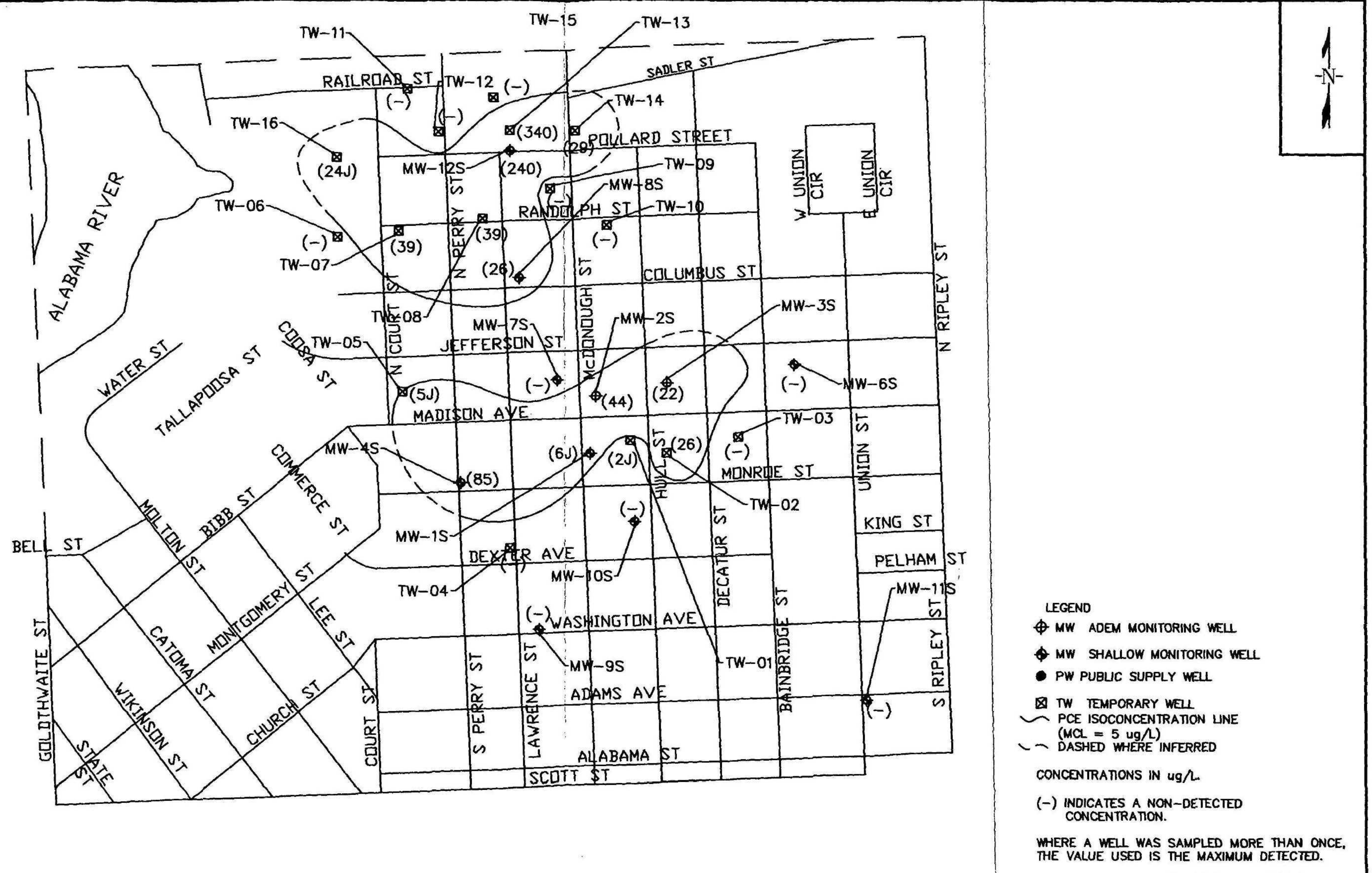
FIGURE 4-11

3 10 0077

CAD DWG NO: PCE_isoconc
DATE: 08-21-02 ACM
PLOT SCALE: 1:600

ORIGINAL DWG SIZE
11 x 17
LOCATION: R:\48011\109\CAD

MOST RECENT REVISION
REVISION DATE: 07-08-02
DRAFTERS INITIALS: ACM



SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

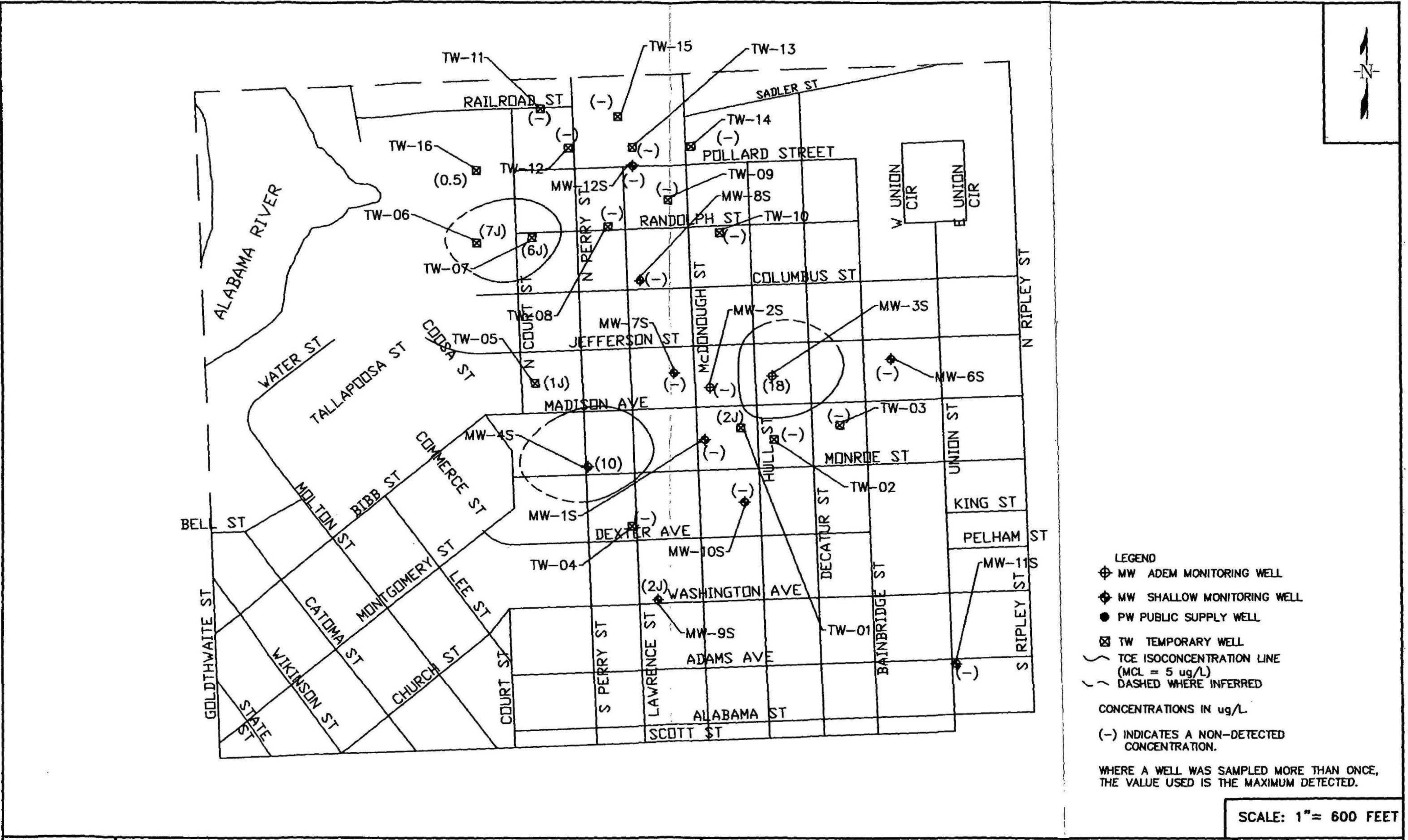
GROUNDWATER MCL ISOCONCENTRATION MAP – PCE

FIGURE
4–12

CAD DWG NO: TCE_isocona
DATE: 08-21-02 ACM
PLOT SCALE: 1:600

ORIGINAL DWG SIZE
11 x 17
LOCATION: R:\48011\109\CAD

MOST RECENT REVISION
REVISION DATE: 07-08-02
DRAFTERS INITIALS: ACM



CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

GROUNDWATER MCL ISOCONCENTRATION MAP – TCE

FIGURE
4–13

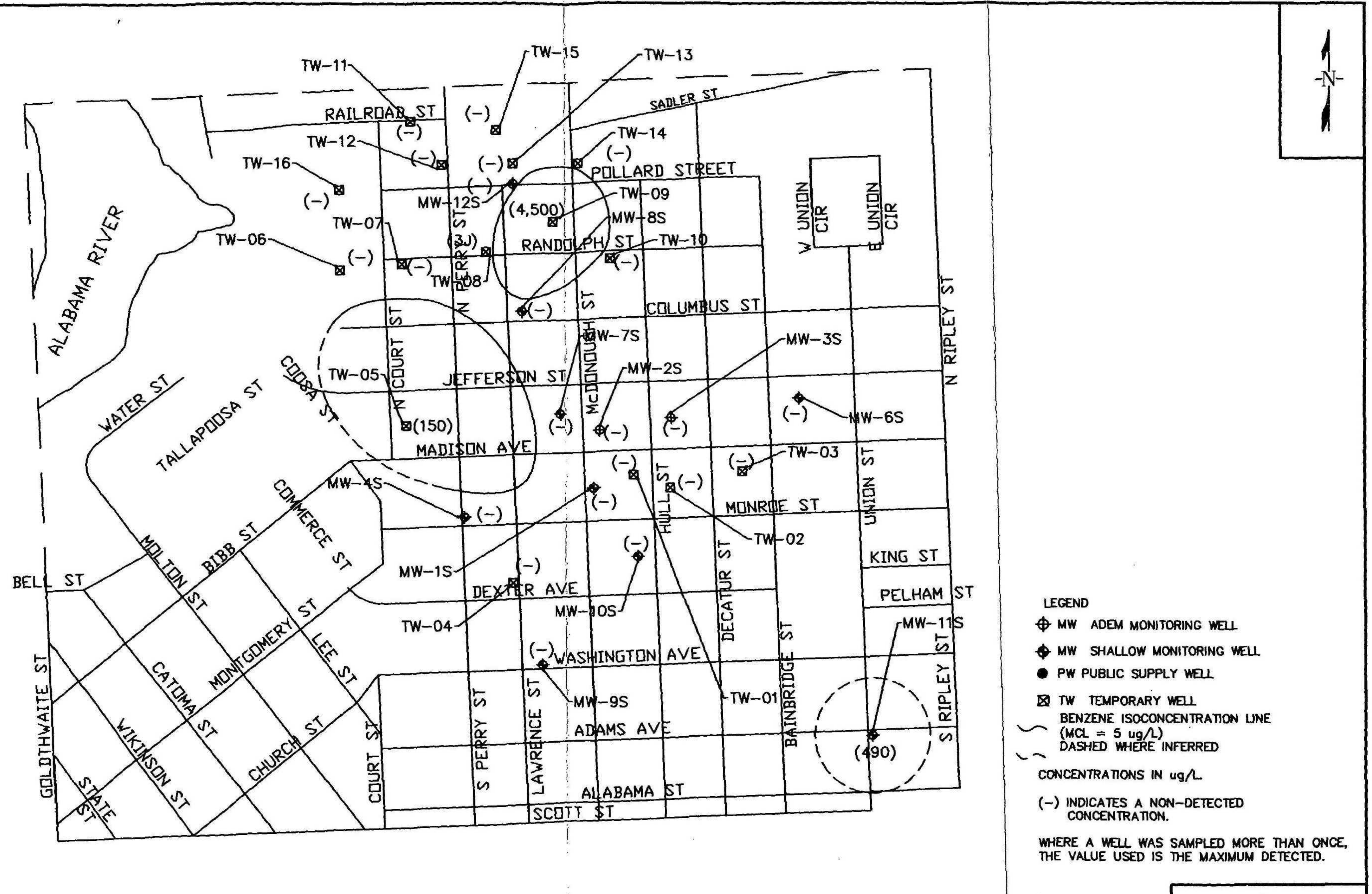
Benzene contamination was detected above the MCL in only three wells; however, the contamination was found to be 30 (TW-05) to 900 times (TW-09) the MCL value. The data points to three discrete areas of benzene contamination around these wells. Elevated concentrations of benzene ranged from 150 to 4,500 ug/L. Figure 4-14 presents the isoconcentration map for benzene in shallow wells. The contaminant, bis(2-ethylhexyl)phthalate, was detected above MCL in three areas: MW-11S to the southeast, MW-12S to the north, and around centrally-located wells MW-1S, MW-7S, and TW-01. Elevated concentrations of bis(2-ethylhexyl)phthalate ranged from 11 to 600J ug/L. Figure 4-15 presents an isoconcentration map of bis(2-ethylhexyl)phthalate conatmination.

Barium, beryllium, cadmium, and copper were detected in concentrations that exceed MCLs, but no more than two shallow wells were found to be contaminated with the same contaminant. In 15 shallow wells, chromium is the most widespread of all contaminants exceeding MCL values. Like TCE, a chromium hotspot exists at MW-11S. Two smaller plumes appear at well TW-04 and wells MW-6S, TW-02 and TW-03. A larger plume in the northeast encompasses wells MW-12S, TW-5, TW-6, TW-7, TW-8, TW-9, TW-10, TW-11, TW-13, and TW-15. Figure 4-16 presents the isoconcentration map for chromium in shallow wells.

Lead contamination was detected at or above the MCL in six shallow wells. A small plume at the MCL value exists around wells MW-10S and TW-02. A small plume around well TW-09 to the north was found at nearly twice the MCL value. The highest contamination of lead in the shallow groundwater was found in wells TW-11, TW-15, and TW-16. Figure 4-17 presents an isoconcentration map of lead contamination. Thallium contamination was detected above the MCL in many of the same wells. A small plume has been noted around TW-09, and a larger plume around TW-11, TW-13, TW-15, and TW-16. Figure 4-18 presents the shallow groundwater isoconcentration map for thallium.

The RI focused on the investigation of contamination in the shallow surficial aquifer; however, some contamination was noted in the lower surfical aquifer. PCE, beryllium, chromium, and lead were detected above MCLs in MW-5I. Well MW-11I contained bis(2-ethylhexyl)phthalate and lead above MCLs, and bis(2-ethylhexyl)phthalate also was detected above the MCL in MW-1I.

CAD DWG NO: Benzene_isoconc ORIGINAL DWG SIZE MOST RECENT [illegible]SION
DATE: 08-15-02 ACM 11 x 17 REVISION DATE: 08-16-02
PLOT SCALE: 1:600 LOCATION: R:\46011\109\CAD DRAFTERS INITIALS: ACM



SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

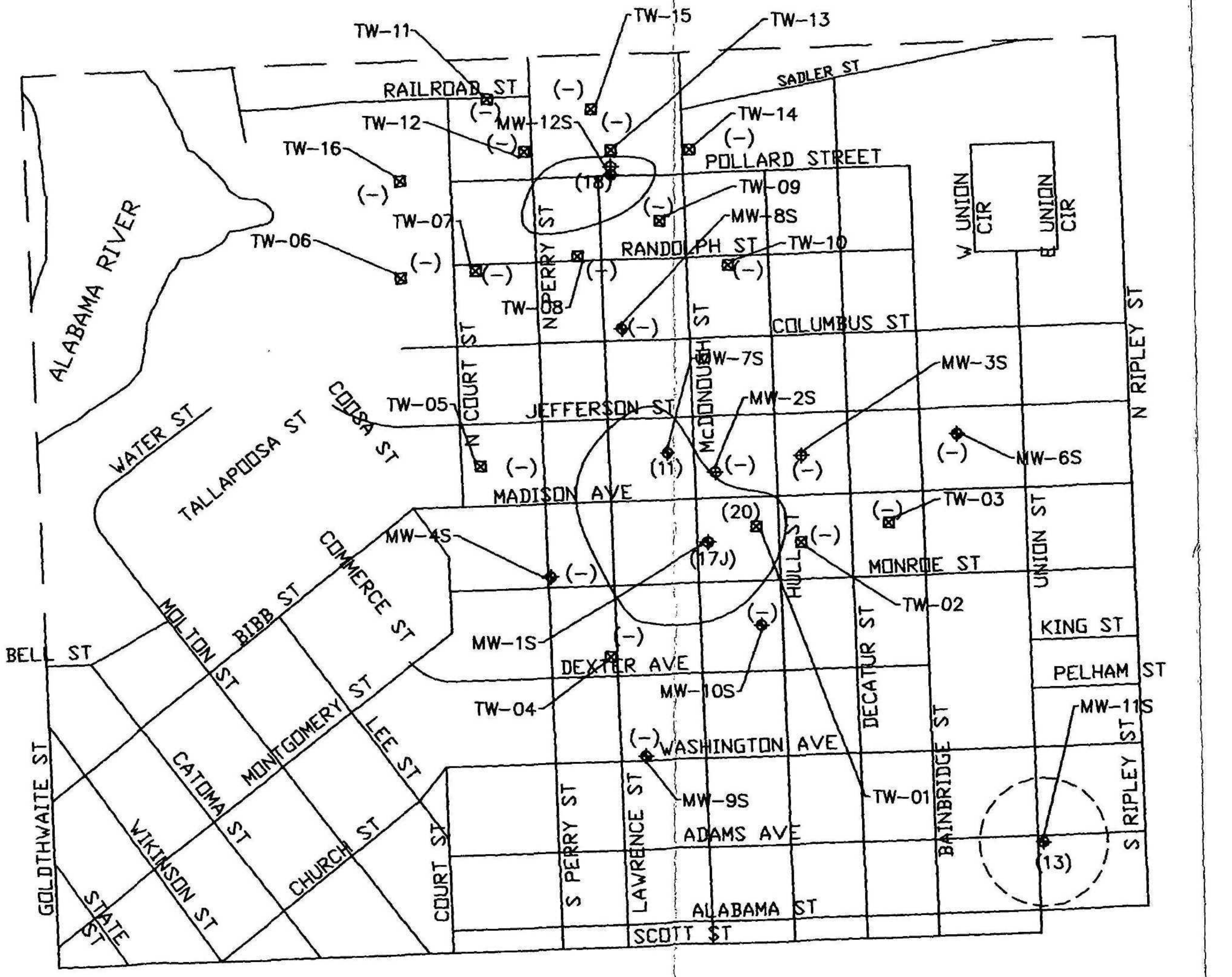
GROUNDWATER MCL ISOCONCENTRATION MAP – BENZENE

FIGURE 4-14

CAD DWG NO: DEHP_isoconc
DATE: 08-15-02 ACM
PLOT SCALE: 1:600

ORIGINAL DWG SIZE
11 x 17
LOCATION: R:\48011\109\CAD

MOST RECEN[illegible]ISION
REVISION DATE: 08-16-02
DRAFTERS INITIALS: ACM



LEGEND
- MW ADEM MONITORING WELL
- MW SHALLOW MONITORING WELL
- ● PW PUBLIC SUPPLY WELL
- ⊠ TW TEMPORARY WELL
- DEHP ISOCONCENTRATION LINE (MCL = 6 ug/L) DASHED WHERE INFERRED

CONCENTRATIONS IN ug/L

(-) INDICATES A NON-DETECTED CONCENTRATION.

