N61414.AR.001120
NAB LITTLE CREEK
5090.3a

FINAL ENHANCED REDUCTIVE DECHLORINATION ANNUAL GROUNDWATER MONITORING SUMMARY FOR SITE 11 JEB LITTLE CREEK VA

06/01/2011

CH2M HILL

Final

Enhanced Reductive Dechlorination Annual Groundwater Monitoring Summary Site 11—School of Music Plating Shop

Joint Expeditionary Base (JEB) Little Creek-Fort Story
JEB Little Creek
Virginia Beach, Virginia

Prepared for

Department of the Navy

Naval Facilities Engineering Command
Mid-Atlantic

Contract No.
N62470-08-D-1000
CTO-0062

June 2011

Prepared by

CH2MHILL.

Final

Enhanced Reductive Dechlorination Annual Groundwater Monitoring Summary Site 11—School of Music Plating Shop

Joint Expeditionary Base (JEB) Little Creek-Fort Story
JEB Little Creek
Virginia Beach, Virginia

Contract Task Order 0062

June 2011

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 1000 Program
Contract N62470-08-D-1000

Prepared by

CH2MHILL

Virginia Beach, Virginia

Contents

Acronyms and Abbreviations ..... **v**

1 Introduction **1-1**
1.1 Facility Background 1-1
1.2 Site 11 Description and History 1-2
1.3 Hydrogeology 1-4
1.4 Remedial Action Objectives 1-5

2 Remedial Action Design and Field Approach **2-1**
2.1 ERD Overview 2-1
2.2 Rationale for the Remedial Design 2-2
2.2.1 Injection Wells 2-2
2.2.2 Monitoring Wells 2-2
2.3 Groundwater Monitoring 2-2

3 Results and Discussion **3-1**
3.1 Analytical and Field Parameters 3-1
3.2 Performance Monitoring 3-1
3.2.1 Source Treatment Area 3-2
3.2.1 Downgradient Plume 3-3
3.3 Overall Effectiveness 3-6

4 Conclusions and Recommendations **4-1**

5 References **5-1**

Appendices

A Groundwater Elevation Hydrographs
B Complete Analytical and Field Data Tables
C COC and TOC Concentrations in Performance Monitoring Wells

Tables

1-1 Previous Investigation Summary
1-2 Groundwater Elevations
1-3 Contaminants of Concern Cleanup Goals

2-1 Well Screen Intervals and Sampling Dates
2-2 Monitoring Schedule

3-1 Detected Analytes and Field Parameters

Figures

1-1 Site Location
1-2 Site Layout
1-3 Groundwater Elevation (August 2008)
1-4 Groundwater Elevation (January 2009)
1-5 Groundwater Elevation (June 2009)
1-6 Groundwater Elevation (August 2009)
1-7 Groundwater Elevation (November 2009)
1-8 Groundwater Elevation (February 2010)
1-9 Groundwater Elevation (May 2010)
1-10 Groundwater Elevation (November 2010)

2-1 Total COC Isoconcentration Contours Columbia Aquifer (Baseline)

3-1 Analytical Results
3-2 Total COC Isoconcentration Contours Columbia Aquifer (Annual)

Acronyms and Abbreviations

bgs	below ground surface
CCR	Construction Completion Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	contaminant of concern
CT	carbon tetrachloride
DCA	dichloroethane
DCE	dichloroethene
DNAPL	dense nonaqueous phase liquid
DO	dissolved oxygen
Ebasco	Ebasco Environmental Consultants
ER	Environmental Restoration
ERD	enhanced reductive dechlorination
FS	Feasibility Study
ft/day	feet per day
ft/ft	feet per foot
ft/yr	feet per year
FWES	Foster Wheeler Environmental Services
JEB	Joint Expeditionary Base
JV I	AGVIQ-CH2M HILL Joint Venture 1
LTM	long-term monitoring
LUC	land use control
µg/L	micrograms per liter
MCL	maximum contaminant level
mg/L	milligrams per liter
mV	millivolt(s)
NAB	Naval Amphibious Base
NAVFAC	Naval Facilities Engineering Command
Navy	United States Department of the Navy
NPL	National Priorities List
ORP	oxidation-reduction potential
PCE	tetrachloroethene
PVC	polyvinyl chloride
RA	remedial action
RAO	remedial action objective
RAWP	Remedial Action Work Plan

RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RI	Remedial Investigation
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SERA	Screening Ecological Risk Assessment
SRI	Supplemental Remedial Investigation
SRS	Slow-Release Substrate
SWMU	Solid Waste Management Unit
TCA	trichloroethane
TCE	trichloroethene
TOC	total organic carbon
U.S.	United States
USEPA	United States Environmental Protection Agency
VC	vinyl chloride
VDEQ	Virginia Department of Environmental Quality
VFA	volatile fatty acids
VOC	volatile organic compound

SECTION 1

Introduction

On October 1, 2009, the first Joint Base of Hampton Roads was established. This new installation includes the former Naval Amphibious Base (NAB) Little Creek and the Army post Fort Story; the new name is Joint Expeditionary Base (JEB) Little Creek-Fort Story. With the forming of this new command, the Navy assumes responsibility for managing both properties and will now merge public meetings regarding the ongoing environmental restoration. However, separate records will be maintained to ensure the integrity of ongoing efforts at both properties. When required for public notices and distributions, the former bases will be identified as JEB Little Creek-Fort Story. For Environmental Restoration (ER) Program documents, the bases will be referred to separately as JEB Little Creek and JEB Fort Story.

As documented in the Record of Decision (ROD) (CH2M HILL, 2007), the selected remedy for Site 11 at JEB Little Creek, Virginia Beach, Virginia, is enhanced reductive dechlorination (ERD) with groundwater monitoring and land use controls (LUCs). ERD was initiated through the injection of a carbon source in the groundwater in January through February 2009. This report summarizes the first year of post-injection groundwater data to evaluate the effectiveness of the ERD treatment and to provide recommendations for a path forward.

This groundwater monitoring summary is divided into five sections. The remainder of Section 1 describes the facility, the site description and history, the site hydrogeology, and the remedial action objectives (RAOs). Section 2 presents the remedial action (RA) design and field approach. Section 3 presents and discusses the results of the first year of post-injection groundwater monitoring. Section 4 provides conclusions and recommendations for future steps. Section 5 provides a list of references.

Hydrographs using data from select wells were used to evaluate site hydrogeology and are provided in **Appendix A**. The complete sets of field and analytical data, as well as data trends for select monitoring wells, are included in **Appendixes B** and **C**, respectively.

1.1 Facility Background

JEB Little Creek consists of 2,215 acres in the northwest portion of Virginia Beach, Virginia, adjacent to the Chesapeake Bay (**Figure 1-1**). JEB Little Creek is primarily an industrial facility that provides logistic facilities and support services for local commands, organizations, home ported ships, and other United States (U.S.) and allied units to meet the amphibious warfare training requirements of the U.S. Armed Forces.

The area surrounding the facility is low lying and relatively flat with several freshwater lakes—Lake Chubb, Lake Bradford, Little Creek Reservoir, and Lake Whitehurst—located on or adjacent to the base. Little Creek Reservoir, located south of the base, serves as a secondary drinking-water supply for parts of the city of Norfolk. JEB Little Creek contains

three saltwater bodies: Little Creek Cove, Desert Cove, and Little Creek Channel. The channel connects the coves with the Chesapeake Bay, which borders the facility to the north.

JEB Little Creek was placed on the National Priorities List (NPL) in May 1999 (United States Environmental Protection Agency [USEPA] ID #VA5170022482). The Federal Facilities Agreement for JEB Little Creek was signed in November 2003 (Navy, 2003).

1.2 Site 11 Description and History

Site 11 at JEB Little Creek is located in the eastern portion of the base near the intersection of 7th and E Streets (**Figure 1-2**), and is the site of the former School of Music Plating Shop (Building 3651). The School of Music, located in Building 3602, is 10 feet southwest of the former plating shop. When in operation, the plating shop had an in-ground concrete neutralization tank approximately 10 feet east of the south corner of Building 3651 that was used to neutralize plating solutions. The tank was used from 1964 to 1974 when the plating operations were transferred to a separate facility and discharges into the neutralization tank was discontinued. Small quantities of plating baths, acids, and lacquer strippers were disposed of down the sink in the plating shop, which drained into the neutralization tank and its associated piping and eventually into the storm sewer system (Ebasco Environmental Consultants [Ebasco], 1991). It was reported that 10 gallons of plating baths, acids, and lacquer strippers were disposed of into the neutralization tank through the sink in the plating shop each year of its operation (Rogers, Golden, and Halpern, 1984). There are no records of chlorinated solvents being used at this site; however, degreasing solvents such as trichloroethene (TCE) and 1,1,1-trichloroethane (TCA) historically have been associated with operations at similar facilities.

Site 11 was included in preliminary basewide investigations consisting of an Initial Assessment Study (Rogers, Golden, and Halpern, 1984), a Round 1 Verification Step (CH2M HILL, 1986), and a Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) (A.T. Kearney, 1989) (**Table 1-1**). The Round 1 Verification Step was followed by an Interim Remedial Investigation that was completed in 1991, and a second round of groundwater sampling (Ebasco, 1991). A Remedial Investigation/Feasibility Study (RI/FS) was performed by Foster Wheeler Environmental Services (FWES) in 1993; the RI/FS report indicated that the Site 11 surface soil and groundwater were affected by contamination resulting from the neutralization tank and its contents (FWES, 1994a). Subsequent to the RI/FS, a Decision Document was issued by the Navy in November 1994 (FWES, 1994b) proposing removal of the neutralization tank, associated piping, and neighboring surface and subsurface soil. As a result, the neutralization tank, piping, and surrounding soil were excavated in 1995. A Closeout Report was completed in 1996 documenting the removal action and recommending further evaluation of the nature and extent of volatile organic compounds (VOCs) in groundwater resulting from the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) release (IT Corporation, 1996). Sampling results for Site 11 were scheduled to be assessed and the groundwater monitoring program reevaluated after 1 year (two rounds) of sampling. The first round of post-removal monitoring was conducted in May 1996 by FWES; the second round of monitoring was completed by CH2M HILL in December 1996. The groundwater monitoring report completed in 1998 (CH2M HILL, 1998) documented the

post-removal monitoring and recommended additional groundwater sampling to define the extent of groundwater contamination.

A Screening Ecological Risk Assessment (SERA) for Site 11 was completed in June 2000 (CH2M HILL, 2000). The SERA concluded that potential ecological risks at Site 11 were negligible based on the lack of complete and significant exposure pathways, and no further action was recommended for protecting ecological resources. A Membrane Interface Probe Investigation was conducted in 2001 to further characterize the extent of VOCs in groundwater. The results indicated that there had not been significant degradation of TCE (CH2M HILL, 2003). An Environmental Security Technology Certification Program-funded pilot test was conducted in 2002 to evaluate the *in situ* removal of organic contaminants from groundwater through the injection and extraction of a cyclodextrin solution (Boving et al., 2003). The pilot study concluded that the use of cyclodextrin increased the rate of dense nonaqueous phase liquid (DNAPL) removal relative to conventional water flooding. A Supplemental Remedial Investigation (SRI), initiated in June 1998, was finalized in 2004 (CH2M HILL, 2004). The SRI identified potential risk associated with select VOCs and an SVOC (pentachlorophenol) in groundwater and select inorganic constituents in groundwater (iron, manganese, or thallium) and inorganic constituents in soil (iron and chromium). The SRI concluded VOCs in groundwater were limited to the lower portion of the Columbia aquifer in the area of the former plating shop, and extending south beneath the School of Music building toward Gator Boulevard.

A vapor intrusion assessment was conducted in 2005 to evaluate potential risks associated with VOCs in groundwater underlying the School of Music (Building 3602). The investigation included a site visit to identify potential pathways and building envelope characteristics, an analysis of shallow groundwater and soil data, and quantitative and qualitative evaluations of risk. Following field investigation activities, site-specific aquifer and building conditions were used in the Johnson and Ettinger model to develop conservative risk-based screening levels in groundwater for comparison against VOCs detected. The results suggested that even in the event the building condition would promote vapor intrusion, concentrations of VOCs in groundwater are unlikely to present a risk to human health due to vapor intrusion (CH2M HILL, 2005). Therefore, the JEB Little Creek Partnering Team determined no further assessment of the potential for vapor intrusion into Building 3602 was warranted. Additional investigation activities were completed in 2005 to assess remedial alternatives for consideration in the FS.

In March 2005, two directional wells were installed underneath the School of Music, and all site monitoring wells were sampled to provide a complete round of groundwater data. An SRI addendum was completed in March 2006 to reassess risk using data representative of current site conditions. The Navy in partnership with the USEPA Region III and the Virginia Department of Environmental Quality (VDEQ) agreed there is no unacceptable risk associated with iron, manganese, or thallium in groundwater and iron or chromium in soil at Site 11 (CH2M HILL, 2006a). Groundwater samples were collected in September 2006 to verify the presence/absence of PCP, which was detected in only one 1998 groundwater sample. PCP was not detected in groundwater in 2006; therefore, the Navy in partnership with the USEPA Region III and VDEQ agreed PCP is not a COC in Site 11 groundwater (CH2M HILL, 2006c). An FS was developed for Site 11 to address VOCs in groundwater.

The remedial alternatives evaluated were: no action, electrical resistance heating with ERD, and ERD (CH2M HILL, 2006b). The FS identified ERD accompanied by groundwater monitoring and LUCs as the recommended alternative.

A Proposed Plan (CH2M HILL, 2006d) was presented to the public in September 2006 and a ROD documenting the selected remedy (ERD, LUCs, and post-injection groundwater monitoring) was signed in July 2007 (CH2M HILL, 2007). The Remedial Action Work Plan (RAWP) and Sampling and Analysis Plan (SAP) (AGVIQ-CH2M HILL Joint Venture 1 [JV I], 2009) and the LUC Remedial Design (RD) were developed in accordance with the RAOs established in the ROD (CH2M HILL, 2007). A Five-Year Review was completed in March 2009 to determine if the selected remedy for Site 11 remained protective of human health and the environment. The Five-Year Review recommended the following: (1) re-evaluate the potential for vapor intrusion risk at Site 11 following resolution of risk evaluation methodology; (2) implement LUCs in accordance with the LUC RD and document the implementation in the Interim Remedial Action Completion Report for Site 11; and (3) apply permanent identification to all well casings (CH2M HILL, 2009). The RA construction activities were initiated in January 2009 and completed in May 2009 in association with the selected remedy outlined in the ROD (CH2M HILL, 2007). An RA Construction Completion Report (CCR) was completed in June 2010 (CH2M HILL, 2010) to document the RA.

1.3 Hydrogeology

JEB Little Creek is located within the Atlantic Coastal Plain Physiographic Province. The uppermost geologic unit at the facility is the Columbia Formation, which is characterized by interbedded clay, sand, gravel, and silt with some shell fragments. These sediments comprise the water-bearing strata of the shallow water table aquifer (Columbia aquifer). At Site 11, the water table is at a depth ranging seasonally from 2 to 7 feet below ground surface (bgs). The bottom of the Columbia aquifer is approximately 15 to 20 feet bgs, and is underlain by a clay confining unit (Yorktown Confining Unit) that ranges in thickness from 22 to 40 feet. This confining unit separates the Columbia aquifer from the deeper confined Yorktown aquifer.

Within the southern and eastern portions of Site 11, a leaking sanitary sewer located below the water table likely influenced the localized groundwater flow direction. The sanitary sewer was repaired in the Fall of 2007 before implementation of the RA. Groundwater elevations were measured during the baseline groundwater sampling events (September 2008 and February 2009) and 1, 3, 6, 9, and 12 months post-injection (injections performed in May 2009), as well as January 2009 and November 2010 to verify groundwater flow direction following repair of the sanitary sewer.

Groundwater elevations measured from August 2008 to November 2010 at Site 11 monitoring wells are tabulated in **Table 1-2**. Hydrographs presenting the groundwater elevations and monthly precipitation through time are included in **Appendix A**. Groundwater elevation contour maps for the Columbia aquifer are provided in **Figures 1-3** through **1-10**.

The groundwater flow direction from August 2008 to February 2010 generally ranged from southwest to south, with an average hydraulic gradient of approximately 0.0015 foot per foot (ft/ft) (**Figures 1-3 through 1-8**). However, during elevated precipitation events (such as August and November 2009), the hydraulic gradient is steeper (0.0027 ft/ft) due to

localized recharge in the grassy areas of the site and limited recharge in the footprint of Building 3602. In May 2010, the groundwater flow direction ranged from northwest to west, with an average hydraulic gradient of 0.002 ft/ft (**Figure 1-9**). In November 2010, the groundwater flow direction returned to southwest to west (**Figure 1-10**).

The hydraulic conductivity for Site 11 has historically been estimated based on pumping test data collected from nearby ER Site 12 in 2005. Based on the pump test data at Site 12, the hydraulic conductivity was approximated to be 110 feet per day (ft/day). In 2008, *in situ* hydraulic conductivity ("slug") testing was completed at ER Site 11a (located adjacent to the northern boundary of Site 11). Using the hydraulic conductivity estimated from ER Site 11a (3.15 ft/day), an effective porosity of 0.35, and an average gradient range of approximately 0.0005 ft/ft to 0.0036 ft/ft, the groundwater flow velocity in the Columbia aquifer at Site 11 is estimated to range from approximately 1.68 feet per year (ft/yr) to 11.83 ft/yr. This calculated groundwater flow velocity is much less than the groundwater flow velocity (230 ft/yr) calculated based on the hydraulic conductivity from ER Site 12 (110 ft/day); however, due to the proximity of Site 11a to Site 11 and the movement of the Site 11 plume from the source area, the hydraulic conductivity measured for Site 11a is more representative of Site 11 conditions, and therefore, the groundwater flow velocity calculated using the Site 11a hydraulic conductivity is more representative of the groundwater flow velocity at Site 11.

The extremely flat groundwater gradient at Site 11 is likely driven by the relative elevations in the surface water bodies that surround the site. These surface water bodies, including several golf course irrigation ponds approximately 2,700 ft to the northwest and a drainage canal approximately 650 ft to the south, are controlled by weirs and may not always be kept at the same elevation. Because of the flat water table, seemingly minor changes in a pond elevation, a leak into a sewer line, or the imperviousness of the ground surface can cause changes in the groundwater flow direction. The change in groundwater flow direction observed in May 2010 may have been influenced by well development and injection activities at nearby ER Site 13 conducted during the same time period as the water level survey; however, because the flow velocity is so low (a couple feet per year) these changes do not seem to have had a significant effect on the movement of the plume.

1.4 Remedial Action Objectives

Because of the potential human health risks associated with VOC contamination of groundwater in the Columbia aquifer, the Navy, USEPA, and VDEQ determined that RA was necessary to protect public health, welfare, and the environment from actual or threatened releases of VOCs from Site 11. Cleanup levels are the maximum contaminant levels (MCLs). When no MCL was available, a site-specific risk-based cleanup level was calculated, as in the case for 1,1-dichloroethane (DCA). The site-specific RAOs are as follows:

- Prevent exposure to Site 11 groundwater until concentrations of VOCs have been reduced to levels that allow for unlimited use and unrestricted exposure.
- Reduce concentrations of VOCs in Site 11 groundwater to the maximum extent practicable (with remediation goals at MCLs) within a reasonable amount of time.

The selected remedy presented in the ROD (CH2M HILL, 2007), is ERD with LUCs and groundwater monitoring. The effectiveness of ERD treatment of VOCs in groundwater will

TABLE 1-1
Previous Investigation Summary
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

Date	Investigation
December 1984	Initial Assessment Study
October 1986	Round I Verification Step
December 1989	Resource Conservation and Recovery Act Facility Assessment
November 1991	Interim Remedial Investigation
November 1994	Remedial Investigation/Feasibility Study
November 1994	Decision Document
May 1996	Interim Removal Action Final Closeout Report
February 1998	Final Groundwater Monitoring Report Sites 5 and 11
June 2000	Screening Ecological Risk Assessment
April 2003	CD Pilot Study
November 2003	Membrane Interface Probe Investigation
June 2004	Supplemental Remedial Investigation
July 2005	Vapor Intrusion Investigation
June 2006	Feasibility Study
September 2006	Proposed Plan
July 2007	Record of Decision
March 2009	Five-Year Review
April 2009	Remedial Action Work Plan and Sampling and Analysis Plan
May 2010	Land Use Control Remedial Design
June 2010	Remedial Action Construction Completion Report

TABLE 1-2
Groundwater Elevations
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

Groundwater Elevations (ft amsl)								
Well ID	**08/28/2008**	**01/30/2009**	**06/10/2009**	**08/13/2009**	**11/23/2009**	**02/01/2010**	**05/24/2010**	**11/08/2010**
LS11-MW04D	1.39	2.03	N/A	N/A	3.02	2.70	2.47	2.12
LS11-MW05D	N/A	2.01	2.42	2.86	3.20	2.76	2.46	2.14
LS11-MW05S	1.42	2.06	2.43	2.83	3.04	2.73	2.48	2.11
LS11-MW06D	1.29	1.81	1.29	2.95	2.72	2.66	1.78	1.95
LS11-MW07D	1.33	1.94	2.33	2.42	2.81	2.50	2.31	2.11
LS11-MW08D	1.36	1.87	N/A	2.22	2.54	2.74	2.45	2.13
LS11-MW09D	N/A	1.84	2.20	2.21	2.96	2.83	2.62	2.24
LS11-MW10D	1.16	1.68	2.29	1.95	2.85	2.52	2.68	1.97
LS11-MW11D	1.30	1.57	1.76	1.81	2.37	2.41	4.45	N/A
LS11-MW12D	N/A	1.70	1.98	2.03	2.82	2.85	2.72	2.25
LS11-MW13D	1.92	2.36	N/A	2.20	2.73	2.87	2.57	N/A
LS11-MW14D	1.27	1.63	1.95	2.02	2.29	2.52	2.00	1.90
LS11-MW15D	1.51	1.94	2.04	1.79	2.94	2.62	1.88	1.97
LS11-MW17D	1.49	2.07	2.38	2.75	3.18	2.93	2.63	N/A
LS11-MW23D	N/A	N/A	2.41	3.02	2.33	3.33	2.38	2.16
LS11-MW24D	1.37	1.39	2.41	2.88	N/A	N/A	2.34	2.22
LS11-MW25D	1.18	1.76	2.43	3.11	2.80	2.67	2.40	2.13
LS11-MW26D	N/A	N/A	2.35	2.91	2.94	2.76	1.65	1.91
LS11-MW27D	N/A	N/A	2.38	3.05	2.90	2.62	1.30	2.08
LS11-MW28D	N/A	N/A	N/A	3.03	N/A	2.25	2.40	2.14
LS11-MW29D	N/A	N/A	2.52	2.95	3.96	2.43	2.23	2.15
LS11-MW30D	N/A	N/A	2.42	3.05	3.00	1.41	2.42	2.14
LS11-MW38D	N/A	1.43	2.36	2.24	2.55	2.51	2.16	2.04
LS11-MW39D	N/A	N/A	2.41	2.73	3.25	2.79	2.44	2.15
LS11-MW40D	N/A	1.57	1.95	2.08	2.62	2.73	N/A	2.16
LS11-MW41D	N/A	1.26	2.17	1.95	1.84	2.65	2.30	2.17
LS11-MW42D	N/A	1.97	2.23	1.95	3.09	2.71	1.97	N/A

Notes:
ft amsl - feet above mean sea level
N/A- groundwater elevation not collected

TABLE 1-3
Contaminants of Concern Cleanup Goals
ERD Annual Groundwater Monitoring Summary
Site 11 School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

Contaminants of Concern	Cleanup Goal (µg/L)	Maximum Concentration (µg/L)			
		Baseline		12-Month Post-injection	
		Concentration	Monitoring Well	Concentration	Monitoring Well
Trichloroethene	5	120,000	MW38D	92,000 L	MW38D
cis-1,2-Dichloroethene	70	83,000	MW38D	200,000 L	MW38D
trans-1,2-Dichloroethene	100	22 J	MW39D	1.2	MW06D
1,1-Dichloroethene	7	7,500	MW38D	8,400	MW38D
Vinyl chloride	2	4,600	MW38D	2,600	MW38D
1,1,1-Trichloroethane	200	62,000	MW38D	71,000	MW38D
1,1-Dichloroethane	2,900*	14,000	MW38D	16,000	MW38D
1,1,2-Trichlorothane	5	ND		ND	
1,2-Dichloroethane	5	ND		ND	
Carbon tetrachloride	5	ND		ND	
Methylene chloride	5	2,700	MW38D	3,800	MW38D
Chloroform	9.6*	1.2 J	MW10D	1	MW10D
1,2-Dichloropropane	5	1.4 J	MW10D	1.3	MW10D

Notes:
Cleanup levels are the maximum contaminant level (MCL) unless otherwise noted
* Risk-based cleanup level
Exceeds cleanup level
L - Analyte present, value may be biased low, actual value may be higher
J - Analyte present, value may or may not be accurate or precise
mg/L - Micrograms per liter
ND - Not detected

\\NORTHEND\PROJ\USNAVFACENGCOM\LITTLECREEK\MAPFILES\386509_SITE11_ERD_AGM_SUMMARY\FIGURE 1-1 - SITE LOCATION.MXD CBOWMAN 7/21/2010 14:55:19

Legend

- JEB Little Creek Boundary
- LUC Boundary

N
W E
S

0 1,000 2,000
Feet

Figure 1-1
Site Location
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\LITTLECREEK\MAPFILES\386509_SITE11_ERD_AGM_SUMMARY\FIGURE 1-2 - SITE LAYOUT WELLS.MXD CBOWMAN 1/27/2011 11:44:59

Legend

- Existing Monitoring Well not Employed for the Remedial Action
- Flushmount Access to Existing 45° Directional Monitoring Well
- Annual Monitoring Well
- Performance Monitoring Well (1, 3, 6, and 9 months)
- Monitoring Well used for injection
- Injection Well
- LUC Boundary
- Water Line
- Sanitary Sewer
- Sanitary Sewer Line Repaired
- Storm Water
- Heat Cool Line
- Electrical Cable Line

N W E S

0 50 100 Feet

Figure 1-2
Site Layout
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\LITTLECREEK\MAPFILES\386509_SITE11_ERD_AGM_SUMMARY\FIGURE 1-3 - POT SURFACE AUGUST 2008.MXD CBOWMAN 7/21/2010 14:59:36

Legend

- Existing Monitoring Well not Employed for the Remedial Action
- Flushmount Access to Existing 45° Directional Monitoring Well
- Annual Monitoring Well
- Performance Monitoring Well (1, 3, 6, and 9 months)
- Monitoring Well used for injection
- Injection Well
- Groundwater Contour (dashed where inferred)
- Groundwater Flow Direction
- Water Line
- Sanitary Sewer
- Sanitary Sewer Line Repaired
- Storm Water
- Heat Cool Line
- Electrical Cable Line
- LUC Boundary

All elevations in feet mean sea level
* Groundwater elevation not used for contouring

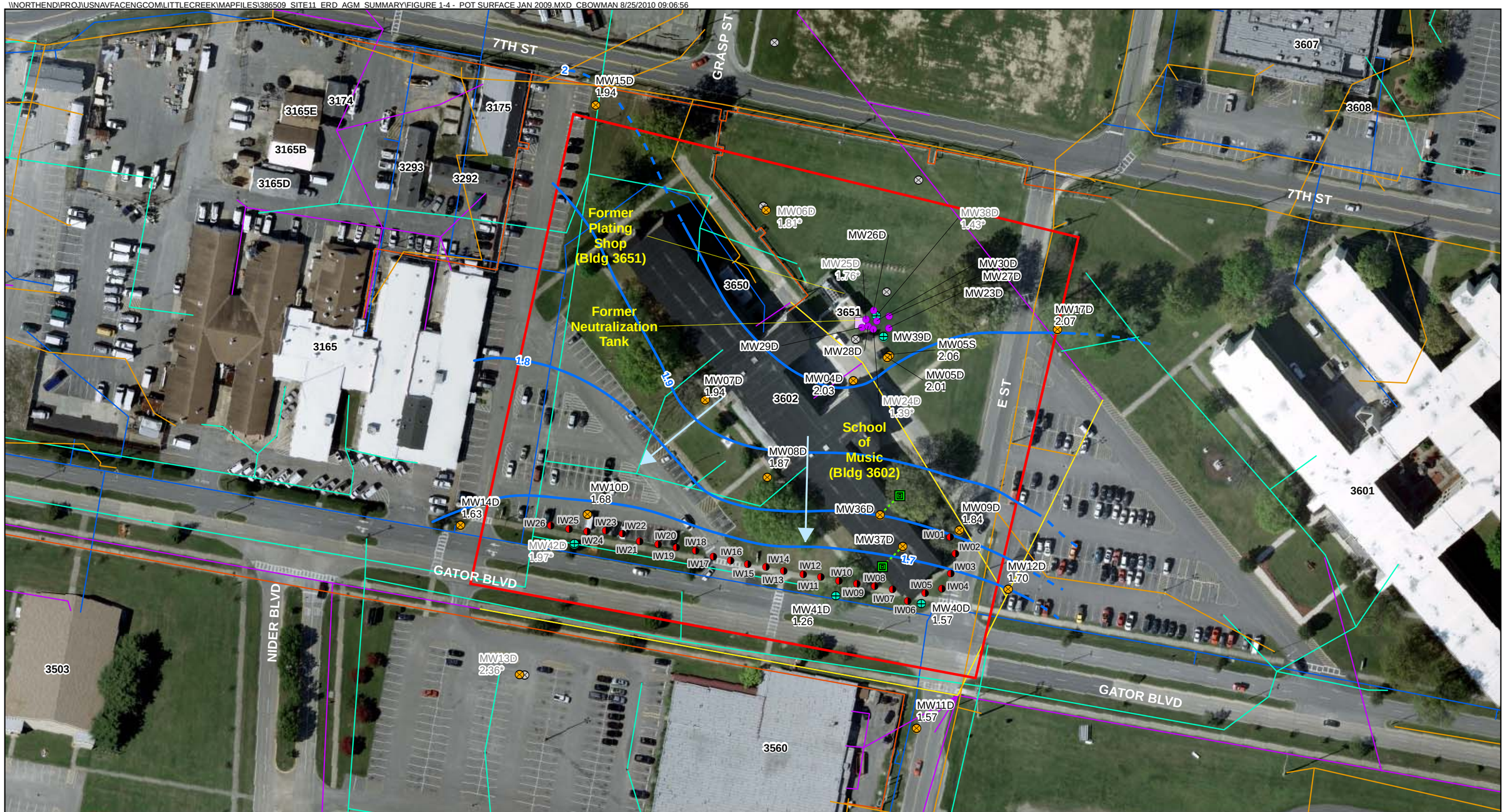
N
W E
S

0 50 100
Feet

Figure 1-3
Groundwater Elevation (August 2008)
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\LITTLECREEK\MAPFILES\386509_SITE11_ERD_AGM_SUMMARY\FIGURE 1-4 - POT SURFACE JAN 2009.MXD CBOWMAN 8/25/2010 09:06:56



Legend

- Existing Monitoring Well not Employed for the Remedial Action
- Flushmount Access to Existing 45° Directional Monitoring Well
- Annual Monitoring Well
- Performance Monitoring Well (1, 3, 6, and 9 months)
- Monitoring Well used for injection
- Injection Well
- Groundwater Contour (dashed where inferred)
- Groundwater Flow Direction
- Water Line
- Sanitary Sewer
- Storm Water
- Sanitary Sewer Line Repaired
- Heat Cool Line
- Electrical Cable Line
- LUC Boundary

All elevations in feet mean sea level
* Groundwater elevation not used for contouring

