808 0

File: 541.460.000n
C.H.

THE MEMPHIS DEPOT
TENNESSEE

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 808

TECHNICAL MEMORANDUM **CH2MHILL**

Early Implementation of Selected Remedy Component to Address Groundwater Contamination West of Dunn Field

PREPARED FOR: USACE-Huntsville Center

PREPARED BY: CH2M HILL/ATL

COPIES: Defense Logistics Agency (DLA), U.S. Environmental Protection Agency, Region IV (EPA), Tennessee Department of Environment and Conservation (TDEC), MACTEC, Inc., and MitreTek Systems, Inc.

DATE: October 14, 2004

REVISION: 01

I. Introduction & Objective

This memorandum documents the basis for conducting early implementation of a selected remedy in an area of groundwater contamination west of Dunn Field of the Defense Distribution Center (Memphis) in Memphis, Tennessee (see Figure 1).

Groundwater contaminant extent and remedies selected for remediation of the groundwater were identified in the April 2004 Final Dunn Field Record of Decision (ROD). The remedy selected for treatment of groundwater for chlorinated volatile organic compounds (CVOCs) in the most contaminated part of the plume is injection of zero-valent iron (ZVI). ZVI consists of pure iron metal granules or powder, which must be specially manufactured and packaged to prevent premature corrosion. Once released into the environment, iron oxidation fosters anaerobic conditions, which yields ferrous iron and hydrogen ions, both of which are reducing agents for chlorinated solvents.

New data collected during the Remedial Design (RD) phase of work show that contamination in the shallow aquifer is greater than previously known near areas known to be in connection with the Memphis aquifer and are approximately one-half mile upgradient of the Allen Well Field (Memphis aquifer) capture zone. Both Treatment Areas 1 and 2, identified in Figure 1, were not identified in the ROD as requiring treatment. Treatment Area 1 was previously identified for monitored natural attenuation (MNA) while Treatment Area 2 was expected to receive treatment by being within the zone of influence of a ZVI injection area. For site background and historical information, please refer to the ROD and administrative record on which the document is based.

Based on the results of sampling conducted subsequent to the ROD in June and August 2004, the DLA is conducting an early implementation of a component of the selected groundwater remedy (injection of ZVI) to address the concentrations of CVOCs at the leading edge of the high concentration portion of the plume (within the 500 μg/L total CVOCs).

II. Description of Current Situation

This section describes the hydrogeology of the site west of Dunn Field, the nature and extent of contaminants in this area, and fate and transport parameters associated with the plume.

A. Hydrogeology

Groundwater underlying the Dunn Field and areas west of Dunn Field is within a predominantly medium to fine-grained sand geological formation locally referred to as the fluvial aquifer. The aquifer varies in thickness but has been observed to range from 3 to over 30 feet thick west of Dunn Field with an average thickness of 18 feet. The fluvial aquifer is underlain by a massive clay unit that is regarded as an aquitard (i.e., little to no groundwater flows through the unit). This clay unit is part of the Jackson Formation/Upper Claiborne Formation. A top of clay contour map is presented as Figure 2. The clay map reveals that a swale exists beginning in the area of MW145 and is oriented northwards towards MW40. Current interpretation of the geology indicates that there is a geologic "window" to the underlying intermediate aquifer at MW40. The United States Geological Survey (USGS) has established that the intermediate aquifer is in connection with the lower Memphis aquifer at several points in Memphis. Figure 3 presents a lithologic cross-section through the early remedy implementation area.

As shown in Figure 4, groundwater predominantly flows to the west-northwest in the fluvial aquifer. However, a groundwater divide exists in the area of monitoring wells MW151 and MW152, where groundwater flow appears to split and begins to flow southwest and to the north. Seepage velocities range from 0.17 to 1.58 feet per day (ft/dy) across this area of the higher concentration portion of the area impacted by the subject plume. Seepage velocity from monitoring well MW-77 to MW-150 is estimated to be 0.91 ft/dy. Flow apparently slows down from MW-150 towards MW-152 as the velocity decreases to 0.17 ft/dy.

B. Nature and Extent of Groundwater Contaminants

Groundwater sample data was collected from the site in June 2004 from 7 new wells (MW144 through MW150) installed to identify and define groundwater contaminant extent west of Dunn Field. Analysis of groundwater samples from these wells revealed a high concentration plume in the area of MW144, MW54, and MW150. To verify the extent of the high concentration plume, seven additional wells (MW151 through MW157) were installed in August 2004 west of Dunn Field. Samples from these wells redefined the groundwater plume previously presented in the ROD. As shown in Figure 5, contaminants are highly concentrated within this area. Note that the principal VOC constituents within this plume are 1,1,2,2-tetrachloroethane (1,1,2,2-PCA), trichloroethene (TCE), and 1,2-dichloroethene (1,2-DCE). Figure 3 also displays the contaminant concentrations within the fluvial aquifer along the predominant groundwater flowpath from August 2004.

As shown in Table 1, concentrations of 1,1,2,2-PCA range from 2100 micrograms per liter (μg/L) to 8000 μg/L in the area of wells MW54, MW150 and MW155. TCE levels are also elevated in the area of wells MW54, MW150 and MW155, with concentrations ranging from 1000 to 3000 μg/L.

C. Fate and Transport

Figure 6 presents an historical view of the concentration of TCE and 1,1,2,2-PCA at MW54. Concentrations of these contaminants have been increasing since the beginning of 2002 and, as of the last sampling event, do not appear to have reached a peak. The rapid rise in contaminant concentration indicates that the plume is relatively dynamic and unstable in this area possibly as a result of recent water table fluctuations (periods of drought and recovery). The information from MW54 could suggest that the existing plume (observed at well MW150) is migrating in a more westerly direction than was previously observed.

As discussed in Section II A, groundwater seepage velocities are an order of magnitude higher from MW77 to MW150 than from MW150, through MW155 to MW152, where the solute front of the >500 μg/L total CVOC plume is interpreted to be at this time.

III. Basis of Decision

In the judgement of DLA, EPA, and TDEC, early implementation of a selected remedy is appropriate to address the contamination within the 500 μg/L total CVOC plume . The expedited response action is needed because of the following:

- The identification of higher concentrations of the COCs at the distal portion of the plume that could go untreated and adversely affect the MNA component of the selected remedy;
- At the time of the ROD, contaminant concentrations greater than or equal to 500 μg/L were targeted for active treatment. With the discovery of contamination greater than 500 μg/L downgradient of the proposed PRB, the BCT determined that engineered treatment is appropriate;
- Allowing concentrations to go untreated may adversely affect the proposed PRB component of the selected remedy for this area (e.g., the placement or location of the PRB could be in an area of greater saturated thickness, which may result in higher costs and potential encroachment onto offsite private property); and,
- Proximity of these COCs to potential migration pathways to the drinking water aquifer that supplies the City of Memphis.