WHERE A WELL WAS SAMPLED MORE THAN ONCE, THE VALUE USED IS THE MAXIMUM DETECTED.

SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

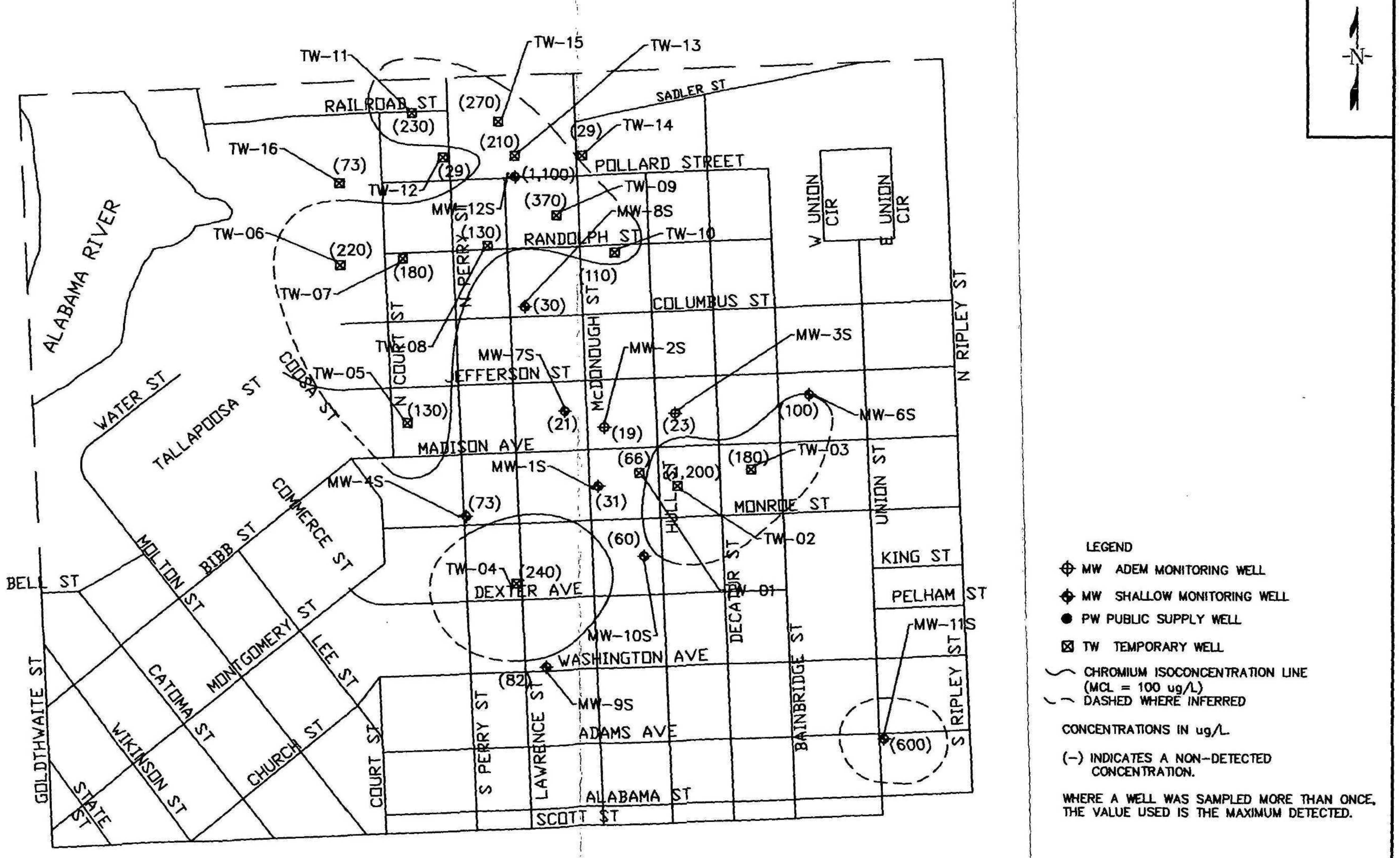
GROUNDWATER MCL ISOCONCENTRATION MAP –
BIS(2-ETHYLHEXYL)PHTHALATE

FIGURE
4-15

MOST RECENT [illegible]ISION
REVISION DATE: 07-19-02
DRAFTERS INITIALS: ACM

ORIGINAL DWG SIZE
11 x 17
LOCATION: R:\48011\109\CAD

CAD DWG NO: Cr_isocone
DATE: 06-21-02 ACM
PLOT SCALE: 1:600



LEGEND

⊕ MW ADEM MONITORING WELL

⊕ MW SHALLOW MONITORING WELL

● PW PUBLIC SUPPLY WELL

☒ TW TEMPORARY WELL

～ CHROMIUM ISOCONCENTRATION LINE
(MCL = 100 ug/L)
- - DASHED WHERE INFERRED

CONCENTRATIONS IN ug/L.

(-) INDICATES A NON-DETECTED CONCENTRATION.

WHERE A WELL WAS SAMPLED MORE THAN ONCE, THE VALUE USED IS THE MAXIMUM DETECTED.

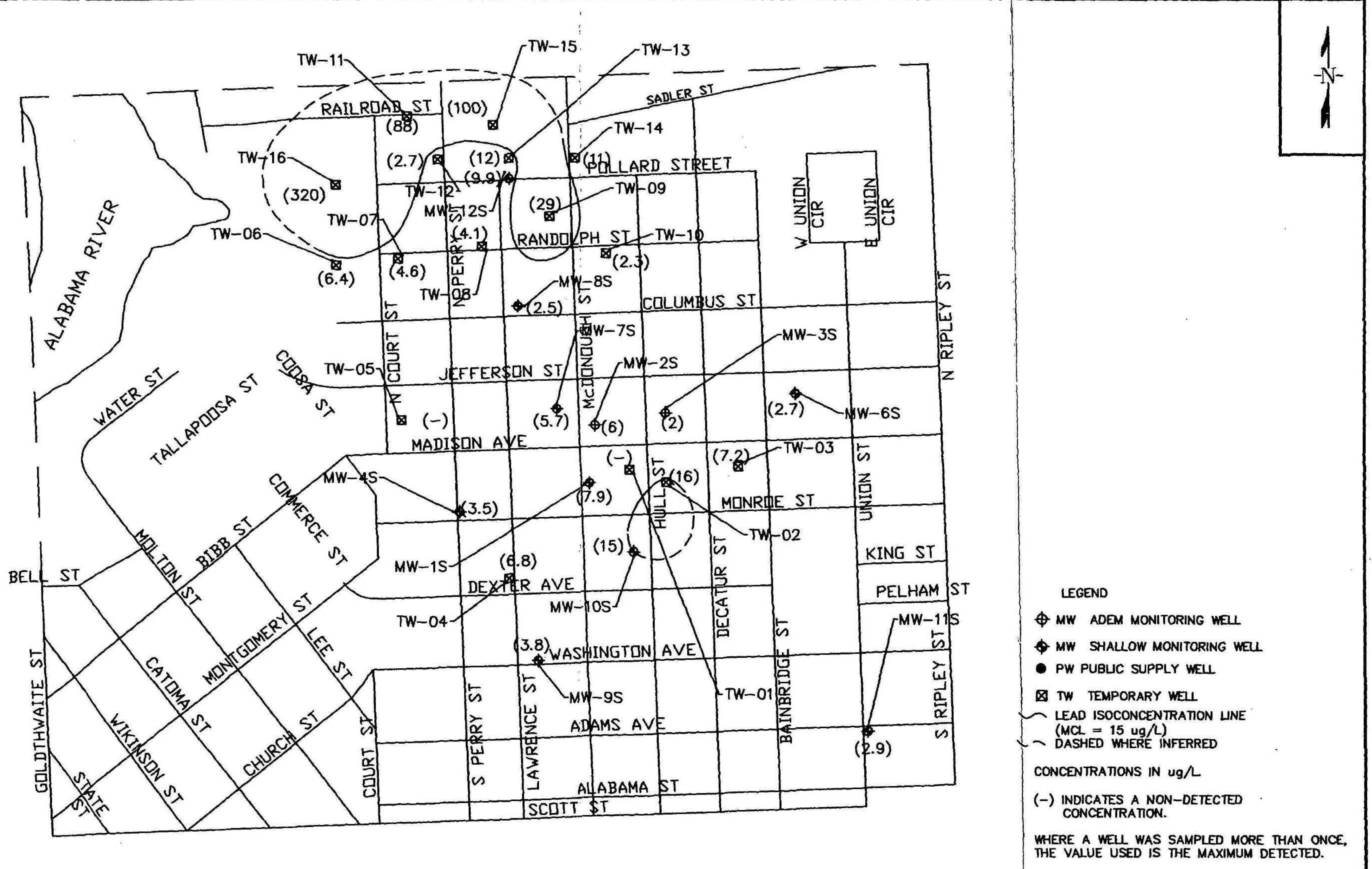
SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

SHALLOW GROUNDWATER ISOCONCENTRATION MAP - CHROMIUM

FIGURE
4-16

CAD DWG NO: Pb_isocono
DATE: 08-18-02 ACM
PLOT SCALE: 1:600
ORIGINAL DWG SIZE
11 x 17
LOCATION: R:\48011\109\CAD
MOST RECENT REVISION DATE: 08-18-02
DRAFTERS INITIALS: ACM



LEGEND

⊕ MW ADEM MONITORING WELL
⊕ MW SHALLOW MONITORING WELL
● PW PUBLIC SUPPLY WELL
☒ TW TEMPORARY WELL
LEAD ISOCONCENTRATION LINE (MCL = 15 ug/L) DASHED WHERE INFERRED

CONCENTRATIONS IN ug/L.

(-) INDICATES A NON-DETECTED CONCENTRATION.

WHERE A WELL WAS SAMPLED MORE THAN ONCE, THE VALUE USED IS THE MAXIMUM DETECTED.

SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

GROUNDWATER MCL ISOCONCENTRATION MAP – LEAD

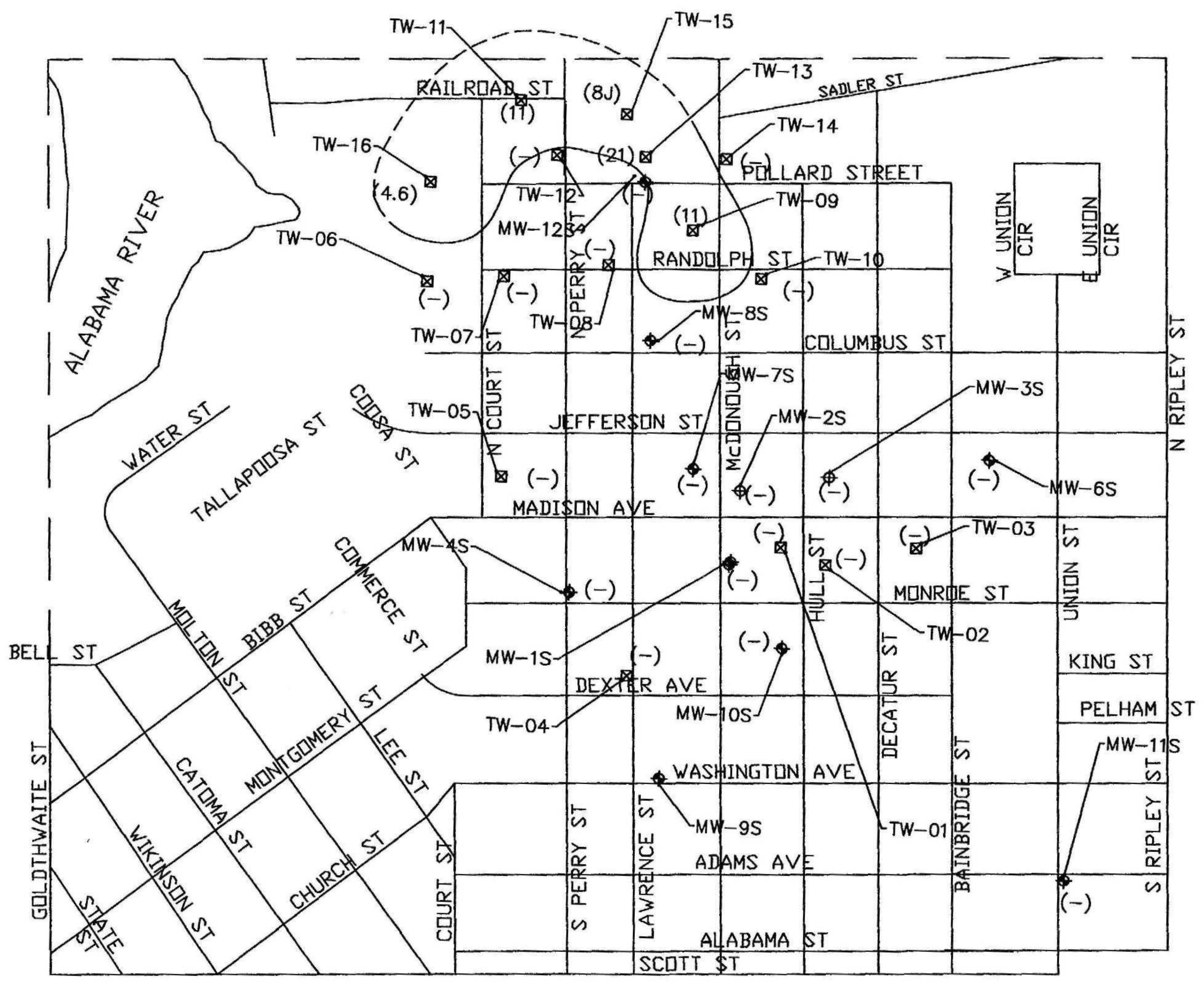
FIGURE 4-17

CAD DWG NO: Th_isoconc
DATE: 08-16-02 ACM
PLOT SCALE: 1:600

ORIGINAL DWG SIZE
11 x 17
LOCATION: R:\48011\109\CAD

MOST RECEN. ...VISION
REVISION DATE: 08-16-02
DRAFTERS INITIALS: ACM

3 10 0084



LEGEND

⊕ MW ADEM MONITORING WELL
⊕ MW SHALLOW MONITORING WELL
● PW PUBLIC SUPPLY WELL
☒ TW TEMPORARY WELL
THALLIUM ISOCONCENTRATION LINE (MCL = 2 ug/L)
DASHED WHERE INFERRED

CONCENTRATIONS IN ug/L.

(–) INDICATES A NON-DETECTED CONCENTRATION.

WHERE A WELL WAS SAMPLED MORE THAN ONCE, THE VALUE USED IS THE MAXIMUM DETECTED.

SCALE: 1"= 600 FEET

CAPITOL CITY PLUME SITE
MONTGOMERY, MONTGOMERY COUNTY, ALABAMA

GROUNDWATER MCL ISOCONCENTRATION MAP – THALLIUM

FIGURE
4–18

Cadmium and lead were elevated in MW-4I. Wells MW-8I, MW-12I, IW-01, and IW-02 were contaminated above MCLs with cadmium, chromium, copper, and lead, respectively.

Additional water quality parameters were collected during the RI. These parameters included alkalinity, ammonia, chloride, nitrate, sulfate, TOC, dissolved organic carbon, methane, ethane, and ethene. MW-7S exceeded the MCL for nitrate; MW-12I, TW-14, and TW-15 exceeded the MCL for sulfate. No samples exceeded the MCL for chloride. No other MCLs are established. Table 4-18 presents the additional groundwater parameter results.

