



RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION WORK PLAN

**WILLOW RUN
COMPANY VEHICLE OPERATIONS (CVO) AREA
YPSILANTI, MICHIGAN**

**Prepared for
Revitalizing Auto Communities Environmental Response (RACER)
Trust**

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FEBRUARY 2012

REF. NO. 017303 (21)

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Based on my knowledge of the conditions of the property described in the remedial action plan (RAP) and my inquiry of the person or persons who manage the system referenced in the operator's certification, 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.



Grant Trigger
Michigan Cleanup Manager
Revitalizing Auto Communities
Environmental Response Trust

2-22-12

Date:

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LIST OF ACRONYMS

BBL	Blasland, Bouck & Lee
bgs	Below Ground Surface
CAT	Complete Auto Transit
CRA	Conestoga-Rovers & Associates
CVO	Company Vehicle Operations
DCE	Dichloroethylene
DEC	Description of Existing Conditions
DO	Dissolved Oxygen
DNAPL	Dense Non-Aqueous Phase Liquid
FMG	Field Method Guidelines
EM	Electromagnetic
GC	Gas Chromatograph
GM	General Motors Corporation
GM LLC	General Motors LLC
GSI	Groundwater Surface Water Interface
HSA	Hollow Stem Auger
IRA	Interim Response Action
Kaiser-Frazer	Kaizer-Frazer Company
LFP	Low Flow Purging
LNAPL	Light Non-Aqueous Phase Liquid
MAGS	Modified Active Soil Gas
MDEQ	Michigan Department of Environmental Quality
mL/min	Milliliters per Minute
MLC	Motors Liquidation Company
MS/MSD	Matrix Spike/Matrix Spike Duplicate
mS/cm	MilliSiemen per Centimeter
mV	Millivolts
NAPL	Non-Aqueous Phase Liquid
ORP	Oxidation-Reduction Potential

LIST OF ACRONYMS
(Continued)

PAOC	Potential Area of Concern
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RACER	Revitalizing Auto Communities Environmental Response Trust
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SGC	Soil Gas Criteria
Site	Company Vehicle Operations Property
SVOCs	Semi-Volatile Organic Compounds
TAL	Target Analyte List
TCE	Trichloroethylene
TCL	Target Compound List
VC	Vinyl Chloride
USCS	Unified Soil Classification Codes
VOCs	Volatile Organic Compounds
Work Plan	RFI Work Plan
WRBC	Willow Run Business Center

1.0 INTRODUCTION

Conestoga-Rovers & Associates, Inc. (CRA) has prepared this Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan (Work Plan) for the Willow Run Company Vehicle Operations (CVO) property (Site) at the former Willow Run Assembly Plant located in Ypsilanti, Michigan. Figure 1.1 presents the Site location. A draft Site Summary Report (CRA, July 2011) was prepared for CVO to summarize historical operations, previous investigations, and remedial activities completed to date and evaluate existing data with respect to applicable criteria. This Work Plan is prepared to further investigate and address data gaps based on the investigations completed at the Site to date.

The former Willow Run Assembly Plant property currently encompasses the Willow Run Business Center (WRBC) and the Site. The WRBC was sold by General Motors Corporation (GM) to In Site Real Estate in 1997, while GM retained ownership of CVO. GM operated the Site until the end of 2010. As a result of GM's bankruptcy, certain operating assets of GM were sold on July 10, 2009 to a newly formed company which is now known as General Motors LLC (GM LLC). Existing, non-conforming assets remained the property of GM, which was renamed Motors Liquidation Company (MLC). On October 20, 2010, MLC entered into a settlement agreement with federal and state governmental authorities regarding MLC's environmental obligations at its owned real property, including this Site (Settlement Agreement). On March 3, 2011, this Settlement Agreement was approved by the United States Bankruptcy Court for the Southern District of New York as part of MLC's Chapter 11 Plan of Liquidation. According to the terms of the Settlement Agreement, MLC transferred its interests in this Site to the Revitalizing Auto Communities Environmental Response Trust (RACER) on March 31, 2011, the Effective Date of MLC's Chapter 11 Plan of Liquidation. As such, the Site is now operated by RACER and this Work Plan has been prepared on RACER's behalf.

Specifically, this Work Plan presents the additional investigative activities that will be conducted to:

- Investigate soil and groundwater impacts at the upgradient western property boundary, northern property boundary, and east of Potential Area of Concern (PAOC) 18
- Delineate paint sludge and petroleum type impacts observed in 2005 in the northwest portion of the Haulaway Building
- Investigate deep aquifer quality

- Determine portion of total chromium related to hexavalent chromium (if any) in soil
- Calculate the Site-specific background metals concentrations in groundwater
- Evaluate unsaturated soil impacts using Modified Active Gas Sampling (MAGS) beneath the Haulaway Building

2.0 BACKGROUND

The Site is bordered on the north and east by Tyler Pond, by WRBC to the west, and Tyler Road and the Fons Landfill abuts the southern Site boundary.

Prior to 1940, the current Willow Run site was agricultural land purchased by the Ford Motor Company. In 1941 the United States Defense Plant Corporation of America purchased the Willow Run facility from Ford and directed Ford to construct and operate a bomber production plant. Along with the plant, Ford constructed various support buildings, an airstrip and a wastewater treatment plant. Military aircraft were manufactured at the plant from 1942 to 1945.

The Kaiser-Frazer Company (Kaiser-Frazer) leased the bomber plant and CVO area from the War Asset Administration in November 1945 and purchased the facility in December 1948. Kaiser-Frazer refurbished the plant to produce automobiles. A dam was built sometime between 1941 and 1942 at Tyler Road, creating Tyler Pond. This pond served as the discharge point for wastewater treatment operations associated with the airport and the bomber production facility. Kaiser-Frazer is thought to have constructed an administration building to house design and engineering facilities. Kaiser-Frazer owned the property until its sale to GM in December 1954.

Prior to 2001, several environmental consultants conducted limited investigations at the Site. Blasland, Bouck & Lee (BBL) prepared a Description of Existing Conditions (DEC) in 1997 that summarized their investigations completed at the former Willow Run Assembly Plant, including the CVO area. CRA became involved in the Site and began groundwater treatment activities in 2001 and 2002 to address impacted groundwater conditions. Table 2.1 summarizes the Site ownership, operations and significant development as identified by aerial photos.

Within the Site, there are several locations designated as PAOCs. Some of these areas were identified by BBL in the DEC. Several additional PAOCs have been identified since the DEC was prepared. The PAOC locations and descriptions are presented on Figure 2.1 and listed below.

- PAOC 18 – Former Outfall 12 non-aqueous phase liquid (NAPL) Area – soil, NAPL and debris within and around the sheet pile area near former Outfall 12. This PAOC no longer includes the area west of the sheet pile area (see PAOC 29).
- PAOC 19 – CVO Property Groundwater – impacted groundwater throughout the Site.

- PAOC 20 – Former Complete Auto Transit (CAT) Site Plume.
- Former PAOC 21 – rescinded (incorporated into PAOC 29).
- Former PAOC 22 – rescinded (incorporated into PAOC 29).
- PAOC 23 – 1949 Fill Area – soil, NAPL, debris, and volatilization to indoor air evaluation near the Haulaway Building.
- PAOC 24 – 1952 Pits.
- PAOC 29 – Kaiser-Frazer Dump Area – soil and debris west of the sheet pile wall area (PAOC 18) extending to the WRBC property boundary. This encompasses previous PAOCs 21 and 22.

PAOCs 1 through 17 and 25 through 28 are located on the WRBC property. Table 2.2 presents a description of each PAOC, summarizes investigation and response activities completed at each PAOC.

A summary of the environmental investigations and interim response actions (IRA) completed to date at the Site are presented in the draft Site Summary Report (CRA, July 2011).

Subsurface groundwater flow conditions at the Site are influenced by utility corridors, various fill areas, and Tyler Pond which is a discharge boundary for part of the groundwater unit. Subsurface utilities include storm sewers, sanitary sewers and a former sludge line. A hydraulic divide exists across the central portion of the property, generally running parallel to Tyler Pond. Groundwater to the south/southwest of the divide flows to the south/southeast, while groundwater to the north/northeast of the divide flows towards Tyler Pond. Groundwater contour map for the September 2011 event is presented on Figure 2.2. The September 2011 groundwater contour map is consistent with historical groundwater contour maps.

3.0 INVESTIGATION PROGRAM

Detailed stratigraphy logs will be completed for each borehole and monitoring well installed. Permanent shallow monitoring wells will be installed using 4-1/4 inch inside diameter hollow stem augers (HSA). Soil borings will be completed using a GeoProbe direct push rig. Locations on the bank of Tyler Pond may be completed using a hand auger/hand probe equipment, as needed. Deep borings will be completed using a rotasonic rig. Continuous soil samples will be collected from each location to record soil stratigraphy and to screen for organic vapors using a photoionization detector (PID).

Soil borings will be completed at least six inches into the confining clay layer which is encountered at approximately 16 feet below ground surface (bgs) at the Site (not including on the bank of Tyler Pond). Monitoring wells will be installed such that the bottom of the screen is sunken into the clay and the top of the screen is above the water table. Ten foot screens have traditionally been used at this Site to monitor both the confining clay surface for dense non-aqueous phase liquid (DNAPL) and the water table surface for light non-aqueous phase liquid (LNAPL) that are related to historical filling activities.

Generally soil samples will be collected at the 0-2 foot bgs interval and the 2-foot interval above the water table. One additional soil sample may be collected per borehole at intervals where significant odor, staining, or elevated PID readings are observed.

Generally soil samples and groundwater samples will be analyzed for target compound list (TCL) volatile organic compounds (VOCs), TCL semi-volatile organic compounds (SVOCs), Site target analyte list (TAL) metals, and polychlorinated biphenyls (PCBs). Additional lead and chromium analysis will also be completed at select locations. Soil samples will be analyzed for fine grain and coarse grain lead if total lead concentrations are greater than 75 mg/kg. If total chromium concentrations in soil are greater than 3.3 mg/kg (Michigan Department of Environmental Quality [MDEQ] Part 201 groundwater surface water [GSI] protection criteria), the sample will be analyzed for hexavalent and trivalent chromium.

The investigative program described in this Work Plan consists of four phases:

- Data gap analysis
- Sitewide groundwater monitoring
- Site-specific background metal concentrations in groundwater
- MAGS Survey

The following subsections present an overview of the four phases. Field related activities (borings, well development, groundwater sampling, etc.) will be conducted following the Site-specific Field Method Guidelines (FMG). Applicable Site-specific FMGs are provided in Appendix A. All proposed soil borings and monitoring well locations are presented on Figure 3.1. Tables 3.1 and 3.2 summarize the sampling program for this Work Plan.

3.1 DATA GAP ANALYSIS

Several data gaps were identified during the review of existing Site data. The data gap analysis/investigation is designed to characterize the following:

Western Property Boundary Investigation: Four monitoring wells (MW19-32 through MW19-35) will be installed along the western (upgradient) property boundary as shown on Figure 3.1. The monitoring wells will be installed to determine soil and groundwater concentrations at the upgradient western property boundary. The groundwater data from these wells will also be used in calculating Site-specific background metal concentrations in groundwater as described in Section 3.3.

Northwestern Buried Debris Investigation: An electromagnetic (EM) survey was completed in the Fall of 2011 to identify anomalies in the northwestern portion of the Site. Four monitoring wells (MW19-36 through MW19-39) will be installed at the locations within this fill area as shown on Figure 3.1. The monitoring wells will be installed to evaluate soil and groundwater conditions within this area.

Northwest of the Haulaway Building: Two soil borings (SB19-49 and SB19-50) will be completed northwest of the Haulaway Building. Soil boring SB19-39 will be completed to delineate paint sludge observed during the 2005 investigation in a gas probe boring (GP19-03D). Soil boring SB19-40 will be completed to delineate the petroleum type (benzene, ethylbenzene, and xylene) impacts observed at SB24-01 in 2005.

GSI Monitoring: Based on the results of the previous investigations, an additional GSI monitoring well, GS-9, is required west of the catwalks to delineate VOCs, SVOCs, and lead impacts near the northern property boundary in soil and groundwater.

East of sheet pile wall area (PAOC 18): Two monitoring wells, MW19-40 and MW19-41, will be installed to delineate groundwater and soil impacts to the east of GS-8. These

wells will be located east of the sheet pile wall area to confirm that soils and groundwater in this area are below the GSI and non-residential drinking water criteria.

Chromium Speciation Analysis: Elevated levels of chromium have been detected in soil at the Site. The total chromium concentrations in soil exceeded the MDEQ GSI protection criteria. Due to the total chromium exceedances, speciation analysis will be conducted to determine trivalent and hexavalent chromium concentrations.

A total of 8 soil borings (SB19-51 through SB19-54 and SB18-276 through SB18-279) will be completed for chromium speciation analysis. The proposed locations and sampling depth intervals were selected based on the highest concentrations of chromium detected at soil borings completed previously.

Chromium exceedances were not observed in groundwater, therefore, groundwater samples for speciated chromium analysis will not be required. Hence, no monitoring wells will be installed for this purpose.

3.2 SITEWIDE GROUNDWATER MONITORING

Deep Aquifer Quality: Based on regional and local geology (including well logs from adjacent properties) the upper sand unit, the lacustrine clay, the lower sand unit, and the Antrim Shale are present across the entire Site. The confining layer is a lacustrine clay unit (50 to 85 feet thick) that separates the upper and lower sand units. Boring logs from several private wells near the Site indicate that a deep aquifer is present 70 to 100 feet bgs.

Using a rotosonic drill rig, two deep monitoring wells, DMW1 and DMW2, will be installed to an approximate depth of 100 feet bgs to determine the groundwater quality in the lower sand unit. A maximum of 10-foot long screens will be used in this deep aquifer to monitor the groundwater quality in the lower sand unit.

Groundwater Monitoring Event: Groundwater samples will be collected from all new locations and a few existing locations to evaluate groundwater conditions. Groundwater samples will be collected from the new locations for TCL VOCs, TCL SVOCs, total PCBs, and Site TAL metals analysis. Figure 3.2 presents groundwater sampling locations. Table 3.2 summarizes the groundwater sampling plan.

3.3 SITE-SPECIFIC BACKGROUND METAL CONCENTRATIONS

During the previous investigations, metal concentrations from soil and groundwater samples have exceeded the MDEQ Part 201 criteria. Based on Site history, the metal exceedances may be naturally occurring or due to local/regional conditions. Additional data will be collected to evaluate potential regional background levels of metals in groundwater.

Groundwater samples will be collected from both up gradient and down gradient locations to examine the impacts coming onto the Site and leaving the Site. Groundwater samples will be collected from six on-Site locations. Groundwater samples will be collected twice with at least three months between events prior to calculating background values. Groundwater samples will be analyzed for TAL metals including hexavalent and trivalent chromium to establish background concentrations of each as part of this investigation. Table 3.2 summarizes the groundwater sampling plan.

Background data evaluations from the existing landfills and industrial plants that are located in close proximity to the Site will be requested to compare and contrast Site-specific background concentrations once determined to evaluate the validity of the results.

A background concentration evaluation will be completed to develop Site-specific concentrations for metals in groundwater using statistical calculation procedures presented in the MDEQ guidance document entitled "Sampling Strategies and Statistics Training Materials" for Part 201 Cleanup Criteria.

A basic statistical analysis will be performed for each metal analyzed in groundwater. Summary statistics such as the mean, median, standard deviation, and the range of concentrations for metals will be calculated.

3.4 MAGS SURVEY

In 2005, eight permanent soil vapor probes were installed beneath the north portion of the Haulaway Building due to the concentrations of VOCs detected in groundwater and temporary soil gas probes. The permanent probes were sampled for TCL VOCs. Following review of the data collected from these probes and calculation of Site-specific soil gas criteria (SGC) (protective of the soil gas to indoor air inhalation exposure pathway) indoor air samples were collected. The highest concentration detected in

indoor air and soil gas samples were found in the northwest corner of the building, where paint sludge was observed in the boring.

A MAGS event will be completed in the northern portion of the building to detect unsaturated soil source areas impacted by VOCs. MAGS is an assessment tool which has the ability to collect a large volume of soil gas. Approximately 34 MAGS points SG19-01 through SG19-34, as shown on Figure 3.3, will be installed in a 20 – 25 foot grid pattern in the north end of the Haulaway Building. MAGS will be installed using a 4-1/4-inch inside diameter HSA to an approximate depth of 7 feet bgs. A 2.5 foot long well screen will be used. A regenerative blower will be used to extract soil vapors from each MAGS point for 30-45 minutes. The exhaust gas will be monitored every five minutes using a gas chromatograph (GC). Ten soil gas samples will be selected randomly and will be submitted to a laboratory for cis-1,2-dichloroethylene (DCE), trichloroethylene (TCE), and vinyl chloride (VC) analysis to verify field data accuracy. Additional MAGS points may be installed in areas of high concentration soil gas to determine the source area. Radius of influence measurements will be collected from the surrounding MAGS points during extraction. This investigation will be used to identify any unknown VOC sources beneath the building and gather radius of influence information useful for indoor air mitigation design.

4.0 SAMPLING METHODOLOGY

Field related activities including soil boring completion, monitoring well installation, sample collection, etc. will be conducted in accordance with Site-specific FMGs. Applicable Site-specific FMGs are provided in Appendix A. Samples will be shipped to the laboratory under chain of custody procedures.

4.1 SAMPLE NOMENCLATURE

Each sample will be labeled with a unique sample number consistent with the Site-specific sample designation system.

Series-Project Number -Date-Initials-xxx

The series is a letter or letters that designates a group of samples (GW, groundwater; S, soil; N, non-aqueous phase liquid; RB, rinse equipment blank; WSS, water storm sewer). Initials refer to the sampler's initials. The xxx sample identification number will carry forward from previously collected samples at the Site.

4.2 QUALITY ASSURANCE/QUALITY CONTROL

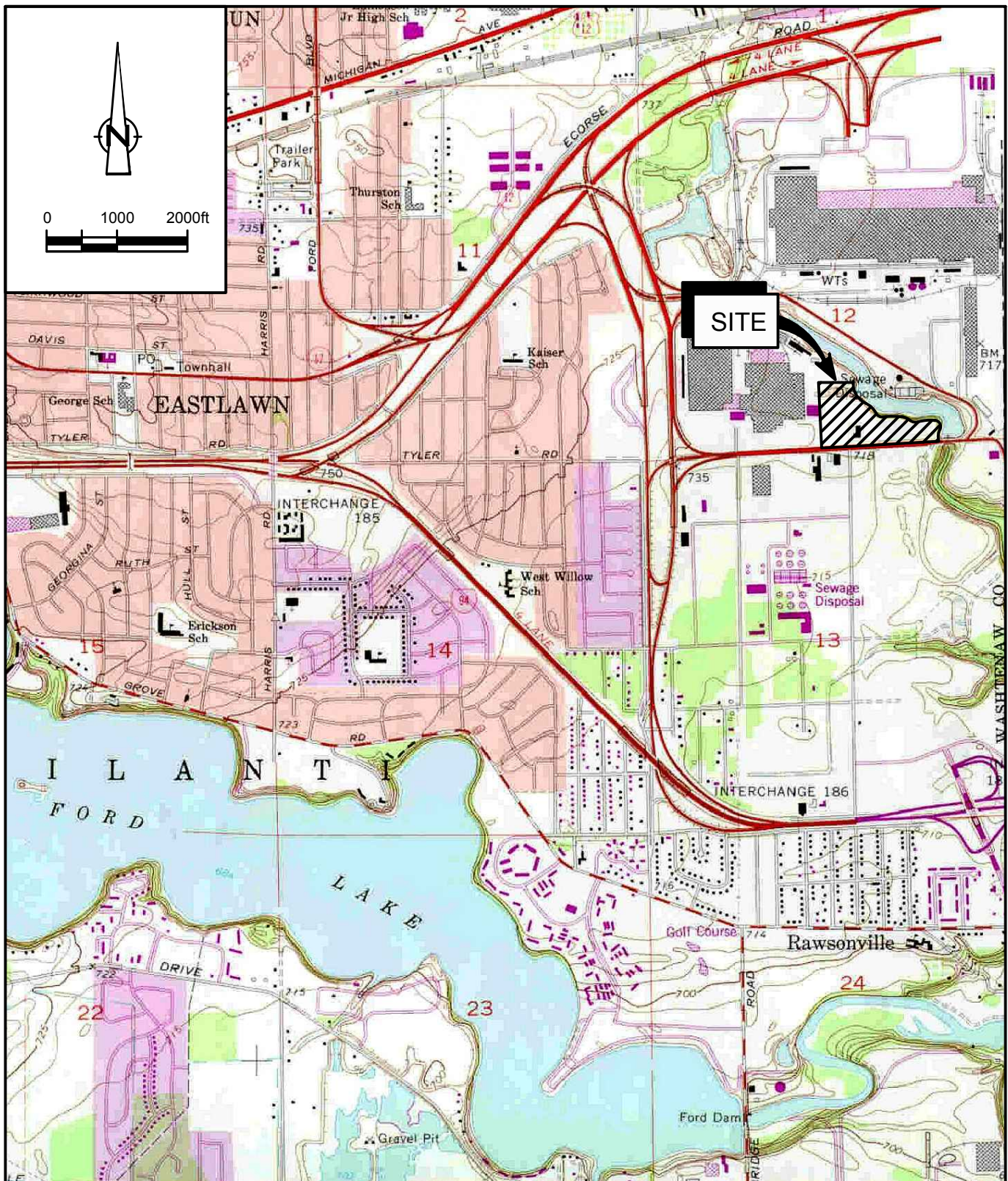
Quality Assurance/Quality Control (QA/QC) field samples (duplicates and matrix spike/matrix spike duplicates [MS/MSD]) will be collected in accordance with in the Site Quality Assurance Project Plan (QAPP). The Site QAPP is provided in Appendix B. Validation of analytical data will be performed by the CRA chemistry department as stated in the QAPP.

5.0 REFERENCES

BBL. June 1997. Description of Existing Conditions Report, Former Willow Run Assembly Plant Property, Ypsilanti, Michigan.

CRA. July 2011. Draft Site Summary Report, Former General Motors Company Vehicle Operations Area, Ypsilanti, Michigan.

FIGURES



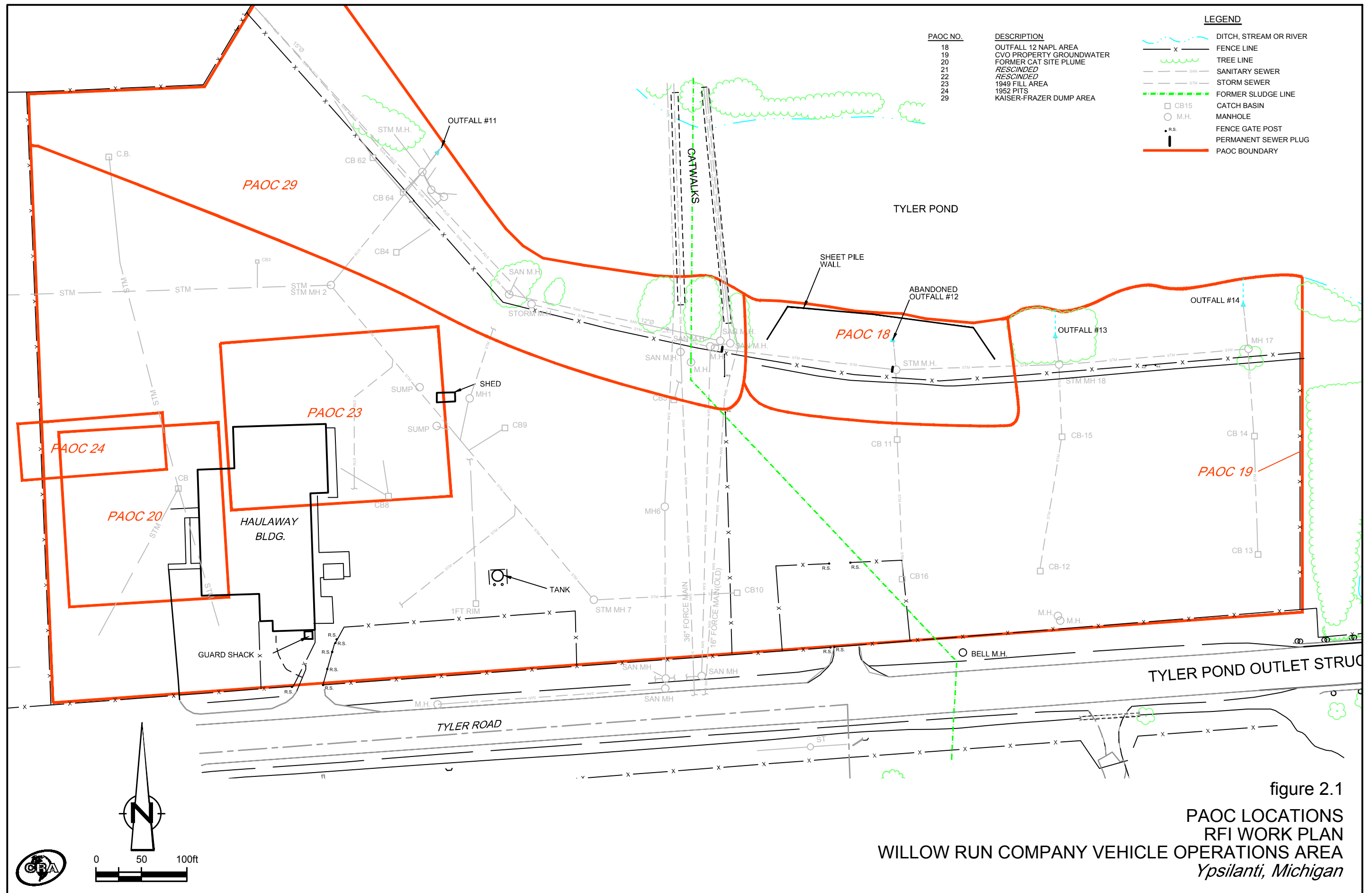
SOURCE: USGS QUADRANGLE MAP;
YPSILANTI EAST, MICHIGAN

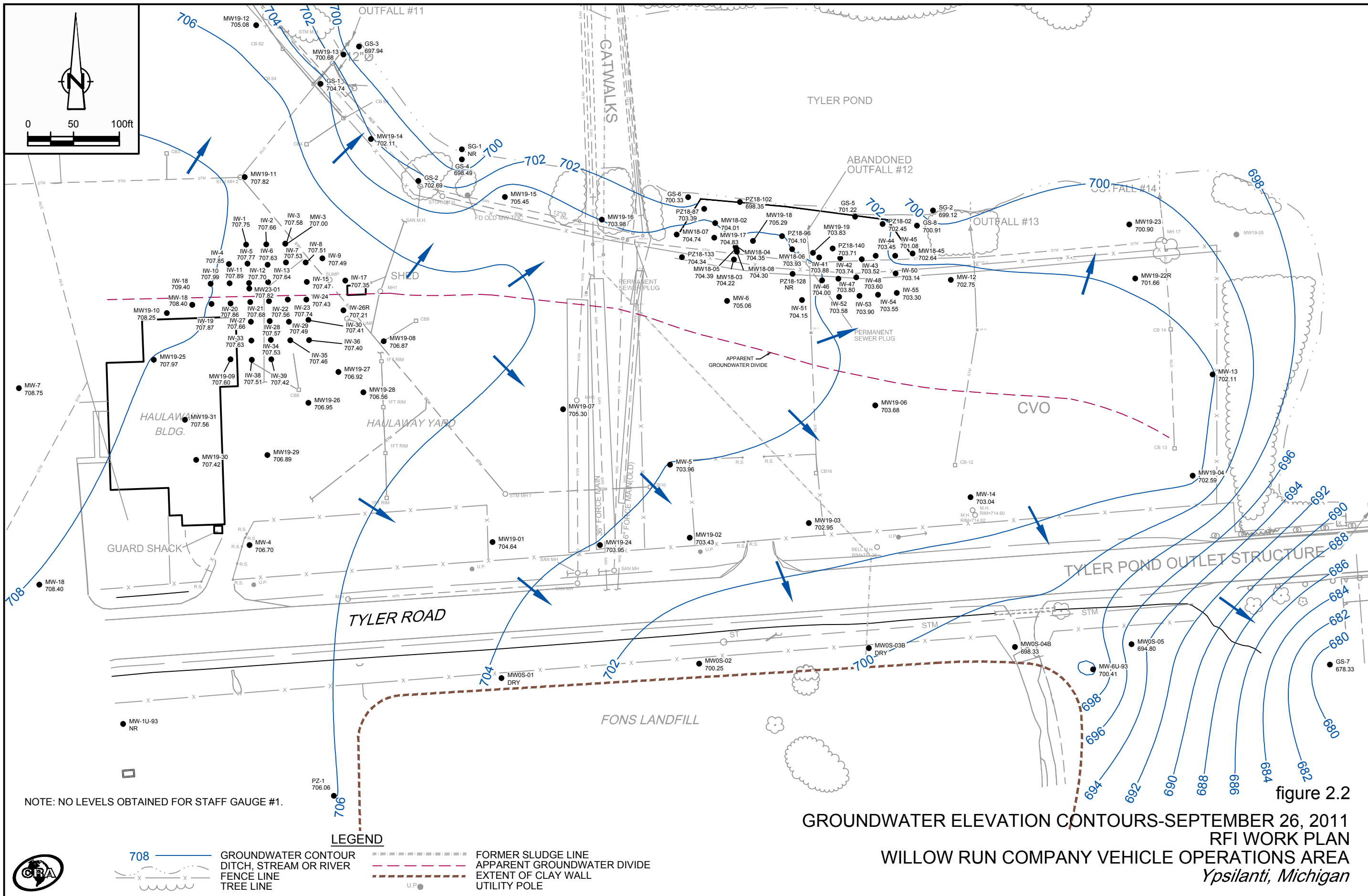
figure 1.1

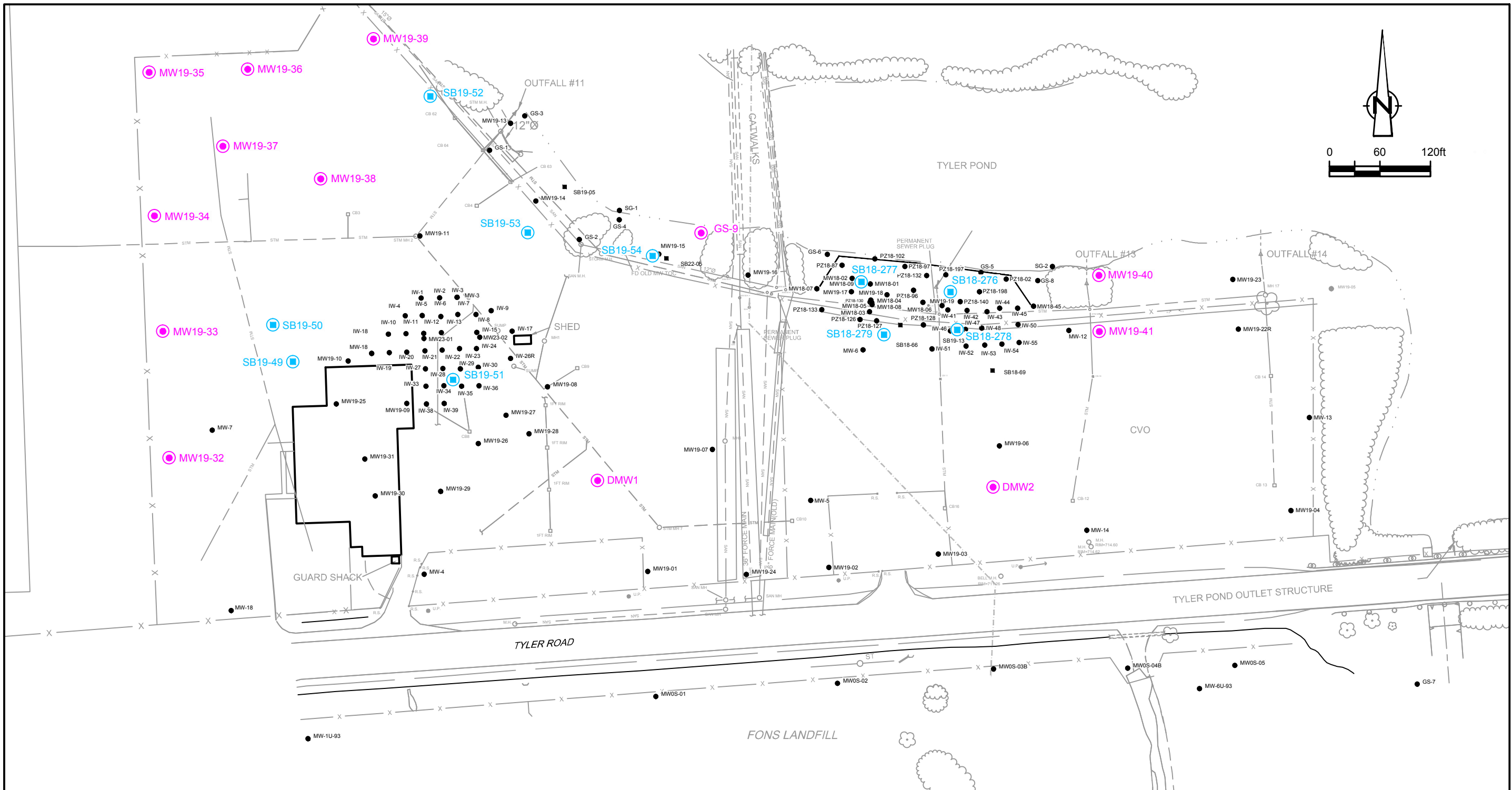


YPSILANTI

SITE LOCATION
RFI WORK PLAN
WILLOW RUN COMPANY VEHICLE OPERATIONS AREA
Ypsilanti, Michigan





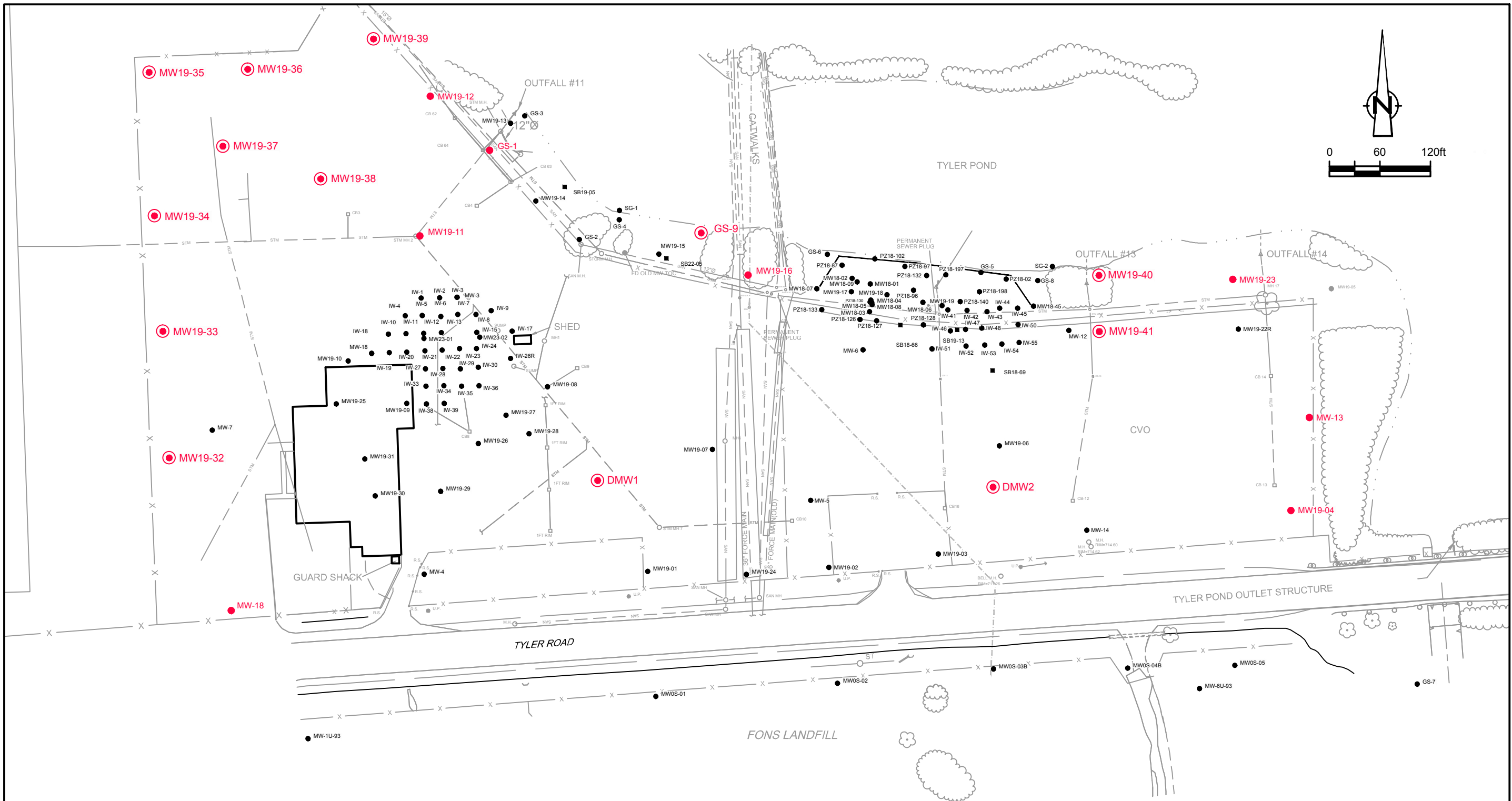


LEGEND

- PROPOSED MONITORING WELL
- PROPOSED SOIL BORING
- EXISTING MONITORING WELL
- EDGE OF WATER
- x - x - FENCE LINE
- ~ ~ ~ TREE LINE
- - - FORMER SLUDGE LINE
- U.P. UTILITY POLE

figure 3.1
PROPOSED BOREHOLE AND MONITORING WELL LOCATIONS
RFI WORK PLAN
WILLOW RUN COMPANY VEHICLE OPERATIONS AREA
Ypsilanti, Michigan





LEGEND

- MW19-32 PROPOSED GROUNDWATER SAMPLING LOCATION (RED)
- MW19-11 EXISTING GROUNDWATER SAMPLING LOCATION (RED)
- - - - - DITCH, STREAM OR RIVER
- - - - - FENCE LINE
- - - - - TREE LINE
- - - - - FORMER SLUDGE LINE
- U.P. ● UTILITY POLE

NOTE

MONITORING WELLS MW19-32, MW19-33, MW19-34, MW19-35, MW19-04 AND MW-13 WILL BE SAMPLED FOR DETERMINING BACKGROUND METAL CONCENTRATIONS.

figure 3.2
PROPOSED GROUNDWATER SAMPLING LOCATIONS
RFI WORK PLAN
WILLOW RUN COMPANY VEHICLE OPERATIONS AREA
Ypsilanti, Michigan



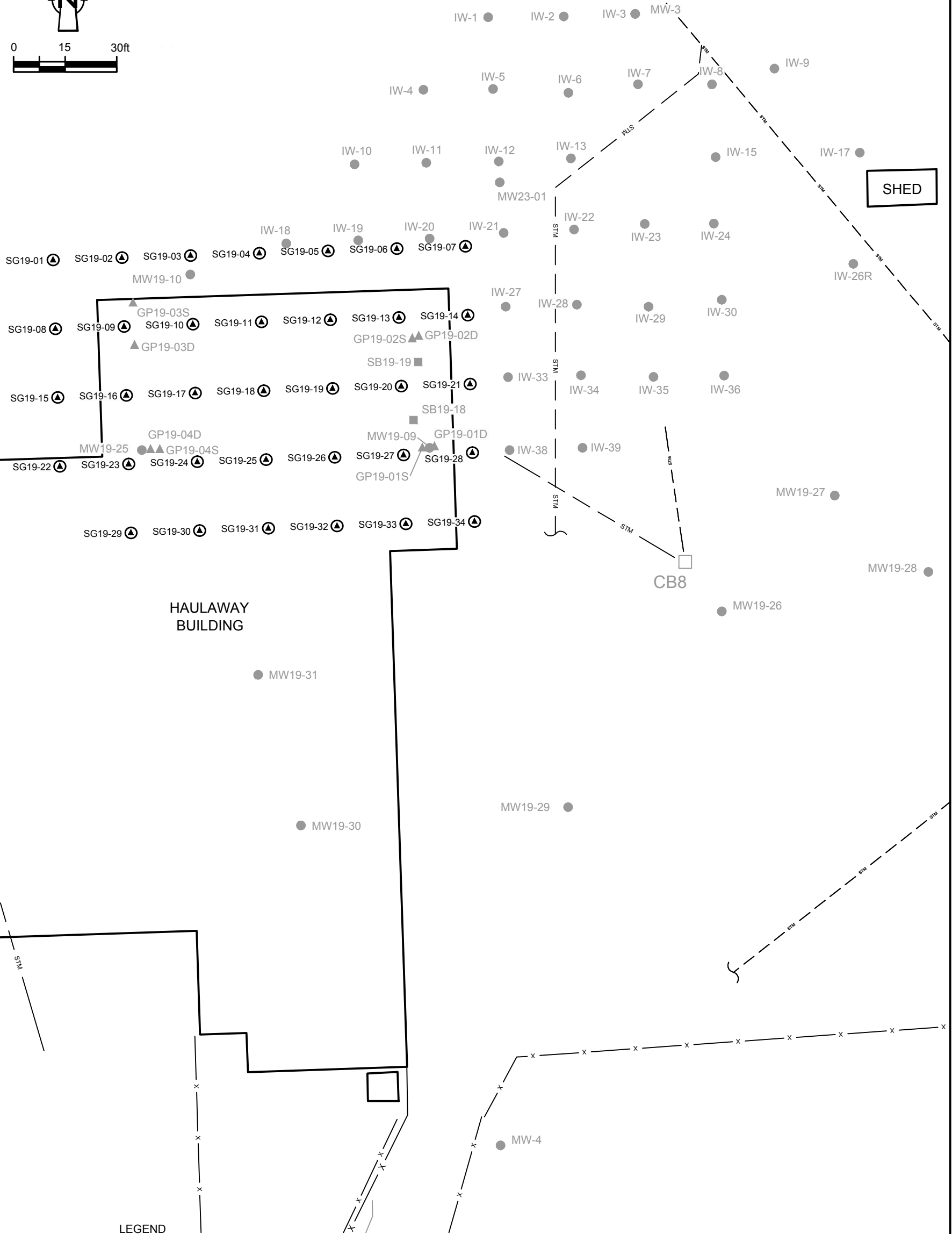
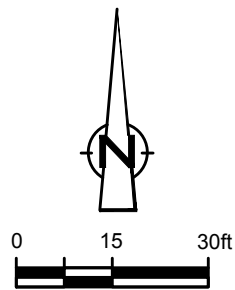


figure 3.3
PROPOSED MODIFIED ACTIVE GAS SAMPLING (MAGS) LOCATIONS
RFI WORK PLAN
WILLOW RUN COMPANY VEHICLE OPERATIONS AREA
Ypsilanti, Michigan



TABLES

**SITE HISTORY
RFI WORK PLAN
WILLOW RUN COMPANY VEHICLE OPERATIONS AREA
YPSILANTI, MICHIGAN**

EFFORT/EVENTS	COMPLETED BY	DATE
Ford Motor Company owned a large section of undeveloped land including the future Willow Run facility.	--	<1940
Aerial Photo: Groundwater movement at the Site likely in a semi-radial direction in the vicinity of the future Haulaway Bldg. Surface elevations of native clay deposits are likely to slope in a semi-radial direction similar to groundwater movement.	--	1940
A dam was constructed in Willow Run Creek at Tyler Road, creating Tyler		After 1941, before 1942
U.S. Defense Plant Corporation of America purchased the Willow Run facility and directed Ford to construct and operate a bomber production plant.	--	1941
Former South Culvert area may have been used as a plating waste sludge disposal area.	--	1942 - 1944
The Kaiser-Frazer Company leased the Willow Run facility from the War Asset Administration.	--	November, 1945
Kaiser-Frazer produced automobiles at the facility. Paint sludge was dumped in the area between the fence line and Tyler Pond at the eastern edge of the southern shore of Tyler Pond (current CVO property).	--	1945 - 1953
Kaiser-Frazer purchased the facility.	--	December, 1948
GM purchased the Willow Run facility. Site building was used as a parts storage warehouse for the GM Parts Division.	--	December, 1954
Aerial Photo: Natural hydraulic gradient of groundwater discharging to Willow Run Creek was lowered when the creek was dammed along Tyler Road (creating Tyler Pond). Potential filling activities along the former riverbank near PAOC 18 of current CVO Site.	--	1955
Chevrolet Motor Division took over operations.	--	1955
Typical automotive assembly plant operations. Various products and management authorities were involved during this period.	--	1956 - July, 1993
Facility light truck assembly began.	--	January 31, 1956
Existing Haulaway Building was constructed.	--	1959
Aerial Photo: Hydraulic gradient/flow direction of groundwater potentially modified by installation of storm sewer lines between the original Haulaway Bldg. and Tyler Road.	--	1963
Additions to Haulaway Bldg. with additional development and pavement in surrounding areas likely required additional storm sewers to be installed.	--	1978, 1985, 1994
Production operations ceased at the former Willow Run Assembly Plant.	--	July, 1993
Facility deactivation/decommissioning activities at the former Willow Run Assembly Plant.	--	1993 - 1997
Soil Investigation - confirm culvert location and fill material northwest of current CVO operations.	Atwell-Hicks	1994
90 cubic yards of visible surface waste and approx. 30 drum remnants removed from the south bank of Tyler Pond. TCLP lead found above RCRA criteria. Samples from post-excavation floor revealed lead and benzo(a)pyrene above applicable criteria.	Weston	February, 1994
Additional soil sampling performed, found lead, dibenzo(a,h)anthracene, and benzo(a)pyrene above applicable criteria.	Weston	May 5, 1994
Phase II ESI conducted.	Chester	June, 1995
Large-scale remedial dredging of Tyler Pond.	PRPs	1995 - 1999
Phase III EOC Study - defined the lateral and vertical extent of lead and PAH-impacted soil.	BBL	December, 1996 - March, 1997
The former Willow Run Assembly Plant was sold and used as a storage warehouse named the Willow Run Business Center (CVO property was retained by GM).	--	1997
Aerial Photo: Hydraulic gradient/flow direction modified by dredging operations to remediate PCB sediments in former creek bottom.	--	1998
Continued Investigations and Interim Response Actions.	CRA	2000-Present
GM bankruptcy.	--	June, 2009
GM Company Vehicle Operations vacates Site.	--	December, 2010
Revitalizing Auto Communities Environmental Response (RACER) Trust formed as operator of Site.	--	March 31, 2011
Vinyl chloride delineation - southern property boundary	CRA	2011-Present

TABLE 2.2
PAOC SUMMARY TABLE
RFI WORK PLAN
WILLOW RUN COMPANY VEHICLE OPERATIONS AREA
YPSILANTI, MICHIGAN

PAOC	Name	Location	Description of Area	Description of Concerns	Previous Investigations/Actions	Remedial Activities/System Status	Further Action/No Further Action
18	Outfall NAPL Area	Southern bank of Tyler Pond, east of catwalks (East of PAOC 29).	•Former owner/operator dumped "paint sludge" in area between CVO fenceline and Tyler Pond •Elevated concentration of CVOCs in groundwater (PAOC area coincides with KMnO₄ 2001-2002 PAOC 19 Injection Area 2) •DNAPL identified in 2004 •Area used as access point during Tyler Pond remediation in between 1995 and 1999. Bank stabilized with clay (surficial).	•DNAPL •LNAPL •Buried Debris •VOCs,SVOCs, PCBs, and metals •Primarily VOCs and PCBs	Late '90s - BBL conducted investigation activities to define the lateral and vertical extent of lead and PAH-impacted soil. 2002 - 2005 - CRA conducted additional investigation activities that identified and delineated extent of DNAPL and buried debris and defined geology along bank of pond.	1994 - surface waste material and drum remnants were removed by Weston 2001-2002 - Chemical Oxidation treatments to target elevated CVOC concentrations in groundwater 2004 - Sheet Pile wall was installed 2004 to Present - Regular DNAPL recovery events (manual & automated) 2005 - Drums and debris were removed during test pitting activities (identified by electromagnetic survey) 2007 - Soy Lactate Injection conducted to target CVOCs above FAV criteria 2007 - GS-6 paint sludge excavation/removal 2010 - Installation of french drain within sheetpile wall area to prevent groundwater venting to groundsurface and then to Tyler Pond	Further Action
19	CVO Site Groundwater	Sitewide Groundwater	•Sitewide impacted groundwater •Includes two areas (Area 1 and Area 2) of higher CVOC contamination that were initially identified as target areas for chemical oxidation treatments (KMnO₄) in 2001 and 2002 •A regular groundwater sampling program (quarterly, semi-annually & annually) was instituted after chemical oxidation treatments	•VOCs, SVOCs, metals, and PCBs •Primarily Sitewide CVOCs (TCE, DCE, VC)	CRA installed five GSI wells (along the southern bank of Tyler Pond) and sixteen monitoring wells, including perimeter wells to investigate and delineate groundwater impacts at the Site.	2001-2002 - four chemox injections using KMnO ₄ completed to reduce CVOC concentrations in two hot spots (Area 1 & Area 2) 2007 - Soy Lactate Injections conducted to target CVOCs above FAV criteria in Area 2 (coincides with PAOC 18) 2010 - Installation of french drain within sheetpile wall area (Area 2) to prevent groundwater venting to groundsurface and then to Tyler Pond	Further Action
20	Former CAT Site VOC Plume	West of the Haulaway Building and beneath western part of the Haulaway Building	•An underground storage tank (UST) farm was located near the northwest corner of the building. Tank farm included two 10,000 gallon diesel USTs and one 550 gallon gasoline UST. A release was discovered when the USTs and the piping were removed in 1994. •This PAOC was originally addressed under Part 213, the leaking UST program. Leak # C-0655-94-release: 06/21/1994 and closed 12/21/2001.	•Petroleum release - BTEX	1994 & 1996 - OBG performed a Phase I Hydrogeologic investigation to address soil and groundwater impacts during the tank removal activities. The extent of BTEX impacts was defined in the vicinity of the former tank and pipe system. The extent of VOH impacts was defined to the east and south. A closure report for the CAT Site (MERA Site ID NO. 810438) was submitted in October 2001 (BBL, 2001). -DEC (BBL, 1997 and 2001) and Closure Reports proposed that since non-BTEX VOC impacts not regulated under Part 213 encompass a majority of the area, the impacts remaining in the PAOC 20 area will be addressed under PAOC 19.	The USTs and the piping were removed in 1994 and the extent of impacts were defined. A Corrective Action Plan (CAP) for the western portion of the Site was submitted with the Final Assessment Report in 1996. The CAP required quarterly sampling of groundwater to monitor the effectiveness of natural attenuation at this site. MDEQ accepted the Closure Report in a letter dated December 10, 2001	No Further Action
23	1949 Fill Area	Northeast corner of Haulaway Building and beneath the northern part of the Haulaway Building	•Pit and soil disturbances were observed in a 1949 aerial. The pit may have contained liquids. •PAOC area coincides with KMnO₄ 2001-2002 Injection Area 1 •PAOC 23 lies on the apparent groundwater divide for site (Groundwater impacts are addressed under PAOC 19-Sitewide groundwater)	•VOCs - Primarily CVOCs (TCE, DCE and VC) •LNAPL - limited •Buried debris •Volatilization to indoor air	2004 - PAOC 23 pit was identified upon review of historical aerial photos 2004 - 2006: CRA conducted additional investigation activities that included EM surveys, test pitting, MIP, soil gas and indoor air sampling activities.	2001 - Chemical Oxidation - Four KMnO ₄ injection events (2001-2002) 2003 - Soil IRA was completed to remove material that was found to be an ongoing source of groundwater contamination 2010-2011 - samples collected to evaluate catalyzed sodium per sulfate as a chemical oxidant to treat the area and the potential effectiveness of enhanced aerobic biodegradation	Further Action
24	1952 Pits	Northwest of Haulaway Building	•Two pits were observed in a 1952 aerial. The pits may have contained liquids.	•Fuel-type impacts, similar to PAOC 20, were identified in this area.	2004 - PAOC 24 was identified upon review of historical aerial photos in 2004. 2004 - CRA conducted investigation activities that included direct push/MIP borings and soil samples were collected from the boreholes adjacent to the MIP borings with the highest detections of CVOCs and VOCs.	None	No Further Action

TABLE 2.2
PAOC SUMMARY TABLE
RFI WORK PLAN
WILLOW RUN COMPANY VEHICLE OPERATIONS AREA
YPSILANTI, MICHIGAN

PAOC	Name	Location	Description of Area	Description of Concerns	Previous Investigations/Actions	Remedial Activities/System Status	Further Action/No Further Action
29	Kaiser-Frazer Dump Area	Southern bank of Tyler Pond, west of catwalks	•Former owner/operator dumped "paint sludge" in area between CVO fenceline and Tyler Pond •Test pits completed in 2005 identified significant amount of buried debris including drums •PAOC 21 (sink hole waste area) and PAOC 22 (paint sludge area), documented in workplans were incorporated into this PAOC based on like fill materials	•Buried debris •VOCs, SVOCs, and Metals	Late '90s - BBL conducted investigation activities to define the lateral and vertical extent of lead and PAH-impacted soil. 2002 - 2005 - CRA conducted additional investigation activities that identified buried debris and defined geology along bank of pond including soil borings, EM surveys and test pits.	1994 - surface waste material and drum remnants were removed by Weston 2005 - Drums and debris were removed during test pitting activities (identified by electromagnetic survey)	Further Action

Notes:
CVO - Company Vehicle Operations Property
PAOC - Potential Area of Concern
VOCs - Volatile Organic Compounds
VOH - Volatile Organic Hydrocarbon
SVOCs - Semi-volatile Organic Compounds
PCBs - Polychlorinated Biphenyls
CVOCs - Chlorinated Volatile Organic Compounds
TCE - Trichloroethylene
DCE - Dichloroethylene
VC - Vinyl Chloride
FAV - Final Acute Value
GW- Groundwater
SO - Soil

BBL - Blasland, Bouck and Lee
CRA - Conestoga Rovers and Associates
IRA - Interim Response Action
UST - Underground Storage Tank
DNAPL - Dense non-aqueous phase liquid
LNAPL - Light non-aqueous phase liquid
NAPL - Non-aqueous phase liquid
PAH - Petroleum Aromatic Hydrocarbon
MDEQ - Michigan Department of Environmental Quality
CAT - Complete Auto Transit
GSI - Groundwater Surface water Interface
OBG - O'Brien & Gere
BTEX - benzene, toluene, ethylbenzene, and xylene

TABLE 3.1

**SOIL SAMPLING PROGRAM
RFI WORK PLAN
WILLOW RUN COMPANY VEHICLE OPERATIONS AREA
YPSILANTI, MICHIGAN**

Soil Boring/or Well ID ¹	Target Depth	Environmental Parameters		Screen Interval	Sampling Reason
		Sample Intervals (feet bgs)	Chemical Analysis ³		
MW19-32	6" into clay	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	10-foot screen, advanced six inches into clay	Western Property Boundary Investigation -Evaluate conditions at upgradient property boundary
MW19-33	6" into clay	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	10-foot screen, advanced six inches into clay	Western Property Boundary Investigation -Evaluate conditions at upgradient property boundary
MW19-34	6" into clay	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	10-foot screen, advanced six inches into clay	Western Property Boundary Investigation -Evaluate conditions at upgradient property boundary
MW19-35	6" into clay	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	10-foot screen, advanced six inches into clay	Western Property Boundary Investigation -Evaluate conditions at upgradient property boundary
MW19-36	6" into clay	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	10-foot screen, advanced six inches into clay	Northwestern Buried Debris Investigation based on EM Survey -evaluate conditions within debris area
MW19-37	6" into clay	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	10-foot screen, advanced six inches into clay	Northwestern Buried Debris Investigation based on EM Survey -evaluate conditions within debris area
MW19-38	6" into clay	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	10-foot screen, advanced six inches into clay	Northwestern Buried Debris Investigation based on EM Survey -evaluate conditions within debris area
MW19-39	6" into clay	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	10-foot screen, advanced six inches into clay	Northwestern Buried Debris Investigation based on EM Survey -evaluate conditions downgradient of debris area
MW19-40	6" into clay	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	10-foot screen, advanced six inches into clay	Delineation of soil impacts - East of Sheet Pile Wall Area
MW19-41	6" into clay	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	10-foot screen, advanced six inches into clay	Delineation of soil impacts - East of Sheet Pile Wall Area
DMW1	Maximum 100'	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	Upper most 10' of deep aquifer	Deep Aquifer Quality
DMW2	Maximum 100'	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	Upper most 10' of deep aquifer	Deep Aquifer Quality
GS-9	5'	Field Observations ⁴	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	3-foot screen, advanced two feet into clay	GSI Monitoring
SB19-49	6" into clay	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	-	Delineation of soil impacts-Northwest of Haulaway Building
SB19-50	6" into clay	0-2, 2 feet above the water table, and Field observations ²	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs, Hex & Tri Cr if total Cr > 3.3 mg/kg, FG/CG Pb if >75 mg/kg	-	Delineation of soil impacts-Northwest of Haulaway Building
SB19-51	6'	3-6	Hex and Tri Cr	-	Chromium Speciation Analysis due to total chromium concentrations

**SOIL SAMPLING PROGRAM
RFI WORK PLAN
WILLOW RUN COMPANY VEHICLE OPERATIONS AREA
YPSILANTI, MICHIGAN**

Soil Boring/or Well ID ¹	Target Depth	Environmental Parameters		Screen Interval	Sampling Reason
		Sample Intervals (feet bgs)	Chemical Analysis ³		
SB19-52	2'	0-2	Hex and Tri Cr	-	Chromium Speciation Analysis due to total chromium concentrations
SB19-53	3'	1-3	Hex and Tri Cr	-	Chromium Speciation Analysis due to total chromium concentrations
SB19-54	9'	7-9	Hex and Tri Cr	-	Chromium Speciation Analysis due to total chromium concentrations
SB18-276	2'	0-2	Hex and Tri Cr	-	Chromium Speciation Analysis due to total chromium concentrations
SB18-277	2'	0-2	Hex and Tri Cr	-	Chromium Speciation Analysis due to total chromium concentrations
SB18-278	10'	8-10	Hex and Tri Cr	-	Chromium Speciation Analysis due to total chromium concentrations
SB18-279	9'	7-9	Hex and Tri Cr	-	Chromium Speciation Analysis due to total chromium concentrations

Notes:

TCL - Target Compound List

VOCs - Volatile organic compounds

SVOCs - Semi-volatile organic compounds

TAL - Target Analyte List

PCBs - Polychlorinated biphenyls

TAL - Target Analyte List

ft bgs - feet below ground surface

Hex and Tri - Hexavalent and Trivalent

Cr - Chromium

FG - Fine Grain

CG - Coarse Grain

Pb - Lead

¹ Monitoring wells will be 2-inch diameter PVC with maximum of 10-foot long screens² Up to one additional sample may be collected at intervals where field observations indicate impacts (i.e. odors, staining, PID readings)³ "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods"

SW846, 3rd Edition, updated November 1986

VOCs U.S. EPA Method SW846-8260

SVOCs U.S. EPA Method SW846-8270

PCBs U.S. EPA Method SW846-8082

Site TAL Meta U.S. EPA Method SW846-6000/7000 series

⁴ Sample to be collected if field observations indicated impacts (i.e. odors, staining, elevated PID readings)

TABLE 3.2

**GROUNDWATER SAMPLING PROGRAM
RFI WORK PLAN
WILLOW RUN COMPANY VEHICLE OPERATIONS AREA
YPSILANTI, MICHIGAN**

Monitoring Well ID	Analysis ¹	Sampling Reason	Sampling Frequency
New Locations			
MW19-32	TCL VOCs, TCL SVOCs, TAL Metals, Tri and Hex Chromium, PCBs	Western Property Boundary Investigation - Evaluate groundwater at upgradient property boundary and Site-Specific Background Metals	Full Analysis One - time and TAL Metals twice ²
MW19-33	TCL VOCs, TCL SVOCs, TAL Metals, Tri and Hex Chromium, PCBs	Western Property Boundary Investigation - Evaluate groundwater at upgradient property boundary and Site-Specific Background Metals	Full Analysis One - time and TAL Metals twice ²
MW19-34	TCL VOCs, TCL SVOCs, TAL Metals, Tri and Hex Chromium, PCBs	Western Property Boundary Investigation - Evaluate groundwater at upgradient property boundary and Site-Specific Background Metals	Full Analysis One - time and TAL Metals twice ²
MW19-35	TCL VOCs, TCL SVOCs, TAL Metals, Tri and Hex Chromium, PCBs	Western Property Boundary Investigation - Evaluate groundwater at upgradient property boundary and Site-Specific Background Metals	Full Analysis One - time and TAL Metals twice ²
MW19-36	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Northwestern Buried Debris Investigation based on EM Survey -Evaluate conditions within debris area	One - time
MW19-37	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Northwestern Buried Debris Investigation based on EM Survey -Evaluate conditions within debris area	One - time
MW19-38	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Northwestern Buried Debris Investigation based on EM Survey -Evaluate conditions within debris area	One - time
MW19-39	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Northwestern Buried Debris Investigation based on EM Survey -Evaluate conditions downgradient of debris area	One - time
MW19-40	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Delineation of groundwater impacts - East of Sheet Pile Wall	One - time
MW19-41	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Delineation of groundwater impacts - East of Sheet Pile Wall	One - time
DMW1	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Deep Aquifer Quality	One - time
DMW2	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Deep Aquifer Quality	One - time
GS-9	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	GSI Monitoring	One - time

**GROUNDWATER SAMPLING PROGRAM
RFI WORK PLAN
WILLOW RUN COMPANY VEHICLE OPERATIONS AREA
YPSILANTI, MICHIGAN**

Monitoring Well ID	Analysis ¹	Sampling Reason	Sampling Frequency
Existing Locations			
MW19-11	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Previously not sampled for full parameter list and monitoring downgradient of fill area	One - time
MW19-16	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Previously not sampled for full parameter list	One - time
MW19-23	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Previously not sampled for full parameter list	One - time
MW-18	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Previously not sampled for full parameter list	One - time
MW19-12	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Northwestern Buried Debris Investigation based on EM Survey -Evaluate conditions downgradient of debris area	One - time
GS-1	TCL VOCs, TCL SVOCs, Site TAL Metals, PCBs	Northwestern Buried Debris Investigation based on EM Survey -Evaluate conditions downgradient of debris area	One - time
MW19-04	TAL Metals, Tri and Hex Chromium	Site-Specific Background Metals	Twice ²
MW-13	TAL Metals, Tri and Hex Chromium	Site-Specific Background Metals	Twice ²

Notes

TCL - Target Compound List
 VOCs - Volatile Organic Compounds
 SVOCs - Semi-volatile Organic Compounds
 PCBs - Polychlorinated Biphenyls
 TAL - Target Analyte List
 TCE - Trichloroethylene
 DCE - Dichloroethylene
 VC - Vinyl Chloride
 Tri and Hex - Trivalent and Hexavalent

¹ "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods"
 SW846, 3rd Edition, updated November 1986

VOCs U.S. EPA Method SW846-8260

SVOCs U.S. EPA Method SW846-8270

PCBs U.S. EPA Method SW846-8082

Site TAL Metals U.S. EPA Method SW846-6000/7000 series

² Groundwater samples from this location will be collected twice with at least 3 months between events for calculating background concentrations

APPENDIX A

SITE-SPECIFIC FIELD METHOD GUIDELINES

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LIST OF FIGURES
(Following Text)

FIGURE A-5.1	TYPICAL OVERBURDEN WELL CONSTRUCTION DETAIL
FIGURE A-8.1	TYPICAL SOIL GAS PROBE CONSTRUCTION DETAIL
FIGURE A-8.2	TYPICAL SUB-SLAB GAS PROBE CONSTRUCTION DETAIL

LIST OF FORMS
(Following Text)

FORM 3.1	STRATIGRAPHY LOG (OVERBURDEN)
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1.0 INTRODUCTION

These guidelines are not intended to provide the basis for an investigation program, but instead assume that a scope of work has been designed, and a Site-specific Work Plan has been established.

2.0 DRILLING METHODS

The standard approach for soil boring completion and well installation at this Site is direct push and hollow-stem auger, respectively. Rotasonic drilling methods will be used for soil borings or wells that extend below the confining clay layer defining the shallow aquifer.

3.0 SOIL CLASSIFICATION

Descriptions for natural undisturbed soils are recorded on a Stratigraphy Log (Overburden) (Form SP-14). An example of a completed Stratigraphy Log (Overburden) is presented on Form 3.1.

Soil descriptions are completed in the following order:

1. Unified Soil Classification System (USCS) group symbol(s) (e.g., SM) of primary soil components or dual or borderline symbols
2. Name and adjective description of primary, secondary, and minor grain size components
3. Relative density for non-cohesive soils or consistency for cohesive soils
4. Gradation and soil structure for non-cohesive soils or structure and plasticity for cohesive soils
5. Color
6. Moisture content
7. Other physical observations including presence of staining and or odors

Note: When describing observed odors, general odor category and strength of odor will be classified as specific as possible. Odors are generally chemical, petroleum, or septic related, varying from slight to moderate to strong. Identification of specific chemical compounds (i.e., benzene, gasoline) is not necessary and is often inaccurate as detailed chemistry commonly shows an array of chemicals present.

When describing vegetative matter presence in soils, the term organic is not used. The use of the term organic often leads to confusion regarding the presence of organic chemicals (i.e., volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs]). Similarly, as noted above, more specific terms for odors than organic will be used.

The description of fill soils is similar to those used to describe native undisturbed soils. Fill soils will be identified as fill (i.e., SP/GP-Sand and Gravel [Fill]). To determine if soils are fill, evidence that the soil has been artificially placed (e.g., brick fragments, slag, glass, wood fragments) will be observed. Relative or inconsistent soil density can also assist in determining if soils are fill, along with irregular soil structure.

Soils are identified and grouped consistently to determine subsurface pattern or changes and non-conformities in the soil stratigraphy. The stratigraphy of each soil boring is compared to ensure that patterns or changes in soil stratigraphy are noted and that consistent terminology is used.

Visual examination, physical observation, and manual tests (based on ASTM D2488, Standard Practice for Description and Identification of Soils [Visual-Manual Procedure]) are used to aid in classifying and grouping soil samples in the field. These procedures are described in the following subsection. ASTM D2488 should be reviewed for detailed explanations of the procedures. Note that the related ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) uses slightly different percentages of soil components. Visual-manual procedures used to aid in soil identification and classification include:

1. Visual determination of grain size, soil gradation, and percentage of various soil components to the nearest 5 percent (i.e., gravel, sand, silt, and clay)
2. Dry strength, dilatancy, toughness, and plasticity tests (i.e., thread or ribbon test) for identification of inorganic fine-grained soils (e.g., CL or CH [clays], and ML or MH [silts])
3. Soil compressive strength and consistency estimates based on thumb indent and or pocket penetrometer (preferred) methods

The three main soil divisions are:

1. Coarse-grained soils (e.g., sand and gravel)
2. Fine-grained soils (e.g., silts and clays)

3. Soils with high natural organic and vegetative matter content (e.g., peat, marl)

These soil divisions are presented in the table of USCS classifications below.

Major Divisions			Group Symbol	Typical Description
Coarse grained soils more than 50% retained on No. 200 sieve	Gravel more than 50% of coarse fraction retained on No. 4 sieve	clean gravel <5% fines	GW	well graded gravel, gravel-sand mixtures
			GP	poorly graded gravel, gravel-sand mixtures
		gravel with >15% fines	GM	silty gravel, gravel-sand-silt mixtures
			GC	clayey gravel, gravel-sand-clay mixtures
	Sand more than 50% of coarse fraction passes No. 4 sieve	clean sand <5% fines	SW	well graded sand, fine to coarse sand, gravelly sand
			SP	poorly graded sand
		sand with >15% fines	SM	silty sand, sand-silt mixtures
			SC	clayey sand, sand-clay mixtures
Fine grained soils more than 50% passes No. 200 sieve	Silt and Clay liquid limit <50, low plasticity	inorganic	ML	Inorganic silt
			CL	Inorganic clay
		organic	OL	organic silt, organic clay
	Silt and Clay liquid limit ≥50, high plasticity	inorganic	MH	silt of high plasticity, elastic silt
			CH	clay of high plasticity, fat clay
		organic	OL	organic clay, organic silt, low plasticity
			OH	organic clay, organic silt, high plasticity

Major Divisions	Group Symbol	Typical Description
Highly organic soils	PT	peat

4.0 SOIL SCREENING & SAMPLING

For environmental sampling, gloves are changed each time between collecting subsequent soil samples to prevent cross-contamination. All tools (e.g., samplers, spatulas) are decontaminated prior to use on each sample to prevent cross-contamination.

When soil sampling at sites with known or suspected VOC impact, it is often required to measure the soil for the presence of undifferentiated organic vapors. This field screening can be performed using a photoionization detector (PID). Immediately upon the opening of the split-spoon or discrete soil sampler, the soil is screened with a PID (HNu, Microtip, or equivalent) for the presence of undifferentiated organic vapors. This is accomplished by recording a head space measurement. This consists of placing a portion of the soil sample in bag and sealing the bag. The bag is set aside for 3 - 5 minutes. After the sample has equilibrated, the bag is punctured with the PID probe, and the air (headspace) above the soil sample is monitored. The headspace reading is recorded on the field form or in the field book.

Subsurface soil samples are usually grab samples, used to characterize the soil at a specific depth or depth interval (e.g., 2 to 4 feet). On occasion, composite samples are collected from a borehole over a greater depth interval (e.g., 5 to 15 feet). Soil samples for VOC analysis will not be homogenized. Soil samples collected for chemical analysis will be placed in a cooler with ice. Samples will be shipped using Chain of Custody procedures to the analytical laboratory.

5.0 WELL CONSTRUCTION

The standard approach for monitoring well construction at this Site includes 2-inch diameter Schedule 40 polyvinyl chloride (PVC) wells with No. 10 slot PVC screens. Screen lengths vary based on location and purpose of the well, with a maximum length of 10 feet. Typical overburden well installation details are provided on Figure A-5.1.

6.0 WELL DEVELOPMENT

Well development can be accomplished by using in-place pumps or by using portable equipment; either peristaltic, bladder, or other appropriate pumps depending on well depth. The well will be purged until the groundwater is relatively silt free; no further change is noted, the temperature, pH and specific conductivity readings have stabilized to within 10 percent.

7.0 GROUNDWATER SAMPLING

Low Flow Purging (LFP) using peristaltic pumps is the preferred groundwater sampling method at this Site.

During LFP, the pumping rate should be between 100 and 500 milliliters per minute (mL/min) to allow for measured groundwater levels to maintain a maximum 0.4 foot of drawdown. During purging, the pumping rate and groundwater level should be measured at least every 10 minutes. It is recommended that water level measurements occur at 5-minute intervals.

During LFP, stabilization of the purged groundwater is required to ensure the collection of representative groundwater samples from the formation and not from the stagnant water in the well casing. Field parameters including pH, temperature, specific conductance, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity should be monitored during LFP. The field measurements should be measured and recorded at 5-minute intervals. Groundwater stabilization is considered achieved when three consecutive readings for each of the field parameters, taken at 5-minute intervals, are within the following limits:

pH	±0.1 pH units of the average value of the three readings
Temperature	±3 percent of the average value of the three readings
Conductivity	±0.005 milliSiemen per centimeter (mS/cm) of the average value of the three readings for conductivity <1 mS/cm and ±0.01 mS/cm of the average value of the three readings for conductivity >1 mS/cm
ORP	±10 millivolts (mV) of the average value of the three readings
DO	±10 percent of the average value of the three readings

Turbidity ± 10 percent of the average value of the three readings, or a final value of less than 5 NTU

If the recharge to the well is insufficient to conduct LFP, the well should be pumped dry and allowed to recharge sufficiently for the collection of the groundwater sample volume. Wells purged dry are required to be sampled within 24 hours of being purged dry. If there is not sufficient volume of water within 24-hours the well will be deemed dry and no sample will be collected.

Variations from this procedure need to be cleared by the CRA project manager or senior hydrogeologist prior to sample collection.

8.0 SOIL GAS SAMPLING

This provides for the installation and sampling of two types of soil gas probes, subslab and a typical soil gas probe (deep soil gas probe). The deeper soil gas probes (typically greater than 5 feet bgs) will be installed using the Geoprobe dual tube sampling system (a direct push method) to advance a borehole six-inches into the clay-confining unit. The dual tube sampling system consists of first advancing a 2½-inch ID inner sampling casing followed by advancing a 3½-inch ID outer casing. The outer casing will cut away disturbed soil immediately surrounding the borehole left by the inner probe. The outer casing will create reduced soil disturbance itself due to the inner probe having already been advanced. The inner casing will be advanced until the pre-determined depth is reached or until the water table is encountered, whichever occurs first. The outer casing will then be used to cut away the disturbed soil to the desired depth (typically between 5 and 10 feet bgs, where the soil probe will be installed. It is anticipated that using the dual tube system will result in a minimum amount of soil disturbance around the borehole annulus. The soil gas probes will be constructed of ½-inch ID polyethylene tubing or ¾-inch PVC. The screened interval for each soil gas probe will be 1 foot in length and will be set between 5 and 10 feet bgs, designed to screen the most permeable unsaturated soils within this interval. A typical deep soil probe construction is presented on Figure A-8.1.

Sub-slab probes will be installed using a rotary hammer drill (or other appropriate portable drill). A shallow outer hole, approximately 7/8-inch inches diameter, will be created using the drill. A smaller diameter inner hole (approximately 5/16-inches in diameter) will be drilled within the outer hole through the concrete slab and approximately 3-inches into the sub-slab material. The sub-slab probes will be constructed from small diameter brass or stainless steel tubing and compression fittings.

A cement grout that expands upon drying will be used to seal between the probe and the outer hole. A typical sub-slab probe construction is presented on Figure 8.2.

The soil gas samples will be collected using 6-liter capacity Summa™ canisters fitted with a laboratory calibrated critical orifice flow regulation device sized to allow the collection of the soil gas sample over a 1-hour sample collection time. The 1-hour sample collection time for a 6-litre capacity Summa™ canister corresponds to a maximum soil gas sample collection flow rate of approximately 200 milliliters per minute (ml/min). Prior to sample collection, soil gas probe purging will be conducted at a maximum flow rate of 200 ml/min. Two soil gas probe volumes (calculated based on casing and sand pack volume) will be purged to remove potentially stagnant air from the internal volume of the soil gas probe and ensure that soil gas representative of the formation is drawn into the soil gas probe.

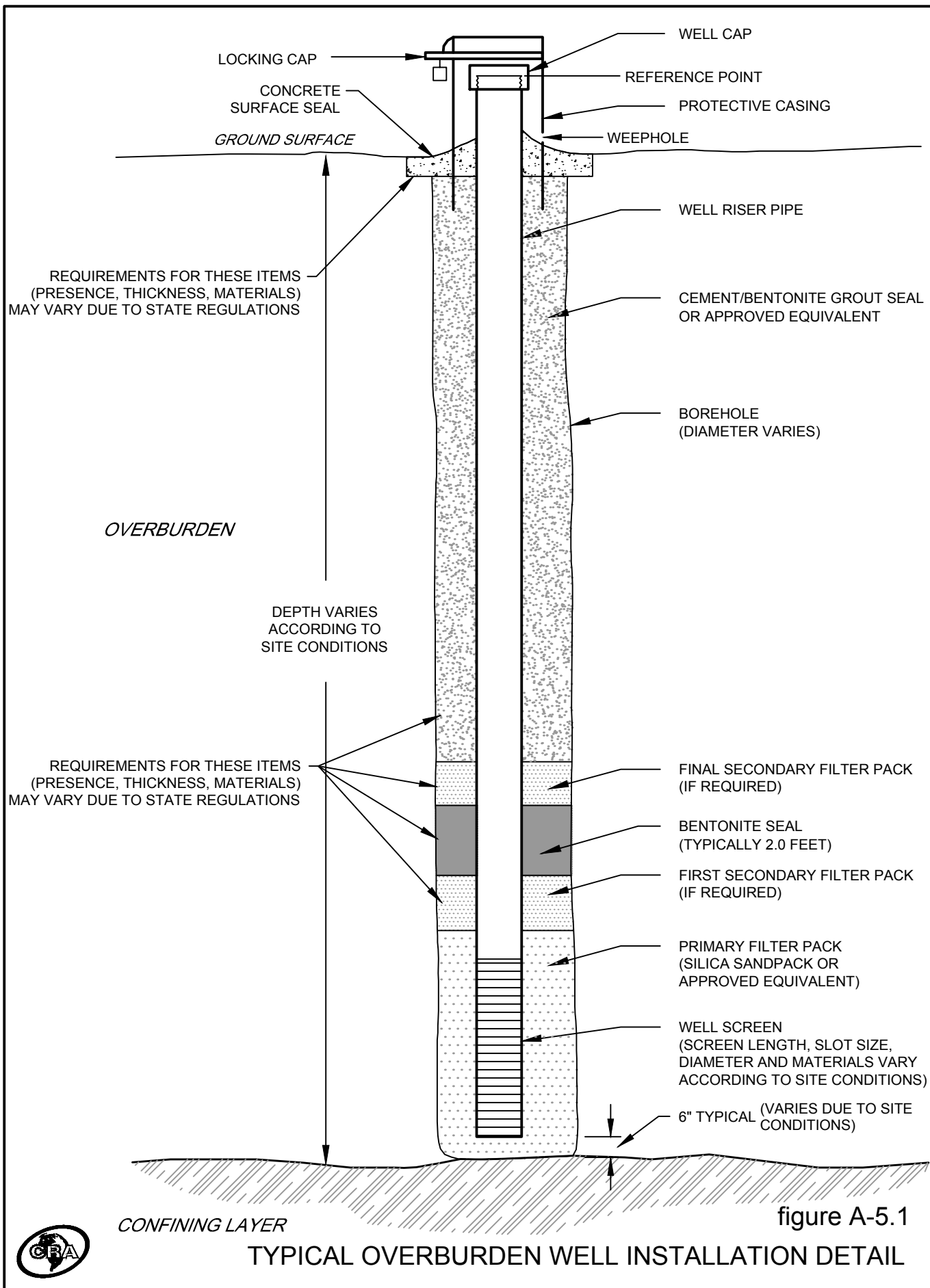
9.0 DECONTAMINATION PROCEDURE

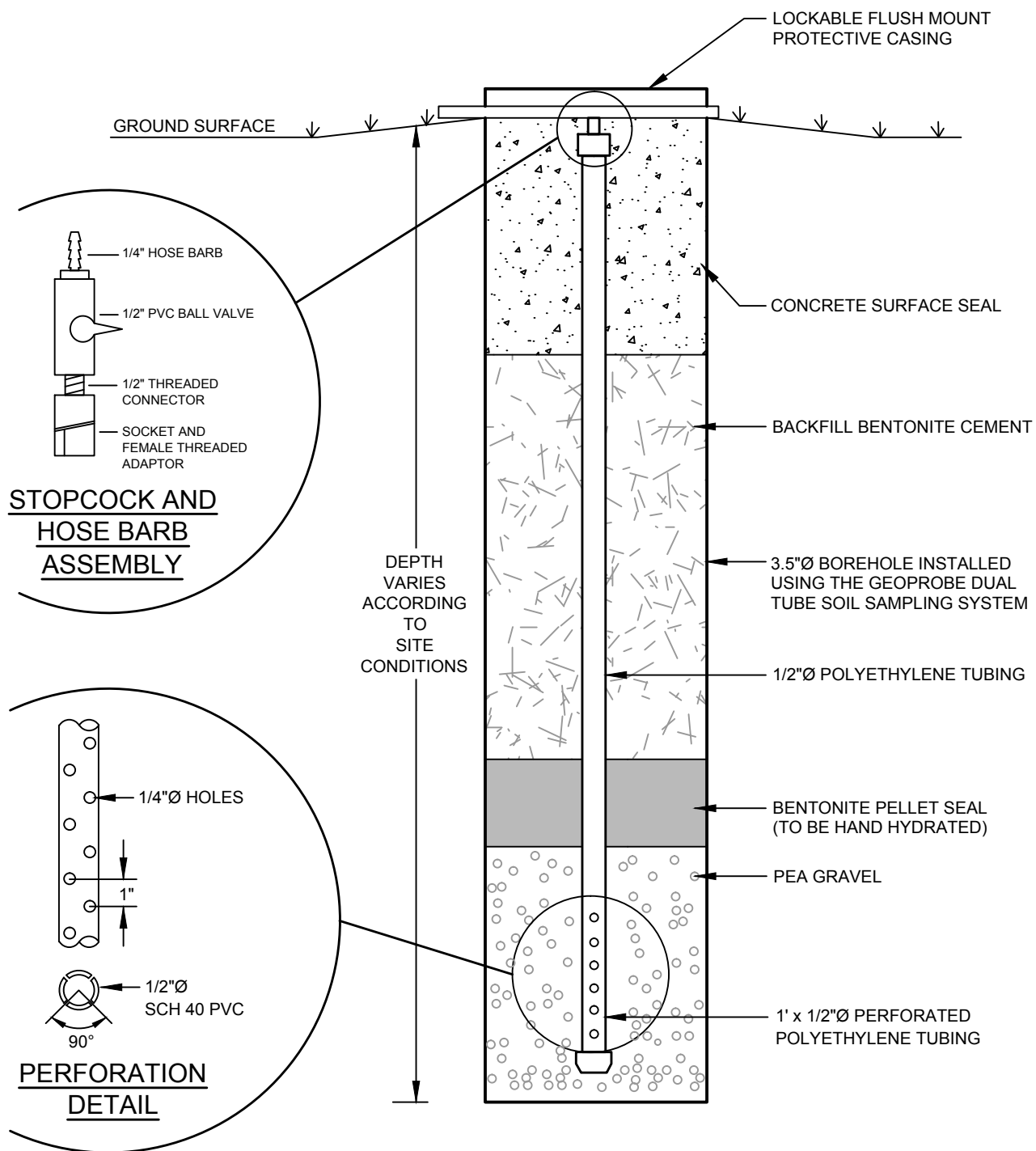
The standard decontamination procedure employed at this Site includes an initial wash with potable water and laboratory detergent (e.g.alconox) followed by a potable water rinse.

Polychlorinated Biphenyls (PCB) Decontamination Procedure

The following cleaning procedures are recommended for decontaminating non dedicated equipment being used for environmental investigation activities in areas where significant levels of PCBs have been detected.

1. Wash equipment with potable water and laboratory detergent (Alconox or Liquinox or similar solution).
2. Rinse thoroughly with potable water.
3. Rinse thoroughly with deionized water.
4. Rinse equipment with 1/10 dilution of hexane. Use a laboratory style bottle for hexane to avoid splashing. Do not use a spray bottle.
5. Rinse equipment with 1/10 dilution of acetone. Use a laboratory style bottle for acetone to avoid splashing. Do not use a spray bottle.
6. Rinse thoroughly with deionized water and allow to air dry.





NOTE: CONNECTIONS AND ADAPTORS ARE NOT TO BE GLUED

figure A-8.1

TYPICAL SOIL GAS PROBE CONSTRUCTION DETAIL



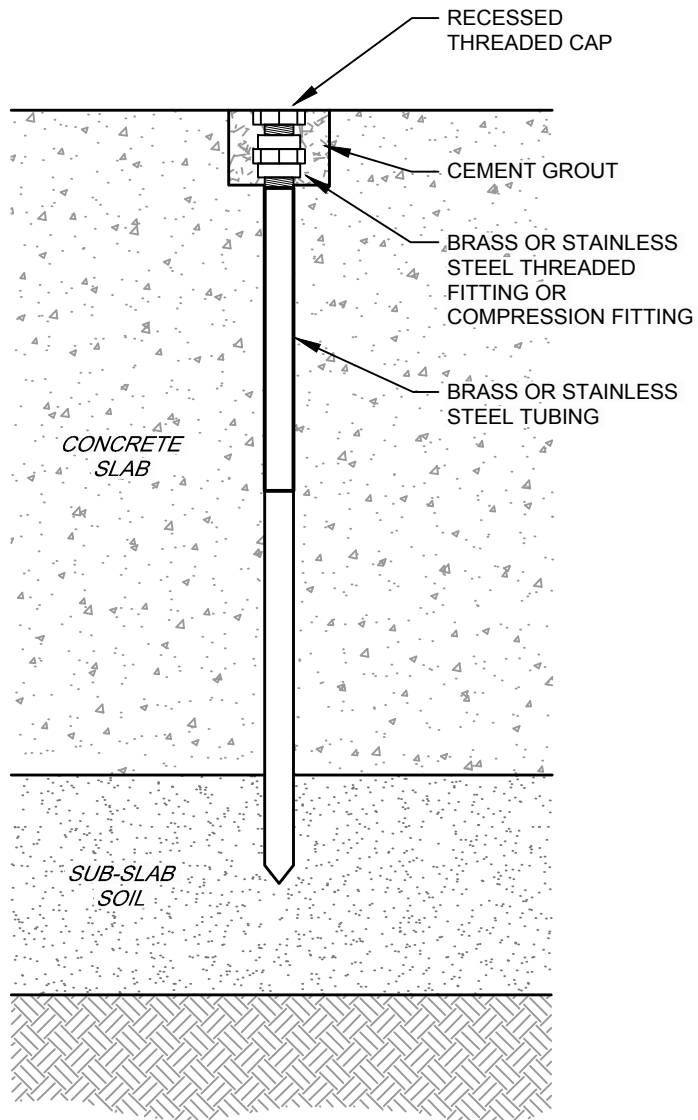


figure A-8.2



TYPICAL SUB-SLAB GAS PROBE CONSTRUCTION DETAIL

STRATIGRAPHY LOG (OVERBURDEN)

PAGE ____ OF ____

PROJECT NAME _____

DRILLING CONTRACTOR _____

HOLE DESIGNATION _____

PROJECT NUMBER _____

DRILLER _____

DATE/TIME STARTED _____

GM SITE

SURFACE ELEVATION _____

DATE/TIME COMPLETED _____

LOCATION _____

WEATHER (A.M.) _____

DRILLING METHOD _____

(P.M.) _____

SUPERVISOR _____

STRATIGRAPHIC INTERVALS (DEPTHS IN ft/m BGS)			SAMPLE DESCRIPTION	SAMPLE DETAILS								P I D / F I D	C H E M I C A L	A N A L Y S I S	G R A I N S I Z E
F R O M	A T	T O	ORDER OF DESCRIPTORS: SOIL TYPE SYMBOL(S) – MAIN COMPONENT(S), (NATURE OF DEPOSIT), SECONDARY COMPONENTS, RELATIVE DENSITY/CONSISTENCY, GRAIN SIZE/PLASTICITY, GRADATION/STRUCTURE (FRACTURE PRESENCE/APPEARANCE),COLOR, MOISTURE CONTENT, SUPPLEMENTARY DESCRIPTORS (FILL OR NATIVE; ROOT PRESENCE/STRUCTURE), NOTE: PLASTICITY DETERMINATION REQUIRES THE ADDITION OF MOISTURE IF THE SAMPLE IS TOO DRY TO ROLL (INDICATE IF MOISTURE WAS ADDED OR NOT).	S A M P L E #	S A M M P L E I N G D	PENETRATION RECORD SPLIT SPOON BLOWS (RECORD N-VALUES & RECOVERIES)				S A M P L E I N T E R V A L	(ppm)				
						6"	6"	6"	6"						
			DEPTH OF BOREHOLE CAVING _____ DEPTH OF FIRST GROUNDWATER ENCOUNTER _____ TOPSOIL THICKNESS _____ WATER LEVEL IN OPEN BOREHOLE ON COMPLETION _____ , AFTER ____ HOURS ____ COMPLETION DETAILS: _____ NOTE: FOR EACH SPLIT-SPOON SAMPLE, RECORD BLOW COUNTS, N-VALUE, SAMPLE RECOVERY LENGTH, AND SAMPLE INTERVAL.												

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN (QAPP) RCRA FACILITY INVESTIGATION WORK PLAN

**COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN**

**Prepared for:
RACER TRUST**

**FEBRUARY 2012
REF. NO. 17303 (22)**

QUALITY ASSURANCE PROJECT PLAN (QAPP)
FOR THE RCRA FACILITY INVESTIGATION WORK PLAN
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN

REVISION NUMBER 1
FEBRUARY 2, 2012

Prepared By: Conestoga-Rovers & Associates (CRA)

Prepared For: Revitalizing Auto Communities Environmental Response (RACER) Trust

Approved By: _____ Date: _____
CRA Project Manager

Approved By: _____ Date: _____
CRA QA Officer

Approved By: _____ Date: _____
CRA Field QA Officer

Approved By: _____ Date: _____
TA Project Manager

Approved By: _____ Date: _____
TA North Canton QA Officer

Approved By: _____ Date: _____
TA Knoxville QA Officer

Approved By: _____ Date: _____
TA Los Angeles QA Office

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1.0 PROJECT DESCRIPTION

The following outlines the scope of the continuing RCRA facility investigation (RFI) to be performed at the Revitalizing Auto Communities Environmental Response (RACER) Trust Company Vehicle Operations (CVO) property located in Ypsilanti, Michigan.

This Quality Assurance Project Plan (QAPP) presents the organization, objectives, planned activities, and specific quality assurance / quality control (QA/QC) procedures associated with the RFI for the Site. Protocols for sample collection, sample handling and storage, chain-of-custody procedures, and laboratory and field analyses are described or specifically referenced to related investigation documents.

This QAPP addresses the QA/QC elements in the U.S. EPA Region 5 QAPP policy presented in the "U. S. EPA RCRA QAPP Instructions" dated April 1998 and other relevant guidance documents. The QA/QC procedures described in this QAPP are generally consistent with U.S. EPA guidance.

1.1 INTRODUCTION

This QAPP has been prepared on behalf of RACER. The QAPP is a component of the RFI Work Plan.

1.1.1 PROJECT OBJECTIVES AND DECISION STATEMENT

The primary objectives for data collection activities include:

- i) Define the nature and extent of releases of hazardous wastes and/or hazardous constituents in environmental media (soil, sediment, groundwater, and/or surface water) at the Site; and
- ii) Collect sufficient data and information to evaluate the risk to human health and the environment, if any, associated with any releases of hazardous waste and/or hazardous constituents.

The Decision Statement for the investigation is as follows:

- i) Determine whether additional interim remedial actions are necessary to control current unacceptable risks, if any, to human health or the environment; and
- ii) Provide data for the development of a study of appropriate remedial actions (if warranted) to control current and future unacceptable risks to human health and the environment.

Associated specific objectives for field and laboratory data collection are discussed in Section 1.0 of the RFI Work Plan and Section 1.4 of this QAPP.

1.1.2 PROJECT STATUS/PHASE

The project status was presented in the Site Summary Report and investigation approach is presented in the RFI Work Plan.

1.1.3 QAPP PREPARATION GUIDELINES

As previously noted, this QAPP has been prepared to present the project specific QA/QC elements in the "U.S. EPA Region 5 QAPP Instructions" dated April 1998.

1.2 SITE DESCRIPTION

The general Site description is provided and is incorporated here by reference to the following documents.

Documents of Existing Conditions (BBL, 1997)

Phase III EOC Work Plan and associated addenda (CRA, 2003 -2005)

Site Summary Report (CRA, 2011)

1.3 SITE HISTORY AND INVESTIGATION BACKGROUND

The Site history and investigation background are provided in the following documents and incorporated here by reference.

Documents of Existing Conditions (BBL, 1997)
Phase III EOC Work Plan and associated addenda (CRA, 2003 -2005)
Site Summary Report (CRA, 2011)

1.4 PROJECT OBJECTIVES AND INTENDED DATA USE

1.4.1 TARGET PARAMETER LIST

The investigative program includes the sampling and analysis of environmental media for the presence of organic and inorganic constituents based on historical operations and previous investigations at the Site. The field and laboratory parameters are summarized below and presented in Table 1.1.

1.4.1.1 FIELD PARAMETERS

Concurrent with sample collection, several field parameters will be determined by the field sampling personnel. For soils and solid matrices, these field parameters will include visual observations, odor identification, and VOC screening using handheld monitoring equipment such as photo-ionization detectors (PID). For aqueous samples (surface water and groundwater), at a minimum, the following parameters will be determined with field testing equipment: pH, specific conductivity, and temperature. The low-flow purging techniques utilized for groundwater sampling will include additional field parameters including turbidity, dissolved oxygen (DO), and oxidation/reduction potential (ORP).

1.4.1.2 LABORATORY PARAMETERS

The laboratory parameters will vary depending on the area and prior investigative results and may include target compound list (TCL) volatile organic compounds (VOCs), TCL semi-volatile organic compounds (SVOCs), TCL polychlorinated biphenyls (PCBs), and target analyte list (TAL) metals excluding earth metals (aluminum, calcium, iron, magnesium, potassium, and sodium). In addition to the TCL/TAL parameters, select samples may be analyzed for total and amenable cyanide, petroleum fingerprinting, hexavalent-chromium, fine/coarse grain lead, pH, and hardness. Non-

aqueous phase liquid (NAPL) samples may also include analysis for petroleum fingerprinting, viscosity, specific gravity, and heating value. Soil gas and/or indoor air samples may be analyzed for VOCs. Groundwater wells monitored for natural attenuation or chemical oxidation may include sample analysis for total and dissolved manganese and iron, alkalinity, ammonia-nitrogen, biochemical oxygen demand, chemical oxygen demand, orthophosphate, nitrate-nitrogen, nitrite-nitrogen, sulfate, sulfide, total organic carbon and dissolved gases (methane, ethane, and ethene).

The estimated quantitation limits (EQL) and method detection limits (MDL) for each compound or analyte are presented in Table 1.2 – TCL/TAL and associated investigative parameters, Table 1.3 – air monitoring parameters, and Table 1.4 – natural attenuation/chemical oxidation monitoring parameters. The MDL studies have been performed by TestAmerica Laboratories, Inc. (TA) in accordance with the procedures established in the Federal Register, Volume 49, number 209, October 26, 1984 pp. 198-199, the results of these MDL studies are presented in Appendix D.

1.5 SAMPLING LOCATIONS

RFI Work Plan (and subsequent Work Plans) provides a summary and rationale for the location of environmental samples at the Site. It is possible, however, that depending on the nature of encountered field conditions, sampling locations will vary. The person responsible for making such decisions will be the Field Quality Assurance (QA) Officer whose responsibilities are described in Section 2.0 of this QAPP. Any change of the sampling strategy will only be implemented after approval from the RACER Project Manager.

1.6 PROJECT SCHEDULE

The schedule is presented in the 2012 Annual Environmental Action Budget Authorization Request package. This will be updated in each year's request.

2.0 **PROJECT ORGANIZATION AND RESPONSIBILITIES**

The CRA Project Manager will have the primary responsibility for the implementation of the RFI Work Plan at the discretion of the RACER Project Manager. TestAmerica will perform the analyses of environmental samples collected at the Site. This section defines the roles and responsibilities of the individuals who will perform the RI activities.

2.1 **MANAGEMENT RESPONSIBILITIES**

Management responsibilities are as follows:

RACER Project Manager

The RACER Project Manager is responsible for authorizing the project, and has the authority to commit the resources necessary to meet project objectives and requirements. The RACER Project Manager's primary function is to ensure that technical, financial, and scheduling objectives are achieved successfully. The RACER Project Manager will provide the major point of contact and control matters concerning the project and represent the project team at regulatory agency meetings and public hearings. The RACER Project Manager will define project objectives and develop a detailed project schedule in conjunction with the CRA Project Manager. The RACER Project Manager will establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task.

CRA Project Manager

The CRA Project Manager is responsible for managing the implementation of the RFI Work Plan and coordinating the collection of data pertaining to the investigation. The CRA Project Manager is responsible for technical quality control and project oversight. The CRA Project Manager also provides approval of the QAPP.

The CRA Project Manager will:

- i) Acquire and apply technical and other resources as needed to ensure performance within budget and schedule restraints;
- ii) Review work performed on each task to ensure quality, responsiveness, and timeliness;

- iii) Be responsible for the preparation and quality of interim and final reports; and
- iv) Communicate with RACER about the progress of the project.

CRA Project Coordinator

The CRA Project Coordinator will assist the Project Manager in day-to-day project management. The CRA Project Coordinator is responsible for coordinating all field activities and the procurement of project subcontractors. Additional responsibilities include:

- i) Assisting in monitoring the RFI progress and quality;
- ii) Preparing and reviewing RFI reports; and
- iii) Providing technical support of project activities.

2.2 QUALITY ASSURANCE RESPONSIBILITIES

The Quality Assurance team will consist of a Quality Assurance Officer and the Project Manager. Quality Assurance responsibilities are described as follows:

CRA Quality Assurance (QA) Officer

The CRA QA Officer reports directly to the CRA Project Manager and will be responsible for ensuring that all QA/QC procedures are being followed. The CRA QA Officer will be responsible for overseeing the review of all field and laboratory data. Additional responsibilities include:

- i) Assuring the application and effectiveness of the QAPP by the analytical laboratory and the project staff;
- ii) Conducting internal QA/QC of the investigation activities;
- iii) Providing input to the CRA Project Manager and CRA Project Coordinator as to corrective actions required resulting from the above-mentioned evaluations;
- iv) Preparation and review of data validation and audit reports; and
- v) Approval of the QAPP.

The CRA QA Officer will be assisted by the data validation staff in the evaluation and validation of field and laboratory generated data. The CRA QA Officer will monitor the

performance of the laboratory to ensure that the Data Quality Objectives for the project are met.

2.3 LABORATORY RESPONSIBILITIES

TA's North Canton, Ohio Laboratory (TA - North Canton) will provide laboratory services in support of the Site work plans with support from their facilities in Los Angeles, California (TA - Los Angeles) and Knoxville, Tennessee (TA - Knoxville).

TA Project Manager

The Laboratory Project Manager will report directly to the CRA QA Officer and will be responsible for ensuring all resources of the laboratory are available on an as-required basis through coordination with the Operations Manager. The Laboratory Project Manager will also be responsible for the approval of the final analytical reports and approval of the laboratory's ability to adhere to the QAPP.

TA Operations Manager

The Laboratory Operations Manager will report to the Laboratory Project Manager and will be responsible for coordinating laboratory analysis, supervising in-house chain-of-custody reports, scheduling sample analyses, overseeing data review, and overseeing preparation of analytical reports.

TA QA Officers

The Laboratory QA Officer is responsible for coordination and oversight of the laboratories quality assurance program which includes:

- i) Coordinate and oversee laboratory system audits;
- ii) Overview of QA/QC documentation;
- iii) Conduct detailed data review upon request;
- iv) Implement and document laboratory corrective actions, if required;
- v) Technical representation of laboratory QA procedures;
- vi) Oversee preparation of laboratory SOPs; and
- vii) Approval of the QAPP.

TA Sample Receiving Group Leaders

The Laboratory Sample Receiving Group Leader will report to the Laboratory Operations Manager and will be responsible for the following:

- i) Receiving and inspecting the incoming sample containers;
- ii) Recording the condition of the incoming sample containers;
- iii) Signing appropriate documents;
- iv) Verifying chain-of-custody and its correctness;
- v) Notifying the Project Manager and Operations Manager of sample receipt and inspection;
- vi) Assigning a unique identification number and customer number, and entering each into the sample receiving log; and
- vii) Controlling and monitoring access/storage of samples and extracts.

Laboratory Technical Personnel

The laboratory technical staff will have the primary responsibility in the performance of sample analysis and the execution of the QA procedures developed to determine the data quality. These activities will include the proper preparation and analysis of the project samples in accordance with the contract laboratory's Quality Assurance Manual and associated Standard Operating Procedures.

Data Validation Staff

The data validation staff reports to the CRA QA Officer. They will be independent of the laboratory and familiar with the analytical procedures performed. The validation will include a review of each validation criterion as prescribed by the guidelines presented in Section 9.2.2 of this document and be presented in a formal written report for submittal to the CRA Project Manager.

2.4 FIELD RESPONSIBILITIES

CRA Field QA Officer

The Field QA Officer is responsible for the overall operation of the field team and reports directly to the CRA Project Manager. The Field QA Officer works with the

project Health & Safety Officer to conduct operations in compliance with the project Health & Safety Plan. The Field QA Officer will facilitate communication and coordinate efforts between the CRA Project Manager and the field team members. Other responsibilities include:

- i) Developing and implementing field-related work plans, ensuring schedule compliance, and adhering to management-developed project requirements;
- ii) Coordinating and managing field staff, including sampling and drilling;
- iii) Performing field system audits;
- iv) Overseeing quality control for technical data provided by the field staff;
- v) Preparing, and approving of text and graphics required for field team efforts;
- vi) Coordinating and overseeing technical efforts of subcontractors assisting the field team;
- vii) Identifying problems in the field, resolving difficulties in consultation with the CRA QA Officer and CRA Project Manager, implementing and documenting corrective action procedures;
- viii) Approving the QAPP; and
- ix) Participating in preparation of the final reports.

Field Team Personnel

Field Team Personnel involved in the RFI will be responsible for:

- i) Performance of field activities as detailed in the RFI Work Plan (and subsequent Work Plans) and in compliance with this QAPP; and
- ii) Immediately reporting any accidents and/or unsafe conditions to the Site Health & Safety Officer and taking all reasonable precautions to prevent injury.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The RFI Work Plan and associated QAPP are designed to produce data of the quality necessary to achieve the project objectives and meet or exceed the minimum standard requirements for field and analytical methods. The overall QA objective for measurement data is to develop and implement procedures for field sampling, chain-of-custody, lab analyses, and reporting that will provide results which are adequate for supporting the RFI objectives and legally defensible in a court of law. The QAPP program will include:

- i) A mechanism for ongoing control of measurements and evaluation of data quality.
- ii) A measure of data quality in terms of precision, accuracy, representativeness, completeness, and comparability.

The following section is a general discussion of the criteria used to measure the field and laboratory analytical data quality. The laboratory reference data and standard operating procedures (SOPs) provided in Attachments 2 and 3, present the performance criteria for laboratory QC objectives.

3.1 PRECISION

3.1.1 DEFINITION

Precision is defined as a quantitative measure of the degree to which two or more measurements are in agreement. Precision will be stated in terms of relative percent difference (RPD). The overall precision of measurement data is a mixture of sampling and analytical factors. Precision will be determined by collecting and analyzing field duplicate samples and by creating and analyzing laboratory duplicates from one or more of the field samples. The analytical results from the field duplicate samples will provide data on sampling precision. The results from the laboratory created duplicate samples will provide data on analytical precision.

3.1.2 FIELD PRECISION SAMPLE OBJECTIVES

Field precision will be assessed through collection and measurement of field duplicates at a rate of 1 duplicate per 20 investigative samples with a minimum of one per sampling event.

3.1.3 LABORATORY PRECISION SAMPLE OBJECTIVES

Laboratory duplicate analyses will be performed through the use of matrix spike/matrix spike duplicates (MS/MSD) for all organic and most inorganic parameters and matrix spike/matrix duplicate (MD) analyses for certain inorganic parameters. The analytical data will be presented in summary table format. The precision criteria for laboratory MS/MSD/MD analyses are provided in the laboratory reference data provided in Attachment 3.

3.2 ACCURACY

3.2.1 DEFINITION

Accuracy relates to the bias in a measurement system. Bias is the difference between the observed and the "true" value. Sources of error are the sampling process, field contamination, preservation techniques, sample handling, sample matrix, sample preparation and analytical procedure limitations.

3.2.2 FIELD ACCURACY OBJECTIVES

Sampling bias will be assessed by evaluating the results of field equipment rinsate and trip blanks. Field equipment rinsate and trip blanks will be collected as appropriate for each sampling effort.

Field equipment rinsate blanks will be collected by passing laboratory purified water over and/or through the respective field equipment utilized during each sampling effort. One field equipment rinsate blank will be collected every 20 investigative samples. If dedicated or disposable sampling equipment is used, equipment rinsate samples may not be collected. However, at a minimum, frequency of one equipment

rinsate blank sample will be collected per sampling event. Field rinsate blanks will be analyzed for each target parameter for the respective sampling effort for which environmental media have been collected.

Trip blank samples will be supplied by the laboratory and provided with each cooler that includes volatile organic compound (VOC) analysis containers. Trip blank samples will be analyzed for each VOC for which environmental media have been collected for analysis.

3.2.3 LABORATORY ACCURACY SAMPLE OBJECTIVES

Analytical bias will be assessed through the use of known laboratory control samples and site specific matrix spike sample analyses. Laboratory control samples (LCS) and MS/MSD sample analysis will be performed as prescribed by the analytical method SOPs. LCS analyses will be performed with each analytical batch of project samples to determine the accuracy of the analytical system.

One (1) set of MS/MSD analyses will be performed with each batch of 20 project samples to assess the accuracy of identification and quantification of analytes within the site-specific sample matrices. Additional sample volume will be collected at sample locations selected for MS/MSD analyses so that MDLs and EQLs can be met.

The results of the LCS and MS/MSD analyses will be presented in a summary table reporting format and evaluated versus the acceptance criteria presented in the laboratory analytical reports. Current acceptance criteria are presented in the laboratory reference data provided in Attachment 3.

The accuracy of organic parameter analyses is also monitored through the analysis of system monitoring or surrogate compounds. Surrogate compounds are added to each sample, standard, blank, and QC samples prior to the sample preparation and analysis. Surrogate compound percent recoveries provide information on the effect of the sample matrix on the accuracy of the analyses and are evaluated against the acceptance criteria presented in laboratory analytical reports. Current acceptance criteria are presented in the laboratory reference data provided in Attachment 3.

3.3 REPRESENTATIVENESS

3.3.1 DEFINITION

Representativeness expresses the degree to which sample data accurately and precisely represents a characteristic of a population, a parameter variation at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is dependent upon the design of the sampling program. The representativeness criterion is satisfied by proper selection of sampling locations and quantity of samples collected.

3.3.2 MEASURES TO ENSURE REPRESENTATIVENESS OF FIELD DATA

Representativeness will be addressed by describing sampling techniques and the rationale used to select sampling locations. Sampling locations may be biased (based on existing data, instrument surveys, observations, etc.) or unbiased (completely random or stratified-random approaches).

For this project, sampling will be biased; that is, sampling associated with the soil and groundwater will be based on the observed presence/absence of site specific contaminants, and/or site knowledge. Specific sampling technique descriptions, which allow consistency, repetitiveness and thus representativeness, are provided as Site-Specific Field Method Guidelines in the RFI Work Plan.

3.3.3 MEASURES TO ENSURE REPRESENTATIVENESS OF LABORATORY DATA

Representativeness in the laboratory is ensured by using proper analytical procedures, and analyzing field duplicate samples. By definition, field duplicate samples are collected to be representative of a given point in space and time. Thus, sample duplicates provide both precision and representativeness information.

3.4 COMPLETENESS

3.4.1 DEFINITION

Completeness is a measure of the amount of valid (usable) data obtained from a measuring system compared to the amount that was expected to be obtained under normal conditions. The completeness goal for all data uses is that a sufficient amount of valid data be generated so that determinations can be made related to the intended data use with a high degree of confidence.

3.4.2 FIELD COMPLETENESS OBJECTIVES

Completeness is a measure of the amount of valid measurements obtained from all measurements taken in this project. Field completeness objective for this project will be 90 percent.

3.4.3 LABORATORY COMPLETENESS OBJECTIVES

Laboratory data completeness objective is a measure of the amount of valid data obtained from all laboratory measurements. The evaluation of the data completeness will be performed at the conclusion of each sampling and analysis effort. Corrective actions such as revised sample handling procedures will be implemented if problems are noted.

The completeness of the data generated will be determined by comparing the amount of valid data, based on independent validation, with the total data set. The completeness objective will be 90 percent.

3.5 COMPARABILITY

3.5.1 DEFINITION

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another.

3.5.2 MEASURES TO ENSURE COMPARABILITY OF FIELD DATA

Sample data should be comparable with other measurement data for similar samples and sample conditions. This goal is achieved through using standard operating procedures to collect, preserve, store, and analyze representative samples and the reporting of analytical results. The Site-Specific Field Method Guidelines for the various activities to be conducted during this investigation provide guidelines to generate reproducible results.

3.5.3 MEASURES TO ENSURE COMPARABILITY OF LABORATORY DATA

Comparability of laboratory data will also be measured with the results from the analysis of reference materials traceable to standards from accredited suppliers for instrument initial and continuing calibration verification. The reported analytical data will be presented in standard units of mass of contaminant within a known volume or mass of environmental media.

- i) Solid Matrices - micrograms (μg) contaminant per kilogram (kg) for organic analyses, and milligrams (mg) contaminant per kilogram (kg) for inorganic analyses of media (Dry Weight).
- ii) Aqueous Matrices - micrograms (μg) contaminant per liter (L) of media for organic and metals analyses, and milligrams (mg) per liter (L) for inorganic analyses.
- iii) Non-Aqueous Phase Liquids - (NAPL) - micrograms (μg) contaminant per kilogram (kg) of media for organic analyses, and milligrams (mg) per kilogram (kg) for inorganic analyses.
- iv) Gaseous Matrices - micrograms (μg) contaminant per cubic meter (M^3) of media

Additional guidance on analytical data reporting is contained in the laboratory SOPs.

3.6 DECISION RULES

3.6.1 DEFINITION

The decision rule is a statement that prescribes a course of action or non-action to be taken, based on assumptions to test its logical and empirical consequences.

3.6.2 DECISION RULE OBJECTIVE

The rationale for sample locations, sample number, and analytical parameters is provided in the main text of the RFI Work Plan. The decision rule for the sampling and analysis data collected is also provided in the RFI Work Plan.

3.7 LEVEL OF QUALITY CONTROL EFFORT

Equipment rinsate, trip, and method blanks samples, field duplicate samples, laboratory control and MS/MSD samples will be prepared and analyzed to determine the data quality provided by the sampling and analysis activities conducted during the execution of the RFI program.

Equipment rinsate blanks will be prepared by field personnel and submitted for analysis of target parameters. Equipment rinsate blanks will provide the means to assess the quality of data resulting from the field program. Equipment rinsate blank samples will be analyzed to check for contamination of equipment introduced during sampling at the Site. One equipment rinsate blank will be collected for every 20 investigative samples. However, a minimum of one will be collected each day of sampling activities for each type of non-dedicated or non-disposable equipment.

Trip blanks are used to assess the potential for contamination during sample storage and shipment. The trip blank consists of laboratory purified water (water samples) or methanol (soil samples) provided with the sample containers to be used for the sampling of VOCs. Trip blanks will be preserved and handled in the same manner as the investigation samples. One trip blank will be included along with each shipment cooler containing project samples to be analyzed for VOCs.

Method blank samples will be prepared by the laboratory and analyzed concurrently with all project samples to assess potential contamination introduced during the analytical process.

Field duplicate samples are analyzed to check for sampling and analytical reproducibility. One field duplicate will be collected for every 20 or fewer investigative samples collected with a minimum of one per sampling event.

Matrix spikes will provide information to assess the precision and accuracy of the analysis of the target parameters within the environmental media collected at the Site. Matrix spikes will be performed in duplicate for all TCL/TAL parameters. One MS/MSD will be collected for every 20 or fewer investigative samples per sample matrix (i.e. soil, groundwater). Soil MS/MSD samples requires a triple sample volume for VOCs only. Aqueous MS/MSD samples require triple the normal sample volume for VOCs analysis and double the volume for the remaining parameters.

4.0 SAMPLING PROCEDURES

Samples of groundwater, surface water, soil, soil gas and sediment will be obtained during the RFI program. The sampling procedures for the RI will be consistent for the objectives of the project. The RFI Work Plan describes each of the sampling tasks and objectives.

Refer to the RFI Work Plan for the Site-Specific Field Method Guidelines.

4.1 SAMPLE CONTAINERS

Sample containers for each sampling task will be provided by the project laboratory. The containers will be cleaned by the manufacturer to meet or exceed the analyte specifications established in the U.S. EPA, "Specifications and Guidance for Obtaining Contaminant-Free Sample Containers", April 1992, OSWER Directive #9240.0-0.5A. Certificates of analysis for each lot of sample containers used during the RFI will be maintained by the laboratory and will be available upon request.

The appropriate sample containers, preservation method, maximum holding times, and shipping information for each target parameter and sampling task are provided in Table 4.1.

4.2 SAMPLE LABELING

Each sample will be labeled with a unique sample number that will facilitate tracking and cross-referencing of sample information. Field blank and field duplicate samples also will be numbered with a unique sample number to prevent analytical bias of field QC samples.

Refer to the RFI Work Plan for the sample labeling procedures.

4.3 FIELD QC SAMPLE COLLECTION

4.3.1 EQUIPMENT RINSATE BLANK SAMPLE COLLECTION

Equipment rinsate blank samples will be collected when non-dedicated or non-disposable sampling equipment is used to collect samples. Equipment rinsate blanks consist of laboratory purified water that has been routed through decontaminated sampling equipment and collected into the appropriate containers. The containers will be filled in order of decreasing analyte volatility (i.e., VOCs first, SVOCs second, which are followed by the containers for the remaining analyses).

4.3.2 FIELD DUPLICATE SAMPLE COLLECTION

4.3.2.1 WATER SAMPLES

Field duplicate samples will be collected concurrently with the investigative sample alternating the filling of each sample container.

4.3.2.2 SOIL AND SEDIMENT SAMPLES

Soil and sediment field duplicates will be collected concurrently with the investigative sample.

4.3.3 MS/MSD SAMPLE COLLECTION

MS/MSD sample collection for aqueous samples requires triple the sample volume. The sampling procedure specified in Section 4.3.2.1 is used to collect aqueous samples. Soil MS/MSD samples require triple volume for VOC analyses. No additional volume is required for remaining soil parameters. Section 4.3.2.2 describes the sampling procedures for soil sample collection.

5.0 CUSTODY PROCEDURES

Custody is one of several factors necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including all originals of laboratory reports, are maintained under document control in a secure area.

Custody of a sample begins when it is collected by or transferred to an individual and ends when that individual relinquishes or disposes of the sample. A sample or evidence file is under your custody if:

1. the item is in actual possession of a person;
2. the item is in the view of the person after being in actual possession of the person;
3. the item was in actual possession but is stored to prevent tampering; or
4. the item is in a designated and identified secure area.

5.1 FIELD CUSTODY PROCEDURES

Field personnel will be required to keep written records of field activities on applicable preprinted field forms or in a bound field notebook. The logbooks provide the means of recording data collecting activities. These records will be written legibly in ink and will contain pertinent field data and observations. Entry errors or changes will be crossed out with a single line, dated and initialed by the person making the correction. Field forms and notebooks will be periodically reviewed by the Field QA Officer. Each member of the field team will be assigned a logbook. Each logbook title page should include field team member's name, project name, project start date, project end date, and unique logbook number.

The beginning of each entry in the logbook will contain the following information:

- i) Date,
- ii) Start ,time

- iii) Weather,
- iv) Names of field personnel (including subcontractors),
- v) Level of personal protection used at the Site, and
- vi) Names of all visitors and the purpose of their visit.

For each measurement and sample collected the following will be recorded:

- i) Detailed description of sample point,
- ii) Equipment used to collect sample or make measurement and the date equipment was last calibrated,
- iii) Time sample was collected,
- iv) Sample description,
- v) Depth sample was collected,
- vi) Volume and number of containers, and
- vii) Sampler identification.

5.1.1 FIELD PROCEDURES

The data quality can be affected by sample collection activities. If the integrity of collected samples is questionable, the data, regardless of its analytical quality, will also be questionable.

The following procedure describes the process to maintain the integrity of the samples:

- i) Upon collection samples are placed in the proper containers. In general, samples collected for organic analysis will be placed in pre-cleaned glass containers, and samples collected for inorganic analysis will be placed in pre-cleaned plastic (polyethylene) bottles. The sample container, preservation methods, shipping, and packaging requirements are presented in Table 4.1.
- ii) Samples will be assigned a unique sample number and will be affixed to a sample label. The information to be placed on the sample label will include the sample ID number, the sample type, the sampler's name, date collected, preservation technique, and analytical parameter and method to be performed.

Information on the labels will be completed with a ballpoint pen or indelible marker.

- iii) Samples will be collected in appropriately laboratory preserved sample containers by field personnel in order to minimize loss of the constituent(s) of interest due to physical, chemical or biological mechanisms.
- iv) Appropriate volumes will be collected to ensure that the EQLs can be successfully achieved and that the required QC Sample Analyses can be completed.

5.1.2 TRANSFER OF CUSTODY AND SHIPMENT PROCEDURES

- i) A chain-of-custody (COC) record will be completed during sample collection and will accompany each shipment identifying the contents of the shipment. The COC record will accompany the samples to the laboratory. The field personnel collecting the samples will be responsible for the custody of the samples until the samples are relinquished to the laboratory. Sample transfer will require the individuals relinquishing and receiving the samples to sign, date and note the time of sample transfer on the COC record. As few people as possible should handle the samples.
- ii) Samples will be shipped or delivered in a timely fashion to the laboratory so that holding-times and/or analysis times as prescribed by the methodology can be met.
- iii) Samples will also be transported in containers (coolers) packed with ice to maintain the temperatures prescribed in Table 4.1. Samples will be packaged for shipment and shipped to the appropriate laboratory for analysis with a separate signed COC record enclosed in each sample cooler. VOC samples will be placed in bubble wrap bags or foam sleeves. The remaining samples in glass containers will be wrapped in bubble wrap and placed in the sample cooler. Samples in polyethylene containers will be placed upright directly in the sample cooler. Water samples will be placed in an upright position and limited to one layer of samples per each cooler. Additional bubble wrap or packaging material will be added to fill the cooler. Shipping containers will be secured with strapping tape and custody tape for shipment to the laboratory.

- iv) When samples are split with the Agency and Site representatives, a separate chain-of-custody will be prepared for the samples and marked to indicate to whom the samples are being split. The person relinquishing the samples to the Agency or the Site will require the representatives' signature acknowledging sample receipt.
- v) If samples are sent by a commercial carrier, a bill of lading will be used. A copy of the bill of lading will be retained as part of permanent documentation. Commercial carriers are not required to sign the custody record as long as the custody record is sealed inside the sample cooler and the custody tape remains intact.
- vi) Samples will be picked up by a laboratory courier or transported overnight by a courier to the laboratory the same day they are collected unless collected on a weekend or holiday. In these cases, the samples will be stored in a secure location until delivery to the lab. Additional ice will be added to the cooler as needed to maintain proper preservation temperatures.

5.2 LABORATORY CHAIN-OF-CUSTODY PROCEDURES

A full-time sample receiving group leader supervises the sample receiving group who are assigned the responsibility of sample control. It will be the responsibility of the sample receiving group leader to receive all incoming samples. Once received, the receiving group leader will document that the custody tape on the coolers is unbroken, that each sample is received in good condition (i.e., unbroken, cooled, etc.), that the associated paperwork, such as chain-of-custody forms have been completed and will sign the chain-of-custody forms. In special cases, the receiving group leader will document from appropriate sub-samples that chain-of-custody with proper preservation has been accomplished. The receiving group leader will also document that sufficient sample volume has been received to complete the analytical program. The sample receiving group leader will then place the samples into secure, limited access storage (refrigerated storage, if required). The sample receiving group leader will assign a unique number to each incoming sample for use in the laboratory. The unique number will then be entered into the sample-receiving log. The laboratory date of receipt will also be noted.

Consistent with the analyses requested on the chain-of-custody form, analyses by the laboratory's analysts will begin in accordance with the appropriate methodologies. Samples will be removed from secure storage only after internal chain-of-custody sign-out procedures have been followed.

5.3 STORAGE OF SAMPLES

Sample containers with volume remaining will be returned to secure and limited access storage. Upon completion of all laboratory analyses for each sample submittal and generation of the laboratory report, samples will be stored by the sample receiving group leader. The length of time that samples are held will be at least thirty (30) days after reports have been submitted. Disposal of remaining samples will be completed in compliance with all Federal, State, and local requirements.

Laboratory custody procedures and document control for those samples analyzed by the project laboratory will be carried out using the laboratory's standard operating procedures.

5.4 FINAL PROJECT FILES CUSTODY PROCEDURES

The final project file will be the central repository for all documents with information relevant to sampling and analysis activities as described in this QAPP. The Project Manager will be the receiving group leader of the project file. The project files for the RFI, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, and data reviews will be maintained in a secured, limited access area and under custody of the CRA Project Manager or his/her designee.

The final project file will include:

- i) Project plans and drawings;
- ii) Field data records;
- iii) Sample identification documents and soil boring/monitoring well logs;
- iv) All chain-of-custody documentation;
- v) Correspondence;

- vi) References, literature;
- vii) Laboratory data deliverables;
- viii) Data validation and assessment reports;
- ix) Progress reports, QA reports; and
- x) Final report.

The laboratory will be responsible for maintaining analytical logbooks, laboratory data and sample chain of custody documents. Raw laboratory data files and copies of hard copy reports will be inventoried and maintained by the laboratory for a period of five (5) years at which time the laboratory will contact CRA regarding the disposition of the project related files.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes procedures for maintaining the accuracy for all the instruments and measurement equipment, which will be used for conducting field tests and laboratory analyses. These instruments and equipment will be calibrated prior to each use or according to a periodic schedule.

6.1 FIELD INSTRUMENT CALIBRATION PROCEDURES

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated as specified in the CRA Quality System Field Data Record Forms (QSF-###D), provided in Attachment 1.

The field instruments are likely to include water quality multi-meters capable of measuring pH, temperature, specific conductivity, turbidity, DO, and ORP or individual meters capable of measuring these parameters separately measuring and PIDs. Field instruments will be used for real-time sample measurement during monitoring well sampling and organics screening for both on-site screening of soil samples and for health and safety air monitoring, as described in the HASP. On-site air monitoring for health and safety purposes and the screening of soil samples may be accomplished using PIDs.

Field instruments will be calibrated prior to use and the calibration will be verified on a daily basis and documented on the appropriate QSF. Specific information concerning calibration frequency, acceptance criteria, and the conditions that require more frequent calibration is contained in the equipment user manual.

Satisfactory completion of the pre-operation inspection will be noted on the Field Sampling Record, along with the results of each field measurement.

6.2 LABORATORY INSTRUMENT CALIBRATION PROCEDURES

Calibration procedures for a specific laboratory instrument will consist of initial calibration, initial calibration verification and continuing calibration verification. The SOPs in Attachment 2 present the specific calibration procedures for each method of

analysis. The SOP for each analysis performed in the laboratory describes the calibration procedures, their frequency, acceptance criteria and the conditions that will require calibration. In all cases, the initial calibration will be verified using an independently prepared calibration verification solution.

The use of materials of known purity and quality will be utilized for the analysis of environmental samples. The laboratory will carefully monitor the use of all laboratory materials including solutions, standards and reagents through well-documented procedures.

All solid chemicals and acids/bases used by the laboratory will be reagent grade or better. All gases will be high purity or better. All Standard Reference Materials (SRMs) or Performance Testing (PT) Materials will be obtained from approved vendors of the National Institute of Standards and Technology (NIST), or the National Environmental Laboratory Accreditation Program (NELAP) accredited supplier.

All materials including standards or standard solutions will be dated upon receipt, and will be identified by material name, lot number, purity or concentration, supplier, receipt/preparation date, recipient/preparer's name, expiration date and all other pertinent information.

7.0 ANALYTICAL PROCEDURES

Analytical procedures to be utilized for off-Site analysis of environmental samples will be based on referenced U.S. EPA analytical protocols and the laboratory SOPs that implement these methods. The laboratory SOPs associated with the RFI Work Plan are provided in Attachment 2 to this QAPP.

7.1 FIELD ANALYTICAL PROCEDURES

Field analytical procedures include the measurement of pH/temperature, specific conductivity, turbidity, DO, and ORP during sampling of groundwater, and the qualitative measurement of VOC with PIDs during the collection of soil samples at the Site. Specific guidance in the measurement of these parameters is presented in the Site Specific Field Method Guidelines, provided in Appendix A of the RFI Work Plan.

7.2 LABORATORY ANALYTICAL PROCEDURES

Laboratory preparation and analytical SOPs and the methods upon which they are based are presented in Table 7.1. The referenced SOPs provided in Attachment 2 of this document are based on the U.S. EPA methodology requirements published in:

- i) "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846 EPA, U.S. EPA office of Solid Waste, 3rd Edition and promulgated updates, 1986;
- ii) "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, March 1983,
- iii) "Standard Methods for Examination of Water and Wastewater", APHA, AWWA & WEF, 19th Edition, 1995, and;
- iv) "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air", EPA-625/R-96/10b, January 1999.

The EQLs for the target analytes and compounds for the environmental media to be analyzed as part of the investigation are presented in Table 1.2, Table 1.3, Table 1.4, and Table 1.5.

7.2.1 LIST OF PROJECT TARGET COMPOUNDS AND LABORATORY DETECTION LIMITS

A complete listing of project target compounds and project EQLs for each analyte group are listed in Table 1.2, Table 1.3, and Table 1.4. MDLs have been experimentally determined by the project laboratory using the procedure identified in 40 CFR, Part 136 Appendix B. The laboratory's MDLs are provided in Attachment 3.

7.2.2 LIST OF METHOD SPECIFIC QUALITY CONTROL (QC) CRITERIA

The laboratory SOPs include a section that presents the minimum QC requirements for the project analyses. Section 8.0 references the frequency of the associated QC samples for each sampling effort and matrix.

8.0 INTERNAL QUALITY CONTROL CHECKS

This section presents the internal quality control checks that will be employed for field and laboratory measurements.

8.1 FIELD QUALITY CONTROL

QC procedures for pH/temperature, specific conductivity, turbidity, DO, and ORP of water samples and PID screening soil samples will include calibrating the instruments as described in Section 6.1 of this QAPP, measuring duplicate samples and checking the reproducibility of the measurements by taking multiple readings on a single sample or the measurement reference standards. The QC information for field equipment is stated in Section 3.0 of this QAPP. Assessment of field sampling precision and bias will be made by collecting field duplicates and equipment rinsate blanks for laboratory analysis. Collection of the samples will be in accordance with the applicable procedures in Section 4.3 of this QAPP.

8.1.1 EQUIPMENT RINSATE BLANKS

Internal quality control checks will include analysis of equipment rinsate blanks to validate successful equipment cleaning activities. Whenever possible, dedicated equipment will be employed to reduce the possibility of cross-contamination of samples.

The frequency of equipment rinsate blank sample preparation will be one for every 20 investigative samples. However, at a minimum, one will be collected each day for each type of sampling equipment on which decontamination procedures have been performed.

8.1.2 TRIP BLANKS

Trip blanks samples will be supplied by the project laboratory using laboratory purchased purified water for water samples and purge and trap grade methanol for soil samples placed within pre-cleaned 40 milliliter (ml) VOC vials equipped with Teflon

septa. Trip blanks will accompany each sample delivery group (SDG) of environmental samples collected for analysis of VOCs.

Appropriate trip blank samples will be placed in each cooler which stores and transports project samples to be analyzed for VOCs along with the project samples by matrix.

8.1.3 FIELD DUPLICATE SAMPLES

Field duplicate samples are collected in a similar fashion to investigative samples at a minimum frequency of one duplicate per at least one in every 20 or fewer investigative samples by matrix with a minimum of one per sampling event. Field duplicate samples are analyzed by the laboratory to evaluate matrix, sample and analytical reproducibility.

8.2 LABORATORY PROCEDURES

The laboratories identified in Section 7.0 of this QAPP have QC programs to ensure the reliability and validity of the analysis performed at the laboratory. All analytical procedures are documented in writing as SOPs and each SOP includes a QC section, which addresses the minimum QC requirements for the procedure. The internal quality control checks may vary slightly for each individual procedure but in general will include the following QC requirements:

- i) Calibration Standards;
- ii) Instrument Performance Checks – Organics;
- iii) Initial and Continuing Calibration Checks;
- iv) Internal Standard Performance;
- v) Method Blank Samples;
- vi) Laboratory Control Samples and QC Check Samples;
- vii) Matrix Spike/Matrix Spike Duplicates;
- viii) Surrogates;
- ix) ICP Interference Check Samples (ICS);
- x) ICP Serial Dilution;

- xi) ICP and ICP/MS QC Analyses;
- xii) Reagent Checks; and
- xiii) Blind Check Samples.

All data will be properly recorded. The data package will include a summary of QC data as presented in Section 9.3.2. Any samples analyzed in nonconformance with QC criteria will be re-analyzed as defined in the SOPs by the laboratory, if sufficient volume is available.

9.0 DATA REDUCTION, VALIDATION AND REPORTING

All data generated through in field activities or by the laboratory operation shall be reduced and validated prior to reporting in accordance with the following procedures:

9.1 DATA REDUCTION

9.1.1 FIELD DATA REDUCTION PROCEDURES

Field data reduction procedures will be minimal in scope compared to those implemented in the laboratory setting. Only direct read instrumentation will be employed in the field. The pH, specific conductivity, temperature, turbidity, DO, ORP and PID readings collected in the field will be generated from direct read instruments following calibration per manufacturer's recommendations. Such data will be written into field logbooks immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed and dated by the field member, and corrected in a space adjacent to the original entry. Later, when the results forms required for this study are being filled out, the Project Coordinator or designee will proof the forms to determine whether any transcription errors have been made by the field crew.

9.1.2 LABORATORY DATA REDUCTION PROCEDURES

For this project, the equations that will be employed in reducing data are found in the appropriate chapter of SW-846, Third Edition. Two of these equations, expressing analytical accuracy and precision, are presented in Section 3 of this QAPP. Such formulae make pertinent allowances for matrix type. All calculations are checked at the conclusion of each operating day. Errors are noted; corrections are made, but the original notations are crossed out legibly. Analytical results for soil samples shall be calculated and reported on a dry weight basis.

Quality control data (e.g., laboratory duplicates, surrogates, matrix spikes, and matrix spike duplicates) will be compared to the method acceptance criteria. Data considered to be acceptable will be entered into the laboratory computer system. Data summaries will be sent to the Laboratory QA Officer for review. If approved, data are logged into

the project database format. Unacceptable data shall be appropriately qualified in the project report. Case narratives will be prepared which will include information concerning data that fell outside acceptance limits and any other anomalous conditions encountered during sample analysis.

9.2 DATA VALIDATION

Data validation procedures shall be performed for both field and laboratory operations as described below:

9.2.1 PROCEDURES USED TO EVALUATE FIELD DATA

Procedures to evaluate field data for this project will include review of field logbooks and checking for transcription errors to project specific documents. This task will be the responsibility of the Field QA Officer or designee.

9.2.2 PROCEDURES TO VALIDATE LABORATORY DATA

The CRA QA Officer or designee will perform analytical data validation using the following documents as guidance for the review process.

- i. "U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review", EPA-540/R-99/008, October 1999, and
- ii. "U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review ", EPA-540/R-94-013, February 1994.

The specific data qualifiers used will be as presented and defined in the CLP National Functional Guidelines. A reduced data review and validation will be performed on all investigative samples (waste characterization samples will not be validated) that will consist of the following components:

- i) Technical holding times;
- ii) method, trip and field blanks;

- iii) system monitoring compounds (surrogate spikes organics);
- iv) MS/MSD/MD results
- v) LCS results; and
- vi) field duplicate samples.

The CRA QA Officer will evaluate the completeness of each data package. Completeness checks will be administered on all data to determine whether deliverables specified in the QAPP are present. At a minimum, deliverables will include sample chain-of-custody forms, analytical results, QC summaries and supporting raw data from instrument printouts. The review will determine whether all required items are present and request copies of missing deliverables.

9.3 DATA REPORTING

Data reporting procedures shall be carried out for field and laboratory operations as indicated below:

9.3.1 FIELD DATA REPORTING

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field and documentation of all field calibration activities.

9.3.2 LABORATORY DATA REPORTING

The laboratory data reporting package will be sufficient to perform a data validation in accordance with protocols described in Section 9.2.2. The task of reporting laboratory data by RACER will be initiated after the completion of data validation.

The laboratory Project Manager will perform a final review of the QC data summary packages and case narratives to determine whether the report meets the project requirements. In addition to the record of the chain-of-custody, the final laboratory data report format shall consist of the following.

- i) Title Page
 - project name and number;
 - laboratory project or lot number;
 - signature of the Laboratory Project Manager or his designee; and
 - date issued.
- ii) Table of Contents - laboratory report contents
- iii) Case Narrative
 - number of samples and respective matrices;
 - laboratory analysis performed;
 - any deviations from intended analytical strategy;
 - definition of data qualifiers used;
 - QC procedures utilized and references to the acceptance criteria;
 - condition of samples "as received";
 - discussion of whether or not sample holding times were met;
 - discussion of technical problems or other observations which may have created analytical difficulties; and
 - discussion of laboratory QC checks which failed to meet project criteria.
- iv) Analytical Methods Summary - methods of sample preparation and analyses for samples.
- v) Analytical Sample Summary - cross-reference table of laboratory sample to project sample identification numbers.
- vi) Shipping and Receiving Documents
 - sample container documentation; and
 - sample reception information and original chain of custody record.
- vii) Chemistry Data Package by Analysis
 - Sample Results
 - sample quantitation (report) limits (RL), reporting MDL and estimated values between the RL and MDL,
 - methods, dates, and times of sample preparation and analyses for samples;

- QC Summary Data with Current Control Limits
 - matrix spike and matrix spike duplicate recoveries,
 - laboratory control samples,
 - method blank results, and
 - surrogate recoveries (organics).

The project laboratory will provide electronic data deliverables (EDDs) in an EQuIS® 4-file format. The laboratory data will be downloaded into the EDDs directly from the laboratory information management system (LIMS). The EDDs are imported into EQuIS and the data are maintained in the database for manipulation and presentation.

The CRA QA Officer will verify the correctness of the analytical database by comparing the data from the database to the hardcopy analytical reports for a minimum of 10 percent of the sample results. If discrepancies between the database and hardcopy analytical reports are detected, a complete verification of the database will be performed.

10.0 PERFORMANCE AND SYSTEM AUDITS

A performance audit is an independently obtained quantitative comparison with data routinely obtained in the field or the laboratory. Performance audits include two separate, independent parts: internal and external audits.

10.1 FIELD PERFORMANCE AND SYSTEM AUDITS

10.1.1 INTERNAL FIELD AUDIT RESPONSIBILITIES

Internal audits of field activities include the review of sampling and field measurements conducted by the Field QA Officer or designee. The audits will verify that all procedures are being followed. Internal field audits will be conducted once during each phase of the sampling and at the conclusion of the project. The audits will include examination of the following:

- i) Field sampling records, screening results, instrument operating records;
- ii) Sample collection;
- iii) Handling and packaging in compliance with procedures;
- iv) Maintenance of QA procedures; and
- v) Chain-of-custody reports.

Follow up audits will be conducted to correct deficiencies and to verify that procedures are maintained throughout the investigation. The field audit checklist is included in Appendix 4.

10.1.2 EXTERNAL FIELD AUDIT RESPONSIBILITIES

External audits may be conducted by the Agency Project Manager at any time during the field operations. These audits may or may not be announced and are at the discretion of the regulatory agency. The external field audits can include (but are not limited to) the following:

- i) Sampling equipment decontamination procedures;

- ii) Sample bottle preparation procedures;
- iii) Sampling procedures;
- iv) Examination of health and safety plans;
- v) Procedures for verification of field duplicates; and
- vi) Field screening practices.

10.2 LABORATORY PERFORMANCE AND SYSTEM AUDITS

10.2.1 INTERNAL LABORATORY AUDIT RESPONSIBILITIES

The laboratory system audits will be conducted by the Laboratory QA Officer or designee and performed on an annual basis. Laboratory performance audits will be conducted prior to field activities or on an annual basis, depending on the duration of the project.

The system audit will include an examination of laboratory documentation including: sample receiving logs, sample storage, chain-of-custody procedures, sample preparation and analysis, and instrument operating records.

The performance audits will include submittal of blind performance evaluation samples along with project samples. The Laboratory QA Officer will evaluate the analytical results to ensure the lab is maintaining acceptable QC performance. The laboratory audit checklist is provided in Attachment 5.

System audits, as opposed to performance audits, are strictly qualitative and consist of an on-site review of a laboratory's quality assurance system and physical facilities for calibration and measurement.

At the conclusion of internal or external system audits, reports are provided to the laboratory's operating divisions for appropriate comment and remedial/corrective action where necessary. Written response to internal as well as external audits will be required. Records of audits and corrective actions are maintained by the Laboratory QA Officer.

10.2.2 EXTERNAL LABORATORY AUDIT RESPONSIBILITIES

External audits will be conducted as required, by appropriate QA personnel of the regulatory agency and may be conducted at least once prior to sampling and analysis activities.

External audits may include any of the following:

- i) Review of laboratory analytical procedures;
- ii) Laboratory on-site visits; and
- iii) Submission of performance evaluation samples for analysis.

Failure of any of the above audit procedures can lead to laboratory disqualification, and another suitable laboratory will have to be chosen. An on-site review can consist of:

- i) Sample receipt procedures;
- ii) Custody, sample security, and log-in procedures;
- iii) Review of instrument calibration logs;
- iv) Review of QA procedures;
- v) Review of log books;
- vi) Review of analytical SOPs; and
- vii) Personnel interviews.

A review of a data package from samples recently analyzed by the laboratory can include (but not be limited to) the following:

- i) Comparison of resulting data to the SOP or method;
- ii) Verification of initial and continuing calibrations within control limits;
- iii) Verification of surrogate recoveries and instrument timing results;
- iv) Review of extended quantitation reports for comparisons of library spectra to instrument spectra, where applicable; and
- v) Assurance that samples are run within holding times.

11.0 PREVENTATIVE MAINTENANCE

11.1 FIELD INSTRUMENT PREVENTATIVE MAINTENANCE

The field equipment preventative maintenance program ensures the effective completion of the sampling effort and is designed to minimize equipment down time. Program implementation is concentrated in three areas:

- Maintenance responsibilities.
- Maintenance schedules.
- Inventory of critical spare parts and equipment.

The maintenance responsibilities for field equipment will be assigned to the task leaders in charge of specific field operations. Field personnel will be responsible for daily field checks and calibrations and for reporting any problems with the equipment. The maintenance schedule will follow the manufacturer's recommendations. In addition, the field personnel will be responsible for determining that critical spare parts are included with the field equipment. An adequate inventory of spare parts will be maintained. The inventory will primarily contain parts that are subject to frequent failure, have limited useful lifetimes and/or cannot be obtained in a timely manner.

11.2 LABORATORY INSTRUMENT PREVENTATIVE MAINTENANCE

Analytical instruments at the laboratory will undergo routine and/or preventative maintenance. The extent of the preventative maintenance will be a function of the complexity of the equipment.

Generally, annual preventative maintenance service will involve cleaning, adjusting, inspecting and testing procedures designed to deduce instrument failure and/or extend useful instrument life. Between visits, routine operator maintenance and cleaning will be performed according to manufacturer's specifications by laboratory personnel.

Maintenance records will be placed on file at the laboratory and can be made available upon request.

12.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The following sections include the procedures and formulae utilized to assess the levels of precision, accuracy and completeness achieved during the associated sample analyses.

12.1 FIELD MEASUREMENTS

Field generated information such as pH and specific conductance data will be reviewed for validity. The review will be performed by the Field QA Officer or designee and typically include bound logbooks/forms, data entry and calculation checks. Field data will be assessed by the Project Field QA Officer or designee who will review the field results for compliance with the established QC criteria that are specified in Section 3.0 of this QAPP. The accuracy of the field measurements will be assessed using daily instrument calibration, calibration check, and blank data. Accuracy will be measured by determining the percent recovery of calibration check standards as defined in Section 12.2.2. Precision of the field measurements will be assessed on the basis of the reproducibility of duplicate readings of a single sample and will be measured by determining the relative percent difference of the readings as defined in Section 12.2.1. Accuracy and precision of the soil VOC screening will be determined using duplicate readings of calibration checks. Field data completeness will be calculated using the following equation:

$$\text{Completeness} = \frac{\text{Valid (usable) Data Obtained}}{\text{Total Data Planned}} \times 100$$

12.2 LABORATORY DATA

Laboratory results will be assessed for compliance with required precision, accuracy and completeness detailed in the following subsections:

12.2.1 PRECISION

The precision of laboratory analysis will be assessed by comparing the analytical results between MS/MSD analyses. The relative percent difference (RPD) will be calculated for each pair of duplicate analyses (laboratory MS/MSDs and field duplicates).

12.2.2 ACCURACY

The accuracy of laboratory results will be assessed for compliance with the established QC criteria that are described in Sections 3.0 and 8.0 of the QAPP using the analytical results of method blanks, reagent/preparation blank, SRMs or QC check samples and MS/MSD samples. The percent recovery (%R) of matrix spike samples and SRMs will be calculated.

12.2.3 COMPLETENESS

Completeness will be assessed by comparing the number of valid (usable) results (as determined by the QA Officer) to the total possible number of results using the formula presented in Section 12.1.

12.3 STATISTICAL EVALUATIONS

In the examination of data and determination of their precision and accuracy, standard statistical formulae will be used. Further details are provided in the following subsections.

12.3.1 PERCENT RECOVERY

The percent recovery of a parameter is calculated by dividing the amount recovered by the true amount added and multiplying by 100. The percent recoveries of spiked samples are evaluated to establish the analytical accuracy of a measurement. Percent recovery is calculated using the following formula:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where:

SSR = Spiked Sample Result
SR = Sample Result or Background
SA = Spike Added

12.3.2 RELATIVE PERCENT DIFFERENCE

The relative percent difference (RPD) is calculated by dividing the absolute value of the difference between two numbers by their arithmetic mean and multiplying by 100. The RPD is used to evaluate the analytical precision of two replicate measurements (e.g., matrix spike/matrix spike duplicate). RPD is calculated using the following formula:

$$RPD = \frac{(R_1 - R_2)}{R_1 + R_2} \times 200$$

where:

R₁ = value of first result
R₂ = value of second result

13.0 CORRECTIVE ACTION

13.1 FIELD CORRECTIVE ACTION

Corrective action is intended to address problems that arise by identification, recommendation, approval, and implementation of measures that counter unacceptable procedures or deficient quality control performance. The Field QA Officer and CRA QA Officer will be responsible for ensuring the quality of the sampling procedures and environmental data and as such, will be responsible for initiating corrective action when appropriate.

The corrective action procedures will be as follows:

- i) Identify/define the problem.
- ii) Assign responsibility for investigating the problem.
- iii) Investigate/determine the cause of the problem.
- iv) Determine an appropriate corrective action to eliminate the problem.
- v) Implement the corrective action.
- vi) Evaluate the effectiveness of the corrective action.
- vii) Verify that the corrective action has eliminated the problem.
- viii) Prepare a written record detailing the problem, corrective action utilized, and solution of the problem.
- ix) Submit the Corrective Action Record (CAR) to the Task Coordinator who initiated the corrective action and the CRA QA Officer, and Project Manager.

The above procedures may be implemented through the use of the Systems Audit as described previously. Any Field Team member of the project may initiate corrective action procedures by reporting in writing the nature of the suspected problem to the CRA Project Manager or CRA QA Officer. The CRA Project Manager will begin corrective action by relating the problem to appropriate personnel.

13.2 LABORATORY CORRECTIVE ACTION

The following paragraphs define the corrective action decision process relative to possible non-compliant events encountered during laboratory analysis of the project samples. Corrective actions will be initiated by the laboratory QA personnel and will be implemented by laboratory staff chemists under the oversight of the laboratory QA personnel. As with field corrective actions, the laboratory QA personnel will document the problem, the corrective action undertaken and the resolution of the problem. The corrective actions will be performed prior to release of the data from the laboratory.

Documentation will be provided to the laboratory QA Officer, CRA QA Officer, CRA Project Manager and RACER Project Manager.

13.3 CORRECTIVE ACTION DURING DATA VALIDATION AND DATA ASSESSMENT

The CRA QA Officer may identify the need for corrective action during either the data validation or data assessment processes. Potential types of corrective action may include re-sampling by the field team or re-injection/reanalysis of samples by the laboratory (if possible).

These actions are dependent upon the ability to mobilize the field team, whether the data to be collected is necessary to meet the required quality assurance objectives (e.g., the holding time for samples is not exceeded). When the CRA QA Officer identifies a corrective action situation, RACER Project Manager will be responsible for approving the implementation of corrective action, including re-sampling, during data assessment. All corrective actions will be documented by the CRA Project Manager.

14.0 QUALITY ASSURANCE (QA) REPORTS

Critically important to the successful implementation of the QA Plan is a reporting system that provides the means by which the program can be reviewed, problems identified and programmatic changes made to improve the plan.

QA reports to management include:

- Audit reports, internal and external audits with responses
- Performance evaluation sample results; internal and external sources
- Daily QA/QC exception reports/corrective actions

QA/QC corrective action reports will be prepared by the CRA QA Officer when appropriate and presented to the project and/or laboratory management personnel so that performance criteria can be monitored for all analyses from each analytical department. The updated trend/QA charts prepared by the laboratory QA personnel will be distributed and reviewed by various levels of the laboratory management.

15.0 REFERENCES

1. United States Environmental Protection Agency, (1999). EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations. EPA QA/R-5 Interim Final, November 1999.
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4. United States Environmental Protection Agency, (1993). Data Quality Objectives Process for Superfund Interim Final Guidance. U.S. EPA/540/R-93-071, Office of Solid Waste and Emergency Response (OSWER), September 1993.
5. United States Environmental Protection Agency, (1992). Specifications and Guidance for Contaminant-Free Sample Containers. OSWER Directive 9240.0-05A, April 1992.
6. United States Environmental Protection Agency. U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. U.S. EPA 540/R-99-012.
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8. United States Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Office of Solid Waste, U.S. EPA, SW-846, November 1986, with updates.

TABLE 1.1

**SUMMARY OF SAMPLING AND ANALYSIS PROGRAM
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN**

<i>Activity/Description</i>	<i>Sample Matrix</i>	<i>Field Parameters</i>	<i>Potential Laboratory Parameters</i>	<i>Investigative Samples</i>	<i>Quality Control Samples (1)</i>			<i>Total</i>
					<i>Field Blanks (2)</i>	<i>Field Duplicates</i>	<i>MS/MSD LCS/LCD (3)</i>	
Soil Investigation	Soil	PID VOC Screen	TCL VOC, TCL SVOC, TCL PCB, Site-specific TAL Metals (4), Fractionated Lead, Hexavalent/Trivalent Chromium, Total Cyanide	TBD	1/20	1/20	1/20	(5)
Groundwater Monitoring	Groundwater	pH/Temperature, DO, Specific Conductivity, Turbidity, ORP	TCL VOC, TCL SVOC, TCL PCB, Site-specific TAL Metals (4), Hexavalent/Trivalent Chromium, Amenable Cyanide	TBD	1/20	1/20	1/20	(5)
Background Metals	Soil	PID VOC Screen	TAL Metals	TBD	1/20	1/20	1/20	(5)
	Groundwater	pH/Temperature, DO, Specific Conductivity, Turbidity, ORP	TAL Metals	TBD	1/20	1/20	1/20	(5)
Natural Attenuation/ Chemical Oxidation/ Monitoring	Groundwater	pH/Temperature, DO, Specific Conductivity, Turbidity, ORP	TCL VOC, Total and Dissolved Metals (6), Alkalinity, BOD, COD, Dissolved Gases, Nitrate, Nitrite, Sulfate, Sulfide, TOC, Select Metals (7), Hexavalent/Trivalent Chromium, Ammonia-N, Orthophosphate,	TBD	1/20	1/20	1/20	(5)
NAPL Characterization	NAPL	n/a	TCL VOC, TCL SVOC, TCL PCB, Site-specific TAL Metals (4) Specific gravity, viscosity, Heating Value Flashpoint, Fingerprinting	TBD	--	--	--	TBD
Surface Water Investigation	Surface Water	pH/Temperature, Specific Conductivity	Hardness, pH	TBD	1/20	1/20	1/20	(5)

TABLE 1.1

**SUMMARY OF SAMPLING AND ANALYSIS PROGRAM
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN**

<i>Activity/Description</i>	<i>Sample Matrix</i>	<i>Field Parameters</i>	<i>Potential Laboratory Parameters</i>	<i>Investigative Samples</i>	<i>Quality Control Samples (1)</i>			<i>Total</i>
					<i>Field Blanks (2)</i>	<i>Field Duplicates</i>	<i>MS/MSD LCS/LCD (3)</i>	
Soil Gas Sampling	Air	None	Site-specific VOC	TBD	0	1/20	1/20	(5)
Ambient Air Sampling	Air	None	Site-specific VOC	TBD	0	1/20	1/20	(5)

Notes:

- (1) - A laboratory trip blank will be submitted with each shipment of samples for TCL VOC analysis.
(2) - Field blank samples will not be required if dedicated or disposable sampling equipment is used.
(3) - Matrix Spike/Matrix Spike duplicate (MS/MSD) analyses are required for samples submitted for organic and inorganic analyses, Laboratory Control Samples/Laboratory Control Duplicates analyses are required for air samples and water samples without adequate volume for MS/MSDs. These are to be analyzed at a frequency of one per group of twenty (20) or fewer investigative samples.
(4) - Site-specific TAL Metals includes the TAL Metals excluding Aluminum, Calcium, Iron, Magnesium, Potassium and Sodium.
(5) - The frequency of Field Blanks and Field Duplicates will be one per 20 investigative samples and will be combined from multiple PAOCs.
The total sample quantity will vary depending on which PAOC the QC samples are collected from.
(6) - Total and Dissolved Metals within the natural attenuation monitoring include Manganese and Iron.
(7) - Select Metals include Arsenic, Chromium, and Sodium.

PID = Photo-Ionization Detector
VOC = Volatile Organic Compounds
TCL = Target Compound List
PCB = Polychlorinated Biphenyls

SVOC = Semi-volatile Organic Compounds
TAL = Target Analyte List
BOD = Biochemical Oxygen Demand
COD = Chemical Oxygen Demand

DO = Dissolved Oxygen
ORP = Oxidation-Reduction Potential
TBD = To be determined

TABLE 1.2

RFI TARGET COMPOUND AND TARGET ANALYTE PARAMETER LIST
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN

<i>Compound</i>	<i>Estimated</i>			<i>Method</i>		
	<i>Quantitation Limits (EQL) ¹</i>			<i>Detection Limits (MDL) ²</i>		
	<i>Water</i>	<i>Soil</i>	<i>NAPL</i>	<i>Water</i>	<i>Soil</i>	<i>NAPL</i>
	(µg/L)	(µg/kg)	(µg/kg)	(µg/L)	(µg/kg)	(µg/kg)
<i>Target Compound List (TCL) Volatile Organic Compounds (VOC) ³</i>						
Acetone	10	600	4000	1.1	170	170
Benzene	1	40	1000	0.13	12	12.0
Bromodichloromethane	1	80	1000	0.15	9.9	10
Bromoform	1	80	1000	0.64	19	19
Bromomethane	1	200	2000	0.41	29	29
2-Butanone	10	600	4000	0.57	43	43
Carbon disulfide	5	200	1000	0.13	12	12
Carbon tetrachloride	1	40	1000	0.13	6.4	6
Chlorobenzene	1	40	1000	0.15	6.4	6.4
Chloroethane	1	200	2000	0.29	61	61
Chloroform	1	40	1000	0.16	8.8	9
Chloromethane	1	200	2000	0.3	14	14.0
Cyclohexane	1	960	2000	0.12	40	40.0
Dibromochloromethane	1	40	1000	0.18	12	12.0
1,2-Dibromo-3-chloropropane	1	200	1000	0.67	50	50
1,2-Dibromoethane	1	200	1000	0.24	10	10.0
1,2-Dichlorobenzene	1	80	1000	0.13	8.6	9
1,3-Dichlorobenzene	1	80	1000	0.14	4.8	4.8
1,4-Dichlorobenzene	1	80	1000	0.13	8	8.0
Dichlorodifluoromethane	1	80	2000	0.31	16	16.0
1,1-Dichloroethane	1	40	1000	0.15	17	17.0
1,2-Dichloroethane	1	40	1000	0.22	10	10.0
1,1-Dichloroethene	1	40	1000	0.19	18	18.0
cis-1,2-Dichloroethene	1	40	1000	0.17	6.9	7
trans-1,2-Dichloroethene	1	40	1000	0.19	9.2	9
1,2-Dichloropropane	1	40	1000	0.18	8.2	8.2
cis-1,3-Dichloropropene	1	40	1000	0.14	7.9	7.9
trans-1,3-Dichloropropene	1	40	1000	0.19	20	20.0
Ethylbenzene	1	40	1000	0.17	5.4	5.4
2-Hexanone	10	2000	4000	0.41	20	20
Isopropylbenzene	1	200	1000	0.13	6.5	6.5
Methyl acetate	10	960	2000	0.38	25	25
Methylene chloride	5	200	1000	0.33	77	77
Methylcyclohexane	1	960	1000	0.13	12	12.0
4-Methyl-2-pentanone	10	2000	4000	0.32	48	48
Methyl tert-butyl ether	5	200	4000	0.17	7.1	7
Styrene	1	40	1000	0.11	5.6	6
1,1,2,2-Tetrachloroethane	1	40	1000	0.18	8.9	8.9
Tetrachloroethene	1	40	1000	0.29	12	12.0

TABLE 1.2

RFI TARGET COMPOUND AND TARGET ANALYTE PARAMETER LIST
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN

<i>Compound</i>	<i>Estimated</i>			<i>Method</i>		
	<i>Quantitation Limits (EQL) ¹</i>			<i>Detection Limits (MDL) ²</i>		
	<i>Water</i> (µg/L)	<i>Soil</i> (µg/kg)	<i>NAPL</i> (µg/kg)	<i>Water</i> (µg/L)	<i>Soil</i> (µg/kg)	<i>NAPL</i> (µg/kg)
<i>TCL VOC (Continued)</i>						
Toluene	1	80	1000	0.13	17	17.0
1,2,4-Trichlorobenzene	1	200	1000	0.15	7.3	7
1,1,1-Trichloroethane	1	40	1000	0.22	21	21.0
1,1,2-Trichloroethane	1	40	1000	0.27	12	12.0
Trichloroethene	1	40	1000	0.17	9.7	10
Trichlorofluoromethane	1	80	2000	0.21	16	16.0
1,1,2-Trichloro-1,2,2-trifluoroethane	1	200	2000	0.28	39	39
Vinyl chloride	1	32	2000	0.22	18	18
Xylenes (total)	2	120	2000	0.28	8.1	8
<i>TCL Semi-Volatile Organic Compounds (SVOC)</i>						
Acenaphthene	5	264	20,000	0.1	3.3	55
Acenaphthylene	5	264	20,000	0.1	3.3	84
Acetophenone	5	264	20,000	0.34	9.2	330
Anthracene	5	264	20,000	0.1	3.3	138
Atrazine	3	40	20,000	0.34	9.1	660
Benzaldehyde	5	264	20,000	0.39	12	414
Benzo(a)anthracene	1	264	20,000	0.1	3.3	84
Benzo(a)pyrene	1	264	20,000	0.1	3.3	138
Benzo(b)fluoranthene	1	264	20,000	0.1	3.3	138
Benzo(g,h,i)perylene	1	264	20,000	0.1	3.3	108
Benzo(k)fluoranthene	1	264	20,000	0.1	3.3	138
1,1'-Biphenyl	5	264	20,000	0.8	27	432
4-Bromophenylphenyl ether	5	264	20,000	0.8	13	282
Butylbenzylphthalate	5	264	20,000	0.8	10	222
di-n-Butylphthalate	5	264	20,000	0.67	15	300
Caprolactam	10	264	20,000	0.8	37	468
Carbazole	10	264	20,000	0.28	27	558
4-Chloroaniline	5	264	20,000	0.8	17	312
bis(2-Chloroethoxy)methane	5	264	20,000	0.32	22	960
bis(2-Chloroethyl)ether	1	80	20,000	0.1	2	246
2,2'-oxibis(1-Chloropropane)	5	264	20,000	0.4	9.5	312
4-Chloro-3-methylphenol	5	264	20,000	0.8	21	3,060
2-Chloronaphthalene	5	264	20,000	0.1	3.3	378
2-Chlorophenol	5	264	20,000	0.29	27	216
4-Chlorophenyl phenyl ether	10	264	20,000	0.8	13	216
Chrysene	1	264	20,000	0.1	1.1	59
Dibenz(a,h)anthracene	2	264	20,000	0.1	3.3	90

TABLE 1.2

RFI TARGET COMPOUND AND TARGET ANALYTE PARAMETER LIST
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN

<i>Compound</i>	<i>Estimated</i>			<i>Method</i>		
	<i>Quantitation Limits (EQL) ¹</i>			<i>Detection Limits (MDL) ²</i>		
	<i>Water</i>	<i>Soil</i>	<i>NAPL</i>	<i>Water</i>	<i>Soil</i>	<i>NAPL</i>
	(µg/L)	(µg/kg)	(µg/kg)	(µg/L)	(µg/kg)	(µg/kg)
<i>TCL Semi-Volatile Organic Compounds (cont'd)</i>						
Dibenzofuran	4	264	20,000	0.1	3.3	50
3,3'-Dichlorobenzidine	1	1,600	96,000	0.37	18	294
2,4-Dichlorophenol	10	264	20,000	0.8	20	318
Diethylphthalate	5	264	20,000	0.6	16	372
2,4-Dimethylphenol	5	264	20,000	0.8	20	408
Dimethylphthalate	5	264	20,000	0.29	17	384
4,6-Dinitro-2-methylphenol	20	150	96,000	2.4	80	2,820
2,4-Dinitrophenol	20	150	96,000	2.4	80	2,460
2,4-Dinitrotoluene	5	264	20,000	0.27	27	342
2,6-Dinitrotoluene	5	264	20,000	0.8	21	348
bis(2-Ethylhexyl)phthalate	5	264	20,000	0.8	19	960
Fluoranthene	1	264	20,000	0.1	3.3	56
Fluorene	5	264	20,000	0.1	3.3	78
Hexachlorobenzene	0.2	264	20,000	0.1	2.1	84
Hexachlorobutadiene	1	40	20,000	0.27	27	150
Hexachlorocyclopentadiene	5	264	96,000	0.8	27	174
Hexachloroethane	5	264	20,000	0.8	9	294
Indeno(1,2,3-cd)pyrene	2	264	20,000	0.1	3.3	120
Isophorone	5	264	20,000	0.27	13	210
2-Methylnaphthalene	5	264	20,000	0.1	3.3	59
2-Methylphenol	5	264	20,000	0.8	80	402
4-Methylphenol	5	264	20,000	0.3	20	348
Naphthalene	5	264	20,000	0.1	3.3	53
2-Nitroaniline	20	200	96,000	0.8	9.1	306
3-Nitroaniline	20	200	96,000	0.28	18	192
4-Nitroaniline	20	200	96,000	0.8	26	216
Nitrobenzene	3	264	20,000	0.04	2.2	384
2-Nitrophenol	5	264	20,000	0.28	27	204
4-Nitrophenol	20	330	96,000	2.4	80	4,860
N-Nitroso-di-n-propylamine	5	264	20,000	0.8	27	456
N-Nitrosodiphenylamine	5	264	20,000	0.31	21	246
di-n-Octylphthalate	5	264	20,000	0.8	27	660
Pentachlorophenol	5	150	20,000	2.4	80	2,700
Phenanthrene	2	264	20,000	0.1	3.3	66
Phenol	5	264	20,000	0.6	27	342
Pyrene	5	264	20,000	0.1	3.3	60
2,4,5-Trichlorophenol	5	264	20,000	0.3	25	294
2,4,6-Trichlorophenol	4	264	20,000	0.8	80	408

TABLE 1.2

RFI TARGET COMPOUND AND TARGET ANALYTE PARAMETER LIST
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN

<i>Compound</i>	<i>Estimated</i>			<i>Method</i>		
	<i>Quantitation Limits (EQL) ¹</i>			<i>Detection Limits (MDL) ²</i>		
	<i>Water</i> ($\mu\text{g/L}$)	<i>Soil</i> ($\mu\text{g/kg}$)	<i>NAPL</i> ($\mu\text{g/kg}$)	<i>Water</i> ($\mu\text{g/L}$)	<i>Soil</i> ($\mu\text{g/kg}$)	<i>NAPL</i> ($\mu\text{g/kg}$)
<i>TCL Polychlorinated Biphenyls (PCB)</i>						
Aroclor 1016	0.1	264	1,000	0.044	21	190
Aroclor 1221	0.1	264	1,000	0.045	16	220
Aroclor 1232	0.1	264	1,000	0.073	14	170
Aroclor 1242	0.1	264	1,000	0.06	13	290
Aroclor 1248	0.1	264	1,000	0.061	17	200
Aroclor 1254	0.1	264	1,000	0.032	17	120
Aroclor 1260	0.1	264	1,000	0.038	17	130
<i>Compound</i>	<i>Estimated</i>			<i>Method</i>		
	<i>Quantitation Limits (EQL) ¹</i>			<i>Detection Limits (MDL) ²</i>		
	<i>Water</i> ($\mu\text{g/L}$)	<i>Soil</i> (mg/kg)	<i>NAPL</i> (mg/kg)	<i>Water</i> ($\mu\text{g/L}$)	<i>Soil</i> (mg/kg)	<i>NAPL</i> (mg/kg)
<i>Site-specific TAL Metals</i>						
Antimony	2	0.16	1	0.13	0.024	0.39
Arsenic	5	0.08	1	0.4	0.062	0.30
Barium	100	0.8	20	0.19	0.071	0.07
Beryllium	1	0.16	0.5	0.2	0.043	0.043
Cadmium	1	0.08	0.2	0.13	0.036	0.036
Chromium	10	0.8	0.5	0.71	0.2	0.20
Cobalt	20	0.4	5	0.058	0.16	0.16
Copper	4	0.8	2.5	0.29	0.74	0.74
Lead						
Lead, total by determination	3	0.24	0.3	0.18	0.19	0.19
Lead, total by fraction calculation	NA	0.24	NA	NA	0.19	NA
Lead, fine grain fraction	NA	0.24	NA	NA	0.19	NA
Lead, coarse grain fraction	NA	0.24	NA	NA	0.19	NA
Manganese	50	0.8	1.5	0.83	0.074	0.074
Mercury	0.2	0.04	0.1	0.2	0.015	0.015
Nickel	20	0.8	4	0.12	0.27	0.27
Selenium	5	0.16	0.5	0.57	0.09	0.45
Silver	0.2	0.08	0.5	0.08	0.016	0.10
Thallium	2	0.08	1	0.14	0.013	0.55
Vanadium	4	0.8	5	0.44	0.12	0.120
Zinc	50	0.8	2	2.3	0.2	1.00

TABLE 1.2

RFI TARGET COMPOUND AND TARGET ANALYTE PARAMETER LIST
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN

<i>Compound</i>	<i>Estimated</i>			<i>Method</i>		
	<i>Quantitation Limits (EQL) ¹</i>			<i>Detection Limits (MDL) ²</i>		
	<i>Water</i> (µg/L)	<i>Soil</i> (mg/kg)	<i>NAPL</i> (mg/kg)	<i>Water</i> (µg/L)	<i>Soil</i> (mg/kg)	<i>NAPL</i> (mg/kg)
<i>Additional TAL Metals</i>						
Aluminum	50	16	NA	19	9.6	NA
Calcium	1,000	400	NA	22	16	NA
Iron	200	8.0	NA	26	4.9	NA
Magnesium	1,000	80	NA	17	5.1	NA
Potassium	1,000	400	NA	8.3	6.2	NA
Sodium	1,000	80.0	NA	6.9	66	NA
<i>Additional Parameters</i>						
Cyanide (amenable)	10	NA	NA	5	NA	NA
Cyanide (total)	NA	0.5	0.5	NA	0.1	0.100
Hexavalent chromium	20	0.8	NA	5	0.2	0.2
pH	NA	NA	NA	NA	NA	NA
Hardness	5000	NA	NA	2800	NA	NA
Specific Gravity	NA	NA	0.01 g/cm ³	NA	NA	NA
Viscosity	NA	NA	0.20 cSt	NA	NA	NA
Heating Value	NA	NA	360 BTU/lb	NA	NA	NA
Petroleum Fingerprinting	NA	NA	NA	NA	NA	NA

Notes:

- ¹ - Please note that these are estimated quantitation limits and are presented for guidance only. Actual quantitation limits are highly matrix dependent and may be elevated due to matrix effects, QA/QC problems and high concentrations of target and non-target analytes.
- ² - Method Detection Limits (MDL) are also presented for guidance only. Actual MDLs will vary depending on sample specific preparation factors. The MDLs are also highly matrix dependant and may be elevated due to matrix effects, QA/QC problems and high concentrations of target and non-target analytes. Laboratory MDLs are updated on a periodic basis and the MDLs in effect when the samples are analyzed will be used for reporting purposes.
- ³ - U.S. EPA Contract Laboratory Program, "Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration", OLM4.2, May 1999 Target Compound List.
- NA - Not Applicable

TABLE 1.3

AIR MONITORING PARAMETER LIST
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN

Compound	<i>Estimated</i>		<i>Method</i>	
	<i>Quantitation Limits (EQL) ¹</i>		<i>Detection Limits (MDL) ²</i>	
	<i>Low Level</i>	<i>Medium Level</i>	<i>Low Level</i>	<i>Medium Level</i>
	($\mu\text{g}/\text{M}^3$)	($\mu\text{g}/\text{M}^3$)	($\mu\text{g}/\text{M}^3$)	($\mu\text{g}/\text{M}^3$)
<i>Site-Specific Volatile Organic Compounds (VOC)</i>				
Acetone	1.90	23.8	0.71	9.50
Benzene	0.96	12.8	0.48	6.39
Bromodichloromethane	2.01	26.8	1.01	13.4
Bromoform	4.13	41.3	2.07	20.7
Bromomethane	3.11	15.5	0.78	7.77
2-Butanone (MEK)	2.36	29.5	1.18	11.8
Carbon disulfide	2.49	31.1	0.62	6.23
Carbon tetrachloride	5.03	62.9	1.57	25.2
Chlorobenzene	1.38	18.4	0.46	9.21
Dibromochloromethane	3.41	34.1	0.85	17.0
Chloroethane	2.11	10.6	0.53	5.28
Chloroform	1.46	19.5	0.49	9.77
Chloromethane	1.65	8.3	0.41	4.13
1,2-Dibromoethane (EDB)	6.15	30.7	1.54	15.4
1,2-Dichlorobenzene	2.40	24.0	0.90	12.0
1,3-Dichlorobenzene	2.40	24.0	0.90	12.0
1,4-Dichlorobenzene	2.40	24.0	0.90	12.0
Dichlorodifluoromethane	1.98	19.8	0.74	9.89
1,1-Dichloroethane	1.21	16.2	0.61	8.09
1,2-Dichloroethane	3.24	16.2	1.21	8.09
cis-1,2-Dichloroethene	1.59	15.9	0.79	7.93
trans-1,2-Dichloroethene	1.59	15.9	0.79	7.93
1,1-Dichloroethene	3.17	15.9	0.79	7.93
1,2-Dichloropropane	1.85	23.1	0.92	9.24
cis-1,3-Dichloropropene	1.82	22.7	0.91	9.08
trans-1,3-Dichloropropene	1.82	45.4	0.91	18.2
Ethylbenzene	1.74	17.4	0.65	8.68
2-Hexanone	1.64	41.0	1.02	8.19
Methylene chloride	1.39	13.9	0.69	6.95
4-Methyl-2-pentanone (MIBK)	1.64	41.0	0.82	8.19
Styrene	1.70	17.0	0.85	8.52
Tetrachloroethene	2.71	27.1	1.36	13.6
Toluene	1.51	15.1	0.75	7.54
1,2,4-Trichlorobenzene	18.6	37.1	7.42	18.6
1,1,1-Trichloroethane	1.64	21.8	0.82	10.9
1,1,2-Trichloroethane	2.18	21.8	1.09	10.9
Trichloroethene	2.15	21.5	1.07	10.7
Trichlorofluoromethane	2.25	22.5	0.84	11.2

TABLE 1.3

**AIR MONITORING PARAMETER LIST
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN**

<i>Compound</i>	<i>Estimated Quantitation Limits (EQL) ¹</i>		<i>Method Detection Limits (MDL) ²</i>	
	<i>Low Level</i>	<i>Medium Level</i>	<i>Low Level</i>	<i>Medium Level</i>
	<i>(µg/M³)</i>	<i>(µg/M³)</i>	<i>(µg/M³)</i>	<i>(µg/M³)</i>
<i>Site-Specific VOC (Continued)</i>				
1,1,2-Trichloro-1,2,2-trifluoroethane	3.07	30.7	1.53	15.3
Vinyl chloride	0.51	10.2	0.26	5.11
Xylenes (total)	5.21	34.7	1.84	17.4

Notes:

- ¹ - Please note that these are estimated quantitation limits and are presented for guidance only. Actual quantitation limits are highly matrix dependent and may be elevated due to matrix effects, QA/QC problems and high concentrations of target and non-target analytes.
- ² - Method Detection Limits (MDL) are also presented for guidance only. Actual MDLs will vary depending on sample specific preparation factors. The MDLs are also highly matrix dependant and may be elevated due to matrix effects, QA/QC problems and high concentrations of target and non-target analytes. Laboratory MDLs are updated on a periodic basis and the MDLs in effect when the samples are analyzed will be used for reporting purposes.

NATURAL ATTENUATION/CHEMICAL OXIDATION MONITORING PARAMETER LIST
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN

<i>Compound</i>	<i>Estimated</i>	<i>Method</i>
	<i>Quantitation Limits (EQL) ¹</i>	<i>Detection Limits (MDL) ²</i>
	<i>Water</i> ($\mu\text{g/L}$)	<i>Water</i> ($\mu\text{g/L}$)
<i>Dissolved Gases</i>		
Methane	0.5	0.1
Ethane	0.5	0.26
Ethene	0.5	0.31
<i>Compound</i>	<i>Estimated</i>	<i>Method</i>
	<i>Quantitation Limits (EQL) ¹</i>	<i>Detection Limits (MDL) ²</i>
	<i>Water</i> (mg/L)	<i>Water</i> (mg/L)
<i>Metals (Total and Dissolved)</i>		
Manganese	0.015	0.00041
Iron	0.1	0.081
<i>Inorganic - General Chemistry Parameters</i>		
Alkalinity	5	2.7
Ammonia, Nitrogen	0.2	0.035
Biological Oxygen Demand	2	2
Chemical Oxygen Demand	20	10
Nitrate, Nitrogen	0.1	0.023
Nitrite, Nitrogen	0.1	0.012
Orthophosphate	0.5	0.044
Sulfate	1	0.12
Sulfide	1	0.94
Total Organic Carbon	1	0.24

Notes:

- ¹ - Please note that these are estimated quantitation limits and are presented for guidance only. Actual quantitation limits are highly matrix dependent and may be elevated due to matrix effects, QA/QC problems and high concentrations of target and non-target analytes.
- ² - Method Detection Limits (MDL) are also presented for guidance only. Actual MDLs will vary depending on sample specific preparation factors. The MDLs are also highly matrix dependant and may be elevated due to matrix effects, QA/QC problems and high concentrations of target and non-target analytes. Laboratory MDLs are updated on a periodic basis and the MDLs in effect when the samples are analyzed will be used for reporting purposes.

TABLE 4.1

CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN

<i>Analyses</i>	<i>Sample Containers¹</i>	<i>Preservation</i>	<i>Maximum Holding Time from Sample Collection²</i>	<i>Volume of Sample</i>	<i>Shipping</i>	<i>Normal Packaging</i>
WATER (Groundwater, Surface Water and Wastewater)						
VOC	Three 40 ml Teflon-lined septum vials per analysis	HCl to pH < 2 Iced, 4 ± 2° C	14 days for analysis	Fill completely, no air bubbles	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
SVOC, PCB	Two 1 liter amber glass bottles per analysis	Iced, 4 ± 2° C	7 days for extraction 40 days after extraction for analysis	Fill to neck of bottle	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Metals	One 500-ml plastic bottle	HNO ₃ to pH < 2 Iced, 4 ± 2° C	180 days (mercury-28 days) for analysis	Fill to neck of bottle	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Cyanide (amenable)	One 250 ml plastic bottle	NaOH to pH>12 Iced, 4 ± 2° C	14 days for analysis	Fill to neck of bottle	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Hexavalent Chromium, pH	One 250 ml plastic bottle	Iced, 4 ± 2° C	24 hours for analysis	Fill to neck of bottle	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Alkalinity	One 500-ml plastic bottle	Iced, 4 ± 2° C	14 days for analysis	Fill to neck of bottle	Overnight or Hand Deliver	Bubble Pack or Foam Chips
Ammonia	One 500-ml plastic bottle	H ₂ SO ₄ to pH < 2 Iced, 4 ± 2° C	14 days for analysis	Fill to neck of bottle	Overnight or Hand Deliver	Bubble Pack or Foam Chips
BOD	One 1-liter plastic bottle	Iced, 4 ± 2° C	48 hours to start analysis	Fill to neck of bottle	Overnight or Hand Deliver	Bubble Pack or Foam Chips

TABLE 4.1

CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN

<i>Analyses</i>	<i>Sample Containers¹</i>	<i>Preservation</i>	<i>Maximum Holding Time from Sample Collection²</i>	<i>Volume of Sample</i>	<i>Shipping</i>	<i>Normal Packaging</i>
WATER (Groundwater, Surface Water and Wastewater) (Cont'd)						
COD	One 250-ml plastic bottle	H ₂ SO ₄ to pH < 2 Iced, 4 ± 2° C	28 days for analysis	Fill to neck of bottle	Overnight or Hand Deliver	Bubble Pack or Foam Chips
Hardness (calculated)	One 250 ml plastic bottle	HNO ₃ to pH < 2 Iced, 4 ± 2° C	180 days (mercury-28 days) for analysis	Fill to neck of bottle	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Nitrate	One 250-ml plastic bottle	Iced, 4 ± 2° C	48 hours to start analysis	Fill to neck of bottle	Overnight or Hand Deliver	Bubble Pack or Foam Chips
Nitrite	One 250-ml plastic bottle	Iced, 4 ± 2° C	48 hours to start analysis	Fill to neck of bottle	Overnight or Hand Deliver	Bubble Pack or Foam Chips
Orthophosphate	One 250-ml plastic bottle	Iced, 4 ± 2° C	48 hours to start analysis	Fill to neck of bottle	Overnight or Hand Deliver	Bubble Pack or Foam Chips
Sulfate	One 250-ml plastic bottle	Iced, 4 ± 2° C	28 days for analysis	Fill to neck of bottle	Overnight or Hand Deliver	Bubble Pack or Foam Chips
Sulfide	One 250-ml plastic bottle	Zinc Acetate/ NaOH to pH>9 Iced, 4 ± 2° C	7 days for analysis	Fill to neck of bottle	Overnight or Hand Deliver	Bubble Pack or Foam Chips
TOC	Two 40 ml Teflon-lined septum vials per analysis	H ₂ SO ₄ to pH < 2 Iced, 4 ± 2° C	28 days for analysis	Fill completely, no air bubbles	Overnight or Hand Deliver	Foam Liner or Bubble-wrap

TABLE 4.1

CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN

<i>Analyses</i>	<i>Sample Containers¹</i>	<i>Preservation</i>	<i>Maximum Holding Time from Sample Collection²</i>	<i>Volume of Sample</i>	<i>Shipping</i>	<i>Normal Packaging</i>
<i>SOLID (Soil/Sediment)</i>						
VOC	One 40 ml Teflon-lined septum vial ³	10 ml methanol, Iced, 4 ± 2° C	14 days for analysis	10 g soil	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
SVOC, PCB	One 4-ounce glass jar per analysis	Iced, 4 ± 2° C	14 days for extraction 40 days after extraction for analysis	Fill to shoulder of jar	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Metals	One 4-ounce glass jar	Iced, 4 ± 2° C	180 days (mercury 28 days) for analysis	Fill to shoulder of jar	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Hexavalent Chromium	One 4-ounce glass jar	Iced, 4 ± 2° C	30 days for extraction 24 hours for analysis	Fill to shoulder of jar	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Cyanide (total)	One 4-ounce glass jar	Iced, 4 ± 2° C	14 days for analysis	Fill to shoulder of jar	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
<i>LIQUID (LNAPL/DNAPL)</i>						
VOC	One 4-ounce glass jar	Iced, 4 ± 2° C	14 days for analysis	10 g soil 5 g soil each	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
SVOC, PCB	One 4-ounce glass jar	Iced, 4 ± 2° C	14 days for extraction 40 days after extraction for analysis	Fill to shoulder of jar	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Metals	One 4-ounce glass jar	Iced, 4 ± 2° C	180 days (mercury 28 days) for analysis	Fill to shoulder of jar	Overnight or Hand Deliver	Foam Liner or Bubble-wrap

TABLE 4.1

CONTAINER, PRESERVATION, SHIPPING AND PACKAGING REQUIREMENTS
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN

<i>Analyses</i>	<i>Sample Containers¹</i>	<i>Preservation</i>	<i>Maximum Holding Time from Sample Collection²</i>	<i>Volume of Sample</i>	<i>Shipping</i>	<i>Normal Packaging</i>
<i>LIQUID (LNAPL/DNAPL) (Cont'd)</i>						
Hydrocarbon Fuel Scan	One 4-ounce glass jar	Iced, 4 ± 2° C	14 days for extraction 40 days after extraction for analysis	Fill to shoulder of jar	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Specific gravity	One 4-ounce glass jar	Iced, 4 ± 2° C	28 days for analysis	Fill to shoulder of jar	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Viscosity	One 4-ounce glass jar	Iced, 4 ± 2° C	28 days for analysis	Fill to shoulder of jar	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
Heating Value, BTU	One 4-ounce glass jar	Iced, 4 ± 2° C	28 days for analysis	Fill to shoulder of jar	Overnight or Hand Deliver	Foam Liner or Bubble-wrap
<i>AIR (Soil Gas, Ambient Air)</i>						
VOC (medium level)	One 1-L Tedlar Bag	None	72 hours for analysis	Fill Tedlar Bag 75 - 85% full	Overnight or Hand Deliver	Double Bag
VOC (low level)	One 6-L Summa Canister	None	14 days for analysis	Fill canister maintaining slight negative pressure	Overnight or Hand Deliver	Cardboard Shipper

Notes:

¹ - Multiple parameters on a single sample may be combined into a single sample container with similar preservation requirements.

² - These are technical holding times, i.e., are based on time elapsed from time of sample collection.

³ - Soil VOC samples will require an additional container of sample for dry weight determination if no other analyses are required.
Sediment samples if non-cohesive, may require standard bulk sampling techniques using a 4 ounce glass jar with no head space.

TABLE 7.1

**SUMMARY OF ANALYTICAL METHODS
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN**

<i>Parameter¹</i>	<i>Preparation Method²</i>	<i>Laboratory Preparation SOP</i>	<i>Analytical Method²</i>	<i>Laboratory Analytical SOP</i>
<u>Groundwater and Surface Water Samples</u>				
VOC	SW-846 5030B	NC-MS-019	SW-846 8260B	NC-MS-019
SVOC	SW-846 3520C	NC-OP-038	SW-846 8270C	NC-MS-018
PCB	SW-846 3500C	NC-OP-038	SW-846 8082	NC-GC-038
Metals ³				
ICP/MS Metals	SW-846 3010A/3020A	NC-IP-011	SW-846 6020	NC-MT-0002
Mercury	SW-846 7470A	NC-MT-014	SW-846 7470A	NC-MT-014
Cyanide (Amenable)	SW-846 9012A	NC-WC-0032	SW-846 9012A	NC-WC-0031
Hexavalent Chromium	SW-846 7196A	NC-WC-0024	SW-846 7196A	NC-WC-0024
Trivalent Chromium	Calculation	NC-WC-0024	SW-846 7196A	NC-WC-0024
pH	NA	NA	EPA-WW 150.1	NC-WC-0010
Hardness (calculation)	NA	NA	SM 2340 B	NC-WC-0036
<u>Soil, Sediment and Sludge Samples</u>				
VOC	SW-846 5035 ⁴	NC-MS-019	SW-846 8260B	NC-MS-019
SVOC	SW-846 3550B	NC-OP-039	SW-846 8270C	NC-MS-018
PCB	SW-846 3550B	NC-OP-039	SW-846 8082	NC-GC-038
Metals ³				
ICP Metals	SW-846 3050B	NC-IP-010	SW-846 6010B	NC-MT-012
ICP/MS Metals	SW-846 3050B	NC-IP-010	SW-846 6020	NC-MT-0002
Mercury	SW-846 7471A	NC-MT-001	SW-846 7471A	NC-MT-001
Coarse/Fine Lead	MDEQ SOP	MDEQ SOP	SW-846 6010B	NC-MT-012
Cyanide (Total)	SW-846 9012A	NC-WC-0032	SW-846 9012A	NC-WC-0031
Hexavalent Chromium	SW-846 3060	NC-WC-0086	SW-846 7196A	NC-WC-0024
Trivalent Chromium	Calculation	NC-WC-0024	SW-846 7196A	NC-WC-0024
<u>NAPL Characterization</u>				
VOC	SW-846 5030B-H	NC-MS-019	SW-846 8260B	NC-MS-019
SVOC	SW-846 3580A	NC-OP-039	SW-846 8270C	NC-MS-018
PCB	SW-846 3580A	NC-OP-039	SW-846 8082	NC-GC-038
Metals ³				
ICP Metals	SW-846 3050B	NC-IP-010	SW-846 6010B	NC-MT-012
Mercury	SW-846 7471A	NC-MT-014	SW-846 7471A	NC-MT-014
Cyanide (Total)	SW-846 9012A	NC-WC-0032	SW-846 9012A	NC-WC-0031
Petroleum Fingerprinting		NC-OP-024	SW-846 8015	NC-GC-038
Specific gravity (TA Knoxville))		NA	ASTM D1475	KNOX-WC-0015
Viscosity (TA Knoxville)		NA	ASTM D445	KNOX-WC-0011
Heating Value (BTU), (TA Knoxville)		NA	ASTM D240	KNOX-WC-0010

TABLE 7.1

**SUMMARY OF ANALYTICAL METHODS
RCRA FACILITY INVESTIGATION
COMPANY VEHICLE OPERATIONS
YPSILANTI, MICHIGAN**

<i>Parameter¹</i>	<i>Preparation Method²</i>	<i>Laboratory Preparation SOP</i>	<i>Analytical Method²</i>	<i>Laboratory Analytical SOP</i>
<u>Air Samples - Medium Level</u>				
VOC (TA-Los Angeles)	EPA-AA TO-14/TO-15	LA-MSA-014	EPA-AA TO-14/TO-15	LA-MSA-014
<u>Air Samples - Low Level</u>				
VOC (TA-Los Angeles)	EPA-AA TO-15	LA-MSA-015	EPA-AA TO-15	LA-MSA-015
<u>Natural Attenuation Monitoring and Chemical Oxidation Parameters</u>				
Metals (Total and Dissolved)				
Manganese	SW-846 3010A/3020A	NC-IP-011	SW-846 6010B	NC-MT-012
Iron	SW-846 3010A/3020A	NC-IP-011	SW-846 6010B	NC-MT-012
Alkalinity, total	EPA-WW 310	NC-WC-0006	EPA-WW 310	NC-WC-0006
Ammonia, Nitrogen	EPA-WW 350.3	NC-WC-038	EPA-WW 350.3	NC-WC-038
Biological Oxygen Demand	EPA-WW 405.1	NC-WC-0008	EPA-WW 405.1	NC-WC-0008
Chemical Oxygen Demand	EPA-WW 410	NC-WC-0019	EPA-WW 410	NC-WC-0019
Ortho phosphorus	SW-846 9056	NC-WC-0084	SW-846 9056	NC-WC-0084
Nitrate, Nitrogen	SW-846 9056	NC-WC-0084	SW-846 9056	NC-WC-0084
Nitrite, Nitrogen	SW-846 9056	NC-WC-0084	SW-846 9056	NC-WC-0084
Sulfate	SW-846 9056	NC-WC-0084	SW-846 9056	NC-WC-0084
Sulfide	SW-846 9034	NC-WC-0060	SW-846 9034	NC-WC-0060
Total Organic Carbon	SW-846 9060	NC-WC-0017	SW-846 9060	NC-WC-0017
Dissolved Gases	EPA SOP RSK 175	NC-GC-0032	EPA SOP RSK 175	NC-GC-0032

Notes:

¹ Refer to Tables 1.2 for the compounds/ elements of each parameter group.

² Preparation and Analytical Method References:

- SW-846 - "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods ", SW-846, 3rd Edition, and Promulgated Updates, November 1986.
- EPA-WW - "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, March 1983.
- SM - "Standard Methods for the Examination of Water and Wastewater", APHA, AWWA, & WEF, 19th Edition, 1995.
- EPA-AA - "
- EPA SOP RSK 175 -

³ Metals by Method

- Water: All by ICP/MS (except Mercury)
- Soil ICP: Barium, Beryllium, Cadmium, Chromium, Cobalt, Lead, Manganese, Nickel, Selenium, Vanadium.
- Soil ICP/MS: Arsenic, Antimony, Selenium, Silver, Thallium, and Zinc.
- Waste/NAPL: All by ICP (except Mercury)

⁴ Sediment and sludge samples may be collected as bulk samples which will be prepared in accordance with SW-846 Method 5030B.

VOC = Volatile Organic Compounds

SVOC = Semi-Volatile Organic Compounds

NA - Not Applicable

PCB = Polychlorinated Biphenyls

NAPL = Non-aqueous Phase Liquid