Implementation of this action is within the scope of the Dunn Field ROD. The action represents a non-significant modification to the remedy, in order to optimize remedy performance in light of new technical information.

The selection of ZVI injection for this early remedy implementation was also based upon the results of a ZVI Treatability Study conducted as part of the RD for Dunn Field. The study was performed on Dunn Field in a known soil and groundwater contaminant source area centered around monitoring well MW73. The study was conducted from October 2003 to April 2004 and, during this study, four injection points were installed in the study area along with five new monitoring wells and, approximately 25,000 pounds of ZVI were injected into the fluvial aquifer. Over the course of five confirmatory separate sampling events, there was an observed 84 to 99 percent reduction of VOCs in the ZVI treatment zone.

This remedy will comply with all applicable or relevant and appropriate requirements (ARARs) as defined in the ROD, including State of Tennessee or Memphis-Shelby County Underground Injection Control (UIC) regulations (Page 2-69 of the Dunn Field ROD). Remedy actions (i.e., ZVI) will occur "onsite", as defined in 40 CFR Part 300.5 and 300.400(e)(1) (Page 2-68 of the Dunn Field ROD). Under CERCLA 121(e)(1), no permit is required for actions conducted entirely on-site; although, the substantive requirements must be met.

IV. Description of Remedial Action

The remedy selected within the Dunn Field ROD for high concentrations of contaminants in the fluvial aquifer underlying Dunn Field and the area west of Dunn Field is injection of ZVI (Page 2-57, Dunn Field ROD).

A. Summary of ZVI Remedy

There are two (2) engineered groundwater remediation components to the groundwater remedy selected within the Dunn Field ROD, including a permeable reactive barrier (PRB) and ZVI injections. The ROD states, "The [selected] alternative employs ZVI injection as a treatment technology of the most contaminated parts of the plume, and treatment of the remaining areas of contaminated groundwater through installation of a PRB and natural attenuation." ZVI does not require extensive lead time to design and implement, has the capacity to reduce contaminants concentrations effectively in the short-term, and requires no long-term operation and maintenance.

Applying the ZVI injection technology to the distal end of the plume where total CVOCs are greater than 500 µg/L is expected to reduce the time to achieve remedial action objectives (RAOs) for groundwater within the overall contaminant plume.

B. Location and Size of Early Remedy Implementation Areas

Figure 1 presents the primary and secondary treatment areas that are part of the early remedy implementation. The larger and primary of the two areas (noted as Area 1 in Figure 1) is west of Dunn Field and extends from the Canadian National (CN) railroad tracks northwest to the Memphis Light, Gas, and Water (MLGW) electrical substation and is bisected by Menager Avenue. The area encompasses monitoring wells MW54, MW150, and MW155. The total surface area in Area 1 is approximately 75,000 square feet.

Area 1 has several access restrictions within the perimeter, including five electric line support towers, CN railroad tracks along the southern edge, and a portion of an MLGW electric substation. Approximately 24,000 square feet of Area 1 is within a security fence for the MLGW substation and access to this area has been denied. There are also several power lines that extend from the towers to the substation, which are low enough that access underneath the lines for heavy equipment used to implement the remedy may not be permissible.

The secondary area (shown as Area 2 in Figure 1) is also west of Dunn Field but is between the perimeter of Dunn Field and the CN rail line. This area is centered around monitoring well MW-144. This area is approximately 80 feet wide and a maximum of 275 feet long for a total surface area of approximately 22,000 square feet. There is one electric line support tower within Area 2, which also has access restrictions surrounding the tower.

C. Scope of Field Work for Early Remedy Implementation

The early remedy implementation field effort will include three main activities:

- Installation of additional monitoring wells
- Installation of ZVI injection points and injection of the ZVI into the fluvial aquifer
- Monitoring of groundwater prior to and subsequent to the injection

Additional Monitoring Well Installation

As shown in Figure 7, approximately 8 new monitoring wells will be installed in seven locations up- and downgradient to the proposed early remedy implementation areas. One new well cluster will be installed near Area 1, approximately midway between MW152 and MW155. The wells will be suitable for sampling using passive diffusion bag (PDB) samplers and have screen lengths of 15 feet or less. Two wells are required to screen the full saturated thickness.

Additional wells will be installed to confirm the limits of the planned early remedy implementation and to allow for monitoring results of the action. One well will be installed in Area 1 immediately south of the MLGW property along Menager Avenue about 160 feet west of MW148. Four wells will be installed in Area 2 at the north and south ends of the planned line of injections and upgradient and downgradient of MW144.

ZVI Injection Points and Injection Locations

Based upon the results of the Dunn Field ZVI Treatability Study, the radius of treatment of the ZVI injections was determined to be up to 40 feet. This radius of treatment is based upon the reduction of VOC concentrations within monitoring well MW131, which is located 40 feet from the study injection point IW-2. However, note that the quantities in this TM are based upon a 25 foot radius of influence (ROI) from each injection point. This distance is based upon observed thickness of ZVI within treatability study confirmation borings.

Area 1

Based on the anticipated 25-foot ZVI ROI, 13 points will be used for ZVI injection at Area 1 (Figure 7). The number of points proposed for this area will provide significant ROI overlap to treat groundwater flowing through the available treatment zone and, groundwater flowing through the treatment area should encounter ZVI at some point in the flowpath before exiting the area.

The aquifer directly beneath Area 1 varies from approximately 8 to 28 feet in thickness. Using an average thickness of 20 feet and the total surface area of approximately 25,525 square feet (thirteen 50-foot diameter injection areas), the amount of soil within the Area 1 aquifer is approximately 510,500 cubic feet. Assuming that there is 30 percent porosity in the aquifer, then the total cubic feet of soil in the Area 1 aquifer is approximately 357,000. Using an iron to soil mass ratio of a 0.5 percent (as was used during the treatability study) for each injection point, a soil density of approximately 100 pounds per cubic ft, then approximately 175,000 pounds of H-200 sponge ZVI will be required to treat the soil.

Area 2

Based on the anticipated ZVI ROI of 25 feet, 5 points will be used for injection of the ZVI at Area 2 (Figure 7). The number of points proposed for this area will provide significant ROI overlap to treat groundwater flowing through the available treatment zone and, groundwater flowing through the treatment area should encounter ZVI at some point in the flowpath before exiting the area.