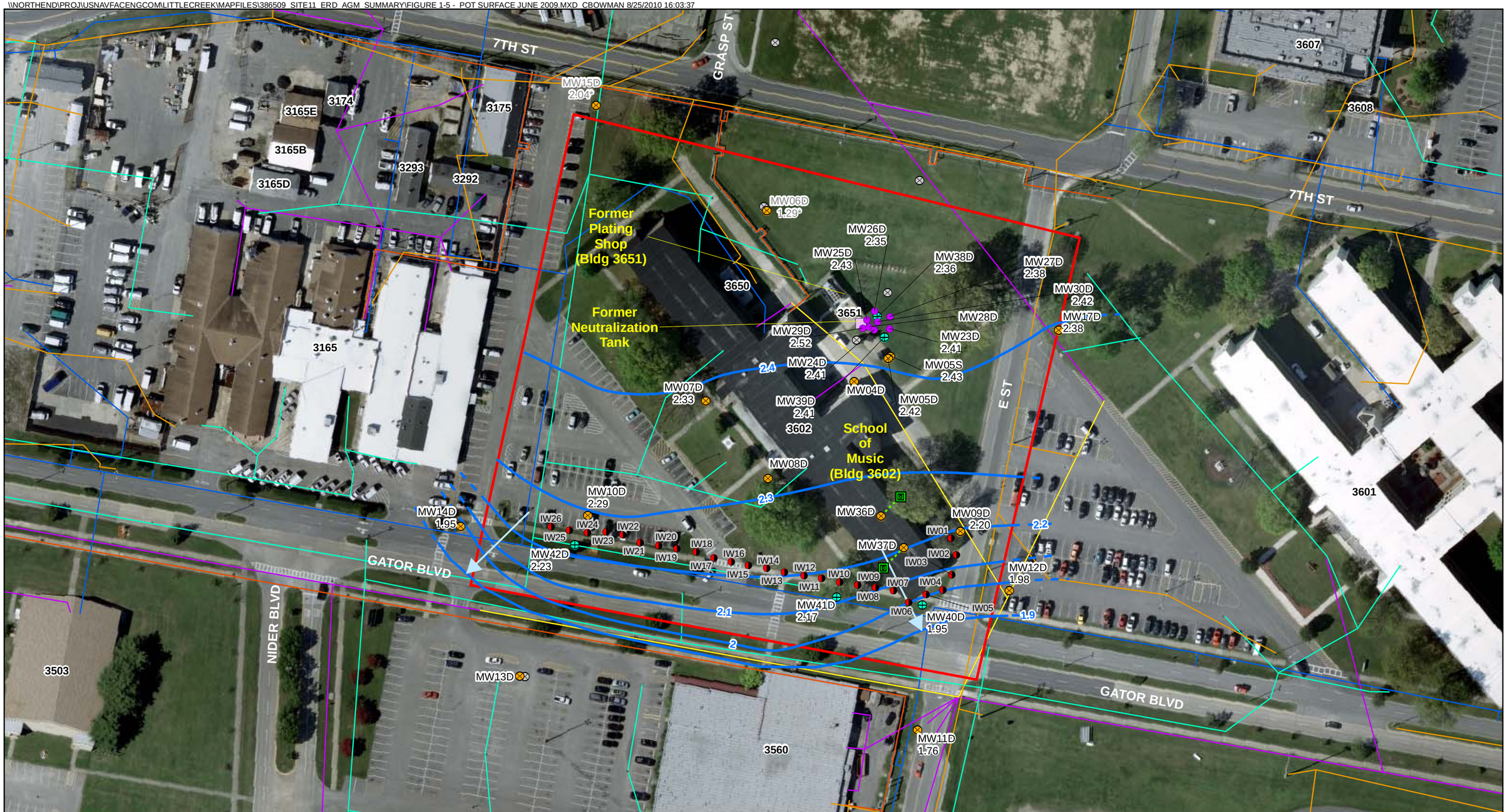
N
W E
S

0 50 100 Feet

Figure 1-4
Groundwater Elevation (January 2009)
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\LITTLECREEK\MAPFILES\386509_SITE11_ERD_AGM_SUMMARY\FIGURE 1-5 - POT SURFACE JUNE 2009.MXD CBOWMAN 8/25/2010 16:03:37



Legend

- Existing Monitoring Well not Employed for the Remedial Action
- Flushmount Access to Existing 45° Directional Monitoring Well
- Annual Monitoring Well
- Performance Monitoring Well (1, 3, 6, and 9 months)
- Monitoring Well used for injection
- Injection Well
- Groundwater Contour (dashed where inferred)
- Groundwater Flow Direction
- Water Line
- Sanitary Sewer
- Sanitary Sewer Line Repaired
- Storm Water
- Heat Cool Line
- Electrical Cable Line
- LUC Boundary

All elevations in feet mean sea level
* Groundwater elevation not used for contouring

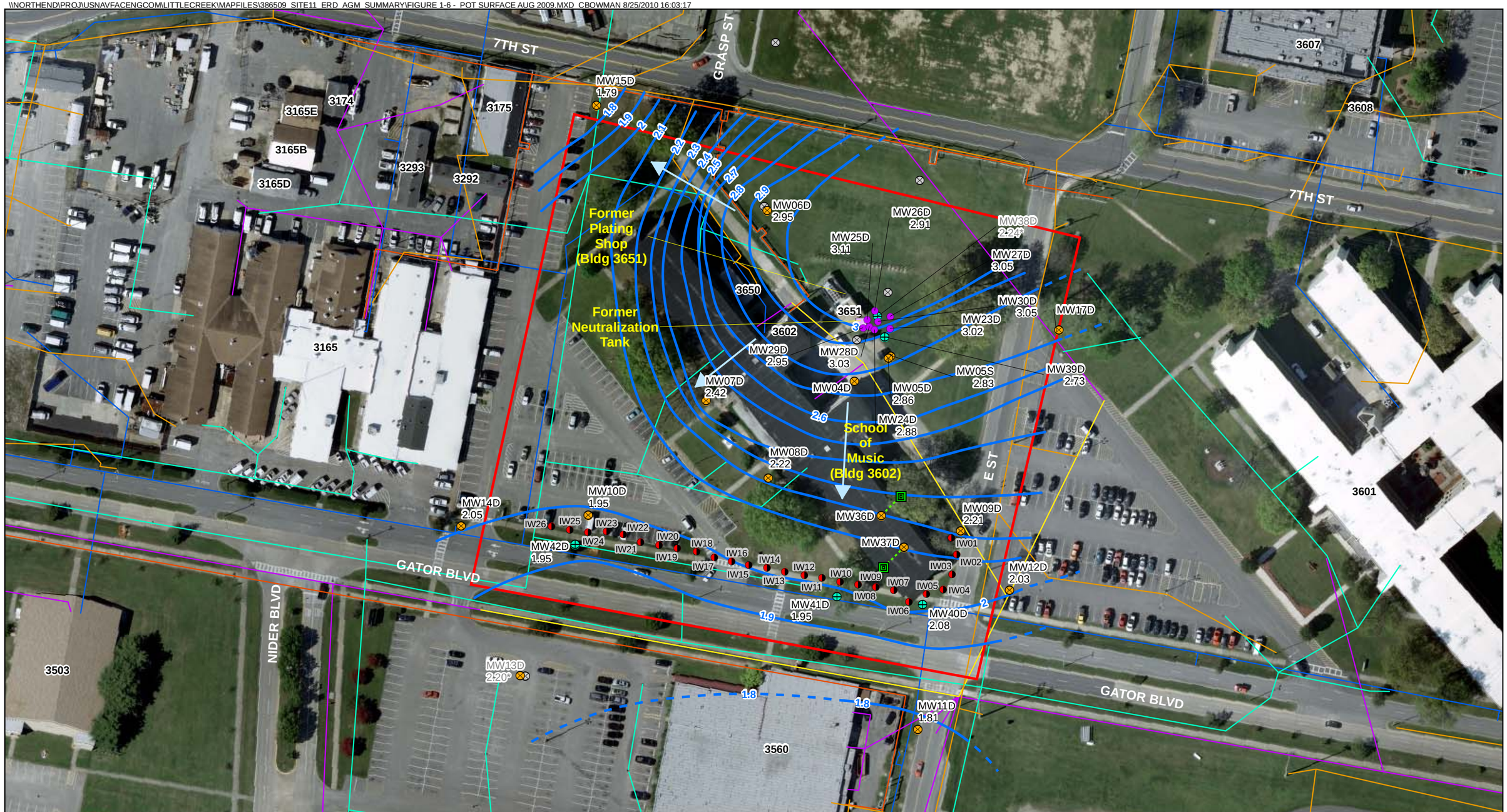
N
W E
S

0 50 100
Feet

Figure 1-5
Groundwater Elevation (June 2009)
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\LITTLECREEK\MAPFILES\386509_SITE11_ERD_AGM_SUMMARY\FIGURE 1-6 - POT SURFACE AUG 2009.MXD CBOWMAN 8/25/2010 16:03:17



Legend

- Existing Monitoring Well not Employed for the Remedial Action
- Flushmount Access to Existing 45° Directional Monitoring Well
- Annual Monitoring Well
- Performance Monitoring Well (1, 3, 6, and 9 months)
- Monitoring Well used for injection
- Injection Well
- Groundwater Contour (dashed where inferred)
- Groundwater Flow Direction
- Water Line
- Sanitary Sewer
- Sanitary Sewer Line Repaired
- Storm Water
- Heat Cool Line
- Electrical Cable Line
- LUC Boundary

All elevations in feet mean sea level
* Groundwater elevation not used for contouring

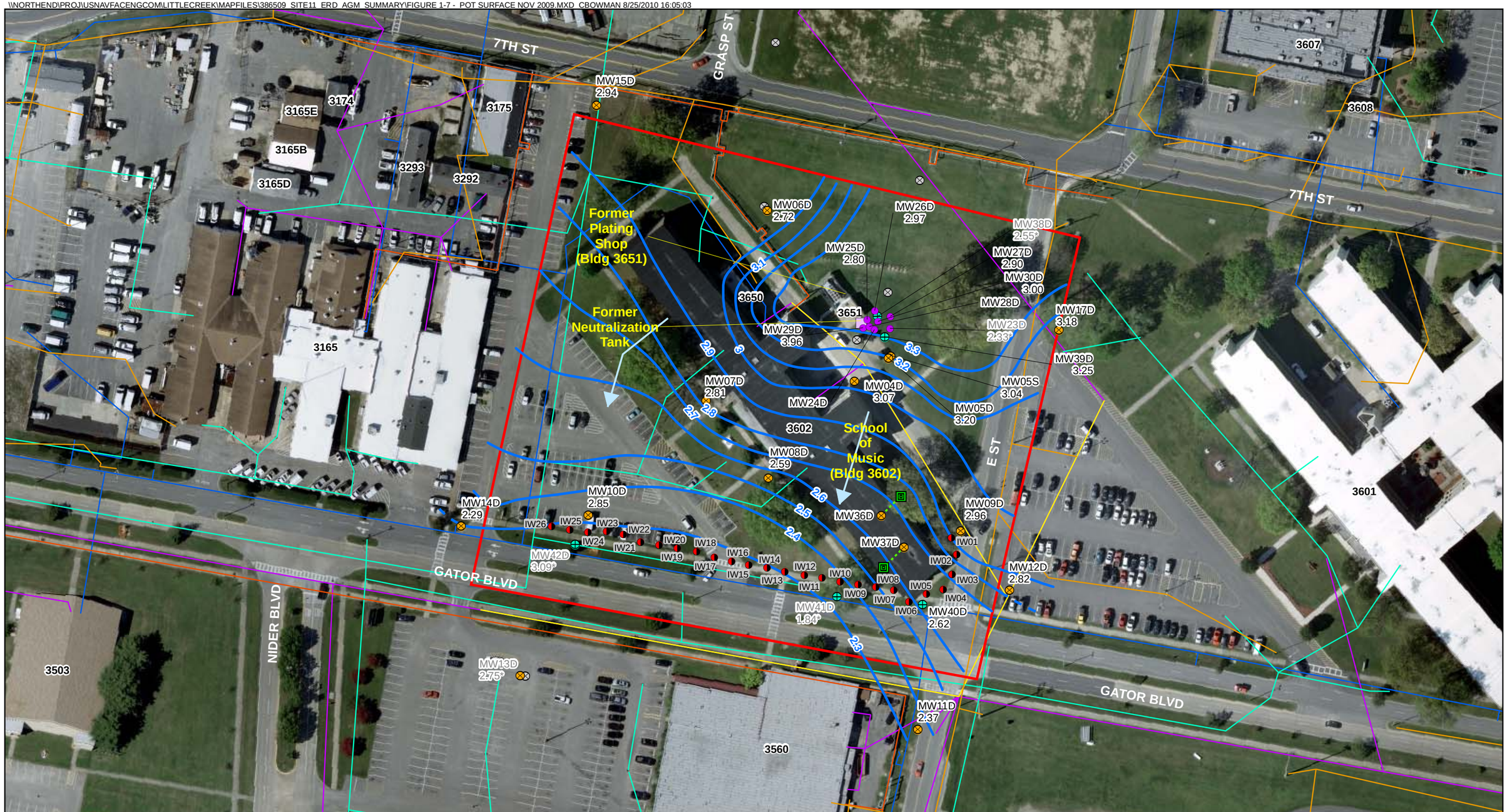
N W E S

0 50 100 Feet

Figure 1-6
Groundwater Elevation (August 2009)
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\LITTLECREEK\MAPFILES\386509_SITE11_ERD_AGM_SUMMARY\FIGURE 1-7 - POT SURFACE NOV 2009.MXD CBOWMAN 8/25/2010 16:05:03



Legend

- Existing Monitoring Well not Employed for the Remedial Action
- Flushmount Access to Existing 45° Directional Monitoring Well
- Annual Monitoring Well
- Performance Monitoring Well (1, 3, 6, and 9 months)
- Monitoring Well used for injection
- Injection Well
- Groundwater Contour (dashed where inferred)
- Groundwater Flow Direction
- Water Line
- Sanitary Sewer
- Sanitary Sewer Line Repaired
- Storm Water
- Heat Cool Line
- Electrical Cable Line
- LUC Boundary

All elevations in feet mean sea level
* Groundwater elevation not used for contouring

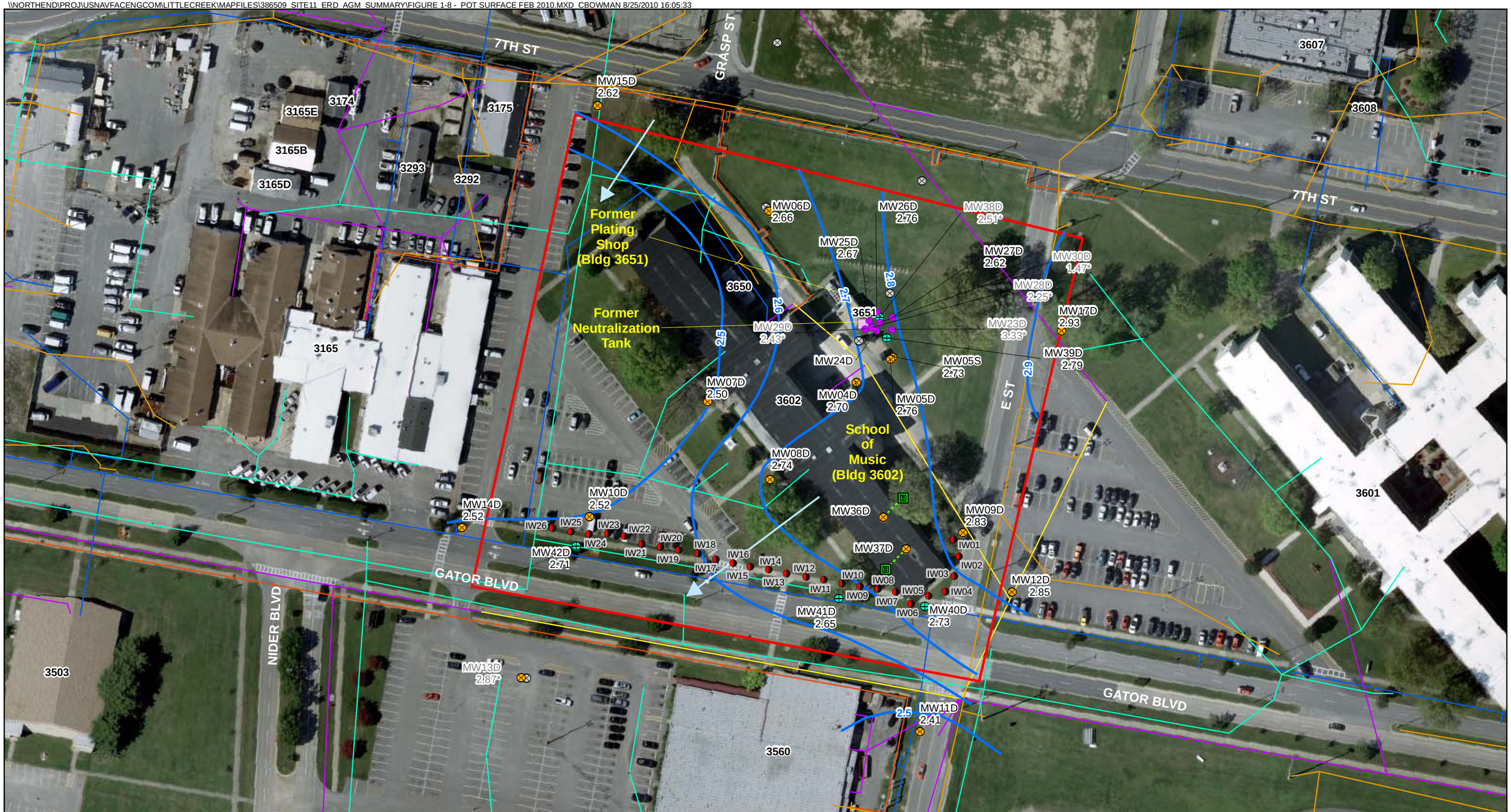
N
W E
S

0 50 100
Feet

Figure 1-7
Groundwater Elevation (November 2009)
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\LITTLECREEK\MAPFILES\386509_SITE11_ERD_AGM_SUMMARY\FIGURE 1-8 - POT SURFACE FEB 2010.MXD CBOWMAN 8/25/2010 16:05:33



Legend

- Existing Monitoring Well not Employed for the Remedial Action
- Flushmount Access to Existing 45° Directional Monitoring Well
- Annual Monitoring Well
- Performance Monitoring Well (1, 3, 6, and 9 months)
- Monitoring Well used for injection
- Injection Well
- Groundwater Contour (dashed where inferred)
- Groundwater Flow Direction
- Water Line
- Sanitary Sewer
- Sanitary Sewer Line Repaired
- Storm Water
- Heat Cool Line
- Electrical Cable Line
- LUC Boundary

All elevations in feet mean sea level
* Groundwater elevation not used for contouring

N
W E
S

0 50 100
Feet

Figure 1-8
Groundwater Elevation (February 2010)
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\LITTLECREEK\MAPFILES\386509_SITE11_ERD_AGM_SUMMARY\FIGURE 1-9 - POT SURFACE MAY 2010.MXD CBOWMAN 8/25/2010 09:17:26

Legend

- Existing Monitoring Well not Employed for the Remedial Action
- Flushmount Access to Existing 45° Directional Monitoring Well
- Annual Monitoring Well
- Performance Monitoring Well (1, 3, 6, and 9 months)
- Monitoring Well used for injection
- Injection Well
- Groundwater Contour (dashed where inferred)
- Groundwater Flow Direction
- Water Line
- Sanitary Sewer
- Sanitary Sewer Line Repaired
- Storm Water
- Heat Cool Line
- Electrical Cable Line
- LUC Boundary

All elevations in feet mean sea level
* Groundwater elevation not used for contouring

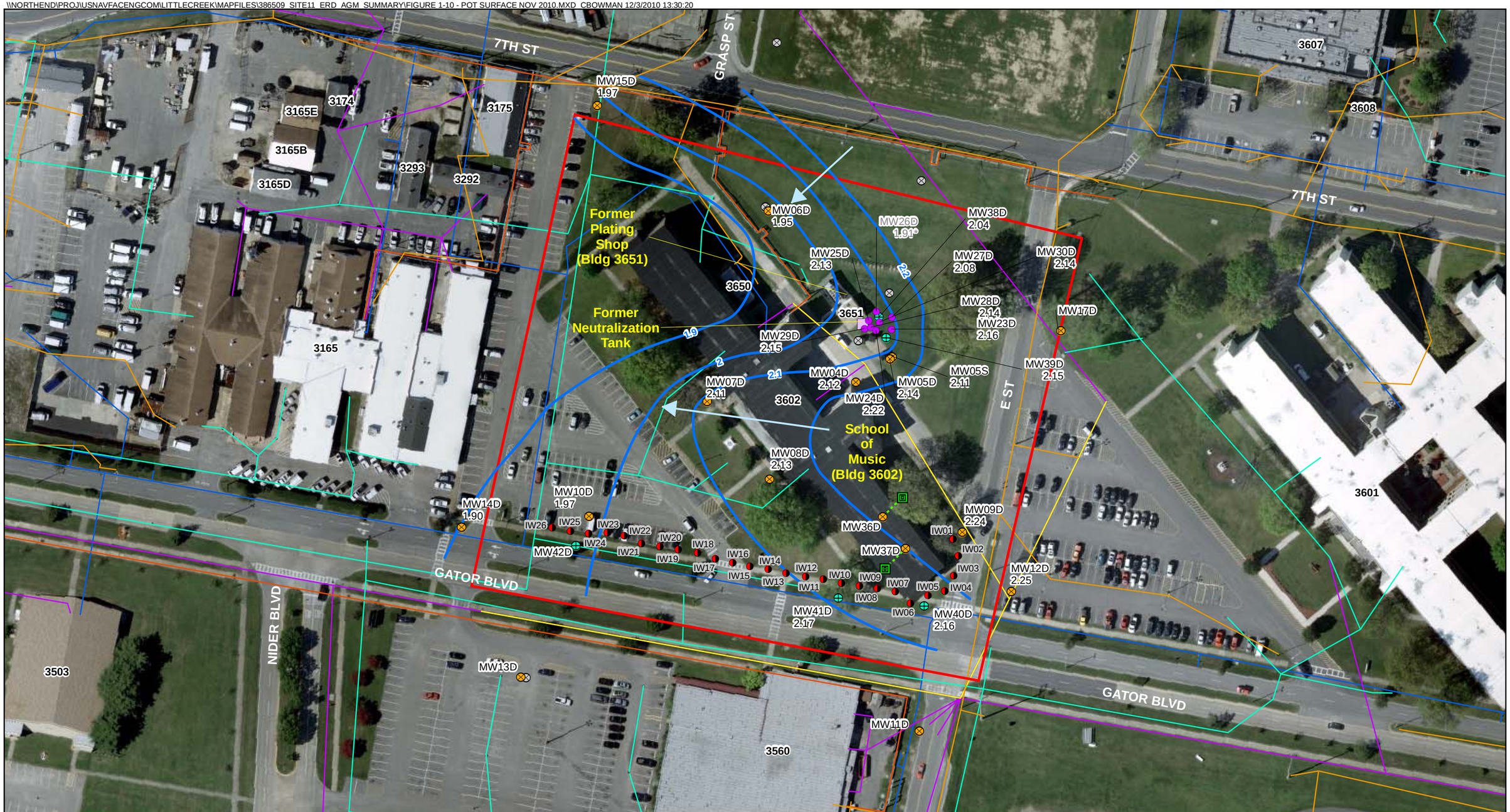
N
W E
S

0 50 100
Feet

Figure 1-9
Groundwater Elevation (May 2010)
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\LITTLECREEK\MAPFILES\386509_SITE11_ERD_AGM_SUMMARY\FIGURE 1-10 - POT SURFACE NOV 2010.MXD CBOWMAN 12/3/2010 13:30:20



Legend

- Existing Monitoring Well not Employed for the Remedial Action
- Flushmount Access to Existing 45° Directional Monitoring Well
- Annual Monitoring Well
- Performance Monitoring Well (1, 3, 6, and 9 months)
- Monitoring Well used for injection
- Injection Well
- Groundwater Contour (dashed where inferred)
- Groundwater Flow Direction
- Water Line
- Sanitary Sewer
- Sanitary Sewer Line Repaired
- Storm Water
- Heat Cool Line
- Electrical Cable Line
- LUC Boundary

All elevations in feet mean sea level
* Groundwater elevation not used for contouring

N
W E
S

0 50 100
Feet

Figure 1-10
Groundwater Elevation (November 2010)
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

SECTION 2

Remedial Action Design and Field Approach

The construction for the remedy was completed in accordance with the RAWP (JV I, 2009) and is documented in the RA CCR (CH2M HILL, 2010). Substrate injection was completed between April 27 and May 6, 2009 followed by performance monitoring 1-, 3-, 6-, 9-, and 12-months post-injection.

2.1 ERD Overview

Reductive dechlorination is a naturally occurring, microbially mediated, anaerobic process in which chlorine atoms on a parent chlorinated VOC molecule are sequentially replaced with hydrogen. In the reductive dechlorination process, electrons are transferred from an electron donor source to the VOC compound, which functions as the electron acceptor. Therefore, an external electron donor source is required for the reaction to occur. Additionally, deeply anaerobic (reducing) conditions are required for reductive dechlorination of many VOCs, and competing electron acceptors such as dissolved oxygen (DO), nitrate, nitrite, manganese (IV), ferric iron, and sulfate must be depleted. The predominant parent COCs at Site 11 are TCE, 1,1,1-TCA, and carbon tetrachloride (CT).

The principal anaerobic biodegradation pathway for TCE is:

TCE → cis-1,2-dichloroethene (DCE) → vinyl chloride (VC) → ethene → ethane

Trans-1,2-DCE and 1,1-DCE are also generated during this process, but to a lesser extent than cis-1,2-DCE. The transformation rate for each step varies but tends to become slower with progress along the breakdown sequence, often resulting in accumulation of 1,2-DCE and VC. Further breakdown from DCE and VC to ethene varies and is based on site-specific conditions.

1,1,1-TCA degrades biotically to 1,1-DCA and abiotically to 1,1-DCE. Following this step, the principal anaerobic biodegradation pathway is:

1,1-DCA → chloroethane
1,1-DCE → VC → ethene → ethane

The principal anaerobic biodegradation pathway for chlorinated methanes is:

CT → chloroform → methylene chloride → methyl chloride → methane

To enhance the degradation of COCs at Site 11, the injectate applied to the site was comprised of Slow-Release Substrate (SRS) brand emulsified oil substrate, sodium bicarbonate, and potable water. SRS is a low-viscosity liquid that contains a combination of slow- and fast-release electron donors and required nutrients. The lactate provides a readily available carbon source, while the food grade oil serves as a slower-release carbon source to provide sustained conditions suitable for reductive dechlorination. The nutrients are intended to aid biotic stimulation. Because the degradation of substrate during the reductive dechlorination process has the potential to lower the pH in systems without adequate

buffering capacity, sodium bicarbonate was added as a pre-emptive measure to provide additional buffering capacity and protect against decreasing pH. This addition was not specified in the RAWP and SAP but was approved via email by USEPA (USEPA, 2009) and VDEQ (VDEQ, 2009) in April 2009. Water was added to increase the substrate volume to achieve the desired radius of influence.

2.2 Rationale for the Remedial Design

Based on analytical data and the membrane interface probe investigation, the concentrations of VOCs in groundwater vary spatially across the site with the greatest concentrations detected in the vicinity of the former School of Music Plating Shop (Building 3651) and extending under and beyond Building 3602 south/southwest toward Gator Boulevard. The spatial extent of the groundwater plume based on the baseline data is depicted in **Figure 2-1**. Vertically, VOCs in groundwater are located within the deep portion of the Columbia aquifer.

The injection and monitoring well network was designed to target both the source zone near the former Plating Shop (Building 3651) and the downgradient edge of the plume along Gator Boulevard and E Street (**Figure 2-1**). When already appropriately positioned, existing monitoring wells were used as either injection or monitoring wells to minimize the number of new wells required for the RA. New injection and monitoring wells were installed to target the deep portion of the Columbia aquifer with a 5-foot well screen placed at the bottom of the Columbia aquifer which ranges from approximately 17 to 25 feet bgs (**Table 2-1)**.

2.2.1 Injection Wells

As shown in **Figure 2-1**, existing monitoring wells MW23D, MW24D, MW25D, MW26D, MW27D, MW28D, MW29D, and MW30D were located within the vicinity of the source zone, and thus used as injection wells to target the area where the highest concentrations were detected. To address the downgradient dissolved-phase contamination and prevent offsite migration, 26 injection wells (IW01 through IW26) were installed along the leading edges of the plume. Injection wells IW01 through IW26 were installed with continuous wire-wrapped screens. The screen intervals in wells used for the RA substrate injection are detailed in **Table 2-1**.

2.2.2 Monitoring Wells

Monitoring wells were used to evaluate both the adequacy and performance of the bioremediation system (performance monitoring wells) and the overall effectiveness of the treatment (annual monitoring wells). The performance monitoring wells are located in close proximity to the injection wells and at the same depth as the corresponding upgradient injection well. Annual monitoring wells are located upgradient of the plume, within the plume, and downgradient of the plume to evaluate changes over time and include performance monitoring wells. The screen intervals for the performance and annual monitoring wells are detailed in **Table 2-1**.

2.3 Groundwater Monitoring

Groundwater monitoring was completed for designated monitoring wells before injection of substrate to serve as a baseline, and 1, 3, 6, 9, and 12 months post-injection to monitor the

effectiveness of the injection and the performance of the substrate over time. Groundwater monitoring was conducted in accordance with the RAWP and SAP (JV I, 2009). Prior to sampling activities (during the baseline, and 1-, 3-, 6-, 9-, and 12-month post-injection events), select site wells were gauged using a water level meter. The depth to water from the top of the polyvinyl chloride (PVC) well casing and total well depth were measured for the selected site wells. The groundwater elevations are shown in **Table 1-2**. The results from the water level measurements are discussed above in Section 1.3 Hydrogeology.

Monitoring well locations are shown in **Figure 1-2**. Monitoring well identification numbers and dates of sample collection are provided in **Table 2-1.** The field and analytical parameters evaluated for each event are detailed in **Table 2-2**. Field parameters were measured using a Horiba U-22 water quality meter. Additionally, field DO measurements were verified with CHEMets field test kits, and ferrous iron concentrations were field determined using HACH field test kits.

TABLE 2-1
Well Screen Intervals and Sampling Dates
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

Well	Screened Interval (ft bgs)	Baseline	Sample Collection Date				
			Month After Injection				
			1	3	6	9	12
Injection Wells							
LS11-IW01	15.5 – 20.5	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW02	15.5 – 20.5	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW03	14.5 – 19.5	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW04	14 – 19	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW05	14.5 – 19.5	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW06	14.5 – 19.5	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW07	14.5 – 19.5	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW08	14 – 19	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW09	13.5 – 18.5	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW10	16 – 21	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW11	17 – 22	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW12	16 – 21	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW13	19 – 24	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW14	19 – 24	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW15	20 – 25	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW16	21 – 26	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW17	17.5 – 22.5	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW18	21 – 26	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW19	21 – 26	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW20	19.5 – 24.5	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW21	18 – 23	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW22	19 – 24	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW23	19.5 – 24.5	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW24	20 – 25	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW25	18 – 23	N/A	N/A	N/A	N/A	N/A	N/A
LS11-IW26	19 – 24	N/A	N/A	N/A	N/A	N/A	N/A
LS11-MW23D	17 – 22	N/A	N/A	N/A	N/A	N/A	N/A
LS11-MW24D	17 – 22	N/A	N/A	N/A	N/A	N/A	N/A
LS11-MW25D	18.5 – 23.5	N/A	N/A	N/A	N/A	N/A	N/A
LS11-MW26D	17 – 22	N/A	N/A	N/A	N/A	N/A	N/A
LS11-MW27D	16 – 21	N/A	N/A	N/A	N/A	N/A	N/A
LS11-MW28D	17 – 22	N/A	N/A	N/A	N/A	N/A	N/A
LS11-MW29D	16 – 21	N/A	N/A	N/A	N/A	N/A	N/A
LS11-MW30D	18 – 23	N/A	N/A	N/A	N/A	N/A	N/A
Monitoring Wells							
LS11-MW04D	15 – 20	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW05D	15 – 20	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW05S	7 – 12	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW06D	15 – 20	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW07D	15 – 20	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW08D	15 – 20	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW09D	15 – 20	Sep 2008	Jun 2009	Aug 2009	Nov 2009	Feb 2010	May 2010

TABLE 2-1
Well Screen Intervals and Sampling Dates
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

Well	Screened Interval (ft bgs)	Baseline	Sample Collection Date				
			Month After Injection				
			1	3	6	9	12
LS11-MW10D	15 – 20	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW11D	15 – 20	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW12D	15 – 20	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW13D	15 – 20	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW14D	18 – 23	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW15D	15 – 20	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW17D	15 – 20	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW36D	29.4 – 40	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW37D	29 – 39	Sep 2008	N/A	N/A	N/A	N/A	May 2010
LS11-MW38D	19 – 24	Feb 2009	Jun 2009	Aug 2009	Nov 2009	Feb 2010	May 2010
LS11-MW39D	17 – 22	Feb 2009	Jun 2009	Aug 2009	Nov 2009	Feb 2010	May 2010
LS11-MW40D	15 – 20	Jan 2009	Jun 2009	Aug 2009	Nov 2009	Feb 2010	May 2010
LS11-MW41D	16 – 21	Jan 2009	Jun 2009	Aug 2009	Nov 2009	Feb 2010	May 2010
LS11-MW42D	18 – 23	Feb 2009	Jun 2009	Aug 2009	Nov 2009	Feb 2010	May 2010

Notes:
ft bgs - feet below ground surface
N/A- well not sampled during remedial action

TABLE 2-2
Monitoring Schedule
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

Parameter	Baseline 2008	Baseline 2009	Month After Injection				
			1	3	6	9	12
Field parameters: (temperature, conductivity, turbidity, pH, oxidation-reduction potential, ferrous iron, dissolved oxygen)	S	S	S	S	S	S	S
Volatile organic compounds	S	S	S	S	S	S	S
Total organic carbon, methane, ethane, ethene,	S	S	S	S	S	S	S
Geochemical parameters: (dissolved iron, dissolved manganese, sulfate, sulfide)	S	S	S	NS	S	NS	S
Volatile fatty acids	S	S	S	S	S	S	S
Dissolved arsenic	S	S	NS	NS	NS	NS	S

Notes:
S = Sampled
NS = Not Sampled

Monitoring Well	Screen Inteval (ft bgs)
LS11-MW04D	15-20
LS11-MW05D	15-20
LS11-MW06D	15-20
LS11-MW07D	15-20
LS11-MW08D	15-20
LS11-MW09D	15-20
LS11-MW10D	15-20
LS11-MW11D	15-20
LS11-MW12D	15-20
LS11-MW13D	15-20
LS11-MW14D	18-23
LS11-MW15D	15-20
LS11-MW17D	15-20
LS11-MW36D	29.4-40
LS11-MW37D	29-39
LS11-MW38D	19-24
LS11-MW39D	17-22
LS11-MW40D	15-20
LS11-MW41D	16-21
LS11-MW42D	18-23

Legend

- Existing Monitoring Well not Employed for the Remedial Action
- Flushmount Access to Existing 45° Directional Monitoring Well
- Annual Monitoring Well
- Performance Monitoring Well (1, 3, 6, and 9 months)
- Monitoring Well used for injection
- Injection Well

Concentrations are in µg/L

- Isoconcentration Contour (Dashed where inferred)

Isoconcentrations (September 2008 and February 2009)

- 1-10
- 10-100
- 100-1,000
- 1,000-10,000
- >10,000

Note:
Baseline Sampling took place in Aug/Sep 2008 and Jan/Feb 2009
ND- Analytes not detected at concentrations greater than the cleanup goal

- Water Line
- Sanitary Sewer
- Sanitary Sewer Line Repaired
- Storm Water
- Heat Cool Line
- Electrical Cable Line
- LUC Boundary

N W E S

0 50 100 Feet

Figure 2-1
Total COC Isoconcentration Contours
Columbia Aquifer (Baseline)
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

SECTION 3

Analytical Results and Discussion

This section summarizes the rationale and results for the analytical and field parameters that were evaluated for this remedy. This section also provides an overview of the treatment system performance for each treatment area, as well as the overall effectiveness of the remedy.

