AECOM

Environment

Prepared for:
United Technologies Corporation
Farmington, Connecticut

Prepared by:
AECOM
Atlanta, Georgia
March 2015

Voluntary Remediation Plan

Former United Technologies Automotive Site
Thomson, GA
HSI # 10543

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Former United Technologies Automotive Site
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PROFESSIONAL CERTIFICATION

"I certify under penalty of law that this report and all attachments were prepared by me or under my direct supervision in accordance with the Voluntary Remediation Program Act (O.C.G.A. Section 12-8-101, et seq.). I am a professional engineer/professional geologist who is registered with the Georgia State Board of Registration for Professional Engineers and Land Surveyors/Georgia State Board of Registration for Professional Geologists and I have the necessary experience and am in charge of the investigation and remediation of this release of regulated substances.

Furthermore, to document my direct oversight of the Voluntary Remediation Plan development, implementation of corrective action, and long term monitoring, I have attached a monthly summary of hours invoiced and description of services provided by me to the Voluntary Remediation Program participant since the previous submittal to the Georgia Environmental Protection Division.

The information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

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REGISTERED
No. 030030
PROFESSIONAL
ENGINEER
SHEAU-YUN CHIANG

Dr. Sheau-Yun Chiang, Ph.D., P.E.
Printed Name and GA PE/PG Number 030030

March 12, 2015
Date

Signature and Stamp

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List of Acronyms

µg/L	micrograms per liter
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethylene
AECOM	AECOM Technical Services, Inc.
CAP	Corrective Action Plan
cis-1,2-DCE	cis-1,2-dichloroethene
COIs	constituents of interest
CSM	Conceptual Site Model
CSR	Compliance Status Report
CTI	Conversion Technology, Inc.
CVOC	chlorinated volatile organic compound
email	electronic mail
ESV	Ecological Screening Value
ft	feet
ft/day	feet per day
ft bgs	feet below ground surface
ft msl	feet above mean sea level
Georgia EPD	Georgia Environmental Protection Division
HI	hazard index
HP Pelzer	H.P. Pelzer Inc.
HSRA	Hazardous Site Response Act
J&E	Johnson and Ettinger
MAROS	Monitoring and Remediation Optimization System
MNA	monitored natural attenuation
RC	representative concentration
RRS	Risk Reduction Standards
Shaw	Shaw Industries, Inc.
Site	Former United Technologies Automotive Facility
TCE	trichloroethene
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
UST	underground storage tank
UTAS	United Technologies Automotive Systems, Inc.
UTC	United Technologies Corporation
VOC	volatile organic compound
VIRP	Voluntary Investigation and Remediation Plan
VRP	Voluntary Remediation Program
WQS	Water Quality Standards

1.0 Introduction

1.1 Overview

AECOM Technical Services, Inc. (AECOM), on behalf of United Technologies Corporation (UTC), has prepared this Voluntary Remediation Plan as part of the Voluntary Remediation Program (VRP) application for the Former United Technologies Automotive Facility (the Site) located at 1884 Warrenton Highway in Thomson, McDuffie County, Georgia (Figure 1-1).

In a letter dated September 17, 2013, the Georgia Environmental Protection Division (EPD) concurred that natural attenuation is occurring at the Site and that sampling has demonstrated plume stability and, therefore, recommended enrolling the Site into the VRP.

1.2 Qualifying Applicant and Property

UTC is considered the qualified applicant and has secured written consent to enroll the parcels solely owned by H.P. Pelzer Inc. (HP Pelzer) in the VRP. Qualifying applicant information is included in the VRP Application Form and Checklist in Appendix A. The Warranty Deed (checklist item #2) for the Site is included as Appendix B. The qualifying property boundary and abutting properties are presented on Figure 1-2 (checklist item #3). The Site was surveyed by McGill and Associates in 1997. Property boundaries are shown on Figure 1-2.

2.0 Current Environmental Information

2.1 Site History

Several investigative actions, including soil boring and sampling, visual inspection, excavation, and groundwater sampling, have been implemented at the Site since 1990. The Site was originally developed by National Homes in 1960, and the property was sold to Sheller-Globe, Inc. in 1979. UTC acquired Sheller-Globe in 1988 and renamed it United Technologies Automotive Systems, Inc. (UTAS). UTAS operated as a wholly owned subsidiary of UTC and owned the Site until 1997, at which time the property was sold to HP Pelzer. UTC sold UTAS in 1999 but continued to perform certain environmental work at the Site.

During its period of ownership of the Site, UTAS conducted an environmental investigations and found that 1,1-dichloroethylene (1,1-DCE) was detected in groundwater above the reportable quantity limit. The groundwater data results were reported to the Georgia EPD, and the Site was subsequently placed on the Hazardous Site Inventory. The thirteen monitoring wells installed as part of the initial investigations were later abandoned and could no longer be used to collect samples.

A limited investigation of the Site was performed by HP Pelzer in 2003, and the results were submitted to the Georgia EPD. The Georgia EPD then requested that a full Compliance Status Report (CSR) be completed for the Site to further evaluate soil and groundwater contamination. A CSR prepared for HP Pelzer by Conversion Technology, Inc. (CTI) was submitted to the Georgia EPD in May 2006. Due to a lack of sufficient delineation data with respect to groundwater contamination, the Georgia EPD requested additional delineation and an addendum to the CSR. UTC thereafter took over the investigation and began working with the Georgia EPD. In November 2007, additional on- and off-site monitoring wells were installed, and the results were summarized in the CSR Addendum (XDD, 2008a) submitted to the Georgia EPD. A Corrective Action Plan (CAP) was submitted in December 2008 for the Site (XDD, 2008b). The Georgia EPD approved the CAP, which proposed monitored natural attenuation (MNA) to address the groundwater contamination. Based on the soil sampling data collected in 2005 and 2007, the soil data met the Type 4 Risk Reduction Standards (RRS) and a certification of compliance letter was included as part of the CSR.

2.2 Conceptual Site Model

A conceptual site model (CSM) provides a framework for understanding the site-specific characteristics that are integral to developing appropriate strategies for Site remediation and management (checklist items #5.a.through 5.c.). These characteristics typically include the types of environmental media impacted by such releases; the geologic, hydrogeologic, chemical, and biological factors influencing the fate and transport of the released constituents within the environment; and the human and ecological receptors potentially affected by the releases. Since contaminants may migrate vertically as well as horizontally from the location of the release(s), it is important to characterize Site conditions in three dimensions. The CSM also helps to identify the relative significance of Site conditions that must be considered in evaluating potentially applicable remedial solutions. This section summarizes the information developed from the phases of investigations and remediation at the Site, which collectively constitute the CSM.

2.2.1 Site Description

The Site is located on approximately 36.4 acres of an industrial/commercial zoned property, generally surrounded by a rural agricultural area, approximately two miles southwest of the City of Thomson, Georgia (Figure 1-1). The Site is bounded by Shaw Industries, Inc. (Shaw) to the southwest, Warrenton Highway 278 to the southeast, Wire Road to the northeast, and a residential property and railroad tracks to the northwest.

According to historical Site documents, the surrounding area is characterized by moderately rolling topography. The majority of the Site gently slopes to the east. There is a ridgeline located along the western edge of the Site, near the building's edge. The Site is located at an elevation of approximately 505 feet above mean sea level (ft msl). A drainage ditch is located on the southern portion of the Site, which receives storm water from the Site and the Shaw property and drains to the east toward Warrenton Highway. A small pond is located near the southeast property line, near Warrenton Highway.

2.2.2 Regional and Site Geologic Conditions

The Site is located within the southern Piedmont physiographic province of Georgia near the Fall Line region and north Sand Hills region. This area is described as chemically and physically weathered metamorphic and igneous rocks with varying thickness of overburden soils. These soils consist of clays, silts, and sands of varying composition. The soils in this part of Georgia are typically well drained. The area of Thompson, Georgia is underlain by granite and granitic gneiss of Precambrian age according to the Geologic Map of Georgia.

The Site soils generally consist of sandy clay and clay of varying colors. Bedrock varies across the Site ranging from 4 feet below ground surface (ft bgs) to approximately 77 ft bgs and consists of granitic gneiss. The elevated range of bedrock is located in the suspected source area, along the southwestern property boundary. The cross section transect lines are shown on Figure 2-1. Cross sections of the Site are shown on Figures 2-2, 2-3, and 2-4.

2.2.3 Regional and Site Hydrogeologic Conditions

Groundwater flow within the Piedmont physiographic province often follows the contour of the bedrock and discharges to regional streams and rivers. General groundwater flow is across the Site from west to east slightly toward northeast. The shallowest depth to groundwater is within the source area that has the shallowest depths to the bedrock. The groundwater elevations ranged from 502.41 ft msl to 519.92 ft msl in December 2013. Local surface water drains to a regional tributary of Whites Creek that is located within the Savannah River basin. Typically, there is no base flow in the ditch located on the southern part of the Site. The ditch receives storm water from the Site and the adjacent Shaw property during rain events. The groundwater elevations and general flow direction are shown on Figure 3-1 and Figure 3-2 for June 2013 and December 2013, respectively.

Hydrogeologic testing conducted and discussed as part of the CSR in 2006 indicated an average hydraulic conductivity of 0.361 feet per day (ft/day) with a range from 0.0066 ft/day at M-6 to 2.06 ft/day at M-12 (CTI, 2006). The average groundwater velocity was estimated to be 0.0126 ft/day (or 4.6 ft/year) in the Semi-Annual Progress Report (October 2011 through February 2012) and MNA Effectiveness Report dated May 2012 (XDD, 2012).

2.3 Contaminant Distribution

The suspected source area is located in the loading rack area on the southwest side of the facility building. The majority of the contaminants detected at the Site have been chlorinated volatile organic compounds (CVOCs).

2.3.1 Soils

Soil samples were collected during monitoring well installations in 2005 and 2007. Constituents of Interest (COIs) in soil were determined to be in compliance with Type 4 RRS (non-residential) in the CSR dated May 2006.

The Type 1 residential RRS for 1,1-DCE, cis-1,2-dichloroethene (cis-1,2-DCE), trichloroethene (TCE), and vinyl chloride were calculated and compared to existing soil data. This comparison is summarized on Table 2-1. COIs in soil are in compliance with the Type 1 RRS. The certification of compliance to Type 1 RRS for soil is included as Appendix C.

2.3.2 Groundwater

The Type 4 RRS were calculated in the CAP and approved for COIs for the Site by the Georgia EPD. The Type 4 RRS were calculated for isopropylbenzene, benzene, 1,1-DCE, cis-1,2-DCE, TCE, and vinyl chloride. 1,1-Dichloroethane (1,1-DCA), ethylbenzene, toluene, and 1,1,1-trichlroethane were eliminated as COIs, since concentrations were below the Type 1 RRS. The impact from non-chlorinated volatile organic compounds (VOCs), including isopropylbenzene, benzene, ethylbenzene, toluene, and naphthalene, were isolated from the CVOC extent and limited to monitoring well M-2. These VOCs are believed to be associated with a former underground storage tank (UST) at the Site. The UST was removed in September 1992. The Georgia EPD issued a no further action letter in response to the report documenting the UST removal. Based on existing groundwater data, the isopropylbenzene, benzene, and naphthalene have been compliant with the Type 4 RRS for over two years and each of these have been eliminated as COIs. Currently, the COIs for the Site are 1,1-DCE, cis-1,2-DCE, TCE, and vinyl chloride.

A summary of the historical COI data is presented in Table 2-2. Isoconcentration contours for TCE, 1,1-DCE, and vinyl chloride detected during the June 2013 and December 2013 monitoring events are shown on Figures 3-3 through 3-8, respectively. The COI plume is generally limited to the suspected source area located in the loading dock area and contained within the property boundary. The concentration trends show that the groundwater plume is stable or decreasing.

2.3.3 Monitoring Natural Attenuation

For CVOCs, the predominant natural attenuation process is reductive dechlorination, which under anaerobic conditions, sequentially replaces chlorine molecules with hydrogen molecules, degrading TCE to cis-1,2-DCE to vinyl chloride to ethene. Organic carbon sources, such as natural organic carbon or fuel hydrocarbons, may serve as the electron donor to a variety of microbial reactions in groundwater and CVOCs are the electron acceptors. In addition, cis-1,2-DCE and vinyl chloride could be aerobically degraded under aerobic conditions.

2.3.3.1 MNA Indicators

Groundwater has been monitored for multiple years, and MNA effectiveness has been monitored at the Site for two years, with at least six sampling events. All MNA parameters suggest the natural attenuation potential. Geochemical and MNA data are stable with no notable changes over the monitoring period. The Georgia EPD concurred that MNA was occurring at the Site in a letter dated September 17, 2013. The following conclusions were drawn based on the analyzed MNA indicators shown in Table 2-3:

- The results of total organic carbon, chemical oxygen demand, and biological oxygen demand indicated that the carbon and energy sources are available at the Site to support biological processes.
- Most of the aquifer is slightly acidic and pH fluctuates between sampling events. The pH values at the Site generally are not favorable for a complete dechlorination from TCE to ethene. However, a partial dechlorination of TCE, which is from TCE to cis-1,2-DCE and/or vinyl chloride, could occur under the Site pH conditions.
- The reduction-oxidation conditions of the aquifer fluctuate between aerobic and anaerobic conditions between sampling events. Anaerobic conditions are favorable for reductive dechlorination of TCE, cis-1,2-DCE, and vinyl chloride, and were found in the source area where the contamination impact is evident. Aerobic conditions are downgradient from the source area and are considered favorable for aerobic degradation of cis-1,2-DCE and vinyl chloride.
- The detections of cis-1,2-DCE and vinyl chloride, the daughter products of TCE degradation, confirmed the presence of reductive dechlorination of TCE to cis-1,2-DCE and vinyl chloride at the Site. However, the detections of vinyl chloride are minimal and an increasing trend of cis-1,2 DCE and vinyl chloride is not apparent.
- The methane detections confirmed the presence of anaerobic conditions and anaerobic microbial activities. The lack of ethane and ethene implies that the complete dechlorination of TCE to ethene, if present, is not a primary degradation pathway for the Site. Aerobic processes are more likely required to degrade cis-1,2-DCE and vinyl chloride.

2.3.3.2 COI Trend Analysis

A decreasing trend of COI concentrations is the most direct indicator to demonstrate the occurrence of MNA. In order to evaluate whether the monitoring data show evidence of increasing or decreasing concentration trends for specific wells and COIs, the Mann-Kendall non-parametric statistical analysis was applied to the groundwater data using the publically-available Monitoring and Remediation Optimization System (MAROS) software, Version 2.2 (Air Force Center for Environmental Excellence, 2007).

Six wells (M-07, M-08R, M-09, M-10, M-14D, and M-17) and three COIs (1,1-DCE, TCE, and vinyl chloride) were selected for Mann-Kendall analysis. The concentration trend analysis was conducted for available groundwater monitoring data collected between 2005 and 2013. The Mann-Kendall statistical trend analysis results are shown in Table 2-4, and the MAROS statistical trend analysis is included in Appendix D.

The trend analysis results indicate that the COI concentrations in the suspected source area monitoring wells are decreasing or stable. The plume is generally limited to the suspected source area, which is the loading dock area at the southwestern side of the building.

2.3.3.3 Degradation Rate Analysis

A degradation rate analysis was performed to determine the rate of the COI concentration changes. A first-order kinetic equation was derived from the historical data (2005 to 2013) for the monitoring wells with Type 4 RRS exceedance (TCE in M-07, M-08R, M-10 and M-14D; and 1,1-DCE in M-09). The trend plots for these monitoring wells are shown in Appendix E. First-order degradation rates were calculated by regression analysis. The degradation rate for TCE was estimated to be 0.0003 day^{-1} at M-07, 0.0006 day^{-1} at M-08R, 0.0009 day^{-1} at M-10, and 0.001 day^{-1} at M-14D. The degradation rate of 1,1-DCE in M-09 was estimated to be 0.00005 day^{-1}. The degradation rates calculated for TCE are less than the average published values (generally 0.0025 day^{-1} for anaerobic biodegradation and 0.008 day^{-1} for methanogenic biodegradation). The observed degradation rates indicate that there is evidence supporting the occurrence of MNA at the Site.

3.0 Human Health and Exposure Pathway Analysis

Risk evaluations were performed for the Site to assess the potential for chemicals detected in groundwater to pose risk to human health and/or ecological receptors. The risk posed to potential future groundwater use will be addressed by placing a deed restriction on the property prohibiting the use of groundwater. Two evaluations were performed:

- Due to the presence of CVOCs in shallow groundwater on the Site, the potential for resident risk as a result of vapor intrusion was evaluated.
- Due to the possibility that groundwater could discharge to the small pond on the Site, a screening-level evaluation of groundwater was performed to identify the potential for ecological risk from exposure to surface water impacted by groundwater.

3.1 Evaluation of Vapor Intrusion Risk

Groundwater has been identified as a potential source medium for impacts to indoor air. A vapor intrusion evaluation was conducted to determine whether groundwater impacts pose indoor air risks to hypothetical on-site residents at the Site. The evaluation was conducted for the COIs posing a potential risk to hypothetical future residents.

The Johnson and Ettinger (J&E) vapor intrusion model (United States Environmental Protection Agency [USEPA], 2004) was used to calculate human health risk from inhalation of indoor air containing CVOCs originating from groundwater contamination. The J&E vapor intrusion model was also used to calculate site-specific, risk-based screening levels for groundwater that are considered protective of a resident exposed to groundwater contaminants in indoor air. The detailed evaluation is included in Appendix F.

3.1.1 Representative Concentration

In order to estimate the potential risks to hypothetical residents, it is first necessary to estimate the representative concentration (RC) in groundwater that may migrate upwards and infiltrate into indoor air. These groundwater RCs are then used in the J&E model to predict the indoor air concentration that a receptor may be exposed to and the resulting potential risks associated with this indoor air concentration. For this Site, to be conservative the historical maximum groundwater concentrations were used to calculate the vapor intrusion risk:

- TCE: 856 micrograms per liter (µg/L) (detected in MW-14D on July 9, 2010)
- Vinyl chloride: 4 µg/L (detected in M-10 on November 8, 2005)
- 1,1-DCE: 1,360 µg/L (detected in M-9 on April 21, 2010)
- Cis-1,2-DCE: 40.6 µg/L (detected in M-14D on July 27, 2011).

3.1.2 Modeling Results

For the purposes of this vapor intrusion evaluation, potential exposure to TCE, vinyl chloride, 1,1-DCE, and cis-1,2-DCE volatilizing from groundwater into indoor air is considered a complete exposure pathway for residents in typical residential building. All vapor intrusion modeling runs are provided in Appendix F. Indoor air risks to hypothetical residents associated with vapor intrusion of COIs are presented in Table 3-1. The cumulative indoor air risk is compared to the acceptable noncancer hazard index (HI) of 1.0 and acceptable cancer target risk level of 1E-05.

3.1.2.1 Noncancer Risks

The cumulative noncancer HI was 0.8, below the target HI of 1.0, indicating that groundwater concentrations do not pose an unacceptable vapor intrusion noncancer risk to hypothetical residents even when based on the historical maximum concentration of each COI.

3.1.2.2 Cancer Risks

Similarly, the cumulative cancer risk was 2.75^{-06}, below the target risk level of 1.0^{-05}, indicating that groundwater concentrations do not pose an unacceptable vapor intrusion cancer risk to residents even when based on the historical maximum concentration of each COI.

3.1.2.3 Vapor Intrusion Risk-Based Screening Levels for Groundwater

Although cumulative indoor air risk was below the target risk levels, risk-based screening levels for groundwater were calculated using the J&E vapor intrusion model to be protective of the residents. These screening levels are intended to be protective of residents exposed to groundwater contaminants in indoor air as a result of vapor intrusion. The following site-specific vapor intrusion screening levels were derived:

- TCE 1,110 µg /L
- Vinyl Chloride 1,110 µg /L
- 1,1-DCE 52,300 µg /L
- cis-1,2-DCE not calculated due to lack of inhalation toxicity values.

The historical groundwater maximum concentrations were below the calculated screening levels, which further supports the conclusion that current groundwater concentrations do not pose an unacceptable vapor intrusion risk for residents in a typical residential building under current or likely future conditions. Although there is uncertainty associated with cis-1,2-DCE because it lacks inhalation toxicity factors, it is not expected to be more toxic than the other compounds evaluated and its historical maximum concentration is lower than that of TCE and 1,1-DCE. Thus, cis-1,2-DCE also would not be expected to pose unacceptable risk through the vapor intrusion pathway.

3.2 Evaluation of Groundwater Ecological Risk

The small pond in the eastern portion of the Site could potentially provide a pathway for exposure of ecological receptors to chemicals in the groundwater if the groundwater discharges to the pond. Given the small size of the pond and its location in a controlled area near the facility entrance, the potential for human exposure to pond surface water is negligible. The source area is approximately 972 feet upgradient from the pond. In addition, VOC concentrations have been in compliance with the groundwater RRS at monitoring well M-19, located between the source area and the pond approximately 372 feet upgradient from the pond. Therefore, it is unlikely that the pond will become impacted from the VOC groundwater plume. However, in order to evaluate the potential for ecological risk from exposure to surface water that could be impacted by the groundwater plume, a conservative, screening-level evaluation using groundwater data was performed, since no surface water data was available from the pond.

A highly conservative screening evaluation was conducted for this Site that assumes that concentrations in groundwater adjacent to the industrial building in the loading rack area of the Site could be transported over 900 feet and discharged to the pond with no attenuation due to processes that actually would be expected to occur, including degradation, dilution, volatilization, and retardation. As part of the screening process, the maximum detected concentration of TCE (July 2010) compared to the Georgia EPD In-stream Water Quality Standards (WQS) and the maximum detected concentration of 1,1-DCE (April 2010) compared to the USEPA Region 4 Ecological Screening Value (ESV) for Surface Water (USEPA, 2001) were used. The WQS and ESV were not exceeded by the average concentration of either of these CVOCs. In addition, the 95 percent upper confidence level (95 UCL) of the mean for these compounds (see Table 3-1) in groundwater also did not exceed the corresponding surface water screening values. In addition, the most recent groundwater concentrations detected in 2013 did not exceed corresponding surface water screening values. Given the conservatism of the assumptions used in this screening process and the lack of exceedances of surface water screening values by average or 95 UCL concentrations in groundwater, none of the COIs in groundwater are predicted to pose risk to ecological receptors in surface water. The results of the screening evaluation are shown in Table 3-2.

3.3 Point of Demonstration for Groundwater

The proposed monitoring wells for point of demonstration are M-3 and M-3A, which are approximately 600 ft downgradient of the source area in the vicinity of M-14D. These monitoring wells will serve as demonstration wells because of the depths of their screened intervals and groundwater flow direction at the Site. Groundwater flow is from west to east and slightly toward the northeast historically at the Site. Wells M-3 and M-3A are along the flow pathway downgradient from the source area. COI concentrations have not historically been detected in these monitoring wells.

4.0 Proposed Remediation Plan

The risk evaluation indicates that there are no unacceptable risks to humans through the vapor intrusion pathway or to the ecological receptors through surface water at the Site. The COIs in soil meet the Type 1 residential RRS. The institutional controls described in Section 4.0 will be used to restrict the use of groundwater at the Site and insure the protectiveness of the remedy.

4.1 Institutional Controls

The following institutional controls will be applied to ensure that the conditions at the Site are managed accordingly to be protective of human health and the environment:

- Prohibition of the use of groundwater at the Site through compliance with the Georgia EPD uniform environmental covenant.
- Prohibition on the use of Site for residential purposes through compliance with the Georgia EPD uniform environmental covenant.

4.2 Groundwater Sampling

The current schedule of semi-annual groundwater monitoring and reporting will continue until this VRP application is approved by the Georgia EPD. The groundwater monitoring data described in Section 2.3.2 of this report demonstrates that the dissolved COI plume is stable and/or shrinking and will not likely increase in the future.

Once the VRP application is approved, groundwater monitoring will be conducted on an annual basis. During the annual sampling events, monitoring wells will be gauged for depth to water. Groundwater samples will be collected from wells M-02, M-02A, M-03, M-03A, M-06 through M-10, M-14D, M-17, M-18, and M-19. These samples will be analyzed for CVOCs by USEPA Method 8260B. As the MNA parameters have been stable with no changes with time, MNA monitoring will no longer be included in the Site monitoring program. This revision to the groundwater monitoring plan is based on the Georgia EPD’s approval via electronic mail (email) from Mr. Jason Metzger on June 13, 2014. This email also approved the list of monitoring wells to be sampled during the June and December 2015 events as proposed in the 2013 Semi-Annual Progress Report/MNA Effectiveness Report dated March 15, 2014. Once the VRP application is approved, the annual sampling will be conducted for a period of two years and will be documented in annual groundwater monitoring reports.

4.3 Projected Milestone Schedule

The projected milestones include implementation of the institutional controls (deed restriction) discussed in Section 4.1 and two annual groundwater sampling events. The deed restriction will be recorded and submitted to the Georgia EPD by the end of 2015. UTC will request that the Site be delisted from Hazardous Site Response Act (HSRA) after the deed restriction is recorded. Semi-annual progress reports will be submitted to the Georgia EPD, starting six months after the VRP Application is approved. The VRP Property Evaluation Form will be submitted annually for a five (5) year period after the deed restriction is in place. Below is the list of milestones and proposed schedule.

Milestone	Schedule
Current Semi-Annual Sampling Program	June 2015
VRP Application Approval	60 to 90 days after application submittal
Deed Restriction Recorded	60 days after application approval
HSRA Delisting Request	30 days after Deed Restriction Recording
Annual Sampling	December 2015, December 2016
Annual Groundwater Monitoring Report	March 2016, March 2017
Semi-Annual Progress Reports	Semi-annually after VRP approval*
VRP Annual Property Evaluation Form	Annually after deed restriction in place

* Once the deed restriction is in place, the frequency of the semi-annual progress reports will be modified to annually and included as part of the annual groundwater monitoring report.

5.0 References

AECOM 2013. 2013 Semi-Annual Progress Report/MNA Effectiveness Report, Former United Technologies Automotive Facility, Thomson, GA. March 15, 2013.

CTI 2006. Compliance Status Report for Former United Technologies Automotive Facility, Thomson, GA, May 17, 2006.

Georgia Department of Natural Resources Environmental Protection Division (EPD) 2003. Environmental Protection, Hazardous Site Response (HSR) Rule 391-3-19.07 (Risk Reduction Standards), Amended July 3, 2003. Accessed at http://rules.sos.state.ga.us/pages/GEORGIA_DEPARTMENT_OF_NATURAL_RESOURCES/ENVIRONMENTAL_PROTECTION/HAZARDOUS_SITE_RESPONSE/index.html.

Singh, Anita, Ph.D., Robert Maichle, Narain Armbya, Ashok K. Singh, Ph.D., and Sanghee E. Lee 2010. ProUCL Version 4.00.05 User Guide (ProUCL version 5.00). May. Prepared for Brian Schumacher, John Nocerino, and Felicia Barnett, United States Environmental Protection Agency.

United States Environmental Protection Agency (USEPA) 2014a. OSWER Directive 9200.1-120, Attachment 1 – Recommended Default Exposure Factors. February. Office of Solid Waste and Emergency Response, Washington, D.C.

USEPA 2014b. Regional Screening Level (RSL) Summary Table, May 2014. Accessed at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm.

USEPA 2014c. Region 3 BTAG Freshwater Screening Benchmarks. May. Office of Solid Waste and Emergency Response, Washington, D.C.

USEPA 2009. *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual. Part F, Supplemental Guidance for Inhalation Risk Assessment – Final*. January. Office of Superfund Remediation and Technology Innovation, Washington, D.C.

USEPA 2004. *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings*. Revised February 22, 2004. Office of Emergency and Remedial Response. Washington, D.C.

USEPA 2002. OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). November. EPA530-D-02-004. Washington, D.C.

USEPA 2001. USEPA Region 4 Ecological Risk Assessment Bulletins – Supplement to RAGS, Freshwater Surface Water (Chronic) Screening Values. November.

USEPA 1991. *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual. Part B, Development of Risk-Based Preliminary Remediation Goals – Interim*. December. Office of Emergency & Remedial Response, Washington, D.C.

XDD 2008a. Compliance Status Report Addendum 01 for Former United Technologies Automotive Facility, Thomson, GA, January 29, 2008.

XDD 2008b. Corrective Action Plan, Former United Technologies Automotive Facility, Thomson, GA. December 12, 2008.