4.2.4 Groundwater Conclusions

Groundwater quality in the shallow surficial aquifer at the Capitol City Plume site has been affected by past waste disposal practices in the downtown area. PCE contamination exists throughout the site and exceeded the MCL over a wide area in the northwest and central portions of the site. The greatest detection of PCE occurred in the northern plume at levels nearly 50 to 70 times the MCL. The MCL for TCE was exceeded in multiple wells; however, in only one well was the contamination greater than two times the MCL, and in most wells sampled, TCE was not detected. Although benzene was not detected in most sampled wells, the three wells that are contaminated with benzene are 30 to 900 times the MCL. Bis(2-ethylhexyl)phthalate was detected at approximately two to three times the MCL in five wells; other sampled wells had no detectable concentrations. Chromium was detected above the MCL in many wells, and plumes encompass a wide area in the northwest, center, and southeast corner of the site. Chromium concentrations generally are two times the MCL, but one well in the northwest and one well in the center of the site were each over ten times the limit. Lead and thallium contamination were both detected above MCLs across the northernmost wells, and lead was detected at the MCL in two wells in the center of the site. In the north are of the site, lead was up to 20 times the MCL, and thallium exceeded the MCL by approximately ten times.

Few intermediate aquifer wells were sampled during the RI and little contamination was detected above MCLs. Well MW-5I was the most contaminated intermediate aquifer well with PCE, beryllium, chromium, and lead contamination all exceeding MCLs.

Tabl[illegible]
Water Quality Parameters
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Units	MCL	MW-1S 2000	MW-1I 2000	MW-2S 2000	MW-2S 2001	MW-3S 2000	MW-3S 2001	MW-4S 2000	MW-4S 2001	MW-4I 2000	MW-5I 2000
Alkalinity, Total as CaCO3	mg/L	NE	9.3A	38	9.4	8.7	4.6AJ	6.6	19	34	54	88
Ammonia	mg/L	NE	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	1.0	0.82
Chloride	mg/L	250 *	15A	2.6A	13	13	15	12	19	19	2.9	5.3
Nitrate-nitrogen	mg/L	10	3.0A	0.46A	7.5	7.2	6.1	7.0	2.9	5.0	0.06	0.40
Sulfate	mg/L	250 *	35A	3.7A	43	44	48	51	41	51	18	40
Total organic carbon	mg/L	NE	3.1J	3.2	3.4	4.6	1.8J	3.2A	4.6	5.6	4.0	6.8
Dissolved organic carbon	mg/L	NE	2.2J	NA	2.7	NA	2.8J	NA	3.4	NA	3.8A	NA
Methane	ug/L	NE	1.3U	1.3U	1.3U	1.4U	1.3U	1.4U	1.3U	1.4U	5.0A	1.3A
Ethane	ug/L	NE	2.5U	2.5U	2.5U	2.6U	2.5U	2.6U	2.5U	2.6U	2.2AJ	0.34AJ
Ethene	ug/L	NE	2.6U	2.6U	2.6U	2.6U	2.6U	2.6U	2.6U	2.6U	0.48AJ	2.6U

NOTES:

mg/L	Milligrams per liter.
ug/L	Micrograms per liter.
A	Average value.
J	Estimated value.
U	Material was analyzed for but not detected. The number shown is the sample quantitation limit (SQL).
NA	Not analyzed.
*	Secondary MCL.
NE	Not established.
MW	Monitoring well.
PW	Public Supply Well.
TW	Temporary well.
	Shading indicates a value greater than or equal to the MCL for that analyte.

Table 4-18
Water Quality Parameters
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Units	MCL	MW-6S 2000	MW-7S 2000	MW-7I 2000	MW-8S 2000	MW-8S 2001	MW-8I 2000	MW-9S 2000	MW-10S 2000	MW-11S 2000	MW-11S 2001
Alkalinity, Total as CaCO3	mg/L	NE	65	13	31	5.7	7.2	94	14	27	130A	38
Ammonia	mg/L	NE	0.10	0.050U	0.050U	0.050U	0.050U	1.7	0.050U	0.050U	0.057	0.050U
Chloride	mg/L	250 *	18	NA	NA	NA	23	NA	15A	13	23A	16
Nitrate-nitrogen	mg/L	10	3.6	12	0.10	5.8A	7.0	0.10	3.9A	2.6	4.2	4.0
Sulfate	mg/L	250 *	47	NA	NA	NA	36	NA	24A	45	15A	20
Total organic carbon	mg/L	NE	4.4J	3.2	2.6J	3.6	4.3	5.1AJ	3.3	9.2	8.6A	4.5A
Dissolved organic carbon	mg/L	NE	7.6	2.7	4.3J	2.3	NA	7.2AJ	2.3	8.0	4.7	NA
Methane	ug/L	NE	0.98J	0.18J	1.3U	0.35J	1.4U	0.39J	1.3U	1.3U	0.65J	7.6A
Ethane	ug/L	NE	0.33J	2.5U	2.5U	2.5U	2.6U	2.5U	2.5U	2.5U	0.47J	0.28AJ
Ethene	ug/L	NE	2.6U	2.6U	2.6U	2.6U	2.6U	0.33J	2.6U	2.6U	0.49J	0.26AJ

NOTES:

mg/L	Milligrams per liter.
ug/L	Micrograms per liter.
A	Average value.
J	Estimated value.
U	Material was analyzed for but not detected. The number shown is the sample quantitation limit (SQL).
NA	Not analyzed.
*	Secondary MCL.
NE	Not established.
MW	Monitoring well.
PW	Public Supply Well.
TW	Temporary well.
	Shading indicates a value greater than or equal to the MCL for that analyte.

Tab 8
Water Quality Parameters
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Constituent	Units	MCL	MW-11I 2000	MW-12S 2002	MW-12I 2002	PW-5 2000	PW-8 2000	PW-9W 2000	TW-14 2002	TW-15 2002	TW-16 2002
Alkalinity, Total as CaCO3	mg/L	NE	100	27	150	160A	183	12	14	24	75
Ammonia	mg/L	NE	0.050U	0.050U	0.17	0.20	0.20A	0.050U	0.061	0.12	0.58
Chloride	mg/L	250 *	11	26	9.2	11A	8.5	6.0	20	10	9
Nitrate-nitrogen	mg/L	10	0.52	7.2	0.5	0.05	0.05	3.3	4.6	3.0	0.3
Sulfate	mg/L	250 *	34	31	1,200	27	14	6.0	1,100A	2,400	NA
Total organic carbon	mg/L	NE	6.0	1.1	3.5	3.5J	4.2J	2.4	1.2	2.7	3.1
Dissolved organic carbon	mg/L	NE	5.1	NA	NA	7.6J	8.0J	2.2	NA	NA	NA
Methane	ug/L	NE	1.2AJ	1.4U	1.5A	2.4	4.2	1.3U	NA	12	14A
Ethane	ug/L	NE	2.5U	2.6U	2.6U	2.5U	2.5U	2.5U	NA	0.84J	2.6U
Ethene	ug/L	NE	2.6U	2.6U	2.6U	2.6U	2.6U	2.6U	NA	0.89J	2.6U

NOTES:

mg/L	Milligrams per liter.
ug/L	Micrograms per liter.
A	Average value.
J	Estimated value.
U	Material was analyzed for but not detected. The number shown is the sample quantitation limit (SQL).
NA	Not analyzed.
*	Secondary MCL.
NE	Not established.
MW	Monitoring well.
PW	Public Supply Well.
TW	Temporary well.
	Shading indicates a value greater than or equal to the MCL for that analyte.

During the third event, groundwater samples were analyzed for the totals and dissolved fractions. Based on minimal concentrations in dissolved fraction samples, it is assumed that most inorganic groundwater contamination at the site is bound in suspended solids. In addition, selected wells were analyzed for chromium speciation (i.e., Cr^{+6}). Speciation results did not detect the hexavalent form of chromium in groundwater.

5.0 Contaminant Fate and Transport

This section assesses the environmental behavior of the classes of contaminants detected in environmental samples collected at the Capitol City Plume site. The persistence and mobility of each constituent has been evaluated to determine its potential for degradation and migration. The classes of contaminants detected in the media at the site include volatile organic compounds, extractable organic compounds, and metals. Media considered in the section include soil, groundwater, and air.

5.1 Pathways of Migration

The, Phase I and Phase II investigation reports (ADEM, 1993a; ADEM, 1994a), the Preliminary Assessment (PA) report (ADEM, 1995) and other technical reports produced for ADEM and the MWWSSB did not precisely identify the locations of the sources of contamination at the Capitol City Plume site (Black & Veatch, 1999). Numerous potential sources of the contamination including dry cleaning facilities, metal finishing operations, automobile maintenance shops, and petroleum stations have been located in the area of the Capitol City Plume site. This information is further discussed in Section 2.3.

During the first RI sampling event, samples were collected near the areas believed to be potential sources. However, no evidence of source areas for groundwater contamination was found in the groundwater or subsurface soil samples collected. Two additional sampling events were performed to delineate the extent of the groundwater contamination indicated in the groundwater samples, and additional subsurface soil samples were collected during these field events. Very few soil samples detected elevated concentrations of organic and inorganic analytes above MCLs or PRGs. Overall, samples collected from across the site, including the area near MW-01 and the location of the soil removal action, did not contain concentrations of organic or inorganic contaminants to indicate any subsurface soil sources. This RI did not identify any previously unknown source areas nor confirm the presence of significant existing sources of contamination. Table 5-1 shows the elevated analytes by media; Tables 5-2 and 5-3 show the frequency of elevated organic and inorganic contaminants by media, respectively.

Table 5-1

Organic and Inorganic Analytes Reported Above MCLs and/or PRGs
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Parameter (µg/L)	Source Subsurface Soils	Groundwater (RI/FS Only)	
		Shallow	Intermediate
Volatile Organic Compounds			
Benzene [2]	–	X	X
Bromodichloromethane	–	X	X
Chloroform	–	X	X
1,2-Dichloroethane	–	X	–
1,1-Dichloroethene [1]	–	X	–
Cis-1,2-Dichloroethene [1]	–	X	–
Ethyl benzene [2]	–	X	–
Methyl elthyl ketone	–	–	X
Propylbenzene	–	X	–
Tetrachloroethene [1] (PCE)	– [3]	X	X
Tetrahydrofuran	–	–	X
Toluene [2]	– [3]	X	–
Trichloroethene [1] (TCE)	–	X	–
1,2,4-Trimethyl-benzene [2]	– [3]	X	–
1,3,5-Trimethyl-benzene [2]	– [3]	X	–
Xylenes, total [2]	– [3]	X	–
Semivolatile Organic Compounds			
Benzo(b)fluoranthene	–	X	–
Benzo(a)pyrene	X	–	–
Bis(2-ethylhexyl)phthalate (DEHP)	–	X	–
(3-and/or 4-)Methylphenol	–	–	–
Naphthalene	–	–	–
Pesticides			
Beta-BHC	–	X	–
Alpha-Chlordane	–	X	–
Dieldrin	–	X	–
Heptachlor epoxide	–	X	–
Inorganic Analytes			
Aluminum	X	X	X
Antimony	–	X	–
Arsenic	X	X	–
Barium	–	X	X
Beryllium	–	X	–
Cadmium	–	X	X
Chromium	X	X	X
Copper	–	X	–
Iron	X	X	X
Lead	X	X	X
Manganese	–	X	X
Nickel	–	X	–
Vanadium	–	X	–
Zinc	–	X	–

[1] Indicates compound (or degradation product of a compound) typically used in dry cleaning operations

[2] Indicates compound typically used in automotive repair or service stations

[3] Indicates compound was detected in non-RI/FS samples collected (e.g. MWWSSB, 1999)

– Not Detected above EPA PRGs or MCLs level.

J Indicates analyte was detected only in estimated concentrations.

X Indicates that the analyte was detected in the associated media above the MCLs or PRGs

Table 5-2

Frequency of Samples with Elevated Organic Compounds Reported

Capitol City Plume Site

Montgomery, Mongomery County, Alabama

Analyte	Subsurface Soils	Groundwater (RI Only)	
		Shallow	Intermediate
Volatile Organic Compounds			
Benzene	0 of 66	5 of 37*	1 of 21*
Bromodichoromethane	0 of 66	3 of 37^{J}	1 of 21*
Chloroform	0 of 66	6 of 37^{J,*}	3 of 21*
1,2-Dichloroethane	0 of 66	2 of 37^{1,2,*}	0 of 21*
1,1-Dichloroethene	0 of 66	3 of 37^{1,2,J,*}	0 of 21*
Cis-1,2-Dichloroethene	0 of 66	2 of 37^{1}	0 of 21*
Ethyl Benzene	0 of 66	1 of 37	0 of 21*
Methyl ethyl ketone	0 of 66	0 of 37	1 of 21^{J}
Methyl t-butyl ether	0 of 66	2 of 37	0 of 21*
Propylbenzene	0 of 66	1 of 37	0 of 21*
Tetrachloroethene (PCE)	0 of 66	18 of 79^{1,J}	3 of 21^{J}
Tetrahydrofuran	0 of 66	0 of 37	1 of 21
Toluene	0 of 66	1 of 37	0 of 21*
Trichloroethene (TCE)	0 of 66	8 of 37^{1,J,*}	0 of 21^{J}
1,2,4-Trimethylbenzene	0 of 66	3 of 37^{5}	0 of 21*
1,3,5-Trimethylbenzene	0 of 66	1 of 37^{5}	0 of 21*
Xylenes, total	0 of 66	1 of 37	0 of 21
Semi-Volatile Organic Compounds			
Benzo(b)fluoranthene	0 of 66	1 of 37^{J}	0 of 21^{J}
Benzo(a)pyrene	1 of 66	0 of 37	0 of 21J
Bis(2-ethylhexyl)phthalate (DEHP)	0 of 66	5 of 37^{J}	2 of 21^{J}
(3-and/or 4-)Methylphenol	0 of 66	1 of 37J	0 of 21J
Naphthalene	0 of 66	3 of 37	0 of 21J
Pesticides			
Beta-BHC	0 of 66	1 of 37	0 of 21
Alpha-Chlordane	0 of 66	1 of 37	0 of 21
Dieldrin	0 of 66	6 of 37^{1,*}	0 of 21*
Heptachlor epoxide	0 of 66	7 of 37^{1}	0 of 21

NOTES:

Analytes considered elevated are those with concentrations higher than MCLs or Region 9 PRG industrial values for soil or groundwater

[1] Analyte detected at the same location during more than one sampling event

[2] Analyte was elevated in a sample or a duplicate sample, but not both.

[J] One or more of the reported exceedences is an estimated value.

[*] Indicates quantification limits at least one order of magnitude higher than the Region 9 PRG values

1 OF 1 Indicates frequency of elevated detects/total number of samples collected.

Table 5-3
Frequency of Samples with Elevated Inorganic Analytes Reported
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Parameter	Subsurface Soils	Groundwater	
		Shallow	Intermediate
Analytes			
Aluminum	1 of 66	20 of 40	5 of 22[J]
Antimony	0 of 66	3 of 40[J]	2 of 22[J]
Arsenic	3 of 66	6 of 40*	4 of 22*
Barium	0 of 66	9 of 40	3 of 22
Beryllium	0 of 66	2 of 40	1 of 22
Cadmium	0 of 66	2 of 40	5 of 22
Chromium	1 of 66	34 of 40	12 of 22
Copper	0 of 66	2 of 40	1 of 22
Iron	8 of 66	33 of 40	11 of 22
Lead	1 of 66	6 of 40	5 of 22J
Manganese	0 of 66	32 of 40	12 of 22
Nickel	0 of 66	17 of 40	1 of 22
Thallium	0 of 66	5 of 40[J,*]	0 of 22
Vanadium	0 of 66	7 of 40	1 of 22
Zinc	0 of 66	3 of 40	2 of 22

NOTES:

Analytes considered elevated are those with concentrations higher than MCLs or Region 9 PRG industrial values for soil or groundwater

[J] One or more of the reported exceedences is an estimated value.

* Indicates quantification limits at least one order of magnitude higher than the Region 9 PRG values

1 OF 1 Indicates frequency of elevated detects/total number of samples collected.

5.1.1 Soil

Contaminants in the soil can migrate by several transport processes:

1. Direct volatilization of the contaminant to air (surface soil)
2. Through the air, adsorbed to particulate matter (surface soil)
3. Leaching of pure product adhering to soil particles as a result of rainwater infiltration through unsaturated soil into groundwater
4. Volatile gases from soil vapor plumes dissolve into migrating rainwater as it moves from the surface towards the aquifer

Analytical results of subsurface soil samples collected during the RI mobilization events exhibited some detections of volatile organic and semivolatile organic compounds above quantification limits. However, subsurface soil results indicate only one location of elevated organic contamination at the Capitol City Plume site when compared to EPA Region 9 PRGs for industrial soil. The only organic compound detected in the soil above the PRG is benzo(a)pyrene at SB-16, the subsurface sample taken just above the water table at TW-16. This semivolatile is not expected to volatilize significantly from the soil based on its high affinity for adsorbtion to soil (Log Koc = 6.71) and low Henry's Law constant (1.13E-6) (Reinbold et al., 1979). The subsurface soil samples collected and analyzed during the three RI mobilization efforts did not report concentrations of volatile organic compounds or pesticides above their respective PRGs in the soil.

Subsurface soil samples were collected at depths directly above the water table at each monitoring and temporary well location, and at intervals with elevated VOC levels detected by the OVA. Additionally, continuous soil samples were collected at SB-1I and SB-5I.

