

**UNITED STATES ARMY CORPS OF ENGINEERS, BALTIMORE DISTRICT**

10 South Howard Street • Baltimore, Maryland 21201

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**Final  
Fort George G. Meade  
Off-Post Well Investigation Interim  
Measures Report**

September 2011

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## Acronyms

<b>Acronym</b>	<b>Definition</b>
µg/L	micrograms per liter
AACDH	Anne Arundel County Department of Health
Agreement	Agreement for Provision of Bottled Water
bgs	below ground surface
CCl <sub>4</sub>	Carbon Tetrachloride
COC	Contaminant of Concern
CSL	Closed Sanitary Landfill
DCE	cis-1,2-Dichloroethene
EDR	Environmental Data Resources, Inc.
FGGM	Fort George G. Meade
IDW	Investigation-Derived Waste
ITRC	Interstate Technology Regulatory Council
MCL	Maximum Contaminant Level
MDE	Maryland Department of the Environment
MW	Monitoring Well
ND	not detected
NELAC	National Environmental Laboratory Accreditation Conference
PAO	Public Affairs Office
PCE	Tetrachloroethene
ppb	Parts per billion
RAB	Restoration Advisory Board
RI	Remedial Investigation
ROE	Right of Entry
TCE	Trichloroethene
U.S.	United States
USACE	United States Army Corps of Engineers
USACHPPM	United States Army Center for Health Promotion and Preventative Medicine
USAIPH	United States Army Institute of Public Health
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WWTP	Wastewater Treatment Plant

# Executive Summary

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This Fort George G. Meade (FGGM) Off-Post Well Investigation Interim Measures Report has been prepared on behalf of the United States (U.S.) Army under the Federal Facilities Agreement (United States Environmental Protection Agency [USEPA], et al, 2009). The scope for this project was based on the Interim Measure Required letter from the USEPA to FGGM dated 29 January 2009 (Appendix A).

This FGGM Off-Post Well Investigation Interim Measures Report presents the results of the U.S. Army's actions to determine if private wells within a one-mile radius of monitoring wells (MW) MW-125d and MW-126d have been contaminated by volatile organic compounds (VOCs) that may have originated at FGGM, and to determine the risk to human health, if any, presented by VOCs intruding into indoor air.

In November 2008, the U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM; now the U.S. Army Institute of Public Health [USAIPH]) redeveloped and re-sampled the two existing monitoring wells, MW-125d and MW-126d. The results of this sampling event showed that concentrations of Carbon Tetrachloride (CCl<sub>4</sub>) from MW-125d and CCl<sub>4</sub>, trichloroethene (TCE), and tetrachloroethene (PCE) from MW-126d increased from the 2007 levels and remained above their respective maximum contaminant levels (MCL). On 29 January 2009, the USEPA issued FGGM an Interim Measure Required letter requiring FGGM to implement interim measures to “determine the magnitude of any risk that may be presented by the contaminants in the water” to residents within one mile of MW-125d and MW-126d from “consumption, inhalation, contact with well water, and by vapor intrusion.” CCl<sub>4</sub>, TCE, and PCE were the only VOCs detected above their respective MCL; and therefore, are the contaminants of concern for this Interim Measures Report.

The study area was initially determined to be all properties within a one-mile radius of MW-125d and MW-126d. During the private well survey, properties on Gambrills Road, Hammond Lane, and Old Dairy Farm Road were identified as having private drinking water wells. These wells are located down-gradient of MW-125d/123s and MW-126d/124s but outside the one-mile radius. Due to public request and the down-gradient proximity, these properties were added to the study, despite being outside of the initial one-mile study radius.

Groundwater samples were collected from the four existing monitoring wells (MW-125d/123s and MW-126d/124s) on 16 April 2009 and 18 June 2009. Samples collected from both MW-125d and MW-126d had concentrations of CCl<sub>4</sub> above the MCL. Chloroform is a typical disinfection by-product commonly produced during the chlorination of water and wastewater; however, it can also be a primary breakdown

product of  $CC_4$ . Chloroform was detected in both MW-125d and MW-126 in June 2009; however, the concentrations were well below MCLs.

Samples collected from MW-126d also exceeded MCLs for PCE and TCE. Cis-1,2-dichloroethene (DCE), a breakdown product of TCE, was detected in MW-126 but did not exceed the MCL. Samples collected from MW-125d had an estimated value of PCE in April 2009, but was Not Detected (ND) at or above the reporting detection limit in June 2009. All of the contamination was limited to the deep wells (220 to 250 feet bgs) located in the Lower Patapsco Aquifer. According to well data provided by Anne Arundel County Department of Health (AACDH), most private drinking water wells in the area are also screened in the Lower Patapsco Aquifer.

A private well survey was conducted within a one-mile radius of monitoring wells MW-125d and MW-126d to determine the presence of drinking water wells. A letter was sent to all residents and property owners identified within the study area, notifying them of the groundwater impact in the monitoring wells and related private well surveying activities that were planned. Two public meetings were conducted to explain field activities and answer questions from the public.

A door-to-door survey was conducted from 29 April 2009 to 31 July 2009 for the owners/tenants within the survey area. During the survey, at least three attempts were made to interview the owners/tenants by ARCADIS/Malcolm Pirnie in coordination with USEPA, FGGM, AACDH, and Maryland Department of Environment (MDE). Out of 2708 properties identified, 1891 surveys were answered. Seventy-five private drinking water wells were identified during this survey as being a primary drinking water source.

Based on the results of the private well survey, 75 wells were confirmed as a primary drinking water source. This number includes the properties added to the study area, including the Gambrills Road, Hammond Lane, and Old Dairy Farm Road. While 75 wells confirmed as a primary drinking water source were identified, permission from their owners was granted to sample only 59 of these wells. This is due to either residents/tenants being unresponsive to the surveys, unresponsive to attempts to schedule sampling, or declining sampling outright.

Private drinking water well sampling was conducted between 5 June 2009 and 31 August 2010. Drinking water samples were collected from each of the 59 private wells. Each private drinking water well was sampled two times within a two-month period, with the exception of two wells that were only sampled once, per the owners' requests. During Round 1, 1,1,1-trichloroethane (estimated value),  $CCl_4$ , chloroform, DCE, methylene chloride (estimated value), PCE, TCE, and vinyl chloride (estimated value) were detected above reporting limits. However, none of these detections exceeded the USEPA MCL for their respective contaminant.

Fifty-seven wells were sampled during Round 2 (two residences refused to have their wells sampled a second time). During Round 2, 1,2-dichloroethane (estimated value),

CCl<sub>4</sub> (estimated value), chloroform, DCE, PCE, and TCE were detected above reporting limits. One sample collected from a property, on Nevada Avenue, exceeded the USEPA MCL for PCE, with a detected concentration of 5.7 micrograms per liter (µg/L). The MCL of PCE is 5 µg/L. Two other properties on Nevada Avenue had concentrations of PCE near its MCL, with concentrations of 4.5 µg/L and 3.2 µg/L, respectively.

Bottled water is currently being provided to property residents/tenants who have a private well as their primary source of drinking water, as determined by the private well survey. Forty-four of the seventy-five eligible residents/tenants signed this form; the remaining residents/tenants were either unresponsive or declined. Bottled will continue until plume delineation being conducted in a separate investigation program is complete.

With the exception of the Nevada Avenue properties, none of the other properties within the study areas had detections of CCl<sub>4</sub>, TCE, or PCE (or any other VOCs) at or near the MCL. Therefore, the findings of this study demonstrate that none of the private wells located down-gradient of MW-125d and MW-126d was determined to have been impacted by the contaminant of concern (COC). Additionally, the vapor intrusion exposure pathway for these COCs was determined to be incomplete. Based on these findings, no risk to the public from these COCs was identified; therefore, the study is complete. No further action is recommended for these properties, and bottled water delivery should be ceased once the plume associated with the groundwater impact observed at MW-125d and MW-126d is fully delineated.

Due to levels of PCE detected at or near the MCL at three properties on Nevada Avenue, it is recommended that monthly monitoring continue at these properties until the separate investigation is complete. A Final Restoration Advisory Board meeting will be held at the close of that project.

It is recommended that the on-going investigation of the Lower Patapsco Aquifer continue to determine source of the elevated VOC concentrations found at MW-125d and MW-126d. These wells should also be re-sampled to determine if concentrations are rising or falling. Impacts to residents on well water will be considered as future investigations progress; a definitive recommendation will be made at that time.

# 1. Introduction

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This Fort George G. Meade (FGGM) Off-Post Well Investigation Interim Measures Report has been prepared on behalf of the United States (U.S.) Army under the Federal Facilities Agreement (U.S. Environmental Protection Agency [USEPA], et al, 2009). The scope for this project was based on the Interim Measures Required letter from the USEPA to FGGM dated 29 January 2009 (Appendix A).

This FGGM Off-Post Well Investigation Interim Measures Report presents the results of the U.S. Army's actions to determine if private wells within a one-mile radius of monitoring wells (MW) MW-125d and MW-126d have been contaminated by volatile organic compounds (VOCs) that may have originated at FGGM, and to determine the risk to human health, if any, presented by VOCs intruding into indoor air.

## 1.1. Background

As part of the semiannual monitoring effort at the Closed Sanitary Landfill (CSL) Installation Restoration Program site at FGGM, four groundwater monitoring wells (identified as MW-123s, -124s, -125d, and -126d) were installed in 2003 outside the southeastern border of the installation on the east edge of North Patuxent Road (URS, 2007). These wells comprise two groups of deep and shallow well clusters (MW-125d/123s and MW-126d/124s) which were initially sampled in June 2004. The deep monitoring wells (MW-125d and MW-126d) were also sampled in March 2005. Upon completion of the CSL Remedial Investigation (RI) in 2007, tetrachloroethene (PCE), trichloroethene (TCE), and carbon tetrachloride (CCl<sub>4</sub>) were recognized as contaminants of concern within the Lower Patapsco Aquifer due to detections at elevated levels. Beginning in 2004, concentrations of CCl<sub>4</sub> and PCE in MW-125d and MW-126d were detected above their respective Federal Maximum Contaminant Levels (MCLs), but TCE was detected below its MCL. These constituents have not been detected in MW-123s and MW-124s to date. Details of the RI activities and findings, including the purpose, dates of investigation, results, and conclusions, are presented in the August 2007 report *Final FGGM Closed Sanitary Landfill Groundwater RI* (EM, 2007).

Anne Arundel County Department of Health (AACDH) had previously identified residential wells proximal to MW-125d and MW-126d and began sampling some of these wells in 2005 and on an annual basis since that time. Not all residential wells were sampled, as not all the home owners agreed to have their water sampled. Since 2005, there have been no VOCs detected at concentrations exceeding their Federal MCLs in the residential wells sampled by the AACDH. Copper and lead have been detected above

their respective MCL in four and seven homes, respectively, sampled by the AACDH; however, this is believed to be a result of the plumbing in the homes.

In November 2008, the U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM; now the U.S. Army Institute of Public Health [USAIPH]) redeveloped and re-sampled the two existing monitoring wells, MW-125d and MW-126d independent of the CSL monitoring effort (USACHPPM, 2008). Upon receipt of the validated data, the Army conferred with AACDH, the Maryland Department of Environment (MDE), and USEPA on 22 January 2009. The validated data and the Army's general approach to complying with the Administrative Order from USEPA was presented to Restoration Advisory Board (RAB) members and other stakeholders including USEPA, AACDH, and MDE at the 22 January 2009 RAB meeting. The results of this sampling event showed that concentrations of CCl<sub>4</sub> from MW-125d and CCl<sub>4</sub>, TCE, and PCE from MW-126d increased from the 2007 levels and remained above their respective MCLs. On 29 January 2009, the USEPA issued FGGM an Interim Measure Required letter. In this letter, the USEPA required FGGM to implement interim measures to “determine the magnitude of any risk that may be presented by the contaminants in the water” to residents within one mile of MW-125d and MW-126d from “consumption, inhalation, contact with well water, and by vapor intrusion.” CCl<sub>4</sub>, TCE, and PCE were the only VOCs detected above their respective MCL; and therefore, are the contaminants of concern for this Interim Measure.

The study area was initially determined to be all properties within a one-mile radius of MW-125d and MW-126d, as shown in Figure 1-1. During the private well survey, properties on Gambrills Road, Hammond Lane, and Old Dairy Farm Road were identified as having private drinking water wells. These wells are located down-gradient of MW-125d/123s and MW-126d/124s but outside the one-mile radius, as shown in Figure 1-2. Due to public request and the down-gradient proximity, these properties were added to the study, despite being outside of the initial one-mile study radius.

A Final Interim Measures Work Plan was prepared and submitted in March 2009.