XDD 2012. Semi-Annual Progress Report/MNA Effectiveness Report, Former United Technologies Automotive Facility, Thomson, GA. May 15, 2012.

Tables

Table 2-1
Historical Soil Data
Former UTA Facility, Thomson, GA

Sample Location	Sample Depth (Ft)	Constituent Units	Benzene ug/kg	1,1-DCA ug/kg	1,1-DCE ug/kg	cis-1,2-DCE ug/kg	1,1,1-TCA ug/kg	TCE ug/kg	Vinyl chloride ug/kg
		Type 1 RRS (ug/kg)			700	7000		500	200
M3	9	9/22/2005	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<3.8
M4	9	9/22/2005	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<3.6
M5	3	9/22/2005	<2.1	<2.1	<2.1	<2.1	<2.1	<2.1	<4.3
M6	3	9/22/2005	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<3.9
M7	9	9/22/2005	2	<2.0	<2.0	12	<2.0	168J	<4.1
M8	3	11/4/2005	<4.1	<4.1	<4.1	<4.1	<4.1	<4.1	<8.2
M9	3	11/4/2005	<7.1	21	201J	<7.1	<7.1	<7.1	<14
M9	9	11/4/2005	<4.7	<4.7	5	<4.7	<4.7	<4.7	<9.3
M10	3	11/4/2005	<3.6	<3.6	<3.6	<3.6	<3.6	<3.6	<7.1
M10	9	11/4/2005	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<7.9
M11	3	11/4/2005	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<4.6
M12	3	11/4/2005	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<6.8
B-14	13 to 15	11/20/2007	<1.1	<1.2	<1.1	<1.1	<1.1	<1.1	<1.6
B-14	17 to 19	11/20/2007	<1.1	<1.2	<1.1	<1.1	<1.1	<1.1	<1.6
S-1	5 to 7	11/29/2007	<1.1	<1.2	<1.1	<1.1	<1.1	<1.1	<2.4
S-1	19 to 21	11/29/2007	<1.0	<1.2	<1.0	<1.0	<1.0	<1.0	<2.2
S-2	6 to 8	11/29/2007	<1.1	<1.2	<1.1	<1.1	<1.1	<1.1	<2.3
S-2	24 to 26	11/29/2007	<0.98	<1.1	<0.98	<0.98	<0.98	<0.98	<2.1
S-3	10 to 12	11/29/2007	<1.1	<1.2	<1.1	<1.1	<1.1	<1.1	<2.3
S-3	16 to 18	11/29/2007	<1.1	<1.2	<1.1	<1.1	<1.1	<1.1	<2.3

Notes:

ug/kg - micrograms per kilogram

TCE - Trichloroethylene

TCA - Trichloroethane

DCE - Dichloroethylene

RRS - Risk Reduction Standard

J - The associated numerical value is the approximate concentration of the analyte in the sample.

Shaded - The analyte concentration exceeded the Type 1 RRS.

Table 2-2
Historical Groundwater Analytical Table
Former UTA Facility, Thomson, GA

Sample Location	Constituent	1,1-DCE	cis-1,2-DCE	TCE	Vinyl Cholride
	Units	ug/L	ug/L	ug/L	ug/L
	Type 4 RRS	523	1022	34.5	3.29
	Sample Date				
M-1	9/25/2005	5	32	25	<2
	11/8/2005	6	31	23	<2
M-1R	4/21/2010	4.6	16.1	16.8	<1
	7/9/2010	5.7	23.2	21.0	<1
	10/10/2010	5.1	21.6	18.8	<1
	2/15/2011	4.8	18.5	16.6	<1
	4/1/2011	6.3	20.4	19.6	<1
	7/28/2011	3.3	20.6	13.8	<1*
	10/1/2011	4.2	25.8	21.9	<1
	2/14/2012	3.4	30.1	22.7	<1*
M-02	9/25/2005	<2	<2	<2	<2
	11/30/2007	<1	<1	<1	<1
	4/21/2010	<1	<1	<1	<1
	2/14/2012	<1	<1	<1	<1
	6/11/2013	<1.0	<1.0	<1.0	<1.0
M-02A	11/30/2007	<1	<1	<1	<1
	6/10/2013	<1.0	<1.0	<1.0	<1.0
M-02B	11/30/2007	<1	<1	<1	<1
	6/11/2013	<1.0	<1.0	<1.0	<1.0
M-02SW	6/13/2013	<1.0	<1.0	<1.0	<1.0
M-03	9/25/2005	<2	<2	<2	<2
	11/30/2007	<1	<1	<1	<1
	4/21/2010	<1	<1	<1	<1
	10/10/2010	<1	<1	<1	<1
	7/27/2011	<1	<1	<1	<1
	2/14/2012	<1	<1	<1	<1
	6/10/2013	<1.0	<1.0	<1.0	<1.0
M-03A	11/30/2007	<1	<1	<1*	<1
	4/21/2010	<1	<1	<1*	<1
	10/10/2010	<1	<1	<1	<1
	7/27/2011	<1	<1	<1	<1
	2/14/2012	<1	<1	<1*	<1
	6/10/2013	<1.0	<1.0	<1.0	<1.0
M-04	9/25/2005	<2	<2	<2	<2
	11/30/2007	<1	<1	<1	<1
	4/21/2010	<1	<1	<1	<1
	10/10/2010	<1	<1	<1	<1
	7/26/2011	<1	<1	<1	<1
	2/14/2012	<1	<1	<1	<1
	6/12/2013	<1.0	<1.0	<1.0	<1.0
M-05	9/25/2005	<2	<2	<2	<2
	7/1/2011	<1	<1	<1	<1
	2/14/2012	<1	<1	<1	<1
	6/12/2013	<1.0	<1.0	<1.0	<1.0
M-06	9/25/2005	<2	<2	<2	<2
	7/1/2011	<1	<1	<1	<1
	2/14/2012	<1	<1	<1	<1
M-07	9/25/2005	9	23	170	<2
	11/8/2005	9	<2	130	<2
	11/30/2007	<1	19.1	115	<1
	4/21/2010	9.9	24.7	91.3	3.5
	7/9/2010	9.3	19.6	90.2	2.5
	10/10/2010	8.5	20.9	143	2.5
	2/15/2011	11	14.5	99.3	<1*
	4/1/2011	13.9	14.9	118	<2
	7/28/2011	7.7	19.3	97.6	3
	10/1/2011	4.7	22.0	91.6	3.8
	2/14/2012	3.4	12.3	74.1	1.8
	6/5/2013	7.9	15.1	99.2	<1.0
	12/18/2013	4.1	12.1	72.4	0.70 J

Table 2-2
Historical Groundwater Analytical Table
Former UTA Facility, Thomson, GA

Sample Location	Constituent / Units / Type 4 RRS / Sample Date	1,1-DCE	cis-1,2-DCE	TCE	Vinyl Cholride
	Units	ug/L	ug/L	ug/L	ug/L
	Type 4 RRS	523	1022	34.5	3.29
	Sample Date				
M-08	11/8/2005	5	28	220	3
M-08R	4/21/2010	7.3	27.9	125	2.9
	7/9/2010	6.2	20.5	83.1	2.2
	10/10/2010	7	36.8	46.3	2.6
	2/15/2011	6.3	25	94.4	3.1
	4/1/2011	6.3	15.7	81.7	1.5
	7/27/2011	2.3	5.8	29.7	1.2
	10/1/2011	4.0	21.7	56.4	2.3
	2/14/2012	2.7	14.6	82.0	3.5
	6/6/2013	3.1	33.0	88.2	3.8
	12/18/2013	1.1	11.0	36.9	1.4
M-09	11/8/2005	810	7	5	<2
	11/30/2007	388	11.2	9.3	<1
	4/21/2010	1360	8.6	8.5	1.2
	7/9/2010	754	11.1	10.7	<1*
	10/10/2010	577	14.1	13.2	<1
	2/15/2011	957	11.7	10.8	<1*
	4/1/2011	1,000	12.1	11.9	<1
	7/28/2011	949	12.5	11.5	<1*
	10/1/2011	527	12.9	12.0	<1*
	2/14/2012	1,050	13.8	12.6	<1*
	6/5/2013	858	6.1	6.4	2.1
	12/18/2013	327	4.1 J	3.9 J	<5.0
M-10	11/8/2005	3	34	280	4
	11/30/2007	<1	6.3	38.1	<1
	4/21/2010	<1	1.5	9.1	<1
	7/9/2010	<1*	7.7	45.5	1.5
	10/10/2010	<1	15.9	94.3	1.9
	2/15/2011	<1*	8.9	60.8	<1*
	4/1/2011	<1*	10	62.4	<1
	7/27/2011	<1*	20.6	87	2
	10/1/2011	<1*	17.4	74.5	1.2
	2/14/2012	<1*	10.9	43.6	<1
	6/5/2013	<1.0	3.3	10.5	<1.0
	12/18/2013	<1.0	6.3	28.6	<1.0
	12/18/2013 DUP	<1.0	7.0	28.3	<1.0
M-11	11/8/2005	<2	<2	<2	<2
	11/30/2007	<1	<1	<1	<1
	4/21/2010	<1	<1	<1	<1
	2/14/2012	<1	<1	<1	<1
	6/5/2013	<1.0	<1.0	<1.0	<1.0
M-12	11/8/2005	<2	<2	<2	<2
	2/14/2012	<1	<1	<1	<1
M-12R	4/21/2010	<1	1.7	2.9	<1
	7/9/2010	<1*	1.6	3.0	<1
	10/10/2010	<1	3.3	**5.8**	<1
	7/26/2011	<1*	3.2	**5.4**	<1
M-13	11/30/2007	<1	<1	<1	<1
	4/21/2010	<1	<1	<1	<1
	2/14/2012	<1	<1	<1	<1
	6/7/2013	<1.0	<1.0	<1.0	<1.0

Table 2-2
Historical Groundwater Analytical Table
Former UTA Facility, Thomson, GA

Sample Location	Constituent / Units / Type 4 RRS / Sample Date	1,1-DCE	cis-1,2-DCE	TCE	Vinyl Cholride
	Units	ug/L	ug/L	ug/L	ug/L
	Type 4 RRS	523	1022	34.5	3.29
	Sample Date				
M-13A	11/30/2007	<1	<1	<1	<1
	4/21/2010	<1	<1	<1	<1
	2/14/2012	<1	<1	<1	<1
	6/7/2013	<1.0	<1.0	<1.0	<1.0
M-14D	4/21/2010	<10*	18	439	<10
	7/9/2010	<10*	23.3	856	<10
	10/10/2010	11.7	29	701	1.3
	2/15/2011	8.6	21.8	247	3.6
	4/1/2011	10.7	29.1	309	<5
	7/27/2011	5.8	40.6	293	<5
	10/1/2011	4.7	18.3	217	3.1
	2/14/2012	3.1	14.3	93.0	3.3
	6/6/2013	1.5	23.5	37.5	3.3
	6/6/2013 DUP	1.5	22.2	35	3.2
	12/18/2013	2.6	15.3	122	2.0
M-15	7/28/2011	<1	<1	<1	<1
	2/14/2012	<1	<1	<1	<1
	6/12/2013	<1.0	<1.0	<1.0	<1.0
M-16	7/28/2011	<1	<1	<1	<1
	6/12/2013	<1.0	<1.0	<1.0	<1.0
M-17	7/28/2011	94.2	7.8	27.3	<1
	10/1/2011	38.8	2.4	10.4	<1
	2/14/2012	10.8	<1*	7.4	<1
	6/6/2013	2.3	6.0	28.5	<1.0
M-18	7/28/2011	<1	<1	4.5	<1
	10/1/2011	<1	<1	2.9	<1
	2/14/2012	<1	<1*	8.0	<1
	6/5/2013	<1.0	8.0	8.1	<1.0
M-19	7/28/2011	<1	<1	<1	<1
	2/14/2012	<1	<1	<1	<1
	6/7/2013	<1.0	<1.0	<1.0	<1.0
M-20	7/28/2011	<1	<1	<1	<1
	6/11/2013	<1.0	<1.0	<1.0	<1.0
M-21	7/28/2011	<1	<1	<1	<1
	6/11/2013	<1.0	<1.0	<1.0	<1.0
S-01	11/30/2007	<1	<1	<1	<1
	10/1/2008	<1	<1	<1	<1
	12/17/2013	<1.0	<1.0	<1.0	<1.0
S-02	11/30/2007	<1	<1	<1	<1
	10/1/2008	<1	<1	<1	<1
	12/17/2013	<1.0	<1.0	<1.0	<1.0
S-03	11/30/2007	<1	<1	<1	<1
	10/1/2008	<1	<1	<1	<1
	12/17/2013	<1.0	<1.0	<1.0	<1.0

Notes:
ug/L - micrograms per liter
TCE - Trichloroethylene
TCA - Trichloroethane
DCE - Dichloroethylene
RRS - Risk Reduction Standard
J - The associated numerical value is the approximate concentration of the analyte in the sample.
UJ - The analyte was not detected; however, the reported quantitation limit is approximated and may
Shaded - The analyte concentration exceeded the Type 4 RRS.
DUP - duplicate sample

Table 2-3
MNA Summary Table
Former UTA Facility, Thomson, GA

Sample Location	Constituent Units Sample Date	Methane ug/L	Ethane ug/L	Ethene ug/L	Manganese ug/L	Ferrous Iron mg/L	BOD mg/L	COD mg/L	Nitrate mg/L	Sulfate mg/L	Hydrogen nM	TOC mg/l
M-02	6/11/2013	1260	0.61 J	<1.0	460	25.0 J	6.4 J-	24.4	<0.10	16.2	1.1	8.6
M-02A	6/10/2013	6.0	<1.0	<1.0	55.4	<0.10 UJ	NA	24.4	0.15	14.0	1.2	7.2
M-02B	6/11/2013	<0.50	<1.0	<1.0	25.8	<0.10 UJ	<120 UJ	<20	0.20	15.4 J+	0.71	3.4
M-02SW	6/13/2013	228	<1.0	<1.0	137	0.23 J	<4.0	34.2	<0.50	21.0	1.3	17.4
M-03	6/10/2013	<0.50	<1.0	<1.0	22.9	<0.10 UJ	NA	<20	0.16	3.5	0.71	<1.0
M-03A	6/10/2013	<0.50	<1.0	<1.0	<15	<0.10 UJ	NA	<20	0.15	<2.0	1.2	<1.0
M-04	6/12/2013	<0.50	<1.0	<1.0	<15	<0.10 UJ	<120 UJ	58.5 J-	0.12	12.8	0.89	1.8
M-05	6/12/2013	<0.50	<1.0	<1.0	<15	<0.10 UJ	<4.0 UJ	<20	<0.10	<2.0	0.76	<1.0
M-07	6/5/2013	58.3	<1.0	<1.0	86.3	<0.10 UJ	<4.0	27.0	<0.10	25.8	0.76	8.5
	12/18/2013	52.9	<1.0	<1.0	124	<0.10 UJ	31.3 J-	30.2	<0.10	39.1	0.64	12.8 J+
M-08R	6/6/2013	602	<1.0	<1.0	1380	0.28 J	<4.0 UJ	56.4	<0.10	23.3	0.55 J	19.5
	12/18/2013	569	0.67 J	<1.0	619	2.9 J	30.9 J-	45.3	<0.10	25.8	0.57 J	14.5
M-09	6/5/2013	61.3	<1.0	<1.0	<15	0.16 J	<4.0	66.3 J-	0.89 J+	4.8	0.81	4.5
	12/18/2013	6.0	<1.0	<1.0	38.6	0.13 J	31.2 J-	25.2	0.39	13.5	0.58 J	15.2
M-10	6/5/2013	25.3	<1.0	<1.0	860	<0.10 UJ	<4.0	81.0	<0.20	33.9	0.89	17.7
	12/18/2013	23.1 J	<1.0	<1.0	902	0.54 J	31.2 J-	50.3	<0.10	32.5	0.52 J	16.0
	12/18/2013 DUP	44.0 J	<1.0	<1.0	934	0.29 J	30.6 J-	42.8	<0.10	32.8	--	15.7
M-11	6/5/2013	181	<1.0	<1.0	186	18.5 J	<4.0	<20	<0.50	10.9	1.2	14.1
M-13	6/7/2013	<0.50	<1.0	<1.0	<15	0.10 J	<4.0	49.1	<0.50	<10 UJ	0.52 J	12.9
M-13A	6/7/2013	16.1	<1.0	<1.0	576	3.8 J	<4.0	36.8 J-	<0.50	66.6	0.93	7.0
M-14D	6/6/2013	604	0.72 J	<1.0	930	3.9 J	<4.0 UJ	56.4	<0.10	25.1	0.65	17.1
	6/6/2013 DUP	599	0.67 J	<1.0	1090	4.7 J	<4.0 UJ	58.9	<0.10	25.5	0.65	18.1
	12/18/2013	304	<1.0	<1.0	1000	<0.10 UJ	30.6 J-	37.7	<0.10	22.8	0.59 J	17.2
M-15	6/12/2013	0.21 J	<1.0	<1.0	75.6	<0.10 UJ	<120 UJ	<20	<0.10	4.4 J+	0.96	<1.0
M-16	6/12/2013	711	<1.0	<1.0	68.6	12.3 J	<20 UJ	<20	<0.10	10.1	0.91	3.9
M-17	6/6/2013	<0.50	<1.0	<1.0	25.5	<0.10 UJ	<4.0 UJ	56.4	<0.10	6.6	0.71	<1.0
M-18	6/5/2013	0.76	<1.0	<1.0	65.4	0.26 J	<4.0	34.4	<0.10	6.4	1.0	1.4
M-19	6/7/2013	<0.50	<1.0	<1.0	104	<0.10 UJ	<4.0	<20	<0.10	9.3	0.92	1.9
M-20	6/11/2013	0.75	<1.0	1.6	<15	<0.10 UJ	<4.0 UJ	<20	<0.50	<10	1100	1.4
M-21	6/11/2013	<0.50	<1.0	<1.0	<15	<0.10 UJ	<40 UJ	<20	0.38 J+	8.5 J+	1.1	<1.0

Notes:
ug/L - micrograms per liter
mg/L - milligrams per liter
nM - nanometer
BOD - biological oxygen demand
COD - chemical oxygen demand
TOC - total organic carbon
J: The associated numerical value is the approximate concentration of the analyte in the sample.
J-: The associated numerical value is the approximate concentration of the analyte in the sample biased low.
J+: The associated numerical value is the approximate concentration of the analyte in the sample biased high.
UJ: The analyte was not detected; however, the reported quantitation limit is approximated and may be inaccurate or imprecise.
NA - not analyzed
BOD could not be reported for samples M-2A, M-3, and M-3A collected on 6/10/2013 due to bad seed/dilution water.

Table 2-4
Mann-Kendall Statistical Trend Analysis
Former UTA Facility, Thomson, GA

Chemical	Well ID	Number of Samples	Number of Detects	Coefficient of Variation	Mann-Kendall Statistic[1]	Confidence in Trend	All Samples ND?	Concentration Trend[2]
DICHLOROETHYLENES	M-9	12	12	0.38	-4	58.0%	No	S
	M-17	4	4	1.4	-6	95.80%	No	D
TRICHLOROETHYLENE (TCE)	M-10	13	13	1.05	-18	84.7%	No	NT
	M-14D	11	11	0.88	-39	99.9%	No	D
	M-7	13	13	0.26	-40	99.3%	No	D
	M-8R	10	10	0.41	-13	85.4%	No	S
	M-17	4	4	0.6	0	0.375	No	S
VINYL CHLORIDE	M-10	13	5	0.92	-20	87.4%	No	S
	M-14D	11	7	0.36	-12	79.9%	No	S
	M-7	13	7	0.7	-1	50.0%	No	S
	M-8R	10	10	0.37	1	50.0%	No	NT

Notes:

[1] Mann-Kendall analysis was performed using MAROS 2007 software.

[2] I: Increasing; PI: Probably Increasing; S: Stable; PD: Probably Decreasing; D: Decreasing; NT: No Trend;
ND: Not Detected.

Table 3-1
Vapor Intrusion Evaluation -- Summary of Results
Former United Technologies Automotive, Inc.
Thomson, Georgia

COPC	CAS No.	Historical Maximum Detected Concentration in Groundwater (ug/L)	Cancer Risk[(1)]	Noncancer HI[(1)]	Site-Specfic Risk-Based Screening Level[(2)] (ug/L)
Trichloroethene	79-01-6	856 (M-14D, 7/9/2010)	2.7E-06	0.7734	1110
Vinyl chloride	75-01-4	4 (M-10, 11/8/2005)	3.6E-08	0.0002	1110
1,1-Dichloroethene	75-35-4	1360 (M-9, 4/21/2010)	NA	0.0260	52300
cis-1,2-Dichloroethene	156592	40.6 (M-14D, 7/27/2011)	NA	NA	NA
			2.75E-06	0.8	

Notes:
(1) There are no exceedances of the Cancer Target Risk Level of 1E-05 or Noncancer Hazard Index of 1.0.
(2) There are no exceedances of the site-specific, risk-based, vapor intrusion screening level by historical maximum detected concentrations in groundwater.
COPC = chemical of potential concern
HI = hazard index
NA = not applicable

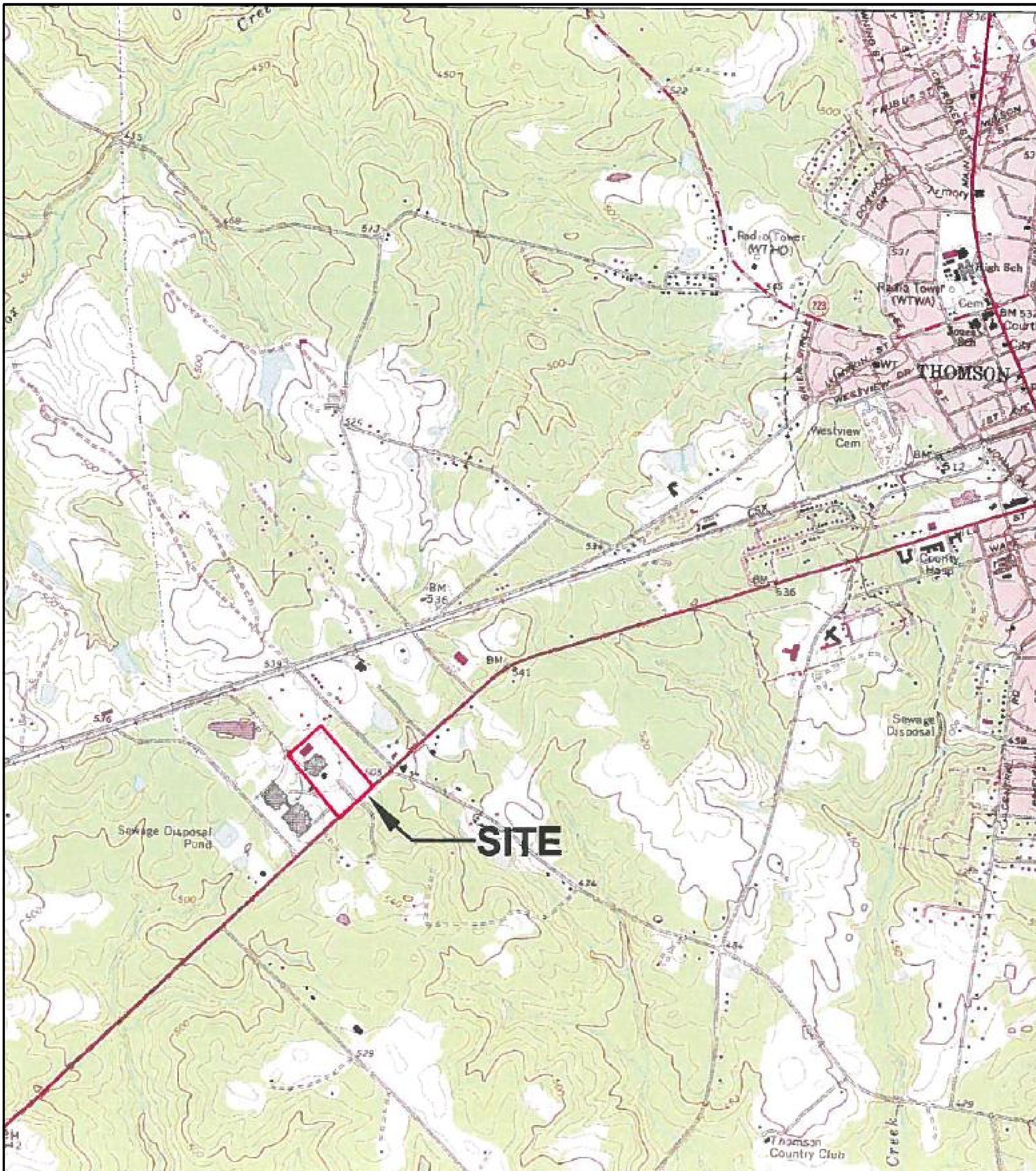
Table 3-2
Evaluation of Groundwater Ecological Risk Via Surface Water
Former United Technologies Automotive, Inc.
Thomson, Georgia

Chemicals Detected in Groundwater	Maximum Detected Conc.	Average Conc. (1)	95% UCL	Georgia EPD Water Quality Standard	USEPA Region 4 Surface Water ESV	USEPA Region 3 Freshwater Screening Benchmark	Predicted to Pose Ecorisk in Surface Water?
1,1-Dichloroethane	13.3	1.1		--	--	47	No
1,1-Dichloroethene	327	16.4	185	7100	303	na	No
Benzene	1.3	0.67		51	53	na	No
Carbon disulfide	0.69	0.69*		--	--	0.92	No
cis-1,2-Dichloroethene	15.3	3.3		10,000(2)	1350(2)	na	No
trans-1,2-Dichloroethene	0.32	0.32*		10,000	1350	na	No
Isopropylbenzene	0.7	0.59		--	--	2.6	No
n-Propylbenzene	0.48	0.48*		--	--	128	No
sec-Butylbenzene	0.32	0.32*		--	--	128(3)	No
Toluene	0.74	0.57		5980	175	na	No
Trichloroethene	122	14.6	27	30	--	na	No
Vinyl chloride	2	0.72	0.95	2.4	--	na	No
Xylene, m&p	0.39	0.39*		--	--	13	No

Notes:
All concentrations are in units of ug/L.
-- = No value available
UCL = Upper Confidence Level
ESV = Ecological screening value
na = Not applicable because values are available from USEPA Region 4 or Georgia EPD.

(1) The average concentration was calculated as the arithmetic mean, using 1/2 the laboratory reporting limit as a surrogate for non-detects. If the arithmetic mean exceeded the maximum concentration, the mean of the detected results is shown (indicated by "*").
(2) Used value for trans-1,2-dichloroethene as a surrogate.
(3) Used value for propyl benzene as a surrogate.