Using an average thickness of 4 feet and the total surface area of approximately 9,820 square feet (five 50-foot diameter injection areas), the amount of soil within the Area 2 aquifer is approximately 39,300 cubic feet. Assuming that there is 30 percent porosity in the aquifer, then the total cubic feet of soil in the Area 1 aquifer is approximately 27,500. Using an iron to soil mass ratio of a 0.5 percent (as was used during the treatability study) for each injection point, a soil density of approximately 100 pounds per cubic ft, then approximately 14,000 pounds of H-200 sponge ZVI will be required to treat the soil.

Groundwater Monitoring

Groundwater samples will be collected from monitoring wells up- and downgradient from each of the treatment areas before and after injection of the ZVI to establish baseline groundwater chemistry and geochemical conditions and to confirm the reduction of the contaminants in groundwater. Samples will be collected through the use of PDB samplers and low-flow groundwater sampling techniques. The methods and procedures used in the field will adhere as closely as possible to procedures described in the site-specific Quality Assurance Project Plan, the U.S. EPA Region 4 Science and Ecosystems Services Division, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual* (EISOPQAM), dated November 2001, as well as sampling and purging procedures presented in *Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures* (Puls and Barcelona, 1996), Sections 7.2.2 and 7.3.3.

Groundwater samples will be analyzed for VOC constituents as well as geochemical parameters, including the metals iron, magnesium, manganese, selenium, and arsenic, as well as calcium, alkalinity, nitrate, and nitrite.

V. Public Notification

A Fact Sheet describing the early implementation of a component of the selected remedy will be produced and distributed to the public in September 2004. The Fact Sheet is for general informational purposes and should present much of the same information contained within this technical memorandum. The Fact Sheet will also provide a date for presentation of this information to the public and the Restoration Advisory Board (RAB). The date for the presentation is currently set for October 21, 2004.

Table 1

Preliminary Summary of CVOCs Detected in Groundwater Samples

Dunn Field Source Area Remedial Design

VOC Constituents	MW-31	MW-32	MW-44	MW-54	MW-70	MW-76	MW-77	MW-79	MW-80	MW-144	MW-145
Sample ID	MW-31	MW-32	MW-44	MW-54	MW-70	MW-76	MW-77	MW-79	MW-80	MW-144	MW-145
Sample Depth (ft. BGS)	75	66.4	77.7	93	89.6	92.8	87.7	101.3	72.2	74.8	95.2
Screen Interval (ft. BTOC)	64.1 - 79.1	52.7 - 67.7	64 - 74	84.5 - 94.5	80.8 - 90.8	73 - 93	68 - 88	82.5 - 102.5	53 - 73	56.1 - 76.1	80 - 100
Date Sampled	12-Aug-04	13-Aug-04	14-Aug-04	14-Aug-04	14-Aug-04	16-Aug-04	15-Aug-04	13-Aug-04	17-Aug-04	12-Aug-04	16-Aug-04
Carbon Tetrachloride	<1.7	7.6	0.8 J	<100	<120	<2	<330	0.8 J	<1	<250	<1
Chloroform	<1.7	58	0.4 J	<100	<120	0.5 J	<330	<1	<1	<250	<1
Chloromethane	<1.7	<2.5	<1	<100	<120	<2	<330	<1	<1	<250	<1
cis-1,2-Dichloroethene	<1.7	2.8	<1	65 J	<120	8.9	94 J	1.9	<1	88 J	<1
trans-1,2-Dichloroethene	<1.7	<2.5	<1	<100	<120	3.5	<330	1.6	<1	<250	<1
1,1-Dichloroethene	26	<2.5	<1	<100	<120	<2	<330	7.8	<1	<250	<1
Methylene Chloride	<1.7	2.1 J	<1	<100	<120	<2	<330	<1	<1	<250	<1
1,1,2,2-Tetrachloroethane	<1.7	21	<1	2300	3800	2.9	11000	<1	<1	7700	<1
Tetrachloroethene	0.6 J	0.97 J	<1	<100	<120	1.8 J	<330	1.7	<1	<250	<1
Toluene	<1.7	<2.5	<1	<100	<120	<2	<330	<1	<1	<250	<1
1,1,1-Trichloroethane	0.4 J	<2.5	<1	<100	<120	<2	<330	0.3 J	<1	<250	<1
1,1,2-Trichloroethane	<1.7	<2.5	<1	<100	<120	<2	<330	<1	<1	<250	<1
Trichloroethene	5.5	24	0.3 J	2200	970	34	3200	14	<1	2800	<1

VOC Constituents	MW-147	MW-148	MW-149	MW-150	MW-151	MW-152	MW-153	MW-154	MW-155	MW-156	MW-157
Sample ID	MW-147	MW-148	MW-149	MW-150	MW-151	MW-152	MW-153	MW-154	MW-155	MW-156	MW-157
Sample Depth (ft. BGS)	76.1	86.5	98.7	90.3	95.5	107.5	94	68	96	67.5	76
Screen Interval (ft. BTOC)	57.6 - 77.6	67.1 - 87.1	79.6 - 99.6	70.6 - 90.6	77 - 97	89 - 109	76 - 96	52.8 - 67.8	75.6 - 95.6	49 - 69	57.2 - 77.2
Date Sampled	17-Aug-04	17-Aug-04	18-Aug-04	18-Aug-04	16-Aug-04	15-Aug-04	19-Aug-04	17-Aug-04	16-Aug-04	20-Aug-04	18-Aug-04
Carbon Tetrachloride	4.3 J	0.7 J	12	<250	2.7	2.1 J	<1	<1	<77	<1	9.4
Chloroform	12	0.6 J	110	<250	3.3	0.87 J	<1	<1	<77	0.4 J	14
Chloromethane	<5.6	<1	<5	<250	0.2 J	<3.3	<1	<1	<77	<1	<6.7
cis-1,2-Dichloroethene	57	13	3.8 J	74 J	0.2 J	9.2	<1	<1	48 J	<1	11
trans-1,2-Dichloroethene	20	4.9	<5	<250	<1	4.1	<1	<1	<77	<1	1.9 J
1,1-Dichloroethene	2.2 J	<1	<5	<250	<1	<3.3	9.1	<1	<77	<1	<6.7
Methylene Chloride	<5.6	<1	2.5 J	130 J	<1	3.4	<1	<1	<77	<1	2.9 J
1,1,2,2-Tetrachloroethane	56	0.7 J	27	8000	<1	11	<1	<1	2100	<1	5.7 J
Tetrachloroethene	5.3 J	3.7	1.6 J	<250	<1	5.4	0.2 J	<1	<77	<1	1.9 J
Toluene	<5.6	<1			<1	<3.3	4	<1	<77	<1	<6.7
1,1,1-Trichloroethane	<5.6	<1	<5	<250	<1	<3.3	4	<1	<77	<1	<6.7
1,1,2-Trichloroethane	<5.6	<1	<5	<250	<1	<3.3	<1	<1	<77	<1	<6.7
Trichloroethene	120	31	38	3000	2.2	75	<1	<1	1000	<1	120