## 1.2. Report Organization

This Interim Measures Report is outlined as follows:

- Section 1: Introduction
- Section 2: Regional Geology and Hydrogeology
- Section 3: Public Involvement
- Section 4: Monitoring Well Sampling
- Section 5: Private Well Survey
- Section 6: Private Well Sampling
- Section 7: Bottled Water
- Section 8: Vapor Intrusion Assessment
- Section 9: Deviations from Work Plan
- Section 10: Conclusions and Recommendations
- Section 11: References

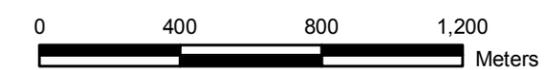
Fort George G. Meade  
Off-Post Well Investigation Interim  
Measures Report



Figure 1-1  
Study Area Features

Legend

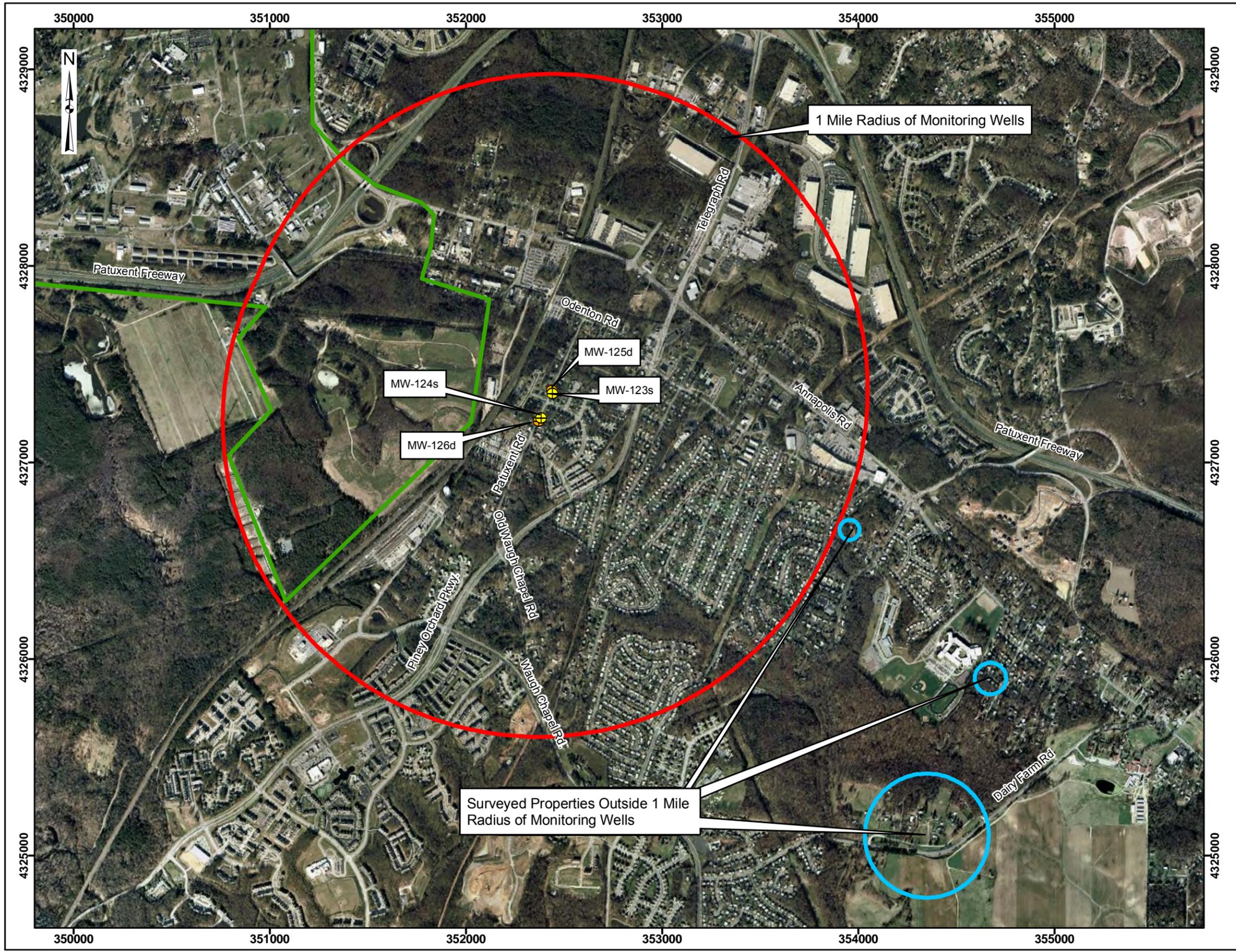
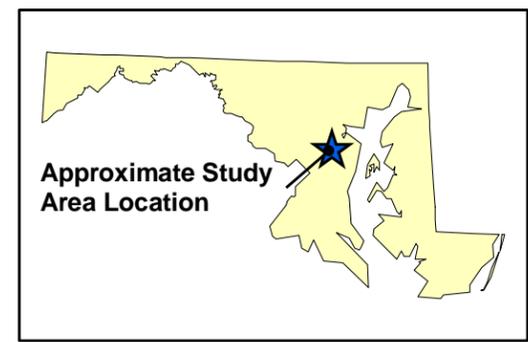
- Installation Boundary
- Deep Monitoring Well
- Shallow Monitoring Well
- 1-Mile Radius of Monitoring Wells
- Surveyed Properties Outside 1-Mile Radius



Data Sources: ESRI, World Imagery, 2003  
FGGM, GIS Data, 2005

Coordinate System: UTM Zone 18  
Datum: NAD 1983  
Units: Meters

Edition: Draft Final  
Date: July 2011



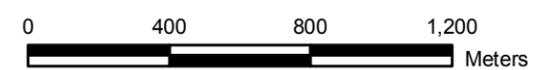
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**Figure 1-2  
Groundwater Flow Direction**

**Legend**

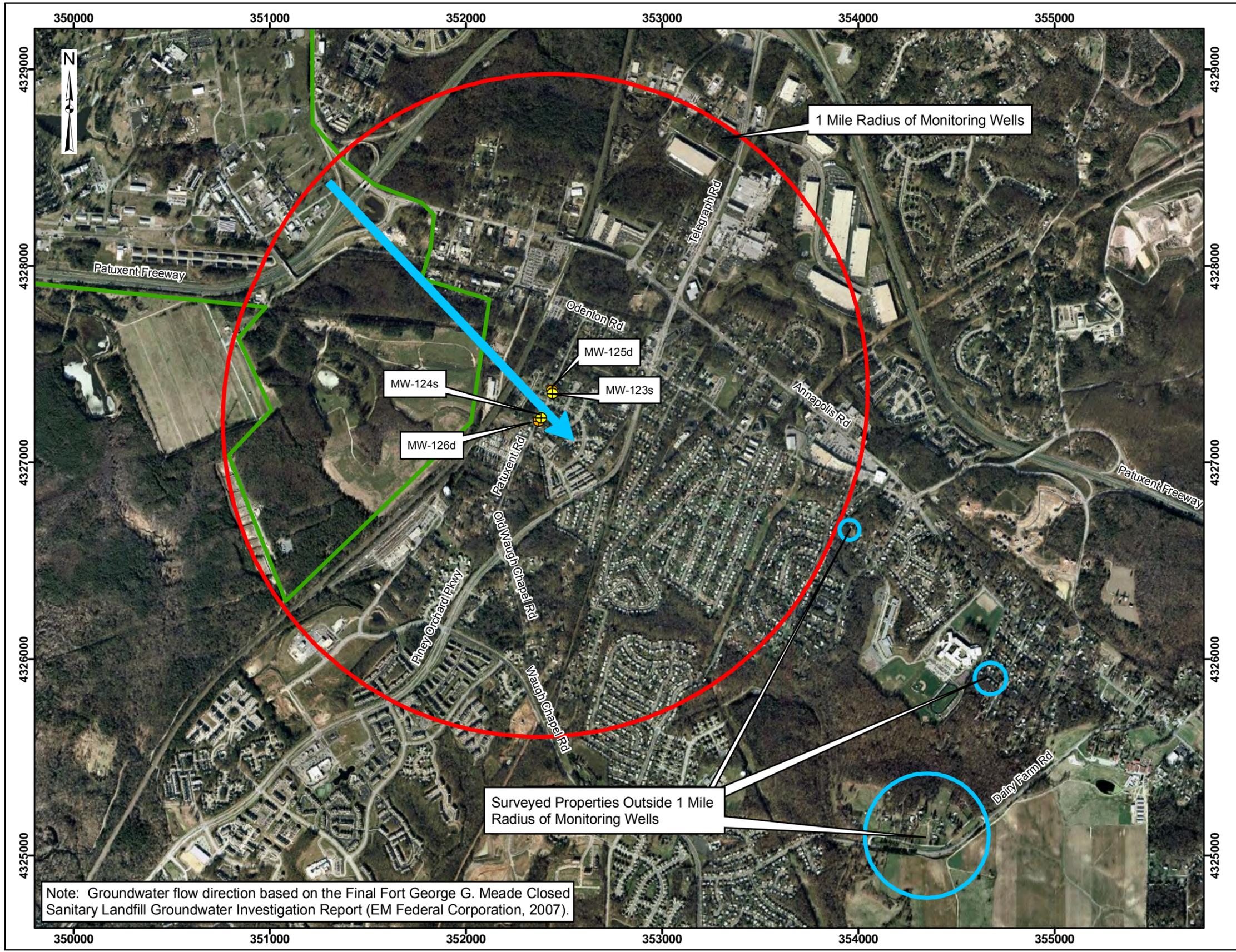
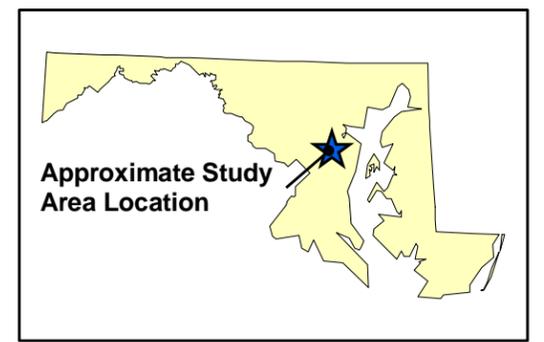
- Installation Boundary
- Deep Monitoring Well
- Shallow Monitoring Well
- 1-Mile Radius of Monitoring Wells
- Surveyed Properties Outside 1-Mile Radius
- Approximate Groundwater Flow Direction



Data Sources: ESRI, World Imagery, 2003  
FGGM, GIS Data, 2005

Coordinate System: UTM Zone 18  
Datum: NAD 1983  
Units: Meters

Edition: Draft Final  
Date: July 2011



Note: Groundwater flow direction based on the Final Fort George G. Meade Closed Sanitary Landfill Groundwater Investigation Report (EM Federal Corporation, 2007).

# Regional Geology and Hydrology

## 2.1. Regional Geology

The study area to the south and east of FGGM is located on the unconsolidated sands, clays, and silts of the Coastal Plain Physiographic Province, which were deposited from the Cretaceous to the Quaternary geologic periods (see Figure 2-1). The Coastal Plain sediments begin at the Fall Line, where they overlie the bedrock of the Piedmont physiographic province, and dip and thicken to the east and southeast. Unconsolidated deposits present at FGGM are from the lower Cretaceous age Potomac Group. This Group consists of, from youngest to oldest, the Patapsco Formation, Arundel Clay, and Patuxent Formation, which have a maximum total thickness of approximately 600 feet at FGGM. The formations were formed as fluvial and lacustrine deposits and consist of interbedded sand, silt, and clay layers. Because these formations dip toward the east, they are progressively exposed at the surface across FGGM and its surrounding areas (EM, 2007).

The Army is currently completing broader remedial investigations and developing a more robust regional conceptual site model for the area surrounding FGGM.

## 2.2. Soil Types

FGGM soils were originally covered with hardwood forests (see Figure 2-2). However, due to development on the installation and the slow successional rates of more excessively drained uplands, they currently support a limited hardwood and conifer cover. The general soil types found in the FGGM vicinity belong to two major associations. Most of the area is comprised of the loamy and clayey land of the Muirkirk-Evesboro soil association, and remaining soils are of the Evesboro-Rumford-Sassafras association (EM, 2007). These soil types are discussed below.

- **Muirkirk-Evesboro:** These soils are primarily located within the Base Realignment and Closure parcel and comprise undeveloped forest land and some portions of the developed section. These soils are loamy and clayey, underlain by an unstable clay of low permeability. This association primarily supports a mixture of pine and hardwood vegetation.
- **Evesboro-Rumford-Sassafras:** These soils are found in the northern part of FGGM, where heavy development has taken place. These soils usually have an unstable and slowly drained substratum that seasonally enhances a high water table. The Evesboro series is characterized by coarse, loose, and drought soils with a clayey substratum of low permeability; the Rumford series is composed of loose loamy soils with a sandy loamy subsoil; and the Sassafras series consists of fine sandy loamy material overlain on sandy clayey loamy subsoil.

Soils in the study area to the south of the eastern boundary of FGGM are comprised of three major soil associations (EDR, 2009b). These are discussed below:

- **Alloway:** This soil is located within the study properties on Nevada Avenue and in the wooded area to the north of the study properties. This soil is classified as a silt loam with slow infiltration rates and fine grain textures.
- **Russett:** This soil is located east and west of the study properties on Nevada Avenue and north of FGGM. This soil is classified as a fine sandy loam with slow infiltration rates and fine grain textures.
- **Patapsco:** This soil is located south of the study properties on Nevada Avenue. This soil is classified as sand with high infiltration rates. The soils are well to excessively well drained sands and gravels.

### 2.2.1. Quaternary Deposits

Quaternary alluvium and river terrace deposits are present in the vicinity of the Patuxent and Little Patuxent Rivers and their tributaries. The alluvium consists of interbedded sand and gravel with some silt, clay, and organic matter. These heterogeneous sediments underlie the river flood plains and may be present at thicknesses of up to 15 feet adjacent to the rivers (EM, 2007).

### 2.2.2. The Patapsco Formation

The Patapsco Formation is divided into an upper, middle, and lower section. On- and off-site drilling logs of the upper section of the Patapsco Formation show the area consists of mottled, medium-fine to silty sand, is present only at the extreme eastern portion of the facility and adjacent areas to the north and east.

The middle section of the Patapsco Formation is thick, hard, highly plastic, mottled clay. A transitional zone of alternating silty sands and silty clays is often observed between the middle and lower sections of the Patapsco Formation.