3.1 Analytical and Field Parameters

The well identification numbers, well screen intervals, and collection date, are provided in **Table 2-1.** The parameters sampled during each event are provided in **Table 2-2**. Analytical and field data are summarized in **Table 3-1.** The complete data set is provided in **Appendix B**.

In addition to monitoring the COCs and their daughter products, several parameters were analyzed to ascertain the effectiveness of the SRS application. While SRS was not directly measured; total organic carbon (TOC) concentrations can be used as a surrogate for the distribution of SRS since the carbon component of the SRS is represented in the TOC concentrations. TOC concentrations of approximately 20 milligrams per liter (mg/L) or greater generally indicate the presence of adequate carbon and energy sources for continued reductive dechlorination. Fermentation of the SRS results in the generation of volatile fatty acids (VFAs) including lactate, pyruvate, propionate, acetate, and butyrate. Therefore, the presence of these constituents is indicative of a robust fermentation environment. Additionally, ferrous iron concentrations greater than 1 mg/L, sulfate concentrations less than 20 mg/L, sulfide concentrations greater than 1 mg/L, and methane concentrations greater than 0.5 mg/L are generally considered indicative of conditions amenable to reductive dechlorination. Because the mobility of arsenic and manganese can increase under reducing conditions, dissolved arsenic and manganese were analyzed to evaluate the degree to which the remedy is influencing the concentrations of these constituents in groundwater.

While field parameters are used to verify well stabilization before sample collection, select field parameters may also be used to evaluate whether the reducing conditions conducive to reductive dechlorination were achieved following the SRS application. Specifically, conditions are generally considered favorable for reductive dechlorination when oxidation-reduction potential (ORP) values are less than -100 millivolts (mV) and DO concentrations are less than 0.5 mg/L. To obtain more accurate measurements, the CHEMets test kit results were used to evaluate DO in the aquifer. Furthermore, pH measurements were evaluated to verify pH remained within the optimal range (pH of 5 to 9) for dechlorinating microbes.

3.2 Performance Monitoring

Figure 1-2 provides the layout of both the injection and monitoring wells used for the ERD treatment. Data collected from performance monitoring wells MW38D and MW39D were used to evaluate the effectiveness of the treatment in the source zone. Monitoring wells MW09D, MW40D, MW41D, and MW42D were identified as performance monitoring wells

for the downgradient plume treatment area. A summary of the performance and annual monitoring data is provided in **Table 3-1,** the complete data set is provided in **Appendix B,** and trends over time for select COCs and TOC are provided in **Appendix C**.

3.2.1 Source Treatment Area

The cyclodextrin injected into the groundwater in the source zone in 2002 for the pilot study is known to persist in groundwater at the site based on the coloration of the groundwater in the source zone. Cyclodextrin is comprised of organic carbon structures in a ring formation and because of its chemical components, when present, will add to the overall TOC concentrations detected in groundwater samples. Unlike the SRS applied at this site, cyclodextrin is not as easily fermentable, and therefore does not serve as an appropriate food and energy source for the biodegradation of the chlorinated VOCs. Consequently, to more appropriately assess the presence of available SRS in the source zone using TOC as a surrogate, TOC concentrations are evaluated as the difference between the baseline and the post-injection TOC concentrations.

Post-injection TOC concentrations increased by more than 300 mg/L above baseline TOC concentrations in both of the source area performance monitoring wells (MW38D and MW39D), peaking at 6 months post-injection. The overall increase in TOC concentrations indicates successful substrate delivery in the target treatment zone. TOC concentrations detected in samples collected 12 months post-injection remain more than 75 mg/L above baseline concentrations, suggesting adequate TOC is available for continued degradation of site COCs. Furthermore, the detection of VFAs in post-injection groundwater samples illustrates the desired fermentation of substrate associated with ERD. The post-injection pH values remained within the optimal range for dechlorinating microbes, indicating the application of sodium bicarbonate provided adequate buffering capacity.

While cyclodextrin is not easily used by the microbial populations to degrade the contaminants, it does promote anaerobic conditions favorable for reductive dechlorination. The review of the baseline field and geochemical data collected from monitoring wells in the source zone versus monitoring wells throughout the remainder of the site suggests the cyclodextrin was creating a more anaerobic environment in the source zone prior to injections. With the exception of the DO concentration measured in monitoring well MW39D 3 months post-injection (0.1 mg/L), DO was not detected in the performance wells for the source zone following the injection. Additionally, post-injection ORP values remained below -100 mV, ferrous iron remained above 1 mg/L, and sulfate concentrations were less than 20 mg/L. The persistence of cyclodextrin in the groundwater coupled with the post-injection field and geochemical data indicates the cyclodextrin continues to create a more anaerobic environment in the source zone following injections, promoting conditions more amenable to continued reductive dechlorination.

Select COC and TOC trends over time for monitoring wells MW38D and MW39D are provided in **Appendix C** as Figures C-1 through C-4.

Monitoring Well MW38D

The COC concentrations detected in groundwater collected from performance monitoring well MW38D were the highest concentrations detected at the site. Concentration trends for the chlorinated ethenes suggest reductive dechlorination of TCE is occurring (Figure C-1);

parent product TCE concentrations are decreasing as daughter product cis-1,2-DCE concentrations are increasing. Concentrations of VC initially declined, but are generally increasing with further degradation of parent compounds. Concentrations of chlorinated ethanes and chlorinated methanes have remained fairly constant, suggesting optimal conditions are not present for the degradation of these compounds (Figure C-2). Chlorinated ethane and chlorinated methane compounds are decreasing elsewhere at the site (see Monitoring Well MW39D discussion below), suggesting the conditions to promote degradation are present at Site 11; however the elevated chlorinated ethene concentrations near monitoring well MW38D may be inhibiting chlorinated ethane and chlorinated methane degradation in this area. As the chlorinated ethene concentrations decrease, the chlorinated ethane and chlorinated methane concentrations are expected to more readily degrade. The rate of degradation may be accelerated if a more robust microbial consortium capable of chlorinated ethane degradation in the presence of elevated chlorinated ethene concentrations is used to augment the microbes present on site.

Monitoring Well MW39D

Total COC concentrations substantially decreased throughout the post-injection sampling period in well MW39D. TCE was not detected during any of the post-injection sampling rounds. The greatest concentration of cis-1,2-DCE (9,600 micrograms per liter [µg/L]) was detected 1 month post-injection; concentrations decreased in subsequent post-injection samples to a low of 15 µg/L after 1 year. VC concentrations increased from approximately 600 µg/L prior to the injection, to as much as 3,000µg/L following the injection and subsequently decreased to the pre-injection value (Figure C-3). Concentrations of chlorinated ethanes decreased to below cleanup goals (Figure C-4). VC (640 µg/L) was the only COC detected at a concentration exceeding its respective cleanup value (2 µg/L) during the annual sampling event.

Source Zone Summary

The data collected from these wells suggest the substrate injections were effective in delivering substrate into the source zone. The data also suggest the conditions amenable to reductive dechlorination have been achieved and are persisting in the source zone. Additionally, the presence of ethene and ethane demonstrate the COCs are degrading to their innocuous end products. While degradation is occurring in the source zone, data collected from monitoring well MW38D suggest the chlorinated ethanes and chlorinated methanes are not degrading at an optimal rate in this localized area.

3.2.2 Downgradient Plume

Monitoring wells MW09D, MW40D, MW41D, and MW42D were designated as performance monitoring wells to evaluate the effectiveness of the in situ bioremediation system in treating the downgradient edge of the plume. The well-specific results for monitoring wells MW09D, MW40D, MW41D, and MW42D are discussed below; the COC and TOC trends over time are provided in **Appendix C**, as Figures C-5 through C-8.

Monitoring Well MW09D

During treatment design, existing monitoring well MW09D was identified as a performance monitoring well due to its proximity to the injection wells IW01 and IW02. However, since MW09D is located 11.8 feet from the closest injection well and is upgradient of the injection

wells, it is not optimally located to evaluate the performance of injection. TOC concentrations did not increase after injection in groundwater samples collected from this monitoring well, although reducing conditions were observed; DO concentrations decreased to 0 mg/L and ferrous iron concentrations remained above 1 mg/L. COC concentrations decreased throughout the monitoring period. TCE (8.3 µg/L) was the only COC detected in groundwater 12 months post-injection at a concentration above its cleanup goal (5 µg/L) (Figure C-5).

Monitoring Well MW40D

Injection well IW05, the nearest injection well to monitoring well MW40D, was shifted during RA installation to avoid a utility line; monitoring well MW40D is located approximately 11.7 feet downgradient of injection well IW05. Because of the slow groundwater flow rate at the site, conditions indicative of reductive dechlorination were observed approximately 6 months post-injection. Groundwater samples collected from 6, 9, and 12 months post-injection indicate that the ERD system is functioning as intended in this area. Beginning at approximately 6 months, TOC concentrations increased, DO concentrations decreased, and ORP values decreased. At 9 months post-injection, VFAs began to be detected and methane concentrations greatly increased above the baseline concentration of 490 µg/L. Correspondingly, at 6 months post-injection, changes in COC concentrations were observed (Figure C-6). TCE concentrations began decreasing while daughter products cis-1,2-DCE and VC increased. Concentrations of 1,1-DCE also began to decrease. At 12 months post-injection, only two COCs (1,1-DCE at 8 µg/L and VC at 30 µg/L) were detected at concentrations greater than the respective cleanup goals (7 µg/L for 1,1-DCE and 2 µg/L for VC). Increases in ethene concentrations suggest the full degradation pathway of chlorinated ethenes has been achieved.

Monitoring Well MW41D

Monitoring well MW41D is located approximately 16.3 feet downgradient of the nearest injection well (IW10). Similar to the results observed in samples collected from monitoring well MW40D, conditions indicative of reductive dechlorination were observed approximately 6 to 9 months post-injection. TOC concentrations detected in groundwater samples collected 6 months post-injection were slightly higher than concentrations detected during the baseline; and by 9 months post-injection were within the optimal range for reductive dechlorination. Similarly, at 6 months post-injection, geochemical and field data suggest that an amenable reducing environment was present; more optimal reducing conditions for ERD were detected at 9 and 12 months post-injection. Methane concentrations detected in groundwater increased throughout the sampling period and beginning at 6 months post-injection, VFAs were detected in groundwater samples.

Corresponding to the changes observed in the geochemical and field data from groundwater samples collected at 6 months post-injection, COC concentrations detected in groundwater also began to demonstrate that degradation was occurring. TCE (190 µg/L) and 1,1-DCE (46 µg/L) were the only COCs detected in baseline groundwater samples at concentrations exceeding the respective cleanup goals. Both TCE and 1,1-DCE concentrations decreased to below the cleanup goals in groundwater samples collected 12 months post-injection. As evidence of the reductive dechlorination pathway, VC concentrations detected in groundwater increased as TCE and 1,1-DCE concentrations

decreased (Figure C-7). VC (35 μg/L) was the only COC detected at a concentration exceeding its cleanup goal (2 μg/L) 12 months post-injection. Ethene was detected in the 12-month post-injection groundwater sample, which suggests the VC being generated through the reductive dechlorination process is also reductively degrading.

Monitoring Well MW42D

Conditions indicative of reductive dechlorination were not observed in the post-injection groundwater data collected from monitoring well MW42D. TOC concentrations did not increase and reducing conditions were not achieved. TCE (77 μg/L) and 1,1-DCE (16 μg/L) were detected in baseline groundwater samples at concentrations exceeding the respective cleanup goals. TCE (92 μg/L) and 1,1-DCE (18 μg/L) were detected at similar concentrations in 12-month post-injection groundwater samples (Figure C-8).

Although a stormwater utility line is located within close proximity to the injection wells and monitoring well MW42D, the absence of notable changes in analytical data collected from MW42D is not expected to be attributed to the presence of the stormwater line. The downgradient plume injection and monitoring wells were installed to target the deep portion of the Columbia aquifer with a 5-foot well screen placed at the bottom of that aquifer (approximately 17 to 25 feet bgs, **Table 2-1**). Consequently, the well screen interval and thus the injection and monitoring zone are well below the elevation of the stormwater line, which is located approximately 6.6 feet bgs. Additionally, as depicted in **Figures 1-3 through 1-10**, there are no localized depressions in this area, and thus no indication of a leak in the stormwater line.

Monitoring well MW42D is located approximately 18.5 feet downgradient of the nearest upgradient injection well (IW24). Since groundwater is estimated to travel at a velocity ranging from 1.68 to 11.83 ft/yr, and monitoring well MW42D is greater than 11.83 feet from injection well IW24, it is assumed that injected substrate did not have adequate time to migrate to monitoring well MW42D at the time of the 12-month post-injection sampling event. Given additional time, detection of elevated TOC at monitoring well MW42D is expected to occur.

Downgradient Plume Summary

The lack of observation of substrate delivery to the immediate vicinity of some of the performance monitoring wells shortly after injection is attributed to the distance between the injection and performance monitoring wells given that the current calculated groundwater flow velocity is much slower than the groundwater flow velocity calculated during design and the May 2010 temporary change in groundwater flow direction from southwest to northwest causing the substrate to flow away from the performance monitoring wells. Although the elevated levels of TOC typically achieved in ERD systems were not immediately observed in the performance monitoring wells, the VOC concentrations measured in monitoring wells MW40D and MW41D demonstrated the biotransformations and declines typical of ERD systems, indicating that delivery of substrate in the downgradient injection wells is achieving its intended purpose. In addition to the VOC data, supporting groundwater data demonstrate that optimal conditions for ERD were achieved and the 12-month post-injection groundwater data collected from these wells suggest that reducing conditions remain and suitable substrate is available for continued degradation. Although monitoring wells MW09D and MW42D are not optimally

located to evaluate the system one-year post-injection, MW09D is expected to be useful in evaluating the long-term effectiveness of the system while MW42D it is expected to be useful for evaluating system performance as groundwater continues to flow from the injection wells toward the monitoring well.

3.3 Overall Effectiveness

Figure 3-1 provides the COC concentrations with respect to the sample location and date for the Columbia aquifer. The overall distribution of COC concentrations in the deep Columbia aquifer for the baseline and annual sampling events is shown in **Figures 2-1** and **3-2,** respectively.

Assessment of the overall effectiveness of the ERD remediation is based on changes in plume configuration, plume containment, and the concentrations of COCs remaining at the site. Evaluation of the treatment area was based on the results from samples collected from annual monitoring wells MW04D, MW05D, MW05S, MW06D, MW07D, MW08D, MW10D, MW11D, MW12D, MW13D, MW14D, MW15D, MW17D, MW36D, and MW37D; and performance monitoring wells MW09D, MW38D, MW39D, MW40D, MW41D, and MW42D.

Based on COC concentrations detected in perimeter monitoring wells (MW11D, MW12D, MW13D, MW14D, MW15D, and MW17D) after 1 year of treatment, the areal extent of the plume is similar to the pre-injection areal extent (**Figures 2-1** and **3-2**). There were no COCs detected at concentrations exceeding the respective cleanup goals in samples collected from the perimeter monitoring wells.

There was an overall decrease in sitewide total COC concentrations detected in groundwater samples. Despite the overall decreasing trend, there was a notable increase in the total COC concentrations detected in three monitoring wells (MW36D, MW37D, and MW38D) (**Figure 3-1**). COCs were not detected in monitoring wells MW36D and MW37D during the baseline sampling event; however, 12 months post-injection, the total COC concentrations detected in monitoring wells MW36D and MW37D increased to 615 µg/L and 341 µg/L, respectively. These increases in total COC concentrations may be attributed to the migration of contaminants from the source zone. The total COC concentrations detected in samples from monitoring well MW38D increased from 293,800 µg/L (baseline) to 393,800 µg/L (12 months post-injection). The total COC concentration increase in well MW38D is due primarily to an increase in the concentration of cis-1,2-DCE. This type of DCE increase has been observed at other sites where ERD has been implemented in a TCE or tetrachloroethene (PCE) source zone and results from the relatively rapid increase in transformation of TCE to cis-1,2-DCE, greater solubility of cis-1,2-DCE compared to TCE or PCE and the slower rate of reductive degradation of cis-1,2-DCE compared to TCE and PCE. With additional treatment, total COC concentrations are expected to decline over time.

Because mobility of arsenic and manganese can increase under reducing conditions, dissolved arsenic and manganese concentrations were monitored to evaluate the degree to which the remedy is influencing the concentration of these constituents in groundwater (**Table 3-1**). Generally, the dissolved arsenic concentration remained the same in the samples collected from the Site 11 monitoring wells. Only groundwater from wells MW39D, MW40D, and MW41D showed an increase in dissolved arsenic concentrations. For those three wells, dissolved arsenic concentrations are expected to decrease when the aquifer re-equilibrates following the completion of the RA. Dissolved arsenic was not detected in samples from

perimeter monitoring wells (MW11D, MW12D, MW13D, MW14D, MW15D, and MW17D). While dissolved manganese concentrations increased in some of the performance monitoring wells, there was no appreciable increase in the dissolved manganese concentrations detected in the perimeter monitoring wells. Dissolved manganese concentrations are expected to decrease when the aquifer re-equilibrates following completion of the RA.

TABLE 3-1
Detected Analytes and Field Parameters
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

Station ID	**Cleanup Goal**	LS11-MW04D		LS11-MW05D		LS11-MW05S			LS11-MW06D		LS11-MW07D		LS11-MW08D		
Sample ID		LS11-MW04D-08C	LS11-MW04D-10B	LS11-MW05D-08C	LS11-MW05D-10B	LS11-MW05S-08C	LS11-MW05S-10B	LS11-MW05SP-10B	LS11-MW06D-08C	LS11-MW06D-10B	LS11-MW07D-08C	LS11-MW07D-10B	LS11-MW08D-08C	LS11-MW08D-10B	LS11-MW08D-P-10B
Sampling Round		Baseline	12-Month	Baseline	12-Month	Baseline	12-Month	12-Month	Baseline	12-Month	Baseline	12-Month	Baseline	12-Month	12-Month
Sample Date		09/03/08	5/25/10	09/03/08	5/24/10	09/03/08	5/24/10	5/24/10	09/05/08	5/26/10	09/04/08	5/27/10	09/03/08	5/27/10	5/27/10
Chemical Name															
Volatile Organic Compounds (µg/L)															
1,1,1-Trichloroethane	200	5 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	**1.7**	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	2,900*	**260**	**17**	**110**	**17**	1 U	1 U	1 U	**0.78 J**	**2.1**	1 U	1 U	1 U	**3**	**3.4**
1,1-Dichloroethene	7	5 U	1 U	5 U	1 U	1 U	1 U	1 U	**1.7**	**2.1**	1 U	1 U	**1.3**	**2.3**	**2.9**
1,2-Dichloropropane	5	5 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	9.6	5 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	70	**8.6**	1 U	5 U	1 U	1 U	1 U	1 U	**20**	**23**	1 U	**1.5**	**1.3**	**8.8**	**9.7**
Methylene chloride	5	5 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	100	5 U	1 U	5 U	1 U	1 U	1 U	1 U	**0.95 J**	**1.2**	1 U	1 U	1 U	1 U	1 U
Trichloroethene	5	**9**	1 U	5 U	1 U	1 U	1 U	1 U	**32**	**7**	**1.1**	**1.8**	**4.9**	**8.5**	**10**
Vinyl chloride	2	**24**	**2.5**	**11**	**3.3**	1 U	1 U	1 U	1 U	**6.1**	1 U	1 U	1 U	**0.66 J**	**0.75 J**
Dissolved Metals (µg/L)															
Arsenic, Dissolved	--	**23.6**	10 U	**38.3**	**27.8**	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Iron, Dissolved	--	**14,900**	**122**	**32,000**	**46,500**	**25,200**	**13,500**	**12,700**	100 U	**862**	100 U	**128**	100 U	100 U	100 U
Manganese, Dissolved	--	**2,190**	**299**	**2,910**	**2,550**	**241**	**182**	**151**	**149**	**94.1**	**101**	**13.5**	**37.5**	**86**	**89.4**
Wet Chemistry															
Acetate (mg/L)	--	1 U	1 U	**17**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Butyrate (mg/L)	--	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Ethane (µg/L)	--	**12**	**27**	**5.7**	**36**	1 U	1 U	1 U	1 U	**1.8**	1 U	1 U	1 U	1 U	1 U
Ethene (µg/L)	--	**530**	1 U	**210**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Lactate (mg/L)	--	1 U	**54**	1 U	**480**	1 U	**2.8**	**3**	1 U	**240**	1 U	**14**	1 U	**69**	**65**
Methane (µg/L)	--	**980**	1 U	**1,300**	1 U	**3.5**	1 U	1 U	**120**	1 U	**11**	1 U	**23**	1 U	1 U
Propionate (mg/L)	--	1 U	0.5 U	1 U	0.5 U	1 U	0.5 U	0.5 U	1 U	0.5 U	1 U	0.5 U	1 U	0.5 U	0.5 U
Sulfate (mg/L)	--	**10.3**	**5.7**	**5.1**	**19.9**	**28.8**	**8.5**	**8.7**	**16**	**10.5**	**19.1**	**6.9**	**23.3**	**20.4**	**19.4**
Sulfide (mg/L)	--	NA	**1.3**	**3.26**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Total organic carbon (TOC) (mg/L)	--	**236 J**	**11.3**	**140 J**	**39.9**	**4.25 J**	1 UL	1 UL	**7.41 J**	**3**	1 UJ	**10.5**	**1.09 J**	**2.4**	**2**
Field Parameter															
Dissolved Oxygen (mg/L)	--	NA	0.94	NA	0.38	NA	0.51	NA	NA	0.53	NA	0.62	NA	1.31	NA
Dissolved Oxygen by CHEMets (mg/L)	--	1	1	1	0	1	0.3	NA	1	1	1	1	1.7	1	NA
Depth to Water (feet)	--	7.01	5.9	6.15	5.06	5.81	4.7	NA	4.71	4.16	6.76	5.76	6.94	5.81	NA
Oxidation Reduction Potential (mV)	--	-101	-53	-209	-217	-71	-63	NA	-58	-173	93	84	203	143	NA
Ferrous Iron (mg/L)	--	4	0	3.5	3.8	3.5	2.4	NA	0	1	0	0	0	0	NA
Gallons Purged (gal)	--	NA	5	4	5	2	3	NA	4	3	3.5	3	2	3	NA
pH (PH)	--	5.41	6.77	5.77	6.74	5.37	5.67	NA	5.74	7.13	5.63	6.12	5.14	5.54	NA
Salinity (PCT)	--	0.02	0	0.02	0	0.01	0	NA	0.02	0	0.01	0	0.01	0	NA
Specific Conductivity (MS/CM)	--	0.447	0.489	0.423	0.9	0.266	0.378	NA	0.558	0.9	0.191	0.476	0.179	0.505	NA
Temperature (°C)	--	23.4	18.3	21.3	16.4	23.4	16.7	NA	20.3	16.4	22.4	18.4	20.5	15.9	NA
Turbidity (NTU)	--	198	0.0	129	5.8	131	22.5	NA	160	150	88.5	49.9	180	58.6	NA

Notes:
Exceeds cleanup goal
Bold indicates detections (field parameters not included)
NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
K - Analyte present, value may be biased high, actual value may be lower
L - Analyte present, value may be biased low, actual value may be higher
U - The material was analyzed for, but not detected
UL - Analyte not detected, quantitation limit is probably higher
mg/L - milligrams per liter
µg/L - micrograms per liter
mV - millivolt(s)
gal - gallon(s)
PCT - percent
MS/CM - millisiemens per centimeter
°C degrees Celsius
NTU - Nephelometric turbidity units
*Risk-based cleanup level was calculated

TABLE 3-1
Detected Analytes and Field Parameters
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

Station ID	**Cleanup Goal**	LS11-MW09D						LS11-MW10D		LS11-MW11D			LS11-MW12D		LS11-MW13D	
Sample ID		LS11-MW09D-08C	LS11-MW09D-09B	LS11-MW09D-09C	LS11-MW09D-09D	LS11-MW09D-10A	LS11-MW09D-10B	LS11-MW10D-08C	LS11-MW10D-10B	LS11-MW11D-08C	LS11-MW11DP-08C	LS11-MW11D-10B	LS11-MW12D-09A	LS11-MW12D-10B	LS11-MW13D-08C	LS11-MW13D-10B
Sampling Round		Baseline	1-Month	3-Month	6-Month	9-Month	12-Month	Baseline	12-Month	Baseline	Baseline	12-Month	Baseline	12-Month	Baseline	12-Month
Sample Date		09/02/08	06/11/09	08/13/09	11/24/09	02/23/10	5/25/10	09/03/08	5/27/10	09/02/08	09/02/08	5/25/10	01/29/09	5/27/10	09/04/08	5/27/10
Chemical Name																
Volatile Organic Compounds (µg/L)																
1,1,1-Trichloroethane	200	5 U	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	2,900*	**16**	**7**	**3.7**	**2.2**	**2.4**	**1.5**	**3.1**	**3**	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	7	**7**	**4**	**3.1**	**1.9**	**2.9**	**1.9**	**60**	**58**	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	5	5 U	1 U	1 U	1 U	1 U	1 U	**1.4 J**	**1.3**	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	9.6	5 U	1 U	1 U	1 U	1 U	1 U	**1.2 J**	**1**	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	70	**81**	**33**	**17**	**9**	**10**	**6.8**	**7.6**	**8.6**	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methylene chloride	5	5 U	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	100	5 U	**0.47 J**	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	5	**22**	**14**	**12**	**8.4**	**9.5**	**8.3**	**290**	**250**	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	2	**11**	**2.6**	**1.2**	1 U	**0.68 J**	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dissolved Metals (µg/L)																
Arsenic, Dissolved	--	10 U	NA	NA	NA	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Iron, Dissolved	--	**4,120**	**4,760**	NA	**2,380**	NA	**1,180**	100 U	100 U	100 U	100 U	100 U	100 U	**222**	**966**	100 U
Manganese, Dissolved	--	**3,940**	**1,950 K**	NA	**2,050**	NA	**1,440**	**59.2**	**79.9**	**73.8**	**70**	**80.2**	**599**	**664**	**79.7**	**30.4**
Wet Chemistry																
Acetate (mg/L)	--	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U
Butyrate (mg/L)	--	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U	2 U
Ethane (µg/L)	--	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U
Ethene (µg/L)	--	**3.7**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U
Lactate (mg/L)	--	1 U	1 U	1 U	1 U	1 U	**12**	1 U	**8.4**	1 U	NA	2 U	1 U	**68**	1 U	**8.8**
Methane (µg/L)	--	**39**	**22**	**30**	**25**	**19**	1 U	**5.3**	1 U	2 U	NA	1 U	**51**	1 U	**11**	1 U
Propionate (mg/L)	--	1 U	1 U	1 U	1 U	1 U	0.5 U	1 U	0.5 U	1 U	NA	0.5 U	1 U	0.5 U	1 U	0.5 U
Sulfate (mg/L)	--	**50.3**	**57.9**	NA	**60.4 L**	NA	**61**	**37.8**	**32.2**	**20**	NA	**18.5**	**36.7**	**23.4**	**15.9**	**10.9**
Sulfide (mg/L)	--	1 U	1 U	NA	1 U	NA	1 U	1 U	**1**	**6.4**	NA	1 U	1 U	1 U	1 U	**1.3**
Total organic carbon (TOC) (mg/L)	--	**63.2 J**	**30.2**	**15.5**	**8.6**	**6.7**	**4.2**	1 UJ	1 UL	1 UJ	NA	1 UL	**1.2**	**1.4 L**	**1.09 J**	1 UL
Field Parameter																
Dissolved Oxygen (mg/L)	--	NA	0.52	1.92	1.63	0	1.12	NA	1.69	NA	NA	1.28	3.08	7.58	NA	0.98
Dissolved Oxygen by CHEMets (mg/L)	--	1	0.4	0.6	0.8	0	2	1	1	4	NA	2	1	0.8	1.5	1
Depth to Water (feet)	--	6.7	5.9	NA	5.07	5.22	5.43	6.1	4.71	7.74	NA	4.6	6.15	5.13	5.81	4.98
Oxidation Reduction Potential (mV)	--	-33	-36	42	22	85	71	164	191	156	NA	166	156	51	-65	18
Ferrous Iron (mg/L)	--	3	2.4	3	1.4	1.8	1.1	0.4	0	0.4	NA	0.1	0.2	0.2	1	0
Gallons Purged (gal)	--	4	8	5	4	3	3.2	3	3	3.5	NA	3	4	4	7	4.5
pH (PH)	--	5.21	6.16	5.31	5.84	5.96	5.64	4.91	5.17	4.94	NA	5.44	6.65	5.75	6.05	7.7
Salinity (PCT)	--	0.02	0	0	0	0	0	0.01	0	0.01	NA	0	NA	0	0.01	0
Specific Conductivity (MS/CM)	--	0.468	0.56	0.44	0.728	61.7	0.9	0.247	0.621	0.166	NA	0.468	NA	0.769	0.284	0.62
Temperature (°C)	--	22.3	19.73	20.6	20.4	15.9	17.8	24	18.5	28	NA	19.3	19.74	20.8	24.8	19.6
Turbidity (NTU)	--	282.0	1.2	41.5	0	NA	3	37.5	146	87.7	NA	196	0	26.1	40	33

Notes:
Exceeds cleanup goal
Bold indicates detections (field parameters not included)
NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
K - Analyte present, value may be biased high, actual value may be lower
L - Analyte present, value may be biased low, actual value may be higher
U - The material was analyzed for, but not detected
UL - Analyte not detected, quantitation limit is probably higher
mg/L - milligrams per liter
µg/L - micrograms per liter
mV - millivolt(s)
gal - gallon(s)
PCT - percent
MS/CM - millisiemens per centimeter
°C degrees Celsius
NTU - Nephelometric turbidity units
*Risk-based cleanup level was calculated

TABLE 3-1
Detected Analytes and Field Parameters
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