Note: Monitoring Wells MW-151, -152, -153, -154, -155, -156 & -157 were installed/sampled in August 2004 and data is preliminary

J = estimated quantity between the Reporting Limit and the Method Detection Limit

BGS = below ground surface

BTOC = below top of casing

All units in ug/L and only COCs are presented in the table

(shaded) = detected concentration

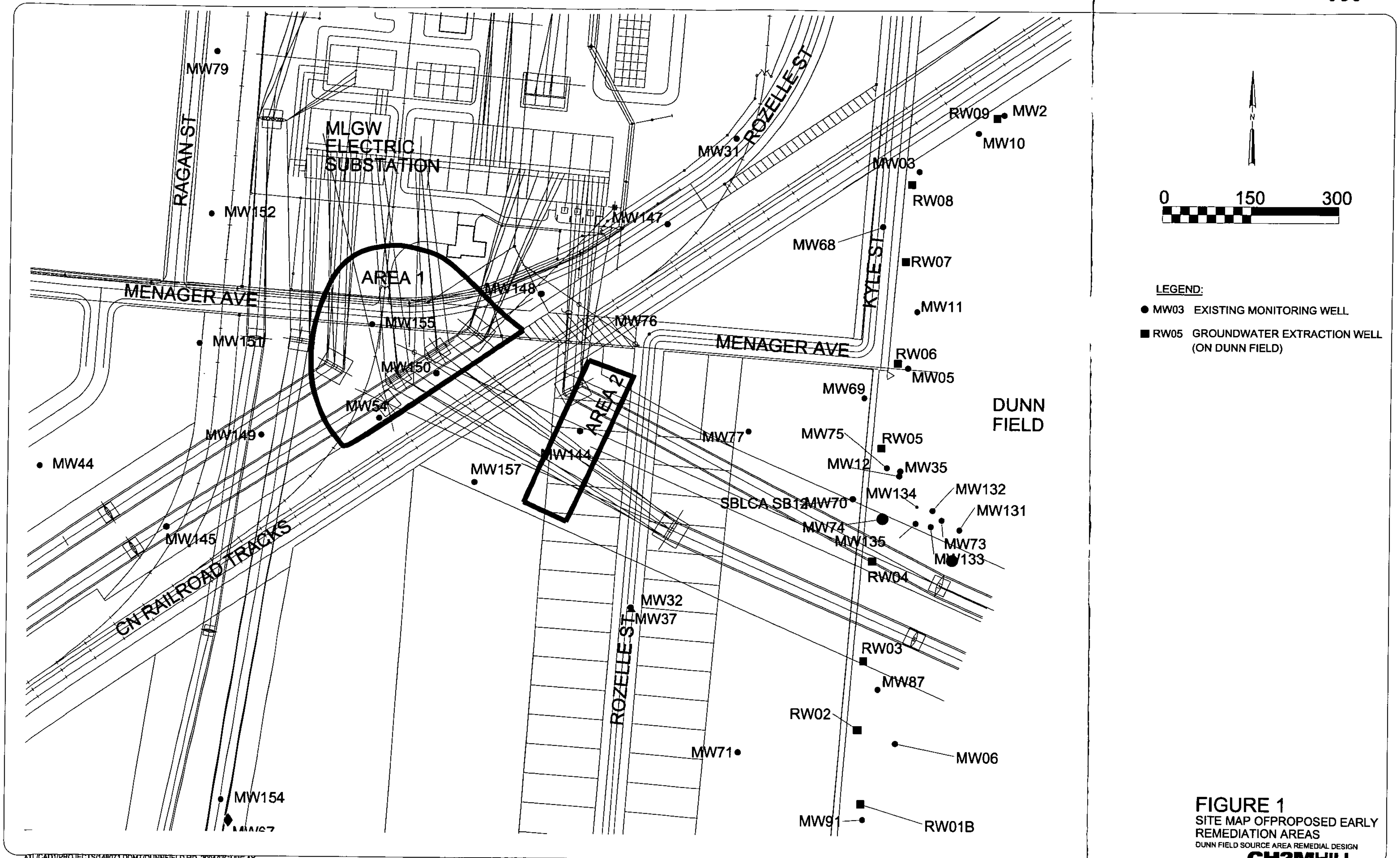
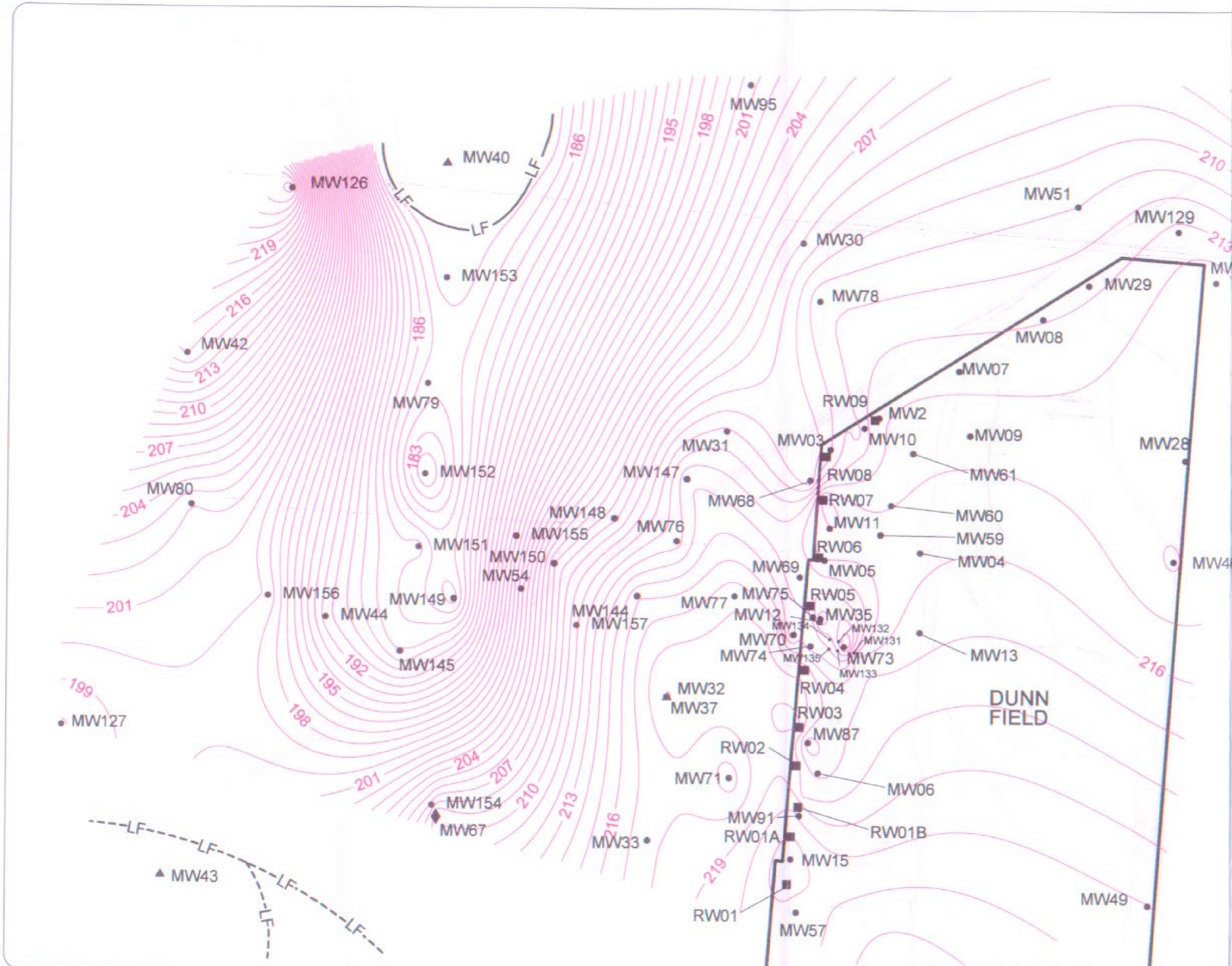