The lower section of the Patapsco Formation typically consists of silty sands that grades downward into coarser sands with silt. Colors observed in this layer include pale to dark yellowish orange, dark brown, and dark yellow (EM, 2007).

### 2.2.3. The Arundel Formation

The Arundel Formation is located between the Patapsco and Patuxent Formations. This formation consists of massive beds of red, brown and gray clay with more permeable layers in some areas. The Arundel Formation acts as a regional confining layer between the Lower Patapsco and Patuxent aquifers and is characterized by low vertical permeability (EM, 2007).

### 2.2.4. The Patuxent Formation

The Patuxent Formation, located below the Arundel Formation, is the oldest of the unconsolidated deposits and is composed of sand and gravel with some silty clay and clay. This formation overlies bedrock and crops out between the western boundary of

FGGM and the Fall Line. The Patuxent Formation, like the rest of the unconsolidated deposits of the coastal plain, slopes to the east or southeast. In the Tipton area, the top of the Patuxent Formation is located approximately 300 feet below ground surface (bgs) (EM, 2007).

### **2.2.5. Bedrock**

The Patuxent Formation is underlain at FGGM by crystalline bedrock of the Piedmont Province. The bedrock, which is probably part of the Baltimore Mafic Complex, is Precambrian to early Cambrian in age and consists of metavolcanic rocks including amphibolite, schist, and serpentinite. Depths to bedrock on the eastern side of FGGM range from approximately 600 to 800 feet bgs (EM, 2007).

## **2.3. Regional Hydrogeology**

Groundwater availability in the Coastal Plain sediments is generally good, with three separate and distinct aquifers: the Upper Patapsco, the Lower Patapsco, and the Patuxent. The Arundel Formation and the middle confining layer of the Patapsco Formation act as confining layers separating each of the aquifers. The aquifers are confined on a regional scale but locally act as water table aquifers in areas where they crop out at the surface.

The regional groundwater flow is to the southeast, generally following the structural dip, as shown in Figure 1-2. However, due to small variations in the surface relief, stratigraphy, and recharge/discharge zones, local flow in the upper hydrostratigraphic unit, which generally mirrors the topography, can be to the east, south, or west. Although flow direction will vary with seasonal fluctuations in the water table, local shallow groundwater flow is controlled by the Patuxent River and Little Patuxent River watersheds (EM, 2007).

In the study area, the water table aquifer (Upper Patapsco Aquifer) is generally encountered around 20 feet bgs. The groundwater flow in this aquifer is influenced primarily by local topography and therefore multiple directions of shallow flow exist within the study area. The Lower Patapsco Aquifer is separated from the upper aquifer by the Middle Patapsco clay sequences. Water level data from well pairs screened in the two aquifers suggest that the two units are hydraulically separated and that there is a strong downward gradient in the Lower Patapsco Aquifer.

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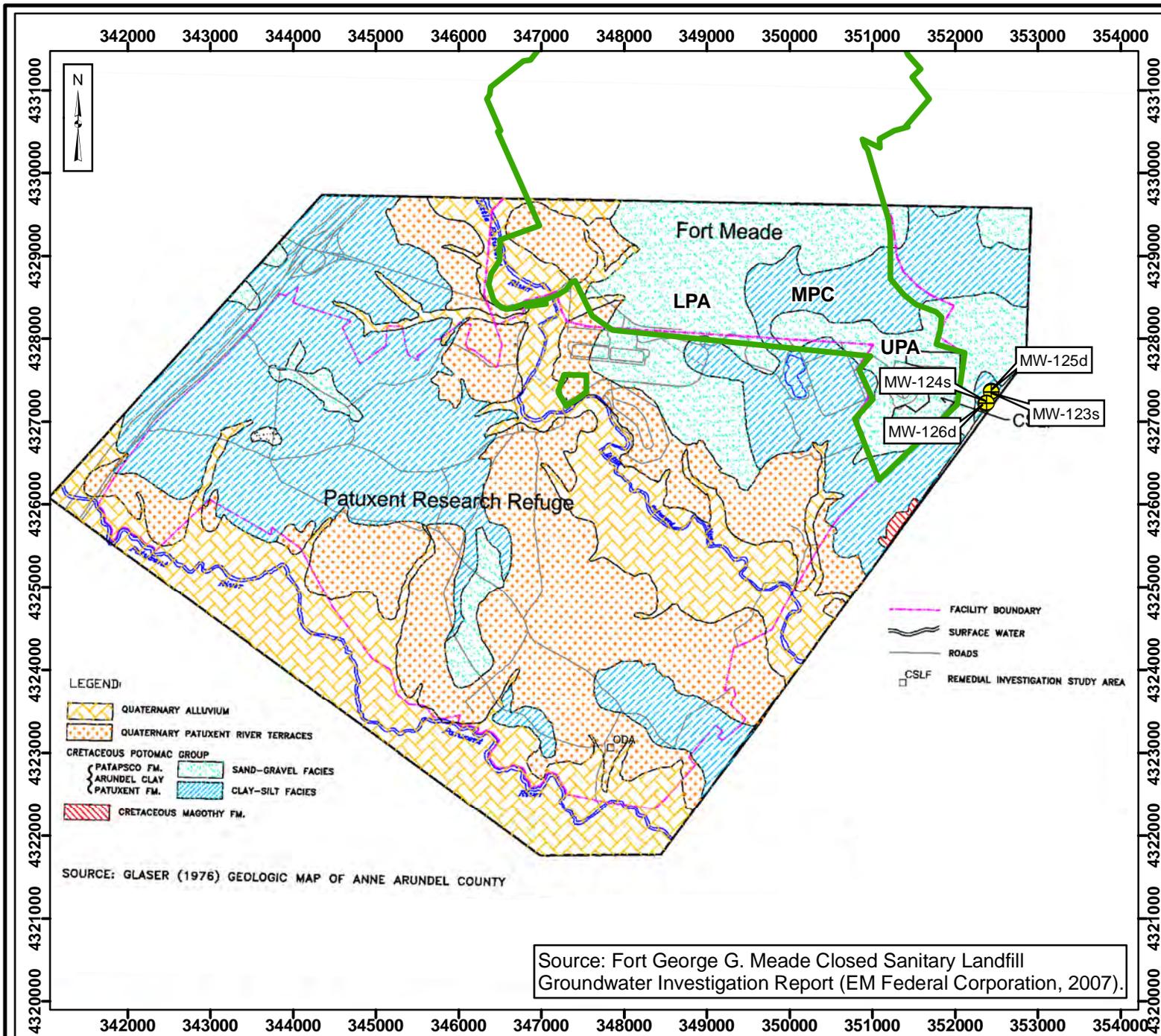


**Figure 2-1  
Geologic Map of  
Fort Meade Area**

**Legend**

- Installation Boundary
- Deep Monitoring Well
- Shallow Monitoring Well

LPA = Lower Patapsco Aquifer  
MPC - Middle Patapsco Clay  
UPA = Upper Patapsco Aquifer



**LEGEND:**

- QUATERNARY ALLUVIUM
- QUATERNARY PATUXENT RIVER TERRACES
- CRETACEOUS POTOMAC GROUP**
  - PATAPSCO FM. SAND-GRAVEL FACIES
  - ARUNDEL CLAY CLAY-SILT FACIES
  - PATUXENT FM. SAND-GRAVEL FACIES
  - PATUXENT FM. CLAY-SILT FACIES
- CRETACEOUS MAGOTHY FM.

SOURCE: GLASER (1976) GEOLOGIC MAP OF ANNE ARUNDEL COUNTY

- FACILITY BOUNDARY
- SURFACE WATER
- ROADS
- CSLF REMEDIAL INVESTIGATION STUDY AREA

0 1,000 2,000  
Meters

Source: Fort George G. Meade Closed Sanitary Landfill  
Groundwater Investigation Report (EM Federal Corporation, 2007).

Data Sources: FGGM, GIS Data, 2005

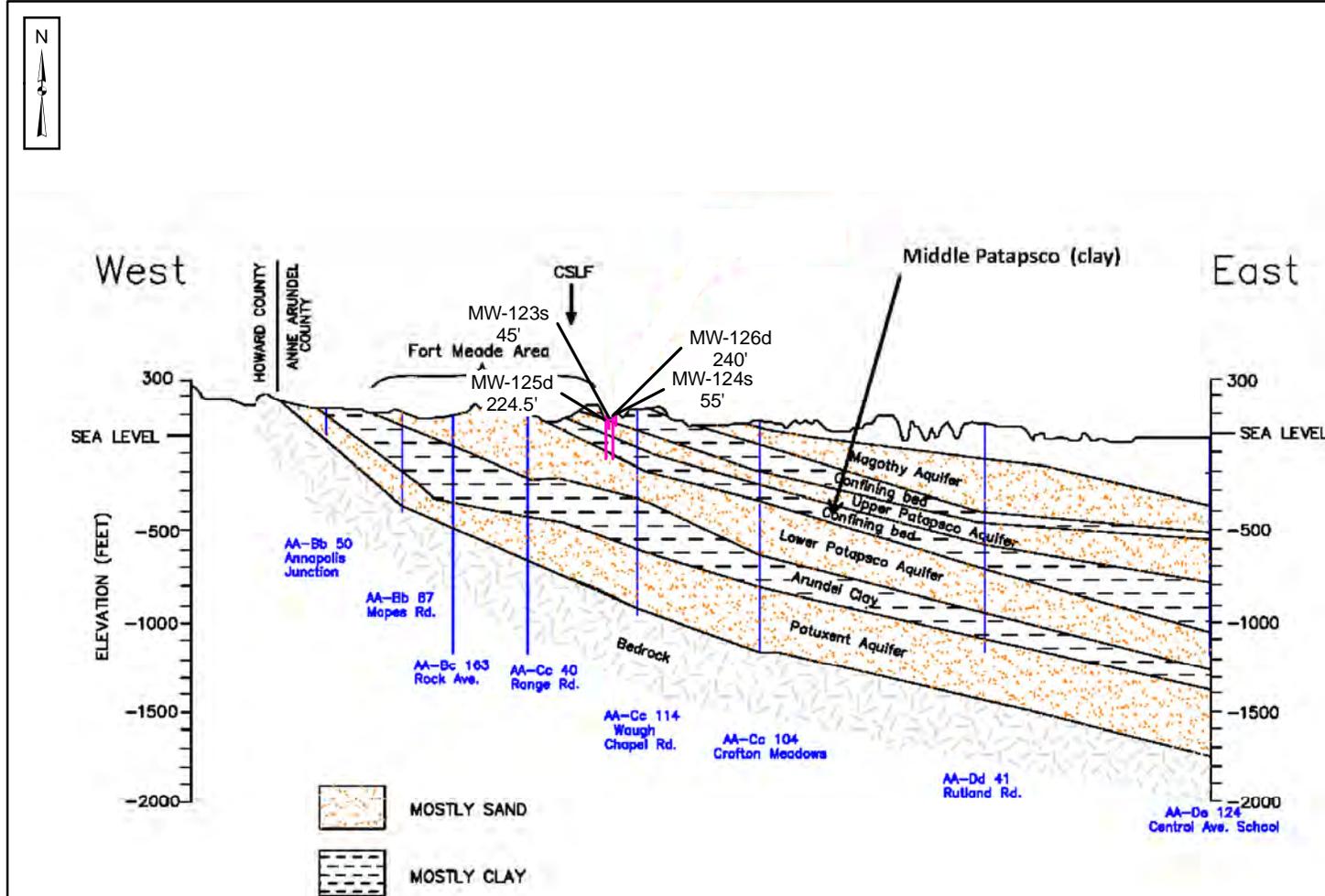
Coordinate System: UTM Zone 18  
Datum: NAD 1983  
Units: Meters

Date: July 2011

Fort George G. Meade  
Off-Post Well Investigation  
Interim Measures Report



Figure 2-2  
Generalized Geologic  
Cross Section across  
Anne Arundel County



Source: Fort George G. Meade Closed Sanitary Landfill  
Groundwater Investigation Report (EM Federal Corporation, 2007).

Coordinate System: UTM Zone 18  
Datum: NAD 1983  
Units: Meters

Date: July 2011

## 3. Public Involvement

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As this project involves public safety concerns and environmental contamination, a proactive program of public involvement was developed to disseminate information to the public and gather public input and comment on the study implementation. All community involvement was coordinated with United States Army Corps of Engineers (USACE), Baltimore District's Public Affairs Office (PAO), FGGM Environmental Division, and FGGM PAO. In collaboration with the Army, public outreach activities were conducted to inform the public of the impacted groundwater and provide information on the potential exposure hazards associated with CCl<sub>4</sub>, TCE, and PCE and related compounds. Community outreach for the interim measure study included correspondence to residents/property owners (via face to face meetings, telephone calls, letters, and fact sheets), public meetings, RAB meetings, establishment of a public hotline, and contact with residents/property owners. All public involvement was conducted in accordance with the March 2009 Work Plan.

### 3.1. Letter to Residents

One week prior to conducting the private well survey, a letter was sent to all residents and property owners identified within the study area, notifying them of the groundwater impact in the monitoring wells and related private well surveying activities that were planned. Attached to the letter was a general fact sheet providing the recipients with more details on the survey, as well as contact information should they have any questions. The letter to residents is discussed in Section 5.1 and is provided in Appendix B.

### 3.2. Public Meetings

Two public meetings were conducted (one at the beginning of the project and one after the majority of fieldwork was completed) to provide a forum to share the current information at that time, outline the plan to obtain additional information needed to determine if anyone is at risk from potential exposure to the identified groundwater contamination, and answer questions from the public. A sign language interpreter was available at both of these public meetings.