Inorganic analytical results from the subsurface soil sampling events lack a pattern with respect to detected contamination. Few soil sample locations exhibit inorganic analyte contamination above the EPA Region 9 PRGs for industrial soil. Inorganic analytes detected at concentrations greater than the PRGs include aluminum (2001: SB-12), arsenic (2000: SB-5I, SB-11S; 2002: SB-16), chromium (2002: SB-16), iron (2000: SB-4I, SB-5I,SB-8I, SB-11S; 2001: SB-02, SB-07, SB-09; 2002: SB-16), and lead (2002: SB-16). The highest concentrations of analytes detected are at SB-16. For arsenic, most of the results for the first sampling event had reporting limits above the PRG concentrations. It is possible that arsenic contamination may have existed below the reporting limits but above the arsenic PRG during this event.

The vertical extents of the inorganic contamination are irregular. The lack of a pattern of contamination provides no evidence of a substantial existing source for the inorganic groundwater contamination.

5.1.2 Groundwater

While contaminated subsurface soil may be present at the site in areas that were not sampled, contaminated soil is not expected to be a significant source for groundwater contamination. Because the site is mostly covered with impervious material (concrete and asphalt) that prevents the infiltration of rainwater, the leaching of contaminants into groundwater from contaminated subsurface soils is not likely to be a substantial problem currently at the Capitol City Plume site.

While the results of the RI did not locate a source, for some wells concentrations of arsenic, chromium, iron, and lead above PRGs were found in corresponding subsurface soils during the RI field mobilizations. Analysis of groundwater data indicates elevated inorganic subsurface soil samples did correspond with inorganic groundwater contamination at MW-5I (arsenic), MW-11S (iron, chromium), MW-11I (iron), and TW-16 (arsenic, iron, and lead). The samples from the third sampling event were analyzed for total and dissolved concentrations of inorganic contaminants. The results of these analyses show that most inorganic groundwater contamination is bound in suspended solids and not in soluble form. The inorganic analytes found in the groundwater may also be associated with the site geology, with the exception of MW-5I, which had numerous elevated inorganic analytes.

Depths to groundwater on the site range from approximately 30 to 106 feet bls. across the site. The background monitoring well MW-11 is at a much higher elevation than the other wells and had the largest depth to groundwater (106 feet bls). All of the other temporary and monitoring wells had depths to groundwater from 30 to 71 feet bls. Figures 4-4 and 4-5 are potentiometric maps showing water levels in the wells monitored.

Within the surficial aquifer, wells designated shallow, with an "S" (e.g. MW-4S), were screened immediately below the water table. Wells designated intermediate, with an "I" (e.g. MW-4I), were installed immediately above the clay layer marking the bottom of the Eutaw aquifer. In general, these two areas of the shallow aquifer appear to have the same permeability (Tables 4-10 and 4-11). Very little groundwater contamination was detected in the lower portion of the shallow aquifer; most of the organic contamination reported is from the monitoring wells screened in the upper portion of the shallow aquifer. However, BTEX and chlorinated solvent contamination was found in the intermediate well MW-12I during the third field event, indicating contamination has migrated downward within the shallow aquifer. Vertical migration of contaminants into the aquifers beneath the shallow aquifer may not be a concern because of the presence of a competent clay confining layer at the base of the shallow aquifer. However, four existing wells and five abandoned wells were identified and inventoried during the creation of a wellhead protection plan for the Montgomery Water Works and Sewer Board (CH2M Hill, 1997) in the vicinity of PW-8, PW-9E, and 9W. These wells vary in screening depth from the Terrace aquifer down to the Coker aquifer (CH2M Hill, 1997). Because of their age and the fact that the construction details of the wells are not known, these wells could be potential conduits for contamination from the surficial aquifer to the lower aquifers. The presence of those nine wells does provide the potential for vertical migration of contamination below the Eutaw aquifer.

The shallow aquifer groundwater discharges to the Alabama River under normal groundwater flow and river stage conditions (CH2M Hill, 1997). This phenomenon presents a pathway for groundwater contamination to migrate to surface water. Classes of compounds detected at elevated concentrations in the groundwater include volatile organic compounds, semivolatile compounds, and pesticides as well as inorganic constituents. All of these contaminants have the potential to migrate with groundwater and discharge to surface water features. ADEM collected six surface water samples from Cypress Creek on February 19, 2002. The five upstream samples did not contain VOC contamination above detection limits, but the sample location at the mouth of the stream, closest to the Alabama River contained PCE at 7.2 ug/L (ADEM, 2002). This reported contamination may be indication that contamination is be migrating from the groundwater to the surface water, however, the PCE concentration in the groundwater sample location nearest Cypress Creek (24ug/L at SB-16) is not elevated much above the levels in the creek. It would be expected that the dilution and volatilization taking place at the groundwater/surface water interface would result in a much lower concentration than that found in the surface water sample.

5.1.3 Air

Migration of contaminants through air is not expected to be significant issue at the site. However, if contaminated soils exist onsite and are disturbed by intrusive activities, such as excavations for construction, as happened with RSA's construction, volatilization of contaminants may be a concern to the population at or near the site.

5.2 Constituent Characteristics

The tendencies of hazardous substances to degrade and/or migrate may be evaluated based on physical and chemical characteristics, as well as physical, chemical, and biological effects on the substance. Information about physical and chemical characteristics is useful in evaluating the potential fate (degradation/accumulation) and transport (mobility) of contaminants.

Tables 5-4 and 5-5 present physical and chemical characteristics used to evaluate environmental behavior of the identified organic and inorganic constituents detected at the site. The following characteristics are presented for organic constituents:

1. **Molecular Weight** The sum of the atomic weights of the atoms of a compound. Generally the larger the molecule, the higher the molecular weight.
2. **Aqueous Solubility** The maximum concentration of a compound that will dissolve in water. Compounds exhibiting high solubility indicate low sorption tendencies and are more mobile in groundwater and surface water.
3. **Vapor Pressure** A relative measure of volatility when in equilibrium at ambient temperature, which aids in determining the rate of vaporization. Organics (and some metals, most notably mercury) with high vapor pressures tend to volatilize from water and oil more easily and migrate through the air.
4. **Henry's Law Constant** The solubility of a compound's gas phase in water. Compounds with high Henry's Law constants may tend to volatilize from the aqueous phase.

Table 5-4
Physical and Chemical Properties Data
Organic Contaminants
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Parameter	CAS #	Molecular Weight (g/mol)	Water Solubility (mg/l)*	Vapor Pressure (mmHg)*	Henry's Law Constant (atm-m^3/mol)*	Koc (ml/g)	Log Koc	Log Kow	Density (g/cm^3)*
Volatile Organic Compounds									
Benzene	71-43-2	78	1.77E+03	7.60E+01	5.48E-03	8.30E+01	1.92	2.05	0.877
Bromodichloromethane	75-27-4	163	4.50E+03	5.00E+01	2.12E-03	5.10E+01	1.71	1.88	1.97$^{\wedge}$
Chloroform	67-66-3	119	8.20E+03	1.51E+02	2.87E-03	3.10E+01	1.49	1.97	NA
Dibromochloromethane	124-48-1	208	4.5E+03$^{\wedge}$	5.00E+01	7.83E-04	9.70E+01	1.99	2.16	2.451
1,2-Dichloroethane	107-06-2	99	8.52E+03	7.89E+01	9.79E-04	3.20E+01	1.51	1.48	1.253
1,1 Dichloroethene	75-35-4	97	2.25E+03	6.00E+02	3.40E-02	6.50E+01	1.81	1.84	1.22$^{\wedge}$
Cis-1,2-Dichloroethene	156-59-2	97	3.50E+03	2.01E+02	4.08E-03	4.90E+01	1.69	1.86	1.284
Ethyl benzene	100-41-4	106	2.06E-02	7.08E+00	8.68E-03	1.10E+03	3.04	3.11	0.867
Methyl ethyl ketone	78-93-3	72	2.56E+05	7.75E+01	4.66E-05	5.20E+00	0.72	0.28	0.805
Methyl t-butyl ether	1634-04-4	88	5.10E+04	2.50E+02	5.87E-04	1.12E+01	1.05	0.94	0.741
Tetrachloroethene	127-18-4	168	1.50+02	1.78E+01	2.59E-02	3.64E+02	2.56	2.60	1.631
Tetrahydrofuran	109-99-9	72	3.00E+03	1.62E+02	7.06E-05	NA	NA	0.46	0.889
Toluene	108-88-3	92	5.46E+02	2.20E+01	6.74E-03	9.50E+01	1.98	2.58	0.867
Trichloroethene	79-01-6	131	1.10E+03	5.79E+01	9.10E-03	1.26E+02	2.10	2.38	1.468
1,2,4-Trimethyl-benzene	95-63-6	120	5.70E+01	2.10E+00	6.16E-03	2.71E+03	3.43	3.63	0.876
Xylenes, total	1330-20-7	106	1.06E+02	7.99E+00	6.63E-03	3.74E+02	2.57	3.16	0.862
Semivolatile Organic Compounds									
Acetophenone	98-86-2	120	6.13E+03	3.97E-01	1.04E-05	3.50E+01	1.54	1.58	1.03
Benzo(a)pyrene	50-32-8	252	1.20E-03	5.60E-04	1.13E-06	5.07E+06	6.71	6.06	NA
Benzo(b)fluoranthene	207-08-9	252	4.30E-03	5.10E-07	3.94-05	5.50E+06	6.74	6.06	NA
Bis(2-ethylhexyl)phthalate	117-81-7	391	1.02E+04	2.00E-07	3.61E-07	5.90E+03	3.77	3.98	0.98
Pesticides/PCBs									
Beta-BHC	319-85-7	291	2.40E-01	2.80E-01	4.47E-07	3.80E+03	3.58	3.90	NA
Alpha-Chlordane	57-74-9	410	5.60E-01	1.00E-05	9.63E-06	1.40E+05	5.15	3.32	NA
Dieldrin	60-57-1	381	1.95E-01	1.78E-07	4.58E-07	1.70E+03	3.23	3.50	NA
Heptachlor epoxide	1024-57-3	389	3.50E-01	3.00R-04	4.39E-04	2.20E+02	2.34	2.70	NA

* At 25 °C unless otherwise stated

^ - At 20 °C

NA - Not Available

Sources:
Clement Associates, 1985.
Chiou et al., 1979.
EPA, 1996.
EPA, 1990
Merck, 1989.
NIOSH, 1997.
Reinbold et al., 1979.
Siep et al., 1986.
SRC, 1988.
Warner et al., 1987.
Weast, 1985

Table 5-5
Physical and Chemical Properties Data
Inorganic Contaminants
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Parameter	CAS #	Atomic Weight	Melting Point °C	Boiling Point °C	Density g/cm^3	Solubility in Water
Analytes						
Aluminum	7429-90-5	27.0	6.60E+02	2.46E+04	2.70E+00	insoluble
Antimony	7440-36-0	121.8	6.31E+02	1.75E+03	6.68E+00	insoluble
Arsenic	7440-38-2	74.9	8.17E+02	6.13E+02	5.73E+.02	soluble
Barium	7440-39-3	137.3	7.25E+02	1.64E+03	3.51E+00	solubility depends on state
Beryllium	7440-41-7	9.0	1.28E+03	2.97E+03	1.85E+00	insoluble
Cadmium	7440-43-9	112	3.20E+02	7.65E+02	8.60E+00	insoluble
Chromium	7440-47-3	52.0	1.86E+03	2.67E+03	7.20E+00	hexavalent is soluble
Copper	7440-50-8	63.6	1.06E+03	2.57E+03	8.92E+00	solubility depends on state
Iron	7439-89-6	55.9	1.54E+03	2.75E+03	7.86E+00	insoluble
Lead	7439-92-1	207.2	3.27E+02	1.74E+03	1.13E+01	insoluble
Manganese	7439-96-5	54.9	1.24E+03	1.96E+03	7.20E+00	soluble
Nickel	7440-02-0	58.7	1.46E+03	2.73E+03	8.90E+00	soluble
Thallium	7440-28-0	204.4	3.04E+02	1.46E+03	1.19E+01	insoluble
Vanadium	7440-62-2	50.9	1.89E+03	3.38E+03	6.60E+00	insoluble
Zinc	7440-66-6	65.4	4.19E+02	9.07E+02	7.14E+00	insoluble

Sources: NA - Not available

Basics of Pump and Treat Groundwater Remediation Technology, EPA/600/8-90/003, March, 1990.

The Merck Index, 10th Edition.

CRC Handbook of Chemistry and Physics, 66th Edition.

Chemical, Physical;, and Biological Properties of Compounds Present at Hazardous Waste Sites,
Clement Associates, September, 1985.
Handbook of RCRA Groundwater Monitoring Constituents Chemical Properties (cfr part 264, Appendix 9) USEPA PB92-233287, September, 1992.
U.S. Environmental Protection Agency (USEPA),
Superfund Public Health Evaluation Manual, EPA/540/1-86/060, OSWER
Directive 9285.4-1, October, 1986.
NIOSH Pocket Guide to Chemical Hazards, U.S. Department of Health and Human Services, June 1997.
U.S. EPA Superfund Chemical Data Matrix EPA/540/R-96/028, June 1996.

5. **Organic Carbon Partition Coefficient (K_{OC})** The measure of the tendency for organic compounds to be adsorbed by organic matter in soil and sediments. K_{OC} is the mass of constituent adsorbed to organic carbon from solution at equilibrium per unit weight of organic carbon. Constituents with greater K_{OC} values tend to adsorb to soil and sediments, reducing the migration potential of the compound through the soils.
6. **Octanol-Water Partition Coefficient (K_{OW})** The measure of the tendency for organic constituents to partition between the groundwater and the soil. A high K_{OW} value signifies a highly hydrophobic constituent which indicates a strong tendency to adsorb.
7. **Density** The mass of a compound per unit volume. For high concentrations, the density of the compound may be greater than the density of pure water, resulting in the downward vertical migration of the contaminant.

The characteristics for inorganic constituents are presented below:

1. **Melting Point** The temperature in degrees Celsius at which a material changes from a solid state to a liquid state at atmospheric pressure (760 mm Hg).
2. **Boiling Point** The temperature in degrees Celsius at which the vapor pressure of the material is equal to or slightly greater than the atmospheric pressure (760 mm Hg).
3. **Density** This characteristic is as discussed above.
4. **Solubility in Water** The tendency for the inorganic constituent to dissolve in water.

Additional information for organic and inorganic constituents includes the Chemical Abstract Service (CAS) Registry Number and the molecular weight (compounds) or atomic weight (elemental contaminants).

5.3 Attenuation Mechanisms

Various chemical and physical processes influence the fate of a constituent in environmental matrices. Such processes include biodegradation (both aerobic and anaerobic), photolysis/ photooxidation, oxidation-reduction reactions, bioaccumulation, hydrolysis, volatilization, adsorption, and ionization. Based on organic and inorganic constituents detected at the Capitol

City Plume site and the matrices in which they are found, adsorption, biodegradation, oxidation-reduction reactions, volatilization, and photolysis/photooxidation are likely to influence the attenuation of contaminants on site.

5.3.1 Adsorption

Adsorption is a transfer process whereby dissolved constituents in water become attracted to solid soil particles and sedimentary materials. The adsorption of a compound is directly related to the organic content of the soil and the organic carbon partitioning coefficient (Koc) of the contaminant (Clement Associates, 1985). Geotechnical results from subsurface samples taken during all three sampling events indicate total organic carbon in the soil ranging from 0.15 to 1.82 percent by weight.

Generally, volatile organic constituents including PCE and TCE adsorb somewhat to soil particles and are found to be moderately mobile in soils (Howard, 1990). Semivolatile organic compounds, including bis(2-ethylhexyl)phthalate have a strong tendency to adsorb to soil particles and sediments (Howard, 1990) and is strongly correlated to organic carbon levels present in the soil. Similarly, many pesticides readily adsorb to soil and sediments, reducing their likelihood of migration to groundwater. This includes the pesticide constituents found at the Capitol City Plume site: chlordane, dieldrin, and heptachlor epoxide (Howard, 1990; Clement Associates, 1985). Certain inorganic contaminants, including iron and lead, are mostly insoluble in water and tend to precipitate and adsorb to sediments at neutral pH levels in the groundwater.

5.3.2 Biodegradation

Biodegradation is the biochemical breakdown of a compound by organisms contained in the immediate environment of the contaminant, in either water or soil. Biodegradation can occur under aerobic (oxygenated) or anaerobic (oxygen-poor) conditions. Volatile and semivolatile organic compounds are expected to biodegrade slowly in soils (Clement Associates, 1985), but can degrade moderately to quickly in groundwater and surface water environments. Table 5-6 shows the likelihood and conditions under which site-specific organic contaminants biodegrade.