Figures



SCALE:

0 mile ½ mile

SOURCE:
USGS THOMSON WEST, GA QUADRANGLE
7.5 MINUTE SERIES

N

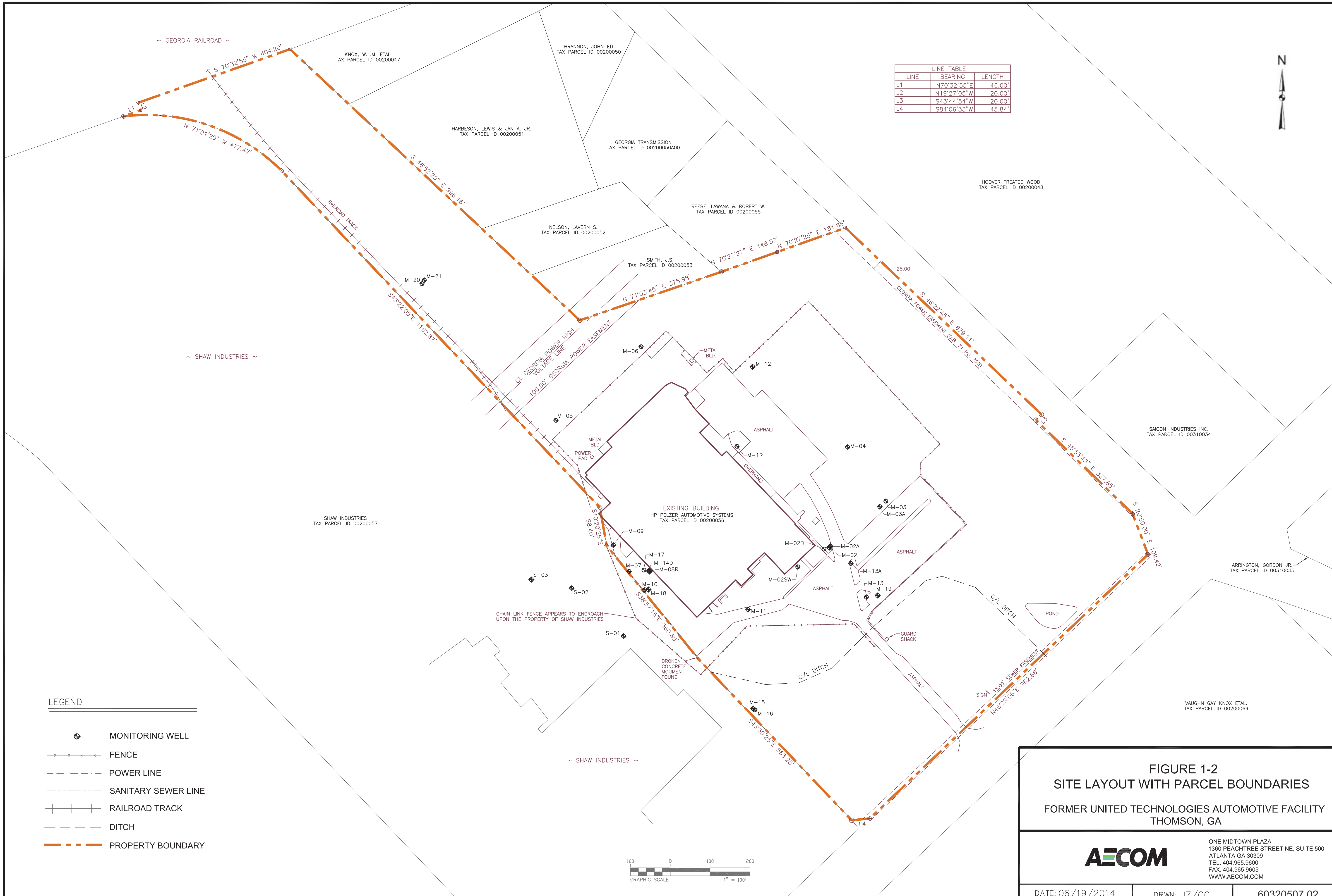
FIGURE 1-1
SITE LOCATION

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM

ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 02/10/2014	DRWN: JZ	60303044



LINE TABLE		
LINE	BEARING	LENGTH
L1	N70°32'55"E	46.00'
L2	N19°27'05"W	20.00'
L3	S43°44'54"W	20.00'
L4	S84°06'33"W	45.84'

FIGURE 1-2
SITE LAYOUT WITH PARCEL BOUNDARIES

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM

ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 06/19/2014 | DRWN: JZ/CC | 60320507.02

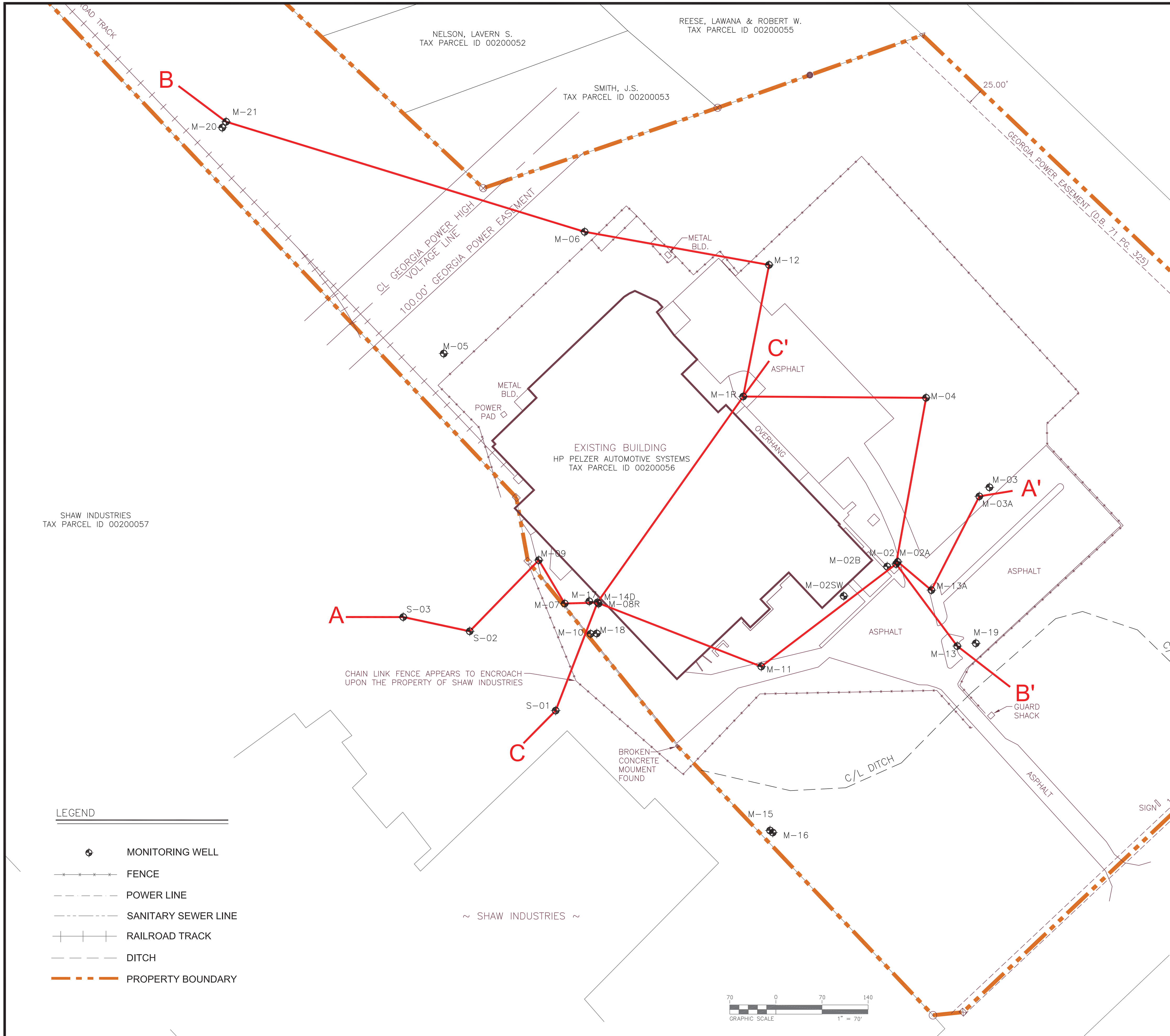


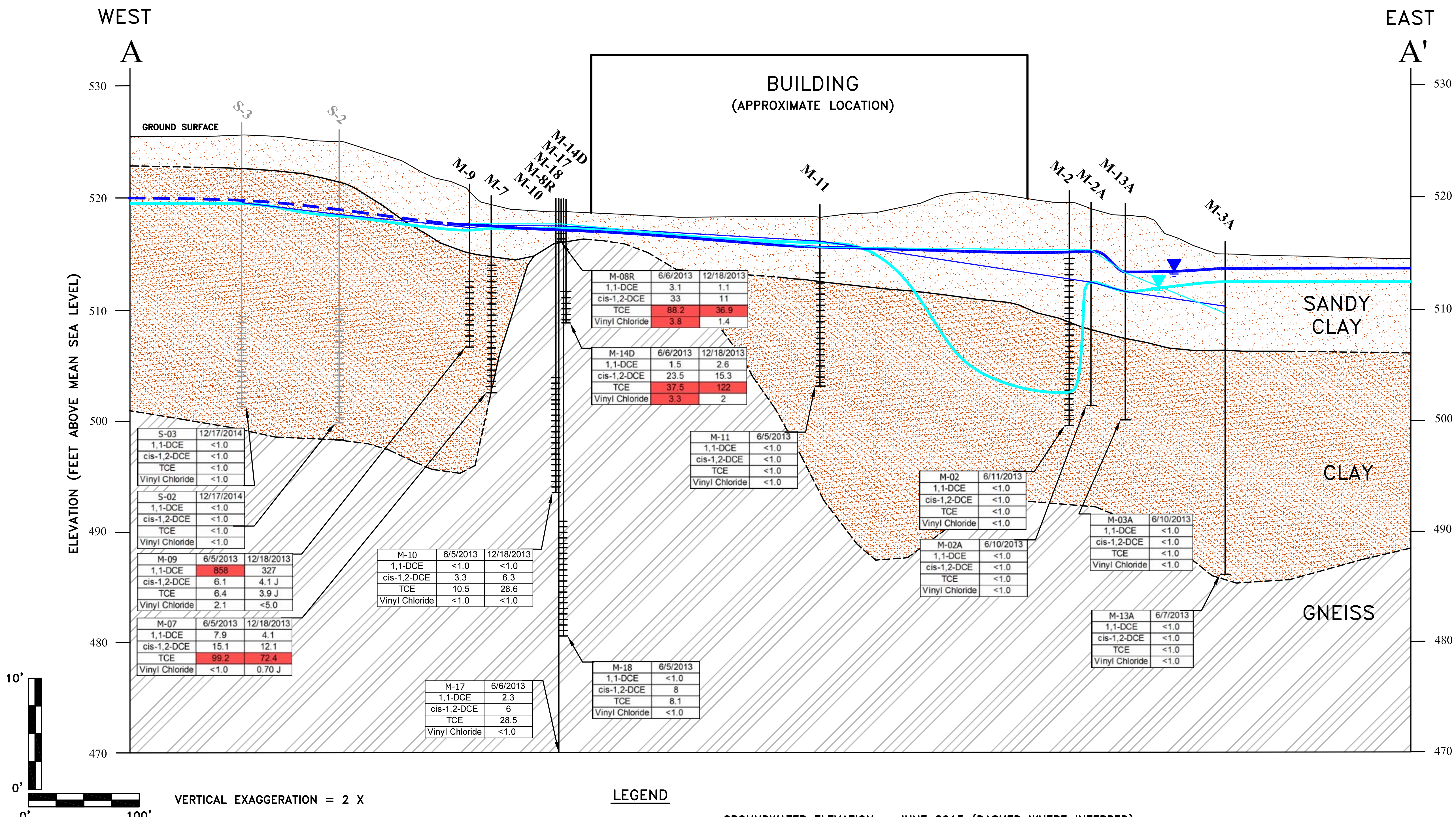
FIGURE 2-1
SITE LAYOUT

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM

ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 06/19/2014 | DRWN: JZ/CC | 60320507.02



LEGEND

GROUNDWATER ELEVATION – JUNE 2013 (DASHED WHERE INFERRED)

GROUNDWATER ELEVATION – DECEMBER 2013 (DASHED WHERE INFERRED)

ACTUAL GEOLOGIC INTERFACE

COC – JUNE 2013 GROUNDWATER CONCENTRATION (11.9), AND DECEMBER 2013 GROUNDWATER CONCENTRATION (11.5); UNITS IN MICROGRAMS PER LITER (UG/L). TYPE 4 RRS EXCEEDENCES IN RED;

GW = GROUNDWATER ELEVATIONS (FEET ABOVE MEAN SEA LEVEL)

NG WELL WAS NOT GAUGED DURING THE JUNE 2013 SAMPLING EVENT

NS WELL WAS NOT SAMPLED DURING THE DECEMBER 2013 SAMPLING EVENT

FT BGS FEET BELOW GROUND SURFACE

NOTES:
1. <1 = RESULT IS BELOW INDICATED LABORATORY REPORTING LIMIT.
2. * ESTIMATED "J" - RESULT IS WITHIN THE LABORATORY METHOD DETECTION LIMIT AND THE REPORTING LIMIT.
3. **GROUNDWATER ELEVATION IN M-2 IN DECEMBER 2013 IS NOT USED IN CONTOURING.
4. SEE FIGURE 2-1: SITE AREA MAP FOR LOCATION OF CROSS SECTION.
5. WELL CONSTRUCTION LOGS WERE NOT AVAILABLE FOR MONITORING WELLS M-2A, M-3A AND M-13A TO DEFINE SCREEN DEPTH AND INTERVAL.
6. MONITORING WELL M-17 IS NOT SHOWN ON FIGURE. REFER TO DATA BOX FOR SCREEN INTERVAL INFORMATION.
7. ALL CONCENTRATION UNITS IN MICROGRAMS PER LITER (UG/L). ALL ELEVATION UNITS IN FEET ABOVE MEAN SEA LEVEL (FT AMSL).
8. S-1, S-2, AND S-3 WERE ABANDONED MAY 2014.

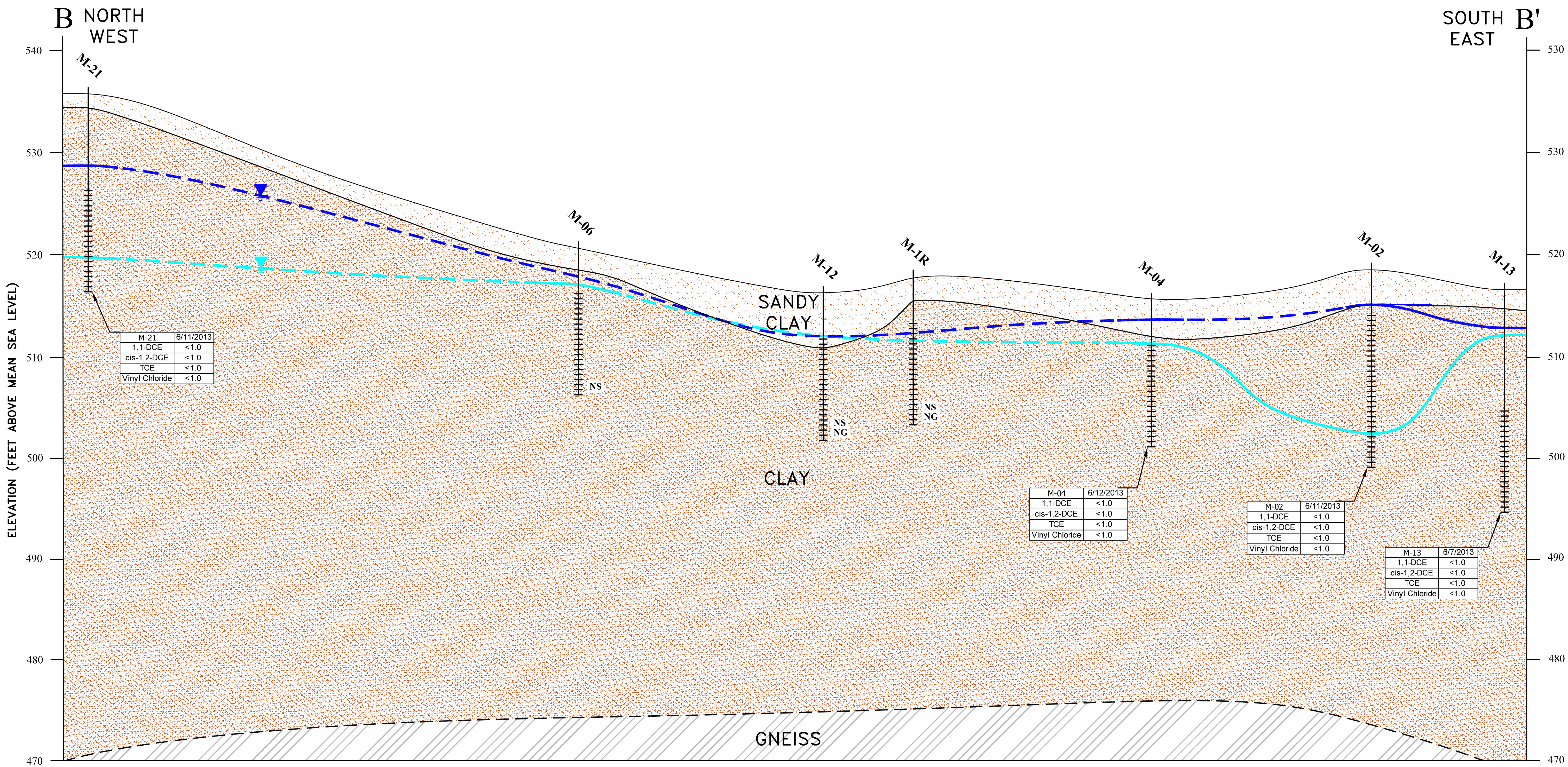
FIGURE 2-2
CROSS SECTION A - A' AND ANALYTICAL RESULTS

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM

ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 06/19/2014 | DRWN: JZ/CC | 60320507.02



10'
0'
0' 100'
VERTICAL EXAGGERATION = 2 X

NOTES:
1. <1 = RESULT IS BELOW INDICATED LABORATORY REPORTING LIMIT.
2. * ESTIMATED "J" - RESULT IS WITHIN THE LABORATORY METHOD DETECTION LIMIT AND THE REPORTING LIMIT.
3. **GROUNDWATER ELEVATION IN M-2 IN DECEMBER 2013 IS NOT USED IN CONTOURING.
4. SEE FIGURE 2-1 SITE AREA MAP FOR LOCATION OF CROSS SECTION.
5. WELL CONSTRUCTION LOGS WERE NOT AVAILABLE FOR MONITORING WELLS M-2A, M-3A AND M-13A TO DEFINE SCREEN DEPTH AND INTERVAL.
6. MONITORING WELL M-17 IS NOT SHOWN ON FIGURE. REFER TO DATA BOX FOR SCREEN INTERVAL INFORMATION.
7. ALL CONCENTRATION UNITS IN MICROGRAMS PER LITER (UG/L). ALL ELEVATION UNITS IN FEET ABOVE MEAN SEA LEVEL (FT AMSL).

LEGEND

GROUNDWATER ELEVATION – JUNE 2013 (DASHED WHERE INFERRED)

GROUNDWATER ELEVATION – DECEMBER 2013 (DASHED WHERE INFERRED)

ACTUAL GEOLOGIC INTERFACE

COC – JUNE 2013 GROUNDWATER CONCENTRATION (11.9), AND DECEMBER 2013 GROUNDWATER CONCENTRATION (11.5); UNITS IN MICROGRAMS PER LITER (UG/L). TYPE 4 RRS EXCEEDENCES IN RED;

GW = GROUNDWATER ELEVATIONS (FEET ABOVE MEAN SEA LEVEL)

NG WELL WAS NOT GAUGED DURING THE JUNE 2013 SAMPLING EVENT

NS WELL WAS NOT SAMPLED DURING THE DECEMBER 2013 SAMPLING EVENT

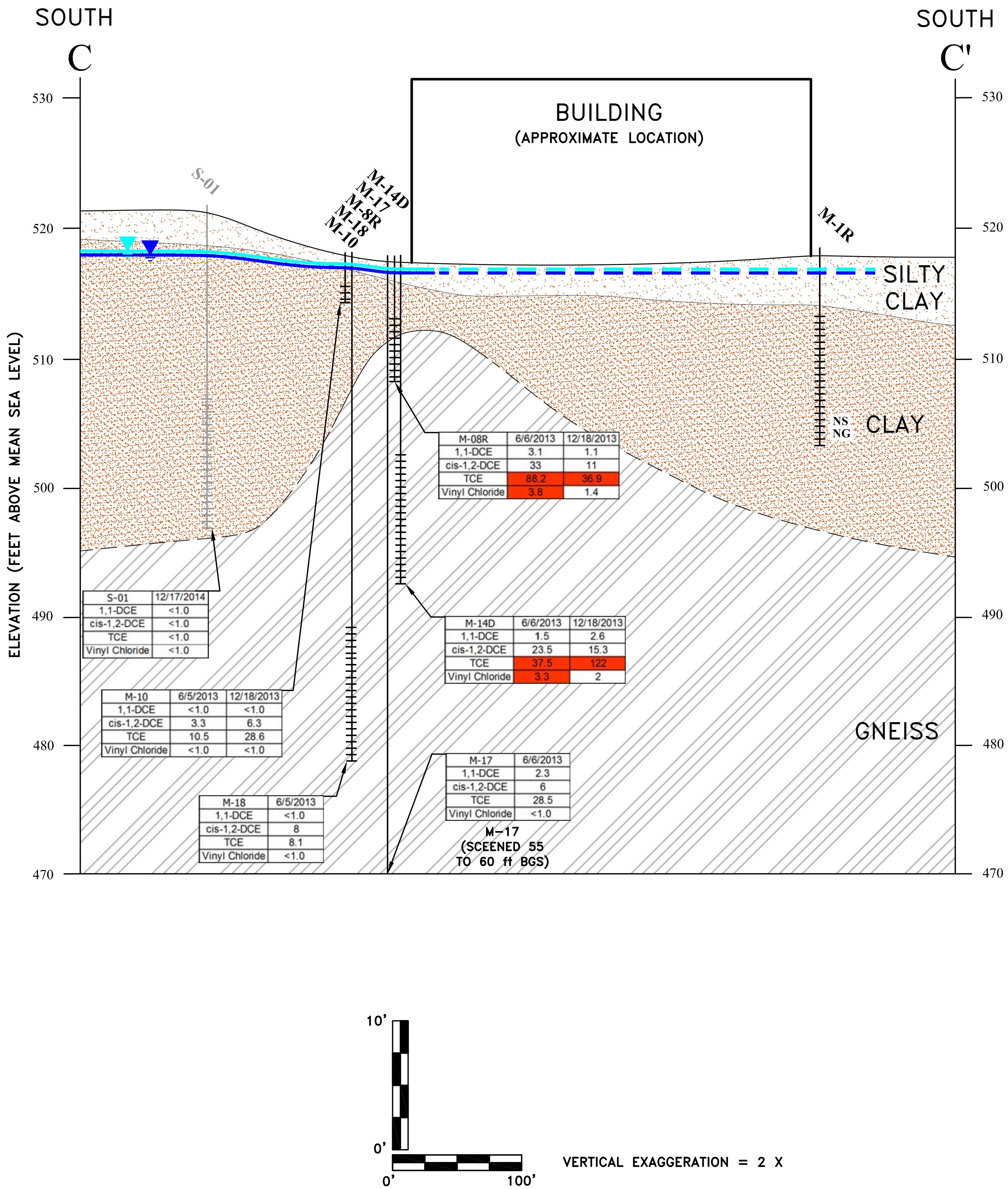
FT BGS FEET BELOW GROUND SURFACE

FIGURE 2-3
CROSS SECTION B - B' AND ANALYTICAL RESULTS

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM
ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 07/09/2014 | DRWN: JZ/CC | 60320507.02



LEGEND

GROUNDWATER ELEVATION – JUNE 2013 (DASHED WHERE INFERRED)

GROUNDWATER ELEVATION – DECEMBER 2013 (DASHED WHERE INFERRED)

ACTUAL GEOLOGIC INTERFACE

COC – JUNE 2013 GROUNDWATER CONCENTRATION (11.9), AND DECEMBER 2013 GROUNDWATER CONCENTRATION (11.5); UNITS IN MICROGRAMS PER LITER (UG/L). TYPE 4 RRS EXCEEDENCES IN RED;

GW = GROUNDWATER ELEVATIONS (FEET ABOVE MEAN SEA LEVEL)

NG WELL WAS NOT GAUGED DURING THE JUNE 2013 SAMPLING EVENT

NS WELL WAS NOT SAMPLED DURING THE DECEMBER 2013 SAMPLING EVENT

FT BGS FEET BELOW GROUND SURFACE

NOTES:

1. <1 = RESULT IS BELOW INDICATED LABORATORY REPORTING LIMIT.
2. * ESTIMATED "J" - RESULT IS WITHIN THE LABORATORY METHOD DETECTION LIMIT AND THE REPORTING LIMIT.
3. **GROUNDWATER ELEVATION IN M-2 IN DECEMBER 2013 IS NOT USED IN CONTOURING.
4. SEE FIGURE 2-1 SITE AREA MAP FOR LOCATION OF CROSS SECTION.
5. WELL CONSTRUCTION LOGS WERE NOT AVAILABLE FOR MONITORING WELLS M-2A, M-3A AND M-13A TO DEFINE SCREEN DEPTH AND INTERVAL.
6. MONITORING WELL M-17 IS NOT SHOWN ON FIGURE. REFER TO DATA BOX FOR SCREEN INTERVAL INFORMATION.
7. ALL CONCENTRATION UNITS IN MICROGRAMS PER LITER (UG/L). ALL ELEVATION UNITS IN FEET ABOVE MEAN SEA LEVEL (FT AMSL).
8. S-1, S-2, AND S-3 WERE ABANDONED MAY 2014.

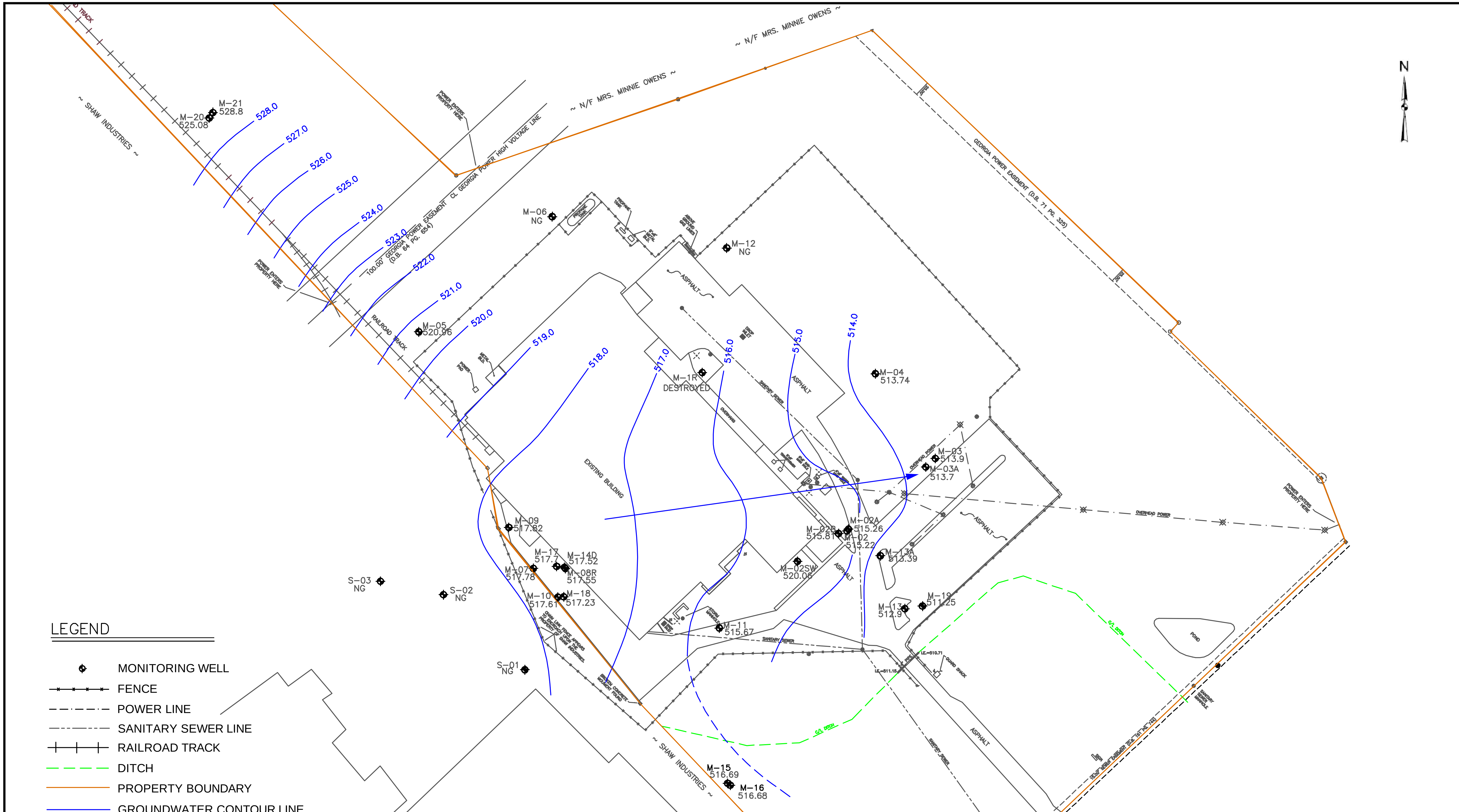
FIGURE 2-4
CROSS SECTION C - C' AND ANALYTICAL RESULTS

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM

ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 06/19/2014 | DRWN: JZ/CC | 60320507.02



LEGEND

⊗	MONITORING WELL
	FENCE
	POWER LINE
	SANITARY SEWER LINE
	RAILROAD TRACK
	DITCH
	PROPERTY BOUNDARY
	GROUNDWATER CONTOUR LINE
	INFERRED GROUNDWATER CONTOUR LINE
	GROUNDWATER FLOW DIRECTION
NG	NOT GAUGED
517.23	GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL

NOTES:
1. M-02SW IS NOT USED IN CONTOURING.
2. DEEP WELLS M-14D, M-15, M-17, M-18, M-19 AND M-20 ARE NOT USED IN CONTOURING.