The first public meeting, held on 20 April 2009, was intended to inform the public of the impacted groundwater and provide information on the potential exposure hazards associated with CCl<sub>4</sub>, TCE, and PCE, as well as to identify the overall strategy to ensure public safety. This meeting laid the foundation for future discussions and interactions with the community. The first public meeting was conducted prior to commencing the external aspects of the private well survey to ensure the residents/property owners were informed prior to receiving the survey notification letters.

The second public meeting was held on 17 November 2009, after the completion of a majority of the private well sampling. A letter was sent to residents announcing the meeting on 10 November 2009. The meeting provided stakeholders, including the public, an opportunity to directly express concerns to the USEPA, Army representatives, AACDH, and MDE. The meeting was also a forum to ask questions or make comments on the results of the interim measures activities, including results of the groundwater sampling and groundwater use survey. The steps taken to mitigate potential exposure to VOCs in the groundwater were also presented at the public meeting.

### **3.3. Restoration Advisory Board Meetings**

FGGM RAB meetings are held at FGGM every other month. Updates on the interim measures activities were presented at the RAB meetings beginning on 26 March 2009. ARCADIS/Malcolm Pirnie assisted FGGM in the preparation and presentation of materials explaining the activities and the progress of the FGGM Off-Post Well Investigation Interim Measures. FGGM Off-Post Well Investigation Interim Measures RAB meeting presentations are ongoing and will continue every other month until resolution has been achieved. These presentations are available to the public on FGGM's Environmental Management System website ([www.fortmeade-ems.org](http://www.fortmeade-ems.org)).

### **3.4. Hotline**

A telephone "hotline" was established so residents/property owners could call with any questions and also provide their well survey information over the phone. This phone number along with contact information for USEPA, FGGM, AACDH, and MDE were provided in the investigation fact sheet.

### **3.5. Communication with Residents**

If the initial attempts at contacting residents believed to have a private drinking water well (based on data provided by AACDH) were unsuccessful, additional attempts were made. These attempts included additional visits in person and calling the resident with a listed phone number or a number provided by a neighbor. Also, in January 2010, representatives from ARCADIS/Malcolm Pirnie, USEPA, FGGM, and translators visited residences believed to have a private drinking water well as a last effort to include them in the study. Certified letters were sent to the remaining residents in June 2010 requesting their response and participation in the sampling program, if appropriate.

Private drinking water well owners, identified within the investigation area during the private well survey, were contacted to request permission to sample their wells for the Contaminant of Concern (COCs) (i.e., PCE, TCE, and CCl<sub>4</sub>). For those owners agreeing to participate in the sampling, a right of entry (ROE) was executed to enter their property to collect the samples. Following review and validation of the analytical data, the analytical results were provided in a summary letter to each owner and resident/tenant where samples were collected.

## 4. Monitoring Well Sampling

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### 4.1. Sample Collection Activities

Groundwater samples were collected from the four existing monitoring wells (MW-125d/123s and MW-126d/124s) on 16 April 2009 and 18 June 2009. The monitoring wells were redeveloped prior to the first event, and water level measurements were collected during both events, in accordance with the Work Plan and Field Sampling Plan approved by USEPA and MDE.

The collected groundwater samples were analyzed for VOCs using USEPA method SW846/8260. All data analyses were completed by Analytical Laboratory Services, Inc., a National Environmental Laboratory Accreditation Conference (NELAC) accredited laboratory, with a five-business-day turnaround time. A third-party data quality review and USEPA Region III Level M3 data validation was conducted for all collected samples, with the exception of some samples that were validated using USEPA Region III Level M2 (see Section 9 for an explanation). Subcontractor Laboratory Data Consultants provided data validation of the samples within five business days of receipt. All laboratory analytical reports and data validation reports are provided in Appendix C.

### 4.2. Monitoring Well Sampling Results

The laboratory and validated data regarding groundwater samples collected from MW-125d and -126d are included in Appendix C. As summarized in Table 4-1, samples collected from both MW-125d and MW-126d had concentrations of CCl<sub>4</sub> above the MCL. Chloroform is a typical disinfection by-product commonly produced during the chlorination of water and wastewater; however, it can also be a primary breakdown product of CCl<sub>4</sub>. Chloroform was detected in both MW-125d and MW-126 in June 2009; however, the concentrations were well below MCLs.

Samples collected from MW-126d also exceeded MCLs for PCE and TCE. Cis-1,2-dichloroethene (DCE), a breakdown product of TCE, was detected in MW-126 but did not exceed the MCL. Samples collected from MW-125d had an estimated value of 0.66 micrograms per liter (µg/L) for PCE in April 2009, but was Not Detected (ND) at or above the reporting detection limit in June 2009. All of the contamination was limited to the deep wells (220 to 250 feet bgs) located in the Lower Patapsco Aquifer. According to well data provided by AACDH, most private drinking water wells in the area are also screened in the Lower Patapsco Aquifer. Sampling results are provided in Table 4-1.

**Table 4-1: Detections of VOCs in Monitoring Wells-Rounds 1 and 2**

Well No.	Round	Date Collected	Compound Detected / MCL				
			Chloroform (80 µg/L)	CCl <sub>4</sub> (5 µg/L)	DCE (70 µg/L)	PCE (5 µg/L)	TCE (5 µg/L)
MW-123s	1	4/16/09	ND	ND	ND	ND	ND
	2	6/18/09	ND	ND	ND	ND	ND
MW-124s	1	4/16/09	ND	ND	ND	ND	ND
	2	6/18/09	ND	ND	ND	ND	ND
MW-125d	--	2004	--	21.3	--	2.8	0.5
	--	11/7/08	1 J	25	< 0.8	5	1 J
	1	4/16/09	ND	<b>20.3</b>	ND	0.66J	ND
	2	6/18/09	1.0	<b>17.0</b>	ND	ND	ND
MW-126d	--	2004	--	4.1	--	12.4	3.5
	--	11/7/08	2 J	<b>51</b>	3 J	<b>51</b>	<b>16</b>
	1	4/16/09	ND	<b>21.8</b>	0.69J	<b>11.5</b>	4.9
	2	6/18/09	1.6	<b>65.8</b>	2.3	<b>31.4</b>	<b>13.1</b>

Note: Values in parenthesis indicate the associated MCL  
 ND = Not Detected at or above the reporting detection limit  
**BOLD** text indicates constituent detected at concentrations above the MCL  
 µg/L = micrograms per liter  
 'J' qualifier indicates the value is estimated

As stated previously, the COCs have not been detected in MW-123s and MW-124s to date. The concentrations of CCl<sub>4</sub> in MW-125d have been slightly decreasing since the prior two sample events in 2004 and 2008 (21.3 and 25 µg/L, respectively) to 20.3 and 17.0 in April and June 2009, respectively. The concentration of PCE has also decreased from a high of 5 µg/L in 2008 to ND in 2009. TCE concentrations also decreased from a high of 1 µg/L (estimated) in 2008 to ND in 2009.

The reported concentrations of CCl<sub>4</sub> in MW-126d have been erratic, but generally increasing. The concentrations have varied from 4.1 µg/L in 2004 to 51 µg/L in 2008 to 21.8 µg/L in April 2009 to 65.8 µg/L in June 2009. PCE has followed a similar pattern varying from 12.4 µg/L in 2004 to 51 µg/L in 2008 to 11.5 µg/L in April 2009 to 31.4 µg/L in June 2009. TCE concentrations have varied from 3.5 µg/L in 2004 to 16 µg/L in 2008 to 4.9 µg/L in April 2009 to 13.1 µg/L in June 2009.

### 4.3. Investigation-Derived Waste (IDW)

As discussed in the IDW Disposal Summary Letter in Appendix D, nine drums of water were produced as IDW from the off-post monitoring wells and temporarily stored at the FGGM Recycling Center. The FGGM Wastewater Treatment Plant (WWTP) agreed in July 2009 to accept the drums of water and ARCADIS/Malcolm Pirnie could empty these drums at their facility. It was also agreed that seven additional drums of groundwater

from the same off-post monitoring wells that had been sampled and tested by USAIPH in 2008 and stored at the FGGM Recycling Center could be disposed of along with the other nine drums. All 16 drums were properly sealed and labeled in accordance with the March 2009 Work Plan. Transportation and disposal was conducted on 1 September 2009. ARCADIS/Malcolm Pirnie procured polyester felt filter bags with woven handles and manufactured with 200 micron filters to pre-screen any silty fine sand material that settled in the drums before emptying the water at the facility. The filter bags were utilized during the emptying of every drum containing liquid. Then ARCADIS/Malcolm Pirnie personnel uncapped every open-topped drum and the WWTP facility provided a high pressure source of water to rinse each drum of any remaining residue. The drums were then loaded and staged at the pre-determined FGGM Recycling Center location. The labels on the emptied drums were modified to indicate that they were indeed emptied and ready to be properly recycled at the FGGM Recycling facility.

## 5. Private Well Survey

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### 5.1. Private Well Survey Activities

A private well survey was conducted within a one-mile radius of monitoring wells MW-125d and MW-126d in response to groundwater contamination detected in these wells. This survey, primarily to identify the presence of drinking water wells, consisted of the following tasks, in accordance with the March 2009 Interim Measures Work Plan:

- Preliminary information gathering to identify properties potentially containing private wells;
- Public notification of the groundwater impact at MW-125d and MW-126d and the private well survey in the study area; and
- Implementation of the private well survey to confirm properties with private drinking water wells.

#### 5.1.1. Preliminary Investigation

The first task in identifying private wells in the study area was to gather and review existing information in the public record about the potential presence of private wells within the 1-mile radius. The preliminary survey included researching state and county records for property information, well permits, and sampling data. An electronic environmental database search was provided by Environmental Data Resources, Inc. (EDR).

The names and addresses for property owners and residents/tenants within the 1-mile radius were identified in conjunction with the AACDH through the review of tax parcel maps (Maryland Department of Planning, 2009), internet searches, and the Maryland Department of Assessments and Taxation's Real Property Data Search website (State of Maryland, 2009).

##### 5.1.1.1. Anne Arundel County and State of Maryland Well Data

The AACDH had been regularly monitoring 98 wells within the study area (AACDH, 2009). Records date back to 2005 for 13 properties within this study area. There were detections of VOCs, pesticides, and metals within the samples. MDE had been monitoring an additional six wells since 1994 for the same list of compounds with detections (MDE, 1994). MDE was monitoring these wells for VOCs as required by the Oil Control Program in association with an underground storage tank. These 19 properties were specifically identified by AACDH to be included on the mailing list for this project.

### **5.1.1.2. Environmental Data Resources Data**

EDR provided physical settings data including topography, hydrology, hydrogeology, and soil characteristics. To identify nearby drinking water wells, EDR also performed a one-mile radius wells search of local and regional water agency records, which included the United States Geological Survey National Water Inventory System database, the Federal Reporting Data System Public Water Systems database, and the Maryland Public Supply Wells database. The EDR Report is included in Appendix E.

An evaluation of the EDR monitoring well data was used to determine possible sources of VOCs in MW-125d and MW-126d. EDR identified many monitored wells within the one-mile radius of the study site (EDR, 2009b). A number of these wells had at some point had detected concentrations of total trihalomethanes, metals, nitrates, or coliforms above their associated MCLs and given violation notices by the State of Maryland. Starting in 1994, a large number of these violations were given to both FGGM and a trailer park. Some violations were also given to a heavy use industrial site, a water company, and a restaurant during the period of 1994 to 2000. No violations were found for VOCs or within one mile of the Old Dairy Farm Road properties (EDR, 2009c). No site coordinates or site addresses, only the property owner addresses, were provided in the EDR Reports.

### **5.1.2. Public Notification**

As described in Section 3.1, the private well survey effort included notification via mail of all owners and residents/tenants within the survey area. The notification letters (Appendix B) were sent at least one week in advance of the door-to-door survey. The notifications stated the purpose of the survey, provided the schedule for performing the door-to-door survey, and provided information about the scheduled public meeting. Contact information for Army and regulator representatives (including USEPA, AACDH, and MDE) was also provided in the notification letter in order to answer property owners' potential questions. Additional attachments to the notification letter included an investigation fact sheet with information about the investigation, contaminants of concern and the survey form (both in Appendix B). These letters were also made available at the first public meeting.

### **5.1.3. Door-to-Door Survey**

A door-to-door survey was conducted from 29 April 2009 to 31 July 2009 for the owners/tenants within the survey area. During the survey, at least three attempts were made to interview the owners/tenants by ARCADIS/Malcolm Pirnie in coordination with USEPA, FGGM, AACDH, and MDE. At least two of these attempts were made in person; however, if the owners/tenants were not available or could not be contacted during the door-to-door survey, a 'leave-behind' notice, including a copy of the survey, was left at the residence/property. The notice indicated the importance of the survey and requested that they either contact the Army to complete it or provide the completed survey via mail, email, or fax.

In addition to the door-to-door survey and ‘leave-behind’ notices, a telephone hotline was established so residents/property owners could call with any questions and also provide their well survey information over the phone. The hotline phone number, along with contact information for USEPA, FGGM, AACDH, and MDE, was provided in the investigation fact sheet.

The door-to-door survey was conducted by multiple teams. Each survey team had a minimum of two personnel. The questionnaire sought to identify which residents had a private well. If it was determined that a well did exist, details were requested about the well use and construction (e.g., depth, construction materials, use for drinking water). Residents were also asked for their contact information and if they were willing to have their well sampled for this investigation.