Station ID	**Cleanup Goal**	LS11-MW14D		LS11-MW15D			LS11-MW17D		LS11-MW36D		LS11-MW37D		LS11-MW38D			
Sample ID		LS11-MW14D-08C	LS11-MW14D-10B	LS11-MW15D-08C	LS11-MW15DP-08C	LS11-MW15D-10B	LS11-MW17D-08C	LS11-MW17D-10B	LS11-MW36D-08C	LS11-MW36D-10B	LS11-MW37D-08C	LS11-MW37D-10B	LS11-MW38D-09A	LS11-MW38D-09B	LS11-MW38D-09C	LS11-MW38D-09D
Sampling Round		Baseline	12-Month	Baseline	Baseline	12-Month	Baseline	12-Month	Baseline	12-Month	Baseline	12-Month	Baseline	1-Month	3-Month	6-Month
Sample Date		09/04/08	5/27/10	09/05/08	09/05/08	5/27/10	09/02/08	5/25/10	09/02/08	5/25/10	09/03/08	5/26/10	02/05/09	06/11/09	08/13/09	11/23/09
Chemical Name																
Volatile Organic Compounds (µg/L)																
1,1,1-Trichloroethane	200	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	**62,000**	**44,000**	**47,000**	**50,000**
1,1-Dichloroethane	2,900*	**0.44 J**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**100**	1 U	**59**	**14,000**	**18,000**	**16,000**	**13,000**
1,1-Dichloroethene	7	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**56**	1 U	**23**	**7,500**	**4,700**	**6,000**	**5,300**
1,2-Dichloropropane	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	1,000 U	1,000 U	2,000 U	1,000 U
Chloroform	9.6	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	1,000 U	1,000 U	**700 J**	1,000 U
cis-1,2-Dichloroethene	70	**0.42 J**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**280**	1 U	**160**	**83,000**	**110,000**	**170,000**	**130,000**
Methylene chloride	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	**2,700**	**3,500**	**3,600**	**2,500**
trans-1,2-Dichloroethene	100	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	1,000 U	**470 J**	2,000 U	1,000 U
Trichloroethene	5	**0.68 J**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**150**	1 U	**62**	**120,000**	**340,000**	**220,000**	**120,000**
Vinyl chloride	2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**29**	1 U	**37**	**4,600**	**1,900**	**3,100**	**1,900**
Dissolved Metals (µg/L)																
Arsenic, Dissolved	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	**38.3**	NA	NA	NA
Iron, Dissolved	--	100 U	100 U	**1,840**	**1,440**	**437**	100 U	**184**	**455**	**658**	**1,080**	**1,300**	**56,600**	**60,800**	NA	**86,200**
Manganese, Dissolved	--	**48.5**	**26.9**	**498**	**445**	**563**	**349**	**257**	**99.8**	**1,260**	**45.2**	**200**	**3,870**	**4,110 K**	NA	**4,690**
Wet Chemistry																
Acetate (mg/L)	--	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**96**	**190**	**170**	**170**
Butyrate (mg/L)	--	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	**2.7**	**2.5**
Ethane (µg/L)	--	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	**97**	1 U	**60**	**36**	**8.9**	**7.6**	10 U
Ethene (µg/L)	--	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**330**	**220**	**390**	**340**
Lactate (mg/L)	--	1 U	**3.4**	1 U	NA	**30**	1 U	**9.6**	1 U	**130**	1 U	**190**	1 U	**7.5**	1 U	1 U
Methane (µg/L)	--	**5.6**	1 U	**28**	NA	1 U	2 U	1 U	**21**	1 U	**110**	1 U	**810**	**500**	**580**	**630**
Propionate (mg/L)	--	1 U	0.5 U	1 U	NA	0.5 U	1 U	0.5 U	1 U	0.5 U	1 U	0.5 U	**11**	**63**	**69**	**58**
Sulfate (mg/L)	--	**37.1**	**34.3**	**29.2**	NA	**30.8**	**49**	**28.3**	**3.81**	**7.8**	**2.21**	**11.7**	**4.6**	**7**	NA	**3.6 L**
Sulfide (mg/L)	--	1 U	1 U	1 U	NA	1 U	**3.72**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Total organic carbon (TOC) (mg/L)	--	1 UJ	1 UL	**2.22 J**	NA	**2**	**1.8 J**	**1.2 L**	1 UJ	**125**	1 UJ	**131**	**636**	**851**	**924**	**938**
Field Parameter																
Dissolved Oxygen (mg/L)	--	NA	0.99	NA	NA	6.08	NA	0.7	NA	0.5	NA	5.26	2.05	0.19	1.93	0.98
Dissolved Oxygen by CHEMets (mg/L)	--	1	1	2.8	NA	1	1	1	>ERR	1	1	2	NA	0	0	0
Depth to Water (feet)	--	6.51	5.75	5.14	NA	4.49	5.8	4.65	8.7	7.28	10.19	8.34	4.8	4.4	NA	4.09
Oxidation Reduction Potential (mV)	--	143	144	-78	NA	-78	158	135	129	-5	100	44	-176	-162	-110	-156
Ferrous Iron (mg/L)	--	0	0	0.8	NA	0.5	0	0.2	>ERR	1.2	1.8	1.8	NA	3	5	4.6
Gallons Purged (gal)	--	4	3	4.5	NA	3.5	3.5	2.5	3.2	5	NA	5	5	4	4	5
pH (PH)	--	5.14	5.57	5.39	NA	6.63	5.31	6.05	4.89	5.63	4.87	5.72	7.56	6.83	6.21	6.54
Salinity (PCT)	--	0.01	0	0.04	NA	0	0.02	0	0.01	0	0.01	0	0.05	0.1	0.1	0.1
Specific Conductivity (MS/CM)	--	0.283	0.697	0.97	NA	0.9	0.441	0.996	0.192	0.641	0.154	0.624	1.07	1.87	1.81	2.11
Temperature (°C)	--	23.3	18.8	23.1	NA	18.5	22.1	17	20.9	18.4	21.9	20.7	14.61	19.21	18.79	19.1
Turbidity (NTU)	--	91.6	117	43.4	NA	135	222	1.1	278	71	81.4	162	30	161	40	5

Notes:

Exceeds cleanup goal

Bold indicates detections (field parameters not included)

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UL - Analyte not detected, quantitation limit is probably higher

mg/L - milligrams per liter

µg/L - micrograms per liter

mV - millivolt(s)

gal - gallon(s)

PCT - percent

MS/CM - millisiemens per centimeter

°C degrees Celsius

NTU - Nephelometric turbidity units

*Risk-based cleanup level was calculated

TABLE 3-1
Detected Analytes and Field Parameters
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

Station ID	**Cleanup Goal**	LS11-MW38D		LS11-MW39D								LS11-MW40D				
Sample ID		LS11-MW38D-10A	LS11-MW38D-10B	LS11-MW39D-09A	LS11-MW39D-09B	LS11-MW39D-09C	LS11-MW39DP-09C	LS11-MW39D-09D	LS11-MW39D-10A	LS11-MW39DP-10A	LS11-MW39D-10B	LS11-MW40D-09A	LS11-MW40D-09B	LS11-MW40DP-09B	LS11-MW40D-09C	LS11-MW40D-09D
Sampling Round		9-Month	12-Month	Baseline	1-Month	3-Month	3-Month	6-Month	9-Month	9-Month	12-Month	Baseline	1-Month	1-Month	3-Month	6-Month
Sample Date		02/23/10	5/24/10	02/05/09	06/11/09	08/13/09	08/13/09	11/23/09	02/23/10	02/23/10	5/24/10	01/29/09	06/11/09	06/11/09	08/14/09	11/24/09
Chemical Name																
Volatile Organic Compounds (µg/L)																
1,1,1-Trichloroethane	200	**51,000**	**71,000**	**890**	**1,400**	**570**	**560**	**97**	**27**	**28**	**15**	10 U	**1.4 J**	**1.4 J**	**1.6 J**	2.5 U
1,1-Dichloroethane	2,900*	**12,000**	**16,000**	**570**	**1,100**	**1,000**	**1,100**	**680**	**280**	**340**	**290**	**44**	**35**	**36**	**41**	**110**
1,1-Dichloroethene	7	**7,200**	**8,400**	**220**	**280**	**180**	**150**	**22**	**10**	**9.2**	5 U	**65**	**87**	**88**	**94**	**58**
1,2-Dichloropropane	5	1,000 U	1000 U	50 U	100 U	50 U	50 U	10 U	5 U	5 U	5 U	10 U	2.5 U	2.5 U	2.5 U	2.5 U
Chloroform	9.6	1,000 U	1000 U	50 U	100 U	50 U	50 U	10 U	5 U	5 U	5 U	10 U	2.5 U	**0.53 J**	2.5 U	2.5 U
cis-1,2-Dichloroethene	70	**130,000**	**200,000 L**	**6,200**	**9,600**	**5,000**	**5,100**	**800**	**320**	**300**	**19**	**160**	**120**	**120**	**140**	**320**
Methylene chloride	5	**2,700**	**3,800**	**16 J**	100 U	50 U	50 U	10 U	5 U	5 U	5 U	10 U	2.5 U	2.5 U	2.5 U	2.5 U
trans-1,2-Dichloroethene	100	1,000 U	1000 U	**22 J**	**64 J**	**25 J**	**26 J**	**5.6 J**	**3 J**	**4.5 J**	5 U	10 U	2.5 U	2.5 U	**4.7**	**2.2 J**
Trichloroethene	5	**86,000**	**92,000 L**	**71**	100 U	50 U	50 U	10 U	5 U	5 U	5 U	**250**	**340**	**350**	**350**	**110**
Vinyl chloride	2	**2,200**	**2,600**	**640**	**1,600**	**2,900**	**2,800**	**1,700**	**860**	**900**	**640**	**6.9 J**	**6.2**	**6.2**	**5.8**	**49**
Dissolved Metals (µg/L)																
Arsenic, Dissolved	--	NA	50 U	**10.6**	NA	NA	NA	NA	NA	NA	**48.3**	10 U	NA	NA	NA	NA
Iron, Dissolved	--	NA	**137,000**	**26,200**	**38,300**	NA	NA	**142,000**	NA	NA	**49,200**	**3,630**	**3,970**	**4,300**	NA	**14,900**
Manganese, Dissolved	--	NA	**8,420**	**2,220**	**2,740 K**	NA	NA	**2,560**	NA	NA	**1,630**	**472**	**449 K**	**446 K**	NA	**974**
Wet Chemistry																
Acetate (mg/L)	--	**210**	**340**	**20**	**55**	**130**	NA	**240**	**42**	**37**	**22**	1 U	1 U	NA	1 U	1 U
Butyrate (mg/L)	--	**4.2**	**9.2**	2 U	2 U	**2.1**	NA	**9.7**	2 U	2 U	2 U	2 U	2 U	NA	2 U	2 U
Ethane (µg/L)	--	**14**	**220**	NA	**2.3**	10 U	NA	10 U	10 U	10 U	**370**	1 U	1 U	NA	10 U	10 U
Ethene (µg/L)	--	**230**	2 U	NA	**110**	**360**	NA	**550**	**310**	**320**	1 U	**15**	**18**	NA	**33**	**120**
Lactate (mg/L)	--	1 U	**4,300**	1 U	1 U	1 U	NA	1 U	1 U	1 U	**2,100**	1 U	1 U	NA	1 U	1 U
Methane (µg/L)	--	**1,200**	**150**	NA	**530**	**540**	NA	**7,200**	**4,300**	**4,100**	**3.5**	**490**	**610**	NA	**520**	**570**
Propionate (mg/L)	--	**91**	1 U	**0.94 J**	**15**	**95**	NA	**120**	**6.9**	**5.4**	0.5 U	1 U	1 U	NA	1 U	1 U
Sulfate (mg/L)	--	NA	**2.8**	**13**	**5.4**	NA	NA	2 UL	NA	NA	**19.8**	**16.1**	**12.9**	NA	NA	**10.7 L**
Sulfide (mg/L)	--	NA	1 U	1 U	1 U	NA	NA	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U
Total organic carbon (TOC) (mg/L)	--	**811**	**901**	**108**	**254**	**381**	NA	**501**	**240**	**223**	**186**	**67.2**	**61.2**	NA	**57.7**	**194**
Field Parameter																
Dissolved Oxygen (mg/L)	--	0	0.45	2.14	0	1.89	NA	0.77	0	NA	0.5	3.28	0.4	NA	1.7	1.33
Dissolved Oxygen by CHEMets (mg/L)	--	0	0	NA	0	0.1	NA	0	0	NA	0	1	0.6	NA	0.6	0.1
Depth to Water (feet)	--	4.13	4.48	4.94	4.44	NA	NA	3.52	3.98	NA	4.33	6.6	6.2	NA	NA	5.41
Oxidation Reduction Potential (mV)	--	-142	-124	-177	-237	-166	NA	-215	-195	NA	-223	103	0	NA	21	-53
Ferrous Iron (mg/L)	--	4.2	4.2	2	2	2.2	NA	3.8	2.9	NA	2.2	0.1	2.4	NA	2.4	2.4
Gallons Purged (gal)	--	4	3.5	9	5	5	NA	5	3.5	NA	NA	5	4	NA	4	4
pH (PH)	--	6.68	6.56	7.6	7.28	6.54	NA	6.91	7.12	NA	6.88	6.64	6.12	NA	5.6	6.02
Salinity (PCT)	--	0.2	0.1	0.01	0	0	NA	0.1	0	NA	0	NA	0	NA	0	0
Specific Conductivity (MS/CM)	--	0.369	2.04	0.07	0.9	0.88	NA	1.39	66.6	NA	0.9	NA	0.26	NA	0.22	0.532
Temperature (°C)	--	14.5	15.6	16.3	18.75	19.25	NA	19.3	14.5	NA	16.1	18.53	23.2	NA	22.58	21.5
Turbidity (NTU)	--	NA	14	27	24	3	NA	58	34	NA	148	0.0	31.3	NA	46.9	5

Notes:
Exceeds cleanup goal
Bold indicates detections (field parameters not included)
NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
K - Analyte present, value may be biased high, actual value may be lower
L - Analyte present, value may be biased low, actual value may be higher
U - The material was analyzed for, but not detected
UL - Analyte not detected, quantitation limit is probably higher
mg/L - milligrams per liter
µg/L - micrograms per liter
mV - millivolt(s)
gal - gallon(s)
PCT - percent
MS/CM - millisiemens per centimeter
°C degrees Celsius
NTU - Nephelometric turbidity units
*Risk-based cleanup level was calculated

TABLE 3-1
Detected Analytes and Field Parameters
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

Station ID	**Cleanup Goal**	LS11-MW40D			LS11-MW41D						LS11-MW42D					
Sample ID		LS11-MW40D-10A	LS11-MW40D-10B	LS11-MW40D-P-10B	LS11-MW41D-09A	LS11-MW41D-09B	LS11-MW41D-09C	LS11-MW41D-09D	LS11-MW41D-10A	LS11-MW41D-10B	LS11-MW42D-09A	LS11-MW42D-09B	LS11-MW42D-09C	LS11-MW42D-09D	LS11-MW42D-10A	LS11-MW42D-10B
Sampling Round		9-Month	12-Month	12-Month	Baseline	1-Month	3-Month	6-Month	9-Month	12-Month	Baseline	1-Month	3-Month	6-Month	9-Month	12-Month
Sample Date		02/23/10	5/26/10	5/26/10	01/30/09	06/11/09	08/14/09	11/24/09	02/23/10	5/26/10	02/05/09	06/11/09	08/14/09	11/24/09	02/23/10	5/26/10
Chemical Name																
Volatile Organic Compounds (µg/L)																
1,1,1-Trichloroethane	200	1 U	1 U	1 U	**3**	1 U	1 U	1 U	1 U	1 U	1 U	**1.8**	1 U	1 U	1 U	1 U
1,1-Dichloroethane	2,900*	**25**	**22**	**22**	**3**	**2.1**	**2.3**	**1.1**	**1.2**	**0.81 J**	**1.2**	**1.4**	**1.3**	**1.1**	**1.1**	**1.3**
1,1-Dichloroethene	7	**12**	**8.7**	**8**	**46**	**37**	**38**	**16**	**18**	**5.9**	**16**	**12**	**17**	**15**	**19**	**18**
1,2-Dichloropropane	5	1 U	1 U	1 U	**1.1**	**0.82 J**	**0.87 J**	**0.44 J**	**0.38 J**	**0.36 J**	1 U	**0.47 J**	**0.54 J**	**0.49 J**	**0.49 J**	**0.53 J**
Chloroform	9.6	1 U	1 U	1 U	**0.54 J**	**0.6 J**	**0.85 J**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	70	**74**	**65**	**62**	**10**	**5.6**	**6.7**	**14**	**59**	**22**	**5.8**	**8.8**	**16**	**9**	**5.9**	**5.8**
Methylene chloride	5	1 U	1 U	1 U	1 U	1 U	**0.6 J**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	100	**0.96 J**	**0.57 J**	**0.73 J**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	5	**19**	**0.67 J**	**0.67 J**	**190**	**160**	**150**	**39**	**14**	**1.3**	**77**	**120**	**75**	**73**	**80**	**92**
Vinyl chloride	2	**28**	**30**	**30**	1 U	1 U	1 U	1 U	**3**	**35**	1 U	1 U	1 U	1 U	1 U	1 U
Dissolved Metals (µg/L)																
Arsenic, Dissolved	--	NA	**35.5**	**29.6**	10 U	NA	NA	NA	NA	**77.3**	10 U	NA	NA	NA	NA	10 U
Iron, Dissolved	--	NA	**144,000**	**138,000**	**158**	**386**	NA	**20,900**	NA	**109,000**	100 U	**689**	NA	505	NA	**168**
Manganese, Dissolved	--	NA	**3,670**	**3,660**	**144**	**191 K**	NA	**5,380**	NA	**10,900**	**229**	**380 K**	NA	365	NA	**325**
Wet Chemistry																
Acetate (mg/L)	--	**23**	**260**	**270**	1 U	1 U	1 U	**7.3**	**95**	**140**	1 U	1 U	1 U	1 U	1 U	1 U
Butyrate (mg/L)	--	2 U	**6.3**	**6.1**	2 U	2 U	2 U	2 U	**3.8**	**3.2**	2 U	2 U	2 U	2 U	2 U	2 U
Ethane (µg/L)	--	10 U	**20**	**18**	1 U	1 U	2 U	5 U	100 U	**4.4**	1 U	1 U	10 U	5 U	2.5 U	1 U
Ethene (µg/L)	--	**23**	1 U	1 U	1 U	1 U	2 U	5 U	100 U	1 U	1 U	1 U	10 U	5 U	2.5 U	1 U
Lactate (mg/L)	--	1 U	**19,000**	**17,000**	1 U	1 U	1 U	1 U	1 U	**22,000**	1 U	1 U	1 U	1 U	1 U	**97**
Methane (µg/L)	--	**3,700**	**2.8**	**2.6**	**47**	**150**	**170**	**260**	**7,400**	**20**	**2.5**	**700**	**540**	**360**	**210**	1 U
Propionate (mg/L)	--	1 U	0.5 U	0.5 U	1 U	1 U	1 U	**5**	**30**	0.5 U	1 U	1 U	1 U	1 U	1 U	0.5 U
Sulfate (mg/L)	--	NA	2 U	2 U	**36.2**	**35.8**	NA	**15.4 L**	NA	2 U	**37.7**	**34.7**	NA	**33.7 L**	NA	**30**
Sulfide (mg/L)	--	NA	1 U	**1.2**	1 U	**8.9**	NA	1 U	NA	**1.1**	1 U	1 U	NA	1 U	NA	**7.9**
Total organic carbon (TOC) (mg/L)	--	**50.9**	**193**	**179**	1 U	1 U	**1.7**	**13**	**75.3**	**91.9**	1 U	**1.6**	1 U	1 U	1 U	1 UL
Field Parameter																
Dissolved Oxygen (mg/L)	--	0	0.54	NA	3.27	0.38	1.82	1.2	0	0.5	2.24	0.11	1.71	1.27	0	8.5
Dissolved Oxygen by CHEMets (mg/L)	--	0.8	0	NA	1	1	0.8	0.5	0	0	1	1	1.5	1	1	2
Depth to Water (feet)	--	5.45	8.65	NA	5.84	5.57	NA	4.9	5.02	5.37	5.73	5.31	NA	4.7	4.82	5.56
Oxidation Reduction Potential (mV)	--	-170	-264	NA	137	148	148	-113	-172	-228	162	18	27	70	100	125
Ferrous Iron (mg/L)	--	2.6	5.8	NA	0.1	0.6	2.2	0	1	2.8	0	1	0.6	0.6	0.6	0.2
Gallons Purged (gal)	--	3.5	NA	NA	4.5	4.5	7.5	NA	4.5	3.75	13	5	5.5	4.2	3.5	3
pH (PH)	--	6.85	6.96	NA	6.25	5.4	4.78	6.31	6.71	6.79	5.62	6.23	5.49	5.69	5.9	5.28
Salinity (PCT)	--	0	0.1	NA	NA	0	0	0	0	0	0.01	0	0	0	0	0
Specific Conductivity (MS/CM)	--	54.9	0.9	NA	NA	0.21	0.23	0.92	93.8	1.03	0.28	0.58	0.37	0.601	42.2	0.9
Temperature (°C)	--	16.6	18.9	NA	17.98	20.55	20.5	20.6	15.6	17.4	18.34	20.77	21.53	20.2	17	16.4
Turbidity (NTU)	--	11	535	NA	10	35	75.1	3.3	0.0	709.0	26.2	40.5	44.6	0	0	150

Notes:

Exceeds cleanup goal

Bold indicates detections (field parameters not included)

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

K - Analyte present, value may be biased high, actual value may be lower

L - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UL - Analyte not detected, quantitation limit is probably higher

mg/L - milligrams per liter

µg/L - micrograms per liter

mV - millivolt(s)

gal - gallon(s)

PCT - percent

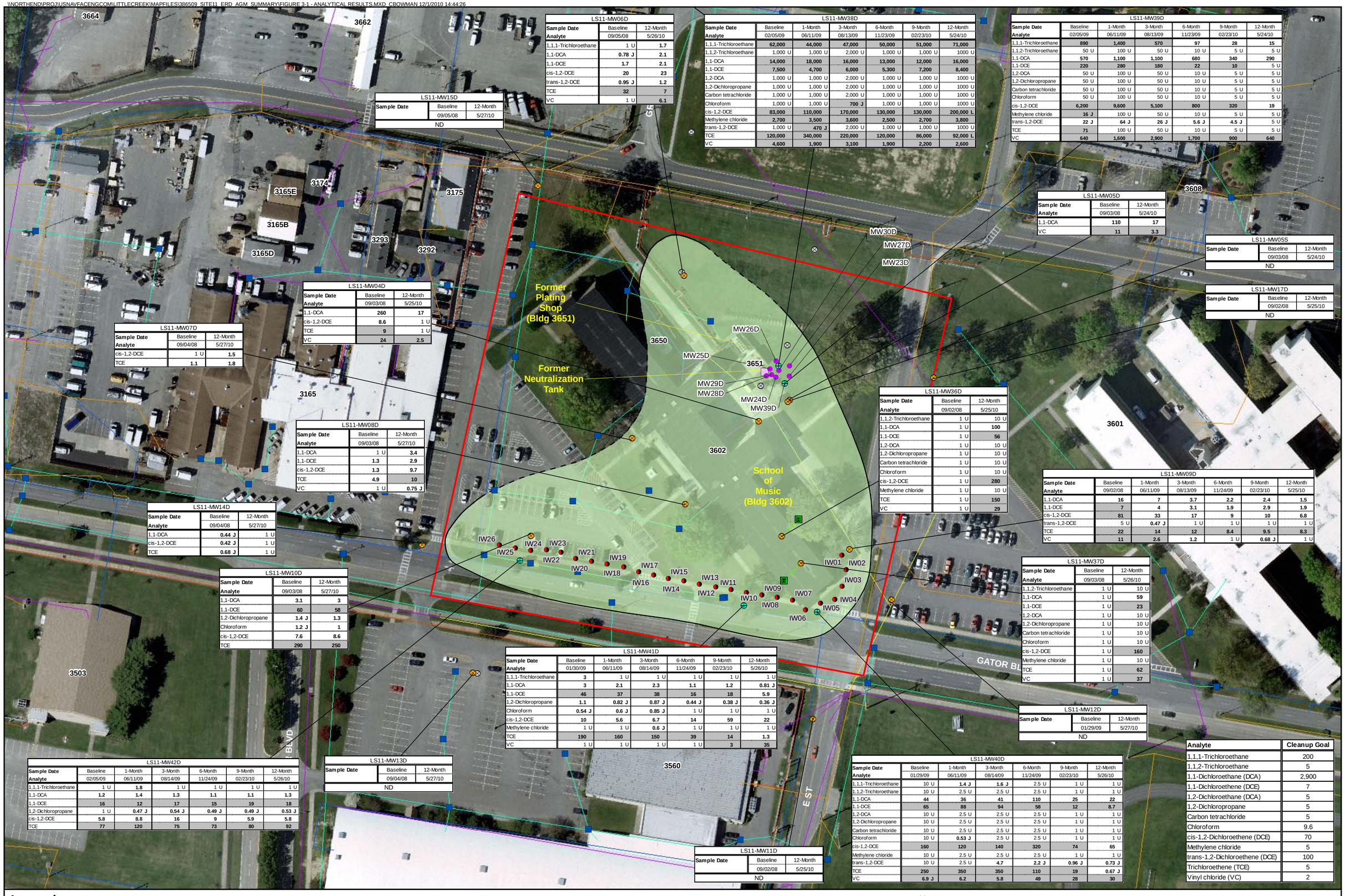
MS/CM - millisiemens per centimeter

°C degrees Celsius

NTU - Nephelometric turbidity units

*Risk-based cleanup level was calculated

\\NORTHEND\PROJ\USNAVFACENGCOM\LITTLECREEK\MAPFILES\386509_SITE11_ERD_AGM_SUMMARY\FIGURE 3-1 - ANALYTICAL RESULTS.MXD CBOWMAN 12/1/2010 14:44:26



LS11-MW06D		
Sample Date	Baseline	12-Month
Analyte	09/05/08	5/26/10
1,1,1-Trichloroethane	1 U	**1.7**
1,1-DCA	**0.78 J**	**2.1**
1,1-DCE	**1.7**	**2.1**
cis-1,2-DCE	**20**	**23**
trans-1,2-DCE	**0.95 J**	**1.2**
TCE	**32**	**7**
VC	1 U	**6.1**

LS11-MW15D		
Sample Date	Baseline	12-Month
	09/05/08	5/27/10
ND		

LS11-MW38D						
Sample Date	Baseline	1-Month	3-Month	6-Month	9-Month	12-Month
Analyte	02/05/09	06/11/09	08/13/09	11/23/09	02/23/10	5/24/10
1,1,1-Trichloroethane	**62,000**	**44,000**	**47,000**	**50,000**	**51,000**	**71,000**
1,1,2-Trichloroethane	1,000 U	1,000 U	2,000 U	1,000 U	1,000 U	1000 U
1,1-DCA	**14,000**	**18,000**	**16,000**	**13,000**	**12,000**	**16,000**
1,1-DCE	**7,500**	**4,700**	**6,000**	**5,300**	**7,200**	**8,400**
1,2-DCA	1,000 U	1,000 U	2,000 U	1,000 U	1,000 U	1000 U
1,2-Dichloropropane	1,000 U	1,000 U	2,000 U	1,000 U	1,000 U	1000 U
Carbon tetrachloride	1,000 U	1,000 U	2,000 U	1,000 U	1,000 U	1000 U
Chloroform	1,000 U	1,000 U	**700 J**	1,000 U	1,000 U	1000 U
cis-1,2-DCE	**83,000**	**110,000**	**170,000**	**130,000**	**130,000**	**200,000 L**
Methylene chloride	**2,700**	**3,500**	**3,600**	**2,500**	**2,700**	**3,800**
trans-1,2-DCE	1,000 U	**470 J**	2,000 U	1,000 U	1,000 U	1000 U
TCE	**120,000**	**340,000**	**220,000**	**120,000**	**86,000**	**92,000 L**
VC	**4,600**	**1,900**	**3,100**	**1,900**	**2,200**	**2,600**

LS11-MW39D						
Sample Date	Baseline	1-Month	3-Month	6-Month	9-Month	12-Month
Analyte	02/05/09	06/11/09	08/13/09	11/23/09	02/23/10	5/24/10
1,1,1-Trichloroethane	**890**	**1,400**	**570**	**97**	**28**	**15**
1,1,2-Trichloroethane	50 U	100 U	50 U	10 U	5 U	5 U
1,1-DCA	**570**	**1,100**	**1,100**	**680**	**340**	**290**
1,1-DCE	**220**	**280**	**180**	**22**	**10**	5 U
1,2-DCA	50 U	100 U	50 U	10 U	5 U	5 U
1,2-Dichloropropane	50 U	100 U	50 U	10 U	5 U	5 U
Carbon tetrachloride	50 U	100 U	50 U	10 U	5 U	5 U
Chloroform	50 U	100 U	50 U	10 U	5 U	5 U
cis-1,2-DCE	**6,200**	**9,600**	**5,100**	**800**	**320**	**19**
Methylene chloride	**16 J**	100 U	50 U	10 U	5 U	5 U
trans-1,2-DCE	**22 J**	**64 J**	**26 J**	**5.6 J**	**4.5 J**	5 U
TCE	**71**	100 U	50 U	10 U	5 U	5 U
VC	**640**	**1,600**	**2,900**	**1,700**	**900**	**640**

LS11-MW05D		
Sample Date	Baseline	12-Month
Analyte	09/03/08	5/24/10
1,1-DCA	**110**	**17**
VC	**11**	**3.3**

LS11-MW05S		
Sample Date	Baseline	12-Month
	09/03/08	5/24/10
ND		

LS11-MW17D		
Sample Date	Baseline	12-Month
	09/02/08	5/25/10
ND		

LS11-MW04D		
Sample Date	Baseline	12-Month
Analyte	09/03/08	5/25/10
1,1-DCA	**260**	**17**
cis-1,2-DCE	**8.6**	1 U
TCE	**9**	1 U
VC	**24**	**2.5**

LS11-MW07D		
Sample Date	Baseline	12-Month
Analyte	09/04/08	5/27/10
cis-1,2-DCE	1 U	**1.5**
TCE	**1.1**	**1.8**

LS11-MW08D		
Sample Date	Baseline	12-Month
Analyte	09/03/08	5/27/10
1,1-DCA	1 U	**3.4**
1,1-DCE	**1.3**	**2.9**
cis-1,2-DCE	**1.3**	**9.7**
TCE	**4.9**	**10**
VC	1 U	**0.75 J**

LS11-MW14D		
Sample Date	Baseline	12-Month
Analyte	09/04/08	5/27/10
1,1-DCA	**0.44 J**	1 U
cis-1,2-DCE	**0.42 J**	1 U
TCE	**0.68 J**	1 U

LS11-MW36D		
Sample Date	Baseline	12-Month
Analyte	09/02/08	5/25/10
1,1,2-Trichloroethane	1 U	10 U
1,1-DCA	1 U	**100**
1,1-DCE	1 U	**56**
1,2-DCA	1 U	10 U
1,2-Dichloropropane	1 U	10 U
Carbon tetrachloride	1 U	10 U
Chloroform	1 U	10 U
cis-1,2-DCE	1 U	**280**
Methylene chloride	1 U	10 U
TCE	1 U	**150**
VC	1 U	**29**

LS11-MW09D						
Sample Date	Baseline	1-Month	3-Month	6-Month	9-Month	12-Month
Analyte	09/02/08	06/11/09	08/13/09	11/24/09	02/23/10	5/25/10
1,1-DCA	**16**	**7**	**3.7**	**2.2**	**2.4**	**1.5**
1,1-DCE	**7**	**4**	**3.1**	**1.9**	**2.9**	**1.9**
cis-1,2-DCE	**81**	**33**	**17**	**9**	**10**	**6.8**
trans-1,2-DCE	5 U	**0.47 J**	1 U	1 U	1 U	1 U
TCE	**22**	**14**	**12**	**8.4**	**9.5**	**8.3**
VC	**11**	**2.6**	**1.2**	1 U	**0.68 J**	1 U

LS11-MW10D		
Sample Date	Baseline	12-Month
Analyte	09/03/08	5/27/10
1,1-DCA	**3.1**	**3**
1,1-DCE	**60**	**58**
1,2-Dichloropropane	**1.4 J**	**1.3**
Chloroform	**1.2 J**	**1**
cis-1,2-DCE	**7.6**	**8.6**
TCE	**290**	**250**

LS11-MW37D		
Sample Date	Baseline	12-Month
Analyte	09/03/08	5/26/10
1,1,2-Trichloroethane	1 U	10 U
1,1-DCA	1 U	**59**
1,1-DCE	1 U	**23**
1,2-DCA	1 U	10 U
1,2-Dichloropropane	1 U	10 U
Carbon tetrachloride	1 U	10 U
Chloroform	1 U	10 U
cis-1,2-DCE	1 U	**160**
Methylene chloride	1 U	10 U
TCE	1 U	**62**
VC	1 U	**37**