FIGURE 3-1
POTENTIOMETRIC SURFACE MAP FOR THE SHALLOW AQUIFER - JUNE 2013

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM
ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 02/10/2014 | DRWN: JZ | 60303044

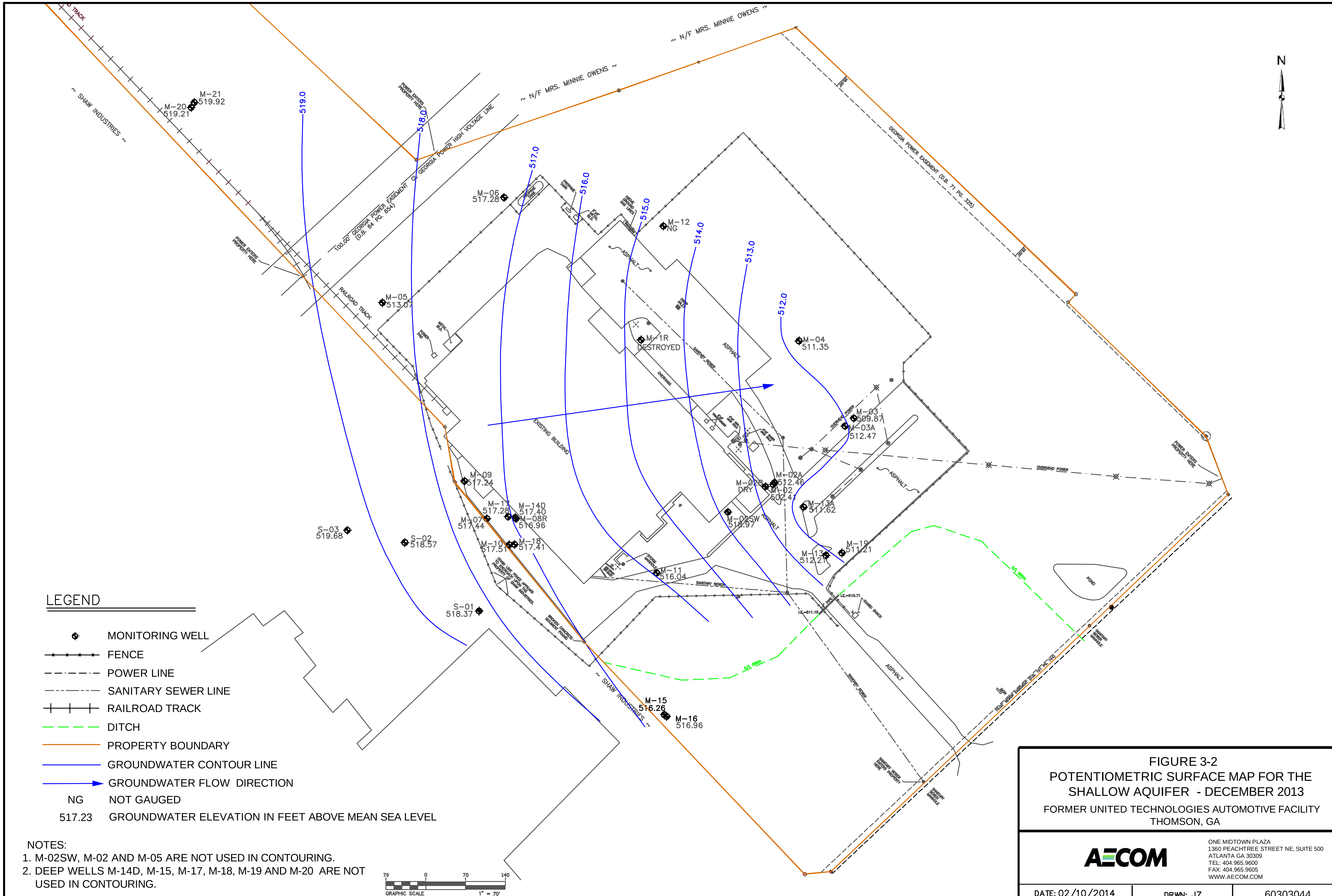
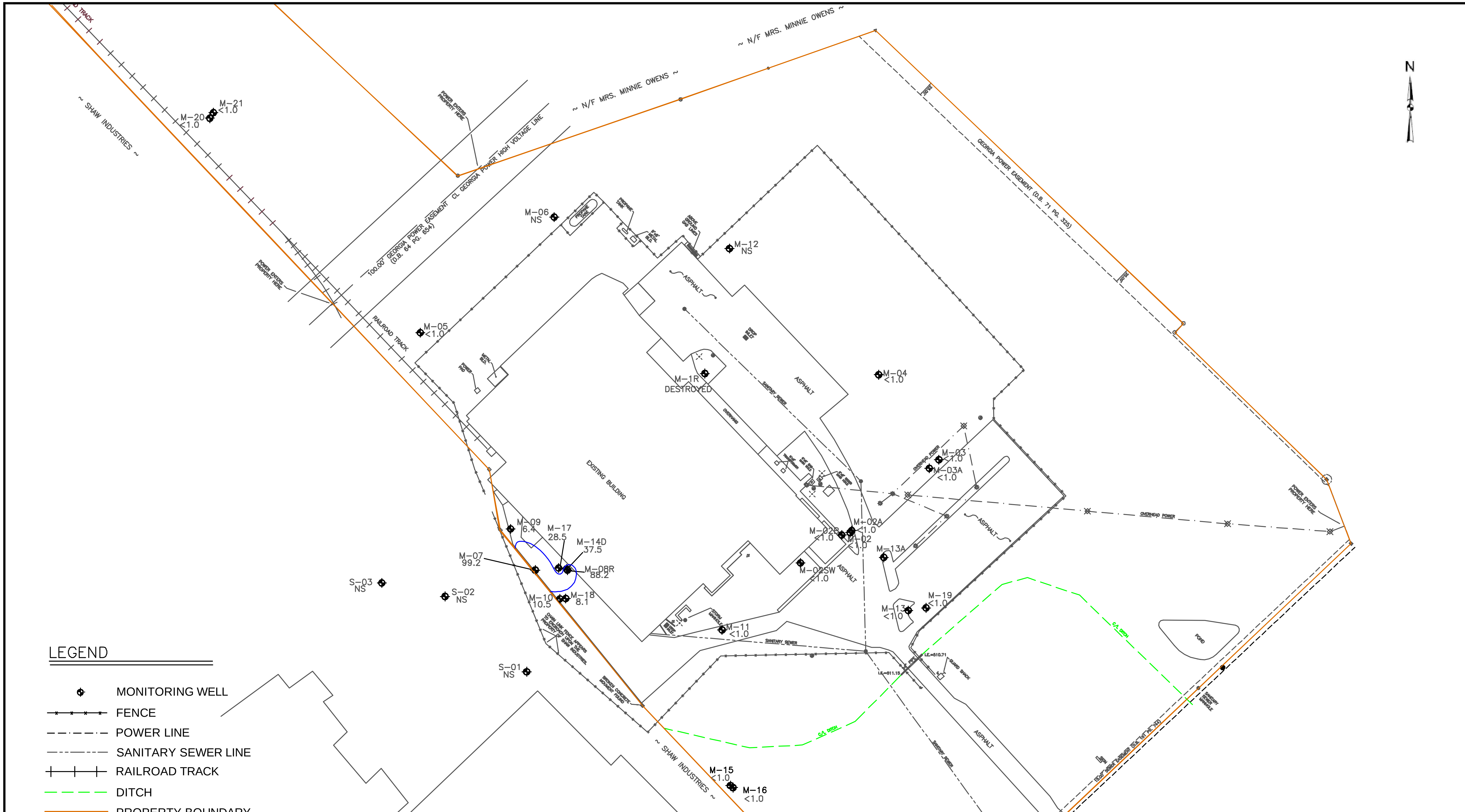


FIGURE 3-2
POTENTIOMETRIC SURFACE MAP FOR THE SHALLOW AQUIFER - DECEMBER 2013
FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM

ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 02/10/2014 | DRWN: JZ | 60303044



LEGEND

	MONITORING WELL
	FENCE
	POWER LINE
	SANITARY SEWER LINE
	RAILROAD TRACK
	DITCH
	PROPERTY BOUNDARY
	TCE ISOCONCENTRATION LINE (TYPE 4 RRS 34.5 UG/l)
NS	NOT SAMPLED

NOTES:

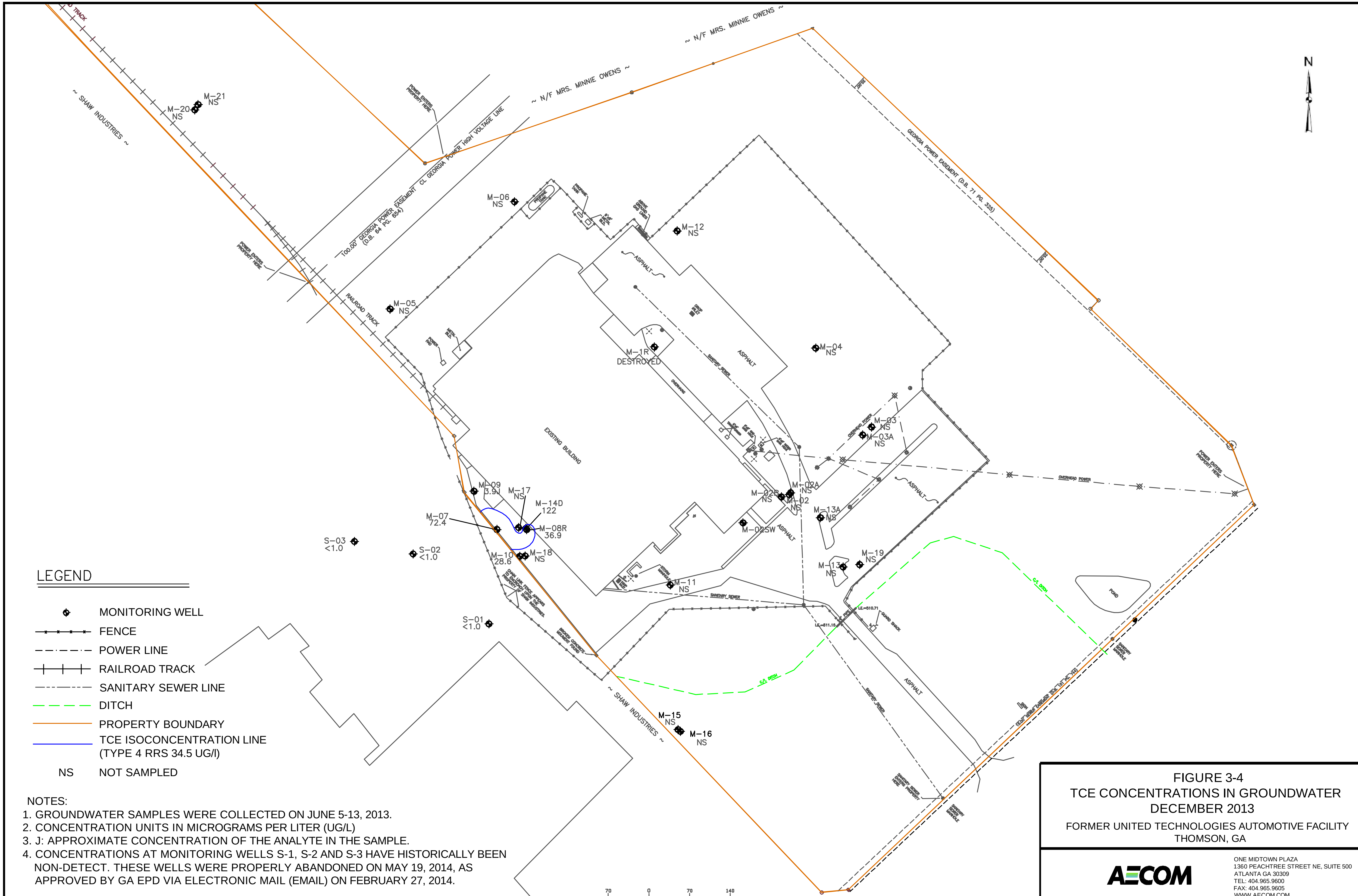
1. GROUNDWATER SAMPLES WERE COLLECTED ON JUNE 5-13, 2013.
2. CONCENTRATION UNITS IN MICROGRAMS PER LITER (UG/L)
3. CONCENTRATIONS AT MONITORING WELLS S-1, S-2 AND S-3 HAVE HISTORICALLY BEEN NON-DETECT. THESE WELLS WERE PROPERLY ABANDONED ON MAY 19, 2014, AS APPROVED BY GA EPD VIA ELECTRONIC MAIL (EMAIL) ON FEBRUARY 27, 2014.

FIGURE 3-3
TCE CONCENTRATIONS IN GROUNDWATER
JUNE 2013

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM
ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 07/02/2014 | DRWN: JZ | 60320507



LEGEND

- MONITORING WELL
- FENCE
- POWER LINE
- RAILROAD TRACK
- SANITARY SEWER LINE
- DITCH
- PROPERTY BOUNDARY
- TCE ISOCONCENTRATION LINE (TYPE 4 RRS 34.5 UG/l)
- NS NOT SAMPLED

NOTES:
1. GROUNDWATER SAMPLES WERE COLLECTED ON JUNE 5-13, 2013.
2. CONCENTRATION UNITS IN MICROGRAMS PER LITER (UG/L)
3. J: APPROXIMATE CONCENTRATION OF THE ANALYTE IN THE SAMPLE.
4. CONCENTRATIONS AT MONITORING WELLS S-1, S-2 AND S-3 HAVE HISTORICALLY BEEN NON-DETECT. THESE WELLS WERE PROPERLY ABANDONED ON MAY 19, 2014, AS APPROVED BY GA EPD VIA ELECTRONIC MAIL (EMAIL) ON FEBRUARY 27, 2014.

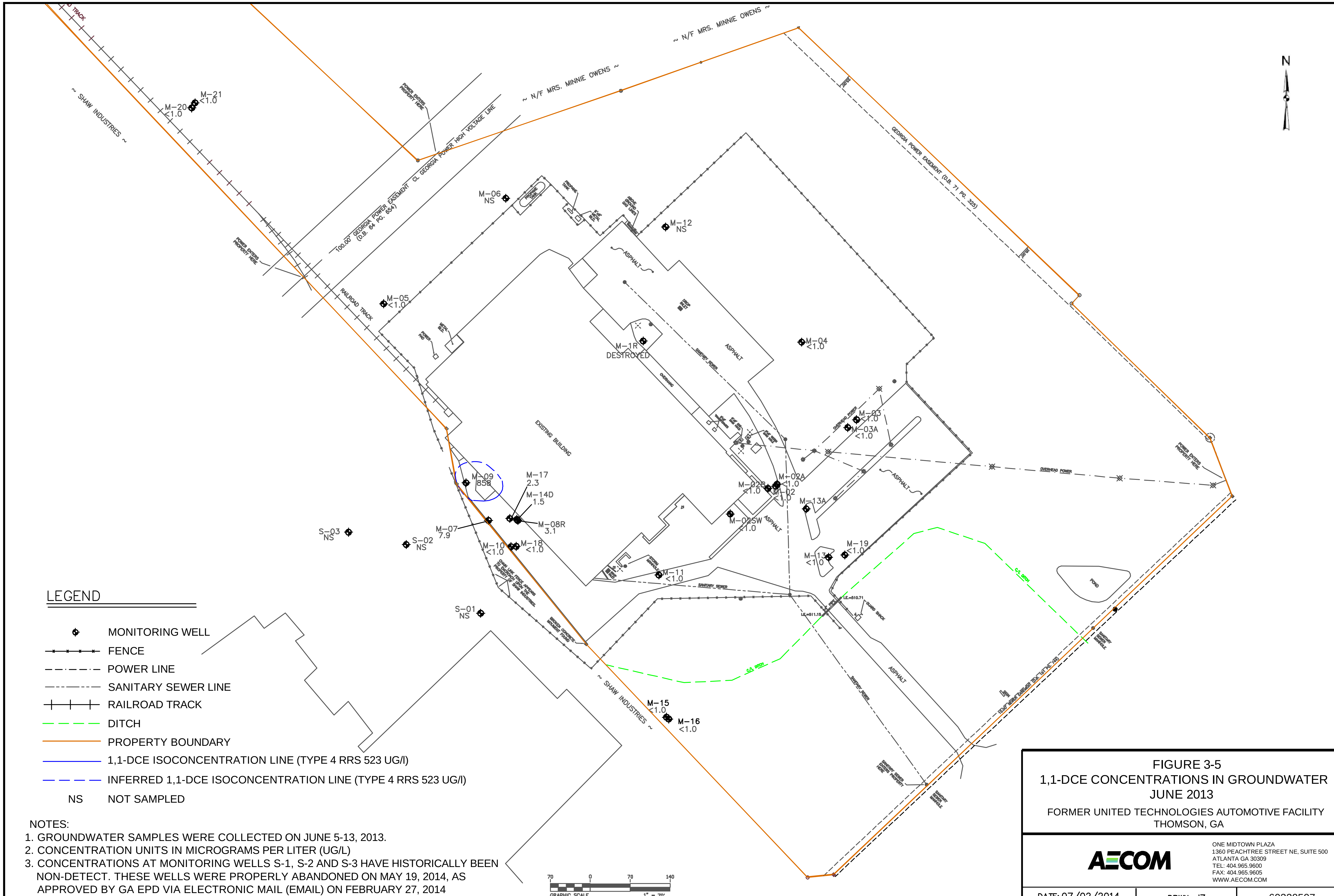
FIGURE 3-4
TCE CONCENTRATIONS IN GROUNDWATER
DECEMBER 2013

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM

ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 07/02/2014 | DRWN: JZ | 60320507



LEGEND

◆	MONITORING WELL
	FENCE
	POWER LINE
	SANITARY SEWER LINE
	RAILROAD TRACK
	DITCH
	PROPERTY BOUNDARY
	1,1-DCE ISOCONCENTRATION LINE (TYPE 4 RRS 523 UG/l)
	INFERRED 1,1-DCE ISOCONCENTRATION LINE (TYPE 4 RRS 523 UG/l)
NS	NOT SAMPLED

NOTES:
1. GROUNDWATER SAMPLES WERE COLLECTED ON JUNE 5-13, 2013.
2. CONCENTRATION UNITS IN MICROGRAMS PER LITER (UG/L)
3. CONCENTRATIONS AT MONITORING WELLS S-1, S-2 AND S-3 HAVE HISTORICALLY BEEN NON-DETECT. THESE WELLS WERE PROPERLY ABANDONED ON MAY 19, 2014, AS APPROVED BY GA EPD VIA ELECTRONIC MAIL (EMAIL) ON FEBRUARY 27, 2014

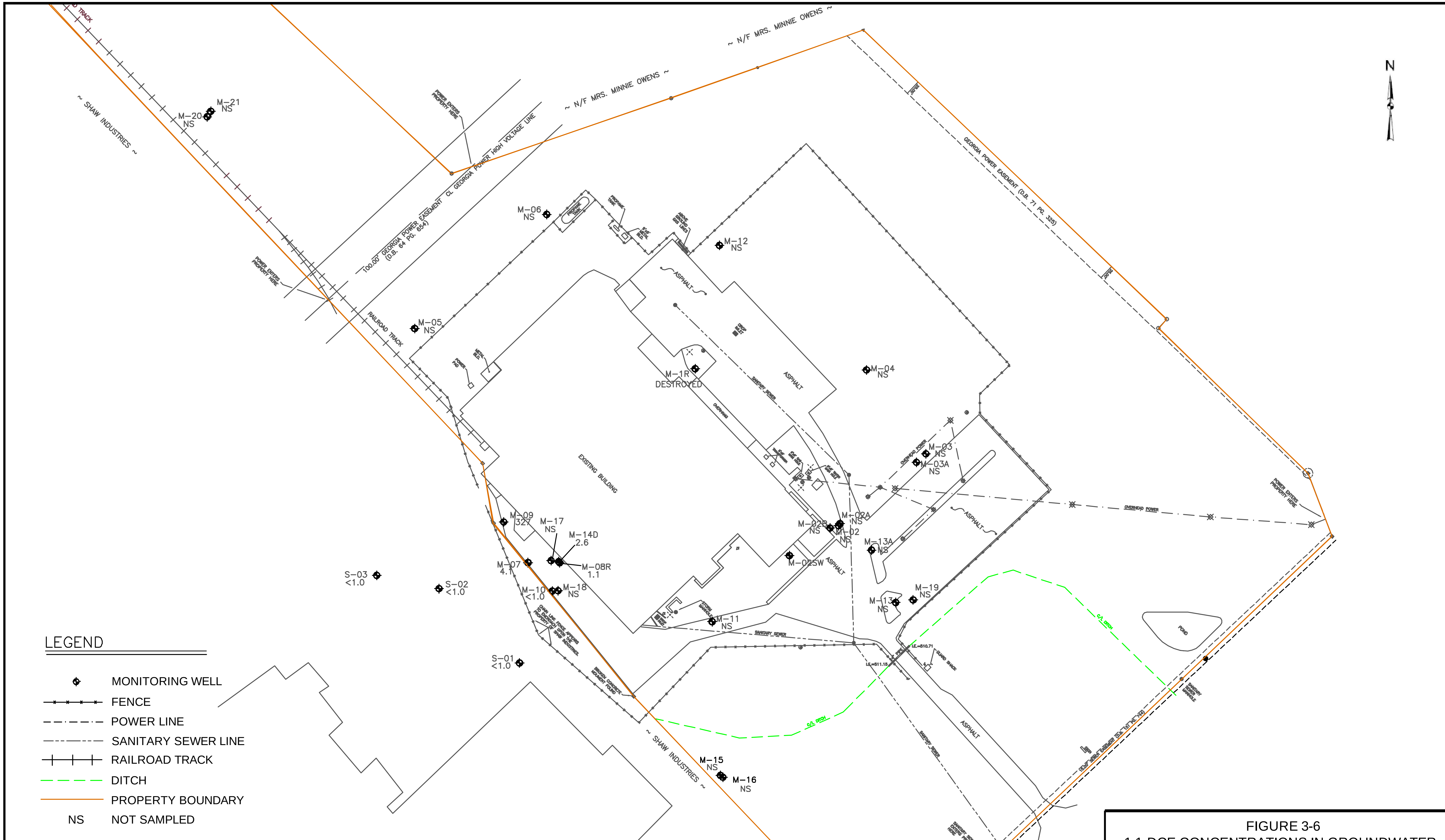
FIGURE 3-5
1,1-DCE CONCENTRATIONS IN GROUNDWATER
JUNE 2013

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM

ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 07/02/2014 | DRWN: JZ | 60320507



NOTES:

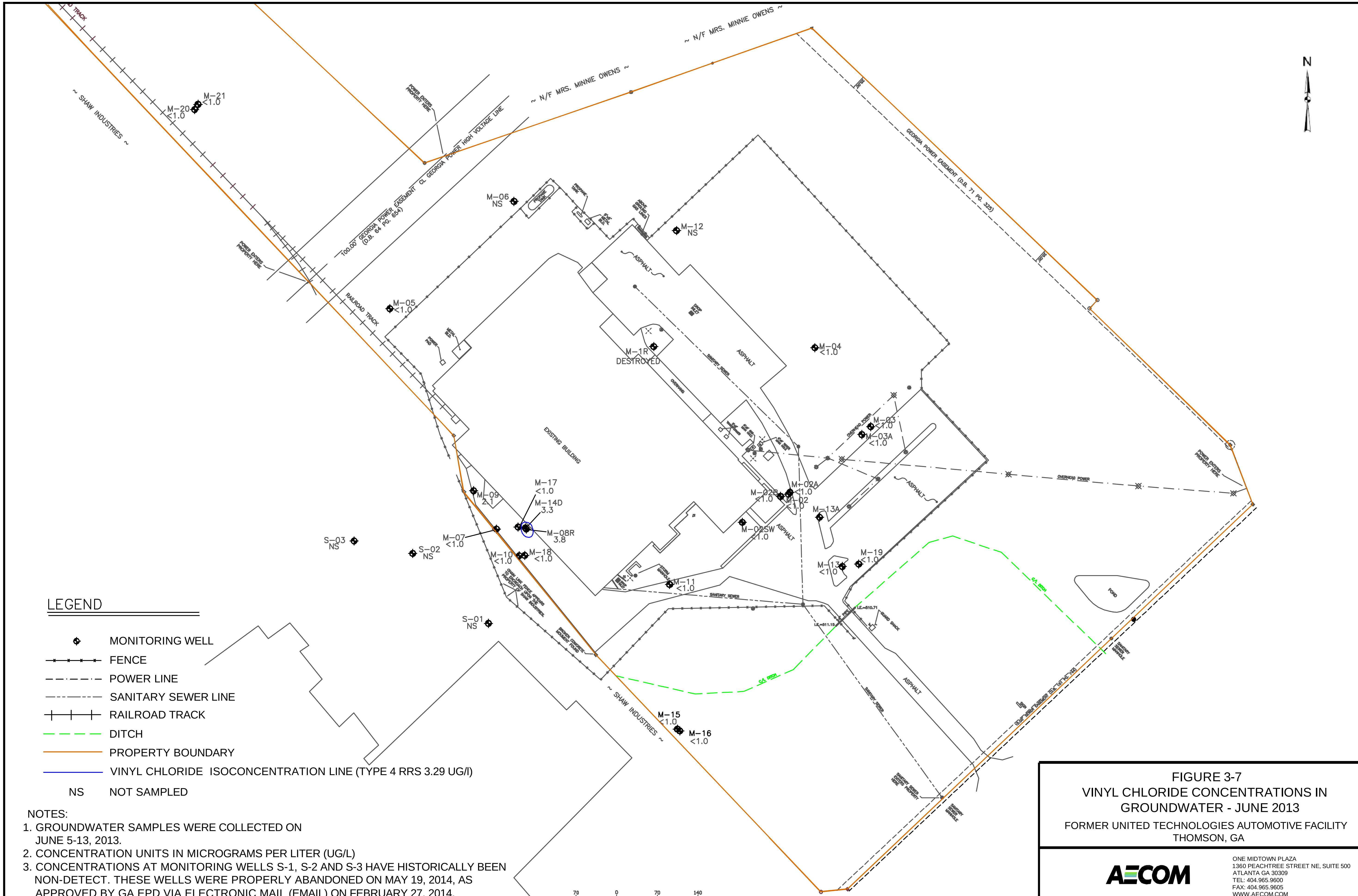
1. GROUNDWATER SAMPLES WERE COLLECTED ON JUNE 5-13, 2013.
2. CONCENTRATION UNITS IN MICROGRAMS PER LITER (UG/L)
3. NO CONCENTRATION EXCEEDED THE TYPE 4 RRS 523 UG/L)
4. CONCENTRATIONS AT MONITORING WELLS S-1, S-2 AND S-3 HAVE HISTORICALLY BEEN NON-DETECT. THESE WELLS WERE PROPERLY ABANDONED ON MAY 19, 2014, AS APPROVED BY GA EPD VIA ELECTRONIC MAIL (EMAIL) ON FEBRUARY 27, 2014.

FIGURE 3-6
1,1-DCE CONCENTRATIONS IN GROUNDWATER
DECEMBER 2013

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM
ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 07/02/2014 | DRWN: JZ | 60320507



LEGEND

- MONITORING WELL
- FENCE
- POWER LINE
- SANITARY SEWER LINE
- RAILROAD TRACK
- DITCH
- PROPERTY BOUNDARY
- VINYL CHLORIDE ISOCONCENTRATION LINE (TYPE 4 RRS 3.29 UG/l)
- NS NOT SAMPLED

NOTES:

1. GROUNDWATER SAMPLES WERE COLLECTED ON JUNE 5-13, 2013.
2. CONCENTRATION UNITS IN MICROGRAMS PER LITER (UG/L)
3. CONCENTRATIONS AT MONITORING WELLS S-1, S-2 AND S-3 HAVE HISTORICALLY BEEN NON-DETECT. THESE WELLS WERE PROPERLY ABANDONED ON MAY 19, 2014, AS APPROVED BY GA EPD VIA ELECTRONIC MAIL (EMAIL) ON FEBRUARY 27, 2014.