The first round of surveying was conducted during the daytime hours of 10:00 am to 5:30 pm Monday through Friday. The second survey was conducted during the evening hours of 3:00 pm to 7:00 pm, Monday through Friday, in an attempt to contact those who might not be present during daylight hours. During the door-to-door survey, a visual inspection of the property was conducted from publically accessible roadways and/or sidewalks to identify visible signs of private wells (e.g., well heads in yards, etc.) or public water supply connections (e.g., water meters, service connections, etc.). If the two door-to-door attempts were unsuccessful, a third attempt to contact the resident/property owner was made via telephone.

Additional attempts were made via telephone if information from AACDH suggested the residence may have had a private well. Phone calls for each additional attempt were based on phone numbers yielded from internet searches and from other residents. Residents were asked the same questions as they would have been asked in person.

Since not all of the additional attempts were successful at obtaining responses from those properties suspected to have a private well, an additional visit by representatives from ARCADIS/Malcolm Pirnie, USEPA, FGGM, and translators was conducted in January 2010 at residences believed to have a private drinking water well. Also, a certified follow-up letter was mailed on 8 June 2010 to each of the remaining property owners/tenants requesting their response and participation in the sampling program, if appropriate. The USEPA, AACDH, and MDE worked in conjunction with the Army to solicit responses from the remaining property owners. Certified letters were sent to the residents/tenants of the 12 properties with suspected wells that were not able to be contacted during the private well survey. All twelve of these letters had confirmed deliveries. One new property was added to the sampling schedule. Ten owners/tenants did not respond to the letter. One owner/tenant declined participation as the property did not contain a well.

## 5.2. Survey Results

The private well survey was concluded in an email from the USEPA dated September 17, 2010 (see Appendix F). During the private well survey, properties on Gambrills Road, Hammond Lane, and Old Dairy Farm Road were identified as having private drinking water wells. These wells are located 1.03, 1.60, and 1.80 miles, respectively, down-gradient of MW-125d/123s and MW-126d/124s. Due to public request and the down-gradient proximity, these properties were added to the study, despite being outside of the initial one-mile study radius. Other requests were made by residents outside the one-mile radius, but because they were not projected to be down-gradient of MW-125d/123s and MW-126d/124s, their addition would not have been consistent with the focus of this study and were, therefore, denied. The results of the survey are presented in Table 5-1.

**Table 5-1: Survey Results**

Responses	# of Surveys
<b>Survey Counts By Result</b>	
Complete - private drinking water well <sup>1</sup>	75
Complete - county water w/ private well as secondary source <sup>2</sup>	17
Complete - county water	1413
Complete - county water meter observed	193
Complete - no water source	1
Undeveloped - Not Applicable	192
<i>Total Number of Surveys Completed</i>	<i>1891 (69.8% completed)</i>
Incomplete - residents could not be contacted	810
Incomplete - residents could not be contacted and property is outside 1-mile study radius	4
Refused to complete survey	3
<b>Total number of Properties</b>	<b>2708</b>

<sup>1</sup> A primary drinking water source includes water used for drinking, washing, cooking, and bathing.

<sup>2</sup> A secondary drinking water source includes water used for watering lawns and plants, washing cars, and other outdoor uses.

Seventy-five private wells were identified during this survey as being a primary drinking water source. Secondary water sources were not considered in this investigation. Based on the reported well depths identified for these wells from AACDH and MDE, the majority of the private drinking water wells are believed to be screened in the Lower Patapsco Aquifer.

## 6. Private Well Sampling

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### 6.1. Private Well Sampling Activities

Based on the results of the private well survey, 75 private wells were confirmed as a primary drinking water source. This number includes the properties added to the study area, including the Gambrills Road, Hammond Lane, and Old Dairy Farm Road properties (see Figure 6-1). While 75 wells confirmed as a primary drinking water source were identified, permission from their owners was granted to sample only 59 of these wells. This is due to either residents/tenants being unresponsive to the surveys, unresponsive to attempts to schedule sampling, or declining sampling outright.

Private drinking water well sampling was conducted between 5 June 2009 and 31 August 2010. Drinking water samples were collected from each of the 59 private wells. Prior to entering private property and collecting samples from private drinking water wells, an approved (signed) ROE was executed, with the exception of one resident that refused to sign an ROE, but allowed AACDH to collect the samples. Those sample results are also presented in this report in Section 6.2.4.

Each private drinking water well was sampled two times within a two-month period, with the exception of two wells that were only sampled once, per the owners' request. Samples were collected from an unfiltered and untreated water source on the property, if available, such as the water tank, an outdoor spigot, or a kitchen/bathroom faucet. During the first sampling visit, the sampling team requested to see the location of the water tank associated with the well to determine if any filtration systems were present. This system was sketched (in homes where the property owner permitted it) in the field log for each property. Water monitoring parameters (specific conductivity, temperature, pH, dissolved oxygen) were recorded every three to five minutes, and the water samples were collected after all parameters had stabilized.

All drinking water samples collected were analyzed for VOCs using USEPA method SW846/8260. The analyses were completed by a NELAC accredited laboratory, with a five-business-days turn-around time. A third-party data quality review and USEPA Region III Level M3 data validation was conducted for all samples collected, with the exception of some samples that were validated using USEPA Region III Level M2 (see Section 9 for explanation). Subcontractor Laboratory Data Consultants provided data validation of the samples within five business days of receipt.

## 6.2. Private Well Sampling Results

Fifty-nine wells were sampled as part of this program in two rounds: initial sampling (Round 1) and confirmatory sampling (Round 2). In Round 1 sampling, 34 samples had concentrations of VOCs detected above reporting limits, but below MCLs; whereas, in Round 2, only 25 did. During Round 2 sampling, one property on Nevada Avenue had detections of PCE in excess of its MCL. During the two rounds of sampling, three properties on Nevada Avenue had detections of PCE, TCE, and DCE near the respective MCLs. TCE, DCE, and vinyl chloride are breakdown products of PCE. One detection (an estimated value of 0.45 µg/L) of vinyl chloride was recorded in April 2009, far below the MCL.

Two detections of CCl<sub>4</sub> were found on Murray Lane in each round (1.2 µg/L and an estimated 0.88 µg/L in Round 1 and estimated values of 0.92 µg/L and 0.93 µg/L in Round 2).

Chloroform was detected above reporting limits; but the concentrations were well below their associated MCLs. 1,2-dichloroethane, 1,1,1-trichloroethane, and methylene chloride were detected at estimated concentrations, also well below MCLs. The majority of these detections in both sampling rounds (27 in Round 1, 14 in Round 2) were for chloroform, a disinfection by-product commonly produced during the chlorination of water and wastewater. However, chloroform and methylene chloride are also breakdown products of CCl<sub>4</sub>. Despite this, it is believed that the presence of this compound in the area groundwater is a result of infiltration of water from the local public water supply as a result of irrigation and other activities. This cannot be certain, because the plume associated with the groundwater impact observed at MW-125d and MW-126d has not been fully delineated. 1,2-dichloroethane and 1,1,1-trichloroethane are not believed to be breakdown products of either of the COCs.

Results of these sampling events are presented in Table 6-2.

### 6.2.1. Round 1 Results

Fifty-nine wells were sampled during Round 1. During Round 1, 1,1,1-trichloroethane (estimated value), CCl<sub>4</sub>, chloroform, DCE, methylene chloride (estimated value), PCE, TCE, and vinyl chloride (estimated value) were detected above reporting limits. However, none of these detections exceeded the USEPA MCL for their respective contaminant.

### 6.2.2. Round 2 Results

Fifty-seven wells were sampled during Round 2 (two residences refused to have their wells sampled a second time). During Round 2, 1,2-dichloroethane (estimated value), CCl<sub>4</sub> (estimated value), chloroform, DCE, PCE, and TCE were detected above reporting limits. One sample collected from a property, on Nevada Avenue, exceeded the USEPA MCL for PCE, with a detected concentration of 5.7 µg/L. The MCL of PCE is 5 µg/L.

Two other properties on Nevada Avenue had concentrations of PCE near its MCL, with concentrations of 4.5 µg/L and 3.2 µg/L, respectively.

### 6.2.3. Nevada Avenue Results

Because Nevada Avenue is not down-gradient of MWs-125d/123s and 126d/124s, the compounds detected in the samples collected from this area are concluded to be associated with a separate source area. As a result of the detections at or near MCLs on Nevada Avenue, a separate investigation has been initiated to determine if this separate source area is on or associated with FGGM. Until this other study is completed, monthly monitoring of the Nevada Avenue private drinking water wells has been initiated and is currently ongoing. The results of this investigation will be reported separately.

### 6.2.4. 2010-2011 Anne Arundel County Sampling Results

Since the start of the field effort for the project in April 2009, AACDH has continued to sample six of the original properties for VOCs and metals. These wells include four properties on Robey Lane and two properties on Tolbert Lane. No additional wells have been added to their investigation. Each property was sampled once during the period from 27 October 2010 to 4 January 2011. No samples were taken in 2009.

The results of this investigation are presented in Table 6-1.

**Table 6-1: 2010-2011 AACDH Results**

Street	Number of properties	Chloroform (ppb)	1,2,4-Trichlorobenzene (ppb)	1,2,3-Trichlorobenzene (ppb)	Naphthalene (ppb)	Hexachlorobutadiene (ppb)
		MCL 80 ppb	MCL 70 ppb	No MCL	No MCL	No MCL
Robey Lane	4	0.6 (1 property)	ND	ND	ND	ND
Tolbert Lane	2	ND	ND	ND	ND	ND

ND= Not detected

ppb = parts per billion

Table 6-2: Analytical Results

Street	Addresses with Detections		Addresses without Detections		1,1,1-Trichloroethane (MCL - 200 ug/L)		1,2-Dichloroethane (MCL - 5 ug/L)		Bromoform (MCL - 80 ug/L)		Carbon Tetrachloride (MCL - 5 ug/L)		Chloroform (MCL - 70 ug/L)	
	Round 1	Round 2	Round 1	Round 2	# of Detections	Range (ug/L)	# of Detections	Range (ug/L)	# of Detections	Range (ug/L)	# of Detections	Range (ug/L)	# of Detections	Range (ug/L)
Annapolis Rd	7	7	4	4	--	--	--	--	--	--	--	--	14	0.33J - 12.40
Baldwin Rd	1	0	1	2	--	--	--	--	--	--	--	--	1	1.40J
Baliol Ln	1	1	1	1	--	--	--	--	--	--	--	--	1	0.34B
Berger St	3	2	0	1	--	--	1	0.51J	--	--	--	--	5	0.18B - 0.74J
Bucklina Ave	0	0	1	1	--	--	--	--	--	--	--	--	--	--
Galloway Rd	1	1	1	1	--	--	--	--	--	--	--	--	--	--
Gambrills Rd	1	0	0	1	1	0.45 J	--	--	--	--	--	--	--	--
Hammonds Lane	0	0	1	1	--	--	--	--	--	--	--	--	--	--
Murray Rd	2	2	0	0	--	--	--	--	--	--	4	0.88 J - 1.20	3	0.32 J - 1.8
Nevada Ave	6	7	4	2	--	--	--	--	--	--	--	--	8	0.31 - 8.30
Odenton Rd	1	0	0	1	--	--	--	--	--	--	--	--	1	0.44J
Old Dairy Farm Rd	0	0	11	10	--	--	--	--	--	--	--	--	--	--
Old Waugh Chapel Rd	1	0	1	2	--	--	--	--	--	--	--	--	1	1.60B
Robey Ln	4	3	2	3	--	--	--	--	--	--	--	--	1	0.44J - 0.48J
Tolbert Dr	4	2	0	2	--	--	--	--	--	--	--	--	5	0.37 - 0.56B

Street	Addresses with Detections		Addresses without Detections		cis-1,2-Dichloroethene (MCL - 5 ug/L)		Methylene Chloride (MCL - 5900 ug/L)		Tetrachloroethene (MCL - 5 ug/L)		Trichloroethene (MCL - 5 ug/L)		Vinyl Chloride (MCL - 2 ug/L)	
	Round 1	Round 2	Round 1	Round 2	# of Detections	Range (ug/L)	# of Detections	Range (ug/L)	# of Detections	Range (ug/L)	# of Detections	Range (ug/L)	# of Detections	Range (ug/L)
Annapolis Rd	7	7	4	4	1	0.23J	--	--	--	--	--	--	--	--
Baldwin Rd	1	0	1	2	--	--	--	--	--	--	--	--	--	--
Baliol Ln	1	1	1	1	--	--	--	--	1	0.72J	--	--	--	--
Berger St	3	2	0	1	--	--	--	--	--	--	--	--	--	--
Bucklina Ave	0	0	1	1	--	--	--	--	--	--	--	--	--	--
Galloway Rd	1	1	1	1	--	--	--	--	2	1.30 - 1.90	2	3.20 - 3.50	--	--
Gambrills Rd	1	0	0	1	--	--	--	--	--	--	--	--	1	0.45J
Hammonds Lane	0	0	1	1	--	--	--	--	--	--	--	--	--	--
Murray Rd	2	2	0	0	--	--	--	--	3	0.94 J - 2.60	--	--	--	--
Nevada Ave	6	7	4	2	6	1.1-1.7	1	0.60J	8	0.60 J - 5.70	3	0.46J - 0.87J	--	--
Odenton Rd	1	0	0	1	--	--	--	--	--	--	--	--	--	--
Old Dairy Farm Rd	0	0	11	10	--	--	--	--	--	--	--	--	--	--
Old Waugh Chapel Rd	1	0	1	2	--	--	--	--	--	--	--	--	--	--
Robey Ln	4	3	2	3	5	0.22B - 0.44J	--	--	--	--	--	--	--	--
Tolbert Dr	4	2	0	2	1	0.18J	--	--	--	--	--	--	--	--

**BOLD** text indicates constituent detected at concentrations above the MCL

J = estimated

B= compound not detected substantially above the level reported in blanks

Data is presented by street, not by residence, to maintain residents' confidentiality.