FIGURE 1
SITE MAP OFPROPOSED EARLY REMEDIATION AREAS
DUNN FIELD SOURCE AREA REMEDIAL DESIGN
CH2MHILL



N

0 150 300
SCALE IN FEET

LEGEND

- RW03 — RECOVERY WELL
- MW53 — FLUVIAL AQUIFER MONITORING WELL
- MW43 — INTERMEDIATE AQUIFER MONITORING WELL
- PZ06 — PIEZOMETER
- MW67 — MEMPHIS AQUIFER MONITORING WELL
- MEMPHIS DEPOT BOUNDARY
- 215 — TOP OF CLAY ELEVATION (FEET MSL)
- LF — LIMITED TO NO FLOW BOUNDARY (SEE NOTE)
- LF — INFERRED LIMITED TO NO FLOW BOUNDARY (SEE NOTE)

NOTES:

- THE "LIMITED TO NO FLOW BOUNDARY" IS AN AREA OF NO SIGNIFICANT SATURATED THICKNESS IN THE FLUVIAL DEPOSITS WHERE THERE IS LITTLE TO NO HORIZONTAL GROUND WATER FLOW.
- CLAY ELEVATION CONTOURS IN INTERVALS OF 1 FOOT.

FIGURE 2
ESTIMATED TOP OF UPPERMOST CLAY IN THE JACKSON FORMATION/UPPER CLAIBORNE GROUP
MEMPHIS DEPOT, DUNN FIELD

CH2MHILL

ATL\PROJ\148071 DDMT\DUNNFIELD_RD 2003\FIGURE_6

03-SEP-2004

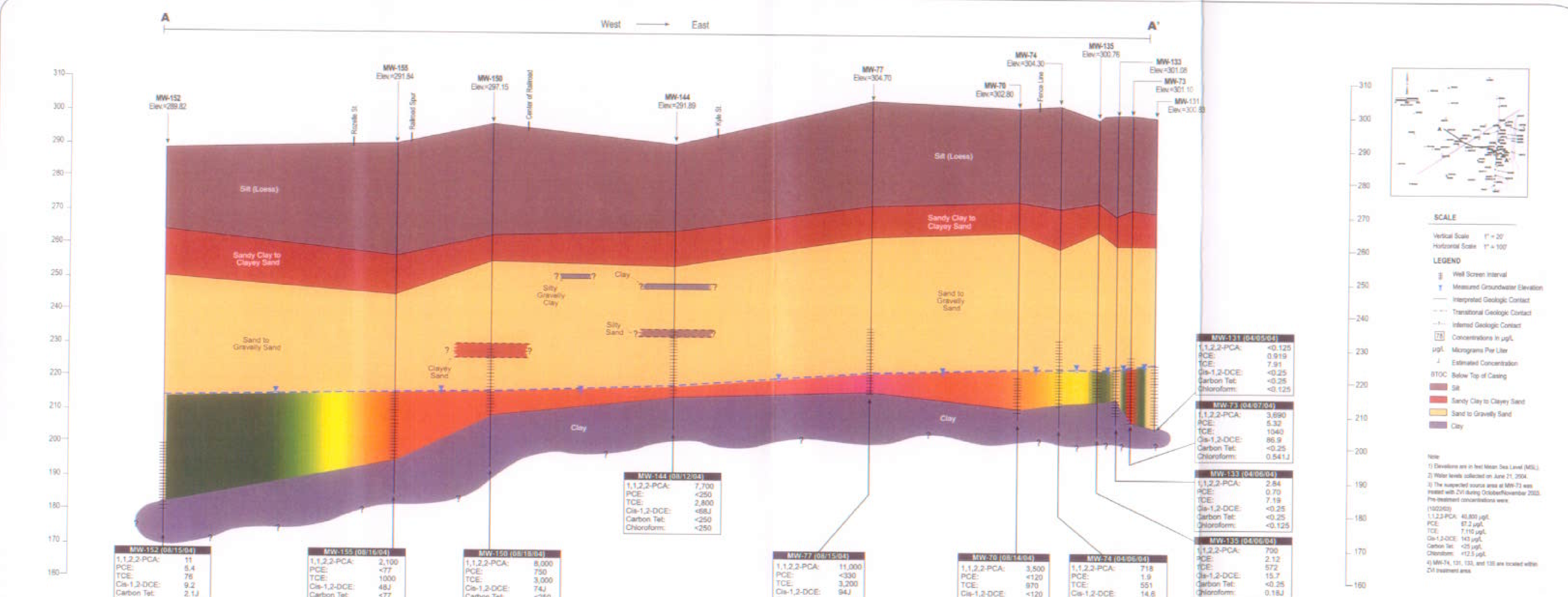
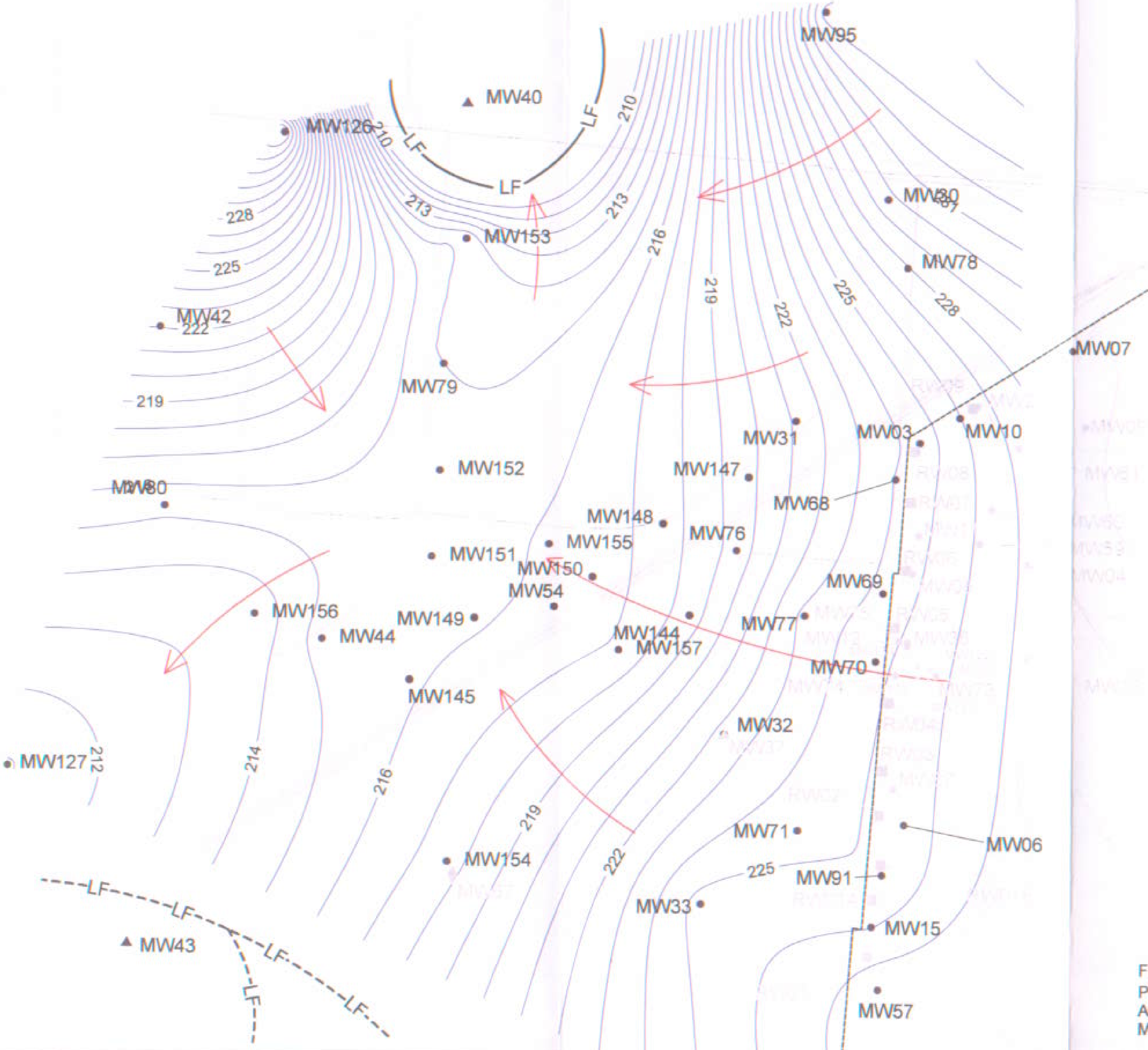


FIGURE 3
Lithologic Cross-Section Along Groundwater Flow Path of Concern
Memphis Depot, Dunn Field

CH2MHILL

Monitoring Well	Water Table Elevation (ft MSL)
MW3	224.37
MW6	225.55
MW7	229.58
MW8	231.82
MW10	225.98
MW15	225.90
MW29	237.19
MW30	229.73
MW31	221.07
MW32	222.34
MW33	225.19
MW42	222.05
MW44	215.48
MW51	236.24
MW54	216.23
MW56	226.91