LS11-MW41D						
Sample Date	Baseline	1-Month	3-Month	6-Month	9-Month	12-Month
Analyte	01/30/09	06/11/09	08/14/09	11/24/09	02/23/10	5/26/10
1,1,1-Trichloroethane	**3**	1 U	1 U	1 U	1 U	1 U
1,1-DCA	**3**	**2.1**	**2.3**	**1.1**	**1.2**	**0.81 J**
1,1-DCE	**46**	**37**	**38**	**16**	**18**	**5.9**
1,2-Dichloropropane	**1.1**	**0.82 J**	**0.87 J**	**0.44 J**	**0.38 J**	**0.36 J**
Chloroform	**0.54 J**	**0.6 J**	**0.85 J**	1 U	1 U	1 U
cis-1,2-DCE	**10**	**5.6**	**6.7**	**14**	**59**	**22**
Methylene chloride	1 U	1 U	**0.6 J**	1 U	1 U	1 U
TCE	**190**	**160**	**150**	**39**	**14**	**1.3**
VC	1 U	1 U	1 U	1 U	**3**	**35**

LS11-MW12D		
Sample Date	Baseline	12-Month
	01/29/09	5/27/10
ND		

LS11-MW42D						
Sample Date	Baseline	1-Month	3-Month	6-Month	9-Month	12-Month
Analyte	02/05/09	06/11/09	08/14/09	11/24/09	02/23/10	5/26/10
1,1,1-Trichloroethane	1 U	**1.8**	1 U	1 U	1 U	1 U
1,1-DCA	**1.2**	**1.4**	**1.3**	**1.1**	**1.1**	**1.3**
1,1-DCE	**16**	**12**	**17**	**15**	**19**	**18**
1,2-Dichloropropane	1 U	**0.47 J**	**0.54 J**	**0.49 J**	**0.49 J**	**0.53 J**
cis-1,2-DCE	**5.8**	**8.8**	**16**	**9**	**5.9**	**5.8**
TCE	**77**	**120**	**75**	**73**	**80**	**92**

LS11-MW13D		
Sample Date	Baseline	12-Month
	09/04/08	5/27/10
ND		

LS11-MW40D						
Sample Date	Baseline	1-Month	3-Month	6-Month	9-Month	12-Month
Analyte	01/29/09	06/11/09	08/14/09	11/24/09	02/23/10	5/26/10
1,1,1-Trichloroethane	10 U	**1.4 J**	**1.6 J**	2.5 U	1 U	1 U
1,1,2-Trichloroethane	10 U	2.5 U	2.5 U	2.5 U	1 U	1 U
1,1-DCA	**44**	**36**	**41**	**110**	**25**	**22**
1,1-DCE	**65**	**88**	**94**	**58**	**12**	**8.7**
1,2-DCA	10 U	2.5 U	2.5 U	2.5 U	1 U	1 U
1,2-Dichloropropane	10 U	2.5 U	2.5 U	2.5 U	1 U	1 U
Carbon tetrachloride	10 U	2.5 U	2.5 U	2.5 U	1 U	1 U
Chloroform	10 U	**0.53 J**	2.5 U	2.5 U	1 U	1 U
cis-1,2-DCE	**160**	**120**	**140**	**320**	**74**	**65**
Methylene chloride	10 U	2.5 U	2.5 U	2.5 U	1 U	1 U
trans-1,2-DCE	10 U	2.5 U	**4.7**	**2.2 J**	**0.96 J**	**0.73 J**
TCE	**250**	**350**	**350**	**110**	**19**	**0.67 J**
VC	**6.9 J**	**6.2**	**5.8**	**49**	**28**	**30**

LS11-MW11D		
Sample Date	Baseline	12-Month
	09/02/08	5/25/10
ND		

Analyte	Cleanup Goal
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	5
1,1-Dichloroethane (DCA)	2,900
1,1-Dichloroethene (DCE)	7
1,2-Dichloroethane (DCA)	5
1,2-Dichloropropane	5
Carbon tetrachloride	5
Chloroform	9.6
cis-1,2-Dichloroethene (DCE)	70
Methylene chloride	5
trans-1,2-Dichloroethene (DCE)	100
Trichloroethene (TCE)	5
Vinyl chloride (VC)	2

Legend

- Existing Monitoring Well not Employed for the Remedial Action
- Flushmount Access to Existing 45° Directional Monitoring Well
- Annual Monitoring Well
- Performance Monitoring Well (1, 3, 6, and 9 months)
- Monitoring Well used for injection
- Injection Well
- Stormwater Drop Inlet
- Water Line
- Sanitary Sewer
- Sanitary Sewer Line Repaired
- Storm Water
- Heat Cool Line
- Electrical Cable Line
- Isoconcentration (Dashed where inferred)
- Groundwater Plume (May 2010)
- LUC Boundary

Notes:
Exceedance of Cleanup Goal
Bold indicates detections
-Analytes are not presented if they were not detected above the reporting value for all sampling events and the reporting value is less than or equal to the cleanup goal
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
L - Analyte present, value may be biased low, actual value may be higher
ND - No analytes were detected above the reporting value and the reporting value is less than or equal to the cleanup goal

N
W E
S

0 40 80 160
Feet

Figure 3-1
Analytical Results
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

Monitoring Well	Screen Inteval (ft bgs)
LS11-MW04D	15-20
LS11-MW05D	15-20
LS11-MW06D	15-20
LS11-MW07D	15-20
LS11-MW08D	15-20
LS11-MW09D	15-20
LS11-MW10D	15-20
LS11-MW11D	15-20
LS11-MW12D	15-20
LS11-MW13D	15-20
LS11-MW14D	18-23
LS11-MW15D	15-20
LS11-MW17D	15-20
LS11-MW36D	29.4-40
LS11-MW37D	29-39
LS11-MW38D	19-24
LS11-MW39D	17-22
LS11-MW40D	15-20
LS11-MW41D	16-21
LS11-MW42D	18-23

Legend

- Existing Monitoring Well not Employed for the Remedial Action
- Flushmount Access to Existing 45° Directional Monitoring Well
- Annual Monitoring Well
- Performance Monitoring Well (1, 3, 6, and 9 months)
- Monitoring Well used for injection
- Injection Well

Concentrations are in µg/L

- Isoconcentration Contour (Dashed where inferred)

Isoconcentrations (May 2010)

- 1-10
- 10-100
- 100-1,000
- 1,000-10,000
- >10,000

- Water Line
- Sanitary Sewer
- Sanitary Sewer Line Repaired
- Storm Water
- Heat Cool Line
- Electrical Cable Line
- LUC Boundary

Note:
ND- Analytes not detected at concentrations greater than the cleanup goal

N
W E
S

0 50 100
Feet

Figure 3-2
Total COC Isoconcentration Contours
Columbia Aquifer (Annual)
ERD Annual Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

CH2MHILL

SECTION 4

Conclusions and Recommendations

The ERD approach at Site 11 was successfully implemented in the source zone and the downgradient plume. This conclusion is supported by the increase in the TOC concentrations, the achievement of the geochemical conditions amenable to reductive dechlorination, and decreasing COC concentrations, with appropriately trending concentrations of daughter products observed at most performance monitoring wells. Although monitoring well MW09D is not optimally located to evaluate the system one-year post-injection, reduction in COC concentrations was observed; therefore, it is expected to be useful in evaluating the long-term effectiveness of the system. Although conditions indicative of reductive dechlorination were not observed in the post-injection groundwater data collected from monitoring well MW42D, based upon the distance of the monitoring well from the nearest upgradient injection well and the estimated yearly groundwater velocity, it is assumed that injected substrate did not have adequate time to migrate to the monitoring well and given additional time, detection of elevated TOC at monitoring well MW42D is expected to occur. While the post-injection areal extent of the groundwater plume is similar to that of the pre-injection areal extent; the overall total COC concentrations have decreased in the aquifer (**Figures 2-1** and **3-2**). In addition, biotransformation of parent compounds (such as TCE) to less chlorinated daughter products is occurring, indicating that reductive dechlorination is proceeding as intended.

Since COC concentrations remain above the respective cleanup goals in some areas, continued remedial action is warranted at Site 11. LUCs should remain in effect until RAOs have been achieved. Based on the data collected over the first year post injection, it is not recommended that an additional injection be undertaken at this time. A long-term (LTM) monitoring SAP should be developed to document the decision flow process to conduct additional sampling; the LTM SAP should include the decision logic to determine when additional injections or other changes to the remedy are necessary. The monitoring wells, the parameters to be sampled, and the sampling frequency should be included in the LTM SAP.

To address the lack of substantial degradation of chlorinated ethanes in the vicinity of MW38D bioaugmentation should be considered for this area. If bioaugmentation is employed, the microbial consortium should contain bacteria capable of degrading chlorinated ethanes in environments with elevated mixed (i.e., both chloroethane and chloroethene) VOC concentrations.

SECTION 5

References

A.T. Kearney, Inc. 1989. *Revised Phase II RCRA Facility Assessment, Naval Amphibious Base, Little Creek, Norfolk, Virginia.* December.

AGVIQ-CH2M HILL Joint Venture I (JV I). 2009. *Site 11- Former School of Music Plating Shop Remedial Action Work Plan and Sampling and Analysis Plan.* April.

Boving, T.B., J.E. McCray, W.J. Blanford, M.L. Brusseau, University of Rhode Island, Colorado School of Mines, University of Texas at San Antonio, and University of Arizona. 2003. *Cyclodextrin Enhanced In situ Removal of Organic Contaminants from Groundwater at Department of Defense Sites.*

CH2M HILL. 1986. *Round 1 Verification Step, Naval Amphibious Base, Little Creek, Virginia Beach, Virginia*. October.

CH2M HILL. 1998. *Final Groundwater Monitoring Report Sites 5 and 11.* February.

CH2M HILL. 2000. *Final Screening Ecological Risk Assessment, Installation Restoration Sites 5, 7, 8, 9, 10, 11, 12, 13, and 16, and SWMU 3, Naval Amphibious Base Little Creek, Virginia Beach, Virginia.* June.

CH2M HILL. 2003. *NAB Little Creek Sites 11, 11a, and 13 Membrane Interface Probe Investigation and Confirmation Sampling, Virginia Beach, Virginia.* November.

CH2M HILL. 2004. *Final Supplemental Remedial Investigation for Site 11 – School of Music Plating Shop Naval Amphibious Base Little Creek, Virginia Beach, Virginia.* June.

CH2M HILL. 2005. *Vapor Intrusion Assessment, Site 11, Naval Amphibious Base Little Creek.* September.

CH2M HILL. 2006a. *Site 11 Revised Human Health Risk Assessment, SRI Addendum. Naval Amphibious Base Little Creek, Virginia Beach, Virginia.* March.

CH2M HILL. 2006b. *Final Feasibility Study, Site 11 – School of Music Plating Shop*. June.

CH2M HILL. 2006c. *Summary of Groundwater Sampling for Pentachlorophenol at Site 11, Naval Amphibious Base Little Creek.* September

CH2M HILL. 2006d. *Proposed Plan Site 11: School of Music Plating Shop Naval Amphibious Base Little Creek Virginia Beach, Virginia.* September.

CH2M HILL. 2007. *Record of Decision, Site 11 School of Music Plating Shop*, *Naval Amphibious Base Little Creek, Virginia Beach, Virginia.* July.

CH2M HILL. 2009. *Five-Year Review, Naval Amphibious Base Little Creek, Virginia Beach, Virginia.* March.

CH2M HILL. 2010. *Final Remedial Action Construction Completion Report, Site 11 – Former School of Music Plating Shop.* June.

Ebasco Environmental Consultants. 1991. *Draft Final Interim Remedial Investigation. NAB Little Creek, Virginia Beach, Virginia.* November.

Foster Wheeler Environmental Services (FWES). 1994a. *Remedial Investigation/Feasibility Study (RI/FS) for Sites 7 and 9-13. NAB Little Creek, Virginia Beach, Virginia.* November.

Foster Wheeler Environmental Services (FWES). 1994b. *Final Decision Document. School of Music Plating Shop. NAB Little Creek, Virginia Beach, Virginia.* November.

IT Corporation. 1996. *Interim Removal Action. Final Closeout Report. Site 11 School of Music Plating Shop. Naval Amphibious Base Little Creek, Norfolk, Virginia.* May.

Rogers, Golden, and Halpern. 1984. *Initial Assessment Study of Naval Amphibious Base, Little Creek, Virginia Beach, Virginia.* December.

United States Department of the Navy (Navy). 2003. *Final Federal Facilities Agreement.* November.

United States Environmental Protection Agency (USEPA). 2009. Jeffrey Boylan, e-mail message to JEB Little Creek Partnering Team, April 8.

Virginia Department of Environmental Quality (VDEQ). 2009. Paul Herman, e-mail message to JEB Little Creek Partnering Team, April 8.

Appendix A
Groundwater Elevation Hydrographs

Figure A-1
Hydrograph for MW04D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

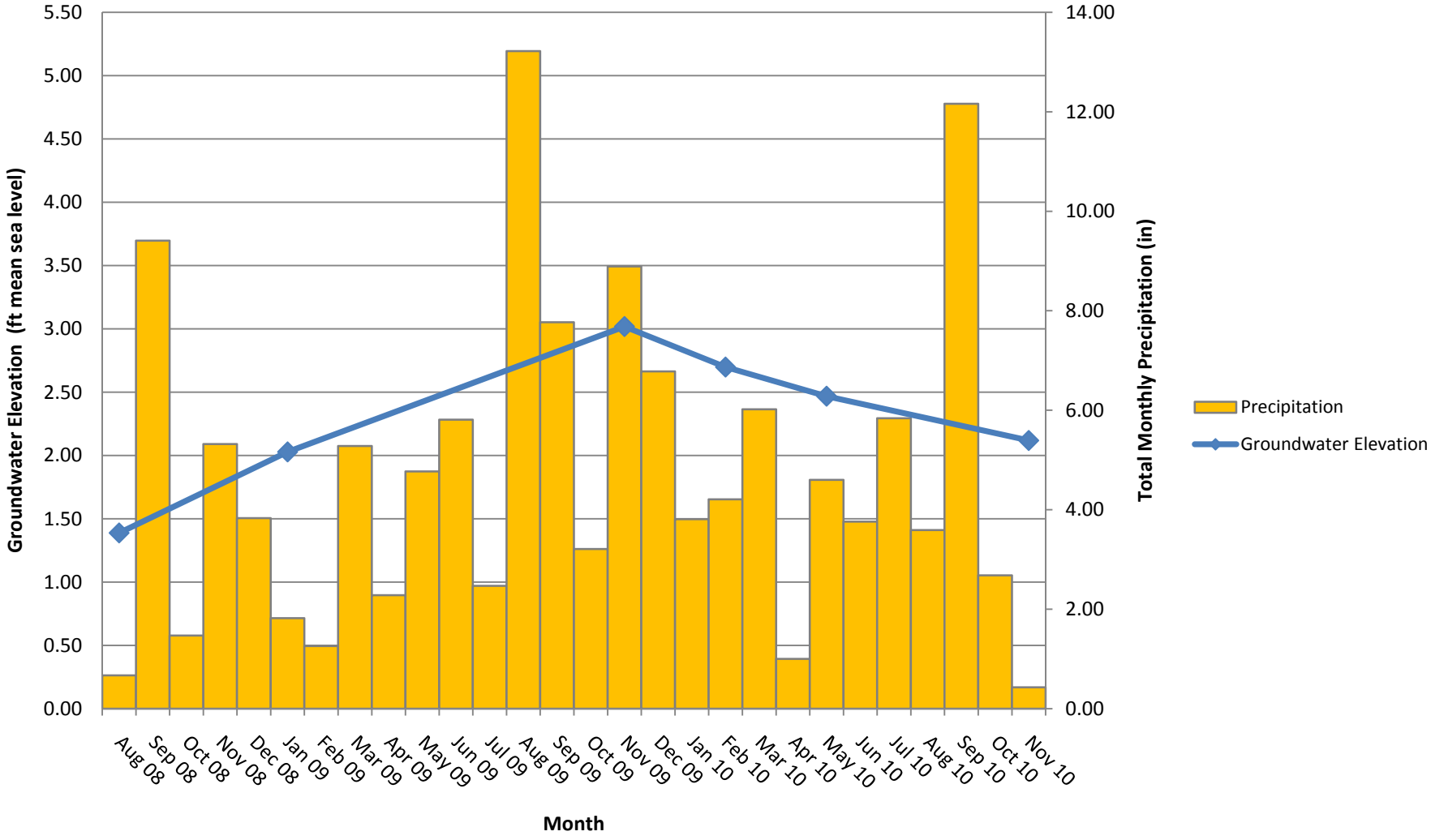


Figure A-2
Hydrograph for MW05D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

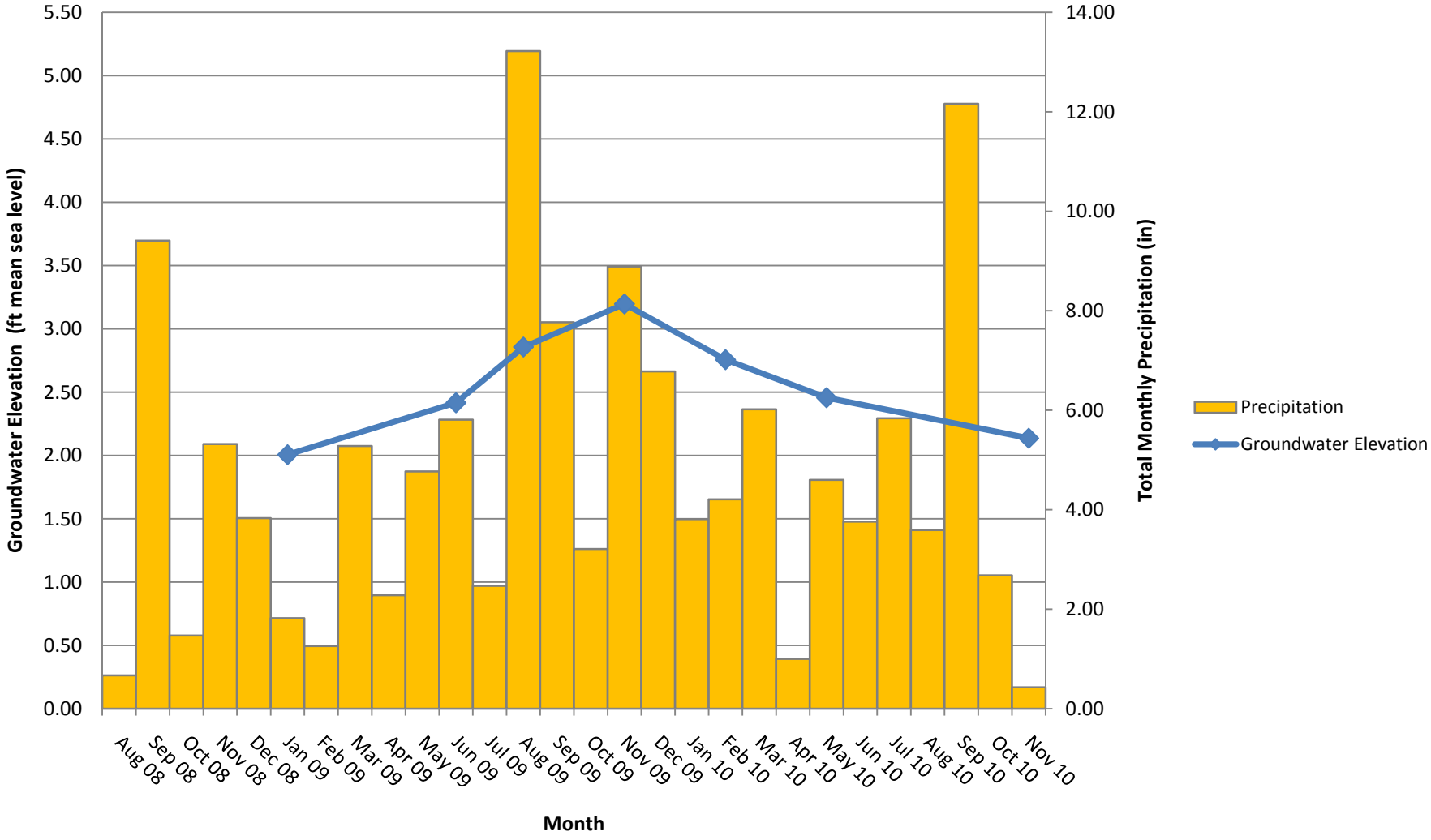


Figure A-3
Hydrograph for MW05S
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

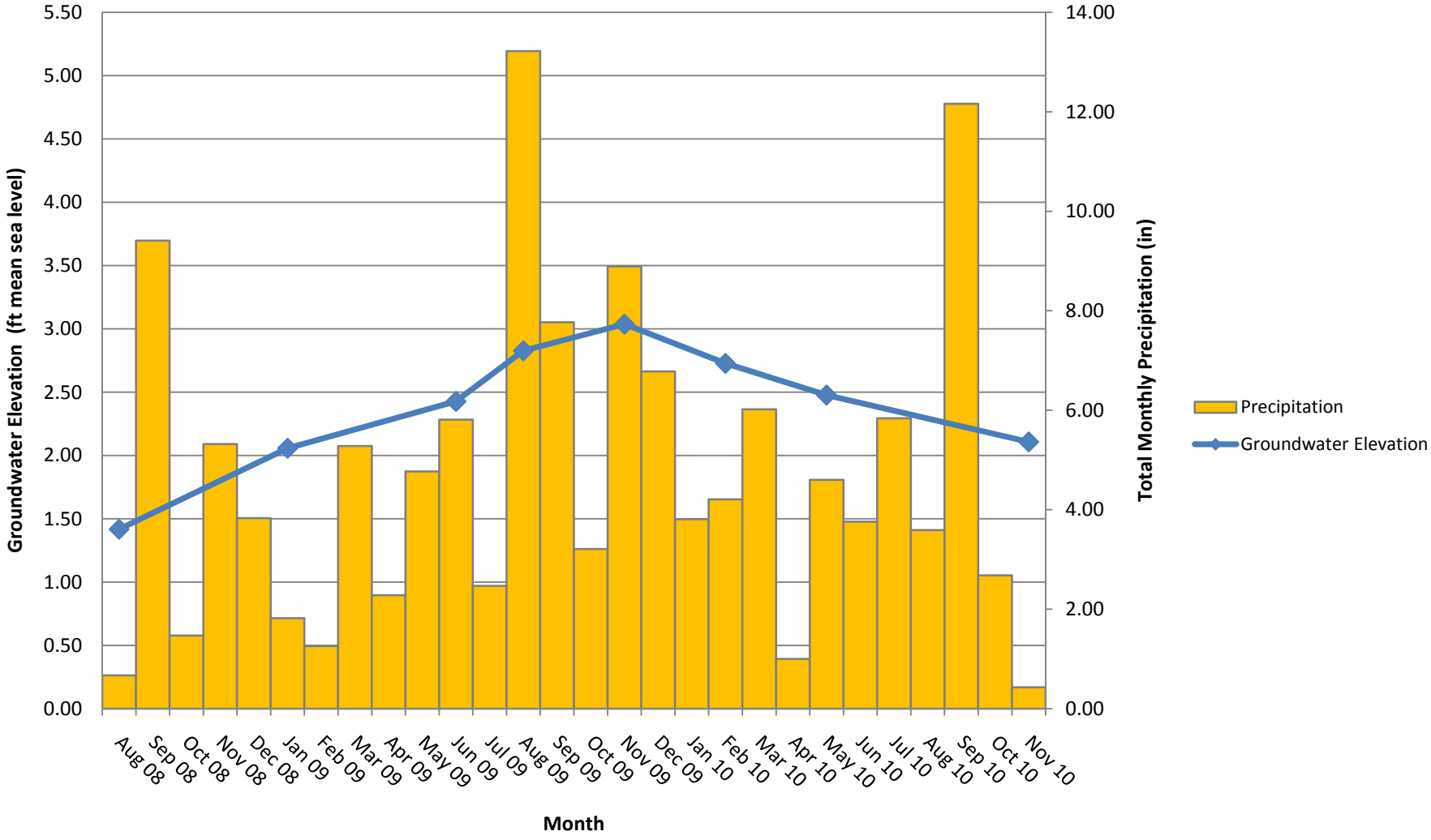


Figure A-4
Hydrograph for MW06D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

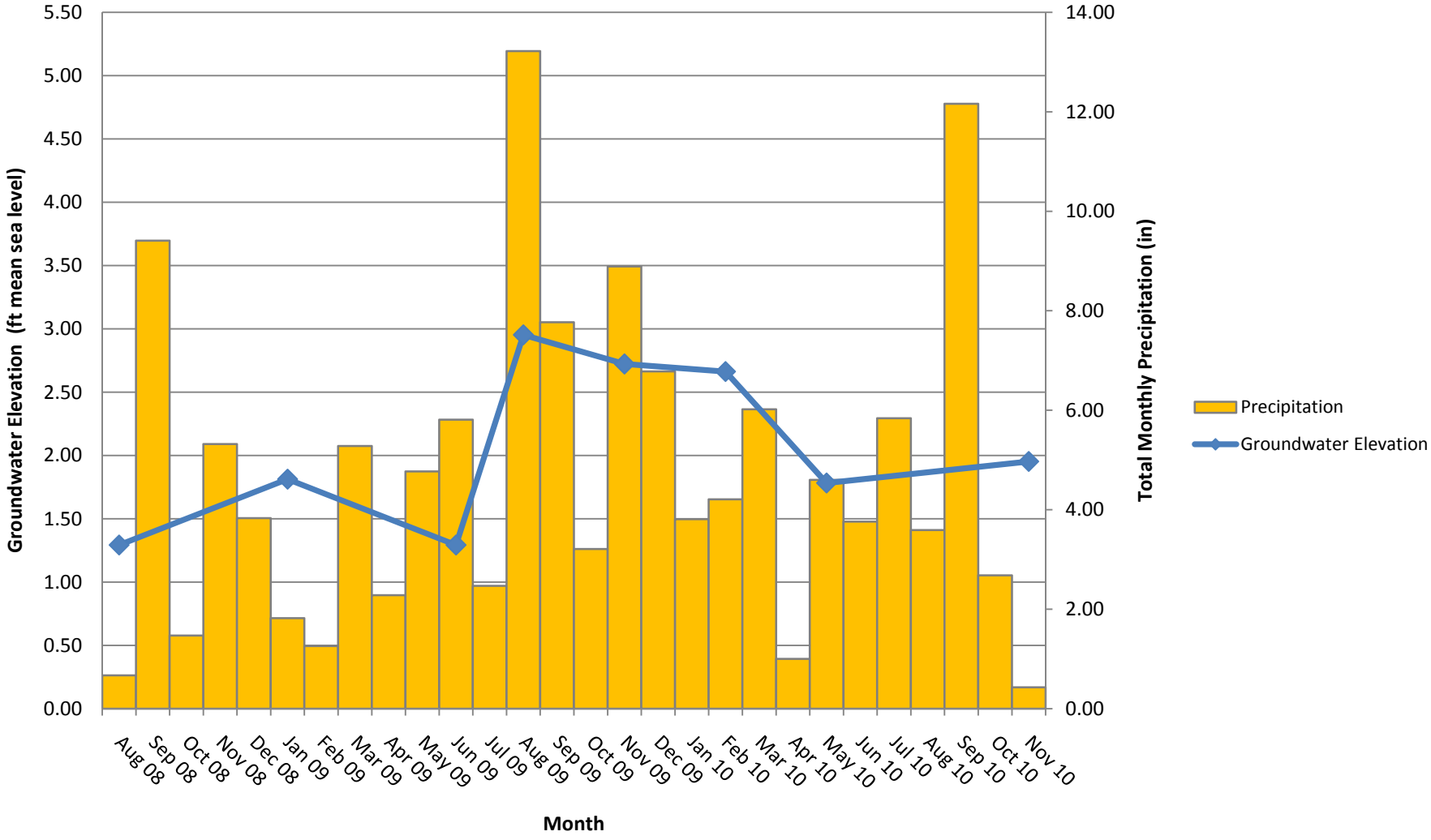


Figure A-5
Hydrograph for MW07D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

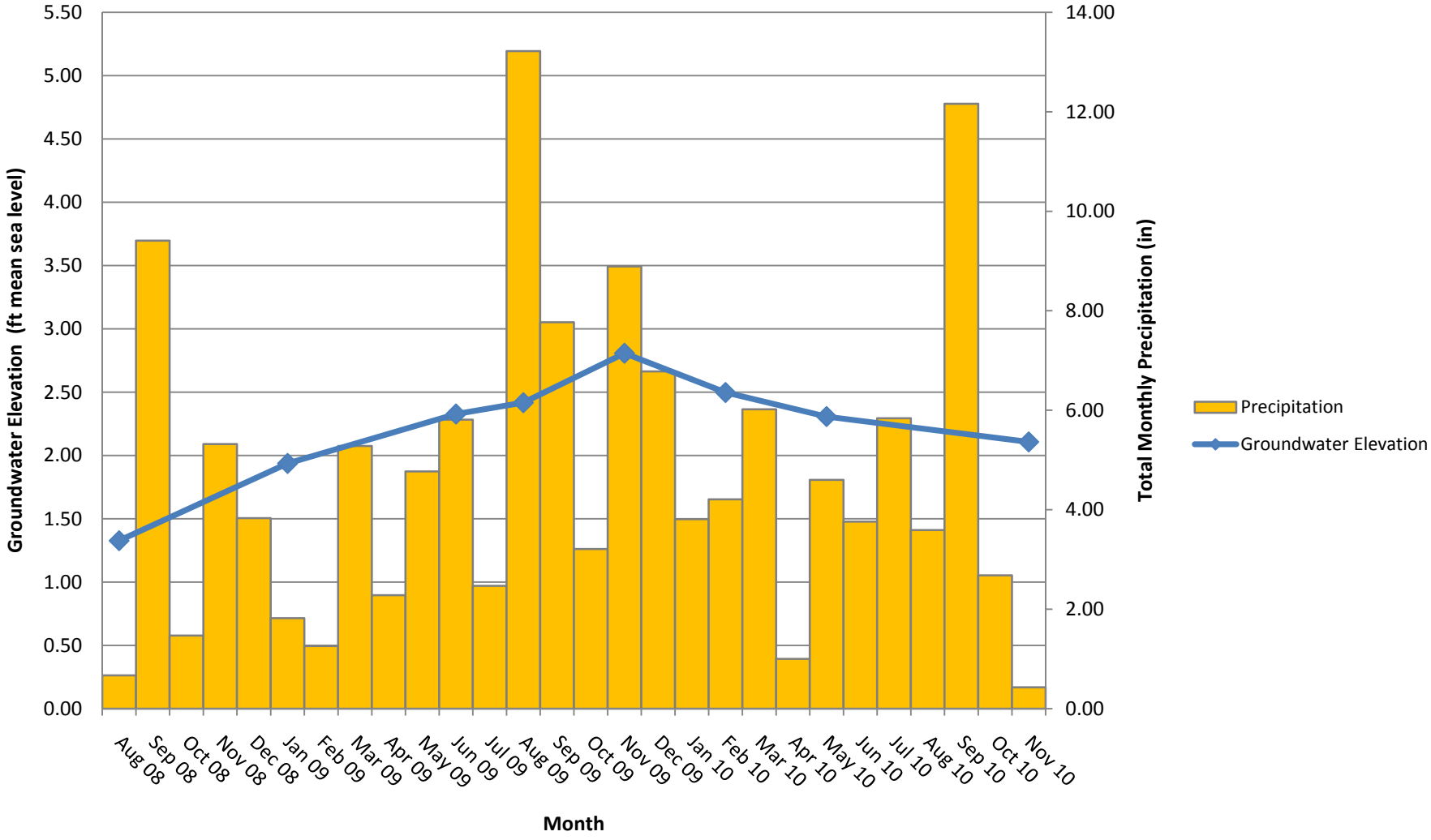


Figure A-6
Hydrograph for MW08D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