4-Jun

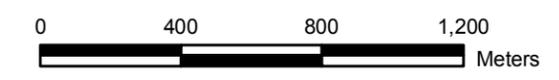
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**Figure 6-1  
General Location of Private Wells in  
Study Area**

**Legend**

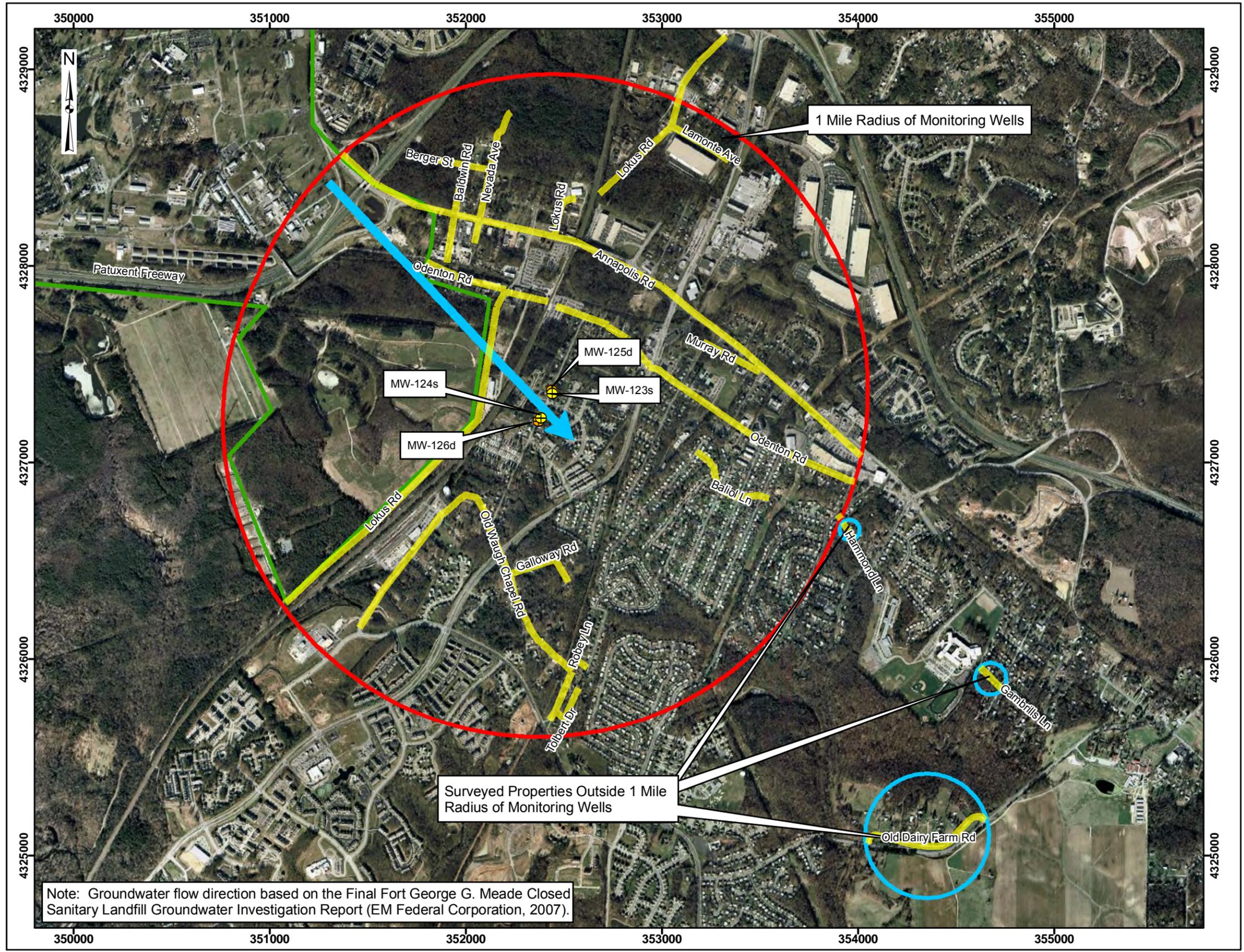
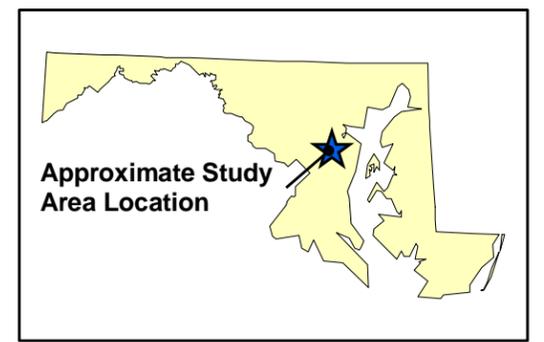
- Installation Boundary
- Deep Monitoring Well
- Shallow Monitoring Well
- 1-Mile Radius of Monitoring Wells
- Surveyed Properties Outside 1-Mile Radius
- Approximate Groundwater Flow Direction
- Street with One or More Drinking Water Wells Identified in Study



Data Sources: ESRI, World Imagery, 2003  
FGGM, GIS Data, 2005

Coordinate System: UTM Zone 18  
Datum: NAD 1983  
Units: Meters

Edition: Draft Final  
Date: July 2011



Note: Groundwater flow direction based on the Final Fort George G. Meade Closed Sanitary Landfill Groundwater Investigation Report (EM Federal Corporation, 2007).

## 7. Bottled Water Distribution

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### 7.1. Rationale

Bottled water is currently being provided to property residents/tenants who have a private drinking water well as their primary source of drinking water, as determined by the private well survey. Residents/tenants were required to sign the Agreement for the Provision of Bottled Water (Agreement) to receive bottled water. Forty-four of the seventy-five eligible residents/tenants signed this form; the remaining residents/tenants were either unresponsive or declined.

Bottled water was selected over filtered water due to its ability to be delivered quickly to all identified private drinking water well users, ensuring a safe drinking water supply until private wells could be sampled for comparison to MCLs. The potential use of filtration would be considered only if concentrations exceeded MCLs and a risk evaluation determined that it was needed to address other potential exposure routes, e.g., inhalation and dermal contact. Because no levels were detected well in excess of MCLs (with the exception of the properties on Nevada Avenue), the need for considering filtration was not required. Continued bottled water supply to Nevada Avenue residents is planned.

### 7.2. Terms of Service

The terms under which the bottled water is being provided include:

- Five gallon bottles of water for purpose of consumption (drinking, cooking), associated pickup/delivery service, and a dispenser are provided. The amount of bottled water delivered to each residence is dependent on the number of residents living there.
- The Agreement covered a term based on the time required to collect and analyze at least two water samples (within 60 days of each other) from the drinking water well located at the subject address.
- The Department of the Army would give a minimum of two weeks written notice of service termination upon the verification that there are no levels of TCE, PCE, and/or DCE detected above the USEPA's safe drinking water standards, also known as MCLs, in the collected drinking water well samples.
- The bottled water supply service is being provided by the Department of the Army at no cost to the property owner or tenant.

- The Department of the Army is responsible for the delivery and setup of the water dispenser. The property owner/tenant is responsible for properly maintaining the water dispenser and coordinating a bottle refill schedule with the bottled water supplier.
- The supplied water is to be used only for the subject property and the bottles or dispenser should not be removed from the property at any time.

Bottled water is currently being removed by resident request only and will continue until plume delineation being conducted in a separate investigation program is complete.

## 8. Vapor Intrusion Assessment

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The Vapor Intrusion Technical Memorandum was completed for the March 2009 Work Plan. Existing groundwater quality data, soil data, and hydrogeologic data were evaluated using USEPA and Interstate Technology Regulatory Council (ITRC) vapor intrusion screening guidance to assess potential vapor intrusion risk to residents within the targeted investigation area (see Figure 8-1). The evaluated data included soil boring and well construction logs (for evidence of elevated photoionization detector readings or staining and geological formations) from MW-123s, -124s, -125d and -126d. In addition, groundwater sampling data from these wells and adjacent wells sampled as part of historic and ongoing groundwater investigations at FGGM was used, as well as published information on the geologic and hydrogeologic features of the subject area.

Based upon this assessment of the existing information and data discussed below, the vapor intrusion exposure pathway is not considered to be complete; therefore, there is no identified vapor intrusion risk to residents or occupants within the study area. However, because the plume associated with the groundwater impact observed at MW-125d and MW-126d has not been fully delineated to date, and the maximum contaminant concentrations have not been determined, the final vapor intrusion assessment will be deferred until the plume delineation being conducted in a separate investigation program is complete.

The following is a summary of the evaluation that supports the conclusion of no identified completed exposure pathway.

### **Deep Groundwater Impact**

VOCs (primarily TCE, PCE, and CCl<sub>4</sub>) detected in the deep wells MW-125d and -126d (screened in the Lower Patapsco formation) are highly unlikely to volatilize to the surface and subsequently into indoor spaces in the study area based on three primary factors: 1) the depth of the VOCs in the Lower Patapsco formation (i.e., greater than 150 feet bgs) relative to the study area structures; 2) the presence of a continuous clay confining unit overlying the Lower Patapsco formation (EM, 2007); and 3) the existence of a non-impacted groundwater unit (Upper Patapsco formation) above the impacted deep groundwater (see Figure 8-2).

Regarding the depth of the identified VOCs, according to the current USEPA vapor intrusion guidance (USEPA, 2002), vapor intrusion should be considered a potential exposure pathway *if volatile chemicals are present at 100 feet or less in depth or are located in close proximity to current or future buildings*. The volatile chemicals in the Lower Patapsco in the study area have been identified at depths of greater than 150 feet bgs and not in the overlying units. Therefore, in accordance with USEPA guidance,

vapor intrusion from the VOCs in the deep groundwater (i.e., Lower Patapsco formation) is not considered to be a potential exposure pathway (see Figure 8-6). Regarding the overlying clay unit, as shown on Figure 8-2, the Patapsco Formation is divided into an upper, middle, and lower section. All three layers of the Patapsco (upper, middle, and lower) are confirmed to be present at the eastern portion of FGGM, as well as the adjacent area east of FGGM. The thickness of the Middle Patapsco clay layer, as shown in Figure 8-2, ranges from approximately 35 to 90 feet in the study area. Groundwater heads measured during previous investigation activities confirm that the Middle Patapsco clay layer acts as a confining layer throughout the area. The presence of this continuous clay layer overlying and confining the impacted groundwater of the Lower Patapsco formation eliminates the vapor migration pathway to the overlying Upper Patapsco formation and subsequently any indoor spaces in the study area.

Concerning the final factor of the overlying non-impacted shallow groundwater unit, the VOCs identified in the deep groundwater (i.e., MWs- 125d and -126d) have not been detected at concentrations exceeding the USEPA MCLs or the USEPA vapor intrusion screening criteria in the shallow aquifer (MW-123s and -124s and other Upper Patapsco wells sampled during the CSL RI and as part of FGGM's ongoing groundwater investigations). According to the ITRC vapor intrusion guidance: *"When non-impacted shallow groundwater lies above an impacted groundwater zone, the shallow groundwater acts as a barrier for volatilization from groundwater at deeper depths."* The lack of shallow groundwater impact further supports the conclusion of an incomplete exposure pathway for vapor intrusion.