Certain volatile organic compounds tend to undergo slow but substantial biodegradation under the proper environmental conditions and when the proper microbial populations exist and are

Table 5-6
Potential for Biodegradation of Organic Contaminants
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Parameter	CAS #	Biodegradation
Volatile Organic Compounds		
Benzene	71-43-2	Is probably important
Bromodichloromethane	75-27-4	Anaerobically only
Chloroform	67-66-3	Important in water
1,2-Dichloroethane	107-06-2	None to slow in water under both aerobic and anaerobic conditions
1,1-Dichloroethene	75-35-4	Significantly biodegraded (after adaptation period)
Cis-1,2-Dichloroethene	540-59-0	Important in groundwater
Ethyl benzene	100-41-4	Rapidly in water under aerobic conditions (not anaerobically)
Methyl ethyl ketone	78-93-3	Degrades aerobically and (slowly) anaerobically
Methyl t-butyl ether	1634-04-4	No degradation under aerobic or anaerobic conditions in groundwater.
Tetrachloroethene	127-18-4	Possible in soil under anaerobic conditions
Tetrahydrofuran	109-99-9	Significantly biodegraded
Toluene	108-88-3	Acclimated microbes may rapidly degrade in soil and water
Trichloroethene	79-01-6	Very slowly in water
Trimethylbenzene	79-01-6	Very slowly in water
Xylenes, total	1330-20-7	Occurs rapidly aerobically; anaerobically only under denitrifying condiditons.
Extractable Organic Compounds		
Acetophenone	98-86-2	Important degradation pathway in soil and water
Benzo(a)pyrene	50-32-8	NA
Benzo(b)fluoranthene	207-08-9	NA
Bis(2-ethylhexyl)phthalate	117-81-7	Rapidly under aerobic conditions in water some in soils
Pesticides/PCBs		
Beta-BHC	319-85-7	NA
Alpha-Chlordane	57-74-9	Slowly in soil
Dieldrin	60-57-1	Insignificant
Heptachlor epoxide	1024-57-3	Insignificant in soil and water

Sources:
API, 1994.
Clement Associates, 1985.
Howard, et.al., 1990.
Tabak et al., 1981.
NA - Not Available

acclimated to the constituent (Howard, 1990). Specifically, chlorinated solvents such as PCE and TCE are degraded under anaerobic, strongly reducing conditions with adequate concentrations of compounds that act as electron donors available. BTEX compounds do act as electron donors, and the presence of BTEX compounds with the chlorinated solvents in the groundwater may provide the conditions favorable for the microbially mediated reactions, facilitating the degradation of both types of compounds. Section 5.3.5 discusses the biodegradation of PCE because the biological transformation of this constituent yields degradation products through a series of transformation reactions.

Biodegradation is most likely the ultimate fate process for PAHs in soils. Biodegradation of PAHs is generally more rapid in soils than in aquatic systems, and is relatively fast in environmental systems chronically affected by PAH contamination (Clement Associates, 1985). Semivolatile organic compounds biodegrade rapidly in water matrices under aerobic conditions (Howard, 1990). Bis(2-ethylhexyl)phthalate (DEHP) is degraded by microbes under most conditions and this is considered an important fate process in soil (Clement Associates, 1985). DEHP biodegrades rapidly in water matrices under aerobic conditions, and some aerobic biodegradation occurs in soils (Howard, 1990).

Biodegradation is not considered a significant fate process for the pesticides detected at the site. Chlordane released to soils may persist for long periods of time because it is only slightly mobile. However, its detection in groundwater indicates that movement into groundwater can and has occurred. Similarly, dieldrin released to soils will persist for extremely long periods of time under both aerobic and anaerobic conditions. Its low water solubility and strong adsorption to soil makes leaching into groundwater a slow process (Howard, 1990). Heptachlor epoxide also adsorbs strongly to soil and is extremely resistant to biodegradation. It persists for many years in soil and does not appear to leach significantly into the lower soil layers (Howard, 1990).

Inorganic constituents do not biodegrade, but may be biologically transformed to less mobile forms. This process is further discussed in Section 5.3.5.

5.3.3 Photolysis/Photooxidation

Photolysis and photooxidation, two types of photodegradation, are both chemical changes caused by light. Photolysis is the chemical decomposition caused by the absorption of light photons of sufficient energy (greater than 290 nanometers) (Howard, 1990). Photooxidation is the oxidation induced by light or some other form of radiant energy with the aid of radical reactions, such as those with hydroxyl radicals; however, not all constituents that absorb light of sufficient energy will ultimately photodegrade (Howard, 1990). Photodegradation is a significant fate process for many constituents detected in natural surface water systems (Howard, 1990).

The tendency to photodegrade does not appear to be a significant loss process for some of the volatile organics detected in groundwater samples at the Capitol City Plume site. Because the contamination at the site is in the groundwater, sunlight does not reach the contamination to photodegrade the contaminants. The only case in which photodegradation may act on the organic contaminants is in the case of groundwater to surface water discharge. Under this scenario, dissolved PAHs are expected to undergo rapid, direct photolysis in aquatic systems; however, the relative importance of this process as an environmental fate is unknown (Clement Associates, 1985). Photolysis and photooxidation of DEHP are not well known (Howard, 1990). Photodegradation is not an environmentally significant fate process for pesticides detected in water and soil matrices (Howard, 1990).

5.3.4 Bioaccumulation

Bioaccumulation is the uptake and retention of a substance by an organism from its surrounding medium and food. Volatile organic compounds, semivolatile organic compounds, and inorganic compounds are expected to bioaccumulate to some extent.

Bioaccumulation is a short-term process for PAHs, and long term partitioning of PAHs into the biota is not a significant fate process. PAHs are metabolized readily and rapidly and secreted by multicellular organisms (Clement Associates, 1985). Bioaccumulation is an important attenuation mechanism for pesticides. Various inorganic compounds, including chromium, lead, and thallium may be accumulated by aquatic organisms (Clement Associates, 1985).

The process of bioaccumulation is not expected to be important in an aquifer setting. However, like photolysis/photooxidation, bioaccumulation becomes more important if contaminated groundwater discharges to surface water and allows multicellular organisms to come in contact with the contaminants.

5.3.5 Transformation Reactions

As opposed to the actual breakdown of chemical molecules into smaller fragments, as happens in some biodegradation processes, transformation reactions only convert or replace selected functional groups within the molecule for organic compounds, or causes a change in oxidation state for inorganic materials. The general structure of the molecule remains intact. For example, although this occurs slowly, the most important destructive process for PCE in groundwater is the biotransformation, generally through a series of reductive dechlorination steps, to vinyl chloride which can be mineralized (EPA, 1997b). Vinyl chloride is considered more toxic than PCE and has a lower MCL in water (EPA, 1996a). Therefore, incomplete transformation of PCE may present a change to a different chemical, but not detoxification of the constituent (EPA, 1997b).

The biotransformation of chlorinated aliphatic hydrocarbons (e.g. PCE, TCE, DCE) can occur under three circumstances: microbial respiration as an electron acceptor, respiration as an electron donor, or through cometabolic reactions - reactions in which organisms derive no benefit from the transformation. Of these biological transformations, organismal respiration using the chlorinated compound as an electron acceptor is the most important. This transformation process is limited by electron donor availability (EPA, 1997b). The presence of BTEX and aliphatic compounds in the groundwater on site is serendipitous in this regard; the petroleum hydrocarbons provide electron donors which make the reductive dechlorination conditions favorable. Similarly, biodegradation of fuel hydrocarbons is an electron-acceptor-limited process, making the presence of chlorinated hydrocarbons (electron acceptors) in the groundwater fortuitous.

The degradation of chlorinated organic compounds is enhanced by a reducing environment. Indicators of a reducing environment in groundwater include nitrate concentrations less than 1 mg/L, sulfate concentrations less than 20 mg/L, TOC greater than 20 mg/L, methane concentrations greater than 0.5 mg/L, ethane/ethene concentrations greater than 0.1 mg/L, dissolved oxygen (DO) of less than 0.5 mg/L, and an oxidation-reduction potential (ORP) of less than 100 millivolts (EPA, 1997b). DO and ORP data, as presented in Appendix A, do not indicate a reducing environment exists at the site. TOC data, as presented in Table 4-18, also decrease the likelihood that a reducing environment exists. However, additional data from Table 4-18, indicate that if a reducing environment is present in any of the wells it would be in the intermediate aquifer (based largely on nitrate, methane, and ethane/ethene data). The data does not suggest a reducing environment exists in the shallow aquifer.

The RI data does not provide enough information to determine the degradation of PCE and TCE. Of all the groundwater samples collected, only two locations (MW-8S and MW-12S/TW-13) showed a decrease in PCE between sampling events (2000 to 2001, and 2000 to 2002, respectively). The three sampling events do not provide sufficient data over time to detect a trend of reduction of the mass of the contaminants. Additional groundwater samples should be collected over time to make the determination as to the occurrence and rates of the biotransformation of contaminants.

5.3.6 Volatilization

Volatilization is the physical process by which constituents with high vapor pressures leave the liquid phase and become a vapor without actually boiling. Volatilization is dependent upon physical properties of the constituent (Henry's Law constant), the presence of modifying materials (adsorbents, organic films, electrolytes, emulsions), and the physical and chemical properties of the environment (water depth, flow rate, presence of waves, sediment content, moisture content, and organic content) (Howard, 1990). In a water matrix, this process is further affected by a constituent's ability to partition between water and air, which is represented by the Henry's Law constant. Constituents with a Henry's Law constant less than 10^{-7} atmospheres per cubic meter per mole (atm-m^3/mole) are less volatile than water and as water evaporates, the concentration will increase; for constituents with a Henry's Law constant around 10^{-3} atm-m^3/mole, volatilization will be rapid. This process generally is significant for low molecular weight organic constituents as a result of their low solubility in water and high vapor pressure.

The site conditions are not favorable for significant volatilization of contaminants from the groundwater through the vadose zone. The depth of the groundwater below land surface would make the continued volatilization from groundwater to soil air difficult, as the organic vapors would have to diffuse long distances through the pore space. Additionally, the low concentrations of the contaminants in the groundwater (well below the saturation values) generally result in low rates of volatilization. However, should the contaminated groundwater discharge to surface water, volatilization would play a larger role in transport. Volatilization is the major transport process for removal of chloroform and chloroethanes from aquatic environments (Clement Associates, 1985). Volatilization is not a significant environmental fate process for the PAHs and the other semivolatile organic compounds found at the site (Clement Associates, 1985; Howard, 1990). The pesticides present on site do not rapidly volatilize from soil and water matrices. Chlordane in clear water is somewhat volatile (Clement Associates, 1985). Table 5-7 shows the volatility for site specific organic contaminants.

5.4 Contaminant Migration

The ultimate fate of contaminants in the environment depends not only on their persistence, but also on their potential to migrate. This section presents factors that may influence the migration of organic and inorganic contaminants of concern at the Capitol City Plume site.

5.4.1 Inorganic Solute Transport

Inorganic constituents also transport through environmental matrices in the solute form. The movement of inorganic contamination in groundwater is controlled primarily by advection and dispersion. Most inorganic materials exist in environmental matrices as salts, soluble ions, complex organic ions, or in colloidal suspensions. To a large extent, the physical behavior of these salts, soluble ions, complex organic ions, or colloidal suspensions determines the fate and transport of the inorganic constituent involved. Analysis of inorganic contaminants during the third RI sampling event included quantifying the dissolved portion of the contaminants present. For inorganic contaminants detected above the PRGs and MCLs during this event, the vast majority of the contamination detected (other than manganese) is in the suspended (non-dissolved) state. Excluding manganese, only 5 of 35 elevated concentrations of inorganic contaminants (antimony, arsenic, chromium (not hexavalent), and iron) in the groundwater samples were in the dissolved form (Table 4-17). Manganese was present in dissolved form in 6 of 8 samples in which elevated levels were analyzed and detected. The widespread detection of manganese throughout the site may suggest that it is present in the geology of the area at naturally high levels.

Table 5-7
Potential for Contaminant Volatilization
Capitol City Plume Site
Montgomery, Montgomery County, Alabama

Parameter	CAS #	Volatilization
Volatile Organic Compounds		
Benzene	71-73-2	Significant in soil and water
Bromodichoromethane	75-27-4	Significant in soil and water
Chloroform	67-66-3	Significant in soil and water
1,2-Dichloroethane	107-06-2	Significant in soil and water
1,1-Dichloroethene	540-59-0	Significant in soil
Cis-1,2-Dichloroethene	156-59-2	Readily from water; rapidly from soil
Ethyl Benzene	100-41-4	Significant in water; may be adsorbed to soil
Methyl ethyl ketone	78-93-3	Significant in soil; medium in water
Methyl t-butyl ether	1634-04-4	NA
Tetrachloroethene	127-18-4	Readily from water; rapidly from soil
Tetrahydrofuran	109-99-9	Readily from soil; high water solubility
Toluene	108-88-3	Significant in water; may be adsorbed to soil
Trichloroethene	79-01-6	Rapidly from water and shallow soils
Trimethyl-benzene	95-63-6	NA
Xylenes, total	1330-20-7	Significant in water; may be adsorbed to soil
Extractable Organic Compounds		
Acetophenone	98-86-2	NA
Benzo(b)fluoranthene	207-08-9	NA
Bis(2-ethylhexyl)phthalate	117-81-7	Insignificant in soil and water
Naphthalene	91-20-3	Varies according to mixing rates in water
Pesticides/PCBs		
Beta-BHC	319-85-7	NA
Alpha-Chlordane	57-74-9	Significant in water
Dieldrin	60-57-1	Limited in soil and water
Heptachlor epoxide	1024-57-3	Limited in soil and water

Source:

Howard, et.al., 1990.

Clement Associates, September, 1985.

NA - Not Available

Arsenic and manganese are highly mobile in water and soil matrices, primarily because their salts are very soluble in water (Clement Associates, 1985). Inorganic constituents that are mostly insoluble in water and tend to precipitate and adsorb to solid (soil) particles include iron and lead. Much of the lead released to the environment will be adsorbed to soil, and less will tend to enter the water matrix. However, the solubility of lead increases in water that has low concentrations of dissolved salts. Chromium may exist as the trivalent state or the hexavalent state, of which the hexavalent state is the more mobile form. The hexavalent state exists mostly in water as the chromate ion, while the trivalent state is often precipitated to sediments as the hydroxide. Partitioning between these two oxidation states is somewhat controlled by the presence of other ions in the media and the pH of the media. The chromium speciation results from samples taken during the third mobilization event do not indicate that hexavalent chromium is present in the groundwater above quantification limits.

The behavior of other inorganic materials in the environment is more dependent on the state of the inorganic constituent, whether elemental, salt, or complexed with organic material. For example, copper adsorbs strongly to organic materials in soil and sediment, but in organic complexes, is much more mobile in water. Thallium can be precipitated, in reducing environments, but much of the element in aquatic systems remains in solution. Chemical speciation is very important for arsenic; in its reduced form, arsenite, it is very mobile, but the oxidized form, arsenate, it readily precipitates out of solution. Elemental iron and many iron compounds, including iron oxides, are insoluble in water; therefore, iron present in aquatic systems tends to partition into the sediment and adsorb to soil. However, under reducing conditions, ferric iron is soluble and mobile in water. Cadmium is removed from aqueous media by complexing with organic materials and subsequently being adsorbed to sediments. Magnesium salts are very soluble at pH levels normally found in natural waters, and the magnesium ion is transported readily in surface water, soil, and groundwater (Clement Associates, 1985). As previously mentioned in Subsection 5.3.5, RI data suggests that a reducing environment does not exist in the surficial aquifer.

5.4.2 Organic Solute Transport

Organic constituents transport through environmental matrices mainly in the solute form. The movement of a contaminant groundwater plume is controlled primarily by advection and dispersion, although adsorption affects the rate at which organic contaminants migrate. Advection causes the plume to move in the direction and at the rate of groundwater flow. Dispersion causes the zone of contaminated groundwater to occupy a greater volume than it would under advection only by moving transversely to the groundwater flow through vertical and lateral migration, as opposed to longitudinal migration in the direction of groundwater flow.

For the purposes of this report, five classes of mobility have been defined based on organic carbon partition coefficients:

High mobility	log Koc = 1.5 or less.
Mobile	log Koc = 1.5 - 2.5.
Moderate mobility	log Koc = 2.5 - 3.5.
Low mobility	log Koc = 3.5 - 4.5.
Immobile	log Koc = 4.5 or above.

The organic carbon partition coefficient (K_{OC}) is a measure of the tendency of an organic compound to adsorb to soil or sediment (Table 5-4). The logarithm of K_{OW} (the octanol/water partition coefficient) may also be used to define mobility. Volatile organic compounds are expected to be very mobile to slightly mobile in water matrices due to their weak tendency to adsorb to soil. Pesticides are not expected to exhibit high mobility in soils and groundwater due to high K_{OC} values and low water solubilities (Howard, 1990). TCE, benzene, and toluene are considered mobile compounds based on their K_{OC} values; PCE and xylenes are only moderately mobile.

Another transport mechanism for volatile organic chemicals is the volatilization from aquatic systems and near-surface soils. However, as discussed in Section 5.3.6, the depth of groundwater below the land surface would make it improbable that the contamination volatilize and migration to the surface.

6.0 Baseline Risk Assessment

6.1 Objectives

The baseline risk assessment evaluates the potential risks to human health and the environment due to releases of chemicals at the Capitol City Plume site. The main objective of the baseline risk assessment is to provide the information necessary to assist in the decision-making process at remedial sites. The specific objectives of the baseline risk assessment are to:

- Identify and provide analysis of baseline risks (defined as risks that might exist if no remediation or institutional controls were applied at the site) and help determine what action is needed at the site.
- Provide a basis for determining the levels of chemicals that can remain onsite and still not adversely impact public health and the environment.
- Provide a basis for comparing potential health and environmental impacts of various remedial alternatives.

The baseline risk assessment results will be used to document the magnitude of potential risk at the site and associated cause(s) of that risk. The results will also be used to establish any remedial goal options that may be necessary. Finally, the results of the baseline risk assessment will help determine what, if any, remedial response actions may be necessary and assist in establishing the remediation goals that will be presented in the feasibility study.