MW57	227.66
MW58	227.71
MW68	224.07
MW69	224.26
MW70	224.71
MW71	224.64
MW76	219.41
MW77	223.03
MW78	227.93
MW79	215.00
MW80	215.30
MW91	225.09
MW95	233.54
MW126	234.24
MW127	210.91
MW144	218.52
MW145	215.87
MW147	219.80
MW148	217.58
MW149	215.89
MW150	216.46
MW151	215.75
MW152	215.37
MW153	214.85
MW154	217.57
MW155	216.17
MW156	213.26
MW157	217.19



LEGEND

- RW03 RECOVERY WELL
- MW53 FLUVIAL AQUIFER MONITORING WELL
- MW43 INTERMEDIATE AQUIFER MONITORING WELL
- PZ08 PIEZOMETER
- MW67 MEMPHIS AQUIFER MONITORING WELL
- MEMPHIS DEPOT BOUNDARY
- 215 WATER TABLE ELEVATION IN THE FLUVIAL AQUIFER (FEET MSL)
- LF LIMITED TO NO FLOW BOUNDARY (SEE NOTE)
- LF INFERRED LIMITED TO NO FLOW BOUNDARY (SEE NOTE)
- GROUNDWATER FLOW DIRECTION

NOTES:

- THE "LIMITED TO NO FLOW BOUNDARY" IS AN AREA OF NO SIGNIFICANT SATURATED THICKNESS IN THE FLUVIAL DEPOSITS WHERE THERE IS LITTLE TO NO HORIZONTAL GROUND WATER FLOW.
- MW-37, 40 AND 43 ARE SCREENED IN THE INTERMEDIATE AQUIFER AND THEREFORE NOT INCLUDED IN THIS POTENTIOMETRIC SURFACE MAP.
- MW-67 IS SCREENED IN THE MEMPHIS AQUIFER AND THEREFORE NOT INCLUDED IN THIS POTENTIOMETRIC SURFACE MAP.
- WATER LEVEL MEASUREMENTS WERE COLLECTED ON AUGUST 18/19, 2004 BY MACTEC, EXCEPT MW31 (AUGUST 12), MW76 (AUGUST 16) AND MW156 (AUGUST 20).
- GROUNDWATER CONTOURS IN INTERVALS OF 1 FOOT.