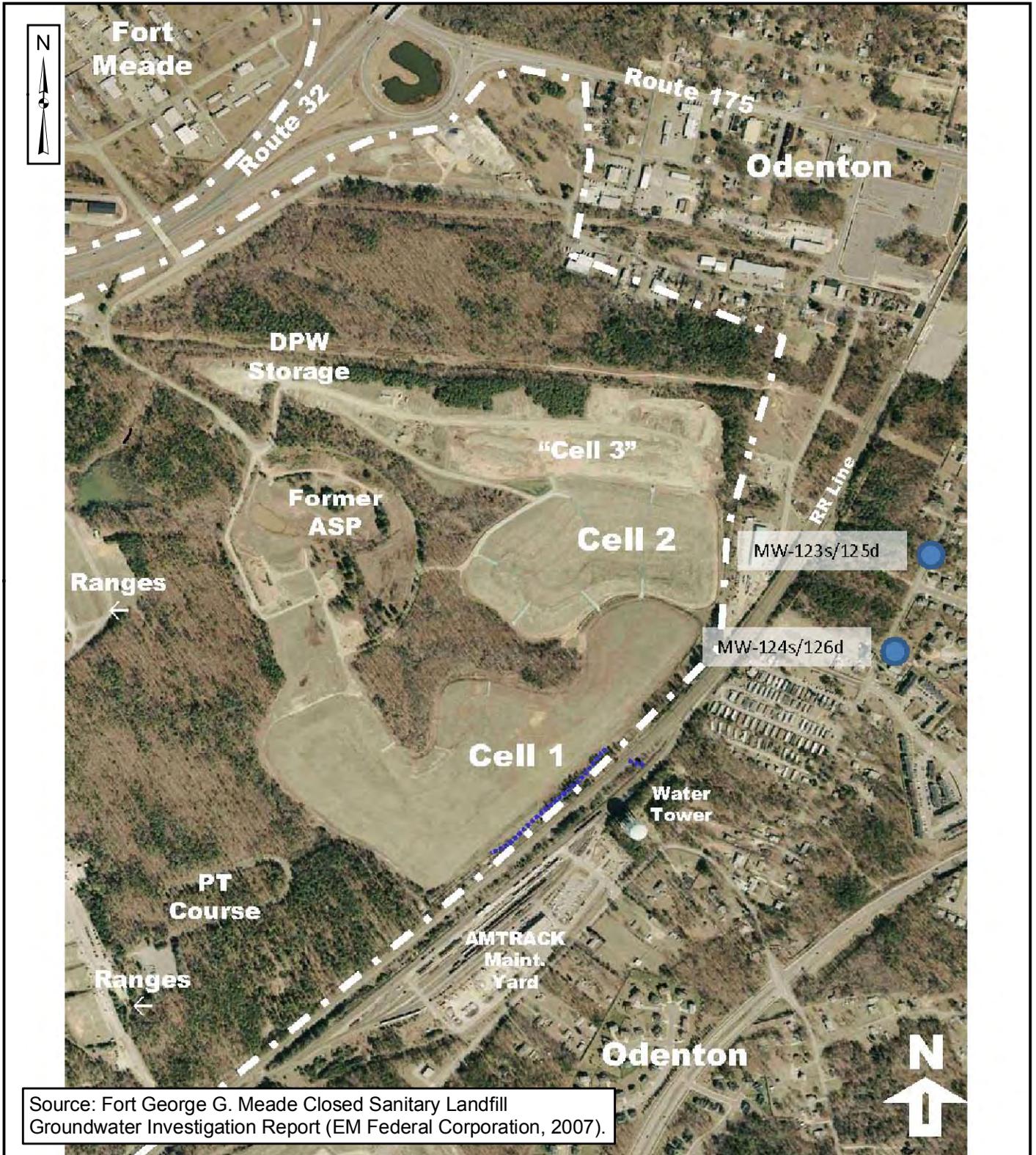
In conclusion, according to USEPA and ITRC vapor intrusion guidance, the potential exposure pathway related to the observed deep groundwater contamination in MW-125d and MW-126d is incomplete based on several factors and therefore, no further action with regard to vapor intrusion assessment is recommended as part of this study. This assessment should be deferred until plume delineation being conducted under a separate study is completed.



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Figure 8-1  
Monitoring Well Locations

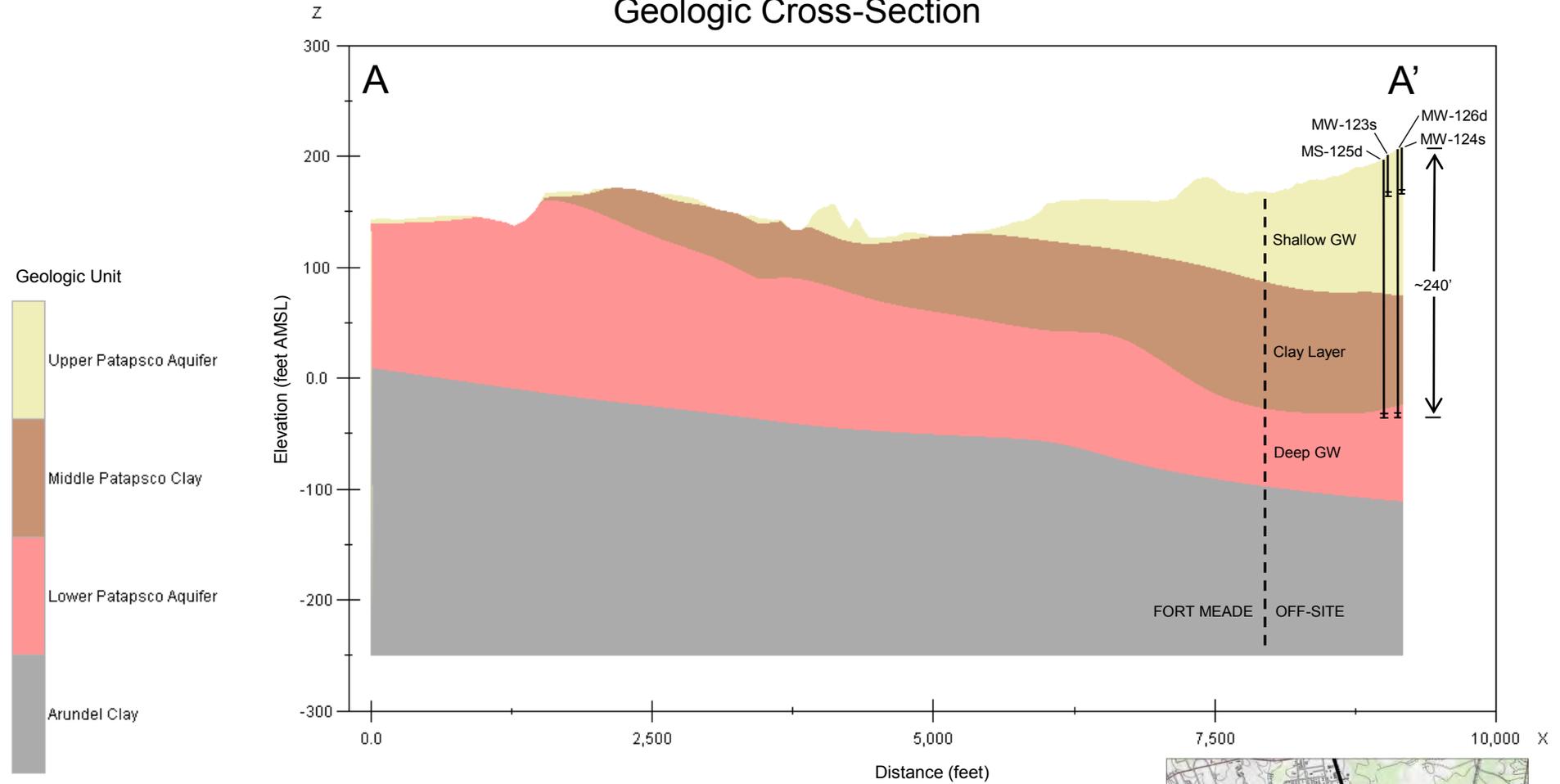


Source: Fort George G. Meade Closed Sanitary Landfill  
Groundwater Investigation Report (EM Federal Corporation, 2007).

Coordinate System: UTM Zone 18  
Datum: NAD 1983  
Units: Meters

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Date: July 2011

# Figure 8-2: Geologic Cross-Section

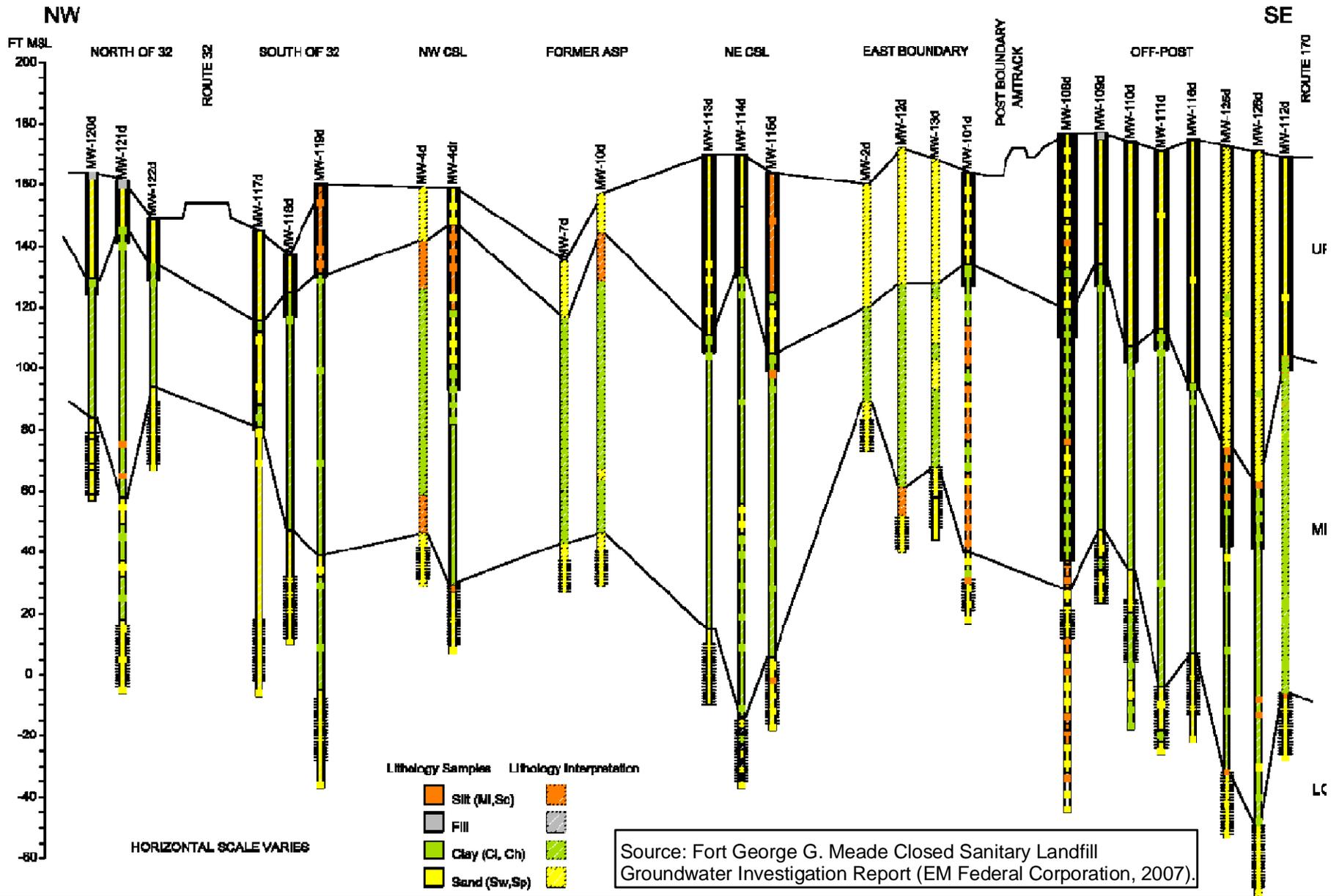


⊥ Existing Monitoring Well

CROSS SECTION A-A'  
VERTICAL EXAGGERATION = 10X

Wells shown on the figure have been transposed onto the existing cross-section of the Fort George G. Meade area.





### **Shallow Groundwater**

As stated above, the VOCs identified in the deep groundwater of the Lower Patapsco formation were not detected at concentrations exceeding the USEPA MCLs or the USEPA vapor intrusion screening criteria in the shallow aquifer in the study area and adjacent areas of FGGM (i.e., MW-123s and -124s and other Upper Patapsco wells sampled during the CSL RI and as part of FGGM's ongoing groundwater investigations). As shown in Figure 8-6, benzene was the only VOC that was detected in the Upper Patapsco above its MCL during the 2004 CSL RI sampling event; however, the benzene detected did not exceed the USEPA vapor intrusion screening criteria. Therefore, in accordance with USEPA vapor intrusion guidance; there is currently no complete exposure pathway from VOCs in the Upper Patapsco formation based on existing data. Furthermore, based on the local topographic high (200+ feet above mean sea level) located in the study area (see Figure 8-4), it is unlikely that any potential contamination present in the Upper Patapsco on FGGM would flow off-site toward the residential area east of FGGM in the future. As reported in the CSL annual groundwater and surface water monitoring report (EM, 2007), groundwater elevations in the Upper Patapsco are strongly influenced by surface drainage which is controlled by the topography and the impervious landfill cap. Also, water level elevations in the Upper Patapsco collected during the CSL RI indicate that the Amtrak railroad and associated right-of-way (located just north of Waugh Chapel Road) lie in a northeast-southwest trending topographic low which crosses the regional groundwater flow at a high angle. This results in surface water seeps and southerly or southwesterly deflection of unconfined groundwater flow, as shown on Figure 8-5. This demonstrates that shallow groundwater flow (i.e., in the Upper Patapsco formation) from FGGM does not migrate into the neighboring area east of FGGM.