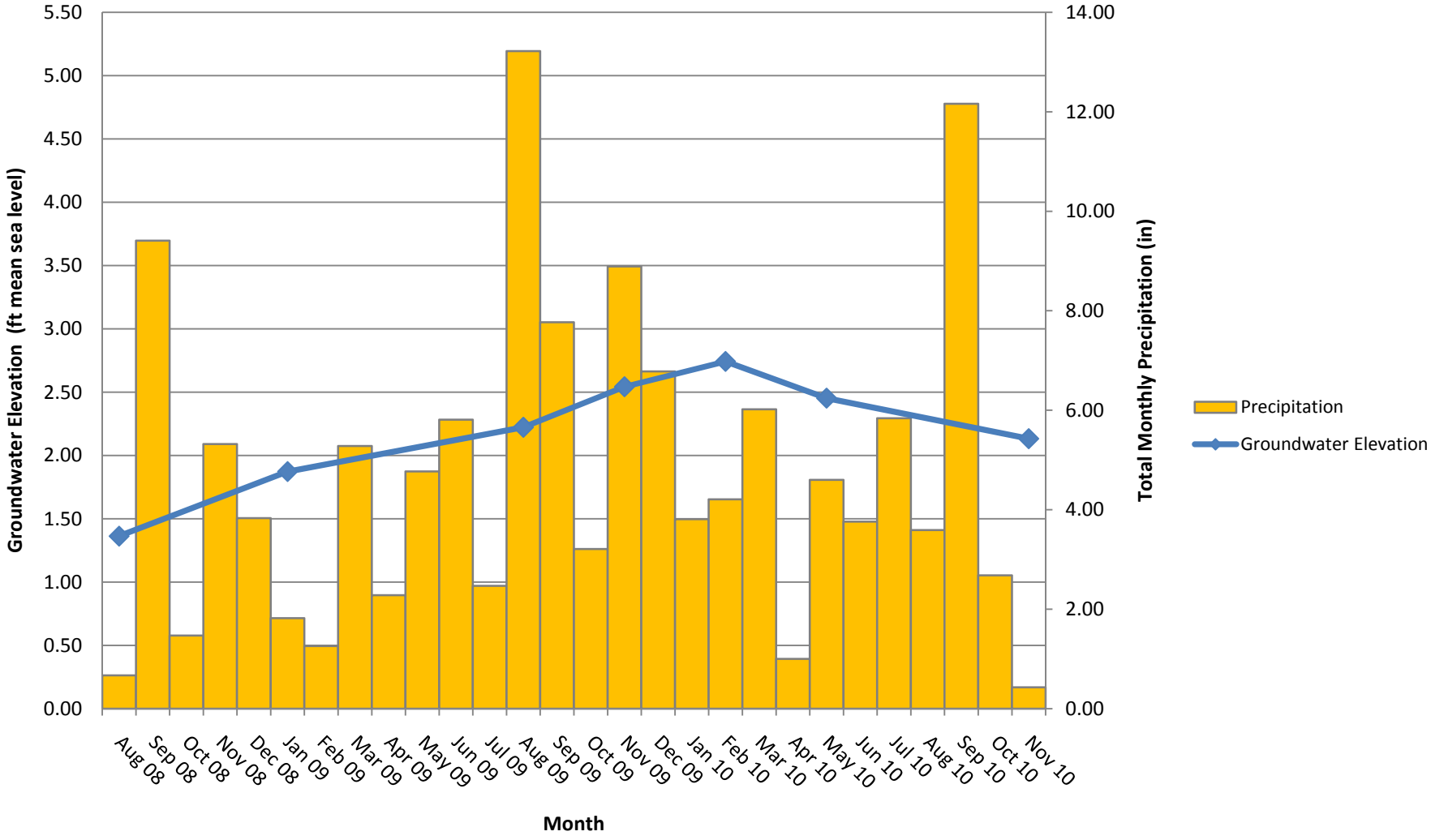


Figure A-7
Hydrograph for MW09D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

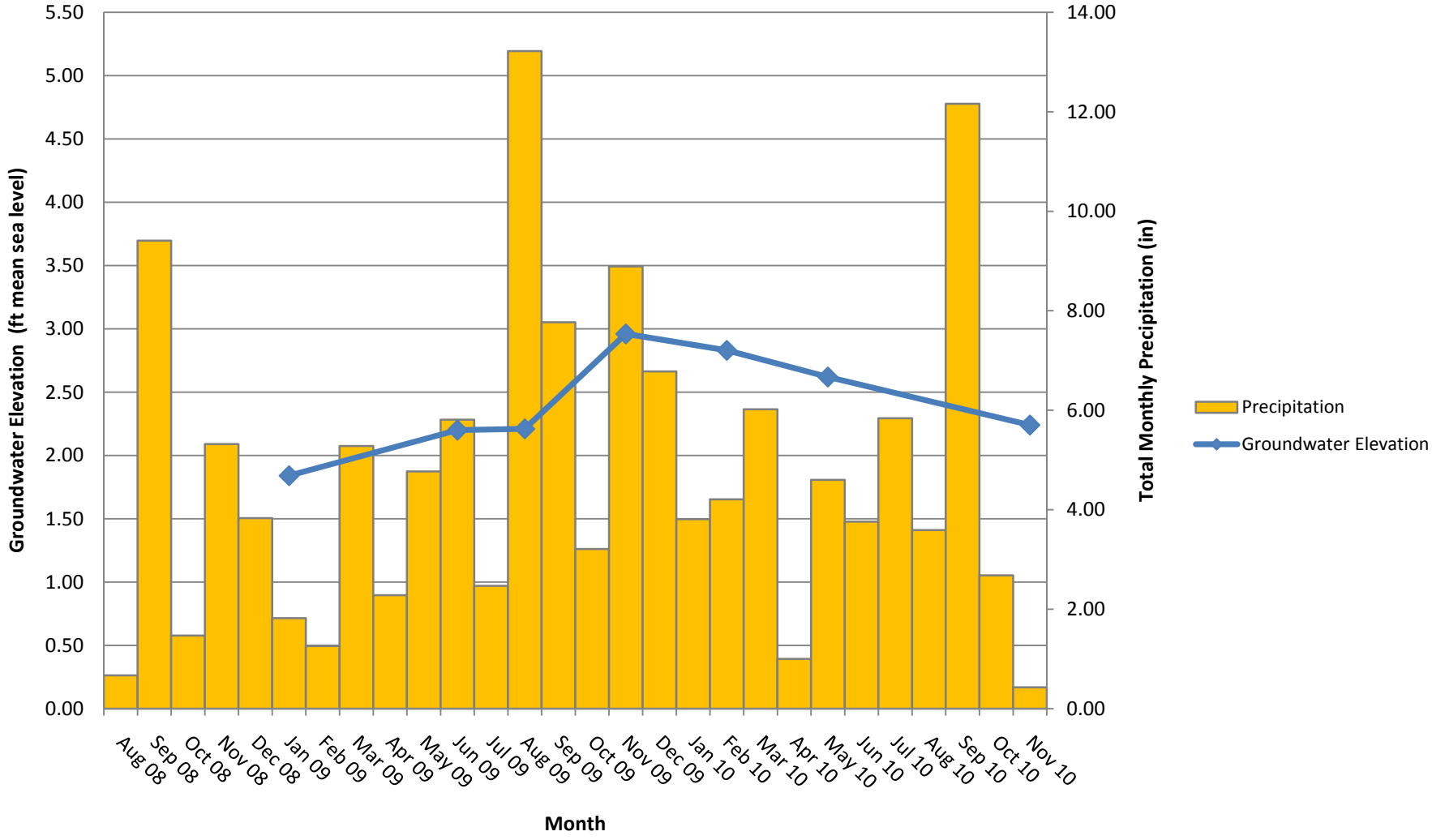


Figure A-8
Hydrograph for MW10D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

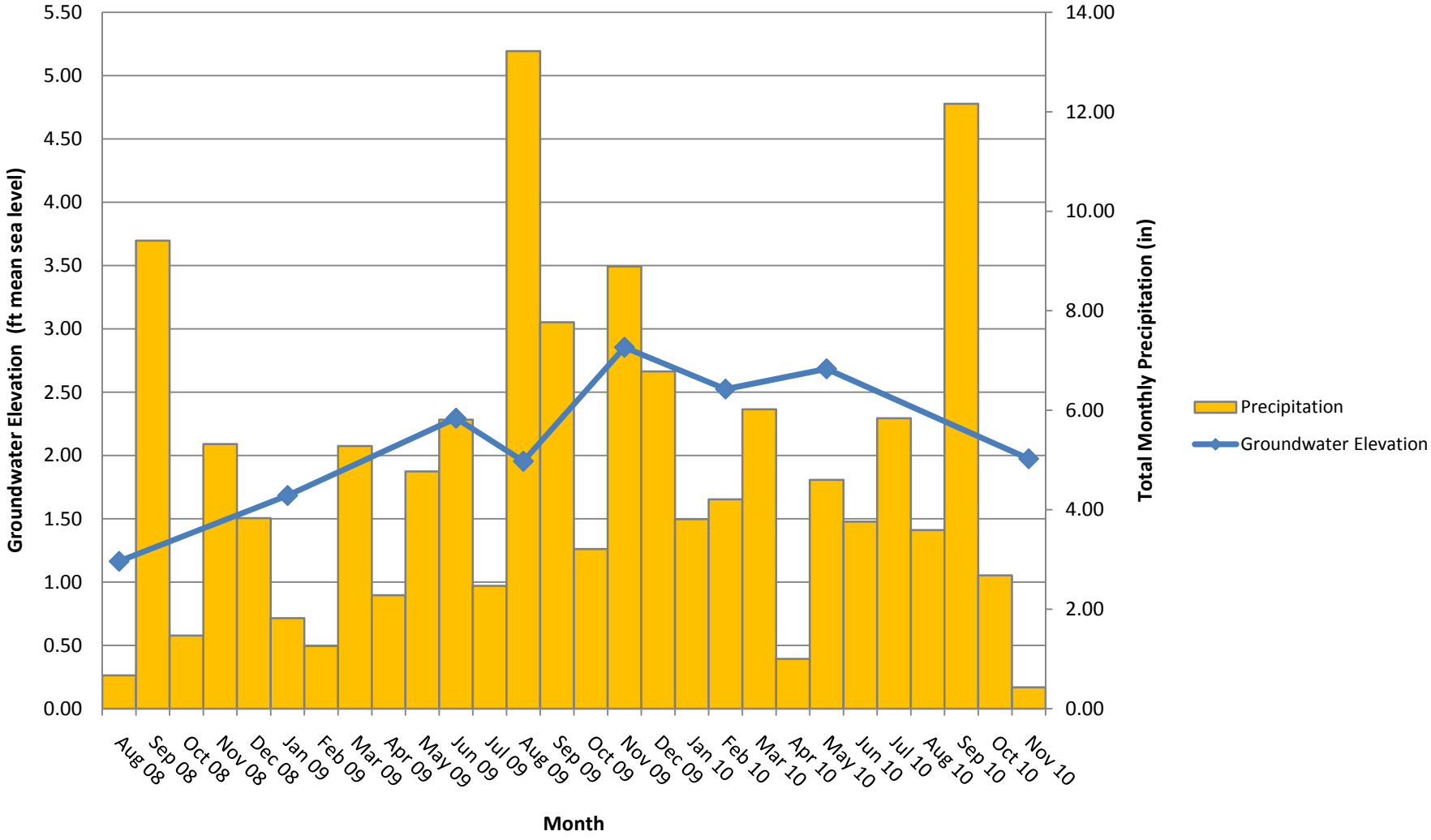


Figure A-9
Hydrograph for MW11D
ERD Groundwater Monitoring Summary
Site 11
JEB Little Creek
Virginia Beach, Virginia

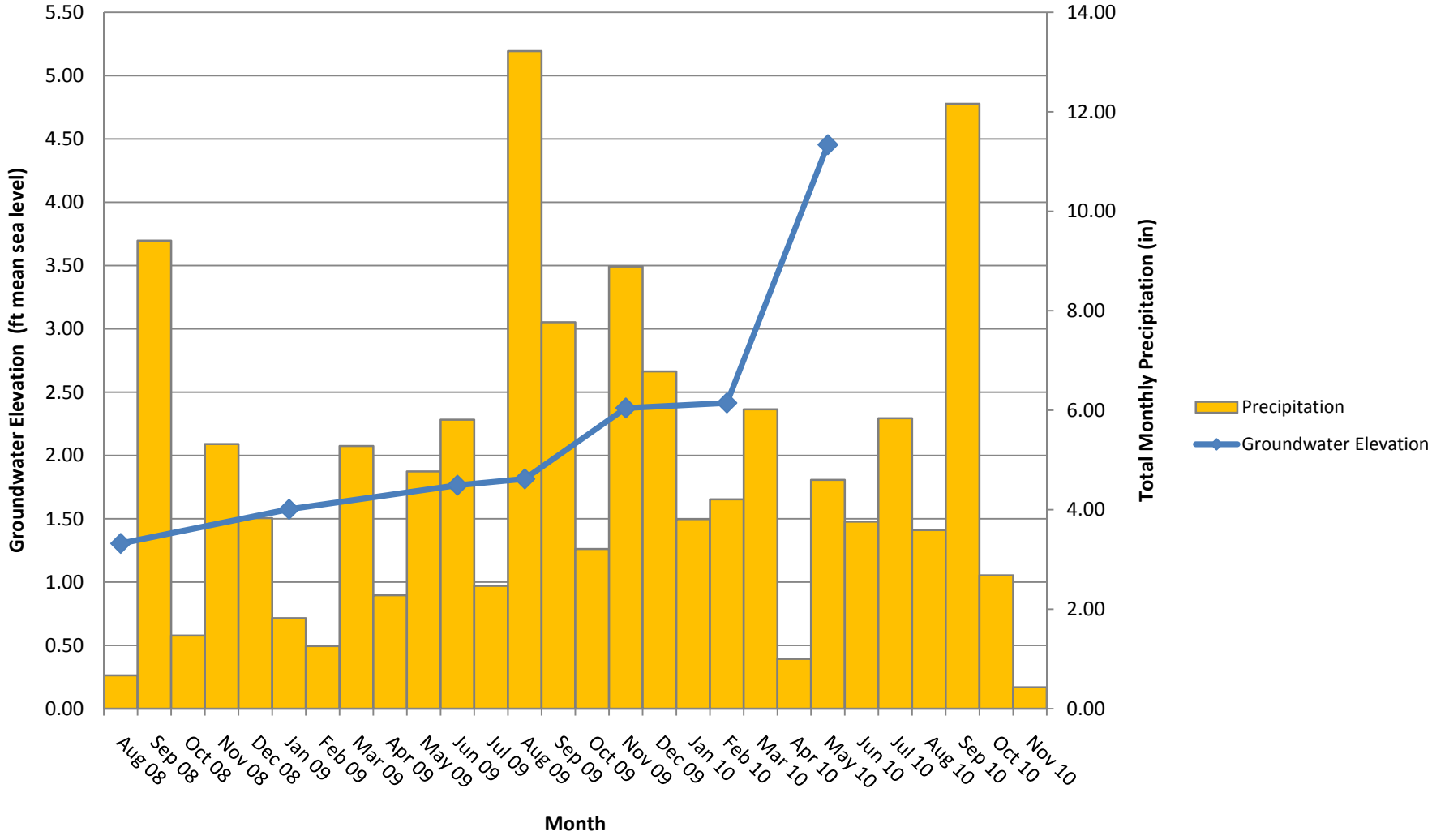


Figure A- 10
Hydrograph for MW12D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

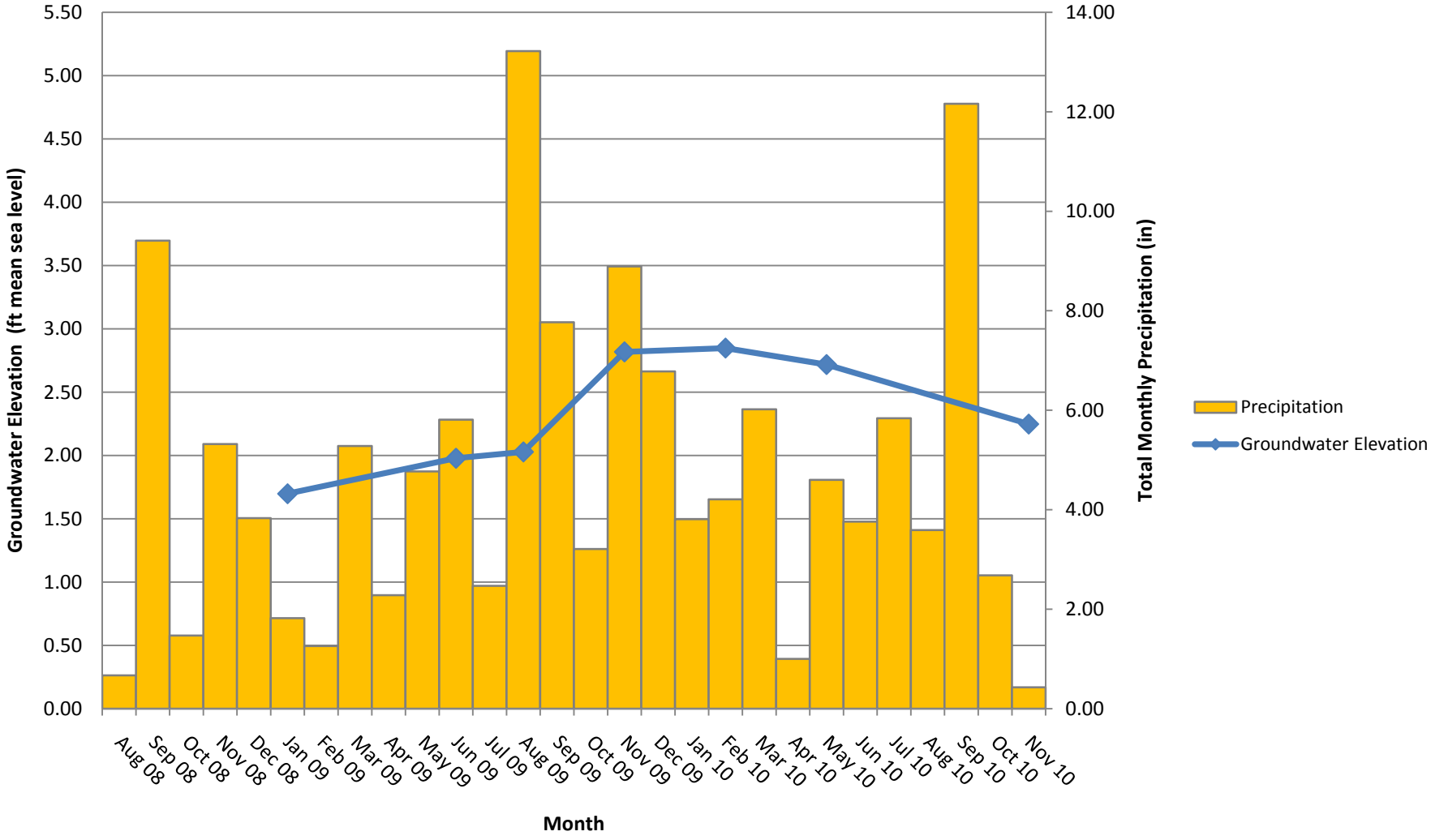


Figure A-11
Hydrograph for MW13D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

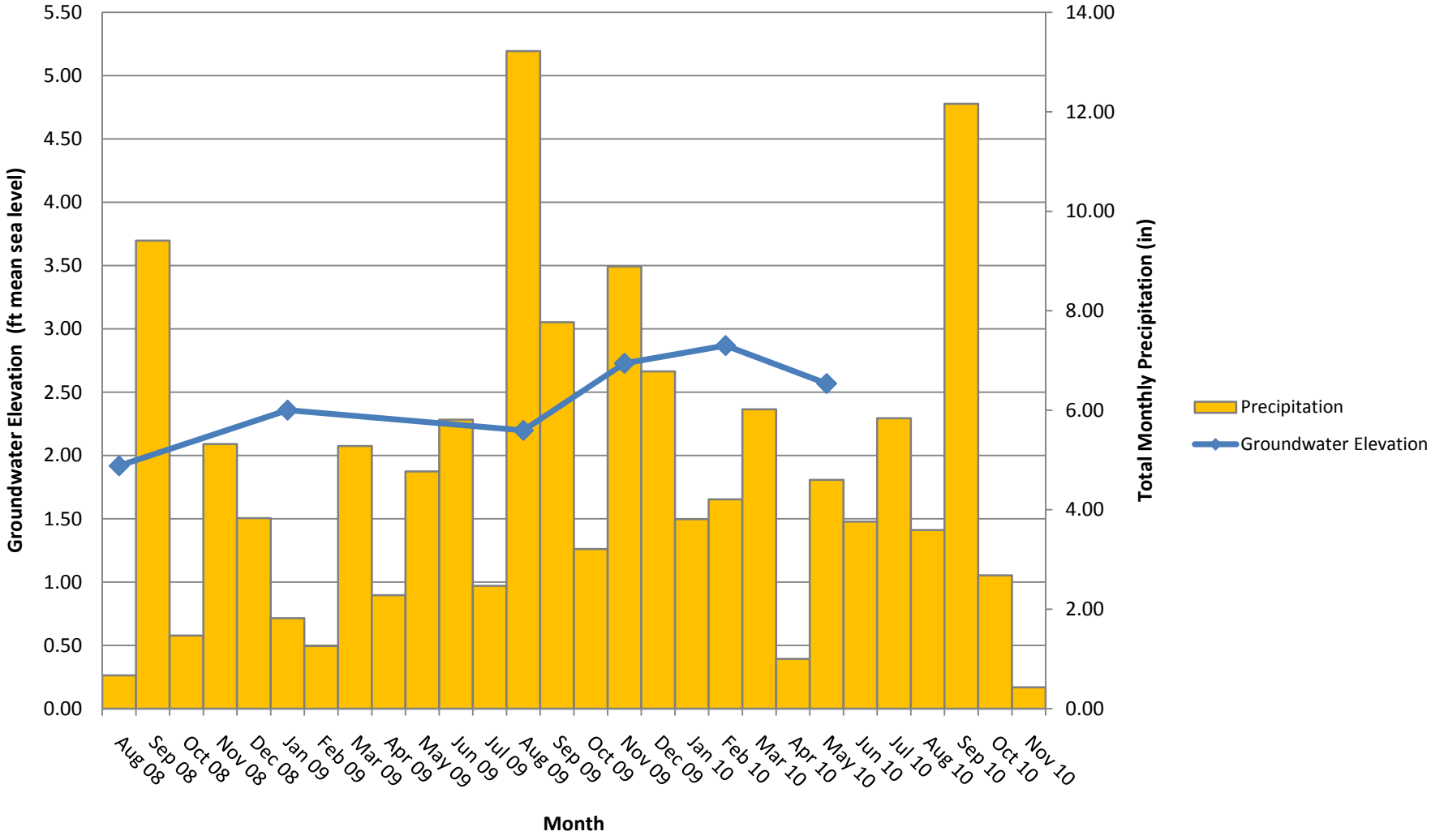


Figure A-12
Hydrograph for MW14D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

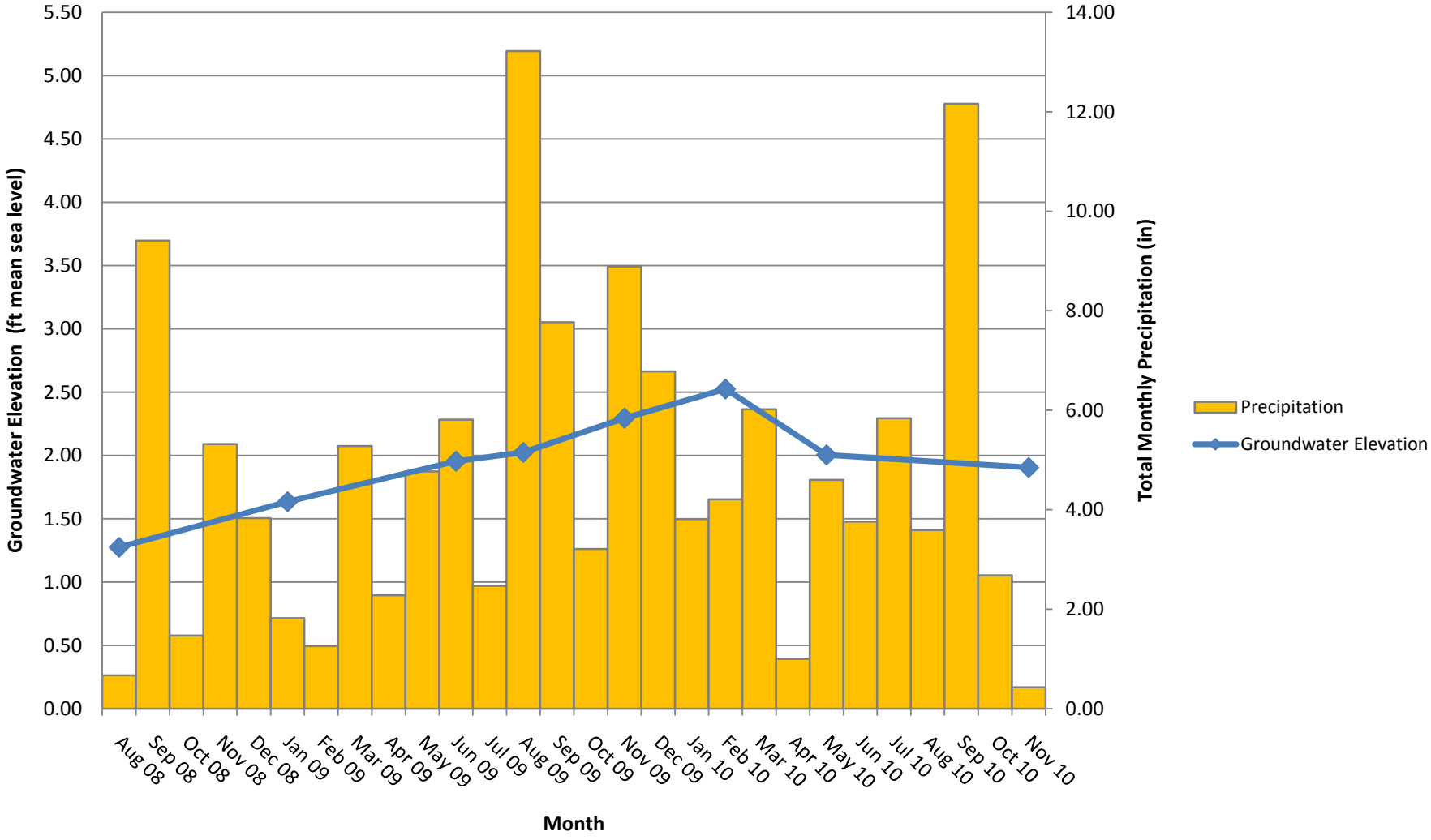


Figure A-13
Hydrograph for MW15D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

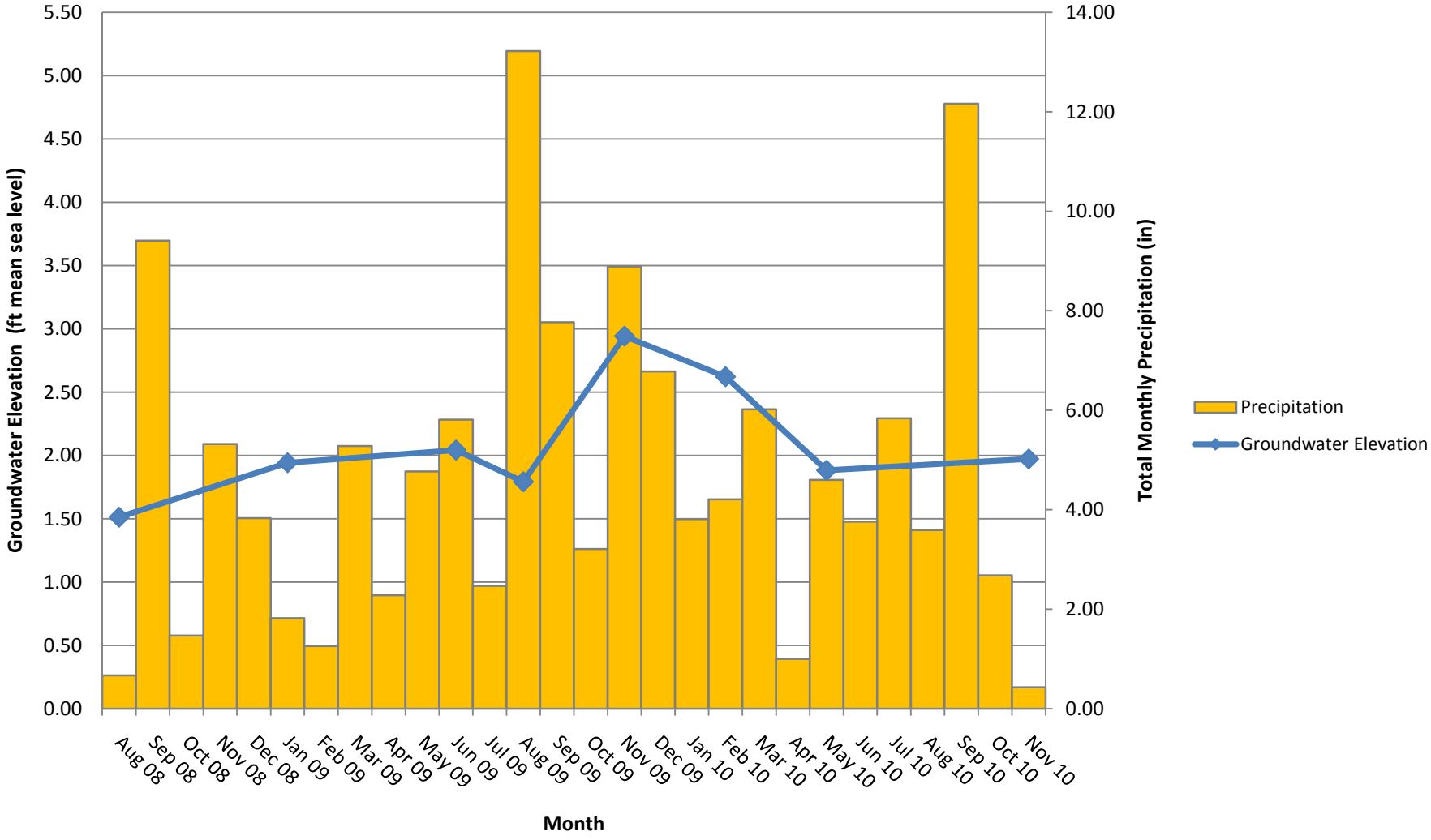


Figure A-14
Hydrograph for MW17D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

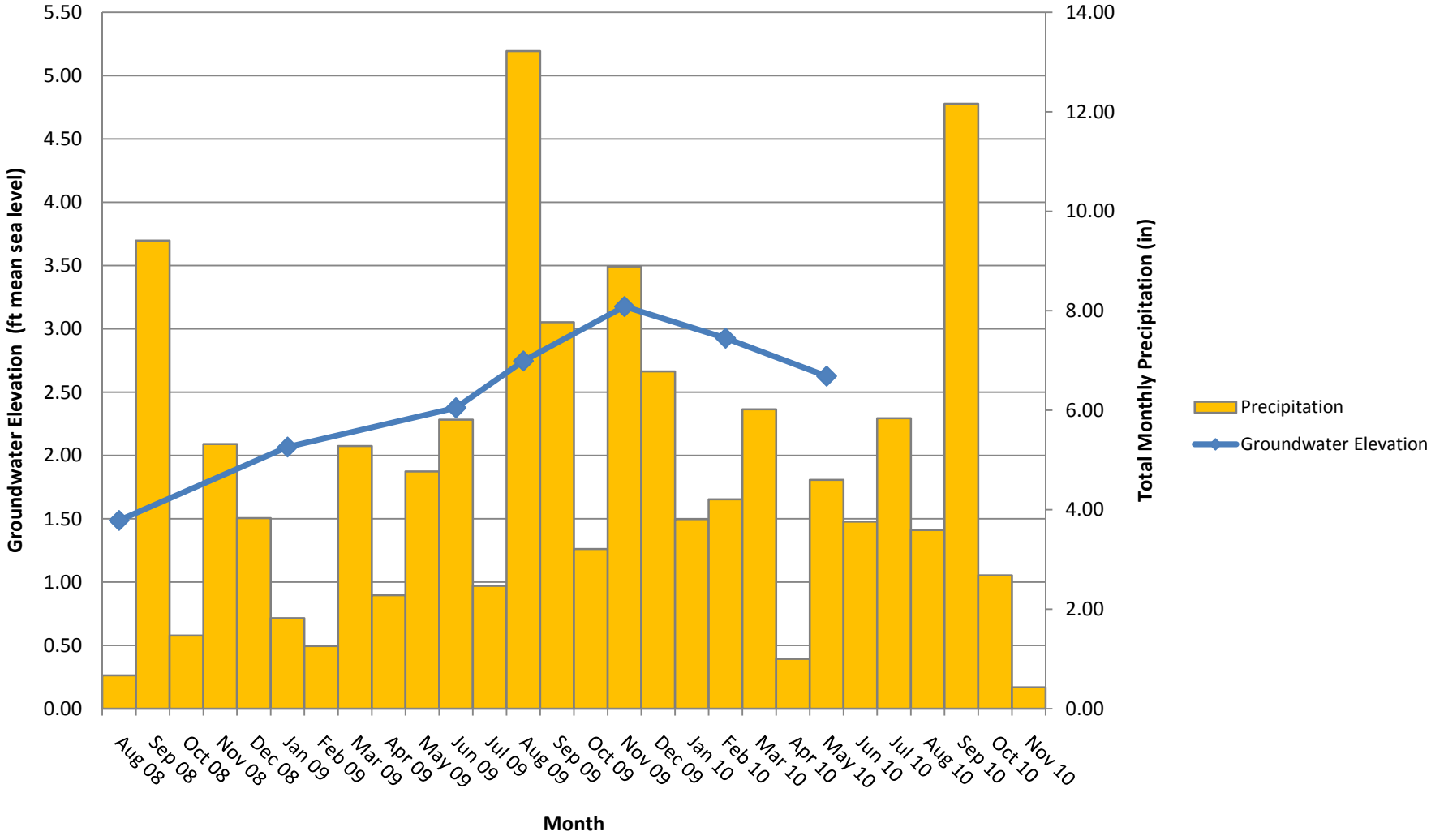


Figure A-15
Hydrograph for MW23D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