6.2 Human Health Risk Assessment

6.2.1 Scope and Organization of the Human Health Risk Assessment

The scope of this baseline risk assessment is to evaluate the potential risks to human health due to exposure to chemicals of potential concern in groundwater associated with the site. No attempt has been made to differentiate between the risk contributions from other sites and those being contributed from the Capitol City Plume site. This human health risk assessment was derived primarily from the data collected during the three phases of the RI field investigation. All tables for the human health risk assessment are in Appendix F.

The procedures used in the performance of this risk assessment and its scope are consistent with and based on EPA guidance procedures and policies for the performance of risk assessments at hazardous waste sites. The primary guidance used in the human health risk assessment included the following documents:

- U.S. Environmental Protection Agency (EPA), Interim Final Risk Assessment Guidance for Superfund - Human Health Evaluation Manual (Part A), December 1989. (EPA, 1989)
- U.S. EPA, Interim Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments), January 1998. (EPA, 1998)
- U.S. EPA, Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment, October 1995. (EPA, 1995)
- U.S. EPA, Integrated Risk Information System (IRIS), June 2002. (EPA, 2002)
- U.S. EPA, Exposure Factors Handbook, August 1997. (EPA, 1997c).
- U.S. EPA, Health Effects Assessment Summary Tables (HEAST), 1997.(EPA, 1997d)
- U.S. EPA, Soil Screening Guidance (July 1996). (EPA, 1996b)
- U.S. EPA, Supplemental Guidance: Standard Default Exposure Factors, 1991. (EPA,1991)
- U.S. EPA, Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure November 1993. (EPA, 1993)

EPA Region 4 guidance was given preference over federal EPA guidance where required. Other specific documents were referenced in the report where relevant.

The human health baseline risk assessment for the Capitol City Plume site consists of the following subsections:

- Data Collection and Evaluation.
- Exposure Assessment.
- Toxicity Assessment.
- Risk Characterization.
- Remedial Goal Options.

6.2.1.1 Data Collection and Evaluation. This step in the risk assessment process involved gathering and analyzing the site data relevant to human health and identifying the contaminants present at the site that will be included in the risk assessment process (EPA, 1989).

Analytical data collected during the three phases of the RI field investigation were used in this baseline risk assessment. Black & Veatch utilized these data to develop analytical summary tables which include statistical information about the chemicals detected in each medium. Using approved screening criteria, a list of the chemicals of potential concern (COPCs) was developed for each medium (EPA, 1995). Uncertainties associated with data evaluation and selection of COPCs were also discussed in this subsection. Data evaluation and selection of COPCs are performed in Section 6.2.2 of this report.

6.2.1.2 Exposure Assessment. An exposure assessment was conducted to estimate the magnitude of actual (current) and potential (future) human exposures to site media, the frequency and duration of these exposures, and the pathways that result in human exposures. In the exposure assessment, conservative estimates of exposure were developed for both current and future land-use assumptions. Current exposure estimates were used to determine if a threat exists based on existing exposure conditions at the site. Future exposure estimates were to provide decision-makers with an understanding of potential exposure pathways and their associated threats. Conducting the exposure assessment involved analyzing contaminant releases; identifying exposed populations; identifying all the potential pathways of exposure; estimating exposure point concentrations for specific pathways; estimating contaminant intakes for specific pathways; and outlining the uncertainties associated with this process. The results of the exposure assessment are pathway-specific intakes of chemicals at the site under current and future exposure scenarios (EPA, 1989). The exposure assessment is presented in Section 6.2.3 of this report.

6.2.1.3 Toxicity Assessment. The toxicity assessment determined the types of adverse health effects associated with chemical exposures, the relationship between magnitude of exposure and adverse effects, and the related uncertainties involved. Risk assessments rely heavily on existing toxicity information developed for specific chemicals. The two primary sources for this information were the Integrated Risk Information System (IRIS) database and the Health Effects

Assessment Summary Tables (HEAST). The toxicity component in a risk assessment falls into two categories, those related to noncarcinogenic hazards and those related to carcinogenic risks. To evaluate noncarcinogenic hazards, the intake of a chemical was compared to the corresponding reference dose (RfD) of that compound. The RfD used in the risk assessment is a best estimate of the level at which there will be no observed adverse effects to the exposed population. To evaluate carcinogenic risks, the intake of a chemical was factored with the slope factor (SF) for that contaminant. The slope factor used in the risk assessment represents the 95 percent upper confidence limit (UCL) for the best estimate of the carcinogenic potency of a compound, or its ability to cause cancers in an exposed population. For humans, both the RfDs and Sfs are usually derived from animal dose-response relationships and sometimes human epidemiology studies (EPA, 1989). The toxicity assessment is presented in Section 6.2.4 of this report.

6.2.1.4 Risk Characterization. The risk characterization subsection of the risk assessment summarized and combined the exposure and toxicity assessments to characterize baseline risks, both quantitatively and qualitatively. During risk characterization, chemical-specific toxicity information was compared with the estimated exposure levels to determine whether chemicals at the site pose current or future risks that are of a magnitude to cause concern. This subsection includes an uncertainty analysis that shows that the calculated risks are relative in nature and do not present an absolute quantification. The risk characterization is presented in Section 6.2.5 of this report.

6.2.1.5 Remedial Goal Options. Remedial goal options (RGOs) for human receptors were presented based on the site-specific results of the risk characterization. The RGO subsection of the human health risk baseline risk assessment contains an appropriate narrative and media cleanup levels for each contaminant of concern in each land-use scenario evaluated. Chemicals of concern are chemicals that significantly contribute to a use scenario for a receptor that exceeds a 10^{-4} total carcinogenic risk or exceeds a hazard index of 1 (EPA, 1995). Individual chemicals contributing to these pathways did not have RGOs developed if their contribution was less than 10^{-6} risk for carcinogens or a hazard quotient less than 0.1 for noncarcinogens. The tables show the, 10^{-6}, 10^{-5}, and 10^{-4} risk levels and the 0.1, 1, and 3 hazard quotient levels for each applicable chemical in each medium (EPA, 1995).

In cases where applicable or relevant and appropriate requirements (ARARs) have been developed for specific chemicals of concern, a comparison between these ARARs and estimated exposure levels was made.

RGOs are presented in Section 6.2.6 of this report.

6.2.2 Data Collection and Evaluation

This step in the risk assessment process involves gathering and analyzing the site data relevant to the human health evaluation and identifying the chemicals present at the site that will be included in the risk assessment process (EPA, 1989). The objectives of this subsection are to review and summarize the analytical data for each medium sampled at the Capitol City Plume site and to select the chemicals of potential concern to be evaluated in the human health risk assessment.

6.2.2.1 Evaluation. Contamination at the site was characterized by sampling during the three phases of the RI field investigation. A total of 66 subsurface soil and 62 groundwater samples, excluding duplicates, were collected from locations across the Capitol City Plume site. Subsurface soil samples were collected from depths ranging from 8 to 238 feet below ground surface. Black & Veatch assumed that humans will not directly contact soils at these depths. Therefore, exposure to subsurface soil was eliminated from the HHRA as an environmental medium of concern. Section 3.0 contains a detailed description of the sampling investigation.

As part of the detailed evaluation of the analytical data, any analytical data with "R" qualifiers were eliminated from further consideration in the baseline risk assessment (EPA, 1989). Also, common laboratory contaminants were eliminated from further consideration if the detected concentration did not exceed ten times the maximum blank concentration (EPA, 1989). For "uncommon" laboratory contaminants, chemicals were eliminated if the detected concentration was not five times greater than the maximum amount detected in any blank (EPA, 1989). Any duplicate samples that were collected during the field investigation were averaged to reduce the bias introduced when more than one sample was collected from any one location.

Table 1 (located in Appendix F) outlines the receptors, exposure pathways, and exposure routes that were evaluated in this baseline risk assessment.

6.2.2.2 Selection of Chemicals of Potential Concern. Chemicals of potential concern are a subset of all chemicals positively identified at the site. The risks associated with the COPCs are expected to be more significant than the risks associated with other less toxic, less prevalent, or less concentrated chemicals at the site that are not evaluated quantitatively. The process of determining the COPCs for the Capitol City Plume site included a detailed evaluation of the analytical data, a careful analysis of the sources of contamination and areas that the sources impact, and a review of site characteristics.

Table 2.1 lists all chemicals that have been detected in at least one groundwater sampling location. Sampling locations for groundwater are presented on Figures 3-1 and 3-2. In accordance with RAGS Part D, Table 2.1 also contains statistical information about the chemicals detected in each medium, the detection limits of chemicals analyzed, risk-based screening values for COPC selection, and the chemicals selected or deleted as COPCs. In accordance with EPA Region 4 guidance (EPA, 1995), the following screening criteria were used to select or eliminate each chemical:

1. For groundwater data, concentrations of detected chemicals were compared to the EPA Region 9 Preliminary Remediation Goals for tap water (EPA, 2000). If the maximum detected concentration was less than a carcinogenic risk level of 1×10^{-6} or hazard quotient of 0.1, the chemical was eliminated from the COPC list (EPA, 1995).

2. Inorganic chemicals were eliminated from further consideration if the chemical is considered to be an essential nutrient and have relatively low toxicity (i.e., calcium, magnesium, potassium, and sodium) (EPA, 1995).

The constituents retained as COPCs for groundwater are listed below.

- **Groundwater:** 1,1-dichloroethene, 1,2-dichloroethane, benzene, bromodichloromethane, chloroform, cis-1,2-dichloroethene, dibromochloromethane, ethyl benzene, isopropylbenzene, methyl-t-butyl ether (MTBE), tetrachloroethene, total xylenes, trichloroethene, 2-methylnaphthalene, benzo(b)fluoranthene, bis(2-

biochemical alterations, birth defects) occurring during a given exposure period. The RfD is derived from a no-observed-adverse-effect level (NOAEL) or lowest-observed-adverse-effect level (LOAEL) obtained from human or animal studies. Standard order-of-magnitude uncertainty factors, and in certain cases, an additional modifying factor are applied to account for professional assessment of scientific uncertainties in the available data (EPA, 1989).

A NOAEL is that dose of chemical at which no toxic effects are observed in any of the test subjects or animals. The study chosen to establish the NOAEL is based on the criterion that the measured toxic endpoint represents the most sensitive ("critical") target organ or tissue to that chemical (i.e., that target organ or tissue that shows evidence of damage at the lowest dose). Since many chemicals can produce toxic effects on several organ systems, with each toxic effect possibly having a separate threshold dose, the distinction of the critical toxic effect provides added confidence that the NOAEL is protective of health. In contrast to a NOAEL, a LOAEL is the lowest dose at which the most sensitive toxic effect is observed in any of the test subjects or animals. If a LOAEL is used in place of a NOAEL to derive a RfD, an additional level of uncertainty is involved and, therefore, an additional order-of-magnitude uncertainty factor is applied.

A variety of regulatory agencies have used the threshold approach for noncarcinogenic substances in the development of health effects criteria, such as worker-related threshold limit values (TLVs), air quality standards, and food additive and drinking water regulations. EPA has developed chronic RfDs for the oral and inhalation routes, but not for the dermal route. Human data are used preferentially if they are deemed adequate through scientific evaluation. However, in many cases, adequate human toxicity data are not available and animal studies have to be used.

(1) Oral Reference Doses. Chronic RfDs were available for most chemicals of potential concern at the Capitol City Plume site. Provisional (interim) RfD values were available for aluminum, iron, and trichloroethylene (TCE). Chemicals for which no RfDs were available are benzo(b)fluoranthene, 1,2-dichloroethane, isopropylbenzene, 2-methylnapthalene, lead, and mercury (elemental). An oral RfD is not available for elemental mercury because it is not readily absorbed through the oral route. Other forms of mercury, such as mercuric chloride and methylmercury, are more readily absorbed and have oral RfDs available. Since the mercury was detected in abiotic media (i.e. water), the risk assessment assumed that the mercury was in its inorganic form. Therefore, the oral RfD for mercuric chloride was used to evaluate exposure to mercury in the environmental media at the site. IRIS lists the oral RfD of 1.4E-01 mg/kg-day for manganese. The explanatory text in IRIS recommends using a modifying factor of three when calculating risks associated with non-food sources (i.e., drinking water). It further recommends subtracting dietary exposure (default assumption is 5 mg). Thus, the IRIS RfD was changed in this baseline risk assessment to 0.024 mg/kg-day for water (EPA, 2002). Hexavalent chromium is more toxic than trivalent chromium; however, it is easily converted to trivalent chromium in soil in the presence of organic matter. Limited analysis of hexavalent chromium during the third sampling event showed no detections of the hexavalent form of chromium. However, this risk assessment used a conservative assumption that only hexavalent chromium was present at the site. The oral RfDs for the COPCs are listed in Table 5.1.

(2) Inhalation Reference Doses. Inhalation RfDs are used to evaluate the risk from exposure to chemicals through inhalation exposure pathways such as the inhalation of particulate emissions from VOCs while showering. Inhalation toxicity values are given as reference concentrations for systemic toxicants. The conversion to an inhalation reference dose is accomplished as follows:

$$\textit{Inhalation RfD (mg/kg-day)} = \textit{RfC mg/m}^3 \times (70\ kg)^{-1} \times 20\ m^3/day$$

The inhalation reference doses are listed in Table 5.2.

(3) Dermal Reference Doses. No RfDs have been developed by EPA for the dermal route. Therefore, dermal RfDs were derived for the COPCs in accordance with EPA guidelines (EPA, 1989). A chronic dermal RfD was derived for each chemical by multiplying the value used as the chronic oral RfD by an appropriate GI absorption factor. This adjusts the dermal dose for the amount absorbed since dermal exposure doses are expressed as "absorbed" doses (note that oral and inhalation doses are usually expressed as "administered" doses). Oral RfDs are normally developed from long-term studies where a substance is administered orally to laboratory animals. Depending on the form in which the chemical is administered, the relative absorption of the chemical through the gastrointestinal tract (and therefore the relative absorption factor) may vary considerably. Organic compounds tend to be more readily absorbed through the GI tract than inorganic compounds. An absorption factor of 80 percent was used for volatile compounds. This value corresponds to the default values suggested by EPA Region 4 for cases in which the GI absorption of a volatile organic substance is not known (EPA, 1995). An absorption factor of 50 percent was used for semivolatile compounds (PAHs, pesticides). This value corresponds to the default values suggested by EPA Region 4 for cases in which the GI absorption of a semivolatile organic substance is not known (EPA, 1995). Metals in general, tend to be poorly absorbed through the GI tract. However, absorption is highly dependent on the water and lipid solubility of the specific chemical form(s) in which it is present. An absorption factor of 20 percent was used for inorganics (metals). This value corresponds to the default value suggested by EPA Region 4 for cases in which the GI absorption of a metal is not known (EPA, 1995). The adjusted dermal RfDs are presented in Table 5.1.

(4) Other Issues Pertaining to Reference Doses. Only chronic RfDs, which are developed to evaluate potential toxicity at greater than 7 years of exposure, are presented in Tables 5.1 and 5.2 and are used in estimating both childhood and adult noncarcinogenic risk. Subchronic RfDs are sometimes used to evaluate subchronic exposures of a duration ranging from 2 weeks to 7 years, which may be more appropriate to address childhood exposure (age 1-6 years). However, chronic RfDs, which are lower than subchronic RfDs, are used in this risk assessment to ensure a conservative risk estimate (EPA, 1995).

6.2.4.2.2 Estimates of carcinogenic potency. Cancer slope factors (CSFs) are developed by the EPA under the assumption that the risk of cancer from a given chemical is linearly related to dose. EPA may develop cancer slope factors from laboratory animal or epidemiological studies in which relatively high doses of the chemical were administered. It is conservatively assumed that these high doses can be extrapolated downward to extremely small doses, with some incremental risk of cancer always remaining until the dose is zero. This nonthreshold theory assumes that even a small number of molecules, possibly even one uncontrolled cell division, could eventually lead to cancer. The slope factor for a chemical is usually derived by EPA using a linearized multistage model and reflects the upper-bound limit of the cancer potency of the chemical. As a result, the estimated carcinogenic risk is likely to represent a plausible upper limit to the risk. The actual risk is unknown, but is likely to be considerably lower than the predicted risk (EPA, 1989), and may even be as low as zero.

There is some dispute as to whether the extrapolation from high to low doses is a realistic approach. It has been argued that at low doses cells may have the ability to detoxify carcinogens or repair chemical-induced cellular damage. Although it is important to recognize the possibility that some carcinogens may have a threshold for toxicity, it was assumed in the estimates of risk that no threshold exists.

Specific carcinogenicity classifications for carcinogenic chemicals of potential concern at the Capitol City Plume site are presented in Table 6.1. Risk assessments follow the rationale used by EPA in developing these categories of classification. Only those chemicals classified as "A" have sufficient human evidence of carcinogenicity. Carcinogens classified as "B" and "C" have insufficient human data to support their cancer-causing potential, but have varying degrees of supportive animal data. It should be noted that A, B, and C carcinogens are evaluated in risk assessments according to EPA guidance (EPA, 1989). This adds a degree of conservatism to t risk assessment since possible human carcinogens (B and C) are weighted equally in terms of total cancer risk relative to known human (A) carcinogens. Finally, it is important to note that slope factors are periodically under review by the EPA. In some cases, the EPA may withdraw the criteria until the review is completed.