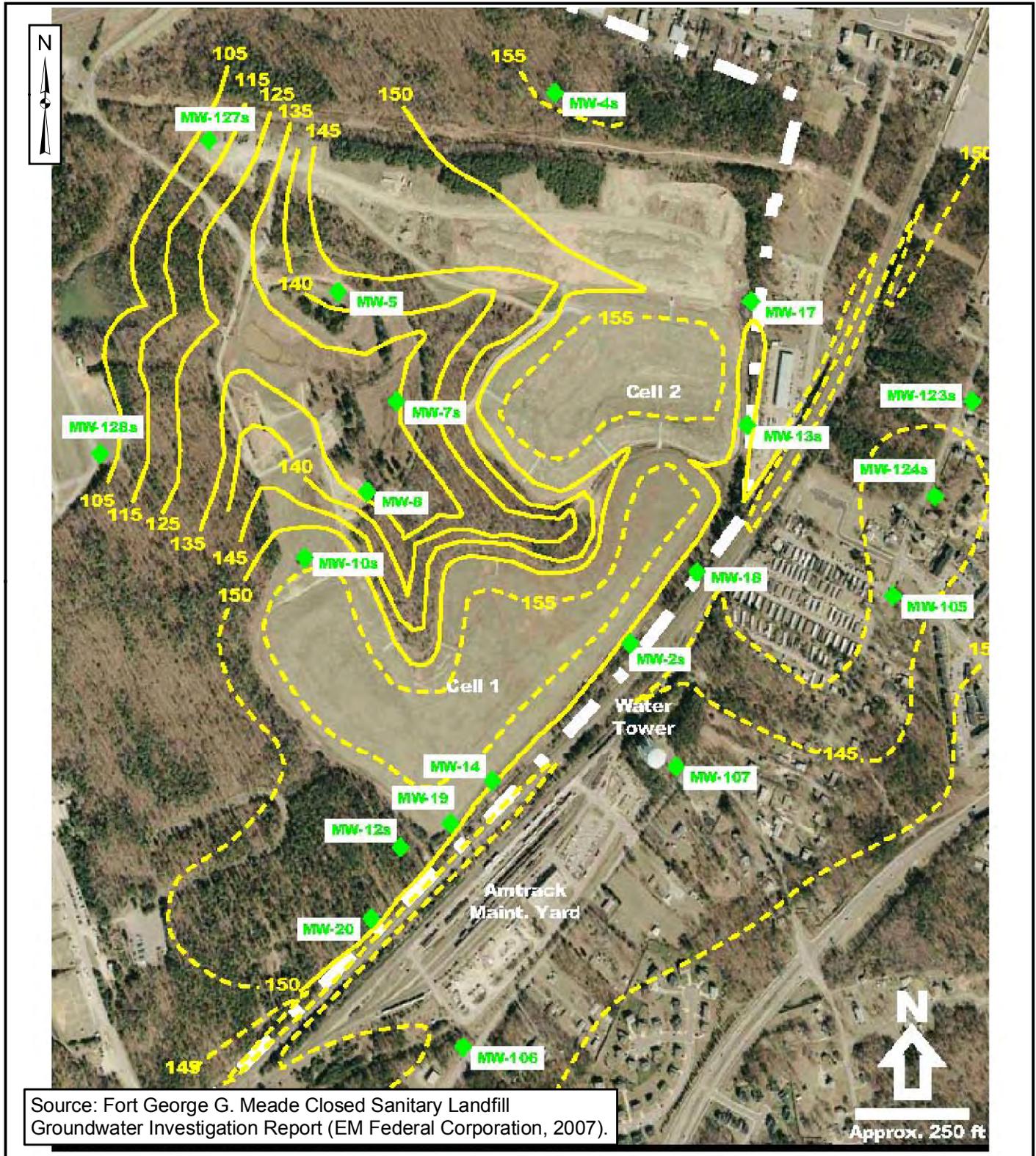
In summary, there is no current potential vapor intrusion exposure pathway related to groundwater in the study area, and therefore, no further action with regard to vapor intrusion assessment is recommended for this study. However, as previously stated, the final vapor intrusion assessment related to groundwater in the area will be deferred until the plume delineation being conducted in a separate investigation program is complete.





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Figure 8-5  
Upper Patapsco Aquifer Potentiometric Surface



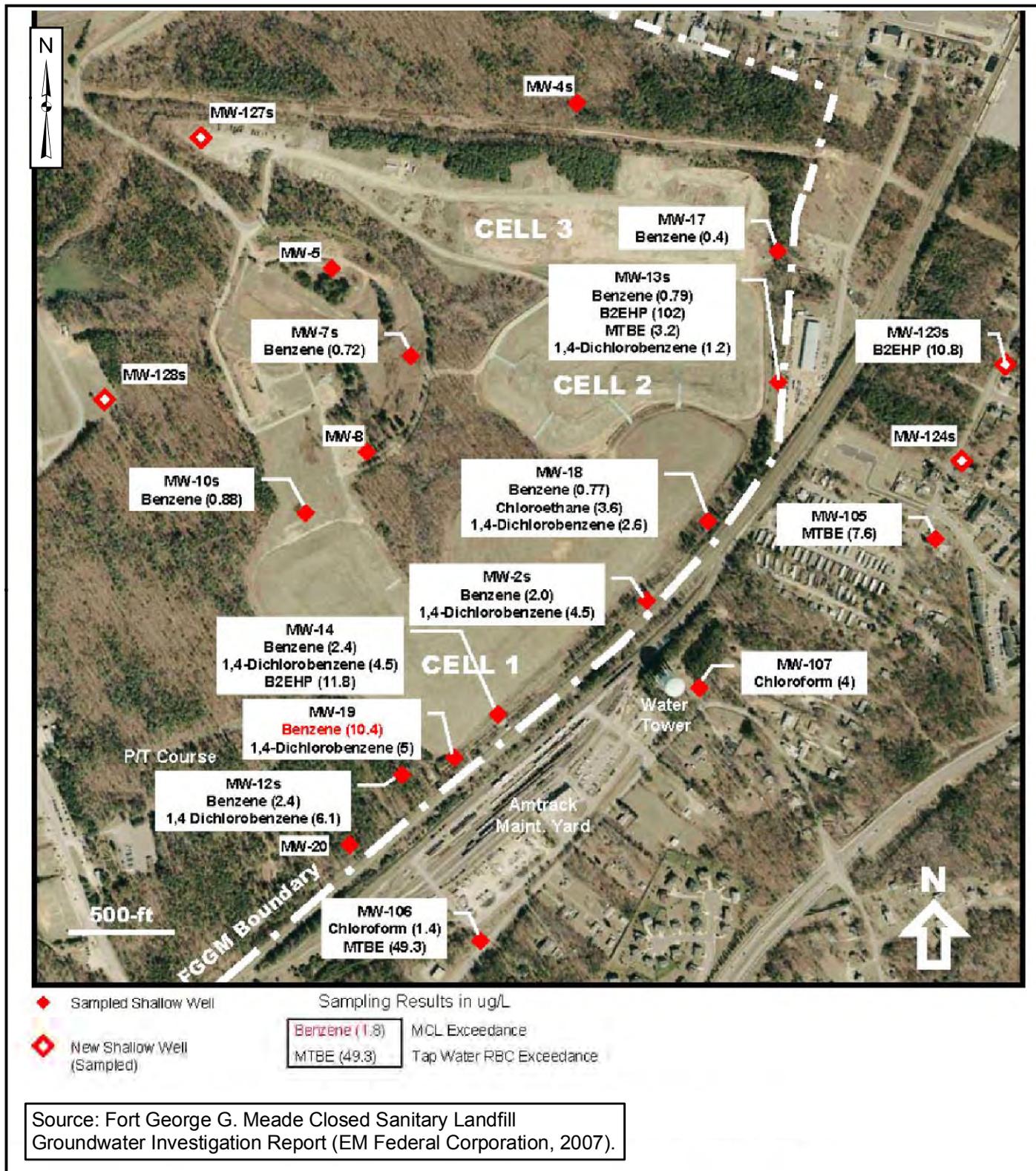
Coordinate System: UTM Zone 18  
Datum: NAD 1983  
Units: Meters

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Figure 8-6  
2004 VOC Detections in the Upper Patapsco Aquifer



## 9. Deviations from Work Plan

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Deviations from the Interim Measures Work Plan are as follows:

- Some residents with private wells were unable to be contacted. This delayed the schedule for first and second round sampling events, in deviation with Figure 4-1 of the Work Plan. First and second round monitoring was completed on 29 June 2010 and 31 August 2010, respectively.
- The properties located on Gambrills Road, Hammond Lane, and Old Dairy Farm Road, though outside of the study radius, were added to the private well survey, adding onto the study area outlined in Section 1 of the Work Plan. These properties all contain private drinking water wells and are located 1.03, 1.60, and 1.80 miles, respectively, down-gradient of MW-125d/123s and MW-126d/124s. These properties were added at the request of the residents and due to their down-gradient proximity.
- In Section 3.2.2 of the Work Plan, it stated that transcripts were to be taken at each public meeting. No transcripts were taken as the meeting was an open “Question and Answer” format with poster boards and a running loop of information slides. ARCADIS/Malcolm Pirnie personnel were present to answer questions from the public.
- A second public meeting was scheduled to be held during the comment period for the Draft Final Interim Measures Report. Due to a request to hold the meeting sooner, the second public meeting was held on 17 November 2009 after the completion of the majority of the second round sampling events and submission of results to residents/tenants, in deviation with Figure 4-1 of the Work Plan. A public meeting is not planned during the review of the Interim Measures Report.
- As described in Section 3.1.3 of the Work Plan, three or more attempts were made to contact all properties owners/residents within the study area as stated in the Final Interim Measures Work Plan. After the required two visits, additional visits and calls were made to reach the property owner. However, if a property with a suspected well was not successfully contacted after the three or more attempts, a certified letter was mailed to the resident/tenant.
- Reporting is outlined in Section 3.6 of the Work Plan, and the following items were not submitted:

- Sampling results letter report after each round of sampling,
- Final Vapor Intrusion Technical Memorandum, and
- IDW Management Report.

A sampling results letter report was not generated after the initial round of sampling due to the simultaneous sampling of the first and second rounds. A Draft Vapor Intrusion Technical Memorandum was prepared, it but was not finalized. An IDW management letter was not submitted. While these documents were not submitted, all information that would be contained in these documents is included in this report.

- Because samples collected from three properties on Nevada Avenue had detections at or near the MCL for PCE, monthly monitoring was implemented for those three properties. As stated previously, a separate investigation has been initiated to determine if this separate source area is on or associated with FGGM. The monthly monitoring on Nevada Avenue will continue as part of this separate investigation.
- USEPA Region III Level M2 data validation was conducted for the first 82 samples collected during the study, instead of Level M3 validation, due to a miscommunication with the validator. The last 43 samples were validated using Level M3 data validation. Data validation criteria are described in Section 3.3.3 of the Work Plan.

# 10. Conclusions and Recommendations

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## 10.1. Summary of Conclusions

Monitoring wells were sampled on 16 April 2009 and 18 June 2009. Both deep monitoring wells (MW-125d and MW-126d) had CCl<sub>4</sub> concentrations above the USEPA maximum contaminate level. MW-126d also exceeded maximum contaminant levels for PCE and TCE. IDW from these sampling events, along with IDW from an earlier investigation of these wells, were disposed of on 1 September 2009 at the FGGM WWTP. None of the COCs were detected in the shallow monitoring wells (MW-123s and MW-124s).

A private well survey was initiated on 29 April 2009. After sending a letter to residents informing them of activities, a door-to-door survey was conducted within the one-mile study radius. Of the 2,708 properties identified, 1,891 answered the survey (69.8% response rate).

During the private well survey, properties on Gambrills Road, Hammond Lane, and Old Dairy Farm Road were identified as having private drinking water wells. These wells are located 1.03, 1.60, and 1.80 miles, respectively, down-gradient of MW-125d/123s and MW-126d/124s. Due to public request and the down-gradient proximity, these properties were added to the study, despite being outside of the initial one-mile study radius. Including these additional wells, seventy-five private drinking water wells were identified.

Private wells presumed to be down-gradient of MW-125d/123s and MW-126d/124s are located on Baliol Road, Galloway Road, Gambrills Road, Hammond Lane, Old Dairy Farm Road, Old Waugh Chapel Road, Robey Lane, and Tolbert Lane. However, no water level measurements were collected during this investigation, so the actual direction of groundwater flow cannot be definitely stated. This work is being completed as part of an on-going study of the area groundwater at Operating Unit-4. Also, during the private well investigation, samples from all of these wells had VOC detections below their respective MCLs.

Fifty-nine of the residents/tenants with private drinking water wells agreed to have their wells sampled. The remaining drinking water wells were not sampled due to residents/tenants being unresponsive to the surveys, unresponsive to attempts to schedule sampling, or declining sampling outright.

During the private well sampling, one sample collected from a property on Nevada Avenue, exceeded the USEPA MCL for PCE and two other properties on Nevada Avenue had samples with concentrations of PCE near their MCL. Because Nevada

Avenue is not projected to be down-gradient of MW-125d/123s and MW-126d/124s, these detections are believed to be associated with a separate source area. As a result, a separate investigation has been initiated to determine if this separate source area is on or associated with FGGM. Monthly monitoring has been initiated and is currently ongoing. The results of this investigation will be reported separately.

There were VOC detections in other wells, but no others were above or near the MCLs. Chloroform, a common disinfection byproduct and breakdown product of  $\text{CCl}_4$ , was the most common VOC detected. This is believed to be a result of the infiltration of water from the local public water supply as a result of irrigation activities, not degradation of  $\text{CCl}_4$ . However, this cannot be definitive until plume associated with the groundwater impact observed at MW-125d and MW-126d has been fully delineated

## 10.2. Recommendations

With the exception of the Nevada Avenue properties, none of the other properties within the study areas had detections of the COCs (or any other VOCs) at or near the MCL. Therefore, the findings of this study demonstrate that none of the private drinking water wells located down-gradient of MW-125d and MW-126d was determined to have been impacted by the COCs at or near their associated MCLs. Additionally, the vapor intrusion exposure pathway for these COCs was determined to be incomplete. Based on these findings, no risk to the public from these COCs was identified; therefore, the study is complete. No further action is recommended for these properties, and bottled water delivery should be ceased once the plume associated with the groundwater impact observed at MW-125d and MW-126d is fully delineated.

Due to levels of PCE detected at or near the MCL at three properties on Nevada Avenue, it is recommended that monthly monitoring continue at these properties until the separate investigation is complete. A Final RAB meeting will be held at the close of that project.

It is recommended that the on-going investigation of the Lower Patapsco Aquifer continue to determine source of the elevated VOC concentrations found at MW-125d and MW-126d. These wells should also be re-sampled to determine if concentrations are rising or falling. Impacts to residents on well water will be considered as future investigations progress; a definitive recommendation will be made at that time.

# 11. References

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