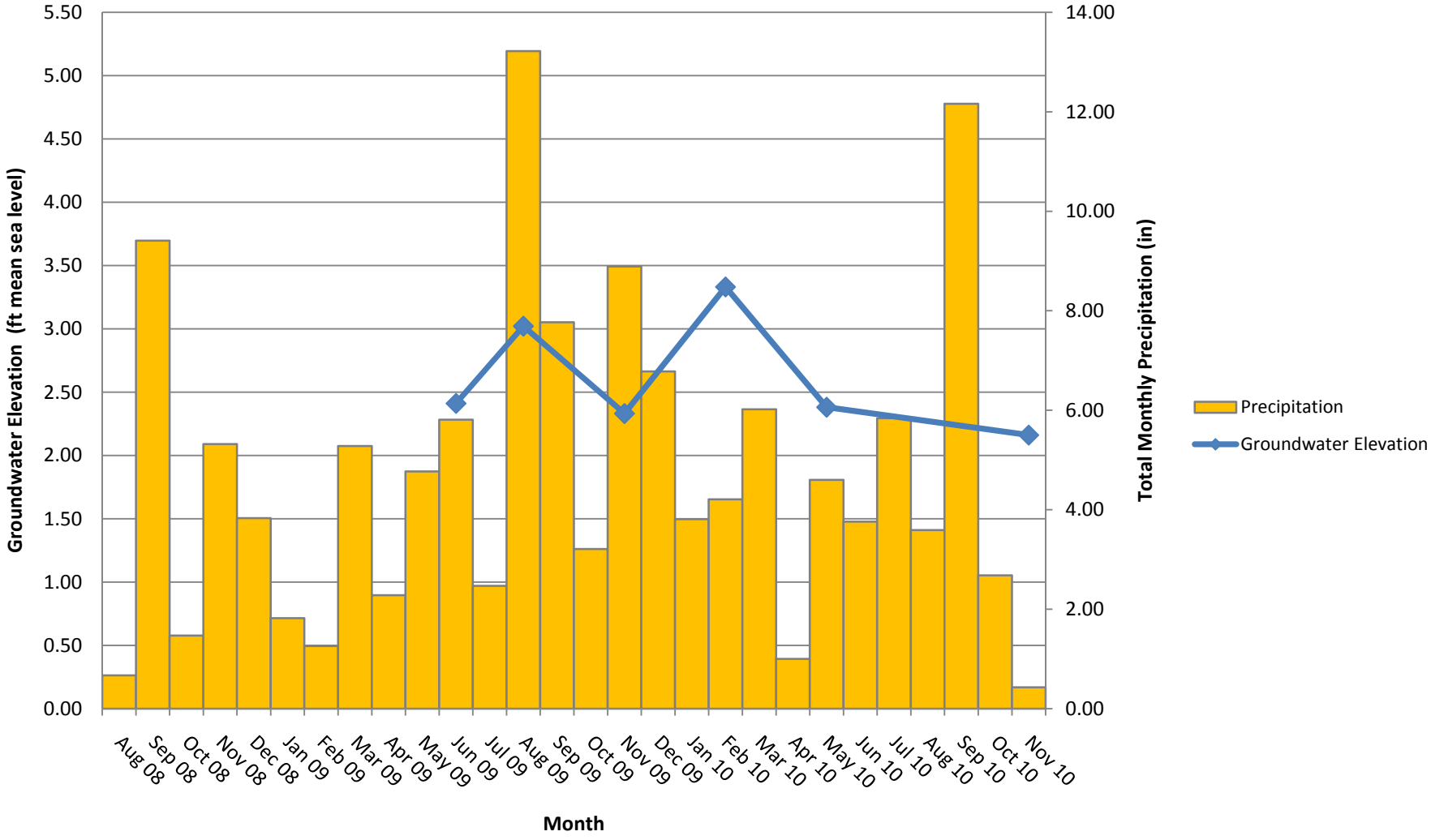


Figure A-16
Hydrograph for MW24D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

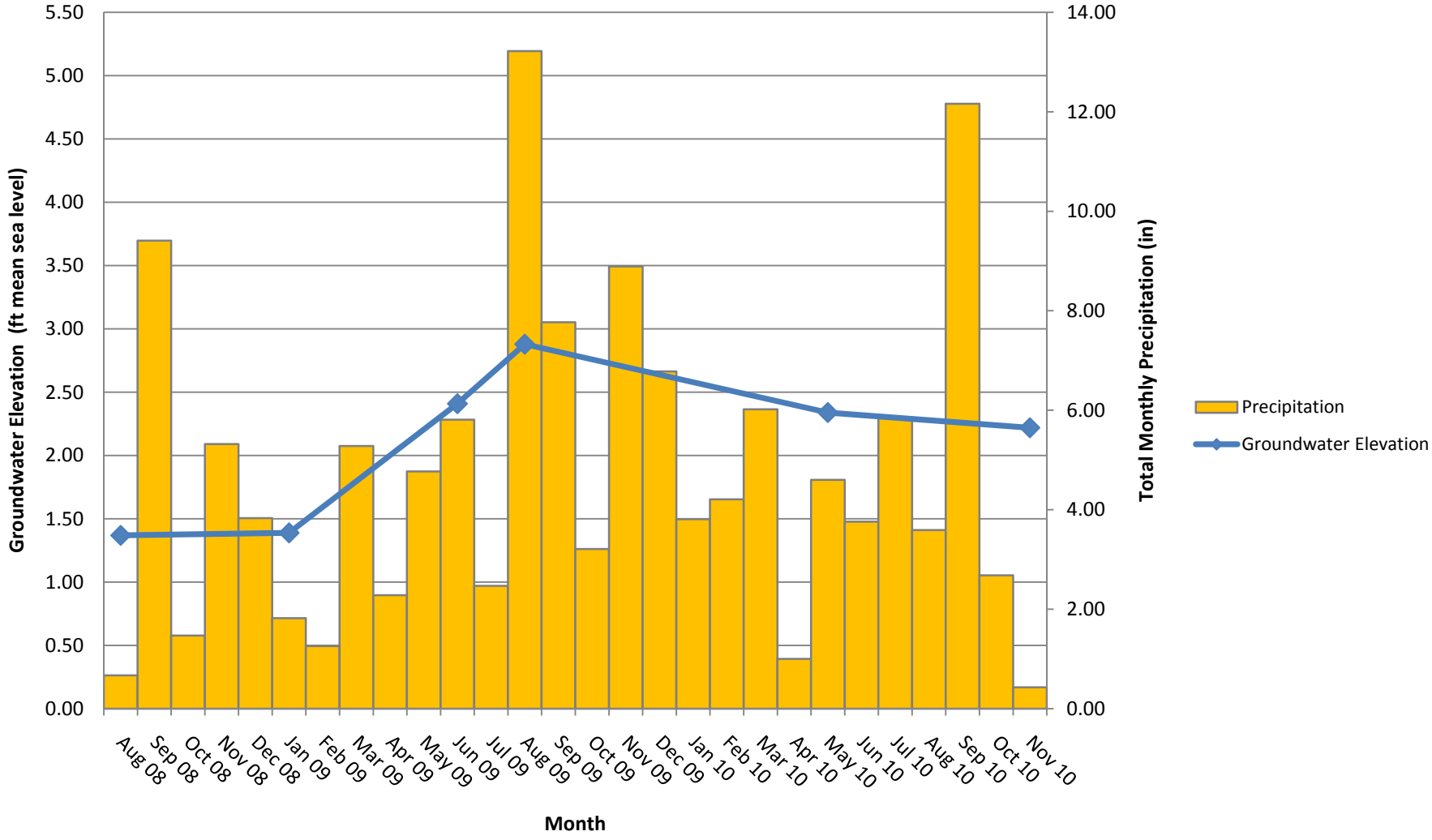


Figure A-17
Hydrograph for MW25D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

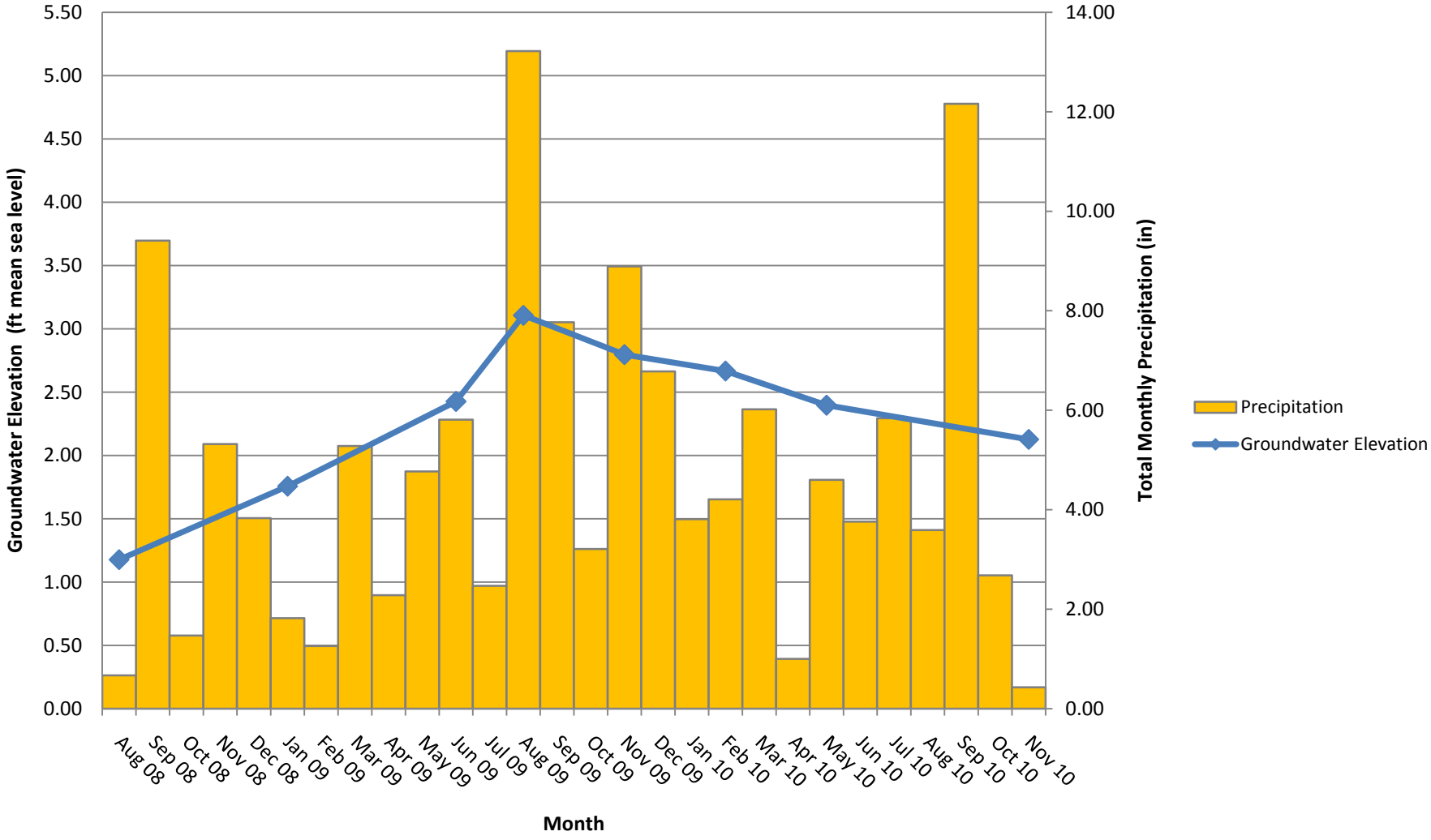


Figure A-18
Hydrograph for MW26D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

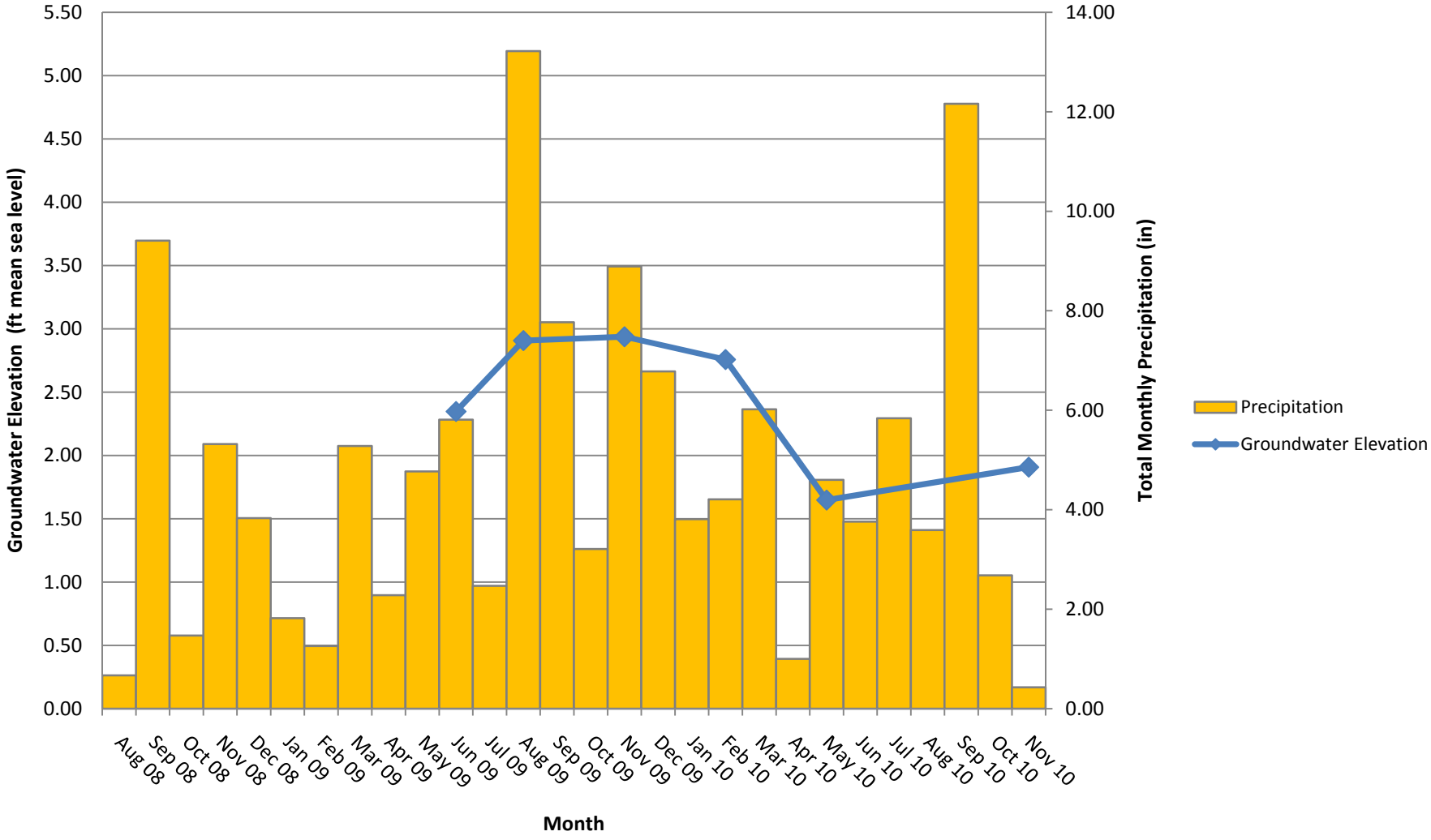


Figure A-19
Hydrograph for MW27D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

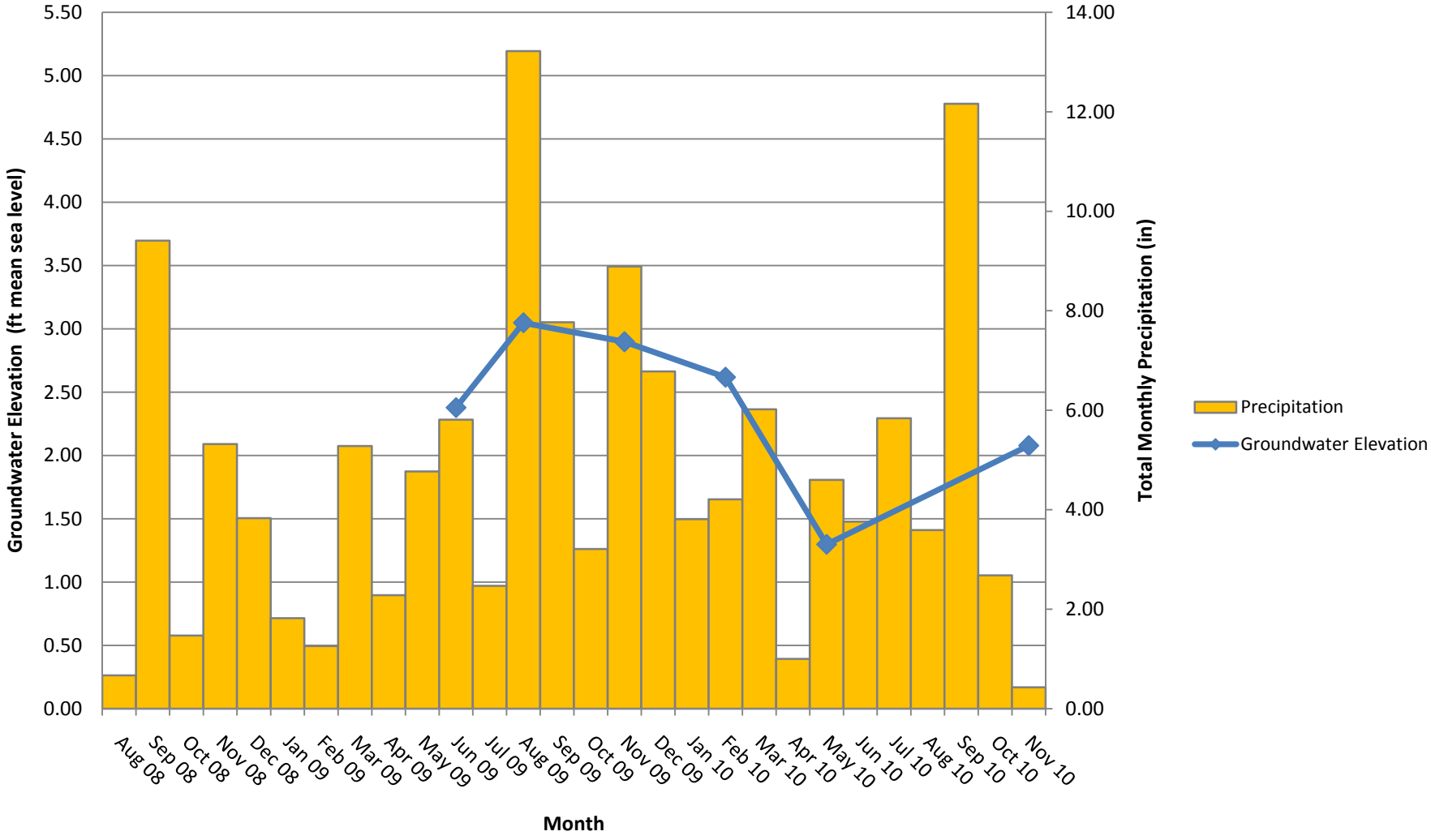


Figure A-20
Hydrograph for MW28D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

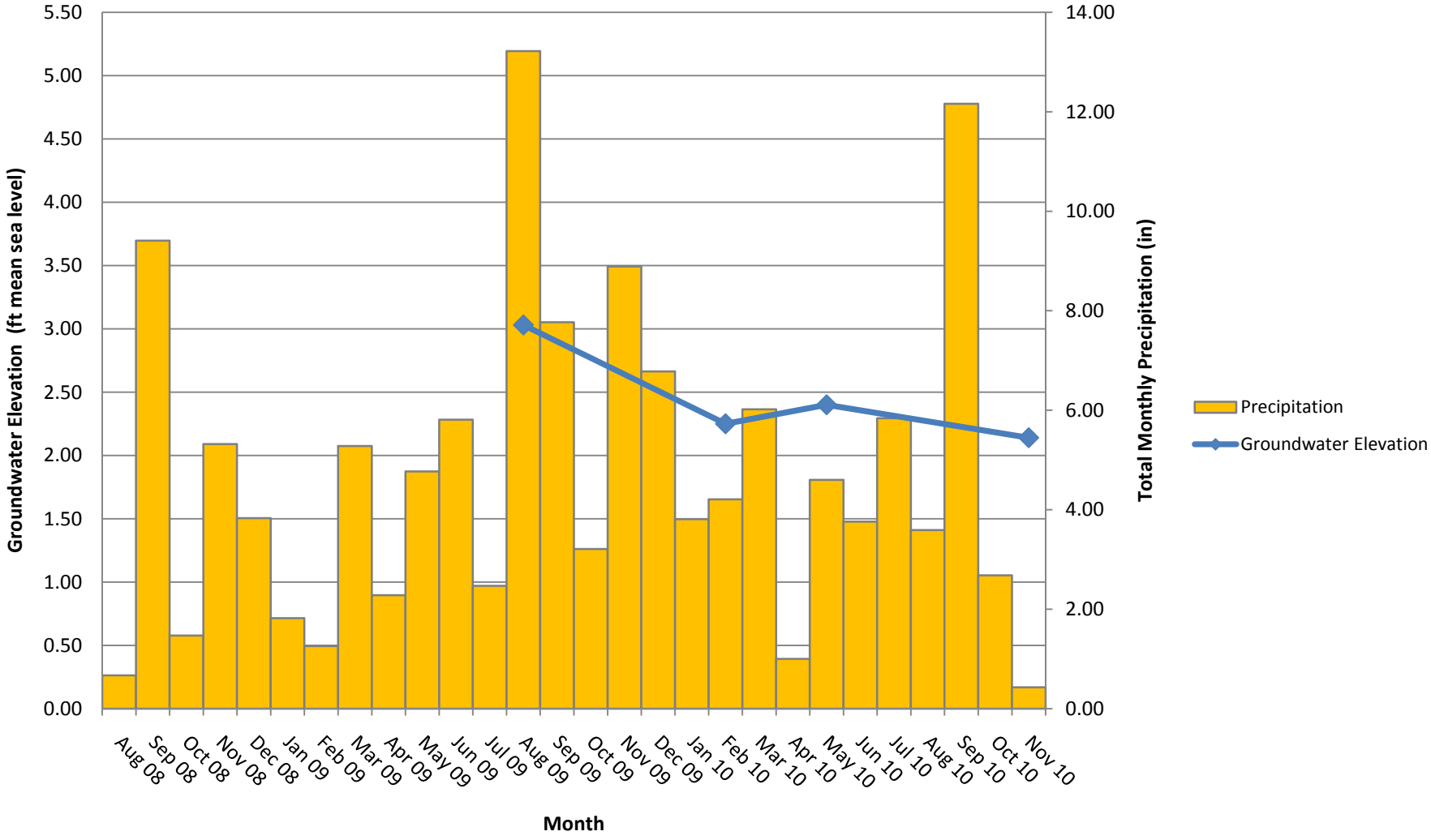


Figure A-21
Hydrograph for MW29D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

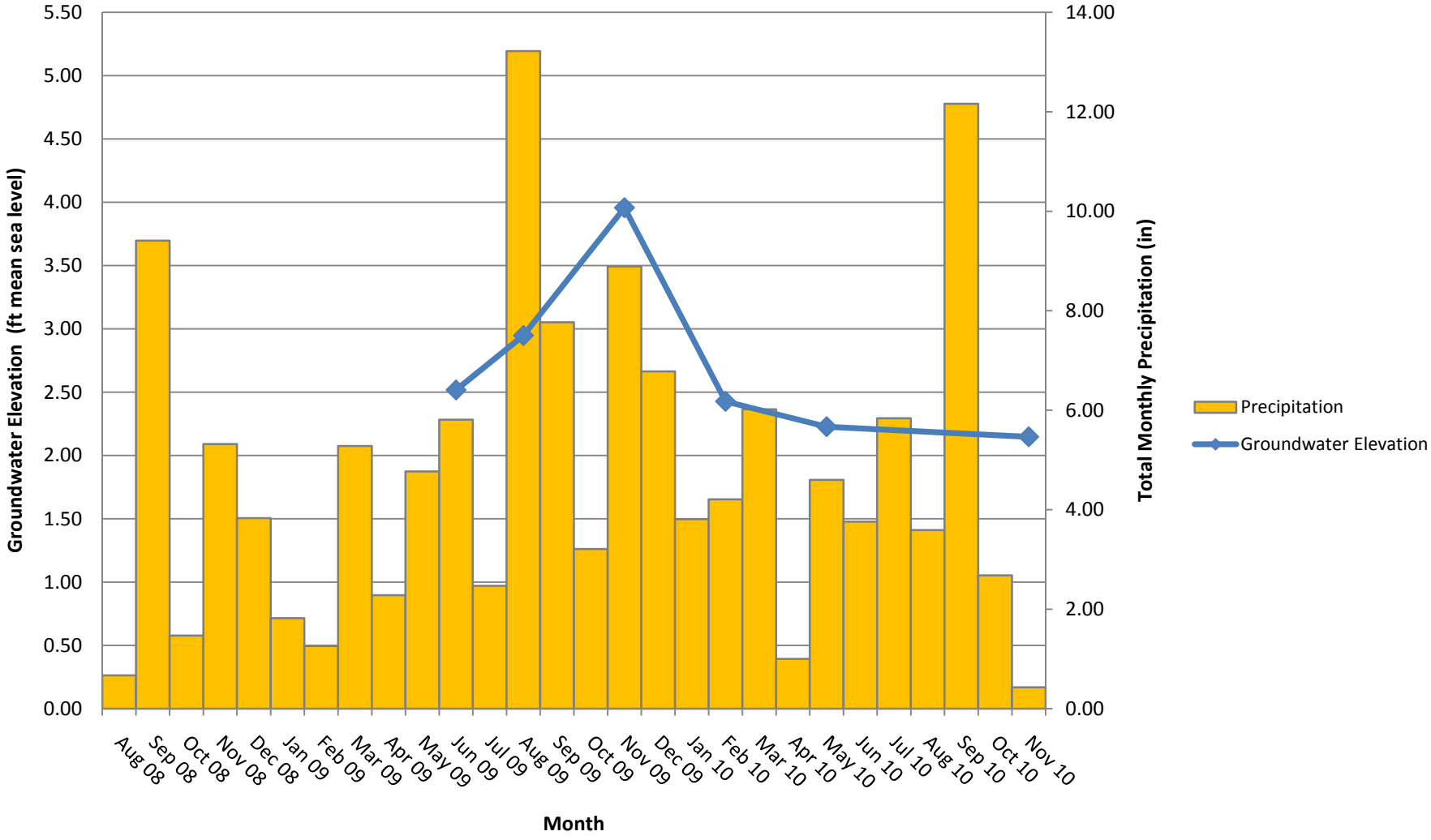


Figure A-22
Hydrograph for MW30D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

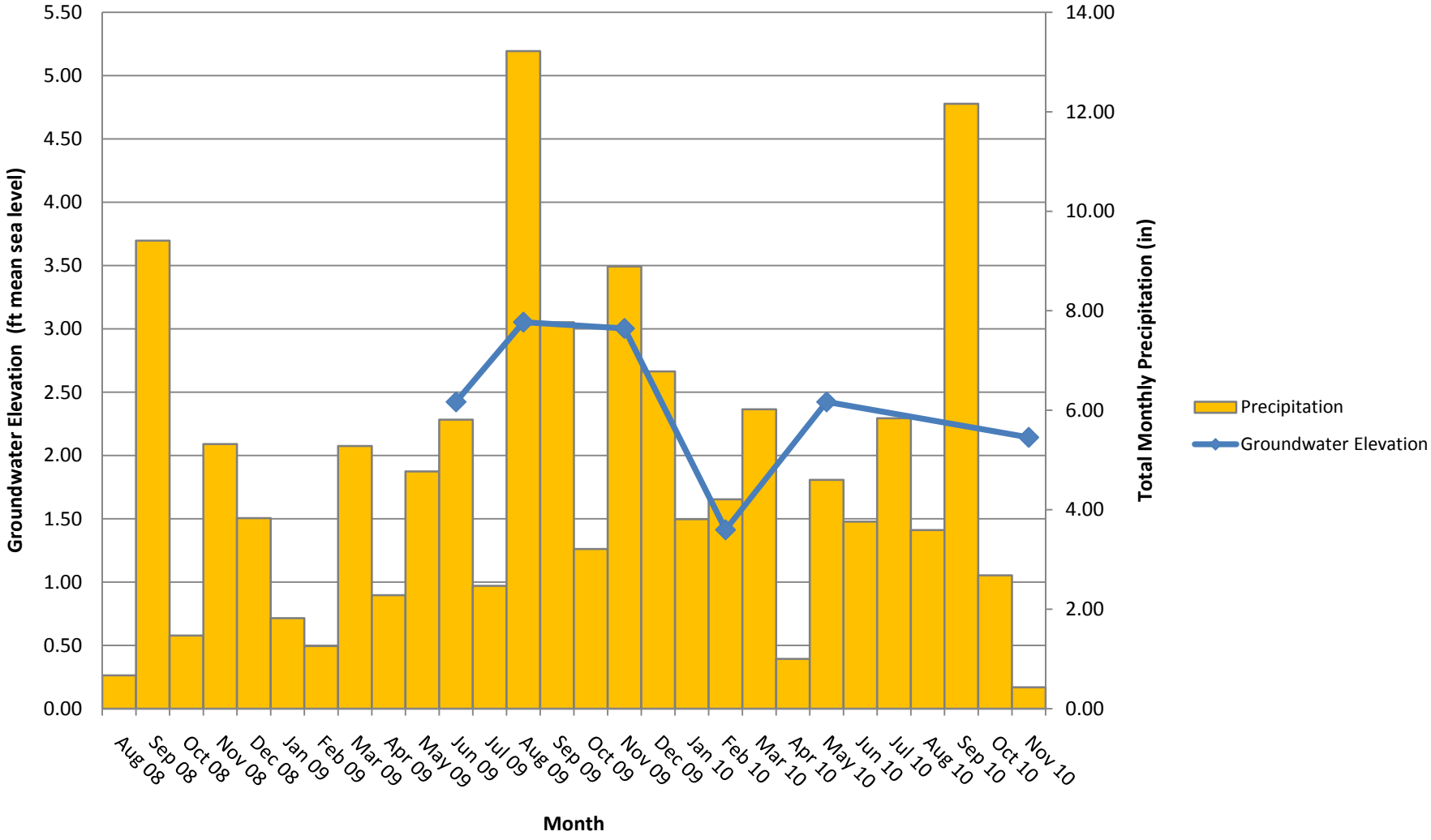


Figure A-23
Hydrograph for MW38D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