The carcinogenic potency of a substance depends on its route of entry into the body (i.e., oral, inhalation, or dermal). Therefore, slope factors are developed and classified according to the administration route. In some cases, a carcinogen may produce tumors only at or near a specific route of entry (i.e., nasal passages) and may not be carcinogenic through other exposure routes. This applies to three of the evaluated chemicals, namely chromium, cadmium, and nickel. Note also that EPA has not developed dermal slope factors for any carcinogens (EPA, 1992).

(1) Oral Slope Factors. Oral slope factors are used to evaluate the risk from exposure to potential carcinogens through oral exposure pathways such as, ingestion of groundwater. With the exception of beryllium, cadmium, and chromium VI, oral slope factors were available for all the carcinogens listed in Table 6.1. An oral slope factor for beryllium is not available because the human carcinogenic potential of ingested beryllium can not be determined. Oral slope factors are not relevant to cadmium and chromium because there is not adequate evidence of carcinogenicity for these substances through the oral route.

(2) Inhalation Slope Factors. Inhalation slope factors are used to evaluate the risk from exposure to potential carcinogens through inhalation exposure pathways such as VOCs from while showering. Inhalation toxicity values are given as unit risks for carcinogens. The conversion to an inhalation slope factor is accomplished as follows:

$$\text{Inhal. SF} = \text{Unit Risk } (\mu g/m^3)^{-1} \times 70 \text{ kg} \times (20 \text{ m}^3/\text{day})^{-1} \times 1{,}000 \ \mu g/mg \ (mg/kg\text{-}day)^{-1}$$

The inhalation slope factors are listed in Table 6.2.

(3) Dermal Slope Factors. As with reference doses, dermal slope factors are not available from the EPA, but it was assumed that chemicals which are carcinogenic orally will also produce cancer by dermal exposure. In the absence of dermal slope factors, the oral slope factor is divided by an appropriate gastrointestinal (GI) absorption factor (EPA, 1989). This adjusts the dermal dose for the amount absorbed since dermal exposure doses are expressed as "absorbed" doses (note that oral and inhalation doses are usually expressed as "administered" doses). Oral slope factors are normally developed from long-term studies where a substance is administered orally to laboratory animals. Depending on the form in which the chemical is administered, the relative absorption of the chemical through the gastrointestinal tract (and therefore the relative absorption factor) may vary considerably. The approach used to select the absorption factor was the same as that previously described for RfDs. The absorption factors were 80 percent for volatile organic compounds, 50 percent for semivolatile organic compounds, and 20 percent for metals (EPA, 1995).

Beryllium, cadmium, and chromium VI are classified as being carcinogenic by the inhalation route only. Beryllium has been shown to produce lung cancer; however, studies regarding the potential carcinogenicity of beryllium via the oral or dermal routes are not available. Hexavalent chromium, which produces cancer only at the route of entry, was not evaluated for oral or dermal cancer risk. There is inadequate evidence that cadmium is carcinogenic via the oral or dermal route. The adjusted dermal slope factors are presented in Table 6.1.

(4) Other Issues Pertaining to Cancer Slope Factors. As an interim procedure, EPA Region 4 has adopted a Toxicity Equivalence Factor (TEF) methodology for evaluating risk from exposure to carcinogenic PAHs. These TEFs are based on the relative potency of each compound relative to that of benzo(a)pyrene. The TEFs are used to convert each carcinogenic PAH concentration to an equivalent concentration of benzo(a)pyrene (see Table 3.1). The slope factor for benzo(a)pyrene is then used to evaluate risks from exposure to the adjusted concentrations of the carcinogenic PAHs.

6.2.4.2.3 Chemical-specific toxicity assessments. Toxicological information on the primary COPCs detected at the site is provided in Appendix G.

6.2.4.3 Uncertainties Associated With Toxicity Assessment For a risk to exist, both significant exposure to the chemicals of potential concern and toxicity at these predicted exposure levels must exist. The toxicological uncertainties primarily relate to the methodology by which carcinogenic and noncarcinogenic criteria (i.e., cancer slope factors and reference doses) are developed. In general, the methodology currently used to develop cancer slope factors and reference doses is very conservative, and likely results in overestimation of human toxicity (EPA, 1989). These and other factors are discussed in the subsections below.

(1) Reference Doses

In the development of RfDs for each chemical by exposure route, it is assumed that a threshold dose exists below which there is no potential for adverse health effects to the most sensitive individuals in the population. The RfD is typically derived from dose-response studies in animals in which a NOAEL or a LOAEL is determined by applying several uncertainty factors of 10 each. An additional modifying factor of up to 10 can be applied which accounts for a qualitative professional assessment of additional uncertainties in the available toxicity data (EPA, 1989). The final degree of extrapolation for a given chemical can range anywhere between 10 and 100,000 resulting in a human subthreshold dose of one tenth to one-hundred thousandth of the study dose. In general, the calculated RfD is likely overly protective, and its use probably results in an overestimation of noncarcinogenic risk.

Oral chronic RfDs were used in calculating hazard quotients for the 1 to 6 year old child. The use of chronic RfDs in this age group is conservative and will result in overestimation of risk. Chronic RfDs are developed assuming a lifetime daily exposure. Subchronic RfDs, which are calculated assuming an exposure duration of 2 weeks to 7 years, generally tend to be higher than chronic RfDs and result in a lower hazard quotient and index.

(2) Cancer Slope Factors

Although there is evidence to suggest some carcinogens may exhibit thresholds, cancer slope factors are developed assuming there is no safe level of exposure to any pollutant proven or suspected to cause cancer. This uncertainty implies that exposure to even a single molecule of a chemical may be associated with a finite risk, however small. The assumption is that even if relatively large doses of a chemical were required to cause cancer in laboratory animals (i.e., much higher than a person would ever likely be exposed to over a lifetime), these exposure doses can be linearly extrapolated downward many orders of magnitude to estimate slope factors. A significant uncertainty for the carcinogens is whether the cancer slope factors accurately reflect the carcinogenic potency of these chemicals at low exposure concentrations. The calculated slope factor is used to estimate an upper bound lifetime probability of an individual developing cancer as a result of exposure to a particular carcinogen level. Therefore, the cancer slope factors developed by EPA are generally conservative and represent the upper bound limit of the chemical's carcinogenic potency. The actual risk posed by each chemical is unknown but is likely to be lower than the calculated risk, and may even be as low as zero (EPA, 1997c). The conclusion is that these toxicity assumptions will typically result in an overestimation of carcinogenic risk.

The assumption that all carcinogens (whether A, B1 or B2) can cause cancer in humans is also conservative. Only those chemicals classified as "A" carcinogens by the EPA are unequivocally considered human carcinogens. In this risk assessment, all "probable" and "possible" carcinogens are given the same weight in the toxicity assessment (and consequently in the estimation of risk) as true human carcinogens. This assumption most likely overestimates actual carcinogenic risk to human receptors.

(3) Metal Speciation

There are many uncertainties associated with toxicity values, especially those that are derived from studies in laboratory animals. One general uncertainty concerns toxicity values for metals. The form in which a metal occurs can greatly influence its toxicity potential. However, the metal speciation in on-site media is not known. Typically, the salts of metals are used for animal testing because these forms are most readily absorbed by the animals. Therefore, the toxicity values that are generated from these data represent the toxicity potential of the metals in their soluble forms. In characterizing risk, the assumption is made that the metals at the site are present in forms similar to those used in characterizing the toxicity potentials of those substances. This uncertainty may specifically apply to beryllium, manganese, and mercury where it is well documented that the nature of the salt can significantly affect gastrointestinal absorption (EPA, 1997c).

(4) Site-Specific Toxicological Uncertainties

Site-specific uncertainties include:

- Not assessing risks for chemicals without critical toxicity values.
- Using route-to-route extrapolation to calculate dermal risks.
- Using the oral RfD for mercuric chloride to assess exposure to mercury via the ingestion route. As stated above, the speciation of mercury at the site is unknown. If elemental mercury is the primary form at the site, using the oral RfD will overestimate the risk since elemental mercury is poorly absorbed via the oral route. However, if methylmercury is the primary form at the site, the hazard will be underestimated since methylmercury is the most toxic form of mercury.
- Using provisional toxicity values to calculate risks. Provisional toxicity values are interim values that are established by the NCEA but have not been through the EPA verification process and, as such, are not listed in IRIS or HEAST.
- Assuming that all of the chromium at the site is present in the hexavalent form. This is likely an overestimation of risk. During the third sampling event groundwater samples were analyzed for total, dissolved, and hexavalent chromium. Although elevated levels of total chromium were detected, no detections of hexavalent chromium were noted in this event. There is no Region 9 PRG screening value for total chromium, therefore the Region 9 PRG screening value for hexavalent chromium was conservatively used.

6.2.5 Risk Characterization

The objective of the risk characterization is to integrate the exposure and toxicity assessments into quantitative and qualitative expressions of risk. A detailed risk characterization is presented in this subsection.

6.2.5.1 Introduction. The risk characterization is an evaluation of the nature and degree of potential carcinogenic and noncarcinogenic health risks posed to current and hypothetical future receptors at the Capitol City Plume site. The pathways of exposure are described in Subsection 6.2.3. Human health risks for noncarcinogenic and carcinogenic effects are discussed independently because of the different toxicological endpoints, relevant exposure durations, and methods employed in characterizing risk. The potential for carcinogenic effects is limited to only those chemicals classified as carcinogens, while both carcinogenic and noncarcinogenic chemicals are evaluated for potential noncarcinogenic effects.

Noncarcinogenic and carcinogenic risks were evaluated for each exposure pathway and scenario by integrating the exposure doses calculated in Subsection 6.2.3 (Exposure Assessment) with the toxicity criteria determined in Subsection 6.2.4 (Toxicity Assessment) for the chemicals of potential concern. The evaluation of noncarcinogenic risks are summarized in Subsection 6.2.5.2, and the evaluation of carcinogenic risks are summarized in Subsection 6.2.5.3.

The risk characterization tables (7.1 through 7.5 and 8.1 through 8.5) present the exposure point concentrations, intake factors, toxicity values, and the quantification of risks and hazards. Each table contains an intake factor which was generated from the formulas and assumptions presented in Tables 4.1 through 4.5. The reference doses and slope factors came from Tables 5.1, 5.2, 6.1, and 6.2. The hazards or risks from each chemical are summed to yield the final pathway risks or HI. Summaries of receptor risks and hazards are presented in Tables 9.1 through 9.3. Finally, Tables 10.1 through 10.3 present cancer risk and noncancer hazard information for those COPCs and media/exposure points that may trigger the need for remedial action.

6.2.5.2 Evaluation of Noncarcinogenic Risks. The risk of adverse noncarcinogenic effects from chemical exposure is expressed in terms of the hazard quotient (HQ). The HQ is the ratio of the estimated dose (DI) that a human receives to the RfD, the estimated dose below which it is unlikely for even sensitive populations to experience adverse health effects. The HQ is calculated as follows (EPA, 1989):

$$HQ = DI/RfD$$

Where:

HQ = Hazard Quotient (unitless)
DI = Daily Intake (mg/kg/day)
RfD = Reference Dose (mg/kg/day)

All the HQ values for chemicals within each exposure pathway are summed to yield the hazard index (HI). Each pathway HI within a land use scenario (i.e., future worker) is summed to yield the total HI for the receptor. If the value of the total HI is less than 1.0, it is interpreted to mean that the risk of noncarcinogenic injury is low. If the total HI is greater than 1.0, it is indicative of some degree of noncarcinogenic risk, or effect, and chemicals of concern are selected (EPA, 1995). Chemicals of concern are those COPCs that contribute a HQ of 0.1 or greater to any pathway evaluated for the use scenario. Using the HQ equation, the chronic DI values, and the RfD values, a hazard index for each of the exposure scenarios considered in this risk assessment was estimated by calculating a HQ for each chemical of potential concern associated with a complete pathway and exposure point. Only chronic HIs are derived, as the subchronic risks will always be equal to or less than the chronic risks. The results of these calculations are presented in Tables 7.1 through 7.5 and 9.1 through 9.3. The following paragraphs summarize the hazard indices for each population.

The total HI for future industrial workers exposed to groundwater was 11 (see Table 9.1). This HI value was primarily due to ingestion of benzene, trichloroethene, arsenic, chromium, iron, manganese, and thallium in groundwater.

The total HI for future adult residents exposed to groundwater was 59 (see Table 9.2). This HI value was primarily due to ingestion of metals and benzene, tetrachloroethene, trichloroethene, naphthalene, and heptachlor epoxide in groundwater.

The total HI for future child residents exposed to groundwater was 140 (see Table 9.3). This HI value was primarily due to ingestion of metals and benzene, ethyl benzene, tetrachloroethene, trichloroethene, caprolactam, naphthalene, dieldrin and heptachlor epoxide in groundwater.

Tables 10.1 through 10.3 present noncancer hazard information for those COPCs and media/exposure points that may trigger the need for remedial action.

6.2.5.3 Evaluation of Carcinogenic Risks. The incremental risk of developing cancer from exposure to a chemical at the site is defined as the additional probability that an individual exposed will develop cancer during his or her lifetime (assumed to be 70 years). This value is calculated from the average daily intake over a lifetime (CDI) and the slope factor (SF) for the chemical as follows (EPA, 1989):

$$\text{Risk} = \text{CDI} \times \text{SF}$$

When the product of CDI x SF is greater than 0.01, this expression may be estimated as:

$$\text{Risk} = 1 - \exp^{(-\text{CDI} \times \text{SF})}$$

Using the first equation, where appropriate, and employing the CDI values calculated for lifetime exposure along with the SF values (Tables 6.1 and 6.2), cancer risks were calculated for lifetime exposures which may occur at the Capitol City Plume site. A summary of the results is presented in the risk characterization tables (8.1 through 8.5 and 9.1 through 9.3). It is important to note that the carcinogenic risk estimates presented in Tables 8.1 through 8.5 and 9.1 through 9.3 represent the summation of the individual risks associated with each of the chemicals of potential concern for which cancer information is adequately available.

According to EPA policy, the target total individual risk resulting from exposures at a Superfund site may range anywhere between 1E-06 and 1E-04 (EPA, 1991). Thus, remedial alternatives should be capable of reducing total potential carcinogenic risks to levels within this range for individual receptors. OSWER Directive 9355.0-30, issued on April 22, 1991, provides further insight into the acceptable risk range when it states: "Where the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both current and future land use is less than 10^{-4}, and the non-carcinogenic hazard quotient is less than 1, action generally is not warranted unless there are adverse environmental impacts. However, if MCLs or non-zero MCLGs are exceeded, action generally is warranted. A risk manager may also decide that a baseline risk level less than 10^{-4} is unacceptable due to site-specific reasons and that a remedial action is warranted. The upper boundary of the risk range is not a discrete line at 1×10^{-4}, although USEPA generally uses 1×10^{-4} in making risk management decisions. A specific risk estimate around 10^{-4} may be considered acceptable if justified based on site-specific conditions."

A risk estimate of 1E-04 was used as the remediation "trigger" in this risk assessment. If the cumulative site cancer risk exceeded 1E-04, then chemicals of concern were identified. A summary of carcinogenic risks for each population is discussed below.

The incremental cancer risk for future industrial workers exposed to groundwater was 2E-04 (see Table 9.1). This risk was primarily due to ingestion of arsenic, benzene, 1,1-dichloroethene, tetrachloroethene, and trichloroethene in groundwater.

The total incremental lifetime cancer risk for future residents (sum of the child and adult risks) exposed to groundwater was 1E-03. This risk was primarily due to ingestion of arsenic, benzene, 1,1-dichloroethene, tetrachloroethene, and trichloroethene in groundwater.

Tables 10.1 through 10.3 present cancer risk information for those COPCs and media/exposure points that may trigger the need for remedial action.

6.2.5.4 Lead Toxicity. Although there is a great deal of information on its health effects, there is not an EPA SF or RfD dose for lead. It appears that some health effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low as to be essentially without a threshold. Therefore, EPA considers it inappropriate to develop an RfD for inorganic lead (EPA, 2002). Quantifying lead's cancer risk involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration influence the absorption, release, and excretion of lead. In addition, current knowledge of lead pharmacokinetics indicates that an estimate derived by standard procedures would not truly describe the potential risk. Thus, EPA's Carcinogen Assessment Group recommends that a numerical estimate not be used (EPA, 2002).

In the absence of lead health criteria, the risk assessment compared the maximum detected concentrations of lead in groundwater at the site to available ARARs (e.g., federal action levels for drinking water).

6.2.5.4.1 Comparison of lead maximum detected concentrations to ARARs. The maximum detected concentrations of lead were compared to relevant ARARs as shown in Table 6-1. The maximum groundwater concentration of 0.32 mg/L is approximately 21 times higher than the current action level of 0.015 mg/L published by the Office of Drinking Water of the EPA. Lead was detected at concentrations exceeding the action level in 5 out of 40 groundwater samples. The 0.015 mg/L level was based on protection of children from adverse effects when their blood lead levels reached 10 μg/dL.

6.2.5.4.2 Conclusions. The area is currently served by a public water supply outside the influence of the site. Should inactive public water supply wells or newly installed private and/or industrial wells in the site area begin supplying water from the shallow aquifer, exposure to lead may present a significant risk to receptors at the site due to the concentration of lead in groundwater.