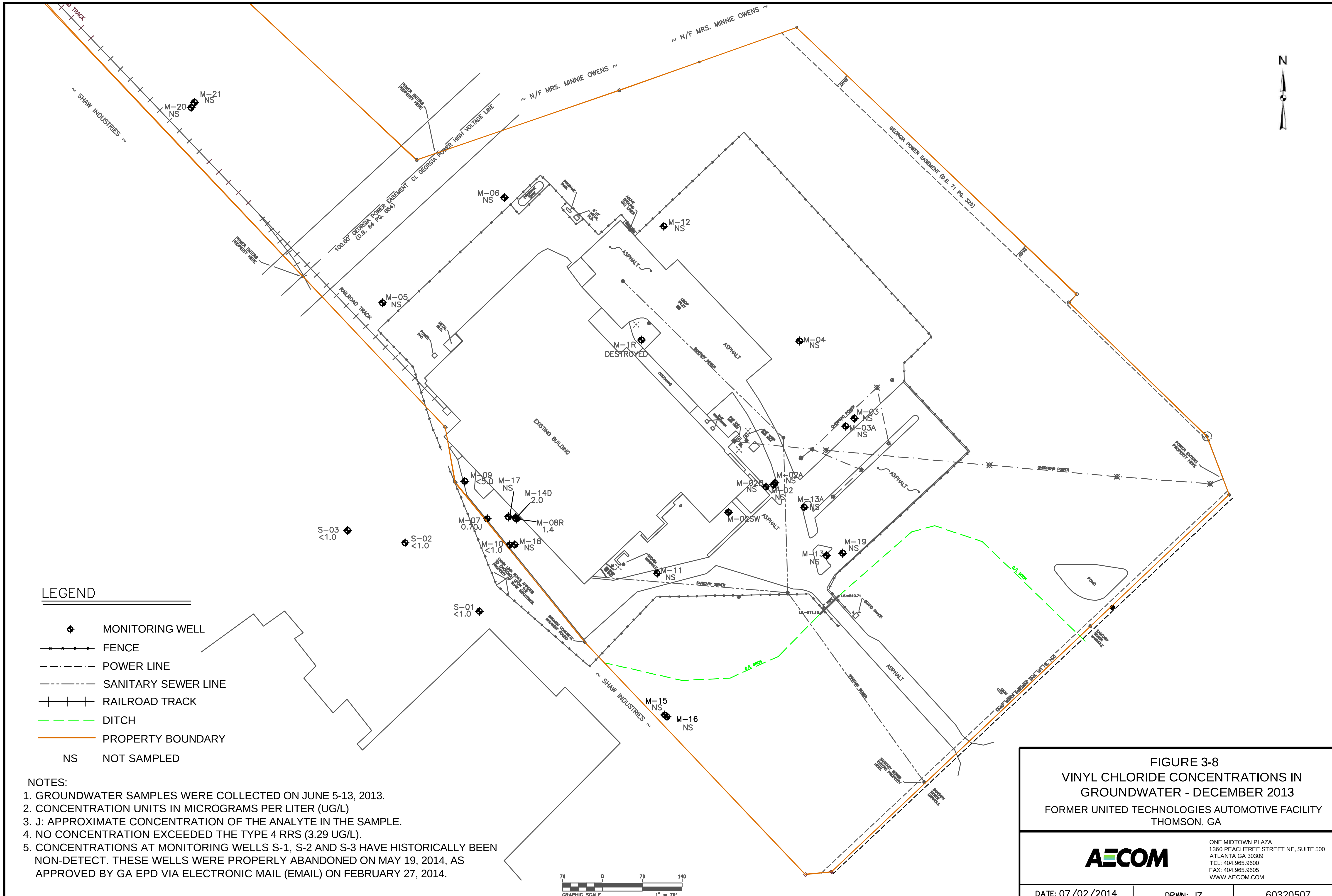
FIGURE 3-7
VINYL CHLORIDE CONCENTRATIONS IN GROUNDWATER - JUNE 2013

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM

ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 07/02/2014 | DRWN: JZ | 60320507



LEGEND

◈	MONITORING WELL
—x—x—x—	FENCE
— - — - —	POWER LINE
- - - - -	SANITARY SEWER LINE
┼──┼──┼	RAILROAD TRACK
— — — (green)	DITCH
—— (orange)	PROPERTY BOUNDARY
NS	NOT SAMPLED

NOTES:
1. GROUNDWATER SAMPLES WERE COLLECTED ON JUNE 5-13, 2013.
2. CONCENTRATION UNITS IN MICROGRAMS PER LITER (UG/L)
3. J: APPROXIMATE CONCENTRATION OF THE ANALYTE IN THE SAMPLE.
4. NO CONCENTRATION EXCEEDED THE TYPE 4 RRS (3.29 UG/L).
5. CONCENTRATIONS AT MONITORING WELLS S-1, S-2 AND S-3 HAVE HISTORICALLY BEEN NON-DETECT. THESE WELLS WERE PROPERLY ABANDONED ON MAY 19, 2014, AS APPROVED BY GA EPD VIA ELECTRONIC MAIL (EMAIL) ON FEBRUARY 27, 2014.

FIGURE 3-8
VINYL CHLORIDE CONCENTRATIONS IN GROUNDWATER - DECEMBER 2013

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM

ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 07/02/2014 | DRWN: JZ | 60320507

Appendix A

Voluntary Remediation Program Application Form and Checklist

HP PELZER

HP Pelzer Automotive Systems, Inc.

November 25, 2014

Mr. Derrick Williams, Program Manager
Georgia Department of Natural Resources – Environmental Protection Division
Response & Remediation Program – Land Protection Branch
2 Martin Luther King Drive, SE Suite 1462
Atlanta, Georgia 30334

RE: Former United Technologies Automotive Systems Facility
1884 Warrenton Highway, Thomson, McDuffie County, GA
HIS Site # 10543

Dear Mr. Williams:

HP Pelzer Automotive Systems Inc. is the current owner of the captioned facility ("Facility") which is subject to the requirements of Georgia's Hazardous Site Response Act ("HSRA"). United Technologies Corporation has and continues to be responsible for completing all required work at the Facility under HSRA. We have been asked by United Technologies Corporation to consent to the entry of the Facility into Georgia's Voluntary Remediation Program for the purposes of completing required closure activities.

Please be advised that, as the current owner of the facility, HP Pelzer Automotive Systems Inc. consents to United Technologies Corporation entering the Facility into the Voluntary Remediation Program.

Very Truly Yours

Matthew Buschbacher,
Secretary and Treasurer
HP Pelzer Automotive Systems Inc.

cc: James O'Brien, Dean and Fulkerson, P.C.

Voluntary Investigation and Remediation Plan Application Form and Checklist

VRP APPLICANT INFORMATION					
COMPANY NAME	United Technologies Corporation				
CONTACT PERSON/TITLE	Beth Lang/Remediation Manager				
ADDRESS	c/o 5469 Jacobs Drive, Holly, MI 48442				
PHONE	248-634-6048	**FAX**	248-634-6049	**E-MAIL**	Beth.Lang@utc.com

GEORGIA CERTIFIED PROFESSIONAL GEOLOGIST OR PROFESSIONAL ENGINEER OVERSEEING CLEANUP					
NAME	Dora Chiang, PhD, P.E.			**GA PE/PG NUMBER**	
COMPANY	AECOM				
ADDRESS	1360 Peachtree Street NE, Suite 500, Atlanta, GA 30309				
PHONE	(404)965-9647	**FAX**	(404)965-9605	**E-MAIL**	Dora.chiang@aecom.com

APPLICANT'S CERTIFICATION

In order to be considered a qualifying property for the VRP:

(1) The property must have a release of regulated substances into the environment;
(2) The property shall not be:
- (A) Listed on the federal National Priorities List pursuant to the federal Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. Section 9601.
- (B) Currently undergoing response activities required by an order of the regional administrator of the federal Environmental Protection Agency; or
- (C) A facility required to have a permit under Code Section 12-8-66.

(3) Qualifying the property under this part would not violate the terms and conditions under which the division operates and administers remedial programs by delegation or similar authorization from the United States Environmental Protection Agency.
(4) Any lien filed under subsection (e) of Code Section 12-8-96 or subsection (b) of Code Section 12-13-12 against the property shall be satisfied or settled and released by the director pursuant to Code Section 12-8-94 or Code Section 12-13-6.

In order to be considered a participant under the VRP:
1. The participant must be the property owner of the voluntary remediation property or have express permission to enter another's property to perform corrective action.
2. The participant must not be in violation of any order, judgment, statute, rule, or regulation subject to the enforcement authority of the director.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I also certify that this property is eligible for the Voluntary Remediation Program (VRP) as defined in Code Section 12-8-105 and I am eligible as a participant as defined in Code Section 12-8-106.

APPLICANT'S SIGNATURE			
APPLICANT'S NAME/TITLE (PRINT)		**DATE**	

QUALIFYING PROPERTY INFORMATION (For additional qualifying properties, please refer to the last page of application form)			
HAZARDOUS SITE INVENTORY INFORMATION (if applicable)			
HSI Number	10543	Date HSI Site listed	4/12/1999
HSI Facility Name	United Technologies Automotive, Inc.	NAICS CODE	
PROPERTY INFORMATION			
TAX PARCEL ID	00200056	PROPERTY SIZE (ACRES)	36.43
PROPERTY ADDRESS	1884 Warrenton Highway NW		
CITY	Thomson, GA	COUNTY	McDuffie
STATE	Georgia	ZIPCODE	30824
LATITUDE (decimal format)	33.450741	LONGITUDE (decimal format)	-82.538918
PROPERTY OWNER INFORMATION			
PROPERTY OWNER(S)	HP PELZER (Automotive Systems Inc.)	PHONE #	248-280-2500
MAILING ADDRESS	1175 CROOKS RD		
CITY	TROY	STATE/ZIPCODE MI 48084	

ITEM #	DESCRIPTION OF REQUIREMENT	Location in VRP (i.e. pg., Table #, Figure #, etc.)	For EPD Comment Only (Leave Blank)
1.	**$5,000 APPLICATION FEE** IN THE FORM OF A CHECK PAYABLE TO THE GEORGIA DEPARTMENT OF NATURAL RESOURCES. (PLEASE LIST CHECK DATE AND CHECK NUMBER IN COLUMN TITLED "LOCATION IN VRP." PLEASE DO NOT INCLUDE A SCANNED COPY OF CHECK IN ELECTRONIC COPY OF APPLICATION.)		
2.	**WARRANTY DEED(S)** FOR QUALIFYING PROPERTY.	**Appendix B**	
3.	**TAX PLAT** OR OTHER FIGURE INCLUDING QUALIFYING PROPERTY BOUNDARIES, ABUTTING PROPERTIES, AND TAX PARCEL IDENTIFICATION NUMBER(S).	**Figure 1-2**	
4.	**ONE (1) PAPER COPY AND TWO (2) COMPACT DISC (CD) COPIES** OF THE VOLUNTARY REMEDIATION PLAN IN A SEARCHABLE PORTABLE DOCUMENT FORMAT (PDF).	**CDs included in front of paper copy**	

5.	The VRP participant's initial plan and application must include, using all reasonably available current information to the extent known at the time of application, a graphic three-dimensional preliminary conceptual site model (CSM) including a preliminary remediation plan with a table of delineation standards, brief supporting text, charts, and figures (no more than 10 pages, total) that illustrates the site's surface and subsurface setting, the known or suspected source(s) of contamination, how contamination might move within the environment, the potential human health and ecological receptors, and the complete or incomplete exposure pathways that may exist at the site; the preliminary CSM must be updated as the investigation and remediation progresses and an up-to-date CSM must be included in each semi-annual status report submitted to the director by the participant; a **PROJECTED MILESTONE SCHEDULE** for investigation and remediation of the site, and after enrollment as a participant, must update the schedule in each semi-annual status report to the director describing implementation of the plan during the preceding period. A Gantt chart format is preferred for the milestone schedule. The following four (4) generic milestones are required in all initial plans with the results reported in the participant's next applicable semi-annual reports to the director. The director may extend the time for or waive these or other milestones in the participant's plan where the director determines, based on a showing by the participant, that a longer time period is reasonably necessary:	**CSM: Sections 2.0 to 3.0; Cross Sections (Figures 2-1 to 2-4; Groundwater Elevations (Figures 3-1 and 3-2); COI Extent (Figures 3-3 to 3-8 Risk Assessment: Section 3.0 and Appendix E** **Projected Milestone Schedule: Section 4.3**	
5.a.	Within the first 12 months after enrollment, the participant must complete horizontal delineation of the release and associated constituents of concern on property where access is available at the time of enrollment;	**Complete (see CSM)**	
5.b.	Within the first 24 months after enrollment, the participant must complete horizontal delineation of the release and associated constituents of concern extending onto property for which access was not available at the time of enrollment;	**Not applicable**	
5.c.	Within 30 months after enrollment, the participant must update the site CSM to include vertical delineation, finalize the remediation plan and provide a preliminary cost estimate for implementation of remediation and associated continuing actions; and	**Complete Delineation (See CSM) Remediation Plan (MNA – Approved CAP; Groundwater Use Restriction – Section 4.0)**	
5.d.	Within 60 months after enrollment, the participant must submit the compliance status report required under the VRP, including the requisite certifications.	**Section 4.3**	
6.	**SIGNED AND SEALED PE/PG CERTIFICATION** AND SUPPORTING DOCUMENTATION:	**Before Table of Contents**	

	"I certify under penalty of law that this report and all attachments were prepared by me or under my direct supervision in accordance with the Voluntary Remediation Program Act (O.C.G.A. Section 12-8-101, et seq.). I am a professional engineer/professional geologist who is registered with the Georgia State Board of Registration for Professional Engineers and Land Surveyors/Georgia State Board of Registration for Professional Geologists and I have the necessary experience and am in charge of the investigation and remediation of this release of regulated substances. Furthermore, to document my direct oversight of the Voluntary Remediation Plan development, implementation of corrective action, and long term monitoring, I have attached a monthly summary of hours invoiced and description of services provided by me to the Voluntary Remediation Program participant since the previous submittal to the Georgia Environmental Protection Division. The information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." _____________________________________ ______________________ Printed Name and GA PE/PG Number Date _____________________________________ Signature and Stamp		

ADDITIONAL QUALIFYING PROPERTIES (COPY THIS PAGE AS NEEDED)

Not Applicable

PROPERTY INFORMATION			
TAX PARCEL ID		PROPERTY SIZE (ACRES)	
PROPERTY ADDRESS			
CITY		COUNTY	
STATE		ZIPCODE	
LATITUDE (decimal format)		LONGITUDE (decimal format)	
PROPERTY OWNER INFORMATION			
PROPERTY OWNER(S)		PHONE #	
MAILING ADDRESS			
CITY		STATE/ZIPCODE	

PROPERTY INFORMATION			
TAX PARCEL ID		PROPERTY SIZE (ACRES)	
PROPERTY ADDRESS			
CITY		COUNTY	
STATE		ZIPCODE	
LATITUDE (decimal format)		LONGITUDE (decimal format)	
PROPERTY OWNER INFORMATION			
PROPERTY OWNER(S)		PHONE #	
MAILING ADDRESS			
CITY		STATE/ZIPCODE	

PROPERTY INFORMATION			
TAX PARCEL ID		PROPERTY SIZE (ACRES)	
PROPERTY ADDRESS			
CITY		COUNTY	
STATE		ZIPCODE	
LATITUDE (decimal format)		LONGITUDE (decimal format)	
PROPERTY OWNER INFORMATION			
PROPERTY OWNER(S)		PHONE #	
MAILING ADDRESS			
CITY		STATE/ZIPCODE	

Appendix B

Warranty Deed

~~Return to: M. Michael Hamburg, Dean & Fulkerson, P.C.~~
~~801 W. Big Beaver, 5th Fl., Troy, MI 48084~~

1241
237-238
1780

WARRANTY DEED FORM 1008 CLYDE CASTLEBERRY CO., COVINGTON, GA. 30209

PLEASE RECORD AND RETURN TO:
ROBERT E. KNOX, JR.
P.O. BOX 539, THOMSON, GEORGIA 30824

State of Georgia, McDuffie **County**

THIS INDENTURE, Made this 3rd day of July in the year of our Lord One Thousand Nine Hundred and Ninety-Seven between United Technologies Automotive Systems, Inc., of 1641 Porter Street, Detroit, Michigan, 48216

of the County of Wayne and State of Michigan of the first part, and IIP Pelzer (Automotive Systems), Inc., of 1175 Crooks Road, Troy, Michigan 48084

of the County of Oakland and State of Michigan of the second part:

WITNESSETH, That the said party of the first part, for and in consideration of the sum of $453,333.00 AND NO/100---------- Dollars, in hand paid at and before the sealing and delivery of these presents, the receipt whereof is hereby acknowledged, has granted, bargained, sold and conveyed, and by these presents do grant, bargain, sell and convey unto the said party of the second part and its heirs and assigns, all the following described property, to wit:

(Legal Description on Attached Exhibit "A")

McDuffie County, Georgia
Real Estate Transfer Tax
Paid $ 453.40 Date 7/8/97
Shirley Tucker Cheeley, Deputy
Clerk of Superior Court

Georgia, McDuffie County.
Office of Clerk of Superior Court
I CERTIFY THE WITHIN PAPER WAS FILED FOR RECORD
8 30 o'clock A 8 day of July 19 97
Recorded in Deed Book 212 Page 237-238
Constance H Cheatham CLERK

TO HAVE AND TO HOLD, The said bargained premises, together with all and singular the rights, members and appurtenances thereof, to the same being, belonging or in anywise appertaining, to the only proper use, benefit and behoof of IIP Pelzer (Automotive Systems), Inc. and its heirs and assigns forever in Fee Simple. the said party of the second part.

And the said party of the first part, for its heirs, executors and administrators, will warrant and forever defend the right and title to the above described property unto the said party of the second part and its heirs and assigns, against the claims of all persons whomsoever.

IN WITNESS WHEREOF the said party of the first part has hereunto set its hand and affixed its seal on the day and year first above written.

Signed, sealed and delivered in presence of:

Brenda A. Ondyke
Brenda A. Ondyke

Steven R. Keyes
(Witness)

Cheryl Hastings
(Notary Public)
CHERYL HASTINGS
Notary Public, Wayne County, MI
My Commission Expires Sept. 3, 1999

United Technologies Automotive Systems, Inc. (Seal)

By: Michael O. Brown (Seal)
Michael O. Brown
Vice President, General Counsel (Seal)

(Seal)

237

EXHIBIT "A"

ALL that tract or parcel of land, with improvements thereon, situate, lying and being in the 134th and 152nd Districts G.M. of McDuffie County, Georgia, containing 36.57 acres and being more fully described as follows: Beginning at a concrete monument located at the intersection of the northern edge of the right-of-way of U. S. Highway 278 with the western edge of the right-of-way of Wire Road and from said point proceeding South 46° 28' 20" West along the northern edge of the right-of-way of U. S. Highway 278 for a distance of 962.66 feet to a concrete monument; thence proceeding South 84° 5' 47" West for a distance of 45.84 feet to a point; thence proceeding North 43° 31' 11" West for a distance of 563.25 feet to a one inch pipe; thence proceeding North 38° 58' 1" West for a distance of 360.80 feet to a point; thence proceeding North 10° 21' 11" West for a distance of 98.40 feet to a point; thence proceeding North 43° 22' 51" West for a distance of 1162.87 feet to a point; thence proceeding North 71° 2' 6" West for a distance of 419.31 feet along chord of curve to a concrete monument; thence proceeding North 70° 32' 9" East for a distance of 46 feet to a point; thence proceeding North 19° 27' 51" West for a distance of 20 feet to a point at the Georgia Railroad right-of-way; thence proceeding North 70° 32' 9" East along the right-of-way line of Georgia Railroad 404.20 feet to a point; thence proceeding South 46° 53' 11" East for a distance of 996.16 feet to a point; thence proceeding North 71° 2' 59" East for a distance of 375.98 feet to a point; thence proceeding North 70° 26' 41" East for a distance of 148.57 feet to a point; thence proceeding North 70° 26' 39" East for a distance of 181.65 feet to a point located at the western edge of the right-of-way of Wire Road; thence proceeding South 46° 23' 31" East along the western edge of the right-of-way of Wire Road for a 679.11 feet to a point; thence proceeding South 43° 44' 8" West along the right-of-way of Wire Road for a distance of 20 feet to a point; thence proceeding South 45° 54' 29" East along the western edge of the right-of-way of Wire Road for a distance of 337.85 feet to a point; thence proceeding South 20° 50' 45" East along the western edge of the right-of-way of Wire Road for a distance of 109.42 feet to the point of beginning. Said property is bounded: On the West by property of Shaw; on the North by Georgia Railroad; on the East by property of Mrs. Minnie Owens and Wire Road; and on the South by U. S. Highway 278, all as shown according to Plat of Survey thereof prepared by John A. McGill, R.L.S. No. 1753, dated July 2, 1997, copy of which is recorded in Plat Record 3 at page 373M in the office of the Clerk of Superior Court of McDuffie County, Georgia.

Appendix C

Type 1 Soil RRS Certification of Compliance

Certification of Compliance

"I certify under penalty of law that this report and all attachments were prepared under my direction in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Based on my review of the findings of this report with respect to the risk reduction standards of the Rules for Hazardous Site Response, Rule 391-3-19-.07, I have determined that this Site is in compliance with Type 1 Risk Reduction Standards in soil."

________________________________	Richard H. Bennett
(Signature)	(Typed Name)

Vice President, EH&S

(Title)

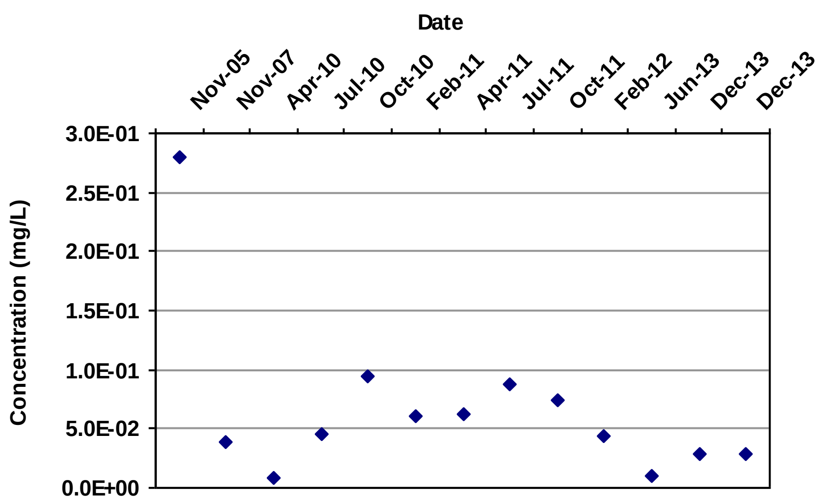
Appendix D

MAROS Statistical Trend Analysis

MAROS Mann-Kendall Statistics Summary

Well: M-10
Well Type: S
COC: TRICHLOROETHYLENE (TCE)

Time Period: 9/25/2005 **to** 12/18/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -18

Confidence in Trend: 84.7%

Coefficient of Variation: 1.05

Mann Kendall Concentration Trend: (See Note) NT

Data Table:

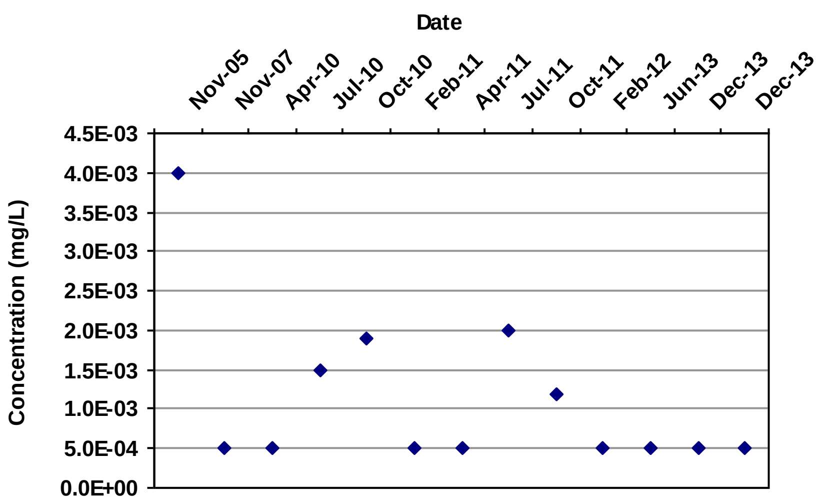
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
M-10	S	11/8/2005	TRICHLOROETHYLENE (TCE)	2.8E-01		1	1
M-10	S	11/30/2007	TRICHLOROETHYLENE (TCE)	3.8E-02		1	1
M-10	S	4/21/2010	TRICHLOROETHYLENE (TCE)	9.1E-03		1	1
M-10	S	7/9/2010	TRICHLOROETHYLENE (TCE)	4.6E-02		1	1
M-10	S	10/10/2010	TRICHLOROETHYLENE (TCE)	9.4E-02		1	1
M-10	S	2/15/2011	TRICHLOROETHYLENE (TCE)	6.1E-02		1	1
M-10	S	4/1/2011	TRICHLOROETHYLENE (TCE)	6.2E-02		1	1
M-10	S	7/27/2011	TRICHLOROETHYLENE (TCE)	8.7E-02		1	1
M-10	S	10/1/2011	TRICHLOROETHYLENE (TCE)	7.5E-02		1	1
M-10	S	2/14/2012	TRICHLOROETHYLENE (TCE)	4.4E-02		1	1
M-10	S	5/2013 12:37:00 F	TRICHLOROETHYLENE (TCE)	1.1E-02		1	1
M-10	S	12/18/2013	TRICHLOROETHYLENE (TCE)	2.8E-02		1	1
M-10	S	18/2013 12:39:00	TRICHLOROETHYLENE (TCE)	2.9E-02		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: M-10
Well Type: S
COC: VINYL CHLORIDE

Time Period: 9/25/2005 **to** 12/18/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -20

Confidence in Trend: 87.4%

Coefficient of Variation: 0.92

Mann Kendall Concentration Trend: (See Note) S

Data Table:

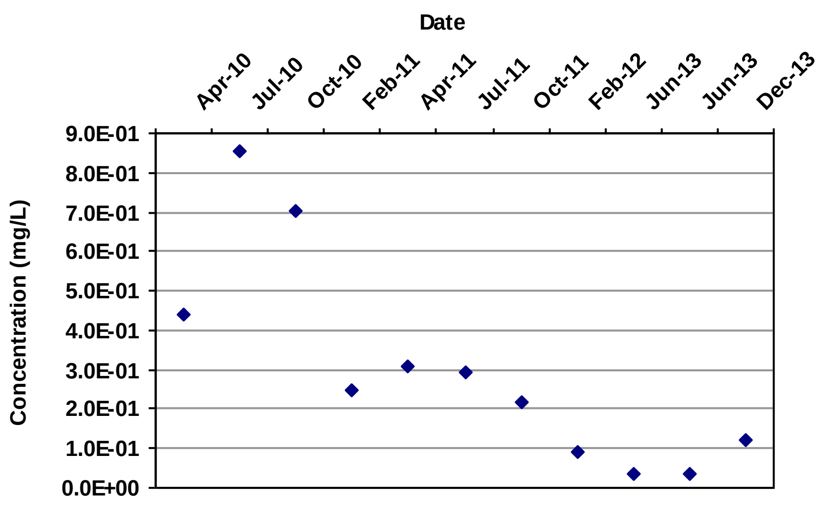
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
M-10	S	11/8/2005	VINYL CHLORIDE	4.0E-03		1	1
M-10	S	11/30/2007	VINYL CHLORIDE	5.0E-04	ND	1	0
M-10	S	4/21/2010	VINYL CHLORIDE	5.0E-04	ND	1	0
M-10	S	7/9/2010	VINYL CHLORIDE	1.5E-03		1	1
M-10	S	10/10/2010	VINYL CHLORIDE	1.9E-03		1	1
M-10	S	2/15/2011	VINYL CHLORIDE	5.0E-04	ND	1	0
M-10	S	4/1/2011	VINYL CHLORIDE	5.0E-04	ND	1	0
M-10	S	7/27/2011	VINYL CHLORIDE	2.0E-03		1	1
M-10	S	10/1/2011	VINYL CHLORIDE	1.2E-03		1	1
M-10	S	2/14/2012	VINYL CHLORIDE	5.0E-04	ND	1	0
M-10	S	5/2013 12:37:00 F	VINYL CHLORIDE	5.0E-04	ND	1	0
M-10	S	12/18/2013	VINYL CHLORIDE	5.0E-04	ND	1	0
M-10	S	18/2013 12:39:00	VINYL CHLORIDE	5.0E-04	ND	1	0