FIGURE 4
POTENTIOMETRIC SURFACE OF THE FLUVIAL AQUIFER
MEMPHIS DEPOT, DUNN FIELD

CH2MHILL

ATL\PROJ\148071 DDMT\DUNNFIELD_RD 2003\FIGURE_7A 15-SEP-2004

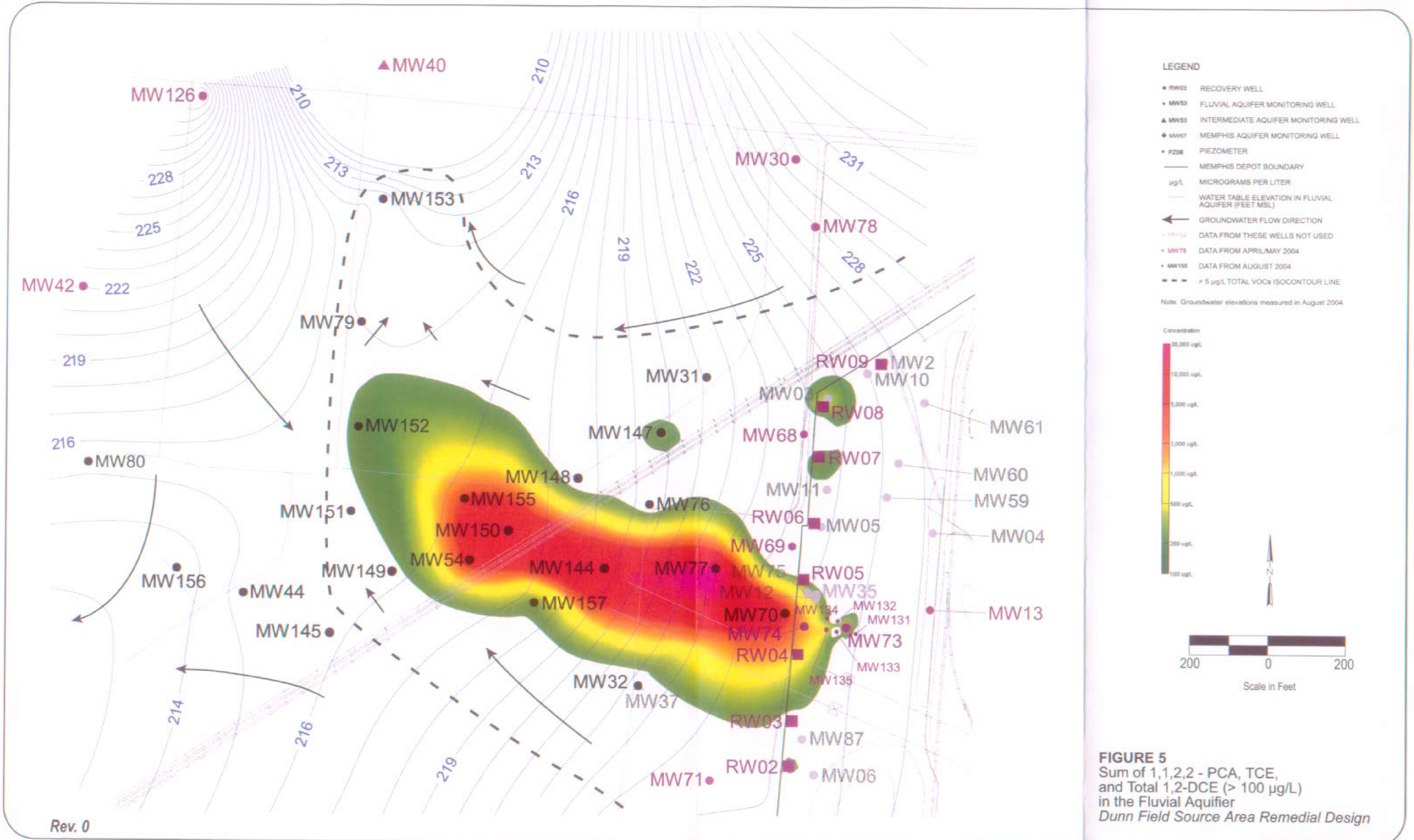
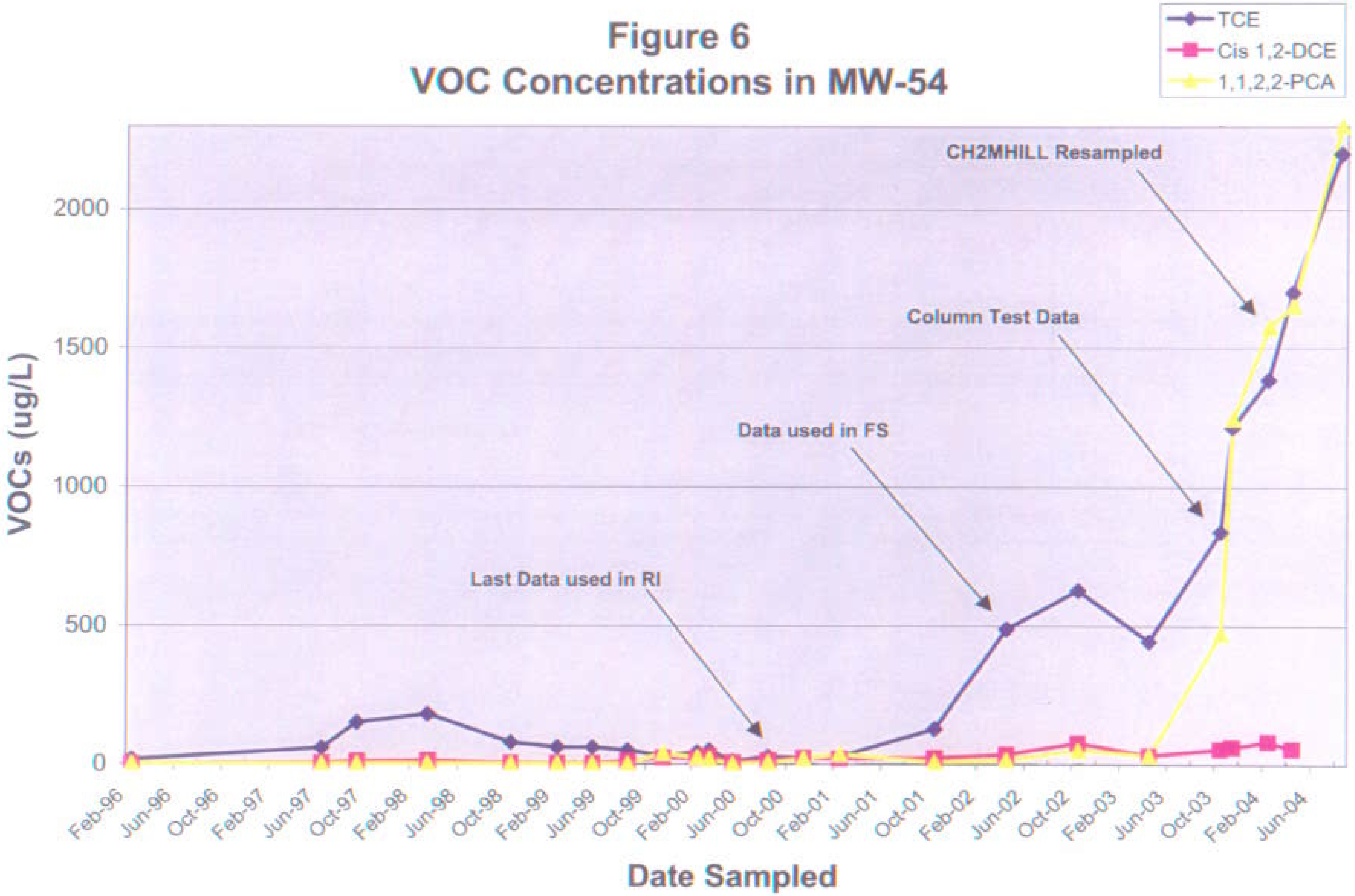
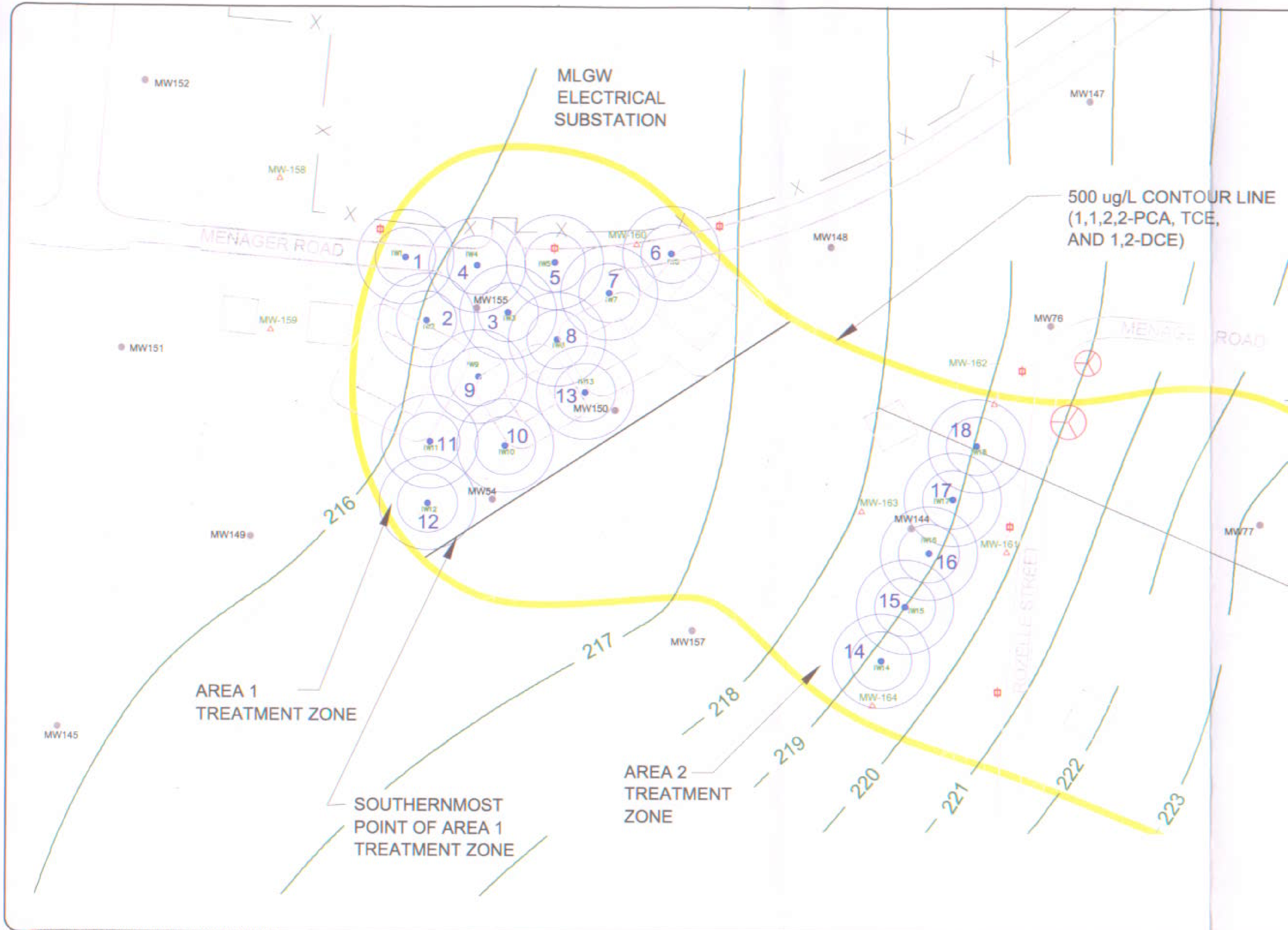


FIGURE 5
Sum of 1,1,2,2 - PCA, TCE,
and Total 1,2-DCE (> 100 µg/L)
in the Fluvial Aquifier
Dunn Field Source Area Remedial Design

Figure 6
VOC Concentrations in MW-54



808 13



LEGEND:

- EXISTING MONITORING WELL
- 218 — GROUNDWATER CONTOUR LINE (IN FEET ABOVE MEAN SEA LEVEL)
- PROPOSED INJECTION POINTS WITH ANTICIPATED 25 FOOT ZVI INJECTION ZONE AND 40 FOOT RADIUS OF INFLUENCE
- RECENTLY INSTALLED MONITORING WELL LOCATION (LOCATIONS APPROXIMATE)
- OVERHEAD POWER LINES
- BRUSH OR WOODED AREAS
- FENCE

FIGURE 7

PROPOSED MONITORING WELL AND INJECTION POINT LOCATIONS

DUNN FIELD SOURCE AREA REMEDIAL DESIGN

CH2MHILL

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE