DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
600 ARMY PENTAGON
WASHINGTON, DC 20310-0600

Reply To Attention Of:
ARMY BASE RELIGNMENT AND CLOSURE PROGRAM

JUN 13 2011

Mr. John Burchette
NPL / BRAC / Federal Facilities Branch
U.S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Re: Draft Final Long-Term Monitoring Report, Clean Fill Dump Operable Unit, September 2010 Sampling Event

Dear Mr. Burchette:

Please find enclosed one original and two copies of the *Draft Final Long-Term Monitoring Report, Clean Fill Dump Operable Unit, Patuxent Research Refuge-North Tract, Anne Arundel County, Maryland, September 2010 Sampling Event* for EPA review and comment.

If you have any questions, please feel free to contact me at (703) 545-2474.

Sincerely,

Markus Craig

Markus A. Craig
Program Manager, Office of the Assistant Chief of Staff for Installation Management; Base Realignment and Closure Division

Enclosure: Draft Final Long-Term Monitoring Report, Clean Fill Dump Operable Unit, September 2010 Sampling - 1 original and 2 copies

DISTRIBUTION:

Elisabeth Green (Maryland Department of the Environment) – 1 copy
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Draft Final

2010 Long-Term Monitoring Report
Clean Fill Dump Operable Unit
Patuxent Research Refuge – North Tract
Anne Arundel County, MD

Legacy Base Realignment and Closure Program

September 2010 Sampling Event

June 2011

Contract Number: W912DR-09-D-0017
Delivery Order: 0020

Prepared for:

US Army Corps of Engineers ®
Baltimore District

10 South Howard Street
Baltimore, MD 21201

Prepared by:

URS

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200 Orchard Ridge Drive, Suite 101
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Project no. 15302066

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LIST OF ACRONYMS

bdl	Below detection limit
BRAC	Base Realignment and Closure
BWI	Baltimore-Washington International Airport
CFD	Clean Fill Dump
cis1,2-DCE	Cis1,2-dichloroethene
cm/sec	Centimeters per second
COC	Chain of Custody
DCE	Dichloroethene
DO	Dissolved oxygen
DOI	United States Department of Interior
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Difference
FD	Field Duplicate
FGGM	Fort George G. Meade
ft	Feet
FWS	United States Fish and Wildlife Service
HCL	Hydrochloric Acid
HNO_3	Nitric Acid
L/min	Liter(s) per minute
LTMP	Long-Term Monitoring Program
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goals
MDE	Maryland Department of the Environment
MDL	Method Detection Limit
MNA	Monitored Natural Attenuation
MS	Matrix Spike
MSD	Matrix Spike Duplicate
mV	mV = millivolts
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum

LIST OF ACRONYMS (CONT'D)

NTU	Nephelometric Turbidity Units
OU	Operable Unit
PCE	Tetrachloroethene
ppm	Parts per million
PRR	Patuxent Research Refuge
PRR-NT	Patuxent Research Refuge-North Tract
QC	Quality control
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
REDOX	Reduction-Oxidation Potential
RI	Remedial Investigation
RL	Reporting Limit
ROD	Record of Decision
RSL	Regional Screening Level
SMCLs	Secondary MCLs
TAL	Target Analyte List
TCE	Trichloroethene
TCL	Target Compound List
TOC	Top of Casing
µg/L	Microgram(s) per liter (i.e., part per billion)
µmohs/cm	Micro (s) per centimeter
URS	URS Group, Inc.
USACE	U.S. Army Corps of Engineers
UWS	Uncontrolled Waste Site
VOCs	Volatile organic compounds
$^{\circ}$C	Degrees Celsius
$^{\circ}$F	Degrees Fahrenheit

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EXECUTIVE SUMMARY

This report presents the results of the 2010 groundwater sampling under the Long-Term Monitoring Plan (LTMP) (USACE, 2002) for the Clean Fill Dump (CFD) Operable Unit (OU) at Fort George G. Meade (FGGM), Maryland. The LTMP is implemented under the purview of the U.S. Army, the U.S. Environmental Protection Agency (EPA) Region III, and the Maryland Department of the Environment (MDE). The Record of Decision (ROD) (U.S. Army, 2000b) identified the selected remedial alternative for the CFDOU (U.S. Army, 2000a) as "no further action with monitoring." This remedy provides for no activity directed at decreasing or removing constituents, or any construction that might reduce the potential of exposure to possible receptors. The remedy does include the activity of monitoring the groundwater quality. The environmental investigations presented in the ROD indicate that chemicals are present at the site at concentrations sometimes exceeding screening criteria, but the risks posed to human health and the environment for workers, trespassers, and site visitors remain within the EPA acceptable risk range of 10^{-4} to 10^{-6}.

The LTMP specifies six wells in the Lower Patapsco aquifer to be monitored on a biennial basis. The primary objective of the LTMP is to ensure the selected remedy continues to provide adequate protection of human health and the environment. To accomplish this, the monitoring results are interpreted to verify 1) contaminant concentrations are not increasing over time, 2) new constituents are not appearing, 3) contaminants are not migrating to potential off-site receptors, and 4) metals concentrations are consistent with concentrations that are naturally occurring in the Lower Patapsco aquifer. Additionally, the chemical results are compared to regulatory standards [e.g., maximum contaminant levels (MCLs) and non-zero maximum contaminant level goals (MCLGs)]. Table ES-1 lists the wells and the analytical parameters in the biennial monitoring.

Groundwater samples from six monitoring wells at the CFDOU were collected on September 23, 24, 27, and 29, 2010 using the low flow procedures described in the LTMP. The samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs) and Target Analyte List (TAL) metals (filtered).

TABLE ES-1
CFD LTMP Monitoring Wells and Analytical Program

Well	TCL[1] VOC[2]s	TAL[3] Metals[4]
CFD-3S	X	X
CFD-5	X	X
MWC-3	X	X
MWC-5	X	X
WP-2	X	X
WP-6	X	X
Analytical Method	EPA SW846	EPA SW846
	8260B	7470A/6020

[1]Target Compound List
[2]Volatile Organic Compound
[3]Target Analyte List
[4]Metals samples will be filtered

Two of the three VOCs detected in the 2010 samples—trichloroethene (TCE) and tetrachloroethene (PCE)—were detected at concentrations exceeding their MCL or Regional Screening Level (RSL) criteria in wells CFD-3S and WP-2. The VOC trend analyses indicate that concentrations have decreased over time in down gradient wells, but the concentrations still remain above the screening criteria. The analysis also indicates that some natural attenuation is occurring, but the process is occurring quite slowly. The historical and current long-term monitoring (LTM) results indicate that VOCs are not migrating off-site to potential receptors. The VOC groundwater contamination remains contained at the site and existing land use controls prevent access to the groundwater.

The metal concentrations have remained consistent over time at the CFDOU and are likely attributed to background; however, background concentrations have not formally been defined for the CFDOU or received regulatory approval. The groundwater measurement data still indicate that a positive vertical gradient and the potential of upward flow in the aquifer exist at the site. Therefore any dissolved constituents in the shallow groundwater are not likely to move to deeper intervals. Some metals (arsenic, chromium, cobalt, iron, manganese, and mercury) were detected above screening criteria at CFD-5 (the most down gradient well at the CFDOU near the Little Patuxent River); only arsenic in CFD-5 drives an MCL exceedance. Oddly, arsenic concentrations elsewhere at the site are much lower (i.e., generally non-detect and have

no MCL exceedances). The elevated arsenic in groundwater at CFD-5 potentially could discharge into surface water at the Little Patuxent River.

Constituents remain in the CFDOU groundwater at concentrations higher than MCLs; therefore, the following recommendations are made based upon the 2010 groundwater sample results and the feedback received from stakeholders regarding the CFDOU 5-year review (URS, 2009):

- Prepare an Explanation of Significant Difference (ESD) that will change the CFDOU remedy from "no further action with monitoring" to "land use controls with long-term monitoring." Use the ESD process to change the sampling frequency from biennial to annual.
- Include sampling for monitored natural attenuation (MNA) parameters and VOC daughter products from the LTM wells in all future LTM events.
- Install a new monitoring well (screened 60 to 70 feet mean sea level) down gradient from CFD-3S to better track vertical migration.
- Sample all existing CFD wells (both shallow and deep) for Resource Conservation and Recovery Act (RCRA) metals and VOCs as a supplemental effort to the LTM program (i.e., one-time event during the next planned LTM round) to 1) provide a better understanding of current site conditions, 2) identify potential background wells, 3) identify LTM program data gaps, and 3) revise the LTMP.
- Discuss the background data gap issue with stakeholders to better determine whether metal concentrations at the CFDOU are attributed to background rather than site-related contamination. The supplemental sampling effort (see bullet above) will provide data for this discussion.
- Collect an up gradient and down gradient surface water sample from the seep adjacent to CFD-5 and two samples from the LPR - one upstream from where the tributary enters the Little Patuxent River and the other one downstream - to determine whether site-related metal concentrations (e.g., arsenic near CFD-5) are migrating off site.

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1.0 INTRODUCTION

The United States Army Corps of Engineers Baltimore District (USACE) contracted URS Group, Inc. (URS) to perform the 2010 biennial groundwater monitoring for the Clean Fill Dump (CFD) Operable Unit (OU), Fort George G. Meade (FGGM), Maryland. The monitoring requirements are described in the CFDOU Long-Term Monitoring Plan (LTMP) (USACE, 2002). The 2010 monitoring was performed under contract W912DR-09-D-0017, delivery order 20. Figure 1-1 illustrates the location of FGGM and the CFDOU in Anne Arundel County, Maryland, midway between Baltimore, Maryland and Washington, D.C. The CFDOU is located within lands from the FGGM Legacy Base Realignment and Closure (BRAC) property transferred to the United States Department of Interior (DOI), Fish and Wildlife Service (FWS) under the 1991 *Transfer Assembly.* The DOI administers the land as the Patuxent Research Refuge- North Tract (PRR-NT); a National Wildlife Refuge. However, the U.S. Army (Army) has retained approximately 13 acres that constitute the CFD site.

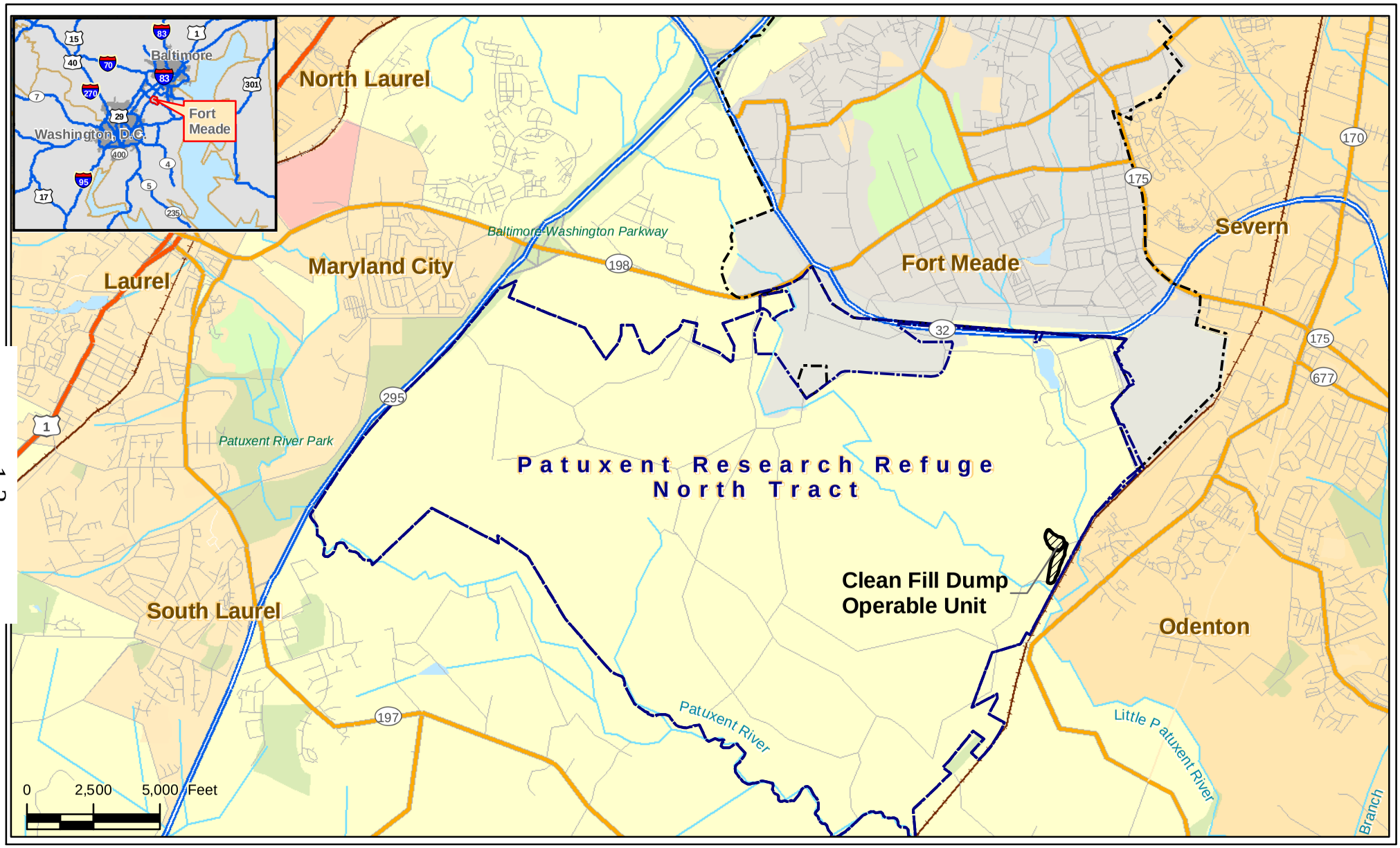
The 1998 Remedial Investigation (RI), (USACE, 1998) reported several VOCs and metals at concentrations in the shallow water table aquifer above the U.S. Environmental Protection Agency (EPA) Region III risk based concentrations: dichloroethene (DCE), tetrachloroethene (PCE), trichloroethene (TCE), chloroform, arsenic, beryllium, and iron. The Army's Record of Decision (ROD) (U.S. Army, 2000b) for the CFDOU presented the remedial alternative of "no further action with monitoring." This remedy is based on site characterization and human health and ecological risk assessments that concluded that with the imposition of institutional controls the site conditions do not pose an unacceptable risk to potential human and ecological receptors. The CFD LTMP (USACE, 2002) is implemented under the purview of the Fort Meade Environmental Partnership, which includes the U.S. Army, EPA Region III, and the Maryland Department of the Environment (MDE). This report covers the 2010 CFDOU groundwater sampling and presents those results in the context of the long-term water quality and the specific objectives defined in the LTMP (USACE, 2002).

1.1 OBJECTIVE

The objective of the CFDOU LTMP is to ensure the remedy of "no further action with monitoring" continues to provide protection to human health and the environment. Long-term monitoring (LTM) is implemented to document 1) contaminant concentrations are not increasing over time, 2) new constituents are not appearing, 3) contaminants are not migrating to potential off-site receptors, and 4) metals concentrations are consistent with background levels in the Lower Patapsco aquifer.

1.2 SAMPLING PROGRAM

The LTMP includes biennial sampling of six shallow monitoring wells and analyzing for Target Analyte List (TAL) metals and Target Compound List (TCL) volatile organic compounds (VOCs). Metals samples are filtered to remove the residual turbidity that is frequently encountered in groundwater samples collected from the Cretaceous age coastal plain sediments. To collect consistent data, the LTMP specifies the low flow purge technique to minimize drawdown in the well and ensure representative samples are collected in each monitoring round. The monitoring program also provides for inspection and gauging all wells at the site to improve the resolution of the water table surface and to ensure all wells are secure and serviceable if future conditions would dictate their use.



CLIENT	U.S. Army Corps of Engineers, Baltimore District			
DATA SOURCE	ESRI Street Maps 9.2; CFD Long-Term Monitoring 2010 Sampling Event			
REVISION NO	0	GIS:	JK	02/03/11
SCALE	1:60,000	CHECKED:	GW	02/03/11
G:\Projects\Fort_Meade\Clean_Fill_Dump\2010\CFD_Figure1-1_locator.mxd		PROJ MGR	FM	-

TITLE
Vicinity Map
Clean Fill Dump Operable Unit

URS
200 Orchard Ridge Drive
Gaithersburg, MD 20878

PROJ NO 15301259.00002

FIGURE **1-1**

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2.0 BACKGROUND

2.1 SITE HISTORY

The Patuxent Research Refuge (PRR) is located in Anne Arundel County, Maryland, approximately halfway between Washington, D.C. and Baltimore, Maryland. The Refuge is bounded on the north by Highways 32 and 198, on the west by the Baltimore-Washington Parkway, on the south by the Patuxent River, and on the east by the active firing ranges, the Amtrak railroad right-of-way, and private property. In 1917 Congress authorized the acquisition of the property for the Army and approximately 4,000 acres of farmland became Camp Meade in honor of Major General George G. Meade. The property was originally used as a training cantonment for World War I troops. In January 1941, training areas were added within the installation, expanding the post to 13,596 acres. During the 1940s, the facility underwent widespread growth to accommodate several regiments that moved their base of operations to FGGM, including the Second Army and the Eleventh Cavalry (USACE, 2002).

In 1988, the Defense Authorization Amendments and BRAC mandated the closure and/or realignment of portions of FGGM. In 1991, the Army transferred 7,600 acres to the DOI FWS, expanding the contiguous Patuxent Wildlife Research Center, which is now known as the PRR-NT. A second land transfer of approximately 500 acres to the PRR-NT took place in January 1993. The CFDOU site was specifically excluded from the 1991 transfer and remains under the administrative control of FGGM until such time as the Army and the DOI have determined that the site is environmentally clean.

The CFDOU covers approximately 13 acres in the eastern portion of the PRR-NT in an otherwise undeveloped wooded area along Boundary Road (Figure 2-1). The CFD is located partially within the boundaries of the Firing Range 7 downrange fan. The CFD was active from approximately 1972 through closure in 1985. The main dump covers an area of approximately 500 by 800 feet. Soil borings have revealed waste materials as deep as 16 feet on the site. The main dump extends to the tree line to the north and east and has a fill-face slope rise of at least 10 feet above the wetlands. Fill included miscellaneous debris such as stumps, trees, logs, concrete waste, construction debris, appliances, and fill soil (USAEC, 1989). Other disposal may have included garbage, food wastes, cans, bottles, ash, and possibly hazardous materials.

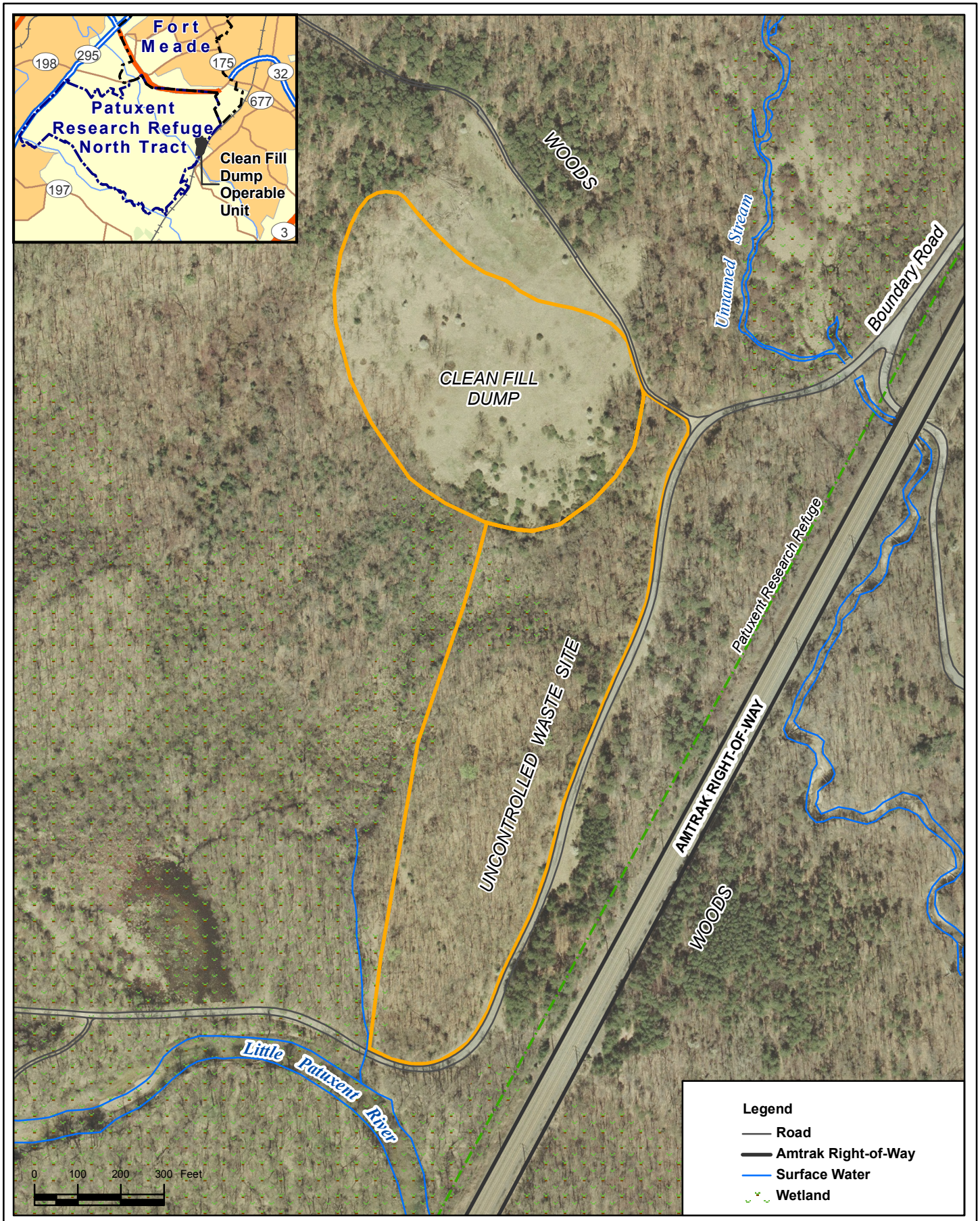
Uncontrolled dumping continued outside the main perimeter after the 1985 site closure. This activity included sporadic surface dumping, primarily along the CFD margins and the access roads, but also in the wetlands south of the CFD and Boundary Road, also known as Wildlife Loop Road, in an area referred to as the Uncontrolled Waste Site (UWS). Figure 2-1 presents its location. The uncontrolled dumping occurred before the parcel was transferred to the DOI. The DOI area is now enclosed (fenced) and managed by the PRR-NT and the FWS. The FWS controls and limits access to the PRR-NT. However, a debris removal action was conducted at the UWS in 2007 and 2008 (USACE, 2008a and 2008b). A total of 76 roll-offs and 641 tons of debris (tires, concrete, construction and demolition debris, and metal) were removed from the UWS. The responsible parties for the uncontrolled dumping activities are unknown.

2.2 ENVIRONMENTAL SETTING

2.2.1 Climate

The climate at the PRR-NT is temperate, influenced by the Chesapeake Bay and the Atlantic Ocean to the east and the Appalachian Mountains to the west. The winter weather in the area is influenced primarily by cold, dry, continental-polar winds from the west and northwest, and less frequent maritime-tropical winds from the south and southwest, that bring warm, often humid air to the region. During the summer, the dominance of these two air masses is reversed and warm, humid weather dominates.

Local weather data are compiled by the National Weather Service Forecast Office for the Baltimore-Washington International Airport (BWI) weather station found at the following URL address: http://www.weather.gov/climate/index.php?wfo=lwx. The 2009 annual precipitation was approximately 55.57 inches. The normal distribution of monthly rainfall at BWI is essentially even throughout the year, varying between 3.0 and 3.98 inches. However, the BWI precipitation data revealed a cumulative rainfall in September 2010 of 6.02 inches. The annual mean daily temperature for the FGGM area is 61 degrees Fahrenheit (ºF), with a daily annual maximum of 72ºF and a minimum of 45ºF. Annual temperature extremes vary from -6ºF to 101ºF (USACE, 2002).



CLIENT	U.S. Army Corps of Engineers, Baltimore District			
PROJ	Clean Fill Dump 2010 Sampling Event			
SOURCE	Base data: USACE, 2002; Aerial, 2003.			
REVISION NO	0	GIS:	AER	07/25/08
SCALE	1:3,600	CHK BY	FM	07/25/08
G:\Projects\Fort_Meade\Clean_Fill_Dump\2008\CFD_Figure2-1_sitemap.mxd		PROJ MGR	FM	-

TITLE

Site Map
Clean Fill Dump Operable Unit

URS

200 Orchard Ridge Drive
Gaithersburg, MD 20878

PROJ NO 15302389.20000

FIGURE 2-1

2.2.2 Topography

The CFDOU is located in the Coastal Plain physiographic province. Low, rolling uplands and low-gradient streams characterize the PRR and the CFDOU. The surface elevation ranges from approximately 70 feet to 120 feet, National Geodetic Vertical Datum (NGVD) of 1929 (NGVD29). The CFDOU lies on the west side of a north-south trending shallow ridge that separates the CFDOU and adjacent wetlands from an unnamed stream and wetlands to the east.

The present topography of the CFDOU is the result of past disposal activities. The fill presumably was dumped in the convenient low area beside Boundary Road on what may once have been wetlands. There is a scarp face from the top of the fill to the southeast, south, and west. The greatest relief is on the southeast side. It is likely that at least the lower portion of the fill material is saturated during the wettest season of the year.

2.2.3 Surface Water Hydrology

The PRR-NT lies within the 932-square-mile Patuxent River watershed, one of the primary drainage systems in Anne Arundel County (USACE, 2002). Several bodies of surface water are present within the refuge, including the Patuxent and Little Patuxent Rivers, Midway and Franklin Branches, and Lake Allen (formerly known as Soldier Lake). The Patuxent River receives drainage from numerous intermittent streams that emerge from the PRR-NT.

Drainage routes through the PRR-NT are generally broad, low relief features with shallow gradients. Marshy areas and wetlands occur along portions of the major drainages. Much of the PRR-NT is nearly at river level and is prone to flooding.

Wetlands are located to the northeast and the south of the CFDOU. These wetlands are largely overgrown and contain significant areas of standing water. Drainage channels generally are not well defined. During earlier investigations (USAEC, 1992a,b; USACE 1998) seeps were observed in at least two areas, one within 10 feet of the southern edge of the main dump.

The area around the CFDOU is drained by several southward-flowing unnamed streams and drainage swales that empty into the Little Patuxent River. The most prominent streams are located to the southwest of the dump and on the east side of the low ridge. The Little Patuxent River, the major drainage in this portion of the PRR, is approximately 1,200 feet south of the CFDOU.

2.2.4 Geology

The PRR-NT is located on the Cretaceous sediments of the Coastal Plain physiographic province. The Coastal Plain is underlain by a wedge of unconsolidated alluvial sediments that dip and thicken eastward toward the Atlantic Ocean. The crystalline rocks of the Piedmont physiographic province (the easternmost portion of the Appalachian Plateau) lie beneath the sediments at the PRR-NT, but they are exposed near the Anne Arundel County line to the west. The demarcation between the Piedmont and Coastal Plain physiographic provinces is termed the "Fall Line" because of the falls and rapids found where streams cross this boundary.

The unconsolidated sands, clays, and silts of the Coastal Plain were deposited during the Cretaceous and the Quaternary geologic periods. Unconsolidated deposits present at the PRR-NT are from the lower Cretaceous age Potomac Group; these sediments include, from oldest to youngest, the Patuxent Formation, the Arundel Clay, and the Patapsco Formation, and have a total thickness of at least 600 feet at the PRR. The Lower Patapsco sand is the surface formation at the CFDOU. For much of the low-lying area of the CFDOU, sand is the dominant lithology to a depth of approximately 100 feet. These sands contain interbedded clay and gravel layers of unknown lateral extent. The higher elevations adjacent to the CFDOU are supported by clay, which may be the remnant of a unit that has eroded from the lower areas, for example, the wetlands that extend south from the CFDOU to the Little Patuxent River.

2.2.5 Hydrogeology

2.2.5.1 Regional Hydrogeology. Groundwater resources in the Potomac Group sediments include three aquifers: the Upper Patapsco, the Lower Patapsco, and the Patuxent (USACE, 2005). The Arundel Formation and the middle confining layer of the Patapsco Formation act as confining layers separating the aquifers. The aquifers are confined on a regional scale, but they act as unconfined aquifers within the respective outcrop areas. The Upper Patapsco is absent at the CFDOU.

2.2.5.2 Local Hydrogeology. Two aquifer units of the Cretaceous Potomac Formation are present at the CFDOU:

- The Lower Patapsco sand is the water table aquifer in this area and consists of approximately 190 to 230 feet of yellowish-orange to brown sand and lesser amounts of sandy gravel. This unit crops out and is in recharge as the water table aquifer.
- The Patuxent Formation is the lowest Cretaceous unit represented in the vicinity of FGGM and the PRR. This confined aquifer is a water supply for nearby municipal systems, including FFGM. Production comes from screens as deep as 800 feet below the surface.

Two clay intervals serve as aquitards (confining layers) between the Potomac aquifers:

- The middle portion of the Patapsco Formation may be locally present as the clay-rich erosional remnants capping the hills. This unit consists of low-permeability silty and sandy clays and sand-silt-clay mixtures, with local zones of silts and sand.
- The Arundel Clay is a regional confining unit. Although the Arundel Clay was not encountered in the drilling at the CFDOU, it is estimated that the top of the Arundel Clay should be encountered at approximately 300 feet below grade in this area. Facility deep well logs indicate that the Arundel Clay consists of stiff, reddish-brown clays with a thickness of 200 to 250 feet.

Although the regional groundwater flow is to the southeast, generally following the eastward structural dip, groundwater flow in the water table aquifer often mirrors the local topography and can deviate significantly from the regional direction. At the CFDOU, the southerly groundwater flow direction is controlled by the Little Patuxent River, and local discharge is into the wetlands and the Little Patuxent River. Flow varies with seasonal effects and local precipitation events. No river stage data are available; however, the groundwater flow suggests that the river is in recharge through base flow.

2.2.6 Groundwater and Surface Water Use

The FGGM obtains water from two sources: (1) surface water from the Little Patuxent River; and (2) six deep facility production wells (PW-1 to PW-6; Maryland regulations (Code of Maryland Regulations 26.08.02) designate the Little Patuxent River south of the Old Forge Bridge as a Use I waterway—suitable for human water contact recreation, fishing, and the protection and propagation of aquatic life. The Little Patuxent River north (upstream) of the Old

Forge Bridge is designated as Use I-P, which is additionally suitable for use as a public water supply. The Water Treatment Plant surface water intake is located north of Route 198.

The six FGGM production wells are screened between 500 and 800 feet below grade in the Patuxent Formation. Production wells PW-1 and PW-2 are located on the FGGM cantonment area north of Route 32. Wells PW-3 to PW-6, located near Range Road, are on the extreme eastern side of the PRR-NT. These deep wells are not near the CFDOU and are screened well below the thick Arundel Clay regional confining layer.

At this time, the PRR-NT produces water from three wells completed in the Patuxent aquifer with screen depths of greater than 230 feet below the surface (Russ Dyrland, Personal Communication). Water is supplied at athletic fields near the entrance from Maryland Route 198, at the Visitor Contact Center, and at the Environmental Education Center. No groundwater is extracted near the CFDOU. Records exist of three additional Patuxent wells that once served isolated facilities on the property, but these wells are not in service and in unknown condition.

Surface water on the PRR-NT is dedicated to wildlife management including wetlands habitats and ponds supporting migratory waterfowl. This resource is important for sportsman's activities during hunting season.

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3.0 2010 MONITORING ACTIVITIES

3.1 WELL INSPECTION AND GROUNDWATER GAUGING

The 2010 activities at CFDOU included measuring the water level in and inspecting the condition of 17 monitoring wells at the site. Figure 3-1 presents a map showing the well locations and the main features of the site. Well construction details and elevations are included in Table 3-1. Water levels were measured with an electronic water level meter that was decontaminated prior to measuring each well. Results are presented as a water table contour map in Section 4. The water level measurements were acquired on September 20 and 21, 2010.

TABLE 3-1
LTMP Monitoring Well Construction Details

Well No.	Well Total Depth (Feet below grade)	Ground Elevation (Feet NAVD*)	Top of Casing Elevation (Feet NAVD*)	Aquifer	Approx. Screen Interval (Feet below grade)	Part of LTM Program
CFD-1	55.3	112.49	114.32	L. Patapsco	40.3-55.3	
CFD-2	8.0	78.98	81.67	L. Patapsco	3-8	
CFD-3S	9.5	78.31	80.21	L. Patapsco	4.5-9.5	✓
CFD-3D	80.0	79.70	81.95	L. Patapsco	60-70	
CFD-4	9.5	77.39	79.99	L. Patapsco	4.5-9.5	
CFD-5	8.0	73.19	75.95	L. Patapsco	3-8	✓
MWC-1	30.0	89.18	90.80	L. Patapsco	18.5-28.5	
MWC-2	101.0	93.43	94.85	L. Patapsco	89-99	
MWC-3	39.0	79.59	81.59	L. Patapsco	29-39	✓
MWC-4	40.5	108.52	110.40	L. Patapsco	30-40	
MWC-5	41.5	111.23	113.53	L. Patapsco	31-41	✓
WP-1	6.0	76.84	79.57	L. Patapsco	3-6	
WP-2	5.5	76.51	79.38	L. Patapsco	2.5-5.5	✓
WP-3	6.0	76.96	79.21	L. Patapsco	3-6	
WP-4	6.0	91.37	93.97	L. Patapsco	3-6	
WP-5	5.5	90.05	91.95	L. Patapsco	2.5-5.5	
WP-6	54.0	113.49	115.49	L. Patapsco	44-54	✓

* NAVD = North American Vertical Datum

Well inspections were made between September 20 and 29, 2010. The mechanical condition of each well was inspected to ensure the wells were intact and secure. A table of the findings is included in Section 4. The well inspection report forms are included in Appendix B.

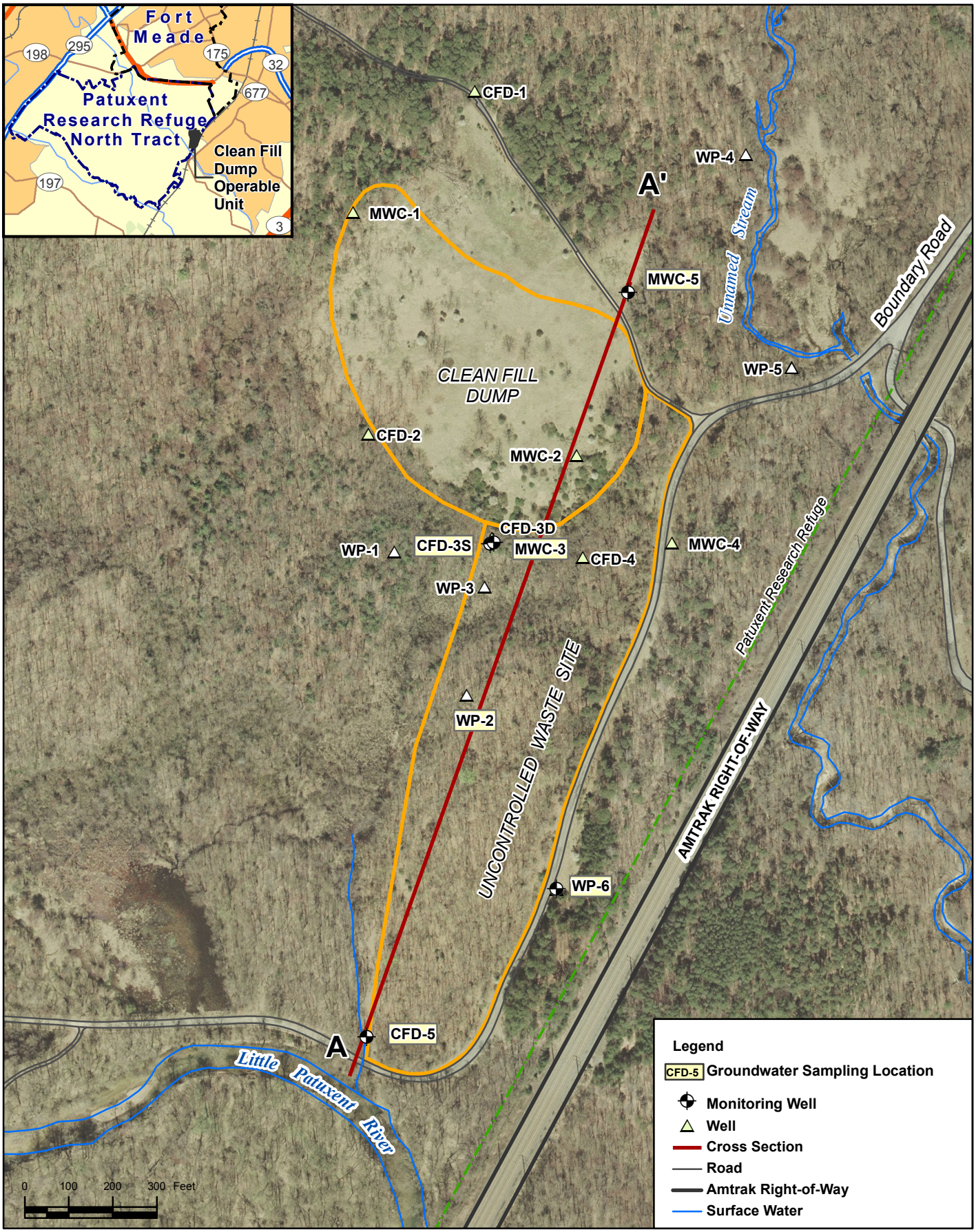
3.2 GROUNDWATER SAMPLING

The LTMP specifies sampling six wells to assess the groundwater condition and detect unexpected changes in conditions. Based on the distribution of the contaminants and the observed slight upward vertical gradient reported in the RI, the monitoring program is focused on characterizing the upper portion of the water table aquifer. Figure 3-2 presents a geological cross section through the CFDOU that illustrates the relative positions of the well screens to the water table. The sampling rationale for the six wells is described below. Construction details of the wells sampled are listed in Table 3-1.

- CFD-3S: This shallow well is located on the down gradient edge of the CFD and contained the highest VOC concentrations during the 1996 sampling event. This well provides data on contaminants that likely originate at the CFD.
- MWC-3: This well is screened in the middle portion of the Lower Patapsco aquifer at the down gradient edge of the CFD, near CFD-3S. It provides data relevant to determining vertical migration of contaminants.
- WP-2: This shallow well is several hundred feet down gradient of the CFD and is on the edge of the UWS. Solvents were detected in early sampling rounds, but at lower concentrations than in CFD-3S. This well monitors conditions down gradient from the landfill.
- CFD-5: This shallow well is located at the farthest down gradient edge of the solvent plume and is 200 feet from the Little Patuxent River. It monitors groundwater conditions near the discharge point into the river.
- WP-6: This well monitors water quality at the edge of the UWS and the southeast property boundary. Data from this well monitors possible migration of contaminants off site. This well screen is positioned just below the water table.
- MWC-5: This shallow well is up gradient of the CFDOU. It characterizes groundwater conditions that are not influenced by the CFD or the UWS. It will also confirm that the site is not influenced by an up gradient source.

The groundwater samples were collected on September 23, 24, 27, and 29, 2010. Field activities followed the procedures specified in the LTMP (USACE, 2002). At the beginning of each day the monitoring instruments were calibrated to the manufacturer's specification. These instructions are included in Appendix F. Each well was inspected for physical condition

including the condition of the protective casing and the lock, the concrete pad, the presence of a well cap, the condition of the casing, and the presence of a marked measuring point. A piece of plastic sheet was placed on the ground around the casing to protect any down-hole equipment from accidental contact with the ground. As the well was first opened, the headspace was tested for the presence of VOCs with a photoionization detector. A water level meter was used to measure the depth to groundwater and the depth of the well. From these measurements the volume of water in the well casing and the saturated sand pack was calculated. A submersible 12 volt pump connected to disposable tubing was lowered in the well to the deeper of the midpoint of the water column or the midpoint of the screen. According to the procedures presented in section 3.0 of the LTMP, the submersible pump was decontaminated prior to each use.



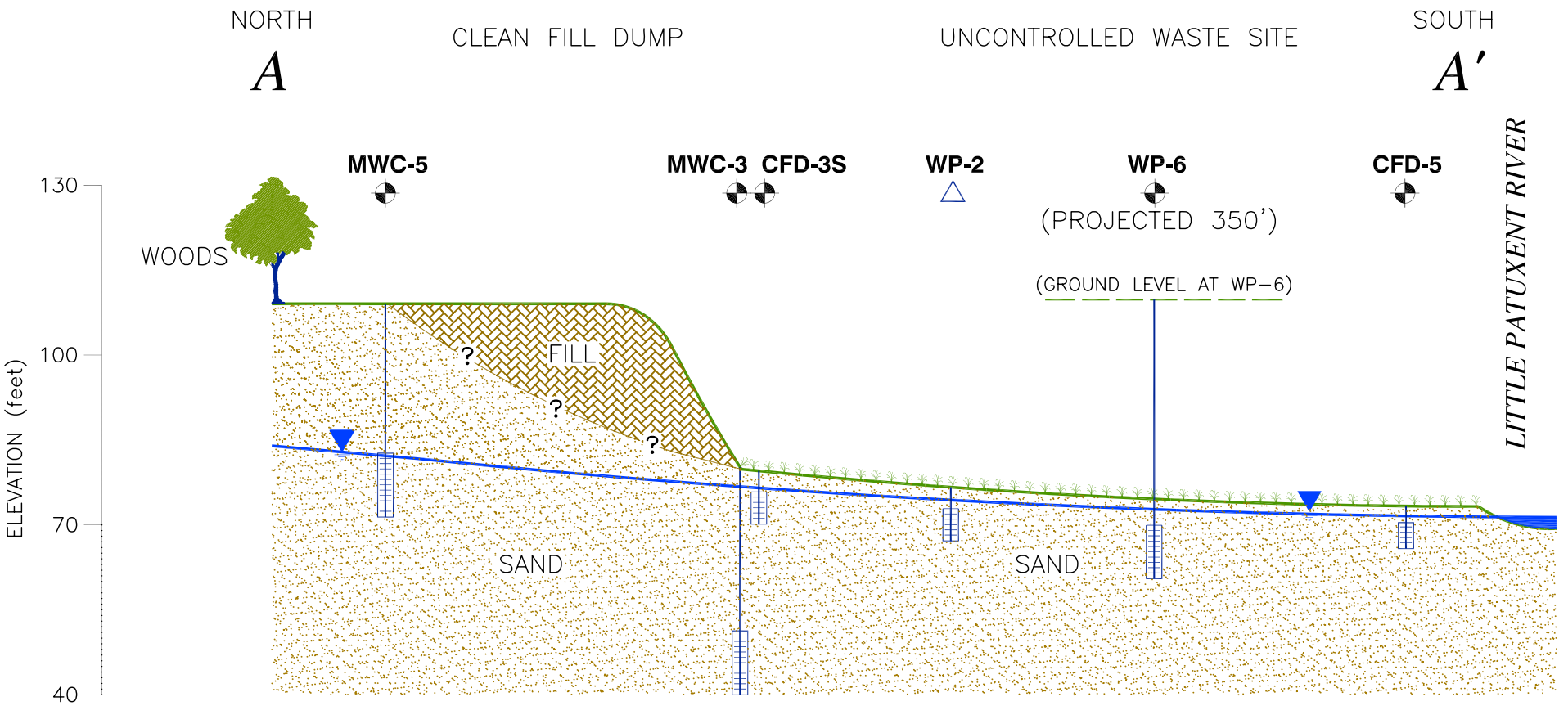
CLIENT	U.S. Army Corps of Engineers, Baltimore District			
PROJ	Clean Fill Dump Well Locations			
SOURCE	Base data: USACE, 2002; Aerial, 2003.			
REVISION NO	1	GIS:	AER	07/25/08
SCALE	1:3,600	CHK BY	FM	-
G:\Projects\Fort_Meade\Clean_Fill_Dump\2008 CFD_Figure3-1_WellLocations.mxd		PROJ MGR	FM	-

TITLE Monitoring Well Locations and Cross Section
Clean Fill Dump Operable Unit

URS
200 Orchard Ridge Drive
Gaithersburg, MD 20878

PROJ NO 15302389.20000

FIGURE 3-1



LEGEND:

WELL SCREEN

WATER TABLE

SCALE

VERTICAL	1" = 30'
HORIZONTAL	1" = 300'
EXAGGERATION	10 : 1

CLIENT: U.S. Army Corps of Engineers, Baltimore District	LOCATION:
DATE: 07/24/08	FILE:
DESIGN: AER	URS 200 Orchard Ridge Drive Gaithersberg, MD 20878
CHECKED: FM	
SENIOR: SM	

Figure 3-2
Geologic Cross Section A-A'
Clean-fill Dump Operable Unit
Patuxent Research Refuge-
North Tract

The wells were purged following low flow procedure. The pump rate was adjusted to approximately 1 liter/minute (L/min) while ensuring the drawdown remained less than approximately 0.1 meter or 0.33 feet. Physical parameters including pH, conductivity, temperature, turbidity, dissolved oxygen (DO), and oxidation/reduction potential (redox) were measured with flow cell instrumentation; and draw down was monitored with a water level meter. These parameters were recorded every 10 minutes on the purging and sampling record sheets provided in Appendix A. Purging continued until approximately one well volume had been removed and the parameters pH, temperature, conductivity, and turbidity had stabilized. Stabilization is defined as three successive readings 10 minutes apart with pH changing by less than 0.1 pH unit, temperature changing by 1°F or less, and conductivity and turbidity changing by less than 10 percent (USACE, 2002). The final purge parameters are listed in Table 3-2.

TABLE 3-2
Final Monitoring Parameters

Well ID	pH	Temperature ^{o}C	Conductivity (µmohs/cm)	DO (ppm)	REDOX (mV)	Turbidity (NTU)	Drawdown (ft)	Date
CFD-3S	6.69	20.04	0.083	1.8	89	21.1	0.3	9/23/2010
CFD-5	6.5	17.75	0.392	<0.2	-54	41.3	-0.02	9/27/2010
MWC-5	4.49	14.66	0.162	6.6	296	12.1	0.18	9/27/2010
WP-2	6.37	18.24	0.169	<0.2	-52	8.2	0.05	9/29/2010
MWC-3	4.59	15.05	0.092	1.7	331	5	0.05	9/24/2010
WP-6	3.81	17.29	0.062	2.11	331	57.5	0.17	9/27/2010

^{o}C = degrees Celsius; µmohs/cm = micromohs per centimeter; mV = millivolts; ppm = parts per million; NTU = Nephelometric turbidity unit; ft = feet

Conductivity was stabilized before one volume had been removed from each well. However, temperature failed to meet the specified stabilization criteria for CFD-3S, but it only slightly exceeded the parameter limit. Also, pH and turbidity failed to meet the 10 percent criterion in WP-6 due to persistent minor pH fluctuations. Turbidity frequently failed to meet the stabilization criterion in past sampling rounds at other FGGM sites. Although the wells were carefully developed after installation and had been purged in previous sampling events, the Patapsco sediments continue to release fine particles, even with the low flow protocol. The final non-stabilized turbidity measurement was 5.0 nephelometric turbidity units (NTU). Because the metals samples are filtered prior to analysis, the residual turbidity is expected not to influence the metals results. The influence the residual turbidity may have on the VOC results is not known.

Purge rates ranged between 0.19 and 0.65 liter per minute, and drawdown in the wells ranged between a gain of 0.02 and a loss of 0.3 feet. In all wells, the DO and redox readings varied by less than 10 percent over the last three measurements.

Samples were collected in appropriately preserved bottles supplied by the laboratory. Table 3-3 lists the analytical program for the CFD samples, and Table 3-4 describes the bottle requirements and preservatives. All bottle labels included the sample identification, sample date and time, analytical method, preservative, and sampler's name. The metals sample was passed through a 0.45 micron in-line filter prior to filling the preserved bottle. The purge water was placed in drums and stored as non-hazardous waste pending the analytical results and proper disposal.

TABLE 3-3
Sample Analyses/Analytical Methods

Well No./QC	TCL VOCs[1]	TAL Metals[2]
CFD-3S, CFD-22[3]	✓	✓
CFD-5	✓	✓
MWC-3	✓	✓
MWC-5	✓	✓
WP-2	✓	✓
WP-6	✓	✓
Trip Blank	✓	

[1]EPA Method 5030B/8260B
[2]EPA Method 3005A/6020
[3]Field Duplicate

TABLE 3-4
Sample Containers and Preservatives

Parameter	Container Quantity	Container Type	Preservative	Holding Time
VOCs	3	40-mL glass vials, Teflon septum cap	HCl to pH <2, Cool, 4°±2°C	14 days
Metals	1	500-mL polyethylene	HNO_3 to pH <2, Cool, 4°±2°C	6 months except Hg – 28 days

mL=milliliter; HCL=Hydrochloric acid; HNO_3=Nitric Acid

The quality control (QC) samples acquired during this event included a field duplicate (FD), trip blanks, and volumes for the lab matrix spike (MS) and matrix spike duplicate (MSD).

The field duplicate was collected from CFD-3S. The laboratory MS/MSD samples were collected from CFD-3S. All samples were placed in sealed, ice-filled coolers for shipment.

The nomenclature for sample ID uses the monitoring well designation, for example "CFD-3S". For the QC samples, the codes appended to the sample IDs are FD, MS, and MSD. The daily trip blanks accompany the VOC samples. These were designated Trip Blank CFD for samples shipped on September 24, 2010, and Trip Blank for samples shipped on September 29, 2010. One equipment blank was collected from the decontaminated submersible pump per the requirement of one blank per 20 environmental samples.

3.3 CHEMICAL ANALYSIS

Samples were shipped overnight to TestAmerica Laboratories, Inc., located in Pittsburgh, Pennsylvania, under a chain of custody (COC) protocol. The COC forms and shipping waybills are included in Appendix A. The parameters specified in the LTMP and the analytical methods are listed in Table 3-3. The FD (labeled "CFD-22") was submitted for the same analyses as sample CFD-3S. Additional sample volume was collected from CFD-3S for the laboratory MS and MSD.

Appendix C contains the laboratory reporting package which provides the laboratory reporting limits (RLs) and method detection limits (MDLs) for each analyte.

3.4 CHEMICAL DATA VALIDATION

URS performed data validation following the EPA Region III Modifications to the National Functional Guidelines for Data Review to assess the quality of the sample data and the usability for the intended purpose in the monitoring program in accordance with the 2002 LTMP. For future work, the following validation resources will be used (in order of preference):

- Project Quality Assurance Plan
- Department of Defense (DoD) Quality Systems Manual (QSM)
- EPA SW-846 Test Methods

These guidelines will be incorporated into the revised LTMP scheduled for fiscal year 2011.

In addition to assessing the results of the various analytical QC, the validation identifies potential errors in the results, such as transcription errors, laboratory methods out of control, or

cross-contamination of samples. The Validation Report is provided in Appendix D. The data qualifiers and abbreviation definitions are provided at the end of the report.

3.5 DATA MANAGEMENT

URS recorded field data in a bound field logbook and on field monitoring sheets and are available in Appendix B. Chemical data were delivered by the laboratory in hardcopy and electronic formats. Physical parameters including pH, conductivity, turbidity, DO, and redox from the field monitoring were incorporated into the chemical data files. The 2010 results are combined with the historical data from the site and loaded into the FGGM environmental database for the CFDOU.

3.6 INVESTIGATION-DERIVED WASTE

Purge water was placed in 55-gallon drums and was collected and will be disposed of by Potomac Environmental, Inc. The water was not sampled, because it is considered investigation-derived waste (IDW) water with trace explosives (i.e., non-hazardous). All disposable sampling material including tubing and personal protective equipment was collected in trash bags and disposed of as directed by Post personnel.

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4.0 RESULTS

4.1 WELL INSPECTION

A visual inspection of the casing of each of the 17 CFDOU wells was performed by URS during the sampling event. The inspection revealed all site wells are in serviceable condition, but various deficiencies were noted ranging from rusty casings to broken fittings that compromise security. Table 4-1 presents the conditions discovered at the time of inspection. Most well locks are stiff and difficult to open. Paint is faded on many well casings and the exterior well ID is difficult to read. The broken casing hinges on CFD-2, CFD-3S, and CFD-5 do not prevent opening the apparently locked casings.

TABLE 4-1
2010 CFD Well Inspection Results

Well ID	Concrete Pad	Paint	Well ID External	Well ID on Cap	Well Permit Tag Present	Other Observations
CFD-1	Good	Rusty	Faded	No	Yes	Stiff lock, wasp nest
CFD-2	None	Rusty	Faded	No	Yes	Broken hinge, stiff lock
CDF-3S	None	Faded	Faded	Yes	Yes	Broken hinge, stiff lock
CFD-3D	Good	Rusty	Faded	Yes	Yes	Wasp nest
CFD-4	Poor	Rusty	Faded	Yes	Yes	No lock; new lock provided
CFD-5	Partially covered	Rusty	Faded	Yes	Yes	Soil on concrete pad, broken hinge
MWC-1	Good	Rusty	Faded	No	Yes	Soil on concrete pad, no lock; new lock provided
MWC-2	Good	Faded	Faded	No	Yes	Heavily overgrown, wasp nest
MWC-3	Good	Faded	Faded	No	Yes	Stiff lock
MWC-4	Good	Rusty	Faded	No	Yes	Stiff lock
MWC-5	Good	Faded	None	No	Yes	Stiff lock
WP-1	None	None	Yes	Yes	No	Only 2-inch pipe, no outer casing, no lock; new lock provided
WP-2	None	None	Yes	Yes	No	Only 2-inch pipe, no outer casing, measuring point not labeled
WP-3	None	None	Yes	Yes	No	Only 2-inch pipe, no outer casing, broken cap, no lock
WP-4	None	Rusted	Faded	No	No	Stiff Lock
WP-5	None	Faded	None	No	No	Stiff Lock
WP-6	Good	Faded	Faded	No	No	Stiff lock

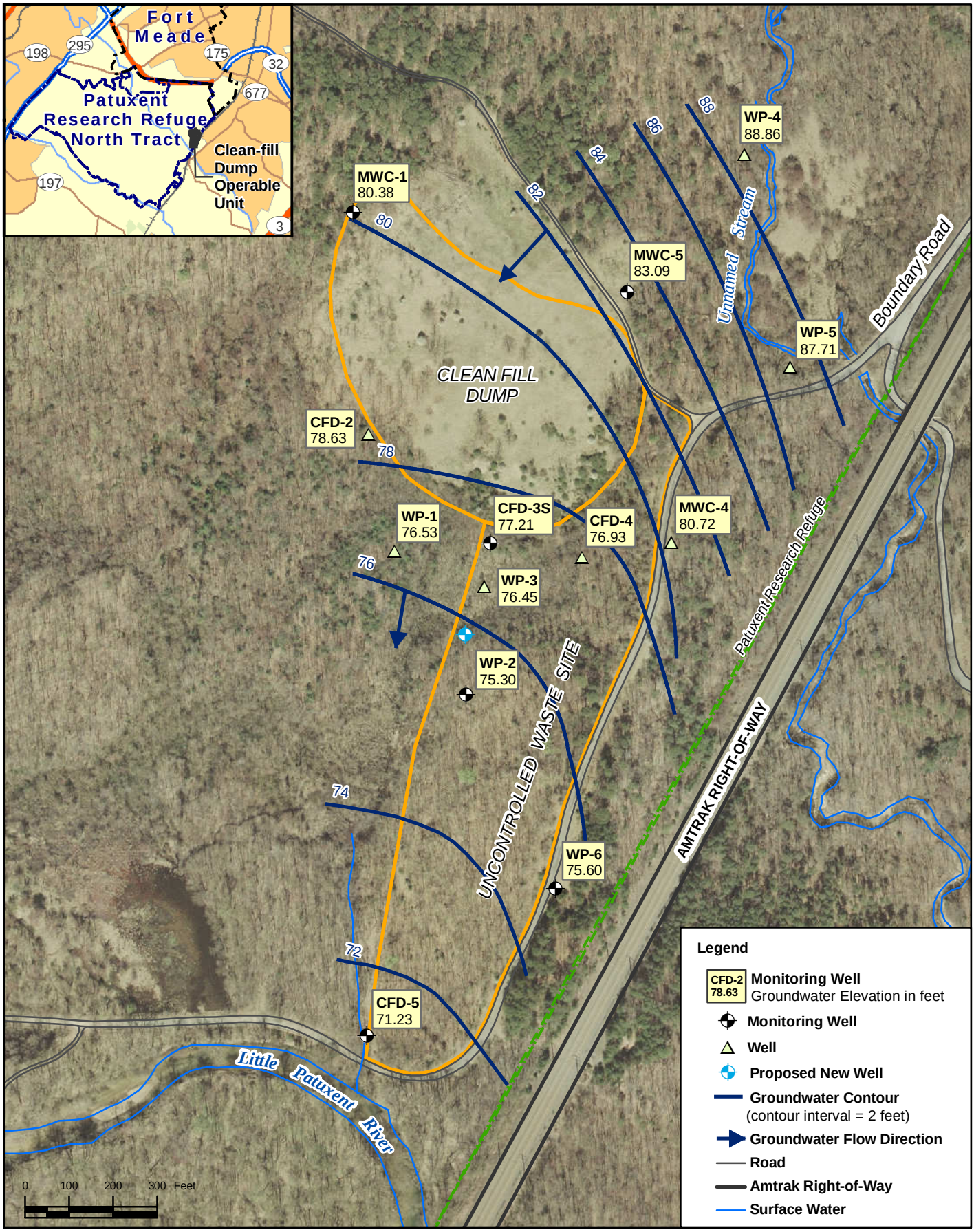
4.2 HYDROLOGICAL RESULTS

A complete round of water level measurements was conducted from September 20 to 21, 2010. Groundwater elevations calculated from these static water levels are presented in Table 4-2 and are contoured on the groundwater map in Figure 4-1. These contours indicate groundwater flow is to the southwest under the CFDOU, and turns southerly in the wetland area to the south of the landfill. The Little Patuxent River serves as a constant head discharge for the shallow groundwater, controlling the groundwater elevation in the vicinity of the site. Groundwater elevations in four wells with deeper screens--CFD-1, CFD-3D, MWC-2, and MWC-3--were not used to construct the water table contours.

TABLE 4-2
Groundwater Elevation September 20 to 21, 2010

Well ID	Top of Casing Elevation (ft NAVD*)	Measured Depth to Water (ft TOC)	Groundwater Elevation (ft NAVD*)	Top of Screen Elevation (ft NAVD*)	Height of Water Above Top of Screen (ft NAVD*)
CFD-1	114.32	49.5	64.82	72.19	-7.37
CFD-2	81.67	3.04	78.63	75.98	2.65
CFD-3S	80.21	3.00	77.21	73.81	3.40
CFD-3D	81.95	2.62	79.33	19.70	59.63
CFD-4	79.99	3.06	76.93	72.89	4.04
CFD-5	75.95	4.72	71.23	70.19	1.04
MWC-1	90.80	10.42	80.38	70.68	9.70
MWC-2	94.85	14.81	80.04	4.43	75.61
MWC-3	81.59	3.11	78.48	50.59	27.89
MWC-4	110.40	29.68	80.72	78.52	2.20
MWC-5	113.53	30.44	83.09	80.23	2.86
WP-1	79.57	3.04	76.53	73.84	2.69
WP-2	79.38	4.08	75.30	74.01	1.29
WP-3	79.21	2.76	76.45	73.96	2.49
WP-4	93.97	5.11	88.86	88.37	0.49
WP-5	91.95	4.24	87.71	87.55	0.16
WP-6	115.49	39.89	75.60	69.49	6.11

* NAVD = North American Vertical Datum
ft = feet
TOC = top of casing



CLIENT	U.S. Army Corps of Engineers, Baltimore District			
PROJ	Clean Fill Dump 2008 Sampling Event			
SOURCE	Base data: USACE, 2002; Aerial, 2003.			
REVISION NO	1	GIS:	JK	02/03/11
SCALE	1:3,600	CHK BY	GW	02/03/11
G:\Projects\Fort_Meade\Clean_Fill_Dump\2010 CFD_Figure4-1_WaterLevels.mxd		PROJ MGR	FM	-

TITLE Water Table Elevation Contour Map, July 2010
Clean Fill Dump Operable Unit

URS
200 Orchard Ridge Drive
Gaithersburg, MD 20878

PROJ NO 15301259.00002

FIGURE 4-1

Flow velocity of the shallow groundwater can be estimated using the assumption of Darcian flow conditions (Freeze and Cherry, 1979), the formation's hydraulic conductivity and porosity, and the horizontal groundwater gradient. Slug tests conducted at the CFDOU during previous investigations (USAEC, 1992a and 1992b) yielded an average hydraulic conductivity of 2.78×10^{-3} centimeters per second (cm/sec) from four wells screened at the water table. The horizontal gradient calculated between CFD-3S and CFD-5 on September 20 to 21, 2010 is 5.11×10^{-3}. Assuming the porosity of 30 percent for the Patapsco sands, the groundwater flow velocity is approximately 4.73×10^{-5} cm/sec or 0.134 feet per day.

The vertical gradient in the water table aquifer was calculated from the water levels in the group of three wells near the base of the landfill: CFD-3S, MWC-3, and CFD-3D. Table 4-3 presents the groundwater elevations, the elevations of the screen midpoints, and the calculated vertical gradients. The water levels (hydraulic heads) increase with depth, resulting in a positive vertical gradient and the potential of upward flow in the aquifer. This result corroborates findings in the RI and suggests any dissolved constituents in the shallow groundwater probably will not move to deeper intervals.

TABLE 4-3
Vertical Hydraulic Gradient

Well ID	Screen Midpoint Elevation (ft NAVD*)	Groundwater Elevation (ft NAVD*)	Vertical Gradient (ft/ft)
CFD-3S	71.31	77.21	0.049
MWC-3	45.59	78.48	
MWC-3	45.59	78.48	0.028
CFD-3D	14.70	79.33	

* NAVD = North American Vertical Datum
ft = feet

4.3 CHEMICAL RESULTS

4.3.1 Laboratory Results

Table 4-4 presents the detections from the 2010 groundwater monitoring. All analytes that are positive detections in at least one sample are included in this table. A "J" flag indicates concentrations lower than the laboratory RL but above the laboratory MDL. These trace detections are positively identified but are only of approximate quantification and appear with

one significant digit. The entry "bdl" (below detection limit) indicates a non-detect. The complete laboratory data report is presented in Appendix C.

VOCs were detected in three downgradient wells: CFD-3S, CFD-5, and WP-2, but not in the upgradient well, MWC-5. TCE and cis-1,2-dichloroethene (cis-1,2-DCE) were reported in CFD-3S, CFD-5, and WP-2. PCE was also reported in CFD-3S. None of these compounds were detected in the deeper screen at the foot of the landfill, MWC-3, suggesting that the positive vertical groundwater gradient discussed in Section 4.2 has prevented constituents in the shallow water from moving deeper into the aquifer.

Twenty-one inorganic analytes were detected in the 2010 samples. With the exception of the essential nutrient metals (calcium, magnesium, potassium, and sodium), most inorganics were reported at low concentrations in only one or two wells. However, some exceptions are notable, including arsenic, iron, and manganese. The 2010 sample results for arsenic in CFD-5 is consistent with historic detections in that location. Mercury, detected in trace concentration near the laboratory MDL, had not been reported in sampling events prior to 2008. The iron and manganese concentrations in the southern part of the site are similar to other VOC-contaminated sites where reductive geochemical conditions are conducive to mobilizing metals that are ready electron accepters.

Evaluation of the CFDOU results includes comparison to several sets of concentration standards. Table 4-4 includes the three sets of screening criteria from EPA used to evaluate the results and the PRR Lower Patuxent aquifer background levels for the inorganic analytes.

- Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs) from the National Primary Drinking Water Regulations are legally enforceable standards that apply to public water systems and protect public health by limiting the levels of contaminants in drinking water. MCLs and MCLGs are available on EPA's Web site: www.epa.gov/safewater/contaminants/index.html. These criteria are current to November 2010.

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TABLE 4-4
Groundwater Chemical Results for 2010 Sampling Event and Screening Criteria

	Screened at Water Table																				Screened Below Water Table															
Well	CFD-3S				CFD-22 (dup)				CFD-5				MWC-5				WP-2				MWC-3				WP-6				Laboratory Method Detection Limit	Laboratory Method Reporting Limit	EPA Drinking Water Maximum Contaminant Level (MCL)	Secondary Drinking Water Maximum Contaminant Level (SMCL)	EPA Region III RSLs		Background Concentration in Lower Patapsco Aquifer**
Sample Collection Date	9/23/2010				9/23/2010				9/27/2010				9/27/2010				9/29/2010				9/24/2010				9/27/2010										
Screen Interval (in feet bgs)	4.5 - 9.5				4.5 - 9.5				3 - 8				31 - 41				2.5 - 5.5				29 - 39				44 - 54										
Height of water above top of screen	3.53				3.53				1.18				3.35				1.39				28.28				6.52										
Upgradient/Dowgradient (U/D)	D				D				D				U				D				D				D										
		LQ	VF	RC		LQ	VF	RC		LQ	VF	RC		LQ	VF	RC		LQ	VF	RC		LQ	VF	RC		LQ	VF	RC							
Field Parameters																																				
Turbidity (NTU)	21.1				21.1				41.3				12.1				8.2				5				57.5				--	--	--	5	--		--
pH	6.69				6.69				6.5				4.49				6.37				4.59				3.81				--	--	--	< 6.5 or > 8.5	--		--
Temperature (Deg C)	20.04				20.04				17.75				14.66				18.24				15.05				17.29				--	--	--	--	--		--
Conductivity (µ-mohs/cm)	0.083				0.083				0.392				0.162				0.169				0.092				0.062				--	--	--	--	--		--
Redox Potential (mV)	89				89				-54				296				-52				331				311				--	--	--	--	--		--
Dissolved Oxygen (ppm)	1.8				1.8				0				6.6				0				1.7				2.11				--	--	--	--	--		--
Volatile Organic Compounds (µg/l)																																				
CHLOROETHANE	bdl				bdl				bdl				bdl				bdl				bdl				bdl				0.21	1	--	--	2100	n	--
CHLOROFORM ***	bdl				bdl				bdl				bdl				bdl				bdl				bdl				0.17	1	80	--	0.19	c	--
CIS-1,2-DICHLOROETHENE	7				6.9				1.6				bdl				31				bdl				bdl				0.24	1	70	--	7.3	n	--
TETRACHLOROETHENE	18				20				bdl				bdl				bdl				bdl				bdl				0.15	1	5	--	0.11	c	--
TOLUENE	bdl				bdl				bdl				bdl				bdl				bdl				bdl				0.15	1	1,000	--	230	n	--
TRANS-1,2-DICHLOROETHENE	bdl				bdl				bdl				bdl				bdl				bdl				bdl				0.17	1	100	--	11	n	--
TRICHLOROETHENE	7.8				6.9				0.4	J'			bdl				7.6				bdl				bdl				0.14	1	5	--	2	c	--
VINYL CHLORIDE	bdl				bdl				NT				NT				NT				bdl				NT				0.23	1	2	--	0.016	c	--
Dissolved Metals (µg/l)																																				
ALUMINUM	12.7	B	B	x	17	B	B	x	3	B			82.2				160				5.9	B	B	x	21.9	B			2.6	30	--	200	3,700	n	759
ANTIMONY	0.072	B	B	o	0.043	B	B	o	0.034	B	B	o	bdl				0.093	B	B	o	0.083	B	B	o	0.035	B	B	o	0.019	2	6	--	1.5	n	--
ARSENIC	bdl				bdl				27.5				bdl				bdl				bdl				bdl				0.29	1	10	--	0.045	c	2
BARIUM	25.5				26.3				18.7				71.8				11.7				23.8				7.1	B			0.098	10	2,000	--	730	n	19.1
BERYLLIUM	0.18	B			0.19	B			bdl				0.23	B			0.046	B			0.071	B			0.73	B			0.037	1	4	--	7.3	n	0.1
CADMIUM	0.15	B			0.12	B			bdl				0.21	B			bdl				bdl				bdl				0.11	1	5	--	1.8	n	--
CALCIUM	4,100				4,010				48,200				4,230				19,700				2,960				1,660				2.8	100	--	--	--		5890
CHROMIUM	5.8	J	B	x	5.9	J	B	x	3.2				3.1				6.7				5.8	J	B	x	2.7				0.54	2	100	--	0.043	c	10.1
COBALT	11.7				11.7				2.7				29				0.68				5				7.4				0.026	0.5	--	--	1.1	n	18.4
COPPER	bdl		UL	w	bdl		UL	w	0.39	B			4.6				0.58	B			2.2		L	w	2.1				0.24	2	1,300 *	1000	150	n	14.6
IRON	5,070				5,290				10,700				27.4	B	B	o	383				19.2	B	B	o	626				6.1	50	--	300	2,600	n	264
LEAD	0.22	J			0.22	B			bdl				0.19	B			0.065	B			0.13	B			0.29	B			0.019	1	15 *	--	--		10.6
MAGNESIUM	2,290				2,280				5,310				5,000				2,340				1,890				897				1.2	100	--	--	--		627
MANGANESE	102				102				142				92.2				157				26.6				26.9				0.039	0.5	--	50	88	n	45.1
MERCURY	bdl		UL	o	bdl		UL	o	0.076	B			0.073	B			0.087	B			bdl		UL	o	0.053	B			0.038	0.2	2	--	0.057	n	--
NICKEL	17.7				17.7				1.6	B			26				1.7	B			6.4				12.6				0.17	2	--	--	73	n	13.6
POTASSIUM	1,280	J			1,300	J			2,890				2,870				1,540				1,320	J			1,020				5.8	100	--	--	--		3840
SELENIUM	1	BJ	B	o	1.3	BJ	B	o	bdl				1	B			0.6	B			1.6	BJ	B	o	0.88	B			0.42	5	50	--	18	n	--
SODIUM	3,790	B			3,780	J			10,700	J			10,200	J			5,730	J			7,890	J			3,930	J			3.8	100	--	--	--		2910
THALLIUM	bdl				bdl				bdl				0.087	B	B	o	0.056	B	B	o	0.018	B			0.051	B	B	o	0.015	1	2	--	--		--
ZINC	73.5				74.8				39.3				51.5				1	B			9.9		B	x	28				0.96	5	--	5000	1,100	n	66.1

Notes:

All results are shown in µg/L or parts per billion.
Shaded results indicate exceedance of MCLs, SMCLs, or RSLs.
MCL = National Primary Drinking Water Regulations, Maximum Contaminant Level, USEPA, November 4, 2010
RSL = EPA Regional Screening Levels, November 2010. The non-cancer RSLs are adjusted by a factor of 10 to represent a hazard quotient of 0.1.
* = EPA Action Levels.
B = Estimated result. Result less than RL.
J = Method blank contamination. The associated method blank contains the target analyte at a reportable level.
J' = Estimated result. Result less than RL.
NT = Not tested.
bdl = Below the method detection limit and reporting limit
c = Cancer
n = Non-cancer
** = Background concentrations are adapted from the metals results from monitoring well ODAMW-6D at the Ordnance Demolition Area.
LQ - Laboratory Qualifier
RC - Reason Code (Validation)
VF - Validation Flag
*** = Inconclusive because RL is above the RSL
w = CRDL Standard Failure
o = Calibration blank contamination

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- National Secondary Drinking Water Regulations or Secondary MCLs (SMCLs) are non-enforceable guidelines regulating contaminants that may cause cosmetic or aesthetic effects. The SMCLs are also available on the EPA Web site. These criteria are current to November 2010.

- Regional Screening Levels (RSLs) are health-protective chemical concentrations that are calculated using conservative residential exposure parameters for tap water and are based on a carcinogenic risk of 1E-06. The non-cancer RSLs are adjusted from a target hazard index of 1 to 0.1 per EPA Region III screening guidance (EPA, 2010). In previous LTM reports, the Army used EPA Region III tap water risk-based concentrations (RBCs) for screening the groundwater results. In September 2008, EPA published RSLs that supersede the EPA Region III RBCs.

  The lower of the cancer and adjusted non-cancer RSL was used as the screening criteria in Table 4-4. The EPA Region III RSLs, which were taken from the RSL table dated November 2010 (EPA, 2010), are available at www.epa.gov/reg3hwmd/risk.

- Background concentrations for inorganics in the Lower Patapsco aquifer on the PRR are adapted from the metals results from monitoring well ODAMW-6D at the Ordnance Demolition Area. Background concentrations were taken as the detections reported for the sample collected in May 1996. A high level of uncertainty is associated with the inorganic concentrations from this single sample and whether these results are considered to be characteristic of background water quality for the Lower Patapsco aquifer on the PRR. Therefore, no background comparison with the 2010 groundwater data will be conducted; instead the background levels are presented for informational purposes only.

4.3.2 MCL and SMCL Exceedances

- TCE exceeded its MCL of 5 micrograms per liter (µg/L) in CFD-3S (7.8 µg/L) and WP-2 (7.6 µg/L).

- PCE exceeded its MCL of 5 µg/L in CFD-3S (18 µg/L).

- Arsenic was the only metal that exceeded its MCL of 10 µg/L; arsenic was detected in the downgradient well CFD-5 (27.5 µg/L).

- Iron and manganese both exceeded their SMCLs in four wells.

4.3.3 RSL Exceedances

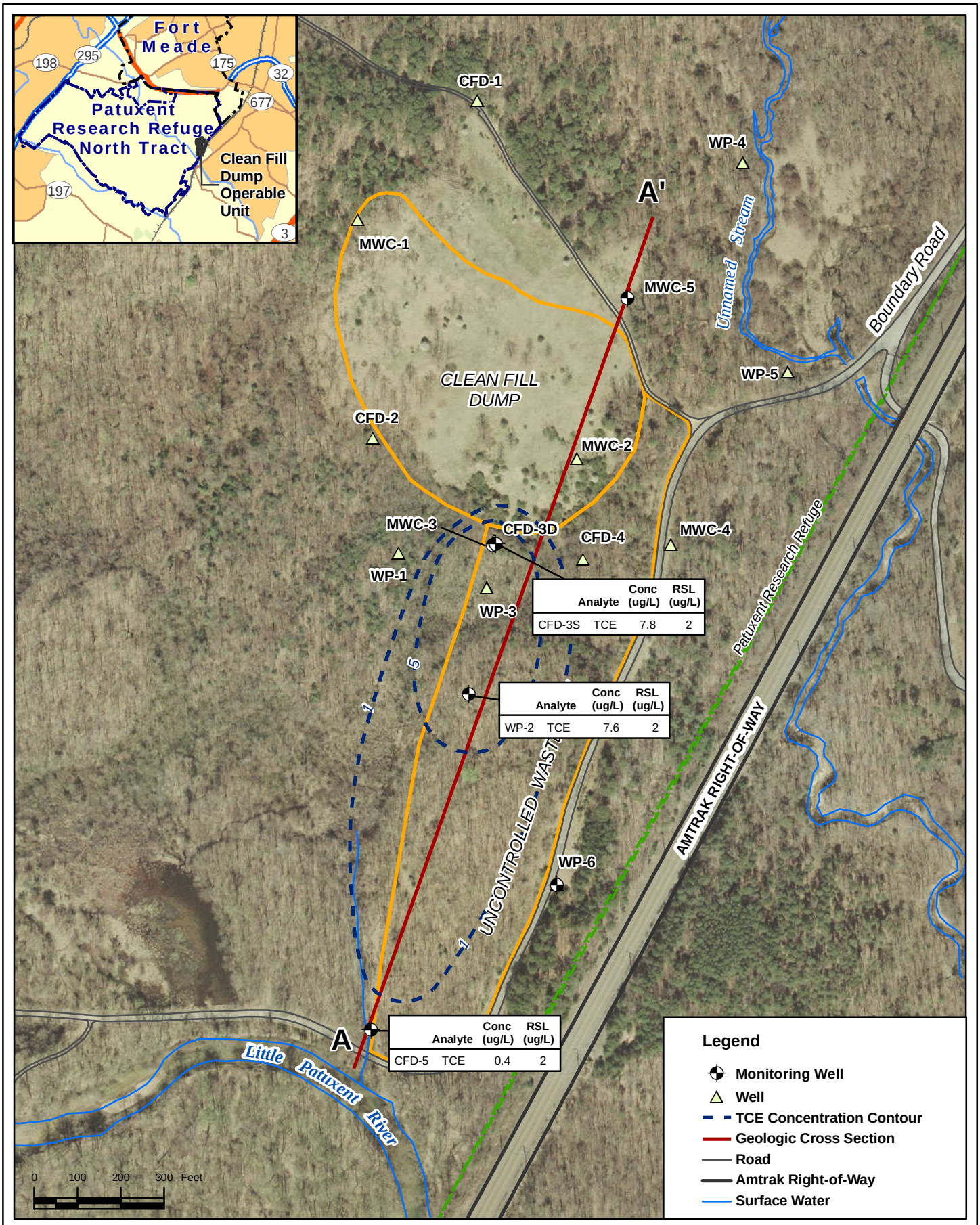
- TCE was detected at concentrations above its RSL of 2 µg/L in CFD-3S (7.8 µg/L) and WP-2 (7.6 µg/L). This compound had exceeded the RSL in CFD-5 in the previous sampling event but now is only detected in a trace concentration of 0.4 µg/L.
- PCE was detected at concentrations above its RSL of 0.11µg/L in CFD-3S (18 µg/L).
- Arsenic exceeded its RSL of 0.045 µg/L in the down gradient well CFD-5 (27.5 µg/L).
- Cobalt exceeded its RSL of 1.1 µg/L in four down gradient wells, CFD-3S (11.7 µg/L), CFD-5 (2.7 µg/L), MWC-3 (5 µg/L), and WP-6 (7.4 µg/L), as well as in the up gradient well MWC-5 (29 µg/L).
- Chromium exceeded its RSL of 0.043 µg/L in all wells: CFD-3S (5.8 µg/L), CFD-5 (3.2 µg/L), MWC-5 (3.1 µg/L), WP-2 (6.7 µg/L), MWC-3 (5.8 µg/L), and WP-6 (2.7 µg/L). The results for CFD-3S and MWC-3 were "B"- flagged indicating that the analyte was also detected in the method blank.
- Mercury exceeded its RSL of 0.057 µg/L in two down gradient wells, CFD-5 (0.076 µg/L) and WP-2 (0.087 µg/L), and the up gradient well MWC-5 (0.073 µg/L). However, all these results are "J"-flagged, indicating that the result is an estimated value.
- Iron exceeded its RSL of 2,600 µg/L in CFD-3S (5,070 µg/L) and CFD-5 (10,700 µg/L).

4.4 DISCUSSION

4.4.1 Current Groundwater Quality

The 2010 results indicate TCE, PCE, arsenic, chromium, cobalt, iron, manganese, and mercury are present at concentrations exceeding MCLs and/or RSLs. Cis-1,2-DCE, TCE, and PCE were detected only in wells downgradient from the CFD and are likely to be site related. Figure 4-2 and 4-3 shows the TCE and cis-1,2-DCE detections above screening level decrease down gradient from the landfill. The absence of the organic compounds in MWC-3 is consistent with the upward vertical gradient discussed in Section 4.2.

Arsenic was detected in CFD-5, the down gradient well, at a concentration exceeding the MCL and RSL, and was "bdl" in all other wells. Iron exceeded the SMCL in four wells and exceeded its RSL in two wells. Manganese exceeded the SMCL and RSL in the up gradient well



Analyte	Conc (ug/L)	RSL (ug/L)
CFD-3S TCE	7.8	2

Analyte	Conc (ug/L)	RSL (ug/L)
WP-2 TCE	7.6	2

Analyte	Conc (ug/L)	RSL (ug/L)
CFD-5 TCE	0.4	2

CLIENT	U.S. Army Corps of Engineers, Baltimore District		
PROJ	Clean Fill Dump Well Locations		
SOURCE	Base data: USACE, 2002; Aerial, 2003.		
REVISION NO	1	GIS:	JK	02/03/11
SCALE	1:3,600	CHK BY	GW	02/03/11
G:\Projects\Fort_Meade\Clean_Fill_Dump\2010 CFD_Figure4-2_TCEShallowAq.mxd		PROJ MGR	FM	-

N

TITLE

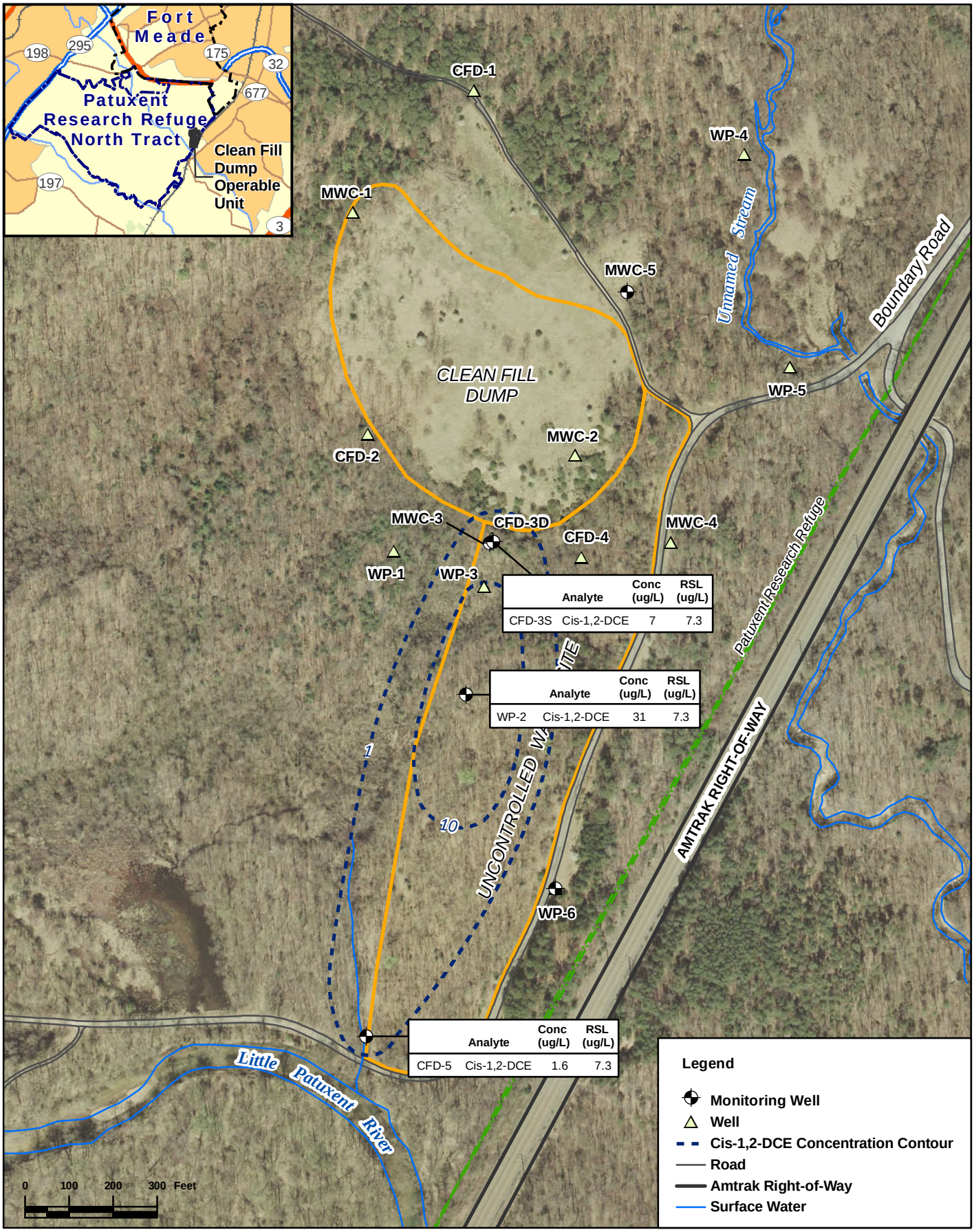
TCE Concentration Contours
Clean Fill Dump September 2010

URS

200 Orchard Ridge Drive
Gaithersburg, MD 20878

PROJ NO 15301259.00002

FIGURE 4-2



Analyte		Conc (ug/L)	RSL (ug/L)
CFD-3S	Cis-1,2-DCE	7	7.3

Analyte		Conc (ug/L)	RSL (ug/L)
WP-2	Cis-1,2-DCE	31	7.3

Analyte		Conc (ug/L)	RSL (ug/L)
CFD-5	Cis-1,2-DCE	1.6	7.3

CLIENT	U.S. Army Corps of Engineers, Baltimore District		
PROJ	Clean Fill Dump Well Locations		
SOURCE	Base data: USACE, 2002; Aerial, 2003.		
REVISION NO 2	GIS:	JK	02/03/11
SCALE 1:3,600	CHK BY	GW	02/03/11
G:\Projects\Fort_Meade\Clean_Fill_Dump\5YearRecurring Review\CFD_Figure4-1_cis_DCE.mxd	PROJ MGR	BE	-

TITLE

Cis-1,2-DCE Detection Contours
Clean Fill Dump September 2010

URS

200 Orchard Ridge Drive
Gaithersburg, MD 20878

PROJ NO 15301259.00007

FIGURE 4-3

MWC-5 as well as down gradient wells CFD-3S, CFD-5, and WP-2. Chromium exceeded its RSL concentrations in all wells. Cobalt and mercury exceeded the RSL in the up gradient well and three or more down gradient wells. Most of these metals were also detected in MWC-3, suggesting the elevated concentrations are related to local subsurface conditions favorable to mobilizing metals.

WP-6 contains several metals at concentrations above the RSLs, but the VOCs were not detected, demonstrating that the organic contaminants are not migrating to the southeast off the property.

4.4.2 Groundwater Quality Trends

One goal of the LTM program is to evaluate the chemical results for possible trends over the span of monitoring, in particular, to document that contaminant concentrations are not increasing over time. Table 4-5 presents the historic and current results for four constituents—DCE, PCE, TCE, and arsenic--that have been consistently detected at the CFDOU. This table reveals a four-dimensional picture of the site contaminants; the wells specify the spatial distribution of the detections, and the succession of sampling rounds records the temporal distribution. For example PCE concentrations have been generally decreasing in CFD-3S since the 1993 sampling event. PCE is rarely detected in other wells.

The CFDOU data were evaluated with the Mann-Kendall trend test to search for trends that would be indicative of changing conditions in the groundwater quality. The Mann-Kendall test does not require particular distributional assumptions, and non-detects are permitted. However, the test requires the data set to contain a minimum of four sample results. The Mann-Kendall tests were conducted using Visual Sample Plan (VSP) version 5.0 for analytes detected during the 2010 sampling event.

In generating the data set for the VSP tool, the non-detections were assigned the value of the RL even though the RL varied over the period of record, and the "J" flag results are included as detections. VSP tools were set to "account for non-detects" which addresses variations in the RL values over time using the Kaplan-Meier Product Limit Estimator (Telephone conversation with Mr. Brent Pulsipher, 17 November 2010). The Mann-Kendall test yields a value that corresponds to a probability level that a trend is the result of random fluctuations, based on the number of observations considered and the desired confidence level. If the probability is low that a

trend is based on random fluctuations (e.g., ≤5%), then the trend is considered to be statistically significant. Conversely, if the probability is high that a trend is based on random fluctuations (e.g., ≥5%), then the trend is considered statistically insignificant. In addition to the Mann-Kendall trend test, VSP was used to produce Lowess curves for analytes of interest in selected downgradient wells. These Lowess curves are presented in Appendix E.

Table 4-6 presents the statistical trend analysis that was performed using the previous 5 years of LTM data (2002 through 2010) to evaluate the chemical results for possible trends. Earlier site data (1991 through 1996) was not used because of the high number of non-detections in the data set and the large variability (2 to 3 orders of magnitude difference) of the chemical RLs used to represent the non-detect concentrations. The data produced skewed Mann-Kendall statistical results when all the available groundwater data were used. As shown in Table 4-6, the statistical analysis indicated very few upward or downward trends with the data even when the 2002 through 2010 data were used. A significant portion of this data set consists of non-detects, which makes it unlikely that statistical tests, including the Mann-Kendall test, will detect a trend.

To clarify possible trends, scatter plots were generated to visually examine the detected concentrations over time for select VOCs (cis-1,2-DCE, PCE, and TCE) and metals (arsenic, chromium, cobalt, manganese, and iron) at the CFD OU. Appendix E presents the results. The PCE concentrations at CFD-3S (Figure E-1) appear to decrease over time (until 2006 when the concentration became steady at 18 µg/L), but the concentrations are above the MCL. The cis-1,2-DCE and TCE concentrations remain fairly consistent over time (between 5 and 15 µg/L); the cis-1,2-DCE concentrations remain below its MCL of 70 µg/L whereas the TCE concentrations remain above its MCL of 5 µg/L.

The Lowess curves for well CFD-3S (Figure E-2) show downward trends for PCE and TCE. The cis-1,2-DCE Lowess curve indicates an inverse relationship with the PCE and TCE results; cis-1,2-DCE is at a low point in 2005 when the curves for PCE and TCE are showing a peak. The reverse occurs in 2007, however the cis-1,2-DCE concentrations decrease after 2007 and the PCE concentration curve appears to stabilize. Table E-1 and the data points in the Lowess curve for TCE show an increase in concentration from 2008 to 2010.

For monitoring well WP-2 (Figure E-3), the VOC concentrations increase during the 2006 sampling event and then decreased again in 2008; however MCLs have never been exceeded

TABLE 4-5
Clean Fill Dump
Summary of Historical Chemical Results for Selected Analytes

DCE[1]	Sampling Event							
	3/91	**2/93**	**10/96**	**6/02**	**4/04**	**9/06**	**8/08**	**9/10**
CFD-3S	5.9	bdl2	bdl	14.2	6.6	9.3	12	7
CFD-5	bdl	bdl	bdl	3.9	1.7	2	3.92	1.6
MWC-3	x[3]	x	bdl	bdl	bdl	bdl	bdl	bdl
MWC-5	x	x	bdl	bdl	bdl	bdl	bdl	bdl
WP-2	x	x	7.4	1 J	bdl	12	8.2	31
WP-6	x	x	bdl	bdl	bdl	bdl	bdl	bdl

PCE[4]	Sampling Event							
	3/91	**2/93**	**10/96**	**6/02**	**4/04**	**9/06**	**8/08**	**9/10**
CFD-3S	37	67	60	25.8	47 D[6]	18	18	18
CFD-5	bdl	2.5	bdl	bdl	bdl	bdl	bdl	bdl
MWC-3	x	x	bdl	bdl	bdl	bdl	bdl	bdl
MWC-5	x	x	bdl	bdl	bdl	bdl	bdl	bdl
WP-2	x	x	bdl	bdl	bdl	17	bdl	bdl
WP-6	x	x	bdl	bdl	bdl	bdl	bdl	bdl

TCE[5]	Sampling Event							
	3/91	**2/93**	**10/96**	**6/02**	**4/04**	**9/06**	**8/08**	**9/10**
CFD-3S	5.4	12	12	12.4	14	9.5	6	7.8
CFD-5	bdl	3	1.6	11.2	0.61 J[6]	1.1	1.9	0.4
MWC-3	x	x	bdl	bdl	bdl	bdl	bdl	bdl
MWC-5	x	x	bdl	bdl	bdl	bdl	bdl	bdl
WP-2	x	x	6.1	1.5 J	bdl	15	4.8	7.6
WP-6	x	x	bdl	bdl	bdl	bdl	bdl	bdl

Arsenic	Sampling Event							
	3/91	**2/93**	**10/96**	**6/02**	**4/04**	**9/06**	**8/08**	**9/10**
CFD-3S	bdl	bdl	bdl	bdl	5.43 J	bdl	1 J	bdl
CFD-5	37.4	10.4	43.3	31	26.5	27	27	27.5
MWC-3	x	x	bdl	bdl	bdl	bdl	0.5 J	bdl
MWC-5	x	x	bdl	bdl	bdl	bdl	0.3 J	bdl
WP-2	x	x	7.81	bdl	bdl	bdl	1 J	bdl
WP-6	x	x	bdl	bdl	bdl	bdl	bdl	bdl

All concentrations in micrograms per liter (parts per billion).

Notes:
1 1,2-Dichloroethene (from 1991 and 1993 sampling events) and cis-1,2-Dichloroethene (from subsequent sampling events) have been combined as "DCE".
2 bdl = Below method detection limit and reporting limit
3 x = Not analyzed in this sampling event
4 PCE=Tetrachloroethene
5 TCE=Trichloroethene
6 Laboratory Qualifiers: D = Dilution, J = Estimated value

TABLE 4-6
Summary Statistics and Trend Analyses

Detected Analytes 2010	No. of Observ. (a)	No. of Non-Detects	Percent Non-Detects (%)	Shapiro-Wilk Distribution Test (b) Significant at alpha = 0.05	Mean (b) ug/L	Standard Deviation of the Mean (b) ug/L	Median (b) ug/L	Range (b) ug/L	Minimum (b) ug/L	Maximum (b) ug/L	Mann-Kendall Trend Test (c) S value	Prob from table	Significant at alpha ≤0.05
MWC-5 (upgradient)													
Chloroform	5	3	60%	normal	0.91	0.71	1	1.79	0.21	2	-5	0.484	No trend
Aluminum	5	2	40%	not normal	121.84	71.76	82.20	137	63	200	-3	0.816	No trend
Arsenic	5	4	80%	not normal	6.26	5.13	10	9.70	0.30	10	-5	0.484	No trend
Cadmium	5	2	40%	normal	3.23	4.28	0.50	9.79	0.21	10	-6	0.234	No trend
Cobalt	5	2	40%	normal	29.20	14.17	29	40	10	50	1	1.184	No trend
Iron	5	3	60%	normal	128.08	121.34	100	287	13	300	-6	0.234	No trend
Magnesium	5	1	20%	not normal	4512	1998.70	5200	5000	1000	6000	0	1.184	No trend
Manganese	5	1	20%	not normal	68.46	33.15	79.10	82.20	10	92.20	6	0.234	No trend
Nickel	5	2	40%	normal	27.20	7.66	26	20	20	40	0	1.184	No trend
Zinc	5	1	20%	normal	42.36	21.29	50	56	10	66	4	0.484	No trend
CFD-3S													
Chloroform	5	4	80%	normal	1.03	0.66	1	1.87	0.13	2	-5	0.484	No trend
cis12DCE	5	0	0%	normal	9.82	3.26	9.30	7.60	6.60	14.20	-2	0.816	No trend
PCE	5	0	0%	not normal	25.96	13.86	18	32	18	50	-5	0.484	No trend
TCE	5	0	0%	normal	9.94	3.27	9.50	8	6	14	-6	0.234	No trend
Aluminum	5	4	80%	not normal	162.54	83.76	200	187.30	12.70	200	-4	0.484	No trend
Arsenic	5	5	60%	normal	5.51	4.48	5.43	9	1	10	-7	0.234	No trend
Cadmium	5	2	40%	normal	3.11	4.38	0.35	9.93	0.07	10	-6	0.234	No trend
Cobalt	5	1	20%	not normal	23.70	15.05	19	38.30	11.70	50	-10	0.008	Downward
Iron	5	0	0%	normal	4460	949.13	4900	2270	3100	5370	2	0.816	No trend
Magnesium	5	1	20%	not normal	2888	1204.60	2300	2900	2100	5000	-8	0.042	Downward
Manganese	5	0	0%	normal	95.48	19.32	89	48	78	126	0	1.184	No trend
Nickel	5	0	0%	normal	30.20	9.10	34	22.30	17.70	40	-8	0.042	Downward
Zinc	5	0	0%	normal	72.92	8.49	69	21.50	65.80	87	1	1.184	No trend
CFD-5													
cis12DCE	5	0	0%	normal	2.56	1.10	2	2.30	1.60	3.90	-4	0.484	No trend
PCE	5	5	100%	not normal	1.20	0.45	1	1	1.00	2.00	-4	0.484	No trend
TCE	5	0	0%	not normal	3.04	4.60	1.10	10.80	0.40	11.20	-4	0.484	No trend
Aluminum	5	4	80%	not normal	160.60	88.10	200	197	3	200	-4	0.484	No trend
Arsenic	5	0	0%	not normal	27.80	1.82	27	4.50	26.50	31	1	1.184	No trend
Cobalt	5	2	40%	not normal	23.38	24.37	7.19	47.30	2.70	50	-5	0.484	No trend
Iron	5	0	0%	normal	12180	995.99	12000	2500	10700	13200	-7	0.234	No trend
Magnesium	5	0	0%	normal	6950	2000.10	6200	4990	5310	10300	-4	0.484	No trend
Manganese	5	0	0%	normal	213	80.31	190	202	142	344	-8	0.042	Downward
Nickel	5	3	60%	normal	21.68	18.02	20	38.40	1.60	40	-5	0.484	No trend
Zinc	5	0	0%	normal	48.24	33.50	39.30	79.40	17	96.40	-4	0.484	No trend
WP-2													
cis12DCE	5	1	20%	normal	10.64	12.33	8.20	30	1	31	7	0.234	No trend
PCE	5	4	80%	not normal	4.40	7.06	1	16	1	17	-3	0.816	No trend
TCE	5	1	20%	normal	5.98	5.71	4.80	14	1	15	4	0.484	No trend
Aluminum	5	1	20%	normal	221.80	46.82	213	116	160	276	-6	0.234	No trend
Arsenic	5	4	80%	not normal	6.40	4.94	10	9.02	0.98	10	-5	0.484	No trend
Cobalt	5	2	40%	normal	24.45	23.97	16	49.32	0.68	50	-3	0.816	No trend
Iron	5	0	0%	normal	663.20	221.13	690	555	383	938	-10	0.008	Downward
Magnesium	5	1	20%	normal	3912	1040.30	3820	2660	2340	5000	-8	0.042	Downward
Manganese	5	0	0%	normal	106.50	49.37	92	106	54	160	8	0.042	Upward
Nickel	5	3	60%	normal	21.68	18.01	20	38.30	1.70	40	-5	0.484	No trend
Zinc	5	1	20%	normal	12.10	8.89	11	21	1	22	-4	0.484	No trend
WP-6													
Aluminum	5	4	80%	not normal	164.38	79.65	200	178.10	21.90	200	-4	0.484	No trend
Cadmium	5	2	40%	normal	3.25	4.27	1	9.87	0.13	10	-4	0.484	No trend
Cobalt	5	0	0%	not normal	15.30	19.45	7.40	45	5	50	-6	0.234	No trend
Iron	5	0	0%	normal	584.40	126.53	626	304	376	680	5	0.484	No trend
Magnesium	5	0	0%	not normal	1707.40	1841.90	897	4210	790	5000	-4	0.484	No trend
Manganese	5	0	0%	normal	23.84	2.97	24	7.60	19.30	26.90	6	0.234	No trend
Nickel	5	2	40%	not normal	23.92	14.72	15	28	12	40	-3	0.816	No trend
Zinc	5	1	20%	normal	28.40	9.61	28	24	20	44	0	1.184	No trend
MWC-3													
Chloroform	5	4	80%	normal	1.01	0.68	1	1.93	0.07	2	-5	0.484	No trend
Aluminum	5	4	80%	not normal	161.18	86.80	200	194.10	5.90	200	-4	0.484	No trend
Arsenic	5	4	80%	not normal	6.30	5.07	10	9.50	0.50	10	-5	0.484	No trend
Cadmium	5	3	60%	normal	3.27	4.26	1	9.87	0.13	10	-2	0.816	No trend
Cobalt	5	2	40%	not normal	24.44	23.43	10.70	45	5	50	-5	0.484	No trend
Iron	5	3	60%	normal	126.44	123.09	100	287	13	300	-8	0.042	Downward
Magnesium	5	1	20%	not normal	2706	1292.80	2200	3110	1890	5000	-10	0.008	Downward
Manganese	5	0	0%	normal	26.22	1.36	26.20	3.30	25	28.30	-1	1.184	No trend
Nickel	5	3	60%	normal	22.62	16.79	20	33.60	6.40	40	-5	0.484	No trend
Zinc	5	1	20%	normal	13.99	6.46	9.90	13.60	8.40	22	-2	0.816	No trend

(a) Number of Observations beginning with the 2002 Long Term Monitoring.

(b) Statistics from Visual Sampling Plan (VSP), Summary Statistics; VSP setting to account for non-detects was involked.

(c) Statistics from Visual Sampling Plan (VSP), Mann-Kendal Trend Analysis; VSP setting to account for non-detects was involked. Data were not required to be normally distributed.

All calculations performed using Visual Sample Plan; field duplicates are treated as lab quality control samples and are not considered in this statistical evaluation.

except for PCE during the 2006 sampling event. The cis-1,2-DCE concentrations have been generally increasing since the 2004 sampling event, however all concentrations remain far below the cis-1,2-DCE MCL of 70 µg/L. From 2008 to 2010, the concentration of cis-1,2-DCE increases from 8.2 to 31 µg/L, possibly indicating that natural attenuation is occurring. The Lowess curves for WP-2 (Figure E-4) show an upward trend for cis-1,2-DCE. The Lowess curves for PCE and TCE trend downward following the June 2007 timeframe.

With the exception of one TCE result (11.2 µg/L) in 2002 at CFD-5 (Figure E-5), the VOC concentrations remain below MCLs. Scatter plots and Lowess curves were not generated for monitoring wells MWC-3, WP-6, and MWC-5 because PCE, TCE and cis-1,2-DCE are not detected from 2004 to 2010.

Scatter plots for arsenic, chromium, cobalt, manganese and iron are presented in Appendix E. Scatter plots were not generated for mercury because the detections are primarily trace or estimated concentrations. These scatter plots examine the metal concentrations over time of the LTM program. With the exception of chromium, the concentrations remain constant over time in each sampled well. Arsenic (Table E-6) and iron (Table E-11) are primarily detected in well CFD-5 at the CFDOU. The 2010 chromium concentrations presented in Table E-8 are an order of magnitude higher in all wells. The increase in chromium concentrations and the detected trace concentrations of mercury are likely attributed to lower laboratory reporting criteria being used during the 2008 and 2010 sampling events analytical work. The cobalt (Table E-9) and manganese (Table E-10) concentrations have remained consistent over time.

Lowess curves were generated for iron and manganese in wells CFD-3S (Tables E-12) and WP-2 (Table E-13). The iron and manganese concentrations in the southern part of the site are similar to other VOC-contaminated sites where reductive geochemical conditions are conducive to mobilizing metals that are ready electron accepters. At CFD-3S, both iron and manganese show an upward trend after the 2007 timeframe which coincides with the downward trends of the PCE and TCE Lowess curves. Scatter plots for CFD-3S were generated for manganese (Table E-10) and iron (Table E-11). The detected concentrations of these metals show a slight increase in the post-2006 LTM sampling event data. These results seem to indicate that natural attenuation of the VOCs is occurring at CFD-3S, but the process is slow and cyclical in nature. The 2010 redox levels reported for CFD-3S are positive (see Appendix A purge form

record); these levels indicate that site conditions at this well are not conducive to natural attenuation.

At WP-2, the Lowess curves (Table E-13) show a downward trend for iron and an upward trend for manganese. The manganese and cis-1,2-DCE scatter plots and Lowess curves for WP-2 seem to indicate that natural attenuation processes are occurring; however, the iron results are contradictory. The 2010 redox levels reported for WP-2 are negative (see Appendix A) and indicate that site conditions are conducive to natural attenuation.

In conclusion, the VOC concentrations have decreased over time in downgradient wells, but the concentrations still remain higher than screening criteria. The groundwater trend analysis indicates that some natural attenuation is occurring, but the process is occurring quite slowly. The historical and current LTM results indicate that VOCs are not migrating off-site to potential receptors. VOC contamination remains contained at the site and land use controls prevent access to the groundwater.

With the exception of arsenic, the metal concentrations have remained consistent over time at the CFDOU and are likely attributed to background; this observation cannot be supported without regulatory approval of background levels for FGGM. Oddly, arsenic concentrations are mostly non-detect throughout the site except at CFD-5 where it is detected above the MCL. Also, chromium, cobalt, iron, manganese, and mercury were detected above screening criteria at CFD-5; therefore migration of metals to off-site receptors is possible. The groundwater measurement data still indicates that a positive vertical gradient and the potential of upward flow in the aquifer exist at the site. Therefore any dissolved constituents in the shallow groundwater are not likely to move to deeper intervals.

4.4.3 IDW Characterization and Disposal

The water was not sampled, because it is considered IDW water with trace explosives (i.e., non-hazardous). Purge water was placed in 55-gallon drums and was collected and will be disposed of by Potomac Environmental, Inc. All disposable sampling material including tubing and personal protective equipment was collected in trash bags and disposed of as directed by Post personnel.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The 2010 sampling event has addressed the four objectives of the LTMP. Key observations include:

- **LTMP Objective 1: contaminant concentrations are not increasing over time.** The scatter plots and Lowess curves indicate that the VOC concentrations are decreasing over time. The metal concentrations remain fairly constant over time at the CFDOU.
- **LTMP Objective 2: new constituents are not appearing.** Generally the same group of analytes appears in the 2010 results as have been detected in previous rounds. The appearance of trace concentrations or increased concentrations of some metals (e.g., mercury and chromium) is attributed to the use of lower laboratory reporting criteria.
- **LTMP Objective 3: contaminants are not migrating to potential off-site receptors.** No VOCs or metal concentrations were above comparison criteria at WP-6. No VOCs appear to be migrating off-site at CFD-5. Oddly, arsenic concentrations are mostly non-detect throughout the site except at CFD-5 where it is detected above the MCL. Also, chromium, cobalt, iron, manganese, and mercury were detected above screening criteria at CFD-5; therefore migration of metals to off-site receptors is possible. It is unknown if the metal concentrations can be attributed to background levels or site-related contamination.
- **LTMP Objective 4: metal concentrations are consistent with background levels in the Lower Patapsco aquifer.** Background level screening was not performed in this report because of the level of uncertainty associated with the background data derived from a single sampling event (1996) in one well, ODAMW-6D. Without screening results, this objective represents a data gap in the report. The scatter plot results indicate that most of the metal concentrations appear to be fairly constant over time; these conclusions are based on subjective visual evaluations. Upward temporal trends were not detected from the Mann-Kendall tests however sample sizes were too small to conduct reliable trend evaluations. Slight detections of some metals have occurred due to lower

laboratory reporting criteria. It is unknown whether the detected levels are consistent with background levels.

At this time several controls continue to protect human health by preventing exposure to potential receptors. Institutional controls established by the ROD restrict the use of groundwater at the site. Refuge policy does not make this site available to refuge visitors. Engineering controls include a concrete barrier on Boundary Road to prevent vehicular traffic entering the site from the north. Barricades on Wildlife Loop at the Little Patuxent River bridge discourage entry from the Patuxent Research Refuge. A locked gate secures the main entrance to the CFDOU from the established roads. The Army plans to take further steps to document the site's land use controls (see Section 5.2) and provide better protection of human health and the environment at the CFDOU.

The well inspection revealed that the protective casings of most LTMP wells were in serviceable condition. The paint was faded on many well casings and the exterior well ID was difficult to read. Hinges were broken on CFD-1, CFD-2, CFD-3S, CFD-5, and should be considered for replacement.

5.2 RECOMMENDATIONS

Constituents remain in the CFDOU groundwater at concentrations higher than MCLs, non-zero MCLGs; therefore, the following recommendations are made based upon the 2010 groundwater sample results and the feedback received from stakeholders regarding the CFDOU 5-year review (URS, 2009):

- Prepare an Explanation of Significant Difference (ESD) that will change the CFDOU remedy from "no further action with long-term monitoring" to "land use controls with long-term monitoring." Use the ESD process to change the sampling frequency from biennial to annual.
- Include sampling for monitored natural attenuation (MNA) parameters and VOC daughter products from the LTM wells in all future LTM events.
- Install a new monitoring well (screened 60 to 70 feet mean sea level) down gradient from CFD-3S to better track vertical migration.

- Sample all existing CFDOU wells (both shallow and deep) for Resource Conservation and Recovery Act (RCRA) metals and VOCs as a supplemental effort to the LTM program (i.e., one-time event during the next planned LTM round) to 1) provide a better understanding of current site conditions, 2) identify potential background wells, 3) identify LTM program data gaps, and 3) revise the LTMP.
- Discuss the background data gap issue with stakeholders to better determine whether metal concentrations at the CFDOU are attributed to background rather than site-related contamination. The supplemental sampling effort (see bullet above) will provide data for this discussion.
- Collect an up gradient and down gradient surface water sample from the seep adjacent to CFD-5 and two samples from the Little Patuxent River - one upstream from where the tributary enters the Little Patuxent River and the other one downstream - to determine whether site-related metal concentrations (e.g., arsenic near CFD-5) are migrating off site.

Table 5-1 presents the proposed 2011 sample analysis plan for the CFDOU.

Table 5-1: Proposed 2011 Sampling Analysis Plan for CFDOU

Well No.	Water Type	Well Type	VOCs (1) (8260B)	Metals(2)(3) (6020)	Pb(3) (7470A)	Nitrate/ Nitrite(3)(4) (353.2)	Ferric/ Ferrous Iron (4) (3500 FED)	Sulfate (4) (300)	Sulfite (4) (377.1)	Alkalinity (4) (2320B)	Total Chloride (4) (300)	Total Organic Carbon (4) (5310C)	Dissolved Organic Carbon (4) (5310C)(3)
CFD-1	groundwater	Existing	✓	✓	✓	--	--	--	--	--	--	--	--
CFD-2	groundwater	Existing	✓	✓	✓	--	--	--	--	--	--	--	--
CFD-3S	groundwater	Existing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CFD-3D	groundwater	Existing	✓	✓	✓	--	--	--	--	--	--	--	--
CFD-4	groundwater	Existing	✓	✓	✓	--	--	--	--	--	--	--	--
CFD-5	groundwater	Existing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CFD-6	groundwater	**NEW** (5)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MWC-1	groundwater	Existing	✓	✓	✓	--	--	--	--	--	--	--	--
MWC-2	groundwater	Existing	✓	✓	✓	--	--	--	--	--	--	--	--
MWC-3	groundwater	Existing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MWC-4	groundwater	Existing	✓	✓	✓	--	--	--	--	--	--	--	--
MWC-5	groundwater	Existing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WP-1	groundwater	Existing	✓	✓	✓	--	--	--	--	--	--	--	--
WP-2	groundwater	Existing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WP-3	groundwater	Existing	✓	✓	✓	--	--	--	--	--	--	--	--
WP-4	groundwater	Existing	✓	✓	✓	--	--	--	--	--	--	--	--
WP-5	groundwater	Existing	✓	✓	✓	--	--	--	--	--	--	--	--
WP-6	groundwater	Existing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CFD_Seep_up	surface water	na	--	✓	--	--	--	--	--	--	--	--	--
CFD_Seep_down	surface water	na	--	✓	--	--	--	--	--	--	--	--	--
CFD_LPR_up	surface water	na	--	✓	--	--	--	--	--	--	--	--	--
CFD_LPR_down	surface water	na	--	✓	--	--	--	--	--	--	--	--	--

(1) Chloroform, Chloroethane, TCE, PCE, Toluene, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride

(2) Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Potassium, Selenium, Sodium, Thallium, Zinc
(3) Filtered Sample
(4) These methods are being considered for future LTMs.
(5) Screened at 60 to 70 bgs

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EPA, 2010, Regional Screening Level (RSL) Table Dated November 2010. Downloaded from EPA website on 8 November 2010: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.

PERSONAL COMMUNICATION

Russ Dyrland, Facilities Manager, Patuxent Research Refuge, Telephone, January 26, 2007.

Mr. Brent Pulsipher, VSP Project Director, Telephone Conversation with Alice Redfield of URS Group, Inc. on November 17, 2010, Subject: "Applying VSP's Mann-Kendall trend analysis to a small data set containing many non-detects and wide variance in the detection limits used as the non-detect values."

APPENDIX A:

PURGING AND SAMPLING RECORDS, CHAIN OF CUSTODY

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MONITORING WELL PURGING & SAMPLING RECORD

MONITORING WELL NUMBER: CFD-3S	DEPTH TO GW (FT): 2.63	DATE & TIME OF WL MEASUREMENT 9-23-10 1014
PROJECT: Long-Term Monitoring Program	MEASURED FROM: Top of Casing	
Clean Fill Dump	REFERENCE ELEVATIONS (FT MSL):	SAMPLE DATE: 9-23-10
LOCATION:	SURFACE: 78.31 NAVD 1988	
Patuxent Research Refuge, Laurel, Maryland	TOP OF PVC CASING: 80.21 NAVD 1988	TECHNICIAN: Bethany Keller

DEPTH OF WELL (FT): AS DRILLED: 9 AS MEASURED AT TIME OF SAMPLING: 12.12

Well Construction Details

Well Diameter (in) 2	Screened Interval (ft) 4.5 - 9.5	Top of Filter Pack (ft)
Borehole Diameter (in) 8	Volume of Water in Screen & Riser (gals)	Volume of Water in Filter Pack (gals)*

*Use 30% for porosity of filter sand

One Well Volume = _____ (gals)

Description of Well Condition: _____

Well Sampling Information

Initial PID Reading: 0 ppm
Pump and Controller:
Purge Method: Low-flow purge
Pumping Rate: ml/min
Pump Depth: TOC
Start Time: 1042
Stop Time: 1307

Physical Appearance of Water
Initial: Clear
During: Clear
Final: Clear
Total Quantity of Water Removed: gallons
Method of Water Disposal:

Time:	Purge Rate	Cum Volume Purged (gals)	Depth to water (ft)	Turbidity (NTUs)	Temp (°C)	pH	Conductivity (u-mohs/cm)	DO (ppm)	Redox (mV)
1042		0	3.07	122.0	19.86	7.19	0.155	3.60	7
1052		1.25	3.03	32.1	18.29	7.44	0.118	2.11	6
1102		2.25	2.98	25.2	18.56	7.20	0.107	2.03	20
1112		3	2.95	18.0	18.62	7.13	0.100	1.91	22
1122		3.75	3.00	15.7	18.61	6.73	0.092	1.77	55
1132		4.5	3.03	14.2	18.48	6.63	0.087	1.63	62
1142		5.25	2.97	10.5	19.70	6.56	0.086	1.77	68
1152		5.75	2.95	9.9	20.09	6.68	0.087	1.77	58
1202		6.25	2.96	10.7	20.12	6.76	0.085	1.70	49
1212		7.0	2.95	10.8	20.79	6.67	0.085	1.75	62
1222		7.5	2.94	11.4	21.36	6.73	0.087	1.69	51
1232		8.0	2.95	10.8	22.29	6.70	0.087	1.68	52
1242		8.5	2.98	22.8	19.90	6.71	0.084	1.75	51

cont. on Back

Sampling Record

Parameter	Method Number	Sample Number	QA/QC Sample Number	Preservative
TCL VOCs	SW-846 8260B			HCL pH<2
TAL Metals	SW-846 6010B			HNO_3 pH<2

Note: Metals samples are filtered in the field. HNO_3 is added after filtering.

Sulfite Test Kit < 1 drop ; < .64 mg/L
EQUIPMENT BLANK CFD35@1000
SAMPLE TIME 1310 DUPE "CFD22" @ 1311

USACE - Baltimore District

PROJECT:
Long-Term Monitoring Program, Clean Fill Dump
Patuxent Research Refuge, Laurel, Mayland

Monitoring Well ID: CFD-3S

9-23-10
CFD-3S
p. 2 purge/sample record

Time	gallons	DTW	Turb	Temp	pH	cond	DO	Redox
1252	9.00	3.00	22.7	19.42	6.63	0.083	1.78	73
1302	9.5	2.93	21.1	20.04	6.69	0.083	1.80	89

—— end of purging ——

sample Time 1310

POST SAMPLING TIME	DTW	Turb	Temp	pH	cond	DO	REDOX
1330	2.96	24.3	17.71	5.95	0.078	2.40	115

MONITORING WELL PURGING & SAMPLING RECORD

MONITORING WELL NUMBER: CFD-5	DEPTH TO GW (FT): 4.48	DATE & TIME OF WL MEASUREMENT 9-27-10 0905
PROJECT: Long-Term Monitoring Program	MEASURED FROM: Top of Casing	
Clean Fill Dump	REFERENCE ELEVATIONS (FT MSL):	SAMPLE DATE: 9-27-10
LOCATION:	SURFACE: 73.19 NAVD 1988	
Patuxent Research Refuge, Laurel, Maryland	TOP OF PVC CASING: 75.95 NAVD 1988	TECHNICIAN: Bethany Keller

DEPTH OF WELL (FT): AS DRILLED: 8 AS MEASURED AT TIME OF SAMPLING: 10.19

Well Construction Details

Well Diameter (in) 2	Screened Interval (ft) 3 - 8	Top of Filter Pack (ft)
Borehole Diameter (in) 8	Volume of Water in Screen & Riser (gals)	Volume of Water in Filter Pack (gals)*

*Use 30% for porosity of filter sand

One Well Volume = (gals)

Description of Well Condition:

Well Sampling Information

Initial PID Reading: 0 ppm
Purge Method: Low-flow purge
Pumping Rate: ml/min
Pump Depth: TOC
Start Time: 0937
Stop Time: 1047

Physical Appearance of Water
Initial: Dark Brown Rust color
During: Clear
Final: Clear
Total Quantity of Water Removed: gallons
Method of Water Disposal:

Time:	Purge Rate	Cum Volume Purged (gals)	Depth to water (ft)	Turbidity (NTUs)	Temp (°C)	pH	Conductivity (u-mohs/cm)	DO (ppm)	Redox (mV)
0937		0	4.50	-5.0	17.98	6.27	0.402	0.00	-11
0947		1	4.47	90.3	18.86	6.31	0.393	0.00	-35
0957		1.75	4.46	76.7	18.70	6.45	0.393	0.00	-46
1007		2.5	4.47	34.1	18.15	6.47	0.394	0.00	-49
1017		3.25	4.47	39.0	17.76	6.49	0.394	0.00	-50
1027		4.25	4.48	42.0	17.65	6.49	0.392	0.00	-51
1037		5.5	4.48	42.3	17.74	6.50	0.391	0.00	-52
1047		6.75	4.46	41.3	17.75	6.50	0.392	0.00	-54
After sampling → 1105		--	4.46	10.6	17.95	6.49	0.397	0.00	-32

Sampling Record

Parameter	Method Number	Sample Number	QA/QC Sample Number	Preservative
TCL VOCs	SW-846 8260B			HCL pH<2
TAL Metals	SW-846 6010B			HNO_3 pH<2

Note: Metals samples are filtered in the field. HNO_3 is added after filtering.

Sulfite Test - color change with one drop; < .64 mg/L

USACE - Baltimore District

PROJECT: Long-Term Monitoring Program, Clean Fill Dump Patuxent Research Refuge, Laurel, Mayland	MONITORING WELL NUMBER:

MONITORING WELL PURGING & SAMPLING RECORD

MONITORING WELL NUMBER:	MWC-3	DEPTH TO GW (FT):	3.06	DATE & TIME OF WL MEASUREMENT	10:15
PROJECT:	Long-Term Monitoring Program	MEASURED FROM:	Top of Casing		
	Clean Fill Dump	REFERENCE ELEVATIONS (FT MSL):		SAMPLE DATE:	September-24-2010
LOCATION:		SURFACE:	79.59 NAVD 1988		
	Patuxent Research Refuge, Laurel, Maryland	TOP OF PVC CASING:	81.59 NAVD 1988	TECHNICIAN:	Richard Muschauer
DEPTH OF WELL (FT):	AS DRILLED: 39	AS MEASURED AT TIME OF SAMPLING:	40.91		

Well Construction Details

Well Diameter (in) 4	Screened Interval (ft) 29 - 39	Top of Filter Pack (ft)
Borehole Diameter (in) 10	Volume of Water in Screen & Riser (gals)	Volume of Water in Filter Pack (gals)*

*Use 30% for porosity of filter sand

One Well Volume = (gals)

Description of Well Condition: see inspection log

Well Sampling Information

Initial PID Reading: 0.0 ppm
Purge Method: Low-flow purge
Pumping Rate: ml/min
Pump Depth: 22' TOC
Start Time: 10:39
Stop Time: 11:54

Physical Appearance of Water
Initial: clear
During: clear
Final: clear
Total Quantity of Water Removed: ~13 gallons
Method of Water Disposal: drum

Time:	Purge Rate	Cum Volume Purged (gals)	Depth to water (ft)	Turbidity (NTUs)	Temp (°C)	pH	Conductivity (u-mohs/cm)	DO (ppm)	Redox (mV)
10:39		Ø	3.11	2.6	16.27	4.68	0.126	4.07	278
1049		1.25	3.08	3.3	16.36	3.47	0.088	2.81	362
10:59		2.50	3.10	3.1	16.49	4.23	0.092	2.96	328
11:09		4.00	3.11	4.1	15.37	4.05	0.080	2.70	347
11:19		5.25	3.11	4.5	15.49	4.38	0.079	2.64	334
11:29		7.50	3.12	4.4	14.93	4.47	0.087	1.95	333
11:39		10.50	3.11	4.6	14.86	4.53	0.092	1.72	332
11:49		12.00	3.11	5.0	15.05	4.59	0.092	1.70	331
12:10			3.13	4.3	14.88	4.59	0.093	1.77	32[illegible]3

Sampling Record

Parameter	Method Number	Sample Number	QA/QC Sample Number	Preservative
TCL VOCs	SW-846 8260B			HCL pH<2
TAL Metals	SW-846 6010B			HNO_3 pH<2

Note: Metals samples are filtered in the field. HNO_3 is added after filtering.
MWC-3 sulfite test kit one drop, less then .64 mg/L

USACE - Baltimore District

PROJECT: Long-Term Monitoring Program, Clean Fill Dump Patuxent Research Refuge, Laurel, Mayland	MONITORING WELL NUMBER: MWC-3

MONITORING WELL PURGING & SAMPLING RECORD

MONITORING WELL NUMBER: MWC-5	DEPTH TO GW (FT): 30.71	DATE & TIME OF WL MEASUREMENT 9-27-10 1227
PROJECT: Long-Term Monitoring Program	MEASURED FROM: Top of Casing	
Clean Fill Dump	REFERENCE ELEVATIONS (FT MSL):	SAMPLE DATE: 9-27-10
LOCATION:	SURFACE: 111.23 NAVD 1988	
Patuxent Research Refuge, Laurel, Maryland	TOP OF PVC CASING: 113.53 NAVD 1988	TECHNICIAN: Bethany Keller

DEPTH OF WELL (FT): AS DRILLED: 41.5 AS MEASURED AT TIME OF SAMPLING: 43.27

Well Construction Details

Well Diameter (in) 4	Screened Interval (ft) 31 - 41	Top of Filter Pack (ft)
Borehole Diameter (in) 10	Volume of Water in Screen & Riser (gals)	Volume of Water in Filter Pack (gals)*

*Use 30% for porosity of filter sand

One Well Volume = (gals)

Description of Well Condition:

Well Sampling Information

Initial PID Reading: 0ppm
Purge Method: Low-flow purge
Pumping Rate: ml/min
Pump Depth: TOC
Start Time: 1246
Stop Time: 1346

Physical Appearance of Water
Initial: Clear
During: Clear
Final: Clear
Total Quantity of Water Removed: 6.75 gallons
Method of Water Disposal:

Time:	Purge Rate	Cum Volume Purged (gals)	Depth to water (ft)	Turbidity (NTUs)	Temp (°C)	pH	Conductivity (u-mohs/cm)	DO (ppm)	Redox (mV)
1246		0	30.71	24.5	14.64	4.92	0.155	7.09	211
1256		1.25	30.81	20.1	15.25	3.82	0.149	6.55	277
1306		2.25	30.87	17.3	14.36	3.75	0.155	6.55	305
1316		3.5	30.92	14.4	14.39	4.06	0.157	6.56	303
1326		4.25	30.90	13.2	14.79	4.40	0.159	6.52	290
1336		5.5	30.90	12.7	14.70	4.50	0.160	6.61	287
1346		6.75	30.89	12.1	14.66	4.49	0.162	6.60	296
After Sample 1404		—	31.05	17.0	13.80	4.47	0.170	6.61	302

Sampling Record

Parameter	Method Number	Sample Number	QA/QC Sample Number	Preservative
TCL VOCs	SW-846 8260B			HCL pH<2
TAL Metals	SW-846 6010B			HNO_3 pH<2

Note: Metals samples are filtered in the field. HNO_3 is added after filtering.

Sulfite Kit color change at one drop; < .64 mg/L

USACE - Baltimore District

PROJECT: Long-Term Monitoring Program, Clean Fill Dump Patuxent Research Refuge, Laurel, Mayland	MONITORING WELL NUMBER:

MONITORING WELL PURGING & SAMPLING RECORD

MONITORING WELL NUMBER: WP-2	DEPTH TO GW (FT): 3.96	DATE & TIME OF WL MEASUREMENT 9-29-10, 0912
PROJECT: Long-Term Monitoring Program	MEASURED FROM: Top of Casing	
Clean Fill Dump	REFERENCE ELEVATIONS (FT MSL):	SAMPLE DATE: 9-29-10
LOCATION:	SURFACE: 76.51 NAVD 1988	
Patuxent Research Refuge, Laurel, Maryland	TOP OF PVC CASING: 79.38 NAVD 1988	TECHNICIAN: Bethany Keller

DEPTH OF WELL (FT): AS DRILLED: 5.5 AS MEASURED AT TIME OF SAMPLING: 8.59

Well Construction Details

Well Diameter (in) 2	Screened Interval (ft) 2.5 - 5.5	Top of Filter Pack (ft)
Borehole Diameter (in) 4	Volume of Water in Screen & Riser (gals)	Volume of Water in Filter Pack (gals)*

*Use 30% for porosity of filter sand

One Well Volume = (gals)

Description of Well Condition:

Well Sampling Information

Initial PID Reading: 0 ppm
Purge Method: Low-flow purge
Pumping Rate: ml/min
Pump Depth: TOC
Start Time: 0933
Stop Time: 1033

Physical Appearance of Water
Initial: Clear
During: Clear
Final: Clear
Total Quantity of Water Removed: gallons
Method of Water Disposal:

Time:	Purge Rate	Cum Volume Purged (gals)	Depth to water (ft)	Turbidity (NTUs)	Temp (°C)	pH	Conductivity (u-mohs/cm)	DO (ppm)	Redox (mV)
0933		0	3.96	9.5	17.87	5.98	0.165	0.00	8
0943		.75	3.98	6.9	18.01	6.20	0.167	0.00	-28
0953		1.5	3.99	7.0	18.23	6.33	0.167	0.00	-41
1003		2	3.99	7.3	18.33	6.35	0.168	0.00	-47
1013		2.25	3.99	7.7	18.36	6.36	0.168	0.00	-50
1023		2.5	4.00	8.0	18.21	6.37	0.169	0.00	-51
1033		3	4.01	8.2	18.24	6.37	0.169	0.00	-52
After Sample 1042		--	4.05	8.2	17.97	6.39	0.170	0.00	-44

Sampling Record

Parameter	Method Number	Sample Number	QA/QC Sample Number	Preservative
TCL VOCs	SW-846 8260B			HCL pH<2
TAL Metals	SW-846 6010B			HNO_3 pH<2

Note: Metals samples are filtered in the field. HNO_3 is added after filtering.

Sulfite Test Kit color change after 3 drops; equals 1.92 mg/L

USACE - Baltimore District

PROJECT: Long-Term Monitoring Program, Clean Fill Dump, Patuxent Research Refuge, Laurel, Mayland	MONITORING WELL NUMBER:

MONITORING WELL PURGING & SAMPLING RECORD

MONITORING WELL NUMBER: WP-6	DEPTH TO GW (FT): 39.87	DATE & TIME OF WL MEASUREMENT
PROJECT: Long-Term Monitoring Program	MEASURED FROM: Top of Casing from TOC	10:25 September-27-2010
Clean Fill Dump	REFERENCE ELEVATIONS (FT MSL):	SAMPLE DATE:
LOCATION:	SURFACE: 113.49 NAVD 1988	September-27-2010
Patuxent Research Refuge, Laurel, Maryland	TOP OF PVC CASING: 115.49 NAVD 1988	TECHNICIAN: Rick Munschauer

DEPTH OF WELL (FT): AS DRILLED: 54 AS MEASURED AT TIME OF SAMPLING: 56.59 from TOC

Well Construction Details

Well Diameter (in) 2	Screened Interval (ft) 44 - 54	Top of Filter Pack (ft)
Borehole Diameter (in) 10	Volume of Water in Screen & Riser (gals)	Volume of Water in Filter Pack (gals)*

*Use 30% for porosity of filter sand

One Well Volume = (gals)

Description of Well Condition:

Well Sampling Information

Initial PID Reading: 0.0 ppm

Purge Method: Low-flow purge

Pumping Rate: ml/min

Pump Depth: 48 TOC re-start

Start Time: 10:54 11:19

Stop Time: 10:59 (pump not pumping) 12:33

Physical Appearance of Water

Initial: clear

During: clear

Final: clear

Total Quantity of Water Removed: 5.00 gallons

Method of Water Disposal:

	Time:	Purge Rate	Cum Volume Purged (gals)	Depth to water (ft)	Turbidity (NTUs)	Temp (°C)	pH	Conductivity (u-mohs/cm)	DO (ppm)	Redox (mV)
	11:20		0	41.19	240.0	14.73	3.87	0.066	3.34	297
*	11:30		2	40.99*	103.0	14.54	3.56	0.064	2.47	320
	11:40		3	40.52	87.4	15.37	3.70	0.063	2.18	312
	11:50		3.75	40.19	64.1	15.91	3.75	0.060	2.14	308
**	12:00		4.25**	40.32	69.2	15.86	3.72	0.062	2.09	312
	12:10		4.50	40.04	52.5	17.50	3.82	0.061	1.95	310
	12:20		4.75	40.00	52.6	17.70	3.86	0.061	2.14	308
	12:30		5.00	40.02	57.5	17.29	3.81	0.062	2.11	311
	13:07		—	39.98	59.9	15.83	3.52	0.062	2.36	315

Sampling Record

Parameter	Method Number	Sample Number	QA/QC Sample Number	Preservative
TCL VOCs	SW-846 8260B			HCL pH<2
TAL Metals	SW-846 6010B			HNO_3 pH<2

Note: Metals samples are filtered in the field. HNO_3 is added after filtering.

* turned down pump

** put barb on end of tubing to help regulate flow rate and help to bring depth to water measurment down

- Sulfite Test Kit one drop, less than .64 mg/L

USACE - Baltimore District

PROJECT: Long-Term Monitoring Program, Clean Fill Dump Patuxent Research Refuge, Laurel, Mayland	MONITORING WELL NUMBER: MW-6

SAMPLE CHAIN OF CUSTODY/AGREEMENT FORM

PHASE SEPARATION SCIENCE, INC. Inc

www.phaseonline.com
email: info@phaseonline.com

(1)

CLIENT: URS CORP — OFFICE LOC. GAITHERSBURG MD

PROJECT MGR: BILL EATON — PHONE NO.: (301) 258 5804

EMAIL: BILL_EATON@URSCORP.COM — FAX NO.: ( )

PROJECT NAME: FT. MEADE ODA ICFD — PROJECT NO.: 15302389.20000

SITE LOCATION: CFD — P.O. NO.:

SAMPLERS: JEFF CHISHOLM SHI

PSS Work Order #: — PAGE 1 OF 1

Matrix Codes:
SW=Surface Wtr **DW**=Drinking Wrt **GW**=Ground Wtr **WW**=Waste Wtr **O**=Oil **S**=Soil **WL**=Waste Liquid **WS**=Waste Solid **W**= Wipe

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX (See Codes)	No. CONTAINERS	SAMPLE TYPE C = COMP G = GRAB	Preservatives Used: HCl	HNO3	HNO3										REMARKS
							Analysis/ Method Required (3): SEE BELOW SEE BELOW VOC 8260	METALS 6020	MERCURY 7470A										
	TRIP BLANK																		
	EQUIPMENT BLANK CFD 35	9/24/10	1000	GW	4	G	X	X	X										
	~~CFD~~ MWC3	9/24/10	1155	GW	3	G	X												
	MWC3	9/24/10	1155	GW	1	G		X	X										FILTERED
	CFD 35	9/24/10	1310	GW	3	G	X												
	CFD 35	9/24/10	1310	GW	1	G		X	X										FILTERED
	CFD 22	9/24/10	1311	GW	3	G	X												
	CFD 22	9/24/10	1311	GW	1	G		X	X										FILTERED

(5)

Relinquished By: (1)	Date	Time	Received By:
	9/24/10	1700	FEDEX 8737 7144 6664
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Relinquished By: (4)	Date	Time	Received By:

(4)

Requested Turnaround Time
☐ 5-Day ☐ 3-Day ☐ 2-Day
☐ Next Day ☐ Emergency ☐ Other

Data Deliverables Required:

# of Coolers:
Custody Seal:
Ice Present: Temp:
Shipping Carrier:

Special Instructions:

VOCs CHLOROETHANE, CHLOROFORM, CIS-12-DCE, PCE, TOLUENE, TRANS-12-DCE AND TCE

6630 Baltimore National Pike • Route 40 West • Baltimore, Maryland 21228 • (410) 747-8770 • (800) 932-9047 • Fax (410) 788-8723

The client (Client Name), by signing, or having client's agent sign, this "Sample Chain of Custody/Agreement Form", agrees to pay for the above requested services per the latest version of the Service Brochure or PSS-provided quotation including any and all attorney's or other reasonable fees if collection becomes necessary.

Chain of Custody Record

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratory location: Pittsburgh

Regulatory program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other _____

TestAmerica Laboratories, Inc.

Client Contact			
Company Name: URS Corp	Client Project Manager: Bill Eaton	Site Contact: Bill Eaton	Lab Contact: Carrie Gamber
COC No: 004113			
Address: 200 Orchard Ridge Dr.	Telephone: 301 258 5804	Telephone:	Telephone: 412 963 7058
1 of 1 COCs			
City/State/Zip: Gaithersburg, MD 20878	Email: Bill_Eaton@URSCORP.com	Analysis Turnaround Time (in BUS days)	Analyses
For lab use only			
Phone: 301 258 9780		TAT if different from below _____ ☐ 3 weeks ☐ 2 weeks ☐ 1 week ☐ 2 days ☐ 1 day	
Walk-in client ☐ Lab pickup ☐ Lab sampling ☐			
Project Name: Ft. Meade ODA/CFD	Method of Shipment/Carrier: Fed Ex		
Job/SDG No:			
Project Number: 15302389.20000	Shipping/Tracking No: 8703 1364 5708		
PO#			

Sample Identification	Sample Date	Sample Time	Matrix: Air	Aqueous	Sediment	Solid	Other:	Containers & Preservatives: H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	Unpres	Other:	Filtered Sample (Y/N)	Composite=C / Grab=G	Analyses: SEE SEPARATE VOC, 8260	METALS 6020	MERCURY 7470A							Sample Specific Notes / Special Instructions:
TRIP BLANK																										
CFD 5	9/27/10	1050		X						3					N	G	X									
CFD 5	9/27/10	1050		X					1						Y	G		X	X							
WP6	9/27/10	1234		X						3					N	G	X									
WP6	9/27/10	1234		X					1						Y	G		X	X							
MWC 5	9/27/10	1355		X						3					N	G	X									
MWC 5	9/27/10	1355		X					1						Y	G		X	X							

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month): ☐ Return to Client ☐ Disposal By Lab ☐ Archive For _____ Months

Special Instructions/QC Requirements & Comments:

VOCs - Chloromethane, Chloroform, cis 1,2-DCE, PCE, Toluene, trans-1,2-DCE and TCE

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
[signature]	URS	9/28/10 1700			
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

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Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratory location: Pittsburgh

Regulatory program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other _____

TestAmerica Laboratories, Inc.

Client Contact			
Company Name: URS Corp	Client Project Manager: Bill Eaton	Site Contact: Bill Eaton	Lab Contact: Carrie Gamber
Address: 200 Orchard Ridge Dr.	Telephone: 301 258 5804	Telephone:	Telephone: 412 963 7058
City/State/Zip: Gaithersburg MD 20878	Email: Bill_Eaton@URSCorp.com		
Phone: 301 258 9780			
Project Name: Ft. Meade ODA/CFD	Method of Shipment/Carrier: Fed EX		
Project Number: 15302389.20000	Shipping/Tracking No: 8737 7144 6675		
PO #			

COC No: 004111

1 of 1 COCs

Analysis Turnaround Time (in BUS days)

TAT if different from below _____

☐ 3 weeks
☐ 2 weeks
☐ 1 week
☐ 2 days
☒ 1 day

For lab use only

Walk-in client ☐
Lab pickup ☐
Lab sampling ☐

Job/SDG No:

Sample Identification	Sample Date	Sample Time	Matrix: Air	Aqueous	Sediment	Solid	Other:	Containers & Preservatives: H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	Unpres	Other:	Filtered Sample (Y/N)	Composite=C / Grab=G	Analyses: Select VOCs SW8260B	METALS 6020	MERCURY 7470A	Sample Specific Notes / Special Instructions:
WP2	9/29/10	1035		X						3					N	G	X			
WP2	9/29/10	1035		X					1						Y	G		X	X	
TRIP BLANK																				

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal By Lab ☐ Archive For _____ Months

Special Instructions/QC Requirements & Comments:
SELECT VOCs: CHLOROETHANE, CHLOROFORM, CIS12DCE, PCE, TOLUENE, TRANS-12-DCE, AND TCE

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
[signature]	URS	9/29/10 1700			
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

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APPENDIX B:

WELL INSPECTION FORMS AND FIELD NOTES

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Inspection Log for LTM Wells
Clean Fill Dump

Inspector's Name:	Bethany Keller	Weather Conditions:	Sunny
Inspection Date:	9-20-10	Air Temperature (°F):	80°
Inspection Time:	1130	Well ID:	CFD-1

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Y
2. Is the well ID clearly labeled? No-faded
3. Is the well casing or cap damaged? Yes, rusted casing + hinge
4. Is the well locked? rusted / cracked hinge
5. Is the measuring point on the well casing clearly marked? Y
6. Does the well appear functional? Y
7. Any signs of insect infestation (bees, wasps, etc.)? N
8. Any evidence of heaving? N
9. Any other evidence of well damage? N
10. Other comments:

MEASUREMENTS:

Total depth of well (from as builts):

Top and bottom of screened interval (from as builts):

Total depth of well (measured): 57.6

Silt accumulation?

Depth to groundwater (measured): 49.5

SUMMARY:

1. Summarize any deficiencies noted.
   Rusted casing - broken hinge, Faded Label
2. Summarize potential causes of deficiency.
   Sun, weather
3. Summarize potential corrective actions.
   Replace casing, Repaint label

Inspector's Signature: B. Keller

Inspection Log for LTM Wells
Clean Fill Dump

Inspector's Name:	B. Keller	Weather Conditions:	Sunny
Inspection Date:	9-20-10	Air Temperature (°F):	80°F
Inspection Time:	1100	Well ID:	CFD-Z

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Y
2. Is the well ID clearly labeled? No - faded
3. Is the well casing or cap damaged? Yes Rusted
4. Is the well locked? NO - Broken Hinge
5. Is the measuring point on the well casing clearly marked? Y
6. Does the well appear functional? Y
7. Any signs of insect infestation (bees, wasps, etc.)? N
8. Any evidence of heaving? N
9. Any other evidence of well damage? N
10. Other comments:

MEASUREMENTS:

Total depth of well (from as builts):

Top and bottom of screened interval (from as builts):

Total depth of well (measured): 10.2

Silt accumulation?

Depth to groundwater (measured): 3.04

SUMMARY:

1. Summarize any deficiencies noted.
   Rusted casing, broke hinge, faded label
2. Summarize potential causes of deficiency.
   Weather, sun
3. Summarize potential corrective actions.
   Replace hinge/casing, repaint and paint label

Inspector's Signature: B. Keller

Inspection Log for LTGM Wells
Clean Fill Dump

Inspector's Name:	Bethany Keller	Weather Conditions:	Sunny
Inspection Date:	9-24-10	Air Temperature (°F):	90°
Inspection Time:	1237	Well ID:	CFD-3S

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Yes
2. Is the well ID clearly labeled? No
3. Is the well casing or cap damaged? Rust, rusted hinge (broken)
4. Is the well locked? Yes, but hinge broken
5. Is the measuring point on the well casing clearly marked? No
6. Does the well appear functional? Yes
7. Any signs of insect infestation (bees, wasps, etc.)? No
8. Any evidence of heaving? No
9. Any other evidence of well damage? NO
10. Other comments: — —

MEASUREMENTS:

Total depth of well (from as builts): 9

Top and bottom of screened interval (from as builts): 4.5 – 9.5

Total depth of well (measured): 12.12 Silt accumulation? yes

Depth to groundwater (measured): 2.63

SUMMARY:

1. Summarize any deficiencies noted.
   Rusted hinge
2. Summarize potential causes of deficiency.
   General weathering
3. Summarize potential corrective actions.
   Replace casing

Inspector's Signature: B. Kuhn

Inspection Log for LTM Wells
Clean Fill Dump

Inspector's Name:	B. Keller	Weather Conditions:	Sunny
Inspection Date:	9-20-10	Air Temperature (°F):	80°F
Inspection Time:	1115	Well ID:	CFD-3D

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Y
2. Is the well ID clearly labeled? No - faded
3. Is the well casing or cap damaged? Rusted
4. Is the well locked? Y
5. Is the measuring point on the well casing clearly marked? Y
6. Does the well appear functional? Y
7. Any signs of insect infestation (bees, wasps, etc.)? Wasp Nest
8. Any evidence of heaving? N
9. Any other evidence of well damage? N
10. Other comments:

MEASUREMENTS:

Total depth of well (from as builts):

Top and bottom of screened interval (from as builts):

Total depth of well (measured): 72.71

Silt accumulation?

Depth to groundwater (measured): 2.62

SUMMARY:

1. Summarize any deficiencies noted.
   Rusted casing, faded label
2. Summarize potential causes of deficiency.
   Weather, SUN
3. Summarize potential corrective actions.
   Repaint + label

Inspector's Signature:

Inspection Log for LTM Wells
Clean Fill Dump

Inspector's Name:	B. Keller	Weather Conditions:	SUNNY
Inspection Date:	9-20-10	Air Temperature (°F):	80 °F
Inspection Time:	1300	Well ID:	CFD-4

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Y
2. Is the well ID clearly labeled? Faded
3. Is the well casing or cap damaged? RUST
4. Is the well locked? N
5. Is the measuring point on the well casing clearly marked? Y
6. Does the well appear functional? Y
7. Any signs of insect infestation (bees, wasps, etc.)? N
8. Any evidence of heaving? N
9. Any other evidence of well damage? N
10. Other comments:

MEASUREMENTS:

Total depth of well (from as builts):

Top and bottom of screened interval (from as builts):

Total depth of well (measured): 11.39

Silt accumulation? yes

Depth to groundwater (measured): 3.06

SUMMARY:

1. Summarize any deficiencies noted.
   Rusted casing, faded label, no lock
2. Summarize potential causes of deficiency.
   weather, sun
3. Summarize potential corrective actions.
   Repaint casing and label
   Lock replaced

Inspector's Signature:

Inspection Log for LTGM Wells
Clean Fill Dump

Inspector's Name:	Bethany Keller	Weather Conditions:	Cloudy/R
Inspection Date:	9-27-10	Air Temperature (°F):	70°
Inspection Time:	1000	Well ID:	CFD-S

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Yes
2. Is the well ID clearly labeled? No, peeled off paint
3. Is the well casing or cap damaged? Yes, hinge rusted and broken
4. Is the well locked?
5. Is the measuring point on the well casing clearly marked? Yes
6. Does the well appear functional? Yes
7. Any signs of insect infestation (bees, wasps, etc.)? No
8. Any evidence of heaving? No
9. Any other evidence of well damage? Rusted, paint peeling off all over casing
10. Other comments: — —

MEASUREMENTS:

Total depth of well (from as builts): 8'

Top and bottom of screened interval (from as builts): 3 - 8'

Total depth of well (measured): 10.19' Silt accumulation? Yes

Depth to groundwater (measured): 4.49'

SUMMARY:

1. Summarize any deficiencies noted.
   Label faded, Hinge busted
2. Summarize potential causes of deficiency.
   general weathering
3. Summarize potential corrective actions.
   Repaint, replace top of casing/new hinge

Inspector's Signature: B. Kell

Inspection Log for LTM Wells
Clean Fill Dump

Inspector's Name:	B. Keller	Weather Conditions:	Sunny
Inspection Date:	9-20-10	Air Temperature (°F):	80°
Inspection Time:	1600	Well ID:	MWC-1

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Y
2. Is the well ID clearly labeled? Y
3. Is the well casing or cap damaged? ~~N~~ Yes- Rusted
4. Is the well locked? N
5. Is the measuring point on the well casing clearly marked? Y
6. Does the well appear functional? Y
7. Any signs of insect infestation (bees, wasps, etc.)? NO
8. Any evidence of heaving? NO
9. Any other evidence of well damage? NO
10. Other comments:

MEASUREMENTS:

Total depth of well (from as builts):

Top and bottom of screened interval (from as builts):

Total depth of well (measured): 30.12

Silt accumulation? Yes

Depth to groundwater (measured): 10.42

SUMMARY:

1. Summarize any deficiencies noted.
   missing lock, Rusted casing
2. Summarize potential causes of deficiency.
3. Summarize potential corrective actions.
   lock Replaced, repaint

Inspector's Signature: B Keller

Inspection Log for LTM Wells
Clean Fill Dump

Inspector's Name:	B. Keller	Weather Conditions:	Sunny
Inspection Date:	9-20-10	Air Temperature (°F):	80
Inspection Time:	1500	Well ID:	MWC-2

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Y
2. Is the well ID clearly labeled? Y
3. Is the well casing or cap damaged? ~~Y~~ N S-rusted casing
4. Is the well locked? Y
5. Is the measuring point on the well casing clearly marked? Y
6. Does the well appear functional? Y
7. Any signs of insect infestation (bees, wasps, etc.)? Empty wasp nest
8. Any evidence of heaving? N
9. Any other evidence of well damage? N
10. Other comments:

MEASUREMENTS:

Total depth of well (from as builts):

Top and bottom of screened interval (from as builts):

Total depth of well (measured): 12

Silt accumulation?

Depth to groundwater (measured): 14.81

SUMMARY:

1. Summarize any deficiencies noted.
   Rusted casing
2. Summarize potential causes of deficiency.
   SUN
3. Summarize potential corrective actions.
   Repaint

Inspector's Signature: B Keller

Inspection Log for LTGM Wells
Clean Fill Dump

Inspector's Name:	Richard Munschauer	Weather Conditions:	Sunny day
Inspection Date:	September, 24, 2010	Air Temperature (°F):	92
Inspection Time:	13:30	Well ID:	MWC 3

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? yes
2. Is the well ID clearly labeled? NO (faded in sun)
3. Is the well casing or cap damaged? No
4. Is the well locked? Yes
5. Is the measuring point on the well casing clearly marked? Yes
6. Does the well appear functional? Yes
7. Any signs of insect infestation (bees, wasps, etc.)? No
8. Any evidence of heaving? No
9. Any other evidence of well damage? No
10. Other comments: N/A

MEASUREMENTS:

Total depth of well (from as builts): 39 bgs

Top and bottom of screened interval (from as builts): 29' bgs 39' bgs

Total depth of well (measured): 40.91 from TOC Silt accumulation? yes soft bottom

Depth to groundwater (measured): 3.06 from TOC

SUMMARY:

1. Summarize any deficiencies noted.

   well ID paint starting to fade

2. Summarize potential causes of deficiency.

   sun

3. Summarize potential corrective actions.

   ~~[illegible]~~ it should be repainted

Inspector's Signature: [signature]

Inspection Log for LTM Wells
Clean Fill Dump

Inspector's Name:	B. Keller	Weather Conditions:	Sunny
Inspection Date:	9-20-10	Air Temperature (°F):	80
Inspection Time:	1615	Well ID:	MWC-4

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Y
2. Is the well ID clearly labeled? ~~Rust~~ Faded
3. Is the well casing or cap damaged? Rusted
4. Is the well locked? Yes, but No Key
5. Is the measuring point on the well casing clearly marked? Y
6. Does the well appear functional? Y
7. Any signs of insect infestation (bees, wasps, etc.)? N
8. Any evidence of heaving? N
9. Any other evidence of well damage? N
10. Other comments:

MEASUREMENTS:

Total depth of well (from as builts):

Top and bottom of screened interval (from as builts):

Total depth of well (measured): 42.67

Silt accumulation? Yes

Depth to groundwater (measured): 29.68

SUMMARY:

1. Summarize any deficiencies noted.
   Lock had to be cut, faded label, Rusted casing
2. Summarize potential causes of deficiency.
   Sun, Weather
3. Summarize potential corrective actions.
   Replaced lock, Repaint

Inspector's Signature: B. Keller

Inspection Log for LTGM Wells
Clean Fill Dump

Inspector's Name:	Bethany Keller	Weather Conditions:	Rain (light)
Inspection Date:	9-27-10	Air Temperature (°F):	70°F
Inspection Time:	1300	Well ID:	mwc-5

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Yes
2. Is the well ID clearly labeled? No
3. Is the well casing or cap damaged? Rusted casing, paint pealing off
4. Is the well locked? Yes
5. Is the measuring point on the well casing clearly marked? Yes
6. Does the well appear functional? Yes
7. Any signs of insect infestation (bees, wasps, etc.)? No
8. Any evidence of heaving? NO
9. Any other evidence of well damage? NO
10. Other comments: — —

MEASUREMENTS:

Total depth of well (from as builts): 41.5

Top and bottom of screened interval (from as builts): 31-41'

Total depth of well (measured): 43.27 Silt accumulation? Yes

Depth to groundwater (measured): 30.71

SUMMARY:

1. Summarize any deficiencies noted.
   Rust, faded label
2. Summarize potential causes of deficiency.
   Weathering, sun
3. Summarize potential corrective actions.
   Repaint

Inspector's Signature: B. Klm

Inspection Log for LTM Wells
Clean Fill Dump

Inspector's Name:	B. Keller	Weather Conditions:	SUNNY
Inspection Date:	9-20-16	Air Temperature (°F):	80°F
Inspection Time:	1330	Well ID:	WP-1

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Y
2. Is the well ID clearly labeled? Y
3. Is the well casing or cap damaged? N
4. Is the well locked? NO - MISSING lock
5. Is the measuring point on the well casing clearly marked? Y
6. Does the well appear functional? Y
7. Any signs of insect infestation (bees, wasps, etc.)? N
8. Any evidence of heaving? N
9. Any other evidence of well damage? N
10. Other comments:

MEASUREMENTS:

Total depth of well (from as builts):

Top and bottom of screened interval (from as builts):

Total depth of well (measured): 8.63

Silt accumulation?

Depth to groundwater (measured): 3.04

SUMMARY:

1. Summarize any deficiencies noted.

   MISSING lock

2. Summarize potential causes of deficiency.

3. Summarize potential corrective actions.

   Lock Replaced ON site

Inspector's Signature: B. Keller

Inspection Log for LTGM Wells
Clean Fill Dump

Inspector's Name:	Bethany Keller	Weather Conditions:	Sunny
Inspection Date:	9-29-10	Air Temperature (°F):	70°
Inspection Time:	1015	Well ID:	WP-2

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Yes
2. Is the well ID clearly labeled? Faded
3. Is the well casing or cap damaged? No
4. Is the well locked? Yes
5. Is the measuring point on the well casing clearly marked? No
6. Does the well appear functional? Yes
7. Any signs of insect infestation (bees, wasps, etc.)? No
8. Any evidence of heaving? No
9. Any other evidence of well damage? No
10. Other comments: — —

MEASUREMENTS:

Total depth of well (from as builts): 5.5'

Top and bottom of screened interval (from as builts): 2.5' – 5.5'

Total depth of well (measured): 8.59 Silt accumulation? No

Depth to groundwater (measured): 3.96

SUMMARY:

1. Summarize any deficiencies noted.
   Faded label and measuring point.
2. Summarize potential causes of deficiency.
   Time.
3. Summarize potential corrective actions.
   Repaint and mark point.

Inspector's Signature: Betty Kurr

Inspection Log for LTM Wells
Clean Fill Dump

Inspector's Name:	B. Keller	Weather Conditions:	SUNNY
Inspection Date:	1-20-16	Air Temperature (°F):	80 °F
Inspection Time:	1400	Well ID:	WP-3

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Y
2. Is the well ID clearly labeled? Y
3. Is the well casing or cap damaged? Broken Well cap
4. Is the well locked? N - cap broken
5. Is the measuring point on the well casing clearly marked? Y
6. Does the well appear functional? Y
7. Any signs of insect infestation (bees, wasps, etc.)? No
8. Any evidence of heaving? No
9. Any other evidence of well damage? No
10. Other comments:

MEASUREMENTS:

Total depth of well (from as builts):

Top and bottom of screened interval (from as builts):

Total depth of well (measured): 8.00

Silt accumulation?

Depth to groundwater (measured): 2.74

SUMMARY:

1. Summarize any deficiencies noted.
   Broken Well cap
2. Summarize potential causes of deficiency.
3. Summarize potential corrective actions.
   Cap Replaced and Lock secured on site

Inspector's Signature: B Kr

Inspection Log for LTM Wells
Clean Fill Dump

Inspector's Name:	B. Keller	Weather Conditions:	Sunny
Inspection Date:	9-20-10	Air Temperature (°F):	80°
Inspection Time:	1400	Well ID:	WP-4

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Y
2. Is the well ID clearly labeled? Y
3. Is the well casing or cap damaged? N
4. Is the well locked? Yes but Not correct key
5. Is the measuring point on the well casing clearly marked? Y
6. Does the well appear functional? Y
7. Any signs of insect infestation (bees, wasps, etc.)? N
8. Any evidence of heaving? N
9. Any other evidence of well damage? N
10. Other comments:

MEASUREMENTS:

Total depth of well (from as builts): _____

Top and bottom of screened interval (from as builts): _____ _____

Total depth of well (measured): 8.41

Silt accumulation? Yes

Depth to groundwater (measured): 5.11

SUMMARY:

1. Summarize any deficiencies noted.
   Unable to open lock - used lock cutters
2. Summarize potential causes of deficiency.
3. Summarize potential corrective actions.
   Lock Replaced

Inspector's Signature: B. Kerr

Inspection Log for LTM Wells
Clean Fill Dump

Inspector's Name:	B. Keller	Weather Conditions:	SUNNY
Inspection Date:	9-20-16	Air Temperature (°F):	80
Inspection Time:	1430	Well ID:	WP-5

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Y
2. Is the well ID clearly labeled? Y
3. Is the well casing or cap damaged? N
4. Is the well locked? Y
5. Is the measuring point on the well casing clearly marked? Y
6. Does the well appear functional? Y
7. Any signs of insect infestation (bees, wasps, etc.)? N
8. Any evidence of heaving? N
9. Any other evidence of well damage? N
10. Other comments:

MEASUREMENTS:

Total depth of well (from as builts):

Top and bottom of screened interval (from as builts):

Total depth of well (measured): 7.62

Silt accumulation? Yes

Depth to groundwater (measured): 4.24

SUMMARY:

1. Summarize any deficiencies noted.
2. Summarize potential causes of deficiency.
3. Summarize potential corrective actions.

Inspector's Signature: B. Keller

Inspection Log for LTGM Wells
Clean Fill Dump

Inspector's Name:	Richard Muschauer	Weather Conditions:	Overcast scattar showers
Inspection Date:	September-27-2010	Air Temperature (°F):	85° F
Inspection Time:	12:15 AM	Well ID:	WP ~~AMW~~-6

GROUNDWATER MONITORING WELL INSPECTION:

1. Has the well been located? Yes
2. Is the well ID clearly labeled? No (sun has faded paint)
3. Is the well casing or cap damaged? NO
4. Is the well locked? Yes
5. Is the measuring point on the well casing clearly marked? Yes
6. Does the well appear functional? Yes
7. Any signs of insect infestation (bees, wasps, etc.)? Yes, some empty nests
8. Any evidence of heaving? no
9. Any other evidence of well damage? no
10. Other comments: N/A

MEASUREMENTS:

Total depth of well (from as builts): 54' bgs

Top and bottom of screened interval (from as builts): 44'- 54' bgs

Total depth of well (measured): 56.59' from TOC Silt accumulation? a little mushy

Depth to groundwater (measured): 39.81' from TOC

SUMMARY:

1. Summarize any deficiencies noted.
   well Id has faded
2. Summarize potential causes of deficiency.
   Sun
3. Summarize potential corrective actions.
   well Id might need to be re painted

Inspector's Signature: [signature]

FT. MEADE 9/20/10

SUNNY 80°F J. CHISHOLMSKI

0630 RICH M - CALLED - VEHICLE BROKEN DOWN OVERNIGHT - WILL NOT BE WORKING TODAY

0800 BK, JM, AH ON SITE - SIGN IN AT VISITOR CENTER - RM HAS HASP

0900 JC OFF SITE TO PICKUP HASP

1100 JC RETURN TO SITE

1130 UXO CLEARANCE AT AOD AREA SEVERAL METALLIC OBJECTS IDENTIFIED AND FLAGGED

9/20/10

WELL	PID	DTW to TOC	DTB to TOC	NOTES
ODAMW-1	0	8.28	16.12	Rusted casing, pad cracked label faded, soft bottom
ODAMW-2	0	DRY	9.85	RUSTED CASING, CUT LOCK LABEL WORN AWAY
ODAMW3	0	9.55	17.62	cracked pad, rusted casing, faded label, soft bottom, sediment on probe
ODAMW-4	0			ANT colony
ODAMW-5	0	11.87	14.39	Soft bottom, sediment on probe
ODAMW-6D	0	24.84		RUSTED CASING LABEL WORN AWAY
ODAMW7	0	15.00	22.14	
ODAMW8D	0	26.41	91.94	
ODAMW9D	0	23.03		Rusted casing
ODAMW10	0	11.93	17.12	Slight rust
ODAMW11	0	4.61	17.28	cracked pad, sed on probe Slight rust, soft bottom
CFD-1	0	49.5	57.6	needs new lock rusted casing and hinge faded label
CFD-2	0	3.04	10.2	label faded, rusted casing hinge broken
CFD-3S	0	3.00	12.12	faded marking, rusted casing soft bottom
CFD-3D	0	2.62	72.71	faded marking, rusted casing WASP
CFD-4	0	3.06	11.39	rusted hinge, lock replaced soft bottom, label faded
CFD-5	1.2	4.72	10.19	Rusted, broken hinge, soft bottom w/ sed
WP-1	0	3.04	8.63	need cap replaced
WP-2	0	4.08	8.59	lock replaced
WP-3	0	2.76	8.00	soft bottom, well cap broken
WP-4	0	5.11	8.41	soft bottom, key doesn't turn lock - Need replaced
WP-5	0	4.24	7.62	soft bottom
WP-6	0	39.89	56.59	soft bottom

9/20/10

BK

well	PID	DTW to TOC	DTB to TOC	Notes
~~CFD BK~~ ~~MWC-1~~	~~0~~	~~49.5~~	~~57.6~~	~~rusted casing and hinge faded label~~
MWC-2	0	14.81		Rusted casing, empty wasp
MWC-3	0	3.11	40.91	marking faded, rusted casing soft bottom
MWC-4	0	29.68	42.67	rusted, faded marking, cut lock, soft bottom with sed
MWC-5	0	30.44	43.27	rusted, faded marking, soft bottom, lock rusted
MWC-1	0	10.42	30.12	soft bottom, rusted casing probe covered in brown silt need lock

Used PID #: 110-004540

Ft. Meade 9/21/10

Sunny 80°F B. Keller

0800 BK, RH, JC arrive on site, checkin at visitors center
Hold Health and Safety meeting

0900 BK, RH travel to the CEF to gauge the wells
JC remains at ODA area to begin sampling
RH BK calibrate PID
Smelled faint petrol odor on interface probe

0930 Drove back to JC to pick up Alkinox cleaner to decon to equipment

0950 washed interface probe/tape in bucket with Alkinox cleaner

1005 Leave truck to locate WP-2

1015 WP-2 PID (0), DTW (4.05), DTB (8.59) measurements taken
Decon Interface probe and tape
replaced lock that was cut

1028 measurements taken at CFD-4
Decon Interface probe and tape
Replace rusted lock

1056 measurements taken at MWC-5
Decon Interface probe and tape need lock

1112 WP-4 measurments taken
Decon Interface probe and tape need lock

1128 measurements taken at ~~MWC-1~~ BK CFD-1
Decon Interface probe and tape
1153 measurements taken at MWC-1 need new lock
Decon Interface Probe which had
come up with brown silty very fine sand
1225 measurements taken of CFD-2
Decon equipment after use
1250 loop to lock broke while opener
lock with lock cutter at WP-1 → Need cap
measurements recorded at WP-1, Decon
1259 Readings taken at MWC-3
Light Brown silty sediment on tip. soft bottom
1309 Decon equip.
1311 Readings taken at MWC-3S
Soft bottom, hinge corroded
Decon Equip.
1315 Wasp Nest in MWC-3D casing - flew away
1319 Readings Taken and Recorded MWC-3D
Decon Equip.
1346 Readings taken and Recorded WP-3
New well cap needed - the current is
broken New Cap
well found under tall pine
Decon equip.

MWC-2
1400 Metal casing has bulge that has
appeared to have fractured PVC
pipe, empty wasp nest in casing
Readings taken and recorded
Decon Equip.
1414 WP-5
Readings taken and recorded
Soft Bottom
Decon Equip.

Note: USACE onsite from 0900 to 1400.

1600 Check out at Visitor Center
Off site

Sunny 90° 9/22/10

0800 RM, BK, JC arrive on site and check in at Visitor Center
Drive to ODA area

0825 Preform Health and Safety meeting

0835 started calibration of Horibas and PIDs

Horiba SN: 01450
PH = 3.96 DO = 9.04
COND = 4.43 ORP = 263

Horiba SN: 11857
PH = 4.00 DO = 9.06
COND = 4.49 ORP = 275

PID SN: 110-004840
cal 103 at 100 ppm cal gas

PID SN: 110-011871
PID reading after calibration slightly elevated, will use other PID for readings

0910 Decon. all equipment

9/22/10

0925 ODAmw-~~1~~ BK
Pid head space reading 0 ppm

0955 ODAmw1 DTW 8.35

1025 ODA MW-4 Pid head space reading: 0 ppm
ODAmw-4 DTW 6.98
DTB 15.02
felt obstructions w/ water level meter when gauging DTB

1319 ODAmw-3
Head Space Reading PID 0.0 ppm
DTW 9.61'

1600 Rick M, Jeff C, Bethany K
check out at welcome center and depart from site

Sunny 90° 9/23/10

800 Jeff C, Rick M, Bethany R arrive on site and check in at welcome Center

810 Tim F arrived at welcome center to deliever needed coolers

815 Jeff C, RM, BK travel to ODA to begin work

835 JC conducted Health and Safety meeting JC, RM, BK signed HASP & Decon equipment

845 Calibrated both sensors to an Autocal Solution (pH 4.00, 00 NTU, 4.49 mS/cm)

SN: 01450

SN: 11857

PID SN: 110-004840

cal 101 at 100 ppm cal gas

PID SN: 110-011871

PID ppm reading slightly elevated after calibration, will use other PID today.

915 BK, JC set up at ODAMW-7

PID head space reading 0.0 ppm

DTW 15.13

930 Begin well purging + sampling ODAMW-7

935 DaTonia Moore (USACE) onsite

1300 Complete Sampling of ODAMW-7

9/23/10

1000 RM begin purging and sampling of ODAMW-11

PID: 0 ppm

DTW: 4.4'

Battery/Pump Problems during the purging event.

1300 RM went to Home Depot to try to find new fuse for voltage gauge - unable to find new fuse

1500 RM back on site

Jeff called Pine. Pine will replace 1 pumpe, 1 gauge, 1 battery and delieve the equipment to his house this evening

1530 DaTonia Moore (USACE) offsite

1545 end sampling of ODAMW-11

1600 Check out at welcome Center

1700 Leave site after packing cooler / decon equipment

Sunny 95° 9/24/10

0800 Arrive on site, check in at visitor center, Rick M, Bethany K, and Jeff C.
Meet up with Wildlife Refuge Ranger Jeffries B. so he can open gate to CFD area.

830 Tree blocking road, Jeff C. uses chain and truck to pull it off road, RM, JC, BK, Jeff B continue on road to CFD

915 Jeffries B open gate, provides us with key to let ourselves in and out the rest of the project, He also granted us permission to work before/after hours of the welcome center hours.

920 ~~RM~~ BK JC preforms Health and Safety meeting for JC, BK, RM. All signed HASP.

930 Calibrated Equipment
PID SN: 110-004840
cal at 100ppm at 100 ppm cal gas
Horibas calibrated to an autocal solution (pH 4.00, 00 NTUs, 4.49 mS/cm)
SN #s: 01450 and 11857

9/24/10

0940 Decon all equipment needed for purging and sampling of wells

1014 CFD-3S
PID: 0 ppm
DTW: 2.63'

1015 MWC-3
PID: 0 ppm
DTW: 3.6'

10:55 sampled MWC-3

12:30 packed up all pumping and sampling gear

12:55 Rick M went to go replace locks and/or locking caps for:
WP-4, MWC-5, MWC-1, WP-1, ~~WP-3BK~~

13:10 Sampled CFD 3S and took a Dup which was labled CFD-22

13:30 Rick M back on site
we had no 2in well caps so WP-1 and WP-3 caps/locks not replace. will replace on monday

9/24/10

13:35 black moccasin slithered by

13:40 started packing up rest of field gear

15:00 ~~Chet~~ BK Pack up coolers for shipping (1 to Pittsburgh) and RM, JC, BK depart from site

Rain 70° 9/27/10

0700 BK arrive on site

0745 Rick M, Jeff C arrive on sit (late due to traffic)

0815 Preform Health and Safety meeting. RM, JC, BK sign HASP

0830 Calibrate and Decon all equipment necessary for daily work PID: 102 ppm 100 ppm cal gas
JC constructing shelters to shield wells from rain

0845 BK set up at CFD-S
Lock cut because didn't have keys
Needs new lock

0905 PID headspace reading 0.0 ppm
DTW: 4.49'
DTB: 10.19'
Trouble reaching the bottom of well-
obstructed bottom ~5 feet
possibly screen failure.
Water initally dark Brown

0937 Purging of CFD-S began

1047 End purging

1050 Sampling of CFD-5

1030 DaTonia Moore (USACE) on site

Rain 75° 9/27/10

Rm at WP-6
PID: Ø ppm
DTW:
Purging
1234 Sample WP-6
1200 BK at MWC-5 - decon equip.
1211 PID reading Ø ppm
1227 DTW: 30.71
DTB: 43.27
1355 Purging end and sampling of MWC-5 occured
1500 BK, RM, JC offsite after pack up field gear (no cooler sent today)
1300 DaTonia Moore offsite (USACE)

Scattered Rain 70° 9/28/10

0700 Bethany K, Rick M on site
0720 Jeff C arrive on site - all three travel back to ODA
0735 JC preformed H&S meeting All participants sign HASP
0750 JC fished out ~ 4' long collection of roots from ODAMW-2
0800 BK, RM decon and calibrate all equipment necessary for the daily activities and set up tarp to sheild ODAMW-5 from rain
0845 ODAMW-5 PID: Ø ppm
DTW: 12.02
DTB: 14.39
0850 Purging of ODAMW-5 begins
0900 well NOT recovering well - BK pumping at lowest rate possible
0950 USACE (DaTonia Moore) onsite
1015 Turned off pump as water approached pump depth
1020 JC called Bill E to inform him of the situation

Partly Sunny 75° 9/28/10

1040 Gauge well depth
DTW: 12.71'

1125 Gauge well again
current DTW: 12.30'
In accordance with Scope of Work, samplers will wait until ODAMW-3 recovers and will collect samples

1250 Well recovered to 12.02, Samples collected

1011 RM at ODAMW-2
PID reading 0ppm
DTW: 10.73'
Purging began

1129 sampling of ODAMW-2

1128 DUP was taken - labled ODAMW-12

1400 DaTonia Moore (USACE) offsite

1405 RM, BK, JC clean up site, pack up gear and Three coolers for samples

1530 RM, BK, JC offsite

Sunny 70° 9/29/10

0730 Jeff C and Bethany Keller onsite

0810 Road Blocking road - Jeff moved it to side so we could pass

0830 JC conducted Health and Safety meeting
JC, BK sign HASP

0912 WP-2
DTW: 3.96'
PID: 0 ppm

1035 Sampling of WP-2 occured
BK and JC cleaned up area and equipment
packed sample cooler

1140 JC and BK replace lock/lock caps (only necessary for WP-3) on the following wells:

MWC-4
WP-3
WP-6
CFD-5
ODAMW-2
ODAMW-3

cloudy 70° 9-29-10

1210 Secured Drums on site
Drum location: On side of dirt road going to OAA "circle" of wells.
4 drums (55-gal) on site

1245 Return Key to Gate (CFD) and Truck pass to Welcome center

1300 OFF site

APPENDIX C:

LABORATORY RESULTS
(CD only)

[Due to the size of the appendix, the data are presented in electronic format only; see the compact disk (CD) included with this report.]

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APPENDIX D:

DATA VALIDATION REPORT
(CD Only)

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APPENDIX E:

SCATTER PLOTS AND LOWESS CURVES

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Table E-1. VOCs for CFD-3S
Downgradient at Water Table

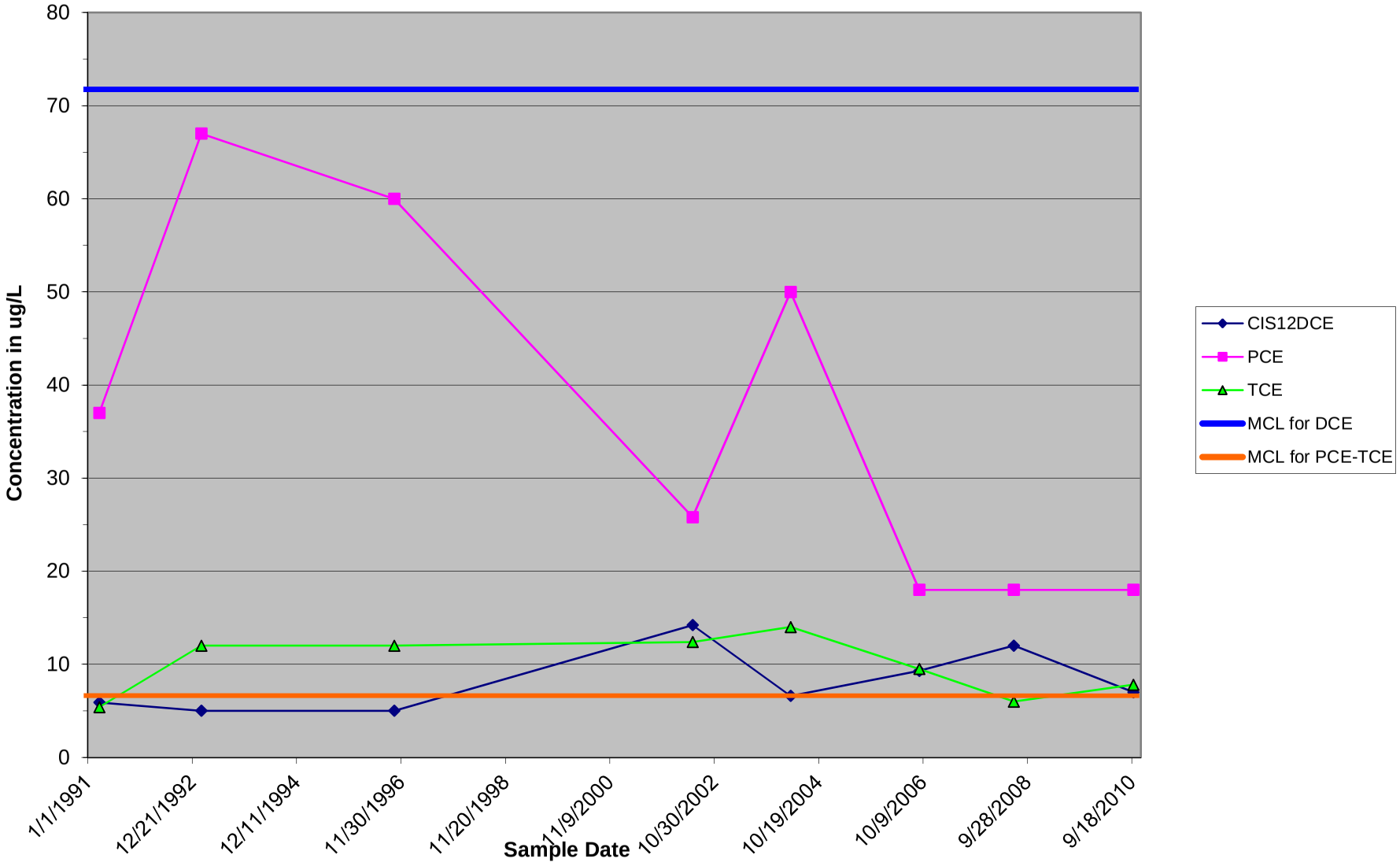
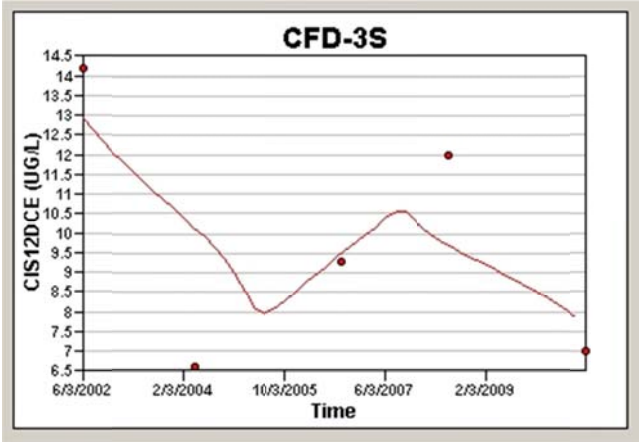
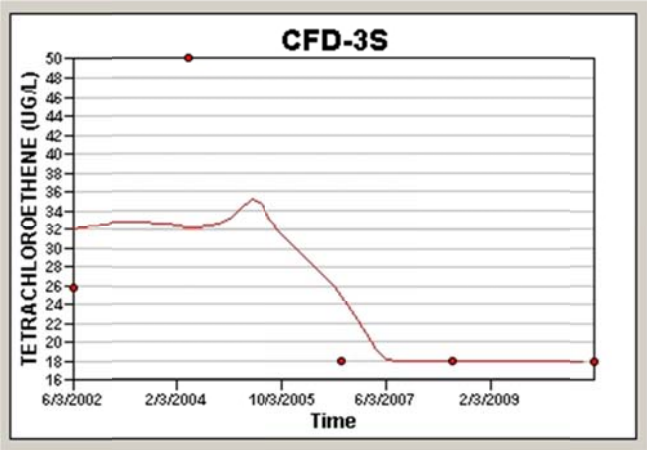


Table E-2. Lowess Curves, Well ID: CFD-3S

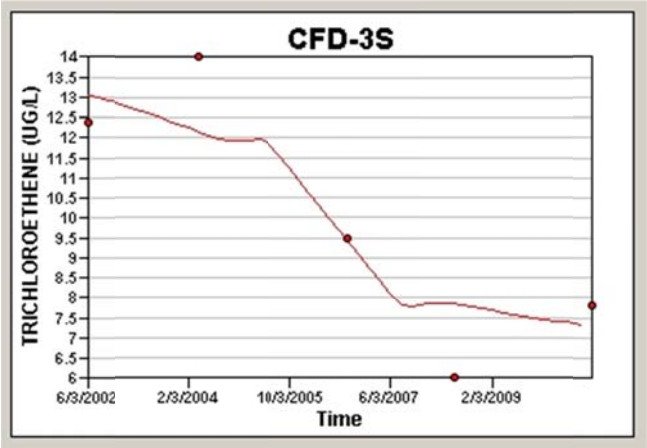
Analyte: cis-1,2-Dichloroethene



Analyte: Tetrachloroethene



Analyte: Trichloroethene



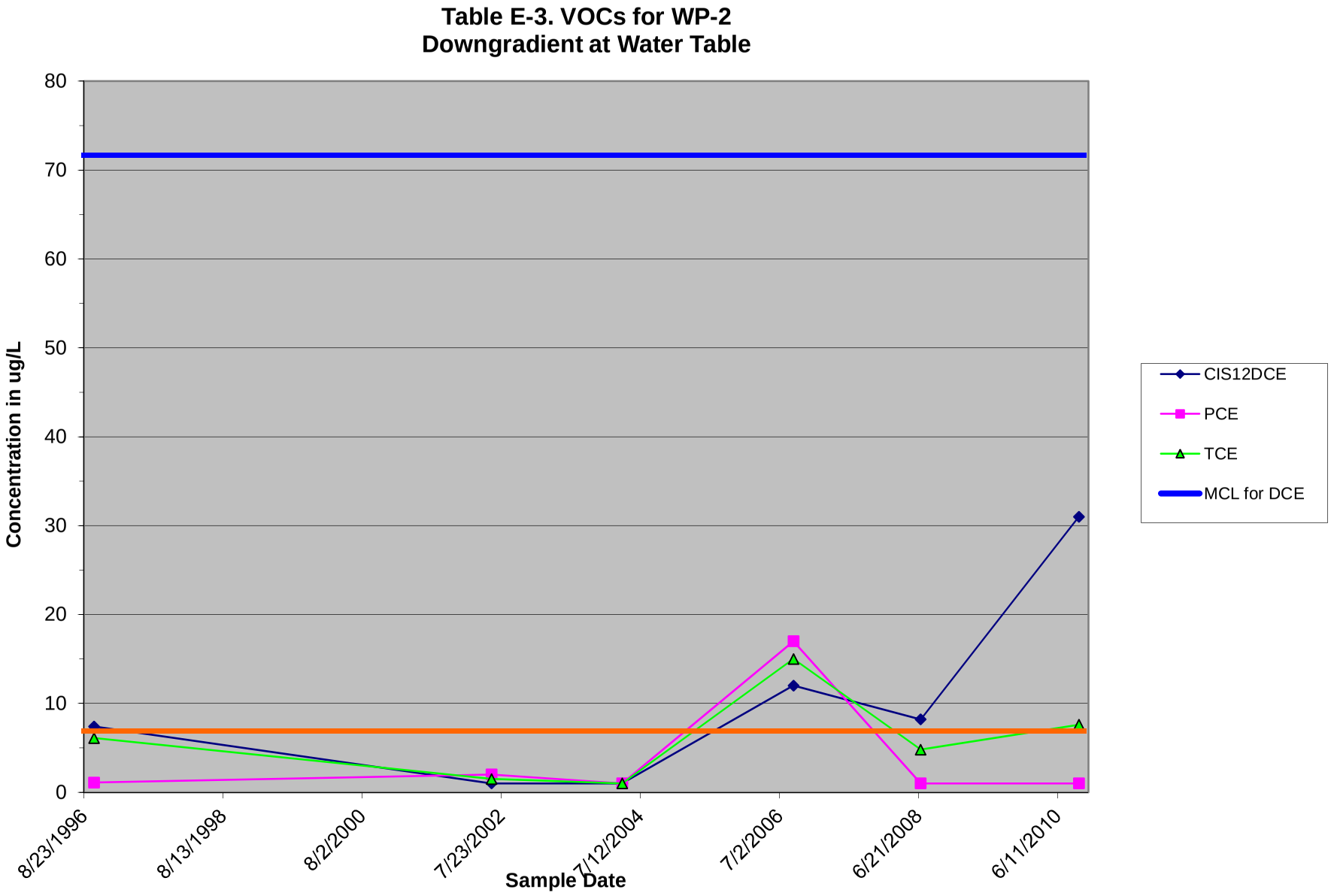
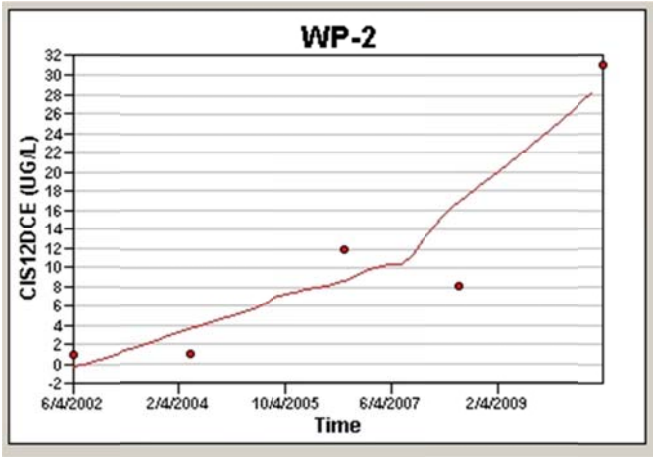


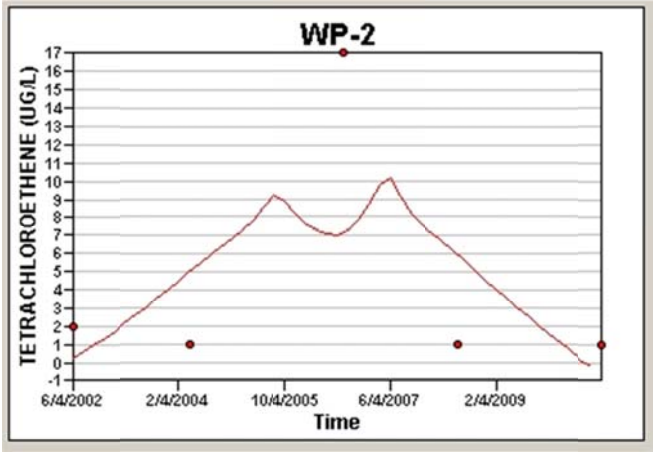
Table E-3. VOCs for WP-2
Downgradient at Water Table
Concentration in ug/L
80
70
60
50
40
30
20
10
0
8/23/1996
8/13/1998
8/2/2000
7/23/2002
7/12/2004
7/2/2006
6/21/2008
6/11/2010
Sample Date
CIS12DCE
PCE
TCE
MCL for DCE

Table E-4. Lowess Curves, Well ID: WP-2

Analyte: cis-1,2-Dichloroethene



Analyte: Tetrachloroethene



Analyte: Trichloroethene

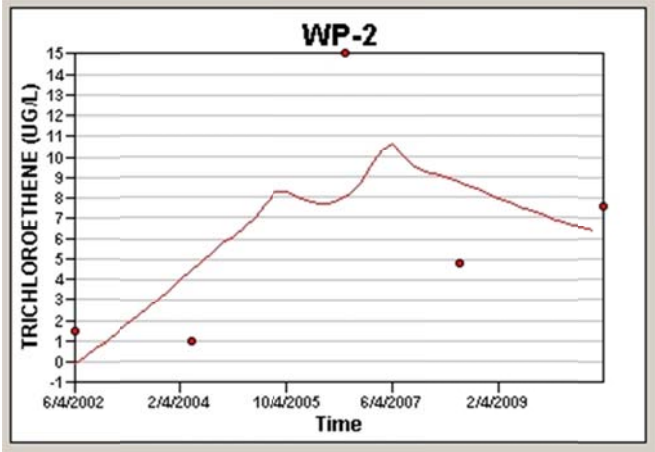
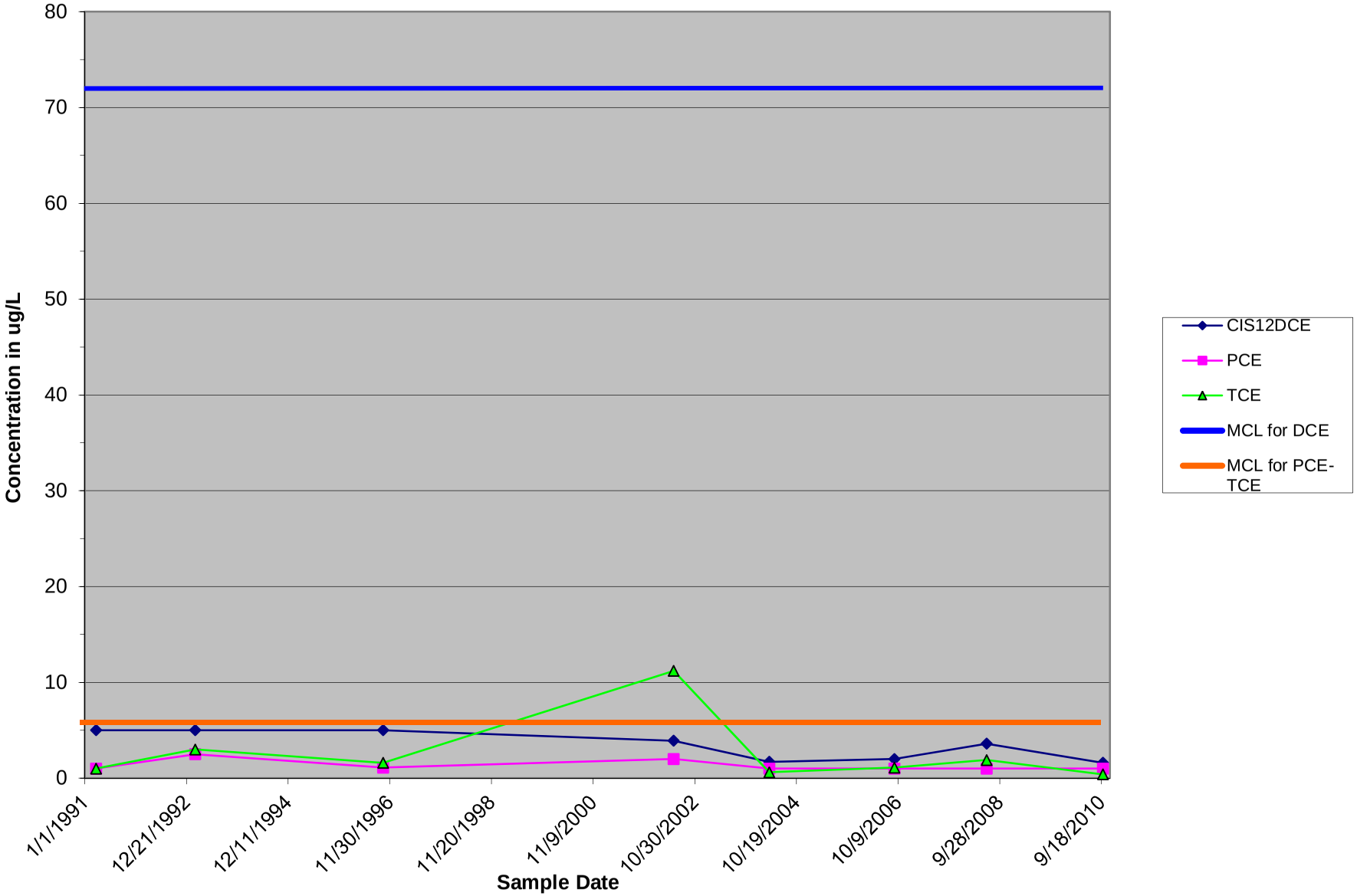


Table E-5. VOCs for CFD-5
Near Discharge Point of LPR at Water Table



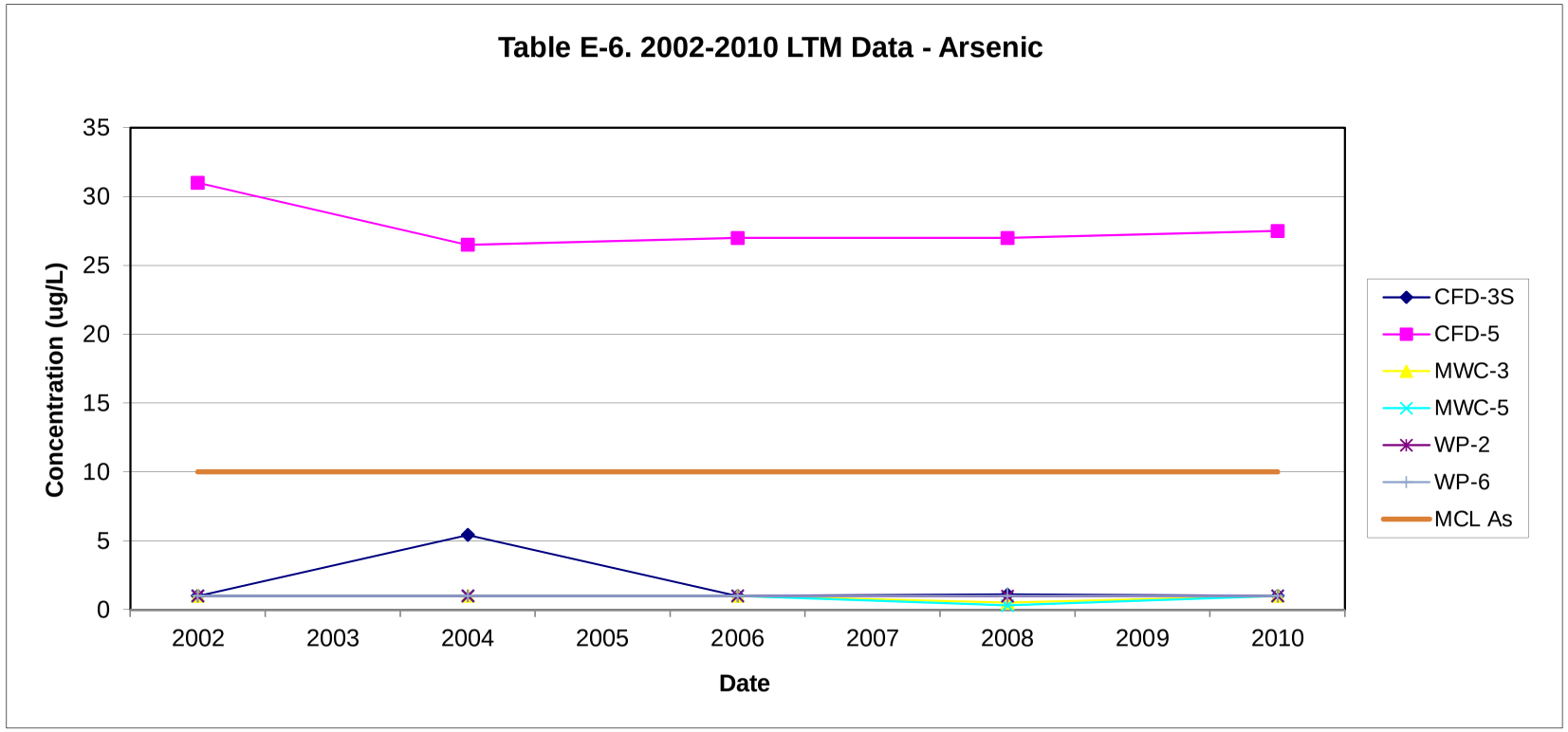
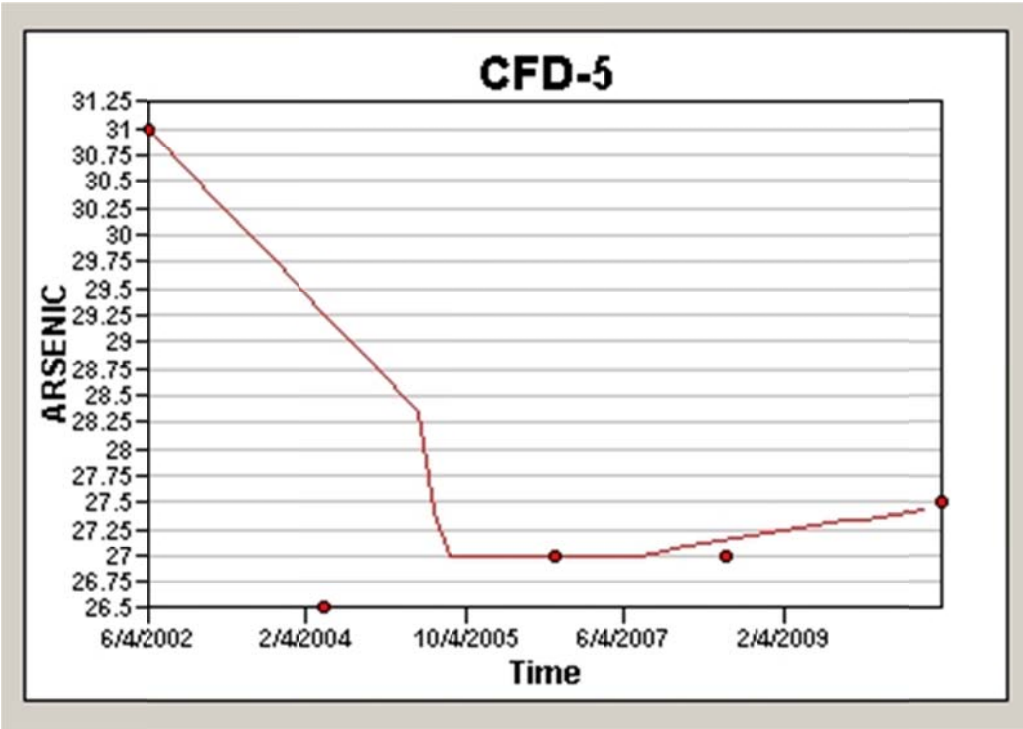


Table E-6. 2002-2010 LTM Data - Arsenic
Concentration (ug/L)
35
30
25
20
15
10
5
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
Date
CFD-3S
CFD-5
MWC-3
MWC-5
WP-2
WP-6
MCL As

Table E-7. Lowess Curves, Well ID: CFD-5

Analyte: Arsenic



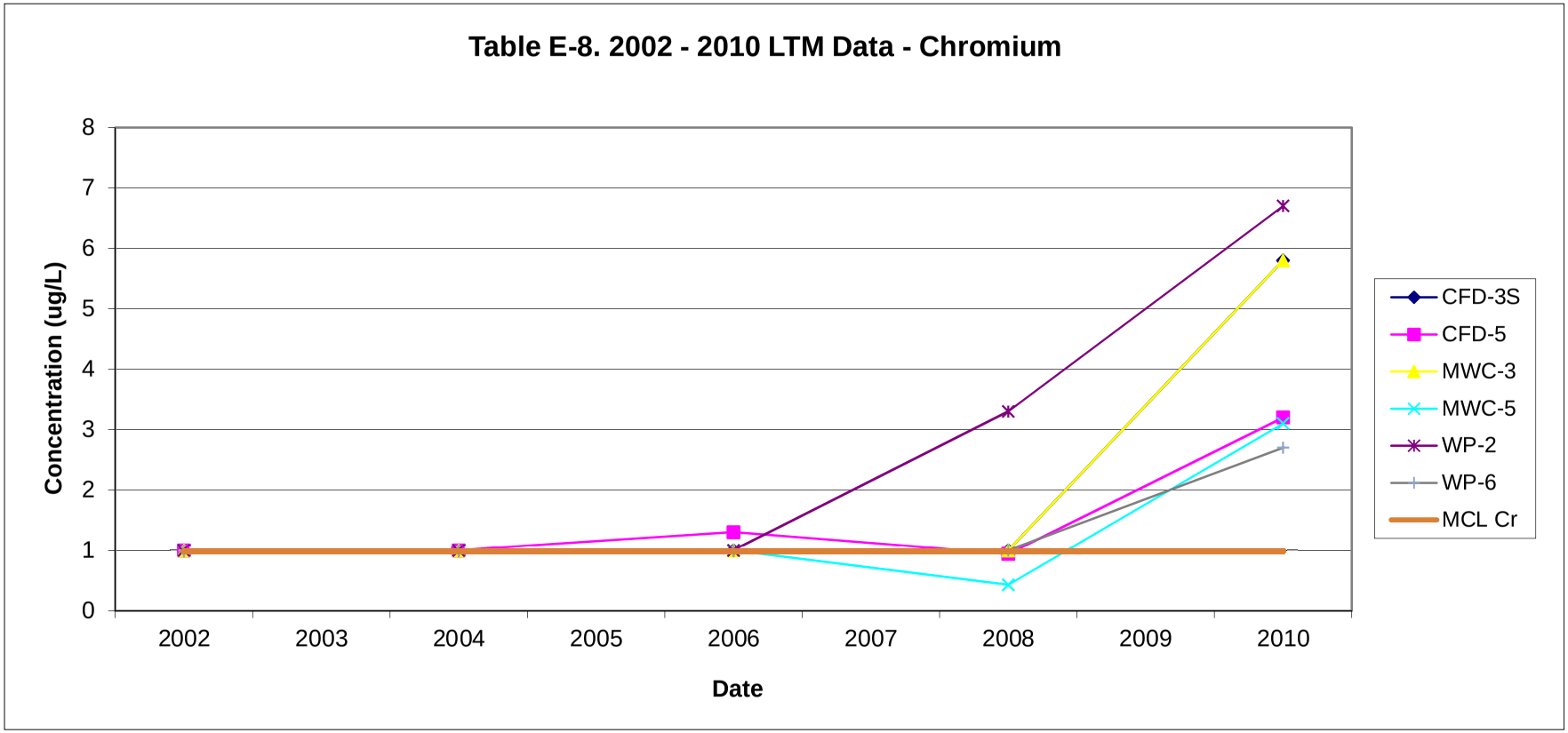


Table E-8. 2002 - 2010 LTM Data - Chromium
Concentration (ug/L)
8
7
6
5
4
3
2
1
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
Date
CFD-3S
CFD-5
MWC-3
MWC-5
WP-2
WP-6
MCL Cr

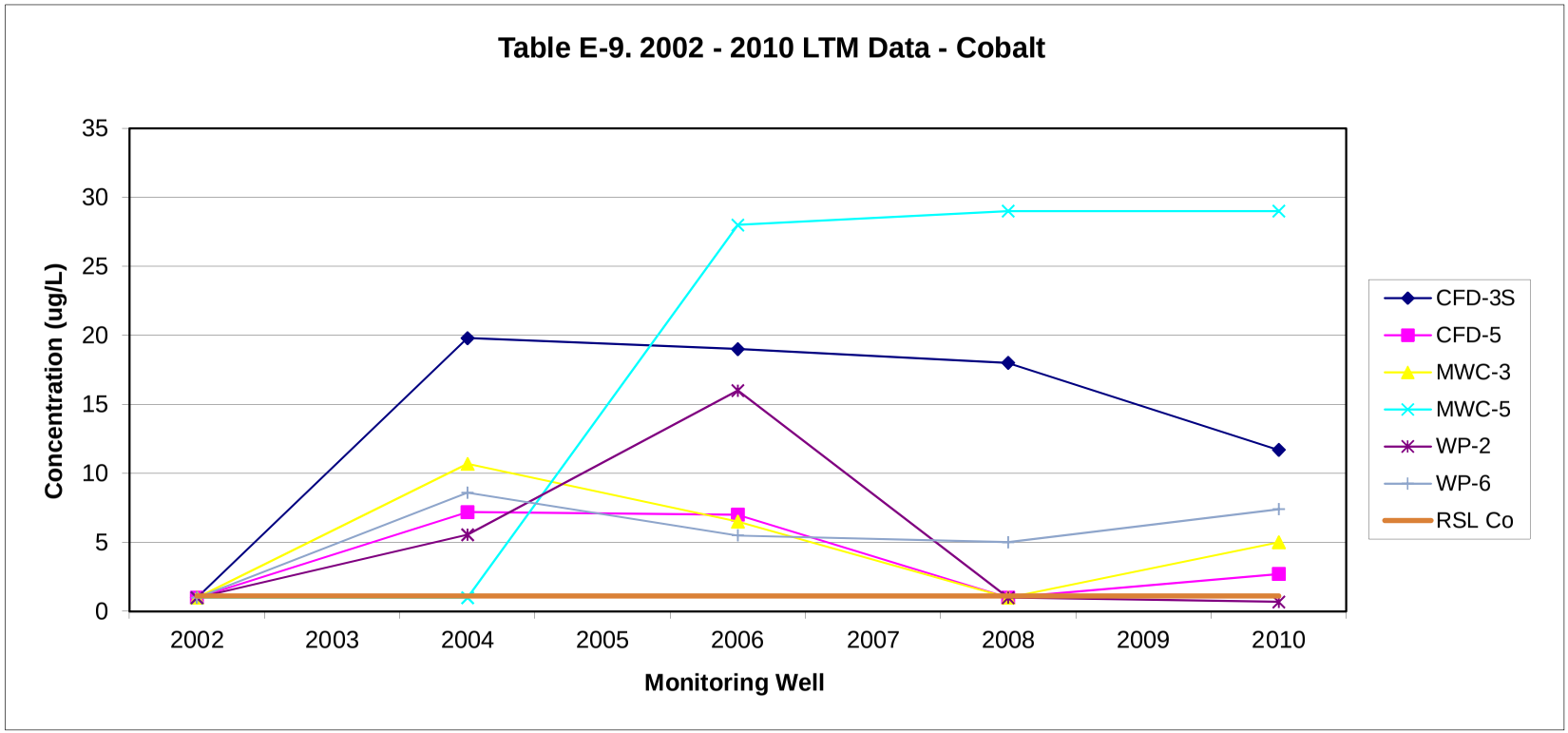


Table E-9. 2002 - 2010 LTM Data - Cobalt
Concentration (ug/L)
35
30
25
20
15
10
5
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
Monitoring Well
CFD-3S
CFD-5
MWC-3
MWC-5
WP-2
WP-6
RSL Co

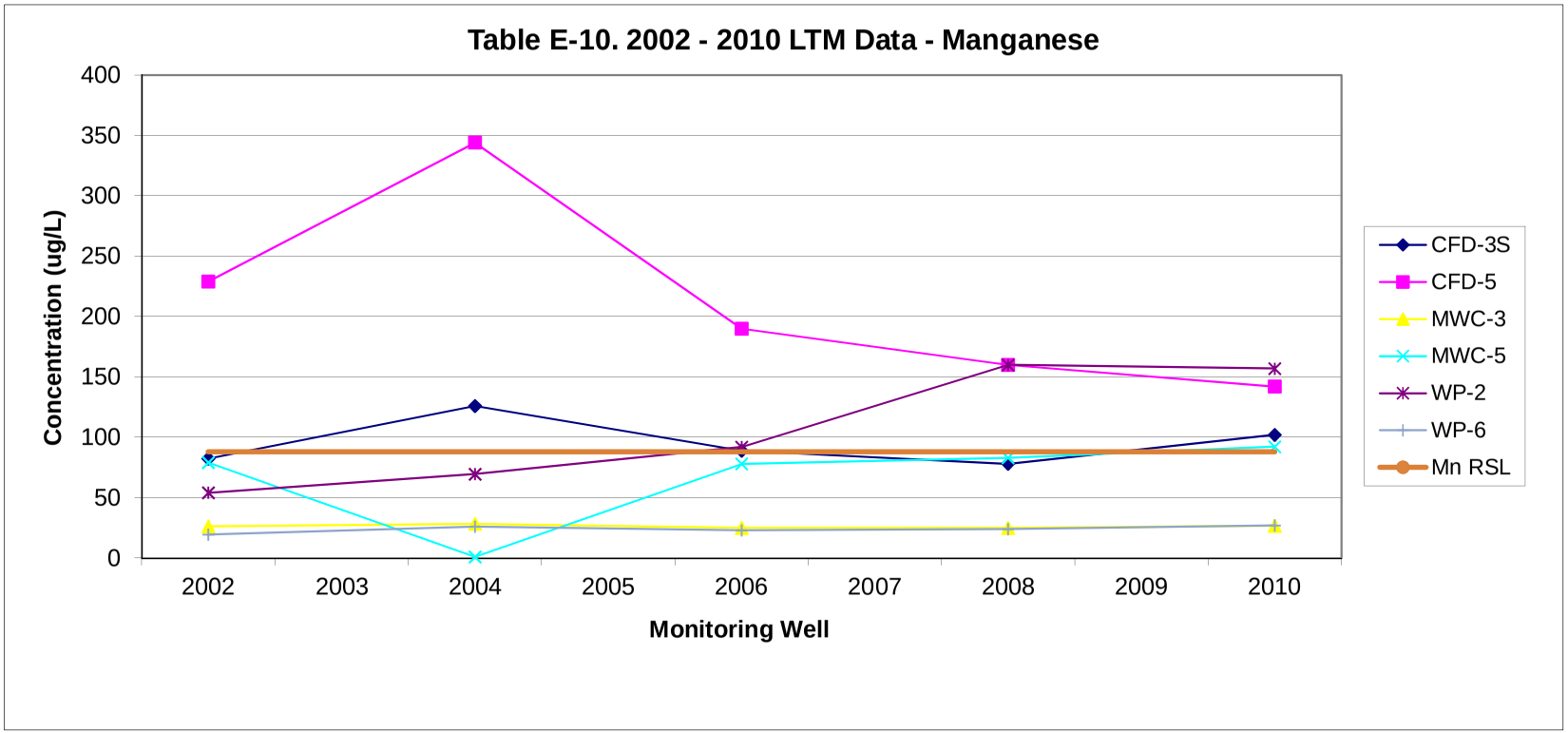


Table E-10. 2002 - 2010 LTM Data - Manganese
Concentration (ug/L)
400
350
300
250
200
150
100
50
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
Monitoring Well
CFD-3S
CFD-5
MWC-3
MWC-5
WP-2
WP-6
Mn RSL

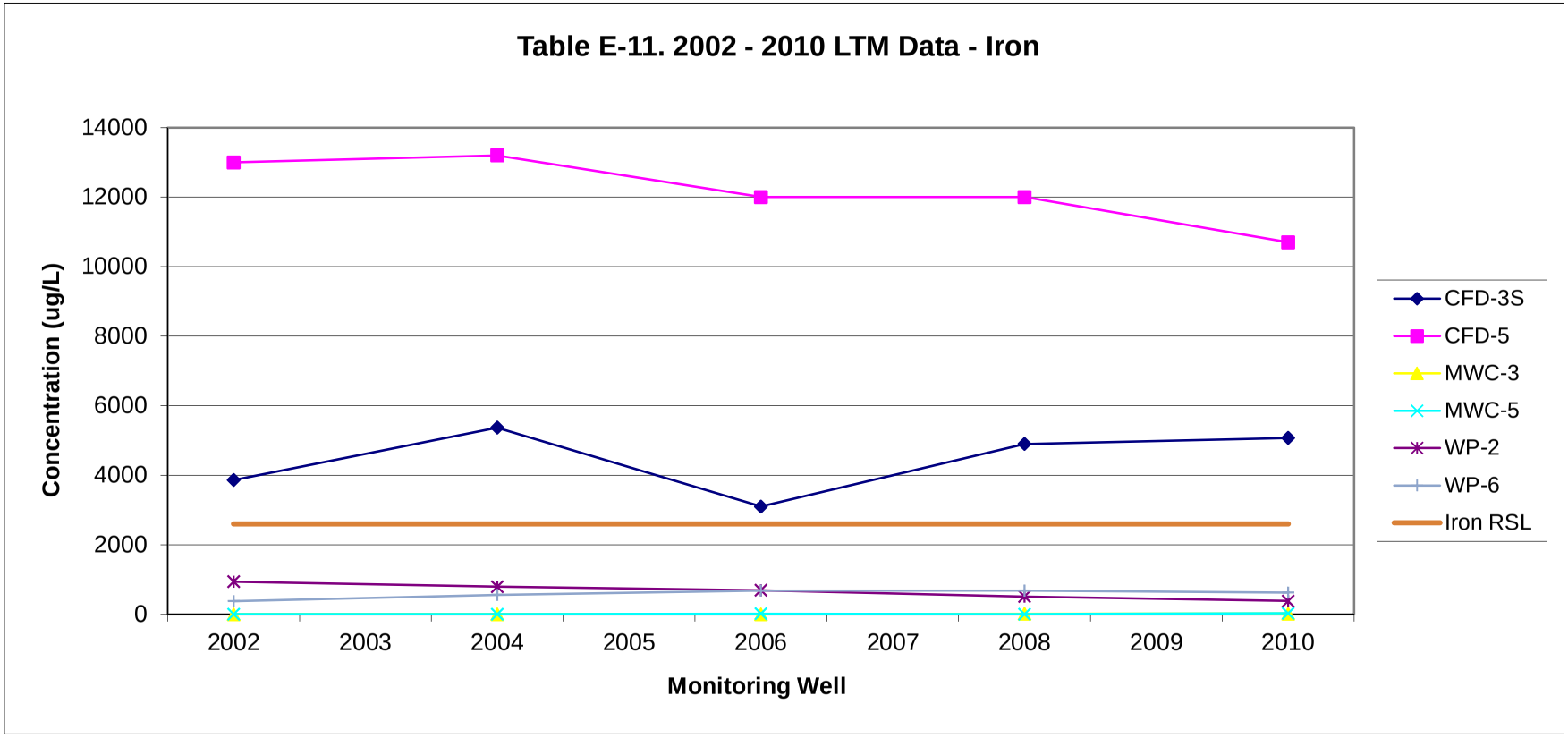
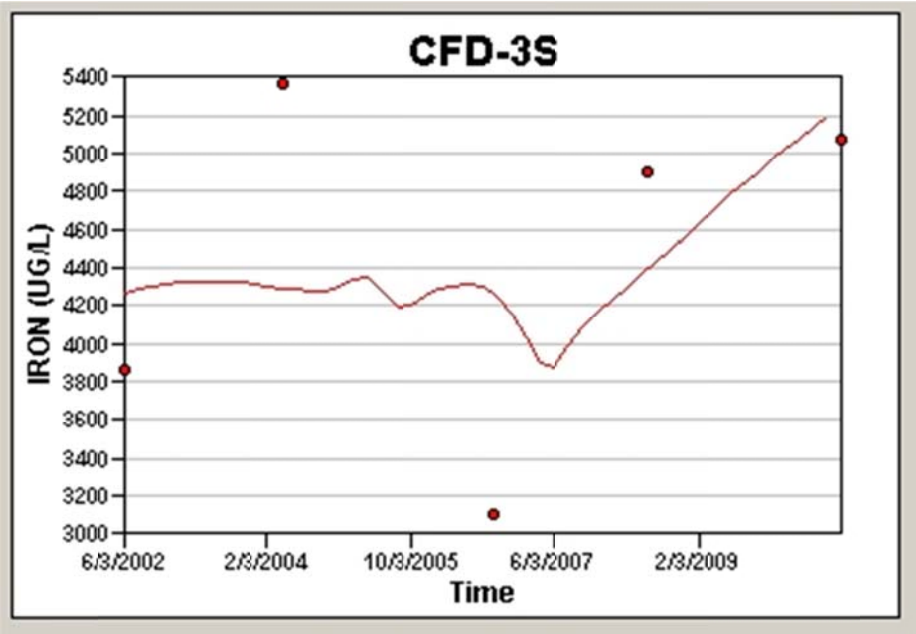


Table E-11. 2002 - 2010 LTM Data - Iron
Concentration (ug/L)
14000
12000
10000
8000
6000
4000
2000
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
Monitoring Well
CFD-3S
CFD-5
MWC-3
MWC-5
WP-2
WP-6
Iron RSL

Table E-12. Lowess Curves, Well ID: CFD-3S

Analyte: Iron



Analyte: Manganese

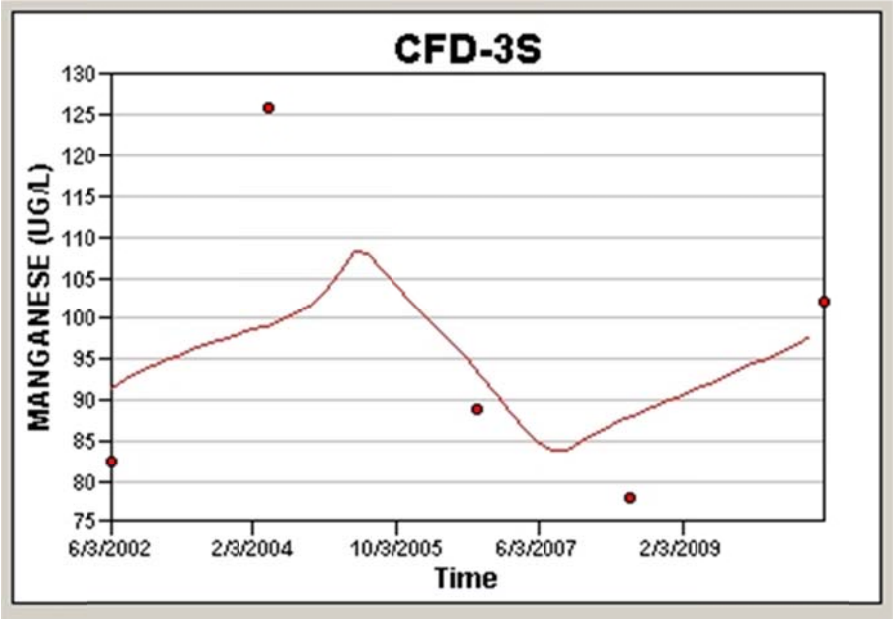
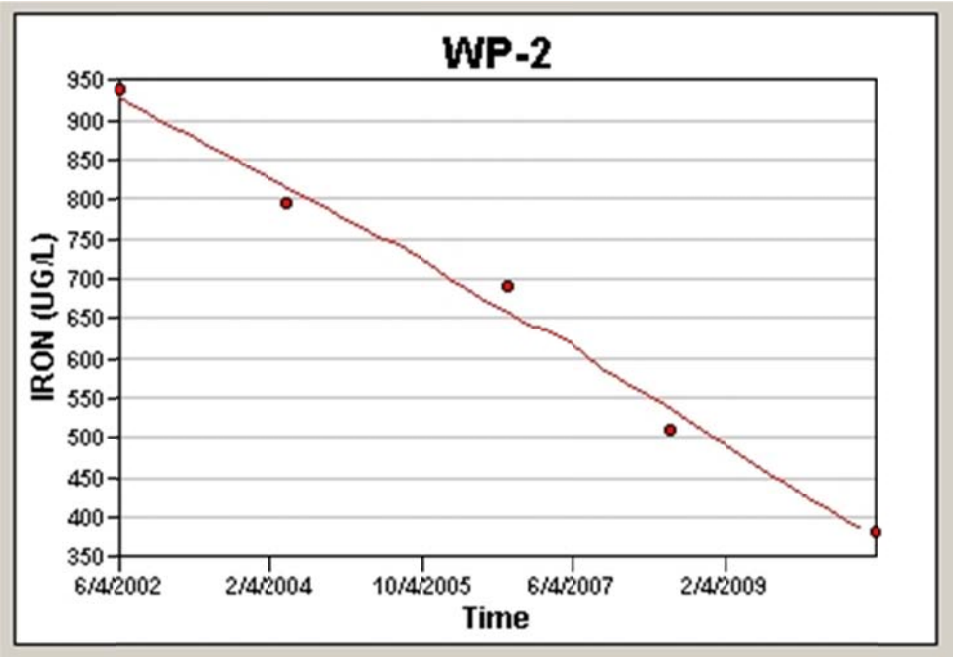
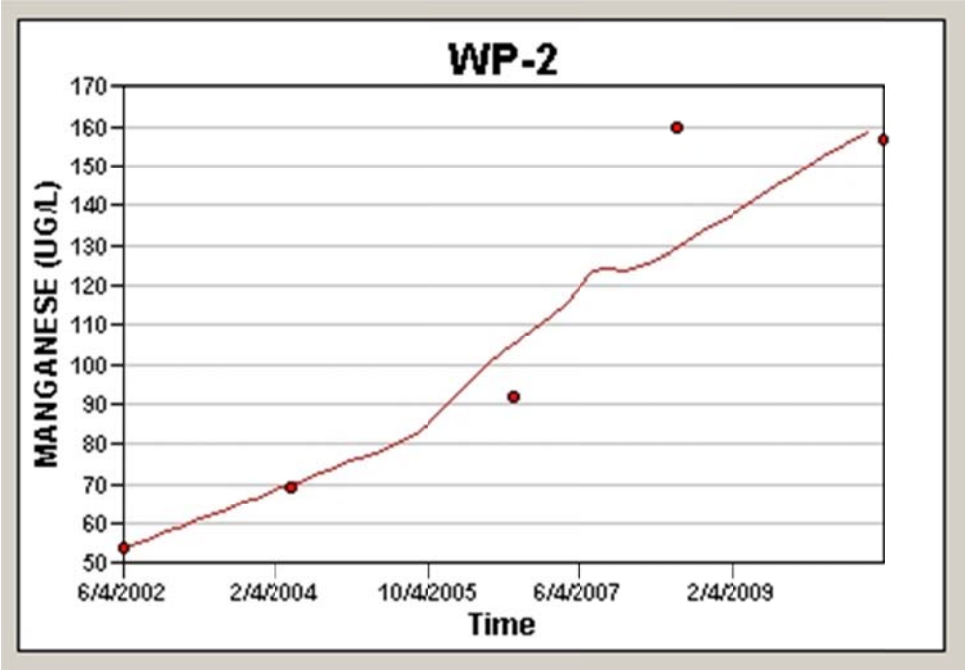


Table E-13. Lowess Curves, Well ID: WP-2

Analyte: Iron



Analyte: Manganese



APPENDIX F:

CALIBRATION INSTRUCTIONS

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3.3 Calibration

To obtain correct measurement values, the sensors need to be calibrated using standard solution before measurement. You can select simultaneous auto calibration of the pH, COND and TURB sensors in pH4 standard solution and DO and DEP sensors simultaneously in air, or manual calibration of individual measurement parameters. You can check the result of the previous calibration using the procedure on “ 3.5.4 Checking the calibration record ” (page 70).

Note

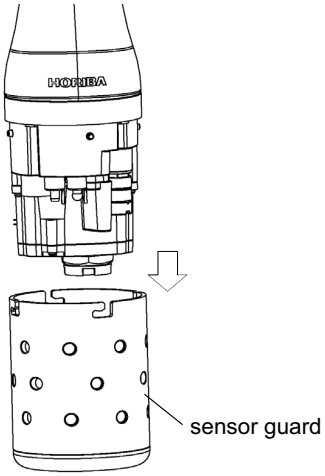
- **Wait at least 20 minutes after turning the system power ON before calibrating the DO sensor.**
- **Make the DO and COND compensation settings before calibration since these settings are applied during calibration.**
- **You can select only the desired parameters for calibration and calibrate just those parameters (see “ 3.2.4 Sensor selection ” (page 25)).**
- **Use about 200 mL of standard solution in the calibration cup.**
- **Calibration data is stored in the sensor probe.**

3.3.1 Auto calibration

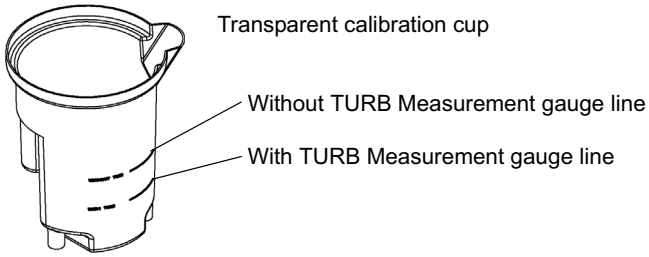
Tip

- **The following parameters are calibrated (at 25°C):**
  pH: Set to 4.01 (zero-point calibration); the span is adjusted to the factory default value.
  COND: 0.449 S/m (4.49 mS/cm, span calibration); the zero point is adjusted to the factory default value.
  TURB: 0 NTU (zero-point calibration); the span is adjusted to the factory default value.
  DO: 8.92 mg/L (span calibration); the zero point is adjusted to the factory default value.
  DEP: 0 m (zero-point calibration); the zero point is adjusted to the factory default value.
- **If the air temperature changes, the readout value may not be stable. Ensure that the ambient air temperature is the same temperature as the calibration solution, because the internal probe temperature sensor and external temperature sensor (in the calibration solution) are used for the auto calibration. Allow the probe and standard solution to equilibrate for 1 hour if a thermometer is not available to verify that these temperatures are the same.**
- **Do not hold the probe while performing the auto calibration. Body temperature may elevate the internal temperature sensor measurement creating DO calibration error.**

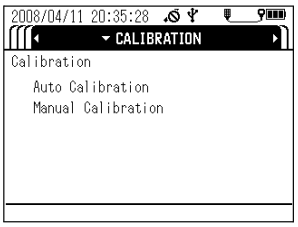
1. **Remove the sensor guard and wash the sensor probe 2 or 3 times with deionized water.**



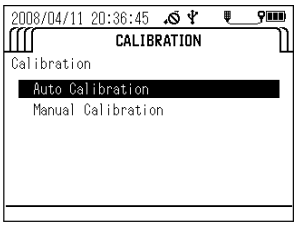
2. **Remove the transparent calibration cup.**
3. **Fill the transparent calibration cup to the line with pH 4 standard solution.**
   The transparent calibration cup has With TURB Measurement and Without TURB Measurement gauge lines.



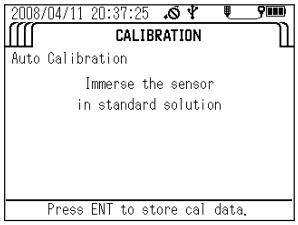
4. **Press the control unit's CAL key to set the calibration mode.**

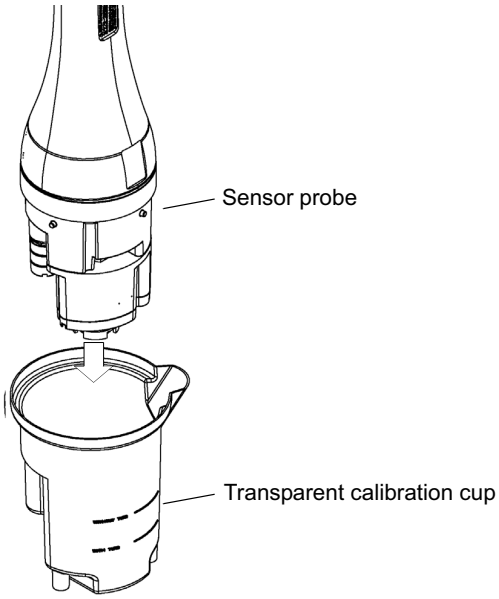


5. **Press the down (▽) key to move the cursor to "Auto Calibration", then press the ENTER key.**

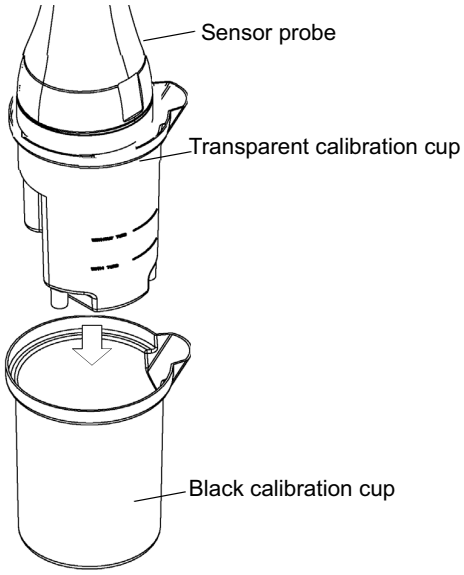


6. **Immerse the sensor probe in the transparent calibration cup.**
Check that the pH sensor, ORP sensor, reference electrode, COND sensor, TURB sensor and temperature sensor are submerged in the pH 4 standard solution and check that there are no air bubbles on the sensor.





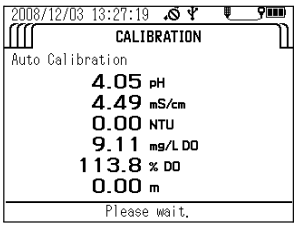
7. **With the sensor probe still in the transparent calibration cup, place the transparent calibration cup into the black calibration cup.**



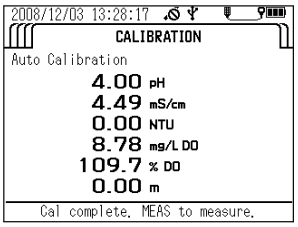
8. **When all the sensor values have stabilized, press the ENTER key to start calibration.**

Note

Do not remove the sensor probe from the calibration solution. U-53 turbidity data will display "----" until the calibration is completed.



Calibration is finished when the message "Cal complete. MEAS to measure." appears. Press the MEAS key to set the measurement screen, then start measurement.



If a calibration error occurs, start calibration after first resolving the issue according to the instructions in " 4.6 Troubleshooting " (page 89).

3.3.2 Manual calibration

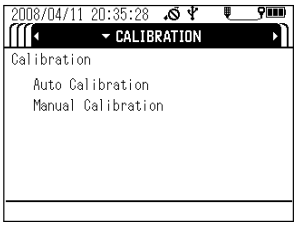
The procedures below describe how to calibrate each sensor individually.

Note

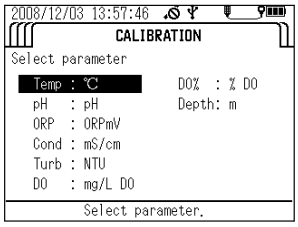
The displayed units are the units set by selecting "Unit for report" in the "SETTINGS" screen.

● **Temperature (TEMP) calibration**

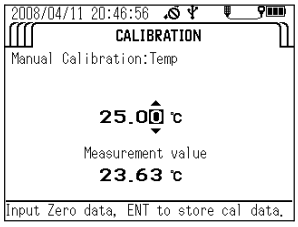
1. **Fill a bucket or similar container with water of a known temperature, and insert the sensor probe in it.**
   Wait 5 minutes before starting calibration to allow the sensor probe temperature to stabilize.
2. **Press the control unit's CAL key to set the calibration mode.**
3. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



4. **In the parameter selection screen, move the cursor to “Temp”, then press the ENTER key.**



5. **Press the up (△) and down (▽) keys to set the calibration value - the temperature of the water containing the submerged sensor probe.**



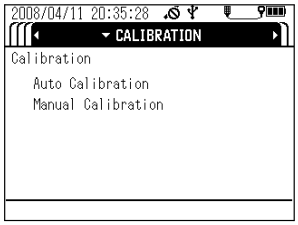
6. **Check that “Measurement value” has stabilized, then press the ENTER key to start calibration.**
   Calibration is finished when the message “Cal complete. CNT to measure.” appears.

● pH calibration

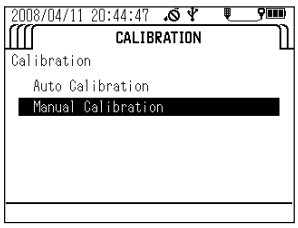
Note

You can select one calibration point (zero-point calibration) or two calibration points (zero-point calibration and span calibration). Carry out two calibration procedures to ensure good measurement precision throughout all measurement ranges.

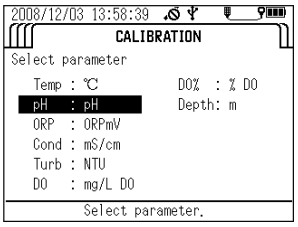
1. **Calibrate the zero point. Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with pH 7 standard solution.**
2. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**
3. **Press the control unit’s CAL key to set the calibration mode.**



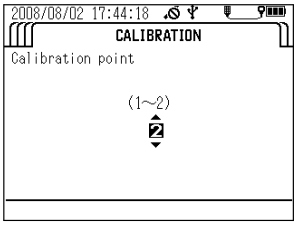
4. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



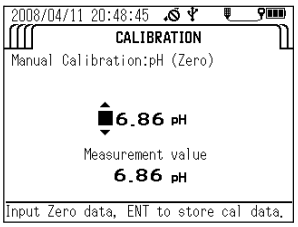
5. **In the parameter selection screen, move the cursor to "pH", then press the ENTER key.**



6. **Set the number of calibration points, then press the ENTER key.**



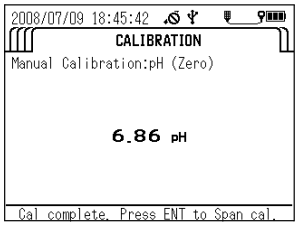
7. **Press the up (△) and down (▽) keys to set the pH value of the pH 7 standard solution containing the submerged sensor probe at the measurement temperature**



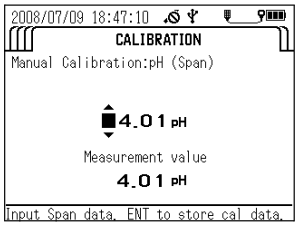
Temp. (°C)	pH 4 standard solution Phthalate	pH 7 standard solution Neutral phosphate	pH 9 standard solution Borate
0	4.01	6.98	9.46
5	4.01	6.95	9.39
10	4.00	6.92	9.33
15	4.00	6.90	9.27
20	4.00	6.88	9.22
25	4.01	6.86	9.18
30	4.01	6.85	9.14
35	4.02	6.84	9.10
40	4.03	6.84	9.07
45	4.04	6.84	9.04

8. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

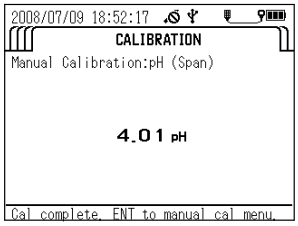
9. **Press the ENTER key to start the span calibration procedure when the message "Cal complete. Press ENT to Span cal." appears.**



10. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with pH 4 or pH 9 standard solution.**
11. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**
12. **Press the up (△) and down (▽) keys to set the pH value of the pH 4 or pH 9 standard solution containing the submerged sensor probe at the measurement temperature.**



13. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**
14. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter**

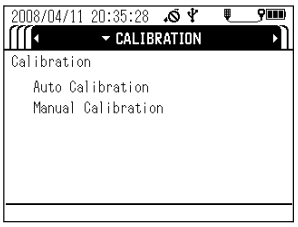


● ORP calibration

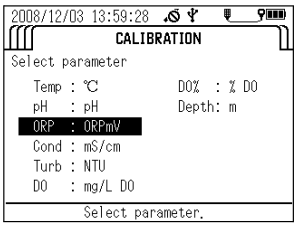
Note

- **If the prepared ORP standard solution is left in open air for one hour or more, the solution may be transformed. For this reason ORP standard solution cannot be stored.**
  Calibrate within one hour of preparing the solution.
- **When measuring sample with low concentrations of oxidants and reductants after conducting an operational check using a standard substance, the measured values may not stabilize or the results of measurement might not be repeatable. If this is the case, start the measurement after immersing the sensors in the sample water sufficiently.**
- **Note that when measuring the ORP of solution with extremely low concentrations of oxidants and reductants, such as tap water, well water, or water treated with purifying equipment, there may be less responsiveness, repeatability, and stability, in general.**
- **When alkaline ion water is left for 5 minutes, its ORP undergoes changes significantly. Always measure alkaline ion water promptly.**

1. **Fill a clean beaker with one bag of ORP standard powder No. 160-22 or No. 160-51. Add 250 mL of deionized water and agitate the solution thoroughly (there will be some excess quinhydrone (a black powder) that floats on the surface when agitating the solution). Fill the transparent calibration cup to the reference line with this standard solution.**
2. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**
3. **Press the control unit's CAL key to set the calibration mode.**
4. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



5. **In the parameter selection screen, move the cursor to ORP, then press the ENTER key.**



6. **Press the up (△) and down (▽) keys to set the mV value of the ORP standard solution containing the submerged sensor probe at the measurement temperature.**

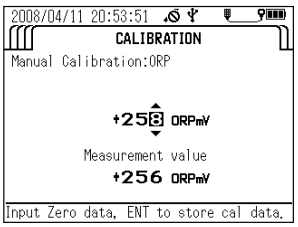


Table 1 Indicated value of ORP standard solution at various temperatures (mV)

Temperature	160-22	16051
5	+274	+112
10	+271	+107
15	+267	+101
20	+263	+95
25	+258	+89
30	+254	+83
35	+249	+76
40	+244	+69

7. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**
8. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**

Conductivity (COND) calibration

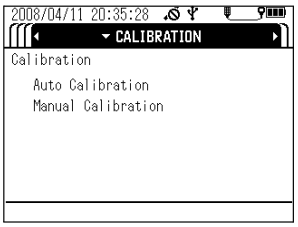
Note

- **To support a wide range of sample concentrations, electrical conductivity is divided into three measurement ranges: 0.0 mS/m to 99.9 mS/m, 0.090 S/m to 0.999 S/m, and 0.9 S/m to 9.99 S/m.**
- **When manually calibrating conductivity, you can select two calibration points (one zero-point calibration point and a span calibration point for one of the three measurement ranges) or four calibration points (one zero-point calibration point and span calibration points for all three measurement ranges). Carry out the four calibration points to ensure good measurement precision throughout all measurement ranges.**
- **Make the compensation setting before calibration since this setting is applied during calibration. (Refer to “ 6.5.3 Temperature coefficient ” (page 104)).**

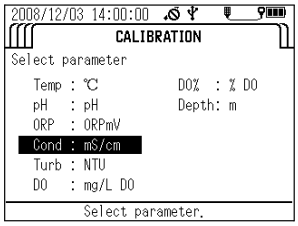
1. **Prepare the standard solution. Dry Potassium chloride (KCl) powder (high-grade commercially available) at 105°C for two hours, and leave it to cool in a desiccator.**
2. **Consult the following table and weigh potassium chloride (KCl), then prepare three standard potassium chloride (KCl) solutions following the procedure below.**

Potassium chloride (KCl) standard solution	Conductivity (COND) value	Potassium chloride (KCl) mass (g) at solution temperature of 25 °C	Calibration range
0.005 mol/L	71.8 mS/m (0.718 mS/cm)	0.373	0.0 mS/m to 99.9 mS/m (0.00 mS/cm to 0.999 mS/cm)
0.050 mol/L	0.667 S/m (6.67 mS/cm)	3.73	0.090 S/m to 0.999 S/m (1.00 mS/cm to 9.99 mS/cm)
0.500 mol/L	5.87 S/m (58.7 mS/cm)	37.2	0.9 S/m to 9.99 S/m (10.0 mS/cm to 99.9 mS/cm)

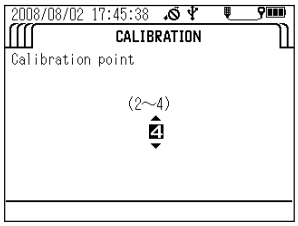
3. **Dissolve the weighed Potassium Chloride (KCl) in deionized water.**
4. **Put the dissolved Potassium Chloride (KCl) into a 1 L measuring flask, and fill to the 1 L mark with deionized water.**
5. **Calibrate the zero point. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then remove all moisture from the sensor probe (it will be calibrated in air).**
6. **Press the control unit’s CAL key to set the calibration mode.**
7. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



8. **In the parameter selection screen, move the cursor to “Cond”, then press the ENTER key.**



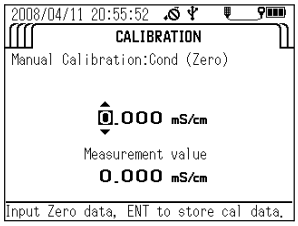
9. **Set the number of calibration points, then press the ENTER key.**



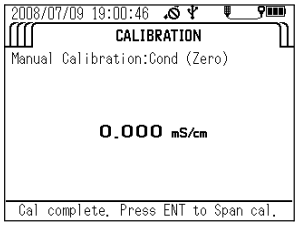
The instructions below assume that four calibration points have been set.

10. **Press the up (△) and down (▽) keys to set the "Cond" value to 0.0 mS/m (0.000 mS/cm).**

11. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**



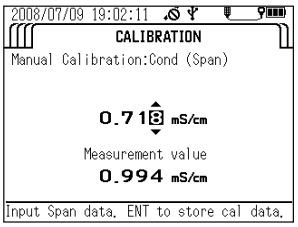
12. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the first span calibration procedure.**



13. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 71.8 mS/m (0.718 mS/cm) standard solution.**

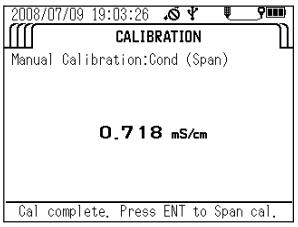
14. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

15. **Press the up (△) and down (▽) keys to set the "Cond" value to 71.8 mS/m (0.718 mS/cm).**
Calibration range = 0 mS/m to 99.9 mS/m (0 mS/cm to 0.999 mS/cm)



16. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

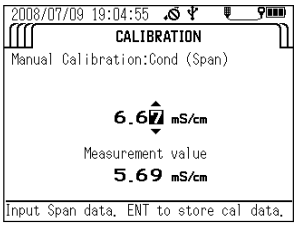
17. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the next span calibration procedure.**



18. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 0.667 S/m (6.67 mS/cm) standard solution.**

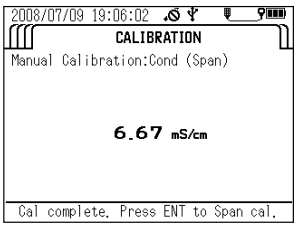
19. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

20. **Press the up (△) and down (▽) keys to set the "Cond" value to 0.667 S/m (6.67 mS/cm).**
Calibration range = 0.100 S/m to 0.999 S/m (1.00 mS/cm to 9.99 mS/cm)



21. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

22. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the next span calibration procedure.**

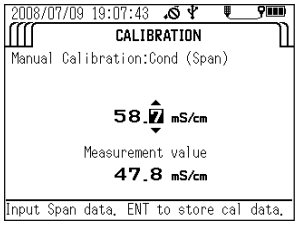


23. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 5.87 S/m (58.7 mS/cm) standard solution.**

24. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

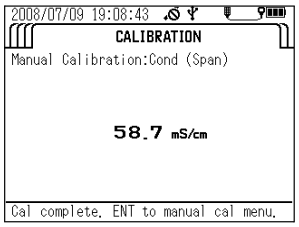
25. **Press the up (△) and down (▽) keys to set the "Cond" value to 5.87 S/m (58.7 mS/cm).**

Calibration range = 1.00 S/m to 10.00 S/m(10.0 mS/cm to 100.0 mS/cm)



26. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

27. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**



Turbidity (TURB) calibration

Note

- **To support a wide range of sample concentrations, turbidity is divided into three measurement ranges: 0.0 to 9.9 NTU, 10 to 100 NTU, and over 100 NTU.**
- **When manually calibrating turbidity, you can select two calibration procedures (one zero-point calibration procedure and a span calibration procedure for one of the three measurement ranges), three calibration procedures (one zero-point calibration procedure and a span calibration procedure for two of the three measurement ranges) or four calibration procedures (one zero-point calibration procedure and span calibration procedures for all three measurement ranges). Carry out the four calibration procedures to ensure good measurement precision throughout all measurement ranges.**
- **Always use the calibration cup provided. Using other containers can create effects from ambient light that cause incorrect calibration.**

Preparing the standard solutions

1. **Weigh out 5.0 g of hydrazine sulfate (commercial special grade or above), and dissolve it in 400 mL of deionized water. Dissolve 50 g of hexamethylene tetramine (commercial special grade or above) in 400 mL of deionized water in anther flask.**
2. **Mix the two solutions and add deionized water until the total solution volume is 1000 mL, and mix well. Store this solution at a temperature of 25°C ±3°C for 48 hours.**
   The turbidity value (TURB) of this solution is equivalent to 4000 NTU.
3. **Dilute 4000 NTU-solution 5 times (use a pipette to measure 50 mL of the 4000 NTU solution and pour it into a 250 mL measuring flask, and fill up to 250 mL meniscus)**
   The turbidity value (TURB) of this solution is equivalent to 800 NTU.
4. **Dilute 800 NTU solution 10 times (use a pipette to measure 25 mL of the 800 NTU solution and pour it into a 250 mL measuring flask, and fill up to 250 mL meniscus)**
   The turbidity value (TURB) of this solution is equivalent to 80 NTU.
5. **Dilute 80 NTU solution 10 times (use a pipette to measure 25 mL of the 80 NTU solution and pour it into a 250 mL measuring flask, and fill up to 250 mL meniscus)**
   The turbidity value (TURB) of this solution is equivalent to 8 NTU.

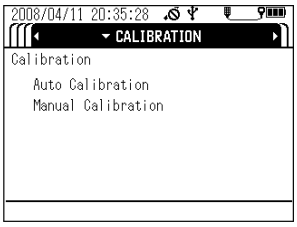
Note

Instead of the standard solutions above, you can use other standard solutions of known concentration measured with other standard instruments.

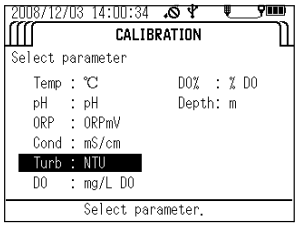
U-52, U-53 turbidity calibration

Set the number of calibration points.
You can set between 2 and 4 points.

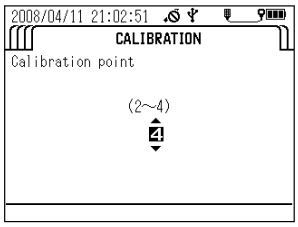
1. **Press the control unit's CAL key to set the calibration mode.**
2. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



3. **In the parameter selection screen, move the cursor to "Turb", then press the ENTER key.**



4. **Press the up (△) and down (▽) keys to set the number of calibration points, then press the ENTER key.**

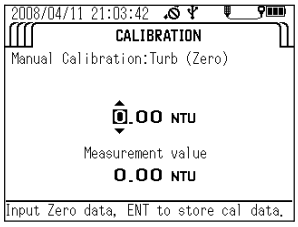


The instructions below assume that four calibration points have been set.

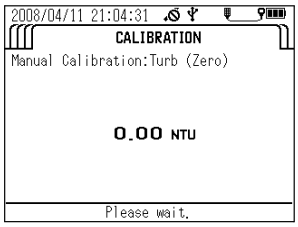
5. **Calibrate the zero point. Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with deionized water.**

6. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

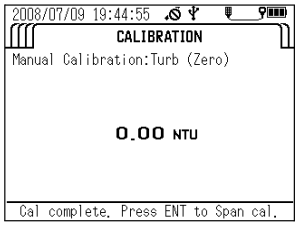
7. **Press the up (△) and down (▽) keys to set the "Turb" value to 0.0 NTU.**



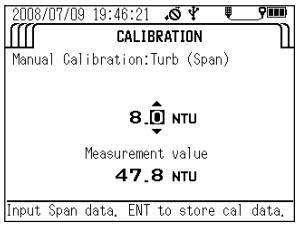
8. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**



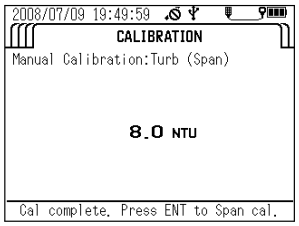
9. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the first span calibration procedure.**



10. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 8 NTU standard solution, or a standard solution of known concentration between 0.1 and 10 NTU.**
11. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**
12. **Press the up (△) and down (▽) keys to set the "TURB" value to 8 NTU, or to the known concentration of the standard solution between 0.1 and 10 NTU. (Input range = 0 NTU to 9.9 NTU (U-51) or 0 NTU to 9.99 NTU (U-52))**

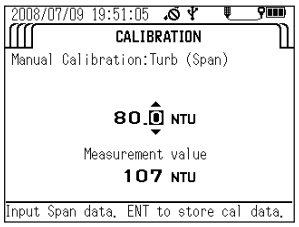


13. **Check that "Current measurement value" has stabilized, then press the ENTER key to start calibration.**
14. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the next span calibration procedure.**



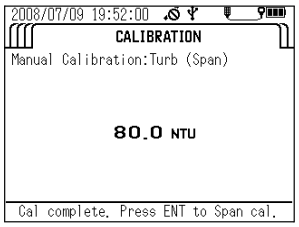
15. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 80 NTU standard solution, or a standard solution of known concentration between 10 and 100 NTU.**
16. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

17. **Press the up (△) and down (▽) keys to set the "Turb" value to 80 NTU, or to the known concentration of the standard solution between 10 and 100 NTU. (Input range = 10.0 NTU to 99.9 NTU)**



18. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

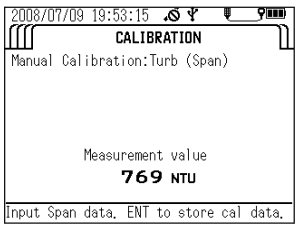
19. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the next span calibration procedure.**



20. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 800 NTU standard solution, or a standard solution of known concentration 100 NTU above.**

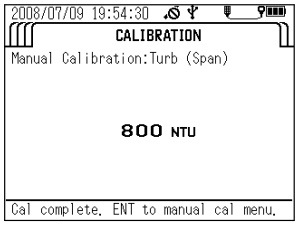
21. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

22. **Press the up (△) and down (▽) keys to set the "TURB" value to 800 NTU, or to the known concentration of the standard solution 100 NTU above.**
(Input range = 100 NTU to 800 NTU (U-51), 100 NTU to 1000 NTU (U-52))



23. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

24. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**

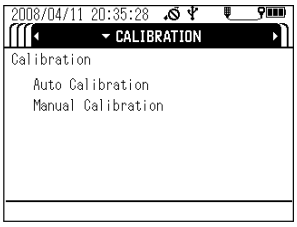


Dissolved oxygen (DO) calibration

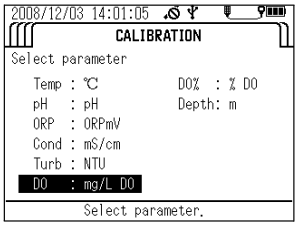
Note

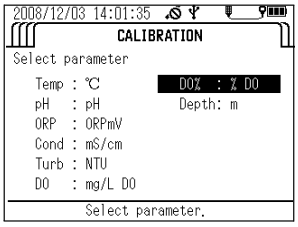
- **You can select one calibration procedure (span calibration) or two calibration procedures (zero-point calibration and span calibration). Carry out the two calibration procedures to ensure good measurement precision throughout all measurement ranges.**
- **It is necessary to prepare new solution before calibration of the Dissolved Oxygen (DO) sensor.**
- **The calibration cup (included) cannot be used to manually calibrate the DO sensor. Use a suitable bottle in which the DO sensor and the temperature sensor can be immersed.**
- **Wait at least 20 minutes after turning the system power ON before calibrating the DO sensor.**
- **Make the compensation setting before calibration since the setting is applied during calibration.**
- **The DO sensor is affected by flow. When performing span calibration with saturated dissolved oxygen water, move the cable slowly up and down (move the sensor probe at a rate of roughly 20 to 30 cm a second) or agitate the saturated dissolved oxygen water.**

1. **Prepare the standard solution.**
   - Add about 50 g of sodium sulfite to 1000 mL of water (either deionized water or tap water) and stir the mixture to dissolve the sodium sulfite in it.
   - Pour 1 to 2 liters of water into a suitable flask (either deionized water or tap water). Using a air pump, feed air into the water and aerate the solution until oxygen is saturated.
2. **First, calibrate the zero point. Press the control unit's CAL key to set the calibration mode.**
3. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**

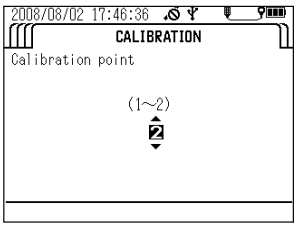


4. **In the parameter selection screen, move the cursor to DO or DO%, then press the ENTER key.**



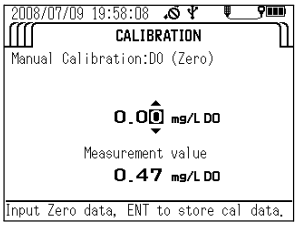


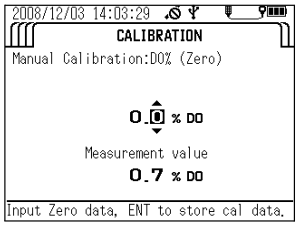
5. **Set the number of calibration procedures, then press the ENTER key.**



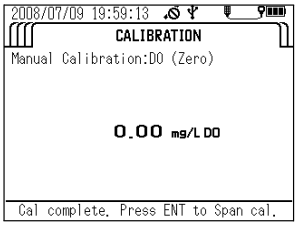
The instructions below assume that two calibration points have been set.

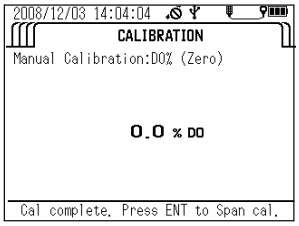
6. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the bottle.**
7. **Press the up (△) and down (▽) keys to set the DO value to 0.00 mg/L or 0.0%.**



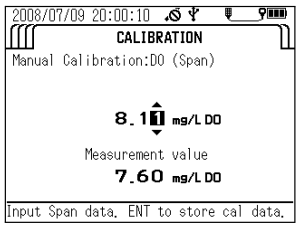


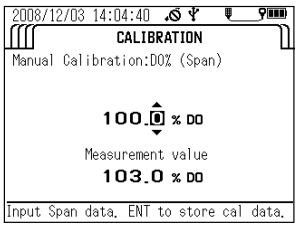
8. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**
9. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the span calibration procedure.**



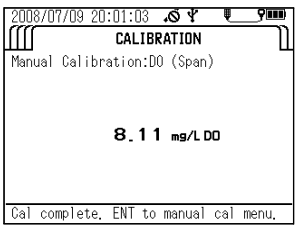


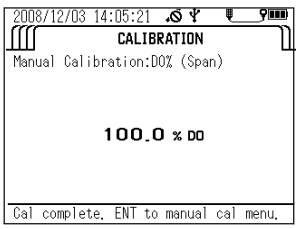
10. **Wash the sensor probe 2 or 3 times with deionized water to remove any dirt, then submerge the sensor probe in the container filled with the span solution.**
11. **Press the up (△) and down (▽) keys to set the DO value to the saturated dissolved oxygen value (mg/L) of the water at that temperature or the dissolved oxygen saturation ratio.**





12. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**
13. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**





Amounts of saturated dissolved oxygen in water at various temperatures (salinity=0.0%)

JIS K0101

Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
0	14.16						
1	13.77	11	10.67	21	8.68	31	7.42
2	13.40	12	10.43	22	8.53	32	7.32
3	13.04	13	10.20	23	8.39	33	7.22
4	12.70	14	9.97	24	8.25	34	7.13
5	12.37	15	9.76	25	8.11	35	7.04
6	12.06	16	9.56	26	7.99	36	6.94
7	11.75	17	9.37	27	7.87	37	6.86
8	11.47	18	9.18	28	7.75	38	6.76
9	11.19	19	9.01	29	7.64	39	6.68
10	10.92	20	8.84	30	7.53	40	6.59

ISO5814

Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
0	14.62				
1	14.22	11	11.03	21	8.91
2	13.83	12	10.78	22	8.74
3	13.46	13	10.54	23	8.58
4	13.11	14	10.31	24	8.42
5	12.77	15	10.08	25	8.26
6	12.45	16	9.87	26	8.11
7	12.14	17	9.66	27	7.97
8	11.84	18	9.47	28	7.83
9	11.56	19	9.28	29	7.69
10	11.29	20	9.09	30	7.56

● **Span setting values for calibration in air**

The software should display these values when auto calibration is performed.
Use this table to input values for manual span calibrations in air.

Tip

The DO measurement value of "air-saturated water" and air are different.
Due to the pressure difference against the membrane in air versus the membrane in water, the measurement value in air is about 10% higher than the value of air-saturated water on average.

Amounts of saturated dissolved oxygen in air at various temperatures

Following tables are applicable only to the air calibration of the U-50 DO sensor. Do not use them for other purpose.

Air calibration value in adopting evaluation based on JIS K0101

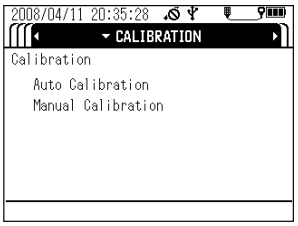
Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)
0	15.58						
1	15.15	11	11.74	21	9.55	31	8.16
2	14.74	12	11.47	22	9.38	32	8.05
3	14.34	13	11.22	23	9.23	33	7.94
4	13.97	14	10.97	24	9.08	34	7.84
5	13.61	15	10.74	25	8.92	35	7.74
6	13.27	16	10.52	26	8.79	36	7.63
7	12.93	17	10.31	27	8.66	37	7.55
8	12.62	18	10.10	28	8.53	38	7.44
9	12.31	19	9.91	29	8.40	39	7.35
10	12.01	20	9.72	30	8.28	40	7.25

Air calibration value in adopting evaluation based on ISO5814

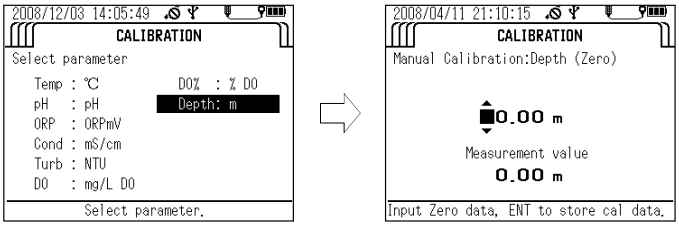
Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
0	16.08				
1	15.64	11	12.13	21	9.80
2	15.21	12	11.86	22	9.61
3	14.81	13	11.59	23	9.44
4	14.42	14	11.34	24	9.26
5	14.05	15	11.09	25	9.09
6	13.70	16	10.86	26	8.92
7	13.35	17	10.63	27	8.77
8	13.02	18	10.42	28	8.61
9	12.72	19	10.21	29	8.46
10	12.42	20	10.00	30	8.32

Water depth (DEPTH) calibration

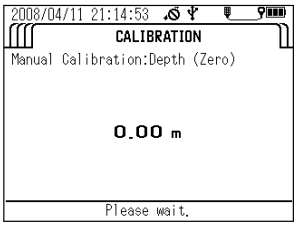
1. **Calibrate the zero point. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then remove all moisture from the sensor probe (it will be calibrated in air).**
2. **Press the control unit's CAL key to set the calibration mode.**
3. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



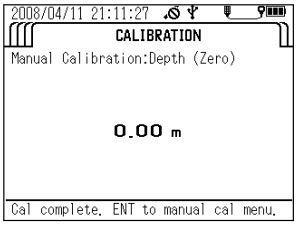
4. **In the parameter selection screen, move the cursor to "Depth", then press the ENTER key.**



5. **Press the up (△) and down (▽) keys to set the "Depth" value to 0.00 m.**
6. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**



7. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**



APPENDIX G:

REGULATORY ACCEPTANCE LETTERS AND RESPONSE TO COMMENTS

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Fort Meade Leagacy BRAC Responses to Regulator Comments
Draft Regulator Review Long-Term Monitoring Report, Clean Fill Dump Area; Sampling Conducted September 2010
Report dated February 2011

Initial Comments				
Commenter / ORG	**Comment Number**	**Comment Origin**	**Comment**	**Fort Meade Legacy BRAC Program Response**
MDE Hazardous Waste Program Federal Facilities Division, March 8,2011				
Elisabeth Green, MDE FFD Remedial Project Manager	Specific Comment 1	Page ES-3 Bullet 1	The text states that the Explanation of Significant Difference (ESD) process will be used "to change the sampling frequency from biennial to annual." It might make more sense to amend the Long-Term Monitoring Plan (LTMP) to meet this goal, instead ofthe ESD. The LTMP will be more readily modified in the future rather than the ESD, should the sampling frequency require further changes.	The Army agrees that the LTMP is more readily modified than the ESD; however, a legal driver is needed in order to appropriate funding for this level of effort increase.
Elisabeth Green, MDE FFD Remedial Project Manager	Specific Comment 2	Figures 4-2 and 4-3	These figures depict all well locations present at the site using the same symbol. Only a portion of these wells were sampled in 2010. Please change the symbols such that it is clear which wells were and were not sampled in 2010.	Symbols will be added to monitoring wells (MW) locations on Figures 4-2 and 4-3 that clearly indicate they were sampled as part of the 2010 LTM program. MW location symbols on Figure 4-2 and 4-3 will be revised to agree with the MW location symbols on Figure 4-1.
Elisabeth Green, MDE FFD Remedial Project Manager	Specific Comment 3	Table 5-1, Page 5-4	This table proposes measuring alkalinity for every well sampled except CFD-3S. Please discuss in the text why the Army proposes not measuring alkalinity in this well.	MW CFD-3S will be sampled for alkalinity. The check mark indicating this analysis was inadvertently omitted.
Elisabeth Green, MDE FFD Remedial Project Manager	Specific Comment 4	Page 2-4, §2.2.3, 1st ¶	Appendix E, Table E-6 through E-ll These charts show metal detections (arsenic, chromium, etc.) from 6 wells over 5 different sampling events. These charts would be easier to read if the sampling events (2002,2004, etc.) were displayed on the x-axes, and different data series represented different monitoring wells. As the data are currently presented, it is impossible to observe temporal trends in metal concentrations.	Comment noted. Tables E-6 through E-11 will be reformatted with the x-axis representing the sampling events in order to better show trend analysies.
U.S. Environmental Protection Agency Region III, Feb 24, 2011				
John Burchette, EPA Region III Remedial Project Manager	General Comment 1	--	I agree with the recommendations.	Comment noted.
John Burchette, EPA Region III Remedial Project Manager	Specific Comment 1	Page ES-3	"The elevated arsenic in groundwater at CFD-5 potentially could discharge into surface water at the Little Pax. River." This is currently a data gap and data should be collected to confirm or deny this notion.	Bullet No. 6 on Page E-3 states that an upgradient and downgradient sample will be collected from the Little Pax River adjacent to CFD-5 and analyzed for RCRA metals to determine whether site-related metals are migrating off-site.
EPA Region III Hyrdogeologist	General Comment 1		The recommendations are acceptable.	Comment noted.
EPA Region III Hyrdogeologist	General Comment 1		Install a new monitoring well: This well is to be installed for vertical delineation of contamination. Please clarify whether the proposed location is within or to the west of the "Uncontrolled waste site." It would be beneficial to have another well to the west as well as the south (most down-gradient).	The proposed MW will be installed downgradient from WP-2 to better determine the horizontal and vertical extent of the PCE contamination detected at CFD-3S. Additionally, all of the existing shallow wells will be sampled to obtain a real-time current condition of the site. Additional MWs may be warranted based upon the results from the 2011 sampling event.

Fort Meade Leagacy BRAC Responses to Regulator Comments
Draft Regulator Review Long-Term Monitoring Report, Clean Fill Dump Area; Sampling Conducted September 2010
Report dated February 2011

Initial Comments				
Commenter / ORG	**Comment Number**	**Comment Origin**	**Comment**	**Fort Meade Legacy BRAC Program Response**
EPA Region III Hyrdogeologist	Specific Comment 1	Page 4-15	"WP-6 contains….VOCs were not detected, demonstrating that the organic contaminants are not migrating to the southeast off the property." This statement is generally true however, as mentioned above, an additional well on the southern tip of the Uncontrolled Waste Site may be beneficial to verify this claim as well as represent the most down-gradient point.	MW CFD-5 represents the southern most downgradient monitoring point; however, additional well(s) may be warranted based upon the 2011 sampling event. See response to EPA Region III General Comment 1.

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