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: M-14D
Well Type: S
COC: TRICHLOROETHYLENE (TCE)

Time Period: 9/25/2005 **to** 12/18/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic:

-39

Confidence in Trend:

99.9%

Coefficient of Variation:

0.88

Mann Kendall Concentration Trend: (See Note)

D

Data Table:

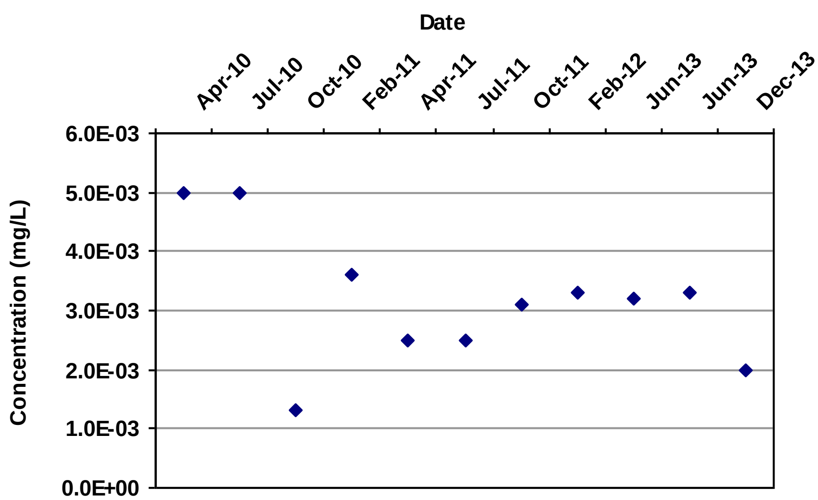
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
M-14D	S	4/21/2010	TRICHLOROETHYLENE (TCE)	4.4E-01		1	1
M-14D	S	7/9/2010	TRICHLOROETHYLENE (TCE)	8.6E-01		1	1
M-14D	S	10/10/2010	TRICHLOROETHYLENE (TCE)	7.0E-01		1	1
M-14D	S	2/15/2011	TRICHLOROETHYLENE (TCE)	2.5E-01		1	1
M-14D	S	4/1/2011	TRICHLOROETHYLENE (TCE)	3.1E-01		1	1
M-14D	S	7/27/2011	TRICHLOROETHYLENE (TCE)	2.9E-01		1	1
M-14D	S	10/1/2011	TRICHLOROETHYLENE (TCE)	2.2E-01		1	1
M-14D	S	2/14/2012	TRICHLOROETHYLENE (TCE)	9.3E-02		1	1
M-14D	S	6/6/2013	TRICHLOROETHYLENE (TCE)	3.5E-02		1	1
M-14D	S	5/2013 10:37:00 A	TRICHLOROETHYLENE (TCE)	3.8E-02		1	1
M-14D	S	'18/2013 4:50:00 I	TRICHLOROETHYLENE (TCE)	1.2E-01		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: M-14D
Well Type: S
COC: VINYL CHLORIDE

Time Period: 9/25/2005 **to** 12/18/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -12

Confidence in Trend: 79.9%

Coefficient of Variation: 0.36

Mann Kendall Concentration Trend: (See Note) S

Data Table:

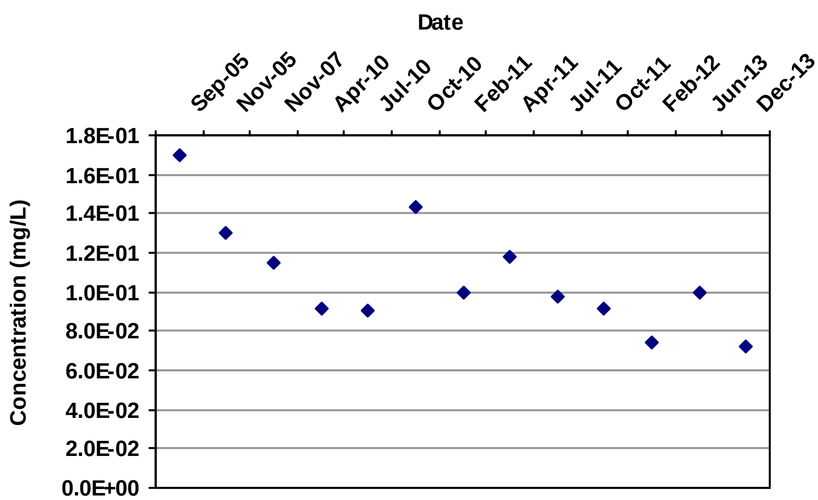
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
M-14D	S	4/21/2010	VINYL CHLORIDE	5.0E-03	ND	1	0
M-14D	S	7/9/2010	VINYL CHLORIDE	5.0E-03	ND	1	0
M-14D	S	10/10/2010	VINYL CHLORIDE	1.3E-03		1	1
M-14D	S	2/15/2011	VINYL CHLORIDE	3.6E-03		1	1
M-14D	S	4/1/2011	VINYL CHLORIDE	2.5E-03	ND	1	0
M-14D	S	7/27/2011	VINYL CHLORIDE	2.5E-03	ND	1	0
M-14D	S	10/1/2011	VINYL CHLORIDE	3.1E-03		1	1
M-14D	S	2/14/2012	VINYL CHLORIDE	3.3E-03		1	1
M-14D	S	6/6/2013	VINYL CHLORIDE	3.2E-03		1	1
M-14D	S	;/2013 10:37:00 A	VINYL CHLORIDE	3.3E-03		1	1
M-14D	S	'18/2013 4:50:00 I	VINYL CHLORIDE	2.0E-03		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: M-7
Well Type: S
COC: TRICHLOROETHYLENE (TCE)

Time Period: 9/25/2005 **to** 12/18/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic:

-40

Confidence in Trend:

99.3%

Coefficient of Variation:

0.26

Mann Kendall Concentration Trend: (See Note)

D

Data Table:

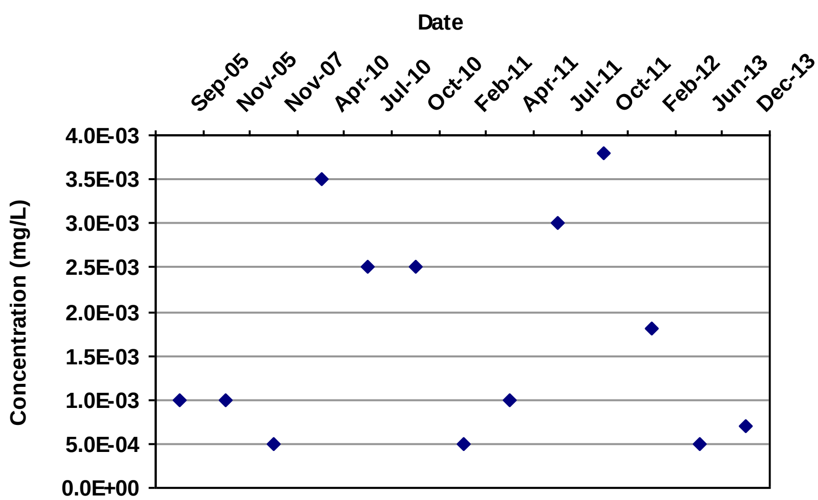
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
M-7	S	9/25/2005	TRICHLOROETHYLENE (TCE)	1.7E-01		1	1
M-7	S	11/8/2005	TRICHLOROETHYLENE (TCE)	1.3E-01		1	1
M-7	S	11/30/2007	TRICHLOROETHYLENE (TCE)	1.2E-01		1	1
M-7	S	4/21/2010	TRICHLOROETHYLENE (TCE)	9.1E-02		1	1
M-7	S	7/9/2010	TRICHLOROETHYLENE (TCE)	9.0E-02		1	1
M-7	S	10/10/2010	TRICHLOROETHYLENE (TCE)	1.4E-01		1	1
M-7	S	2/15/2011	TRICHLOROETHYLENE (TCE)	9.9E-02		1	1
M-7	S	4/1/2011	TRICHLOROETHYLENE (TCE)	1.2E-01		1	1
M-7	S	7/28/2011	TRICHLOROETHYLENE (TCE)	9.8E-02		1	1
M-7	S	10/1/2011	TRICHLOROETHYLENE (TCE)	9.2E-02		1	1
M-7	S	2/14/2012	TRICHLOROETHYLENE (TCE)	7.4E-02		1	1
M-7	S	5/2013 10:15:00 A	TRICHLOROETHYLENE (TCE)	9.9E-02		1	1
M-7	S	18/2013 11:07:00	TRICHLOROETHYLENE (TCE)	7.2E-02		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: M-7
Well Type: S
COC: VINYL CHLORIDE

Time Period: 9/25/2005 **to** 12/18/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -1

Confidence in Trend: 50.0%

Coefficient of Variation: 0.70

Mann Kendall Concentration Trend: (See Note) S

Data Table:

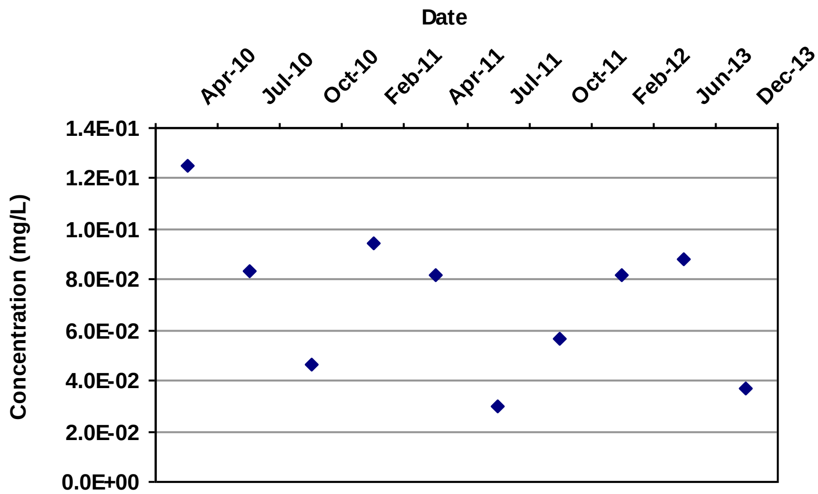
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
M-7	S	9/25/2005	VINYL CHLORIDE	1.0E-03	ND	1	0
M-7	S	11/8/2005	VINYL CHLORIDE	1.0E-03	ND	1	0
M-7	S	11/30/2007	VINYL CHLORIDE	5.0E-04	ND	1	0
M-7	S	4/21/2010	VINYL CHLORIDE	3.5E-03		1	1
M-7	S	7/9/2010	VINYL CHLORIDE	2.5E-03		1	1
M-7	S	10/10/2010	VINYL CHLORIDE	2.5E-03		1	1
M-7	S	2/15/2011	VINYL CHLORIDE	5.0E-04	ND	1	0
M-7	S	4/1/2011	VINYL CHLORIDE	1.0E-03	ND	1	0
M-7	S	7/28/2011	VINYL CHLORIDE	3.0E-03		1	1
M-7	S	10/1/2011	VINYL CHLORIDE	3.8E-03		1	1
M-7	S	2/14/2012	VINYL CHLORIDE	1.8E-03		1	1
M-7	S	5/2013 10:15:00 A	VINYL CHLORIDE	5.0E-04	ND	1	0
M-7	S	18/2013 11:07:00	VINYL CHLORIDE	7.0E-04		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: M-8R
Well Type: S
COC: TRICHLOROETHYLENE (TCE)

Time Period: 9/25/2005 **to** 12/18/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic:
-13

Confidence in Trend:
85.4%

Coefficient of Variation:
0.41

Mann Kendall Concentration Trend: (See Note)
S

Data Table:

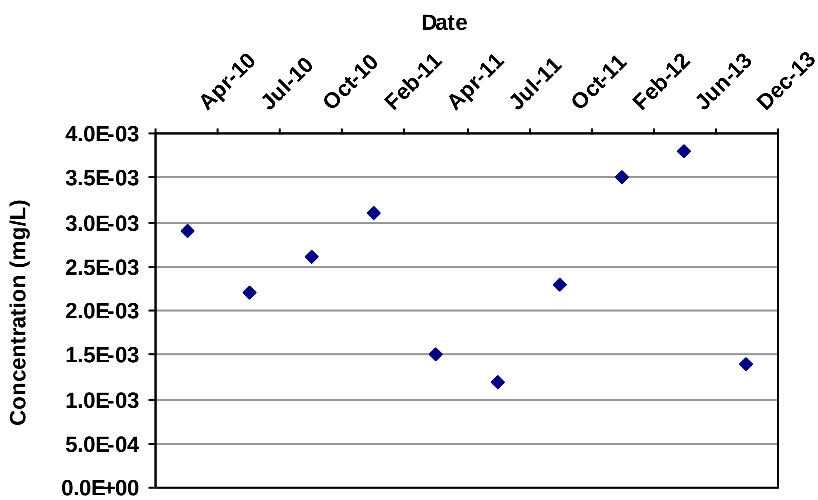
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
M-8R	S	4/21/2010	TRICHLOROETHYLENE (TCE)	1.3E-01		1	1
M-8R	S	7/9/2010	TRICHLOROETHYLENE (TCE)	8.3E-02		1	1
M-8R	S	10/10/2010	TRICHLOROETHYLENE (TCE)	4.6E-02		1	1
M-8R	S	2/15/2011	TRICHLOROETHYLENE (TCE)	9.4E-02		1	1
M-8R	S	4/1/2011	TRICHLOROETHYLENE (TCE)	8.2E-02		1	1
M-8R	S	7/27/2011	TRICHLOROETHYLENE (TCE)	3.0E-02		1	1
M-8R	S	10/1/2011	TRICHLOROETHYLENE (TCE)	5.6E-02		1	1
M-8R	S	2/14/2012	TRICHLOROETHYLENE (TCE)	8.2E-02		1	1
M-8R	S	'6/2013 1:16:00 P	TRICHLOROETHYLENE (TCE)	8.8E-02		1	1
M-8R	S	'18/2013 3:10:00 I	TRICHLOROETHYLENE (TCE)	3.7E-02		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: M-8R
Well Type: S
COC: VINYL CHLORIDE

Time Period: 9/25/2005 **to** 12/18/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: 1

Confidence in Trend: 50.0%

Coefficient of Variation: 0.37

Mann Kendall Concentration Trend: (See Note) NT

Data Table:

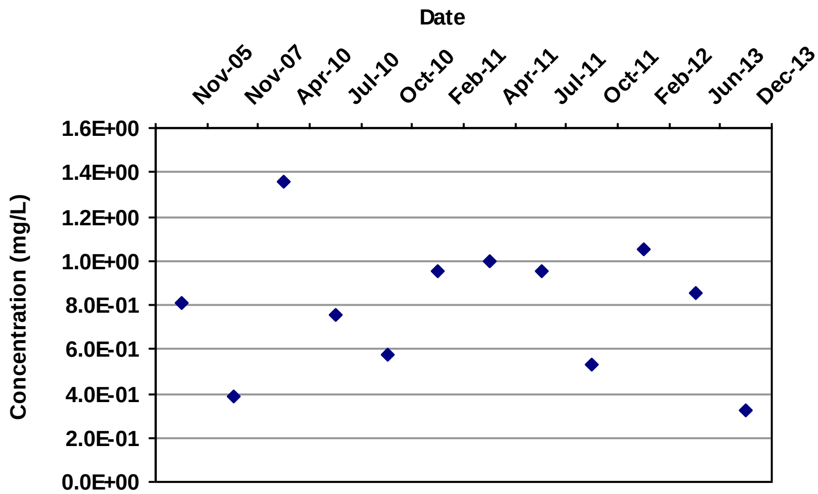
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
M-8R	S	4/21/2010	VINYL CHLORIDE	2.9E-03		1	1
M-8R	S	7/9/2010	VINYL CHLORIDE	2.2E-03		1	1
M-8R	S	10/10/2010	VINYL CHLORIDE	2.6E-03		1	1
M-8R	S	2/15/2011	VINYL CHLORIDE	3.1E-03		1	1
M-8R	S	4/1/2011	VINYL CHLORIDE	1.5E-03		1	1
M-8R	S	7/27/2011	VINYL CHLORIDE	1.2E-03		1	1
M-8R	S	10/1/2011	VINYL CHLORIDE	2.3E-03		1	1
M-8R	S	2/14/2012	VINYL CHLORIDE	3.5E-03		1	1
M-8R	S	'6/2013 1:16:00 P	VINYL CHLORIDE	3.8E-03		1	1
M-8R	S	'18/2013 3:10:00 I	VINYL CHLORIDE	1.4E-03		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: M-9
Well Type: S
COC: DICHLOROETHYLENES

Time Period: 9/25/2005 **to** 12/18/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -4

Confidence in Trend: 58.0%

Coefficient of Variation: 0.38

Mann Kendall Concentration Trend: (See Note) S

Data Table:

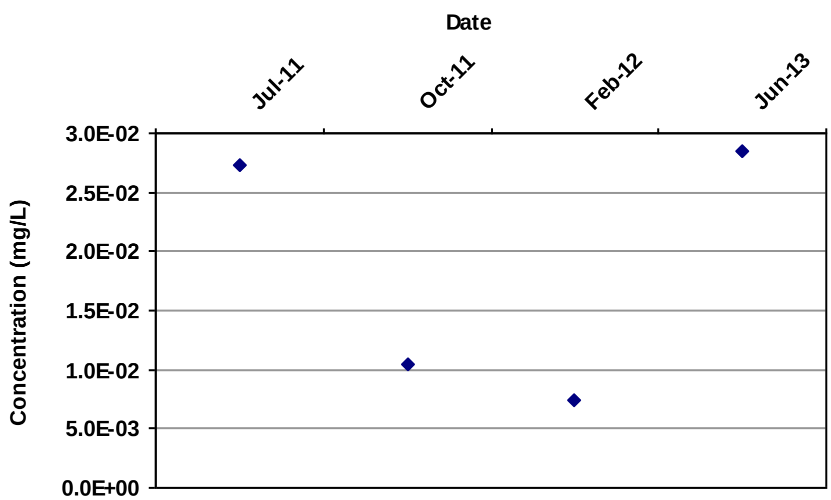
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
M-9	S	11/8/2005	DICHLOROETHYLENES	8.1E-01		1	1
M-9	S	11/30/2007	DICHLOROETHYLENES	3.9E-01		1	1
M-9	S	4/21/2010	DICHLOROETHYLENES	1.4E+00		1	1
M-9	S	7/9/2010	DICHLOROETHYLENES	7.5E-01		1	1
M-9	S	10/10/2010	DICHLOROETHYLENES	5.8E-01		1	1
M-9	S	2/15/2011	DICHLOROETHYLENES	9.6E-01		1	1
M-9	S	4/1/2011	DICHLOROETHYLENES	1.0E+00		1	1
M-9	S	7/28/2011	DICHLOROETHYLENES	9.5E-01		1	1
M-9	S	10/1/2011	DICHLOROETHYLENES	5.3E-01		1	1
M-9	S	2/14/2012	DICHLOROETHYLENES	1.1E+00		1	1
M-9	S	'5/2013 8:30:00 A	DICHLOROETHYLENES	8.6E-01		1	1
M-9	S	'18/2013 9:26:00 /	DICHLOROETHYLENES	3.3E-01		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: M-17
Well Type: T
COC: TRICHLOROETHYLENE (TCE)

Time Period: 9/25/2005 **to** 12/18/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: 0

Confidence in Trend: 37.5%

Coefficient of Variation: 0.60

Mann Kendall Concentration Trend: (See Note) S

Data Table:

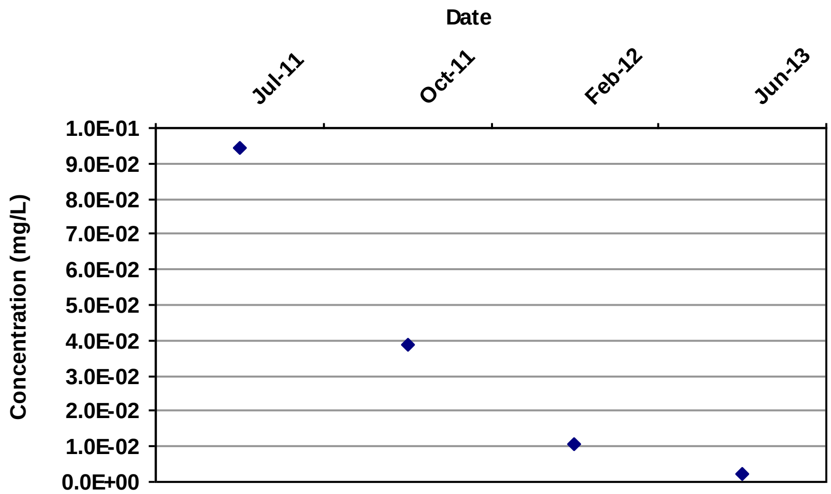
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
M-17	T	7/28/2011	TRICHLOROETHYLENE (TCE)	2.7E-02		1	1
M-17	T	10/1/2011	TRICHLOROETHYLENE (TCE)	1.0E-02		1	1
M-17	T	2/14/2012	TRICHLOROETHYLENE (TCE)	7.4E-03		1	1
M-17	T	'6/2013 8:40:00 A	TRICHLOROETHYLENE (TCE)	2.9E-02		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: M-17
Well Type: T
COC: DICHLOROETHYLENES

Time Period: 9/25/2005 **to** 12/18/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -6

Confidence in Trend: 95.8%

Coefficient of Variation: 1.14

Mann Kendall Concentration Trend: (See Note) D

Data Table:

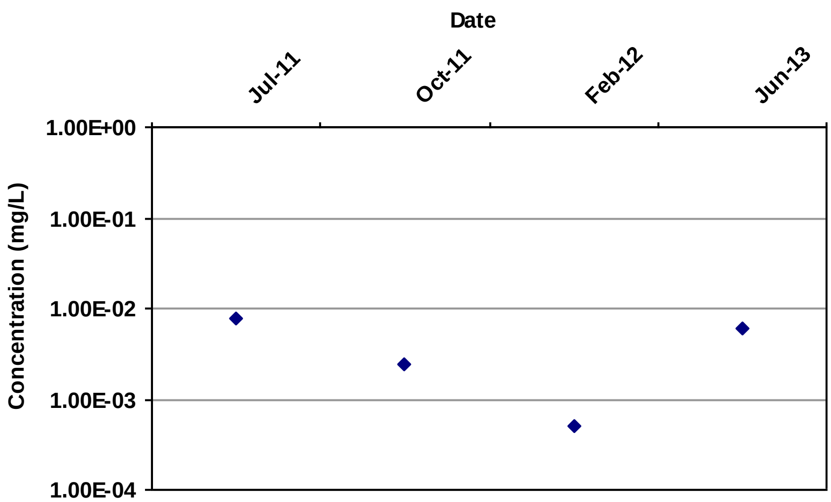
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
M-17	T	7/28/2011	DICHLOROETHYLENES	9.4E-02		1	1
M-17	T	10/1/2011	DICHLOROETHYLENES	3.9E-02		1	1
M-17	T	2/14/2012	DICHLOROETHYLENES	1.1E-02		1	1
M-17	T	'6/2013 8:40:00 A	DICHLOROETHYLENES	2.3E-03		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Well: M-17
Well Type: T
COC: cis-1,2-DICHLOROETHYLENE

Time Period: 9/25/2005 **to** 12/18/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic: -2

Confidence in Trend: 62.5%

Coefficient of Variation: 0.80

Mann Kendall Concentration Trend: (See Note) S

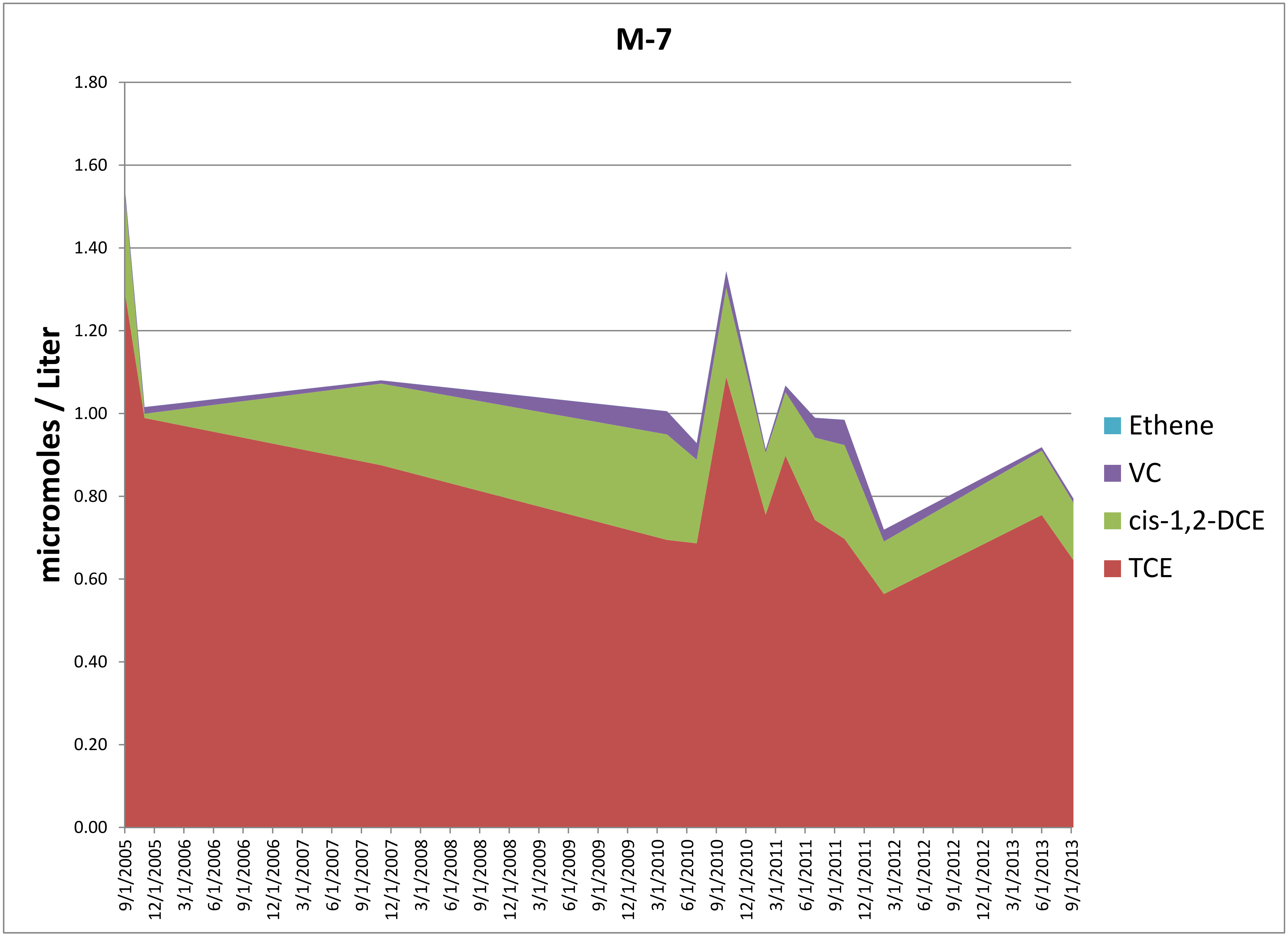
Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
M-17	T	7/28/2011	cis-1,2-DICHLOROETHYLENE	7.8E-03		1	1
M-17	T	10/1/2011	cis-1,2-DICHLOROETHYLENE	2.4E-03		1	1
M-17	T	2/14/2012	cis-1,2-DICHLOROETHYLENE	5.0E-04	ND	1	0
M-17	T	'6/2013 8:40:00 A	cis-1,2-DICHLOROETHYLENE	6.0E-03		1	1