Table 6-1
Comparison of Maximum Detected Concentration of Lead to ARARs and Screening Levels
Capitol City Plume Site
Montgomery County, Alabama

Drinking Water Action Level [a]	Shallow Groundwater Maximum Detected Concentration	Number of Detects Above 0.015 mg/L
0.015 mg/L	0.32	5/40

Notes:
[a] *Represents current action level for lead published by the Office of Drinking Water, EPA.*

6.2.5.5 Uncertainties Associated With Risk Characterization. Groundwater contains more than one COPC. Uncertainties associated with summing risks or hazard quotients for multiple substances are of concern in the risk characterization step. The assumption ignores the possibility of synergistic or antagonistic activities in the metabolism of the contaminants. This could result in over-or under-estimation of risk.

The potential risks developed for the Capitol City Plume site were directly related to COPCs detected in groundwater at this site. No attempt was made to differentiate between the risk contributions from other sites and those being contributed from the Capitol City Plume site.

Aluminum and iron were identified as chemicals of concern at the site. The RfDs for both of these metals are provisional (interim) values, meaning that they have not gone through the verification necessary to be placed by EPA on IRIS or HEAST. Additional toxicological data would be needed in order to complete this verification process. For example, the oral RfD for iron was derived based on inadvertent consumption of iron following consumption of beer brewed in iron vessels. Chromium was also identified as a chemical of concern. As indicated in Subsections 6.2.4.2.1 and 6.2.4.3, this risk assessment assumed that only hexavalent chromium, the more toxic form of chromium, was present at the site. While this likely results in some overestimation of risk--the third sampling event groundwater samples had no detectable concentrations of hexavalent chromium but had elevated levels of total chromium--this uncertainty could not be avoided. There is no Region 9 PRG screening value for total chromium, therefore the Region 9 PRG screening value for hexavalent chromium was conservatively used. For the reasons cited in this paragraph, care should be taken before making any remedial decisions about aluminum, chromium, or iron.

It should be noted that arsenic, benzene, 1,1-dichloroethene, naphthalene, and heptachlor epoxide, which are some of the primary risk drivers in groundwater, were detected in less than 20 percent of the samples. Additional samples should be analyzed for these parameters before making any remedial decisions about these specific COCs.

All of the uncertainties discussed in Subsections 6.2.2.3, 6.2.3.4, and this subsection ultimately effect the risk estimate. Most of the uncertainties identified will result in the potential for overestimation of risk (i.e., the combination of several upper-bound assumptions for some exposure scenarios).

6.2.5.5.1 Central tendency evaluation. In accordance with EPA guidance, quantitative risk values were also developed for "central tendency" exposure assumptions. Central tendency evaluations present average or median (50th percentile) assumptions while reasonable maximum exposure evaluations present upper end (90th - 95th percentile) assumptions. Since risk managers are likely to be most concerned with contaminants and media that pose unacceptable risks, a central tendency evaluation was only conducted for each scenario, exposure unit, medium, and chemical of concern. Conducting both reasonable maximum exposure and central tendency analyses provides perspective for the risk manager.

As indicated in Tables 10.1 through 10.3, the following scenarios, exposure units, media, and contaminants posed unacceptable risks at the Capitol City Plume site:

- **Scenario**: Industrial Worker
  Media: Groundwater
  COCs: Benzene, 1,1-Dichlorethene, Tetrachloroethene, Trichloroethene, Heptachlor Epoxide, Arsenic, Chromium, Iron, Manganese, and Thallium

- **Scenario:** Adult Resident
  Media: Groundwater
  COCs: Benzene, 1,1-Dichlorethene, Bromodichloromethane, Tetrachloroethene, Trichloroethene, Heptachlor Epoxide, Naphthalene, Antimony, Arsenic, Barium, Cadmium, Chromium, Iron, Manganese, Nickel, Thallium, and Vanadium

- **Scenario:** Child Resident
  Media: Groundwater
  COCs: Benzene, 1,1-Dichlorethene, Bromodichloromethane, Chloroform, Dibromochloromethane, Ethyl Benzene, Caprolactam, Tetrachloroethene, Trichloroethene, Heptachlor Epoxide, Naphthalene, Dieldrin, Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Iron, Manganese, Nickel, Thallium, Total Mercury, and Vanadium

The results of the central tendency evaluation are presented in Appendix H and are summarized below.

For industrial workers, the central tendency analyses indicate that if average exposure assumptions instead of upper end assumptions were used when assessing exposure to groundwater the total HI for industrial workers would be reduced from 11 to 5. The incremental cancer risk would be reduced from 2E-04 to 3E-05.

For child residents, the central tendency analyses indicate that if average exposure assumptions were used when assessing exposure instead of upper end assumptions the total HI would be reduced from 140 to 46 when exposed to groundwater.

For adult residents, the central tendency analyses indicate that if average exposure assumptions were used when assessing exposure instead of upper end assumptions the total HI would be reduced from 59 to 20 when exposed to groundwater.

If average exposure assumptions were used when assessing exposure instead of upper end assumptions, the total incremental lifetime cancer risk for residents (sum of child and adult risks) would be reduced from 1E-03 to 9E-04 when exposed to groundwater.

Changing the exposure assumptions from upper end (reasonable maximum exposure) to average (central tendency) values did not decrease any of the total HI values below 1, the level of concern for noncarcinogenic hazards. However, changing the exposure assumptions from upper end to average values did decrease the incremental cancer risk for industrial workers to a level below 1E-04, the level of concern for carcinogenic hazards.

6.2.6 Remedial Goal Options

This section contains the site-specific Remedial Goal Options (RGO) for the chemicals and media of concern at the Capitol City Plume site. In accordance with Region 4 guidance (EPA, 1995), RGOs are included in the baseline risk assessment to provide the Remedial Project Manager with a range of risk-based media cleanup levels options and ARARs as a basis for developing the selected remediation goals in the Feasibility Study and Proposed Plan.

RGOs were developed for each chemical of concern in each land use scenario evaluated in the baseline risk assessment. Chemicals of concern (COCs) are chemicals that significantly contribute to a use scenario for a receptor that exceeds a 1E-04 total carcinogenic risk or exceeds a hazard index of 1. Individual chemicals contributing to these scenarios had RGOs developed if their contribution was greater than or equal to 1E-06 for carcinogens or yielded a hazard quotient greater than or equal to 0.1 for noncarcinogens. Using the above criteria, the appropriate chemicals, exposure units, exposure routes, and receptors for which RGOs were calculated were selected from Tables 9.1 through 9.3.

The site-specific exposure assumptions and models used in the baseline risk assessment were used to develop the RGOs for the Capitol City Plume site. This leads to the risk level for a given chemical being directly proportional to the exposure concentration. The following equation was used to calculate the chemical-specific risk-based RGOs:

$$\underset{(RG)}{\text{Remediation Goal}} = \frac{TR \times EC}{CR}$$

Where:

TR = Target Risk Level (HQ equal to 0.1, 1, and 3 for noncarcinogenic effects and risk level equal to 1E-06, 1E-05, and 1E-04 for carcinogenic effects).

EC = Exposure Point Concentrations in Soil, Sediment, Surface Water, and Groundwater (Tables 3.1 through 3.5).

CR = Calculated Risk Level (Tables 10.1 through 10.3).

Tables 11.1 through 11.3 present the media-specific RGOs for the chemicals of concern for each exposure scenario (refer to Tables 10.1 through 10.3 for the media, scenarios, exposure units, and chemicals of concern which present unacceptable risks and hazards). The derived RGOs reflect the combined exposure through the applicable routes for any given medium (i.e., for exposure to groundwater, ingestion and inhalation were combined).

6.2.7 Summary of the Human Health Risk Assessment

Groundwater is the only environmental medium of concern at the Capitol City Plume site. The COPCs in groundwater included metals, volatile organic compounds, and semivolatile organic compounds, including pesticides.

Site-specific exposure information was unavailable; therefore, default exposure assumptions and professional judgment were used to select exposure assumptions for the various receptors evaluated in the risk assessment. These exposure assumptions are likely to overestimate hazards and risks.

All exposure scenarios evaluated in this baseline risk assessment [future industrial worker and future resident (child and adult)] resulted in unacceptable noncarcinogenic and carcinogenic risks. Several COCs (metals, VOCs, and pesticides) were identified in groundwater. However, since potable water in the area is currently supplied by the City of Montgomery, the exposure pathway is incomplete.

7.0 Summary and Conclusions

This section presents a summary and conclusions based on evaluation of the data generated from the three RI sampling efforts.

7.1 Summary

Field activities for the Capitol City Plume Site RI were performed during three phases that were conducted in March through May 2000, January 2001, and February 2002.

These investigations included installation and sampling of 16 permanent and 16 temporary groundwater monitoring wells, sampling of two existing monitoring wells, three public water supply wells, and two industrial wells. In addition, 66 subsurface soil samples for CLP analysis in from 29 borings in the vadose zone. During the first field event, one subsurface soil sample was collected at each of the borings and, if elevated organic compounds were detected by the organic vapor analyzer (OVA), additional subsurface samples were collected at the boring. Additionally, two borings were sampled continuously during the first mobilization (SB-1I and SB-5I). Samples were also collected for geotechnical analysis from the screened interval at most boring locations. Soil samples from each event were analyzed for TCL/TAL parameters, which include volatile compounds, semivolatile compounds, pesticides, PCBs, metals, and cyanide. Additionally, geotechnical analyses were performed on a sample taken from each boring for the 34 permanent and temporary monitoring wells for the following parameters: grain size distribution, Atterburg limits, moisture content, porosity, bulk density, and TOC.

Twelve of the 16 permanent monitoring wells installed are cluster wells consisting of a shallow and an intermediate well. These wells measure the difference in hydraulic conductivities at different zones within the surficial aquifer, as well as variances in contaminant concentrations across zones. Each well cluster consists of a shallow well positioned at or near the water table and an intermediate well screened above the top of a clay layer at a depth of 102 to 239 feet bls across the site. Wells are screened with 10-foot well screens just below the water table. In addition, two industrial wells (IW-01 and IW-02), three public wells (PW-5, PW-8 and PW-9W), and two existing permanent monitoring wells (MW-2S and MW-3S) were sampled to help characterize the groundwater.

Groundwater samples collected from permanent monitoring, temporary monitoring, public water wells, and industrial wells were analyzed for the same TCL/TAL parameters as soil samples, excluding four previously installed monitoring wells from the 2002 sampling event that were not submitted for organic analyses. Additional analyses included natural attenuation parameters, ammonia, TOC, methane/ethane/ethene, chloride, nitrite/nitrate, sulfate, and total alkalinity. In the 2002 sampling event, groundwater samples, except for industrial wells were also analyzed for dissolved metals and chromium speciation.

7.1.1 Nature and Extent of Soil Contamination

A total of 66 biased subsurface soil samples were collected for CLP analysis for the Capitol City Plume site from 29 locations used as permanent or temporary monitor wells. During the first field event, one subsurface soil sample was collected at each boring and, if elevated organic compounds were detected by the organic vapor analyzer, additional subsurface samples were collected at the boring. Additionally, two borings were sampled continuously during the first mobilization. For the second and third mobilizations, samples were collected from 13 DPT and 5 hollow stem auger borings, respectively. No surface soil samples were collected during RI field efforts.

Analysis of the environmental samples indicated a limited number hazardous substances were present in the subsurface soils collected during the three RI phases. These elevated constituents are:

- Benzo(a)pyrene, the only organic compound detected at an elevated concentration in the subsurface soil samples it was detected in only one sample at more than four times the Region 9 EPA Preliminary Remedial Goal (PRG) (290 ug/kg) for benzo(a)pyrene with a detection of 1,300 J ug/kg.
- Iron is the most widespread of the inorganic contaminants with eight samples containing concentrations greater than or equal to the 10,000 mg/kg Region 9 EPA PRG for industrial soils.
- Elevated arsenic concentrations were detected in three samples and ranged from 3.6 mg/kg (SB-11S) to 26 mg/kg (SB-16).
- Aluminum, chromium, and lead were each detected above Region 9 industrial PRGs in only one sample.

7.1.2 Nature and Extent of Groundwater Contamination

A total of sixteen permanent and sixteen temporary monitoring wells were install during the three phases of the RI. Fourteen permanent monitoring wells were installed and sampled during the Phase I RI. These wells, along with three City wells, were sampled to identify the boundaries of the groundwater plume. During the Phase II RI, thirteen temporary monitoring wells were installed by direct push technology (DPT) and sampled. During the Phase III RI, two permanent monitoring wells and three temporary wells were installed by hollow stem auger method. These five wells were sampled along with industrial wells. Four previously installed monitoring wells were also sampled for inorganic analysis (total and dissolved metals) only during the final sampling event.

Analytical result for groundwater samples collected during the RI indicate that the surficial aquifer at the Capitol City Plume site has been affected by past waste disposal practices in the downtown Montgomery area. Several constituents were detected at elevated concentrations when compared to Federal Drinking Water Maximum Contaminant Levels (MCL) and Region 9 EPA PRGs for drinking water. Several constituents were detected in all sampling events, including: benzene, chloroform, PCE, and bis(2-ethylhexyl)phthalate. 1,2-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, TCE, 1,2,4-trimethylbenzene, dieldrin, and heptachlor epoxide.. PCE was the organic contaminant detected at elevated concentrations in the most wells and data indicates two plumes of PCE contamination. Benzene was detected at elevated concentrations in relatively few groundwater samples; however, the elevated concentrations greatly exceeded the MCL in these three wells.

Of concern are the elevated concentrations of several organic constituents which also exceeded the MCLs, including:

- benzene was detected at concentrations ranging from 150 to 4,500 ug/L.
- bis(2-ethylhexyl)phthalate was detected at concentrations ranging from 11 to 600J ug/L.
- 1,1-dichloroethane was detected at a concentration of 10 ug/L.
- 1,2-dichloroethane was detected at concentrations of 27 and 31 ug/L.
- ethylbenzene was detected at a concentration of 780 ug/L.
- heptachlor epoxide was detected at concentrations of 0.23N and 0.27J ug/L.
- tetrachloroethene was detected at concentrations ranging from 5J to 340 ug/L.
- toluene was detected at a concentration of 3,800 ug/L.
- trichloroethene was detected at concentrations ranging from 6J to 13 ug/L.

Ten inorganic compounds were detected at elevated concentrations in all sampling events, including: aluminum, antimony, arsenic, barium, beryllium, chromium, iron, lead, manganese, and nickel. Chromium was the most widespread inorganic contaminant in the groundwater samples.

Several inorganic constituents were detected at concentrations above MCLs, including:

- barium was detected at a concentration of 2,200 ug/L.
- beryllium was detected at concentrations ranging from 6.3 to 13 ug/L.
- cadmium was detected at concentrations of 8.6 and 32 ug/L.
- chromium was detected at concentrations ranging from 100 to 1,200 ug/L.
- copper was detected at a concentration of 1,600 ug/L.
- lead was detected at concentrations ranging from 15 to 320 ug/L.
- thallium was detected at concentrations ranging from 4.6 to 21 ug/L.

7.1.3 Human Health Risk Assessment Summary

The results of the human health risk assessment are presented in Subsection 6.2.7. Unacceptable risks and/or hazards were calculated for each exposure scenario evaluated in the baseline risk assessment: future industrial worker, future adult resident, and future child resident. Groundwater is the only medium of concern for the Capitol City Plume site. The COPCs in groundwater included metals, volatile organic compounds, and semivolatile organic compounds, including pesticides.

7.2 Conclusions

Based upon the data generated by the RI sampling events, the following conclusions have been reached:

- Groundwater at the Capitol City Plume Site contains organic and inorganic constituents at concentrations greater the federal MCLs. PCE contamination exists throughout the site and exceeded the MCL over a wide area in the northwest and central portions of the site. The greatest detection of PCE occurred in the northern plume at levels nearly 50 to 70 times the MCL.

- No exiting source areas were discovered by the RI; organic contamination in groundwater is particularly unattributable to the subsurface soil samples. It is likely that site contaminants originated from multiple sources within the downtown Montgomery area.

- Five subsurface soil sample locations evidenced inorganic contamination higher than PRGs for industrial soils, but the concentrations in the soil are generally low (SB-16 is exception). These areas may be continuing sources of groundwater contamination

- Horizontal extent of groundwater contamination generally well defined. The exceptions are at the southeast portion of the site (MW-11S/I), and the northeastern and northwestern portions of the site.

- The majority of the detected contamination is in the upper part of the surficial (Eutaw) aquifer, although some low concentrations of PCE and chloroform are found at the bottom of the lower surficial aquifer (MW-5I, MW-12I). The lithological investigation confirmed the presence of a competent clay layer underlying the Eutaw formation throughout the site.

- PCE is the most ubiquitous organic contaminant in the groundwater, with TCE and benzene a distant second and third, respectively. Chromium, iron, and manganese are the most prevalent inorganic contaminants.

- Groundwater level measurements collected during the three phases of the RI indicate the flow within the upper and lower Eutaw aquifer at the site is to the north-northwest, toward the Alabama River.

- The estimates for groundwater flow velocity are between 14.3 and 2,094 feet/year with a geometric mean of 104 ft/year in the upper Eutaw aquifer and between 9.1 and 231 feet/year with a geometric mean of 61 feet/year in the lower Eutaw aquifer.

- Adsorption and biodegradation are likely the most important fate and transport processes acting on the contaminants in the groundwater at the site. However, natural attenuation data collected during the RI did not confirm biodegradation was ongoing.

- Contaminated groundwater may be discharging to the surface water, specifically Cypress Creek to the north. Insufficient data was collected during the RI to confirm this.

- An evaluation of human health risks determined that hypothetical users of the site's groundwater are potentially at risk. However, the Montgomery Water Works and Sewer Board currently supplies potable water from a source outside the site's influence. Therefore, the groundwater exposure pathway is incomplete.

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