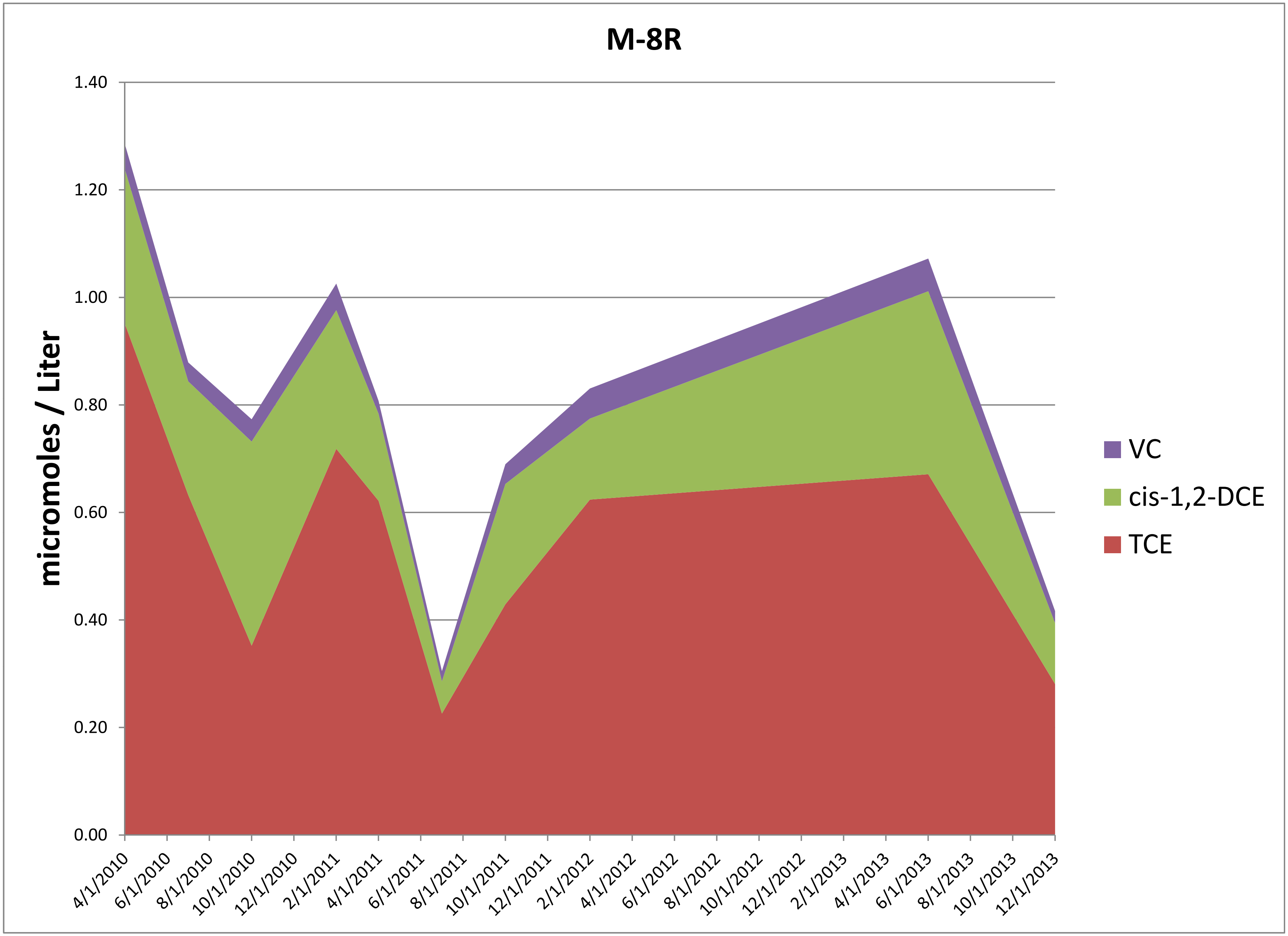
Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

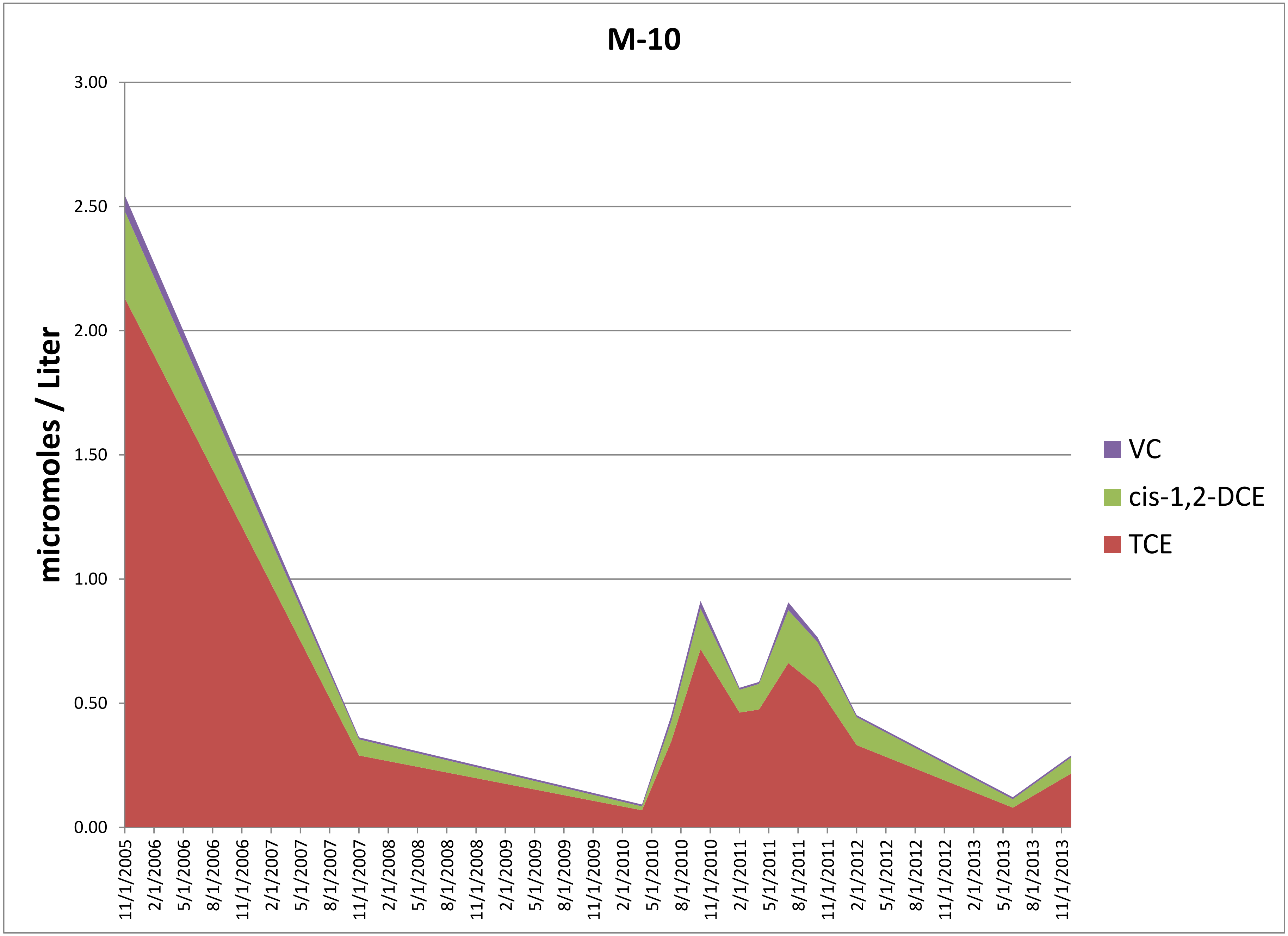
Appendix E

Monitoring Well Trend Plots

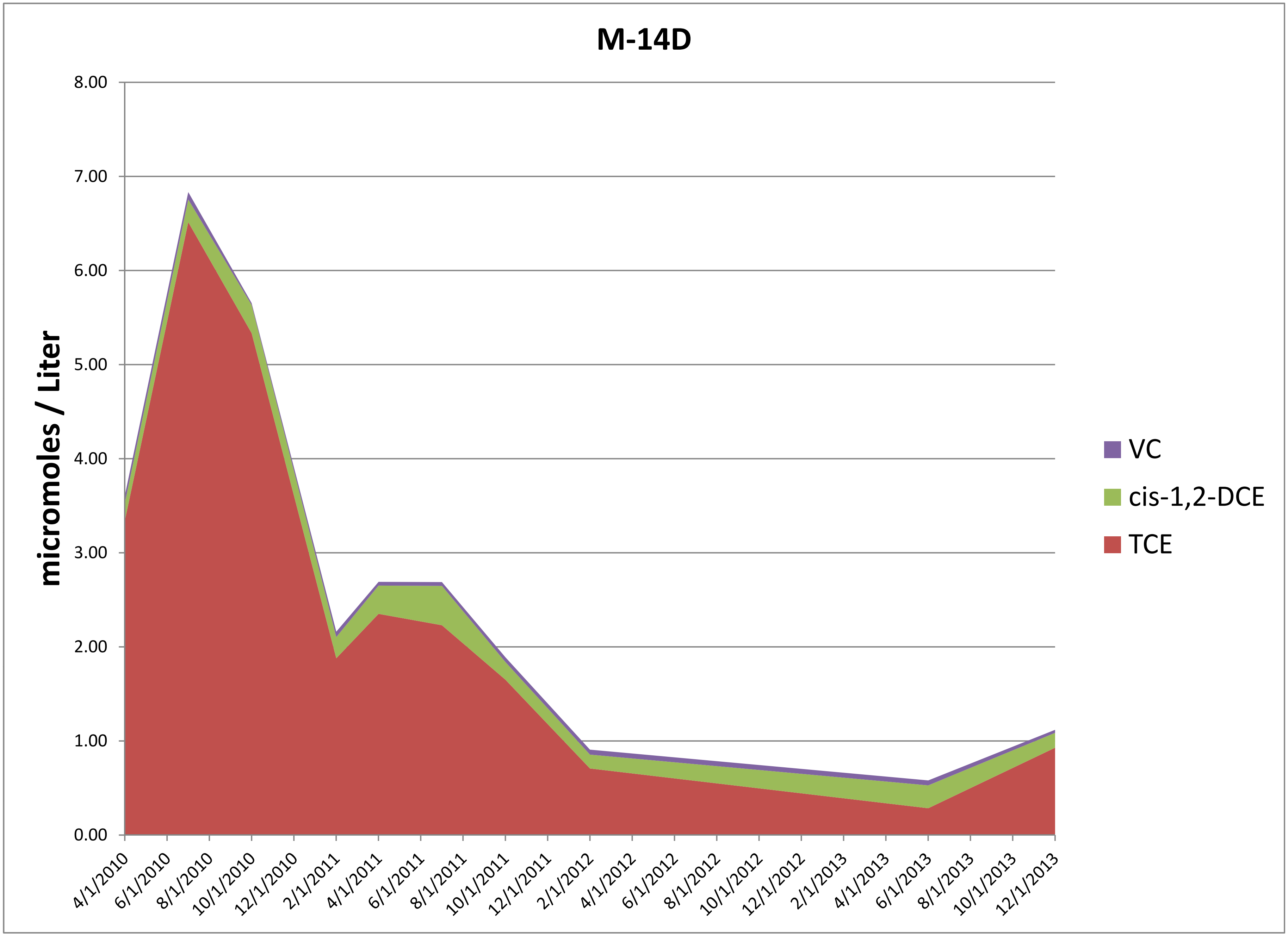


M-7
micromoles / Liter
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
9/1/2005
12/1/2005
3/1/2006
6/1/2006
9/1/2006
12/1/2006
3/1/2007
6/1/2007
9/1/2007
12/1/2007
3/1/2008
6/1/2008
9/1/2008
12/1/2008
3/1/2009
6/1/2009
9/1/2009
12/1/2009
3/1/2010
6/1/2010
9/1/2010
12/1/2010
3/1/2011
6/1/2011
9/1/2011
12/1/2011
3/1/2012
6/1/2012
9/1/2012
12/1/2012
3/1/2013
6/1/2013
9/1/2013
Ethene
VC
cis-1,2-DCE
TCE


M-8R
micromoles / Liter
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
4/1/2010
6/1/2010
8/1/2010
10/1/2010
12/1/2010
2/1/2011
4/1/2011
6/1/2011
8/1/2011
10/1/2011
12/1/2011
2/1/2012
4/1/2012
6/1/2012
8/1/2012
10/1/2012
12/1/2012
2/1/2013
4/1/2013
6/1/2013
8/1/2013
10/1/2013
12/1/2013
VC
cis-1,2-DCE
TCE



M-10
micromoles / Liter
3.00
2.50
2.00
1.50
1.00
0.50
0.00
11/1/2005
2/1/2006
5/1/2006
8/1/2006
11/1/2006
2/1/2007
5/1/2007
8/1/2007
11/1/2007
2/1/2008
5/1/2008
8/1/2008
11/1/2008
2/1/2009
5/1/2009
8/1/2009
11/1/2009
2/1/2010
5/1/2010
8/1/2010
11/1/2010
2/1/2011
5/1/2011
8/1/2011
11/1/2011
2/1/2012
5/1/2012
8/1/2012
11/1/2012
2/1/2013
5/1/2013
8/1/2013
11/1/2013
VC
cis-1,2-DCE
TCE



M-14D
micromoles / Liter
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
4/1/2010
6/1/2010
8/1/2010
10/1/2010
12/1/2010
2/1/2011
4/1/2011
6/1/2011
8/1/2011
10/1/2011
12/1/2011
2/1/2012
4/1/2012
6/1/2012
8/1/2012
10/1/2012
12/1/2012
2/1/2013
4/1/2013
6/1/2013
8/1/2013
10/1/2013
12/1/2013
VC
cis-1,2-DCE
TCE

Appendix F

Risk Evaluation

Environment

Prepared for:
United Technologies Corporation
Farmington, Connecticut

Prepared by:
AECOM
Atlanta, GA
60320507.02
June 20, 2014

Risk Evaluation
Former United Technologies Automotive Site
Thomson, Georgia

Environment

Prepared for:
United Technologies Corporation
Farmington, Connecticut

Prepared by:
AECOM
Atlanta, GA
60320507.02
June 20, 2014

Risk Evaluation
Former United Technologies Automotive Site
Thomson, Georgia

Prepared By [Name]

Reviewed By [Name]

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1.0 Introduction

AECOM Technical Services, Inc. (AECOM), on behalf of United Technologies Corporation (UTC), has prepared this Risk Evaluation for the Former United Technologies Automotive Facility (the Site) located at 1884 Warrenton Highway in Thomson, McDuffie County, Georgia (Figure 1-1). This Risk Evaluation was performed to assess the feasibility of enrolling the Site in the Georgia Environmental Protection Department (EPD) Voluntary Remediation Program (VRP).

Risk evaluations were performed for the Site to assess the potential for chemicals detected in groundwater to pose risk to human health or ecological receptors. The risk posed to potential future groundwater use will be addressed by placing a deed restriction on the property prohibiting the use of groundwater. Two evaluations were performed:

- Due to the presence of volatile organic compounds (VOCs) in shallow groundwater on the Site, the potential for resident risk as a result of vapor intrusion was evaluated.
- Due to the possibility that groundwater could discharge to the small pond on the Site, a screening-level evaluation of groundwater was performed to identify the potential for ecological risk from exposure to surface water impacted by groundwater.

1.1 Site Description

The Site is located on approximately 36.4 acres in an industrial/commercial zoned property surrounded by a rural agricultural area, approximately 2 miles southwest of the City of Thomson, Georgia (Figure 1-1). The Site is bounded by Shaw Industries, Inc. (Shaw) to the southwest, Warrenton Highway 278 to the southeast, Wire Road to the northeast, and a residential property and railroad tracks to the northwest. A site layout is presented as Figure 1-2.

According to historical Site documents, the surrounding area is characterized by moderately rolling topography. The majority of the Site gently slopes to the east. There is a ridgeline located along the western edge of the Site, near the building’s edge. The Site is located at an elevation of approximately 505 feet (ft) above mean sea level (msl). A drainage ditch is located on the southern portion of the Site, which receives stormwater from the Site and the Shaw property then drains to the east toward Warrenton Highway. A small pond is located near the southeast property line, near Warrenton Highway.

1.2 Site Geology and Hydrology

The Site soils generally consist of sandy clay and clay. Bedrock varies across the Site ranging from 4 feet below ground surface (ft bgs) to approximately 77 ft bgs. The elevated range of bedrock is located in the suspected source area, along the southwestern property boundary.

Hydrogeologic testing conducted and discussed as part of the Compliance Status Report (CSR) in 2006 indicated an average hydraulic conductivity of 0.361 feet per day (ft/day) with a range from 0.0066 ft/day at M-6 to 2.06 ft/day at M-12 (Conversion Technology Inc. [CTI] 2006). The average groundwater velocity was estimated to be 4.6 ft per year in the Semi-Annual Progress Report (October 2011 through February 2012)/MNA Effectiveness Report dated May 2012 (XDD 2012).

2.0 Evaluation of Vapor Intrusion Risk

Groundwater has been identified as a potential source medium for impacts to indoor air. A vapor intrusion evaluation was conducted to determine whether groundwater impacts pose indoor air risks to hypothetical on-site residents at the Site. VOCs that historically exceeded Type 4 risk reduction standards (RRS) derived based on Georgia guidance (EPD, 2003) were included in this evaluation: 1,1-dichloroethene (1,1-DCE), trichloroethene (TCE) and vinyl chloride. In addition, cis-1,2-dichloroethene (cis-1,2-DCE) was included because it has been consistently detected at the Site.

The Johnson and Ettinger (J&E) vapor intrusion model (USEPA, 2004) was used to calculate human health risk from inhalation of indoor air containing VOCs originating from groundwater contamination. The J&E vapor intrusion model was also used to calculate site-specific, risk-based screening levels for groundwater that are considered protective of a resident exposed to groundwater contaminants in indoor air.

The J&E model is a one-dimensional analytical solution to convective and diffusive vapor transport into indoor spaces and provides an estimated attenuation coefficient that relates the vapor concentration in the indoor space to the vapor concentration at the source of contamination. The model is constructed as both a steady state solution to vapor transport (infinite or non-diminishing source) and as a quasi-steady-state solution (finite or diminishing source). Inputs to the model include chemical properties, saturated and unsaturated zone soil properties, site-specific exposure assumptions for site receptors, and structural properties of the building (USEPA, 2002). The J&E model provides a relationship between the concentration of a chemical within a source area and the concentration of that chemical in indoor air directly above or proximate to the source area.

The following assumptions were made when using the J&E model:

- Contaminant vapors enter the structure primarily through cracks and openings in the walls and foundation.
- Convective transport occurs primarily within the building zone of influence and vapor velocities decrease rapidly with increasing distance from the structure.
- Diffusion dominates vapor transport between the source of contamination and the building zone of influence.
- All vapors originating from below the building will enter the building unless the floors and walls are perfect vapor barriers.
- All soil properties in any horizontal plane are homogeneous.
- The contaminant is homogeneously distributed within the zone of contamination.
- The areal extent of contamination is greater than that of the building floor in contact with the soil.
- Vapor transport occurs in the absence of convective water movement within the soil column (i.e., evaporation or infiltration), and in the absence of mechanical dispersion.

- The model does not account for transformation processes (e.g., biodegradation, hydrolysis, etc.).
- The soil layer in contact with the structure floor and walls is isotropic with respect to permeability.
- Both the building ventilation rate and the difference in dynamic pressure between the interior of the structure and the soil surface are constant values.
- Groundwater was considered as the only source medium for indoor air impact.

2.1 Site-Specific Model Inputs

2.1.1 Toxicity Assessment

The calculation of human health indoor air risks from groundwater requires chemical-specific inhalation toxicity values in the form of a cancer unit risk factor (URF) / cancer inhalation slope factor (SF), as well as a noncancer inhalation reference concentration (RfC) / noncancer inhalation reference dose (RfD). The toxicological and chemical-specific information originally built into the J&E model are not up-to-date parameters. Therefore, all toxicological and chemical-specific information used in the model for this evaluation was taken from USEPA's May 2014 Regional Screening Level (RSL) Table (USEPA, 2014b), which incorporates updated USEPA-approved and provisional toxicity sources.

2.1.2 Exposure Assessment

As mentioned previously, a hypothetical resident could be exposed to VOCs migrating from groundwater into indoor air. During the evaluation, the following exposure assumptions were made based on EPD RRS calculation guidance (391-3-19.07) (EPD, 2003):

- The exposure frequency (EF) was 350 days per year
- The exposure duration (ED) was 30 years for a resident.
- The noncarcinogen averaging time (AT) was modified to equal the ED, and the AT for carcinogens was modified to a lifetime, 70 years.

2.1.3 Soil Parameters

Soil parameters were estimated based on site-specific measurements. Subsurface soil under the building was classified as sandy clay. The default values for soil bulk density, total porosity, volumetric moisture content (also called water-filled porosity), and fraction of organic carbon content (foc) for the soil type of sandy clay were used.

2.1.4 Building Parameters

The typical residential building parameters, such as length, width, height, and floor thickness, were used for evaluation. The default value of 15 cm was chosen for the depth below grade to the bottom of the enclosed space floor to represent a slab-on-grade construction. In addition, USEPA default values were used for the soil-building soil pressure differential, and floor-wall seam crack.

2.1.5 Representative Concentration

In order to estimate the potential risks to hypothetical residents, it is first necessary to estimate the representative concentration (RC) in groundwater that may migrate upwards and infiltrate into indoor air. These groundwater RCs are then used in the J&E model to predict the indoor air concentration that a receptor may be exposed to and the resulting potential risks associated with this indoor air concentration. For this Site, to be conservative the historical maximum groundwater concentrations were used to calculate the vapor intrusion risk:

- TCE: 856 µg/L (detected in MW-14D on 7/9/2010)
- Vinyl chloride: 4 µg/L (detected in M-10 on 11/8/2005)
- 1,1-DCE: 1,360 µg/L (detected in M-9 on 4/21/2010)
- Cis-1,2-DCE: 40.6 µg/L (detected in M-14D on 7/27/2011).

2.2 Modeling Results

For the purposes of this vapor intrusion evaluation, potential exposure to TCE, vinyl chloride, 1,1-DCE, and cis-1,2-DCE volatilizing from groundwater into indoor air is considered a complete exposure pathway for residents in typical residential building. All vapor intrusion modeling runs are provided in Appendix A. Indoor air risks to hypothetical residents associated with vapor intrusion of constituents of interest (COIs) are presented in Table 2-1. The cumulative indoor air risk is compared to the acceptable noncancer hazard index (HI) of 1.0 and acceptable cancer target risk level of 1E-05.

<u>Noncancer Risks</u>

The cumulative HI was 0.8, below the target HI of 1.0, indicating that groundwater concentrations do not pose an unacceptable vapor intrusion noncancer risk to hypothetical residents even when based on the historical maximum concentration of each COI.

<u>Cancer Risks</u>

Similarly, the cumulative cancer risk was 2.75E-06, below the target risk level of 1E-05, indicating that groundwater concentrations do not pose an unacceptable vapor intrusion cancer risk to residents even when based on the historical maximum concentration of each COI.

<u>Vapor Intrusion Risk-Based Screening Levels for Groundwater</u>

Although cumulative indoor air risk was below the target risk levels, risk-based screening levels for groundwater were calculated using the J&E vapor intrusion model to be protective of the residents. These screening levels are intended to be protective of residents exposed to groundwater contaminants in indoor air as a result of vapor intrusion. The following site-specific VI screening levels were derived:

- TCE 1,110 µg /L
- Vinyl Chloride 1,110 µg /L
- 1,1-DCE 52,300 µg /L
- Cis-1,2-DCE not calculated due to lack of inhalation toxicity values.

All of the historical groundwater maximum concentrations were below the calculated screening levels, which further supports the conclusion that current groundwater concentrations do not pose an unacceptable vapor intrusion risk for residents in a typical residential building under current or likely future conditions. Although there is uncertainty associated with cis-1,2-DCE because it lacks inhalation toxicity factors, it is not expected to be more toxic than the other compounds evaluated and its historical maximum concentration is lower than that of TCE and 1,1-DCE. Thus, cis-1,2-DCE also would not be expected to pose unacceptable risk through the vapor intrusion pathway.

3.0 Evaluation of Ecological Risk

The small pond in the eastern portion of the Site could potentially provide a pathway for exposure of ecological receptors to chemicals in groundwater if groundwater discharges to the pond. Given the small size of the pond and its location in a controlled area near the facility entrance, the potential for human exposure to pond surface water is negligible. The source of contamination is approximately 972 feet upgradient from the surface water body (i.e., the pond). Based on the delineated extent of groundwater plume, VOC concentrations have been in compliance with the groundwater RRS at well M-19, which is located approximately 372 feet upgradient from the pond. The pond is a distance away from the groundwater plume, and based on the plume stability over years, there is no evidence of groundwater plume migration toward the pond. The pond becoming impacted by the groundwater plume is unlikely. In order to evaluate the potential for ecological risk from exposure to surface water that may be impacted by groundwater, a conservative, screening-level evaluation using groundwater data was performed. Surface water data has not been collected from the pond.

As an initial screening, maximum detected concentrations and average concentrations of each chemical detected in groundwater were compared to ecological screening values protective of aquatic organisms, such as fish and invertebrates. The preferred screening values were Georgia EPD In-stream Water Quality Standards (WQS). In the absence of a WQS for a given chemical, the next preferred source was a USEPA Region 4 Ecological Screening Value (ESV) for Surface Water (USEPA, 2001). If values were not available from these sources, USEPA Region 3 Freshwater Screening Benchmarks (USEPA, 2014c) were used. If a chemical lacked a value in a given source but a very similar chemical had a value, this value was used as a surrogate.

The screening is shown in Table 3-1. The methodology used in the screening is considered to be highly conservative because it assumes that concentrations in groundwater adjacent to the industrial building in the loading rack area of the Site could be transported over 900 feet and discharged to the pond with no attenuation due to processes that actually would be expected to occur, including degradation, dilution, volatilization, and retardation. Despite the conservatism of the screening process, exceedances were limited to the maximum detected concentration of TCE (July 2010) compared to the Georgia WQS and the maximum detected concentration of 1,1-DCE (April 2010) compared to the Region 4 ESV. This WQS and ESV were not exceeded by the average concentration of either of these VOCs. In addition, the 95 percent upper confidence level (95 UCL) of the mean for these compounds (see Table 3-1) in groundwater does not exceed corresponding surface water screening values. USEPA's ProUCL software program (Singh et al., 2010) was used to calculate the 95% UCLs. The ProUCL output for the three COIs is included in Appendix B. The most recent concentrations detected in 2013 do not exceed corresponding surface water screening values. Given the conservatism of the assumptions used in the screening and the lack of exceedances of surface water screening values by average or 95 UCL concentrations in groundwater, none of chemicals in groundwater is predicted to pose risk to ecological receptors in surface water.

4.0 Summary

Once a deed restriction is recorded prohibiting the use of groundwater as a drinking water source, the potential exposure pathways are vapor intrusion to indoor air and risk posed to ecological receptor if surface water is impacted by the VOCs in groundwater.

The conclusion of the risk evaluation is as follows:

- Groundwater use restrictions eliminate the ingestion exposure pathway.
- There is no risk associated with indoor inhalation of vapors from groundwater.
- Groundwater data does not exceed the surface water screening values protective of ecological receptors.

5.0 References

CTI 2006. Compliance Status Report for Former United Technologies Automotive Facility, Thomson, GA, May 17, 2006.

Georgia Department of Natural Resources Environmental Protection Division (EPD), 2003. Environmental Protection, Hazardous Site Response (HSR) Rule 391-3-19.07 (Risk Reduction Standards), Amended July 3, 2003. Accessed at http://rules.sos.state.ga.us/pages/GEORGIA_DEPARTMENT_OF_NATURAL_RESOURCES/ENVIRONMENTAL_PROTECTION/HAZARDOUS_SITE_RESPONSE/index.html.

Singh, Anita, Ph.D., Robert Maichle, Narain Armbya, Ashok K. Singh, Ph.D., and Sanghee E. Lee, 2010. ProUCL Version 4.00.05 User Guide (ProUCL version 5.00). May. Prepared for Brian Schumacher, John Nocerino, and Felicia Barnett, United States Environmental Protection Agency.

United States Environmental Protection Agency (USEPA), 2014a. OSWER Directive 9200.1-120, Attachment 1 – Recommended Default Exposure Factors. February. Office of Solid Waste and Emergency Response, Washington, D.C.

United States Environmental Protection Agency (USEPA), 2014b. Regional Screening Level (RSL) Summary Table, May 2014. Accessed at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm.

United States Environmental Protection Agency (USEPA), 2014c. Region 3 BTAG Freshwater Screening Benchmarks. May. Office of Solid Waste and Emergency Response, Washington, D.C.

United States Environmental Protection Agency (USEPA), 2009. *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual. Part F, Supplemental Guidance for Inhalation Risk Assessment – Final*. January. Office of Superfund Remediation and Technology Innovation, Washington, D.C.

United States Environmental Protection Agency (USEPA), 2004. *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings*. Revised February 22, 2004. Office of Emergency and Remedial Response. Washington, D.C.

United States Environmental Protection Agency (USEPA), 2002. OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). November. EPA530-D-02-004. Washington, D.C.

United States Environmental Protection Agency (USEPA), 2001. USEPA Region 4 Ecological Risk Assessment Bulletins - Supplement to RAGS, Freshwater Surface Water (Chronic) Screening Values. November.

United States Environmental Protection Agency (USEPA), 1991. *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual. Part B, Development of Risk-Based Preliminary Remediation Goals – Interim*. December. Office of Emergency & Remedial Response, Washington, D.C.

XDD 2008. Corrective Action Plan, Former United Technologies Automotive Facility, Thomson, GA. December 12, 2008.

XDD 2012. Semi-Annual Progress Report/MNA Effectiveness Report, Former United Technologies Automotive Facility, Thomson, GA. May 15, 2012.

Table 2-1
Vapor Intrusion Evaluation -- Summary of Results
Former United Technologies Automotive, Inc.
Thomson, Georgia

COPC	CAS No.	Historical Maximum Detected Concentration in Groundwater (ug/L)	Cancer Risk[1]	Noncancer HI[1]	Site-Specfic Risk-Based Screening Level[2] (ug/L)
Trichloroethene	79-01-6	856 (M-14D, 7/9/2010)	2.7E-06	7.73E-01	1110
Vinyl chloride	75-01-4	4 (M-10, 11/8/2005)	3.6E-08	1.92E-04	1110
1,1-Dichloroethene	75-35-4	1360 (M-9, 4/21/2010)	NA	2.60E-02	52300
cis-1,2-Dichloroethene	156592	40.6 (M-14D, 7/27/2011)	NA	NA	NA
			2.75E-06	0.8	

Notes:

[1] There are no exceedances of the Cancer Target Risk Level of 1E-05 or Noncancer Hazard Index of 1.0.

[2] There are no exceedances of the site-specific, risk-based, vapor intrusion screening level by historical maximum detected concentrations in groundwater.

COPC = chemical of potential concern

HI = hazard index

NA = not applicable

Table 3-1
Evaluation of Groundwater Ecological Risk Via Surface Water
Former United Technologies Automotive, Inc.
Thomson, Georgia

Chemicals Detected in Groundwater	Maximum Detected Conc.	95% UCL (5)	Average Conc. (1)	Georgia EPD Water Quality Standard	USEPA Region 4 Surface Water ESV	USEPA Region 3 Freshwater Screening Benchmark	Predicted to Pose Ecorisk in Surface Water?
1,1-Dichloroethane	13.3		1.1	--	--	47	No
1,1-Dichloroethene	327	185	16.4	7100	303	na	No
Benzene	1.3		0.67	51	53	na	No
Carbon disulfide	0.69		0.69*	--	--	0.92	No
cis-1,2-Dichloroethene	15.3		3.3	10,000(2)	1350(2)	na	No
trans-1,2-Dichloroethene	0.32		0.32*	10,000	1350	na	No
Isopropylbenzene	0.7		0.59	--	--	2.6	No
n-Propylbenzene	0.48		0.48*	--	--	128	No
sec-Butylbenzene	0.32		0.32*	--	--	128(3)	No
Toluene	0.74		0.57	5980	175	na	No
Trichloroethene	122	27	14.6	30	--	na	No
Vinyl chloride	2	0.95	0.72	2.4	--	na	No
Xylene, m&p	0.39		0.39*	--	--	13	No

Notes:
All concentrations are in units of ug/L.
-- = No value available
ESV = Ecological screening value
na = Not applicable because values are available from USEPA Region 4 or Georgia EPD.

(1) The average concentration was calculated as the arithmetic mean, using 1/2 the laboratory reporting limit as a surrogate for non-detects. If the arithmetic mean exceeded the maximum concentration, the mean of the detected results is shown (indicated by "*").
(2) Used value for trans-1,2-dichloroethene as a surrogate.
(3) Used value for propyl benzene as a surrogate.

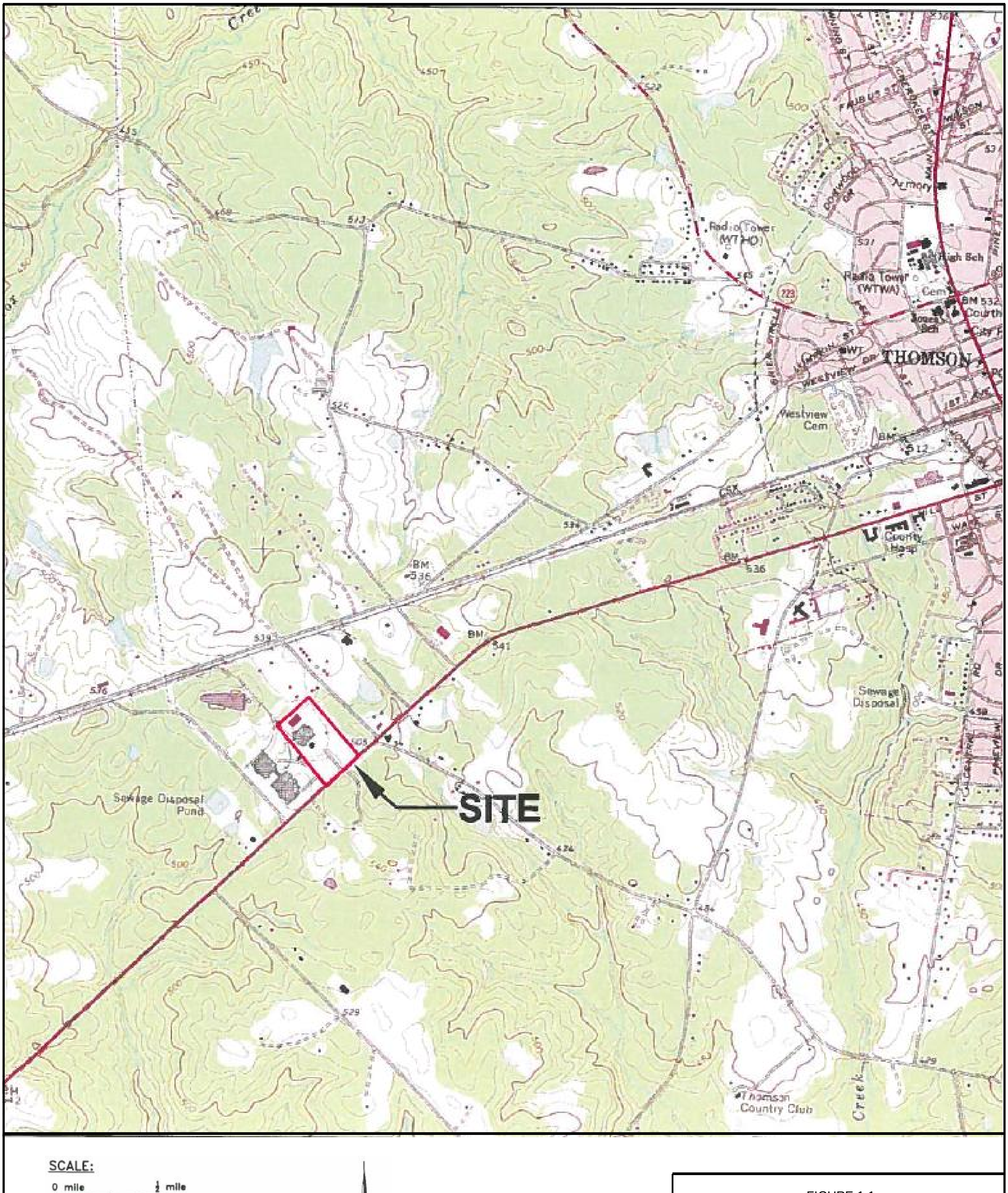

FIGURE 1-1
SITE LOCATION

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM

ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 02/10/2014	DRWN: JZ	60303044

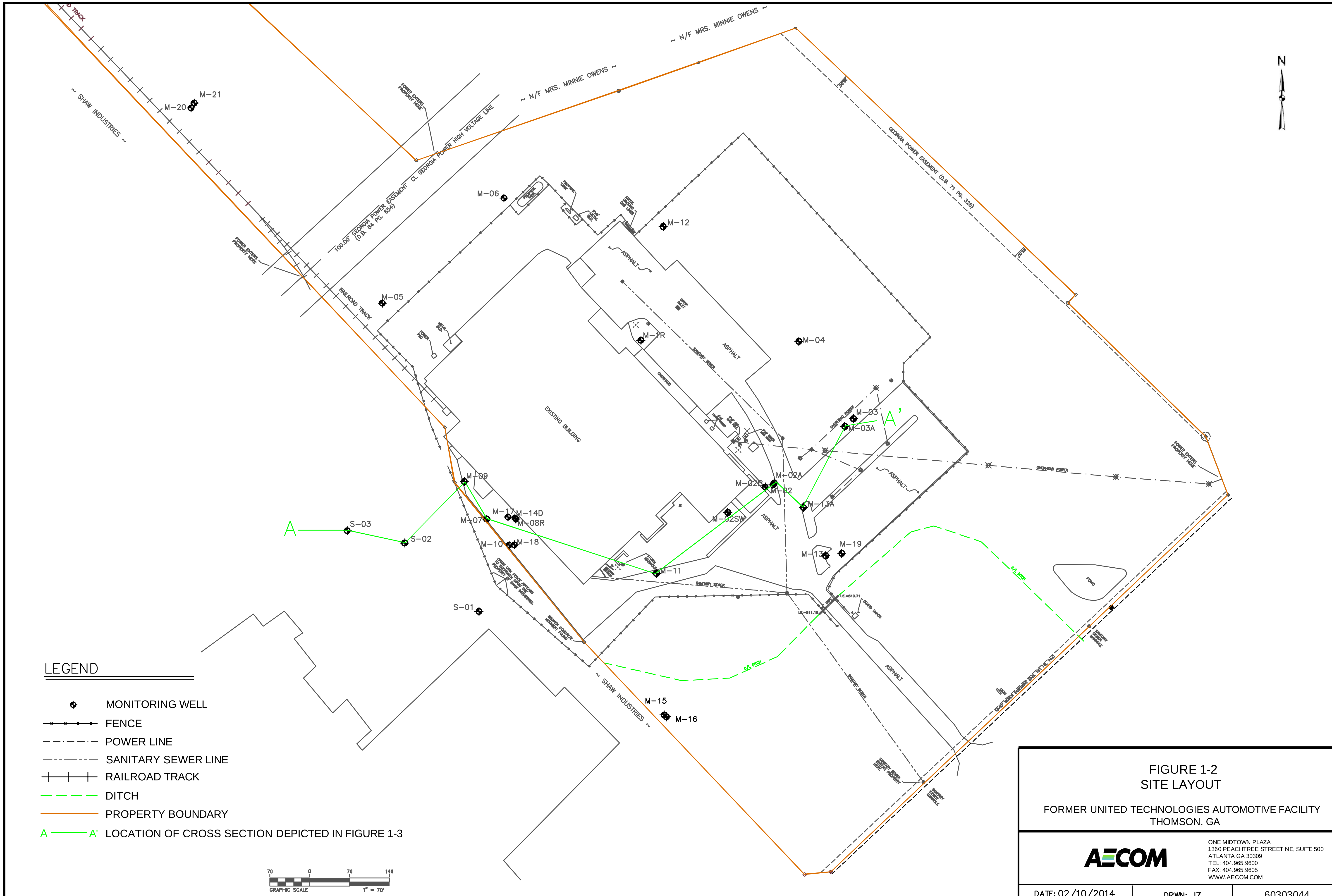

FIGURE 1-2
SITE LAYOUT

FORMER UNITED TECHNOLOGIES AUTOMOTIVE FACILITY
THOMSON, GA

AECOM

ONE MIDTOWN PLAZA
1360 PEACHTREE STREET NE, SUITE 500
ATLANTA GA 30309
TEL: 404.965.9600
FAX: 404.965.9605
WWW.AECOM.COM

DATE: 02/10/2014 | DRWN: JZ | 60303044

Appendix A

Johnson & Ettinger Model

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
75354	1.36E+03	1,1-Dichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (^oC)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
19.4	15	51.576	51.576	0	0	A	SC	SC		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197	C	1.43	0.459	0.215	C	1.43	0.459	0.215

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	366	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-05	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.63E-02	1.10E-05	2.61E-02	25	6,247	304.75	576.05	3.18E+01	2.42E+03	0.0E+00	2.0E-01

END

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	36.576	0.188	0.244	0.244	0.299	1.77E-09	0.837	1.48E-09	30.00	0.385	0.030	0.355	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, $D^{eff}{}_A$ (cm^2/s)	Stratum B effective diffusion coefficient, $D^{eff}{}_B$ (cm^2/s)	Stratum C effective diffusion coefficient, $D^{eff}{}_C$ (cm^2/s)	Capillary zone effective diffusion coefficient, $D^{eff}{}_{cz}$ (cm^2/s)	Total overall effective diffusion coefficient, $D^{eff}{}_T$ (cm^2/s)	Diffusion path length, L_d (cm)
5.08E+04	1.06E+06	3.77E-04	15	6,330	2.13E-02	8.86E-01	1.78E-04	2.23E-03	0.00E+00	0.00E+00	7.69E-06	9.36E-06	36.576

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.21E+06	0.10	1.47E+00	2.23E-03	4.00E+02	1.37E+07	4.50E-06	5.43E+00	NA	2.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	2.42E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	2.6E-02

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
79016	8.56E+02	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (^{o}C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
19.4	15	51.576	51.576	0	0	A	SC	SC		

Note for the thickness columns: Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
Lookup Soil Parameters				Lookup Soil Parameters				Lookup Soil Parameters			
SC	1.63	0.385	0.197	C	1.43	0.459	0.215	C	1.43	0.459	0.215

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	366	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-05	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
6.87E-02	1.02E-05	9.85E-03	25	7,505	360.36	544.20	6.07E+01	1.28E+03	4.1E-06	2.0E-03

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	36.576	0.188	0.244	0.244	0.299	1.77E-09	0.837	1.48E-09	30.00	0.385	0.030	0.355	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, $D^{eff}{}_A$ (cm^2/s)	Stratum B effective diffusion coefficient, $D^{eff}{}_B$ (cm^2/s)	Stratum C effective diffusion coefficient, $D^{eff}{}_C$ (cm^2/s)	Capillary zone effective diffusion coefficient, $D^{eff}{}_{cz}$ (cm^2/s)	Total overall effective diffusion coefficient, $D^{eff}{}_T$ (cm^2/s)	Diffusion path length, L_d (cm)
5.08E+04	1.06E+06	3.77E-04	15	8,440	7.50E-03	3.12E-01	1.78E-04	1.77E-03	0.00E+00	0.00E+00	1.10E-05	1.34E-05	36.576

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.67E+05	0.10	1.47E+00	1.77E-03	4.00E+02	9.28E+08	6.03E-06	1.61E+00	4.1E-06	2.0E-03

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.28E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
2.7E-06	7.7E-01

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
75014	4.00E+00	Vinyl chloride (chloroethene)

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (^oC)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
19.4	15	51.576	51.576	0	0	A	SC	SC		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197	C	1.43	0.459	0.215	C	1.43	0.459	0.215

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	366	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-05	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
1.07E-01	1.20E-05	2.78E-02	25	5,250	259.25	432.00	2.17E+01	8.80E+03	4.4E-06	1.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	36.576	0.188	0.244	0.244	0.299	1.77E-09	0.837	1.48E-09	30.00	0.385	0.030	0.355	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, $D^{eff}{}_A$ (cm^2/s)	Stratum B effective diffusion coefficient, $D^{eff}{}_B$ (cm^2/s)	Stratum C effective diffusion coefficient, $D^{eff}{}_C$ (cm^2/s)	Capillary zone effective diffusion coefficient, $D^{eff}{}_{cz}$ (cm^2/s)	Total overall effective diffusion coefficient, $D^{eff}{}_T$ (cm^2/s)	Diffusion path length, L_d (cm)
5.08E+04	1.06E+06	3.77E-04	15	4,894	2.37E-02	9.89E-01	1.78E-04	2.77E-03	0.00E+00	0.00E+00	8.84E-06	1.08E-05	36.576

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
15	3.95E+03	0.10	1.47E+00	2.77E-03	4.00E+02	5.63E+05	5.06E-06	2.00E-02	4.4E-06	1.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	8.80E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
3.6E-08	1.9E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
75354	1.36E+03	1,1-Dichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (^oC)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
19.4	15	51.576	51.576	0	0	A	SC	SC		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
Lookup Soil Parameters				Lookup Soil Parameters				Lookup Soil Parameters			
SC	1.63	0.385	0.197	C	1.43	0.459	0.215	C	1.43	0.459	0.215

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	366	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-05	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
8.63E-02	1.10E-05	2.61E-02	25	6,247	304.75	576.05	3.18E+01	2.42E+03	0.0E+00	2.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	36.576	0.188	0.244	0.244	0.299	1.77E-09	0.837	1.48E-09	30.00	0.385	0.030	0.355	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
5.08E+04	1.06E+06	3.77E-04	15	6,330	2.13E-02	8.86E-01	1.78E-04	2.23E-03	0.00E+00	0.00E+00	7.69E-06	9.36E-06	36.576

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	8.86E+02	0.10	1.47E+00	2.23E-03	4.00E+02	1.37E+07	4.50E-06	3.99E-03	NA	2.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	5.23E+04	5.23E+04	2.42E+06	5.23E+04

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
79016	8.56E+02	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (^oC)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
19.4	15	51.576	51.576	0	0	A	SC	SC		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197	C	1.43	0.459	0.215	C	1.43	0.459	0.215

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	366	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-05	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
6.87E-02	1.02E-05	9.85E-03	25	7,505	360.36	544.20	6.07E+01	1.28E+03	4.1E-06	2.0E-03

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	36.576	0.188	0.244	0.244	0.299	1.77E-09	0.837	1.48E-09	30.00	0.385	0.030	0.355	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
5.08E+04	1.06E+06	3.77E-04	15	8,440	7.50E-03	3.12E-01	1.78E-04	1.77E-03	0.00E+00	0.00E+00	1.10E-05	1.34E-05	36.576

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	3.12E+02	0.10	1.47E+00	1.77E-03	4.00E+02	9.28E+08	6.03E-06	1.88E-03	4.1E-06	2.0E-03

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
3.15E+03	1.11E+03	1.11E+03	1.28E+06	1.11E+03

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

GW-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75014	4.00E+00	Vinyl chloride (chloroethene)

MORE ↓

Totals must add up to value of L_{WT} (cell G28)

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
19.4	15	51.576	51.576	0	0	A	SC	SC		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SC	1.63	0.385	0.197	C	1.43	0.459	0.215	C	1.43	0.459	0.215

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	366	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-05	1

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.07E-01	1.20E-05	2.78E-02	25	5,250	259.25	432.00	2.17E+01	8.80E+03	4.4E-06	1.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
9.46E+08	36.576	0.188	0.244	0.244	0.299	1.77E-09	0.837	1.48E-09	30.00	0.385	0.030	0.355	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
5.08E+04	1.06E+06	3.77E-04	15	4,894	2.37E-02	9.89E-01	1.78E-04	2.77E-03	0.00E+00	0.00E+00	8.84E-06	1.08E-05	36.576

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
15	9.89E+02	0.10	1.47E+00	2.77E-03	4.00E+02	5.63E+05	5.06E-06	5.00E-03	4.4E-06	1.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
1.11E+03	2.08E+04	1.11E+03	8.80E+06	1.11E+03

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

Appendix B

ProUCL Results

UCL Statistics for Data Sets with Non-Detects

User Selected Options			
Date/Time of Computation	6/4/2014 9:40		
From File	Data for ProUCL.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

1,1-DCE

General Statistics			
Total Number of Observations	21	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	16
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	1.1	Minimum Non-Detect	1
Maximum Detect	327	Maximum Non-Detect	1
Variance Detects	21058	Percent Non-Detects	76.19%
Mean Detects	67.42	SD Detects	145.1
Median Detects	2.6	CV Detects	2.152
Skewness Detects	2.236	Kurtosis Detects	4.999
Mean of Logged Detects	1.817	SD of Logged Detects	2.271
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.559	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.469	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	16.81	Standard Error of Mean	16.92
SD	69.36	95% KM (BCA) UCL	48
95% KM (t) UCL	46	95% KM (Percentile Bootstrap) UCL	47.77
95% KM (z) UCL	44.65	95% KM Bootstrap t UCL	1903
90% KM Chebyshev UCL	67.58	95% KM Chebyshev UCL	90.58
97.5% KM Chebyshev UCL	122.5	99% KM Chebyshev UCL	185.2
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.001	Anderson-Darling GOF Test	
5% A-D Critical Value	0.743	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.456	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.381	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.29	k star (bias corrected MLE)	0.249
Theta hat (MLE)	232.7	Theta star (bias corrected MLE)	270.5
nu hat (MLE)	2.897	nu star (bias corrected)	2.492
MLE Mean (bias corrected)	67.42	MLE Sd (bias corrected)	135.1
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0588	nu hat (KM)	2.468
Approximate Chi Square Value (2.47, α)	0.234	Adjusted Chi Square Value (2.47, β)	0.198
95% Gamma Approximate KM-UCL (use when n>=50)	177.3	95% Gamma Adjusted KM-UCL (use when n<50)	209.1
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	16.06
Maximum	327	Median	0.01
SD	71.25	CV	4.437
k hat (MLE)	0.134	k star (bias corrected MLE)	0.146
Theta hat (MLE)	120.3	Theta star (bias corrected MLE)	109.9
nu hat (MLE)	5.608	nu star (bias corrected)	6.14
MLE Mean (bias corrected)	16.06	MLE Sd (bias corrected)	42
		Adjusted Level of Significance (β)	0.0383
Approximate Chi Square Value (6.14, α)	1.712	Adjusted Chi Square Value (6.14, β)	1.539
95% Gamma Approximate UCL (use when n>=50)	57.6	95% Gamma Adjusted UCL (use when n<50)	64.06

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.747	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.371	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	16.06	Mean in Log Scale	-5.291
SD in Original Scale	71.25	SD in Log Scale	5.344
95% t UCL (assumes normality of ROS data)	42.88	95% Percentile Bootstrap UCL	47.15
95% BCA Bootstrap UCL	62.8	95% Bootstrap t UCL	1520
95% H-UCL (Log ROS)	1.61E+09		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.433	95% H-UCL (KM -Log)	7.752
KM SD (logged)	1.257	95% Critical H Value (KM-Log)	2.934
KM Standard Error of Mean (logged)	0.307		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	16.43	Mean in Log Scale	-0.0955
SD in Original Scale	71.17	SD in Log Scale	1.494
95% t UCL (Assumes normality)	43.22	95% H-Stat UCL	8.354

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

99% KM (Chebyshev) UCL	185.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	6/4/2014 9:42
From File	Data for ProUCL.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

TCE

General Statistics			
Total Number of Observations	21	Number of Distinct Observations	8
Number of Detects	7	Number of Non-Detects	14
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	3.9	Minimum Non-Detect	1
Maximum Detect	122	Maximum Non-Detect	1
Variance Detects	1718	Percent Non-Detects	66.67%
Mean Detects	42.91	SD Detects	41.45
Median Detects	28.6	CV Detects	0.966
Skewness Detects	1.352	Kurtosis Detects	1.518
Mean of Logged Detects	3.264	SD of Logged Detects	1.193
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.862	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.272	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	14.97	Standard Error of Mean	6.997
SD	29.69	95% KM (BCA) UCL	27.09
95% KM (t) UCL	27.04	95% KM (Percentile Bootstrap) UCL	26.61
95% KM (z) UCL	26.48	95% KM Bootstrap t UCL	36.34
90% KM Chebyshev UCL	35.96	95% KM Chebyshev UCL	45.47
97.5% KM Chebyshev UCL	58.67	99% KM Chebyshev UCL	84.59
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.231	Anderson-Darling GOF Test	
5% A-D Critical Value	0.726	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.179	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.319	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	1.148	k star (bias corrected MLE)	0.751
Theta hat (MLE)	37.37	Theta star (bias corrected MLE)	57.11
nu hat (MLE)	16.08	nu star (bias corrected)	10.52
MLE Mean (bias corrected)	42.91	MLE Sd (bias corrected)	49.5
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.254	nu hat (KM)	10.68
Approximate Chi Square Value (10.68, α)	4.373	Adjusted Chi Square Value (10.68, β)	4.066
95% Gamma Approximate KM-UCL (use when n>=50)	36.57	95% Gamma Adjusted KM-UCL (use when n<50)	39.33

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	14.31
Maximum	122	Median	0.01
SD	30.74	CV	2.148
k hat (MLE)	0.163	k star (bias corrected MLE)	0.172
Theta hat (MLE)	87.56	Theta star (bias corrected MLE)	83.28
nu hat (MLE)	6.865	nu star (bias corrected)	7.218
MLE Mean (bias corrected)	14.31	MLE Sd (bias corrected)	34.52
		Adjusted Level of Significance (β)	0.0383
Approximate Chi Square Value (7.22, α)	2.291	Adjusted Chi Square Value (7.22, β)	2.083
95% Gamma Approximate UCL (use when n>=50)	45.09	95% Gamma Adjusted UCL (use when n<50)	49.58

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.949	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.243	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	14.96	Mean in Log Scale	0.494
SD in Original Scale	30.44	SD in Log Scale	2.48
95% t UCL (assumes normality of ROS data)	26.41	95% Percentile Bootstrap UCL	26.42
95% BCA Bootstrap UCL	30.21	95% Bootstrap t UCL	40.15
95% H-UCL (Log ROS)	561		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.088	95% H-UCL (KM -Log)	45.08
KM SD (logged)	1.666	95% Critical H Value (KM-Log)	3.579
KM Standard Error of Mean (logged)	0.393		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	14.64	Mean in Log Scale	0.626
SD in Original Scale	30.58	SD in Log Scale	2.02
95% t UCL (Assumes normality)	26.15	95% H-Stat UCL	94.91

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	27.04	95% KM (Percentile Bootstrap) UCL	26.61

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	6/4/2014 9:43
From File	Data for ProUCL.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

VC

General Statistics

Total Number of Observations	21	Number of Distinct Observations	5
Number of Detects	3	Number of Non-Detects	18
Number of Distinct Detects	3	Number of Distinct Non-Detects	2
Minimum Detect	0.7	Minimum Non-Detect	1
Maximum Detect	2	Maximum Non-Detect	5
Variance Detects	0.423	Percent Non-Detects	85.71%
Mean Detects	1.367	SD Detects	0.651
Median Detects	1.4	CV Detects	0.476
Skewness Detects	-0.23	Kurtosis Detects	N/A
Mean of Logged Detects	0.224	SD of Logged Detects	0.534

Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.998	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.187	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.8	Standard Error of Mean	0.0862
SD	0.315	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.949	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.942	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.059	95% KM Chebyshev UCL	1.176
97.5% KM Chebyshev UCL	1.338	99% KM Chebyshev UCL	1.657

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	5.84	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.234	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	35.04	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	6.465	nu hat (KM)	271.5
		Adjusted Level of Significance (β)	0.0383
Approximate Chi Square Value (271.52, α)	234.4	Adjusted Chi Square Value (271.52, β)	231.7
95% Gamma Approximate KM-UCL (use when n>=50)	0.927	95% Gamma Adjusted KM-UCL (use when n<50)	0.937

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.967	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.25	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.811	Mean in Log Scale	-0.305
SD in Original Scale	0.389	SD in Log Scale	0.441
95% t UCL (assumes normality of ROS data)	0.958	95% Percentile Bootstrap UCL	0.955
95% BCA Bootstrap UCL	0.986	95% Bootstrap t UCL	1.022
95% H-UCL (Log ROS)	0.984		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.27	95% H-UCL (KM -Log)	0.882
KM SD (logged)	0.267	95% Critical H Value (KM-Log)	1.811
KM Standard Error of Mean (logged)	0.0732		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.719	Mean in Log Scale	-0.485
SD in Original Scale	0.552	SD in Log Scale	0.489
95% t UCL (Assumes normality)	0.927	95% H-Stat UCL	0.861

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.949	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.