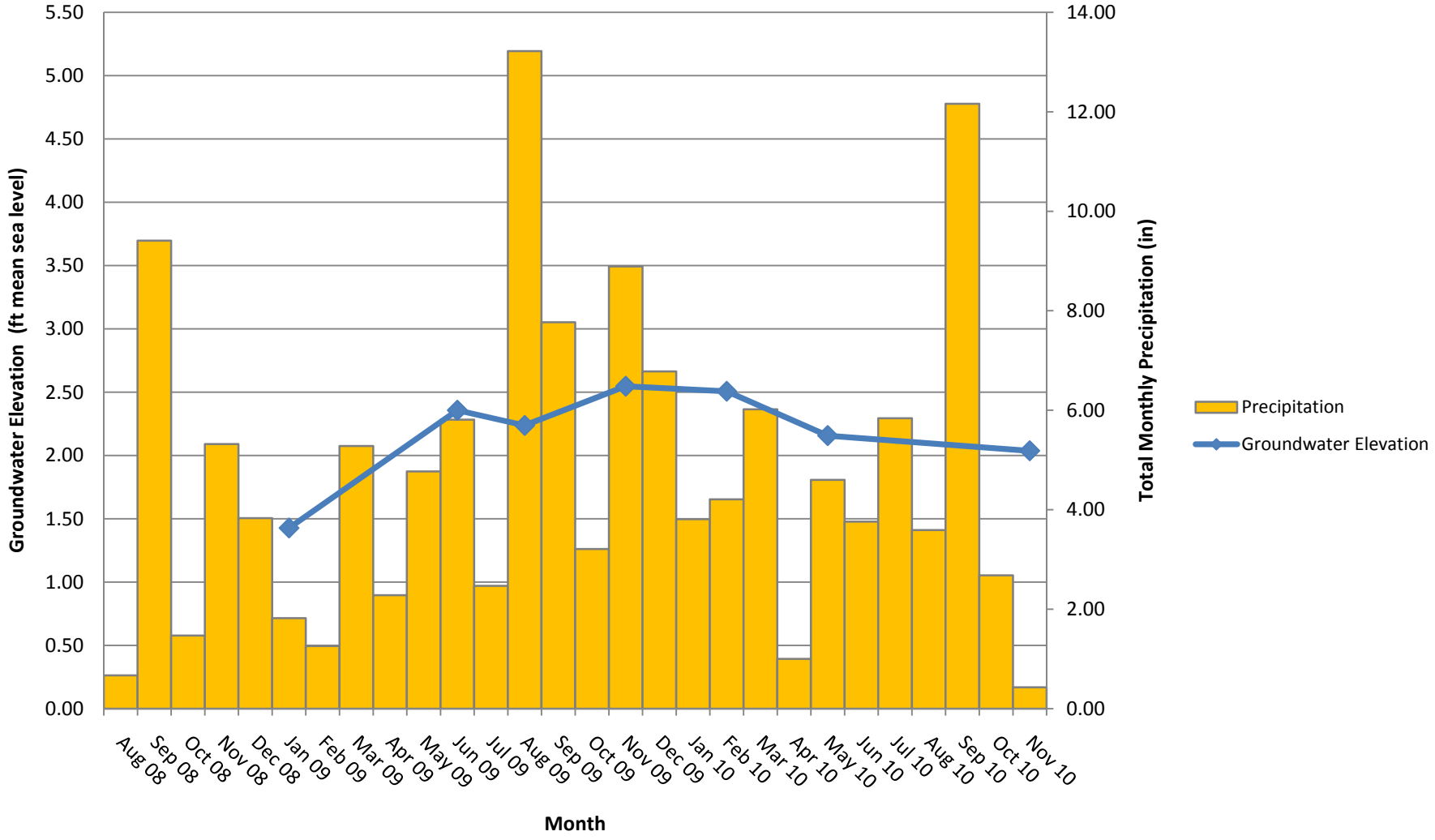


Figure A-24
Hydrograph for MW39D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

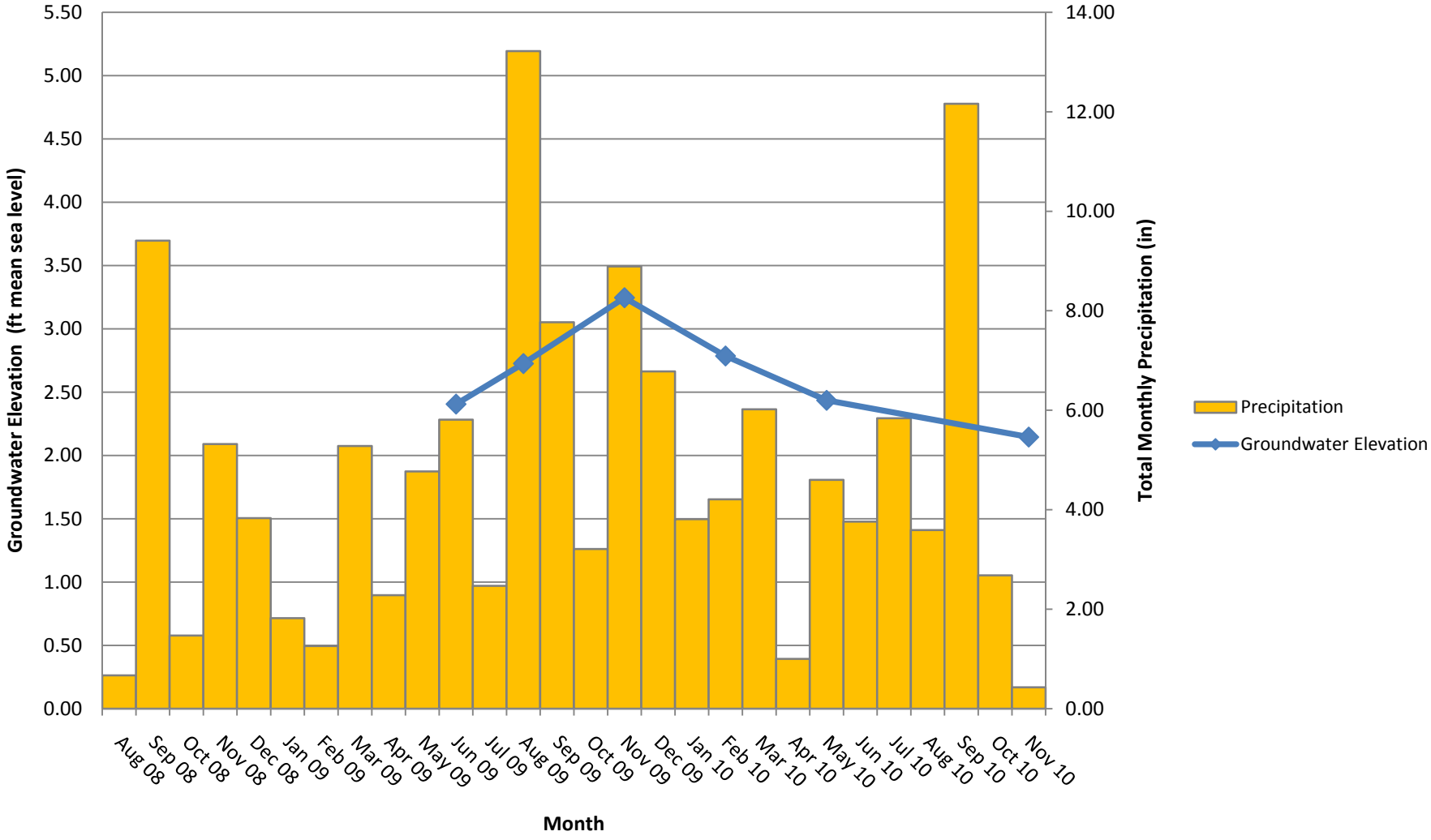


Figure A-25
Hydrograph for MW40D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

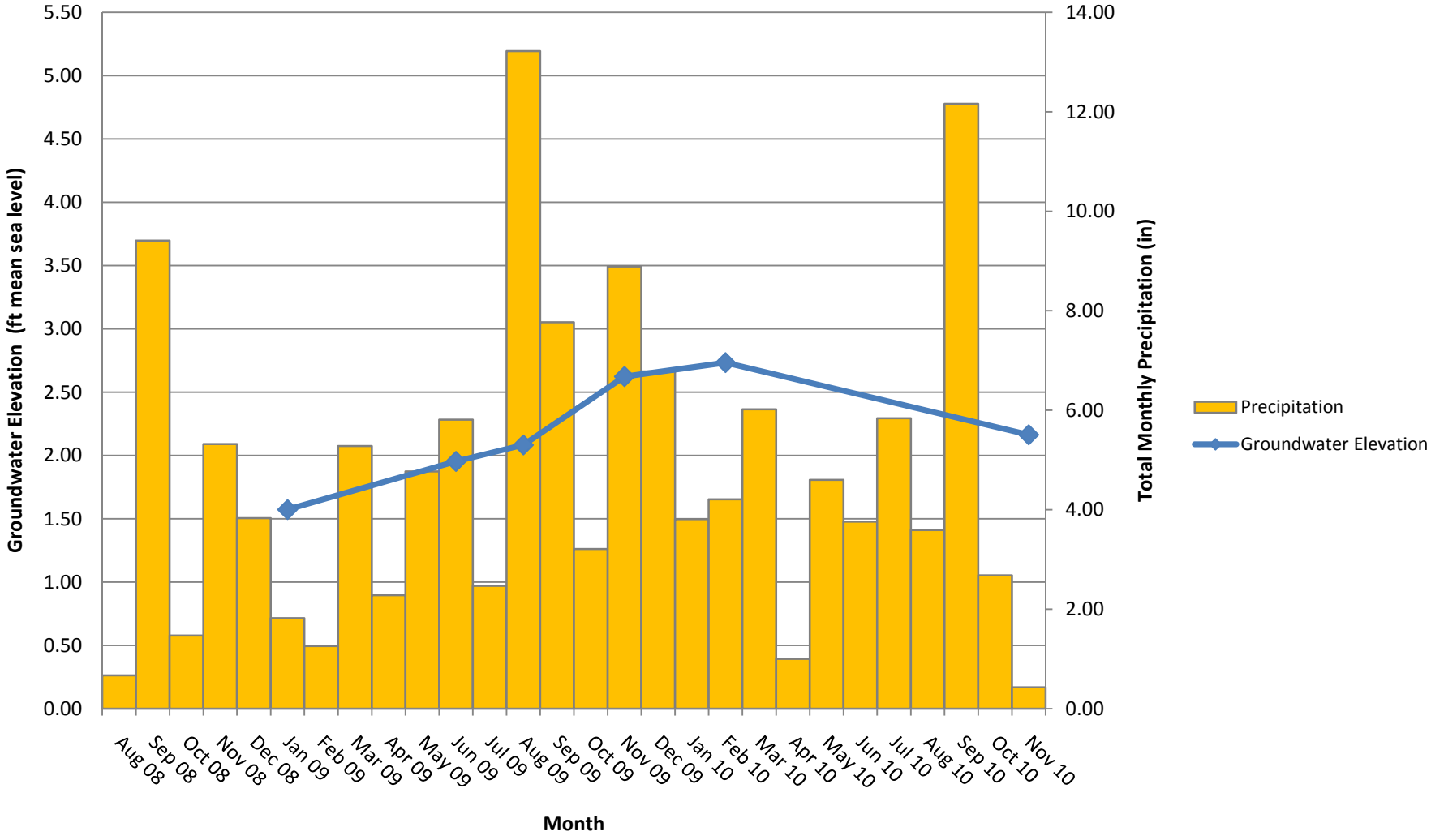


Figure A-26
Hydrograph for MW41D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

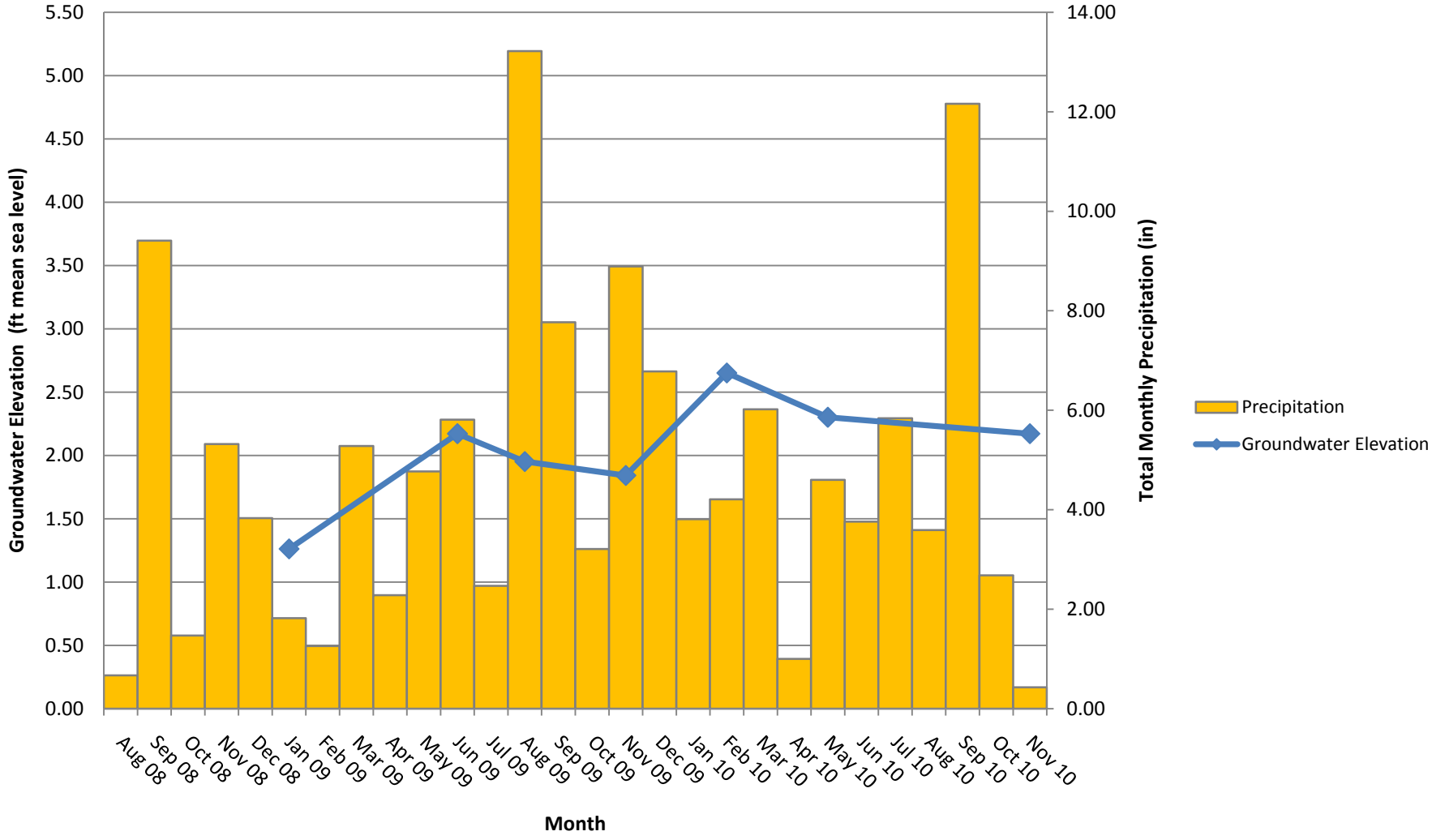
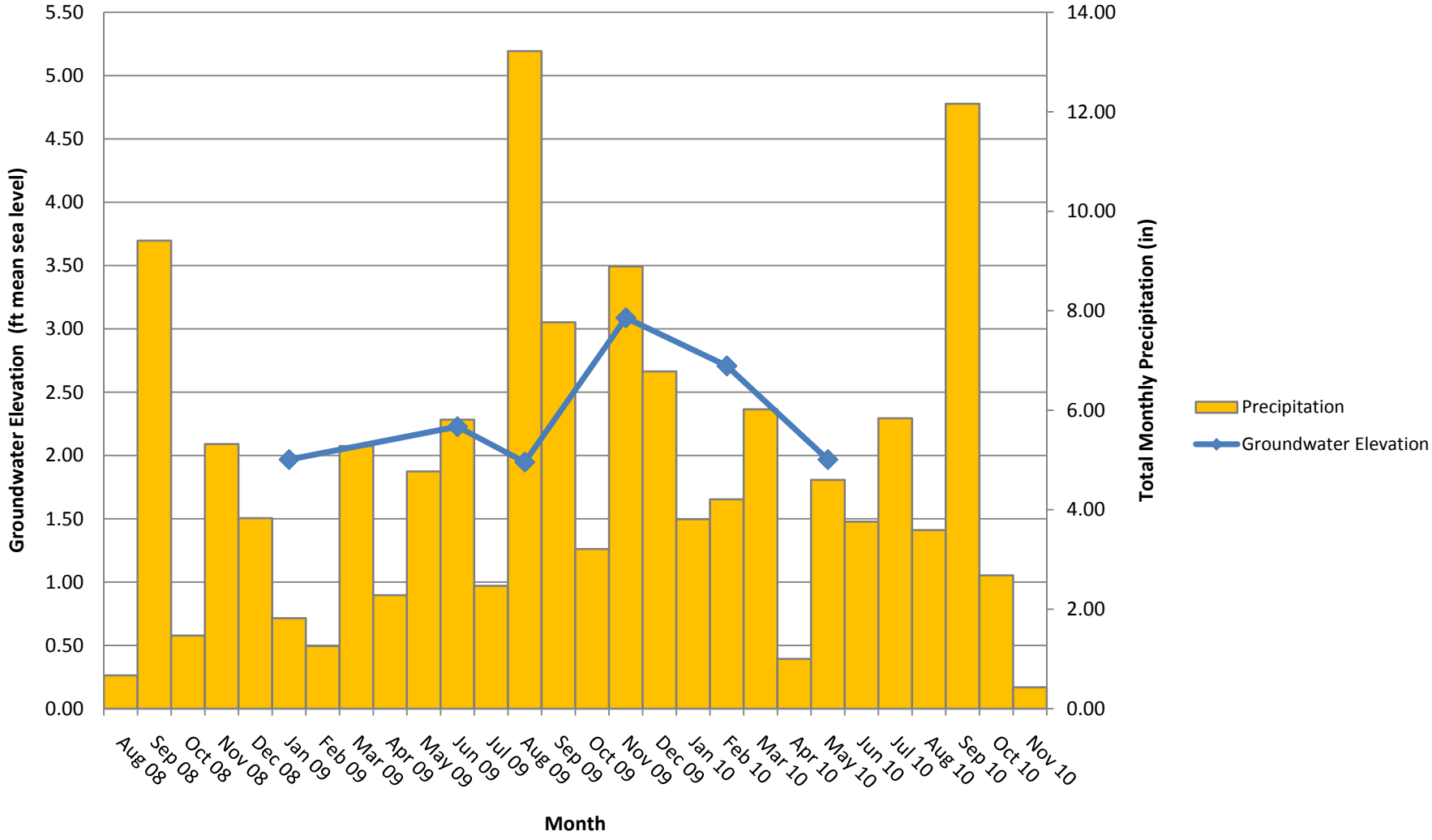


Figure A-27
Hydrograph for MW42D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia



Appendix B
Complete Analytical and Field Data Tables

Appendix B
Complete Analytical and Field Data Table
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, VA

Station ID	LS11-MW04D		LS11-MW05D		LS11-MW05S			LS11-MW06D		LS11-MW07D		LS11-MW08D		
Sample ID	LS11-MW04D-08C	LS11-MW04D-10B	LS11-MW05D-08C	LS11-MW05D-10B	LS11-MW05S-08C	LS11-MW05S-10B	LS11-MW05SP-10B	LS11-MW06D-08C	LS11-MW06D-10B	LS11-MW07D-08C	LS11-MW07D-10B	LS11-MW08D-08C	LS11-MW08D-10B	LS11-MW08D-P-10B
Sampling Round	Baseline	12-Month	Baseline	12-Month	Baseline	12-Month	12-Month	Baseline	12-Month	Baseline	12-Month	Baseline	12-Month	12-Month
Sample Date	09/03/08	5/25/10	09/03/08	5/24/10	09/03/08	5/24/10	5/24/10	09/05/08	5/26/10	09/04/08	5/27/10	09/03/08	5/27/10	5/27/10
Chemical Name														
Volatile Organic Compounds (UG/L)														
1,1,1-Trichloroethane	5 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1.7	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	5 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	260	17	110	17	1 U	1 U	1 U	0.78 J	2.1	1 U	1 U	1 U	3	3.4
1,1-Dichloroethene	5 U	1 U	5 U	1 U	1 U	1 U	1 U	1.7	2.1	1 U	1 U	1.3	2.3	2.9
1,2-Dichloroethane	5 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	5 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Carbon tetrachloride	5 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	5 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	8.6	1 U	5 U	1 U	1 U	1 U	1 U	20	23	1 U	1.5	1.3	8.8	9.7
Methylene chloride	5 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	5 U	1 U	5 U	1 U	1 U	1 U	1 U	0.95 J	1.2	1 U	1 U	1 U	1 U	1 U
Trichloroethene	9	1 U	5 U	1 U	1 U	1 U	1 U	32	7	1.1	1.8	4.9	8.5	10
Vinyl chloride	24	2.5	11	3.3	1 U	1 U	1 U	1 U	6.1	1 U	1 U	1 U	0.66 J	0.75 J
Dissolved Metals (UG/L)														
Arsenic, Dissolved	23.6	10 U	38.3	27.8	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Iron, Dissolved	14,900	122	32,000	46,500	25,200	13,500	12,700	100 U	862	100 U	128	100 U	100 U	100 U
Manganese, Dissolved	2,190	299	2,910	2,550	241	182	151	149	94.1	101	13.5	37.5	86	89.4
Wet Chemistry														
Acetate (mg/l)	1 U	1 U	17	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Butyrate (mg/l)	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Ethane (ug/l)	12	1 U	5.7	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethene (ug/l)	530	27	210	36	1 U	1 U	1 U	1 U	1.8	1 U	1 U	1 U	1 U	1 U
Lactate (mg/l)	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methane (ug/l)	980	54	1,300	480	3.5	2.8	3	120	240	11	14	23	69	65
Propane (ug/l)	NA	1 U	NA	1 U	NA	1 U	1 U	NA	1 U	NA	1 U	NA	1 U	1 U
Propionate (mg/l)	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Pyruvate (mg/l)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sulfate (mg/l)	10.3	5.7	5.1	19.9	28.8	8.5	8.7	16	10.5	19.1	6.9	23.3	20.4	19.4
Sulfide (mg/l)	NA	1.3	3.26	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Total organic carbon (TOC) (mg/l)	236 J	11.3	140 J	39.9	4.25 J	1 UL	1 UL	7.41 J	3	1 UJ	10.5	1.09 J	2.4	2
Field Parameter														
Dissolved Oxygen (MG/L)	NA	0.94	NA	0.38	NA	0.51	NA	NA	0.53	NA	0.62	NA	1.31	NA
Dissolved Oxygen by CHEMets® (MG/L)	1	1	1	0	1	0.3	NA	1	1	1	1	1.7	1	NA
Depth to Water (FT)	7.01	5.9	6.15	5.06	5.81	4.7	NA	4.71	4.16	6.76	5.76	6.94	5.81	NA
Oxidation Reduction Potential (MV)	-101	-53	-209	-217	-71	-63	NA	-58	-173	93	84	203	143	NA
Ferrous Iron (MG/L)	4	0	3.5	3.8	3.5	2.4	NA	0	1	0	0	0	0	NA
Gallons Purged (GAL)	NA	5	4	5	2	3	NA	4	3	3.5	3	2	3	NA
pH (PH)	5.41	6.77	5.77	6.74	5.37	5.67	NA	5.74	7.13	5.63	6.12	5.14	5.54	NA
Salinity (PCT)	0.02	0	0.02	0	0.01	0	NA	0.02	0	0.01	0	0.01	0	NA
Specific Conductivity (MS/CM)	0.447	0.489	0.423	0.9	0.266	0.378	NA	0.558	0.9	0.191	0.476	0.179	0.505	NA
Temperature (°C)	23.4	18.3	21.3	16.4	23.4	16.7	NA	20.3	16.4	22.4	18.4	20.5	15.9	NA
Turbidity (NTU)	198	0.0	129	5.8	131	22.5	NA	160	150	88.5	49.9	180	58.6	NA

Notes:

NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
K - Analyte present, value may be biased high, actual value may be lower
L - Analyte present, value may be biased low, actual value may be higher
U - The material was analyzed for, but not detected
UL - Analyte not detected, quantitation limit is probably higher
MG/L - Milligrams per liter
UG/L - Micrograms per liter
FT - Feet
MV - Millivolts
GAL - Gallons
PCT - Percent
MS/CM - Milli-siemens per centimeter
° Degree Celsius
NTU - Nephlometeric turbidity units

Appendix B
Complete Analytical and Field Data Table
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, VA

Station ID	LS11-MW09D						LS11-MW10D		LS11-MW11D			LS11-MW12D		LS11-MW13D	
Sample ID	LS11-MW09D-08C	LS11-MW09D-09B	LS11-MW09D-09C	LS11-MW09D-09D	LS11-MW09D-10A	LS11-MW09D-10B	LS11-MW10D-08C	LS11-MW10D-10B	LS11-MW11D-08C	LS11-MW11DP-08C	LS11-MW11D-10B	LS11-MW12D-09A	LS11-MW12D-10B	LS11-MW13D-08C	LS11-MW13D-10B
Sampling Round	Baseline	1-Month	3-Month	6-Month	9-Month	12-Month	Baseline	12-Month	Baseline	Baseline	12-Month	Baseline	12-Month	Baseline	12-Month
Sample Date	09/02/08	06/11/09	08/13/09	11/24/09	02/23/10	5/25/10	09/03/08	5/27/10	09/02/08	09/02/08	5/25/10	01/29/09	5/27/10	09/04/08	5/27/10
Chemical Name															
Volatile Organic Compounds (UG/L)															
1,1,1-Trichloroethane	5 U	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	5 U	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	16	7	3.7	2.2	2.4	1.5	3.1	3	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	7	4	3.1	1.9	2.9	1.9	60	58	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	5 U	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	5 U	1 U	1 U	1 U	1 U	1 U	1.4 J	1.3	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Carbon tetrachloride	5 U	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	5 U	1 U	1 U	1 U	1 U	1 U	1.2 J	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	81	33	17	9	10	6.8	7.6	8.6	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methylene chloride	5 U	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	5 U	0.47 J	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	22	14	12	8.4	9.5	8.3	290	250	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl chloride	11	2.6	1.2	1 U	0.68 J	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dissolved Metals (UG/L)															
Arsenic, Dissolved	10 U	NA	NA	NA	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Iron, Dissolved	4,120	4,760	NA	2,380	NA	1,180	100 U	100 U	100 U	100 U	100 U	100 U	222	966	100 U
Manganese, Dissolved	3,940	1,950 K	NA	2,050	NA	1,440	59.2	79.9	73.8	70	80.2	599	664	79.7	30.4
Wet Chemistry															
Acetate (mg/l)	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U
Butyrate (mg/l)	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U	2 U
Ethane (ug/l)	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U
Ethene (ug/l)	3.7	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U
Lactate (mg/l)	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U
Methane (ug/l)	39	22	30	25	19	12	5.3	8.4	2 U	NA	2 U	51	68	11	8.8
Propane (ug/l)	NA	1 U	1 U	1 U	1 U	1 U	NA	1 U	NA	NA	1 U	1 U	1 U	NA	1 U
Propionate (mg/l)	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U
Pyruvate (mg/l)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sulfate (mg/l)	50.3	57.9	NA	60.4 L	NA	61	37.8	32.2	20	NA	18.5	36.7	23.4	15.9	10.9
Sulfide (mg/l)	1 U	1 U	NA	1 U	NA	1 U	1 U	1	6.4	NA	1 U	1 U	1 U	1 U	1.3
Total organic carbon (TOC) (mg/l)	63.2 J	30.2	15.5	8.6	6.7	4.2	1 UJ	1 UL	1 UJ	NA	1 UL	1.2	1.4 L	1.09 J	1 UL
Field Parameter															
Dissolved Oxygen (MG/L)	NA	0.52	1.92	1.63	0	1.12	NA	1.69	NA	NA	1.28	3.08	7.58	NA	0.98
Dissolved Oxygen by CHEMets® (MG/L)	1	0.4	0.6	0.8	0	2	1	1	4	NA	2	1	0.8	1.5	1
Depth to Water (FT)	6.7	5.9	NA	5.07	5.22	5.43	6.1	4.71	7.74	NA	4.6	6.15	5.13	5.81	4.98
Oxidation Reduction Potential (MV)	-33	-36	42	22	85	71	164	191	156	NA	166	156	51	-65	18
Ferrous Iron (MG/L)	3	2.4	3	1.4	1.8	1.1	0.4	0	0.4	NA	0.1	0.2	0.2	1	0
Gallons Purged (GAL)	4	8	5	4	3	3.2	3	3	3.5	NA	3	4	4	7	4.5
pH (PH)	5.21	6.16	5.31	5.84	5.96	5.64	4.91	5.17	4.94	NA	5.44	6.65	5.75	6.05	7.7
Salinity (PCT)	0.02	0	0	0	0	0	0.01	0	0.01	NA	0	NA	0	0.01	0
Specific Conductivity (MS/CM)	0.468	0.56	0.44	0.728	61.7	0.9	0.247	0.621	0.166	NA	0.468	NA	0.769	0.284	0.62
Temperature (°C)	22.3	19.73	20.6	20.4	15.9	17.8	24	18.5	28	NA	19.3	19.74	20.8	24.8	19.6
Turbidity (NTU)	282.0	1.2	41.5	0	NA	3	37.5	146	87.7	NA	196	0	26.1	40	33

Notes:

NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
K - Analyte present, value may be biased high, actual value may be lower
L - Analyte present, value may be biased low, actual value may be higher
U - The material was analyzed for, but not detected
UL - Analyte not detected, quantitation limit is probably higher
MG/L - Milligrams per liter
UG/L - Micrograms per liter
FT - Feet
MV - Millivolts
GAL - Gallons
PCT - Percent
MS/CM - Milli-siemens per centimeter
° Degree Celsius
NTU - Nephlometeric turbidity units

Appendix B
Complete Analytical and Field Data Table
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, VA

Station ID	LS11-MW14D		LS11-MW15D			LS11-MW17D		LS11-MW36D		LS11-MW37D		LS11-MW38D			
Sample ID	LS11-MW14D-08C	LS11-MW14D-10B	LS11-MW15D-08C	LS11-MW15DP-08C	LS11-MW15D-10B	LS11-MW17D-08C	LS11-MW17D-10B	LS11-MW36D-08C	LS11-MW36D-10B	LS11-MW37D-08C	LS11-MW37D-10B	LS11-MW38D-09A	LS11-MW38D-09B	LS11-MW38D-09C	LS11-MW38D-09D
Sampling Round	Baseline	12-Month	Baseline	Baseline	12-Month	Baseline	12-Month	Baseline	12-Month	Baseline	12-Month	Baseline	1-Month	3-Month	6-Month
Sample Date	09/04/08	5/27/10	09/05/08	09/05/08	5/27/10	09/02/08	5/25/10	09/02/08	5/25/10	09/03/08	5/26/10	02/05/09	06/11/09	08/13/09	11/23/09
Chemical Name															
Volatile Organic Compounds (UG/L)															
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	62,000	44,000	47,000	50,000
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	1,000 U	1,000 U	2,000 U	1,000 U
1,1-Dichloroethane	0.44 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	100	1 U	59	14,000	18,000	16,000	13,000
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	56	1 U	23	7,500	4,700	6,000	5,300
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	1,000 U	1,000 U	2,000 U	1,000 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	1,000 U	1,000 U	2,000 U	1,000 U
Carbon tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	1,000 U	1,000 U	2,000 U	1,000 U
Chloroform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	1,000 U	1,000 U	700 J	1,000 U
cis-1,2-Dichloroethene	0.42 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	280	1 U	160	83,000	110,000	170,000	130,000
Methylene chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	2,700	3,500	3,600	2,500
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U	1,000 U	470 J	2,000 U	1,000 U
Trichloroethene	0.68 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	150	1 U	62	120,000	340,000	220,000	120,000
Vinyl chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	29	1 U	37	4,600	1,900	3,100	1,900
Dissolved Metals (UG/L)															
Arsenic, Dissolved	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	38.3	NA	NA	NA
Iron, Dissolved	100 U	100 U	1,840	1,440	437	100 U	184	455	658	1,080	1,300	56,600	60,800	NA	86,200
Manganese, Dissolved	48.5	26.9	498	445	563	349	257	99.8	1,260	45.2	200	3,870	4,110 K	NA	4,690
Wet Chemistry															
Acetate (mg/l)	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	96	190	170	170
Butyrate (mg/l)	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2.7	2.5
Ethane (ug/l)	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	2 U	1 U	2.5 U	36	8.9	7.6	10 U
Ethene (ug/l)	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	97	1 U	60	330	220	390	340
Lactate (mg/l)	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	7.5	1 U	1 U
Methane (ug/l)	5.6	3.4	28	NA	30	2 U	9.6	21	130	110	190	810	500	580	630
Propane (ug/l)	NA	1 U	NA	NA	1 U	NA	1 U	NA	2 U	NA	2.5 U	1 U	1 U	5 U	10 U
Propionate (mg/l)	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	11	63	69	58
Pyruvate (mg/l)	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sulfate (mg/l)	37.1	34.3	29.2	NA	30.8	49	28.3	3.81	7.8	2.21	11.7	4.6	7	NA	3.6 L
Sulfide (mg/l)	1 U	1 U	1 U	NA	1 U	3.72	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Total organic carbon (TOC) (mg/l)	1 UJ	1 UL	2.22 J	NA	2	1.8 J	1.2 L	1 UJ	125	1 UJ	131	636	851	924	938
Field Parameter															
Dissolved Oxygen (MG/L)	NA	0.99	NA	NA	6.08	NA	0.7	NA	0.5	NA	5.26	2.05	0.19	1.93	0.98
Dissolved Oxygen by CHEMets® (MG/L)	1	1	2.8	NA	1	1	1	>ERR	1	1	2	NA	0	0	0
Depth to Water (FT)	6.51	5.75	5.14	NA	4.49	5.8	4.65	8.7	7.28	10.19	8.34	4.8	4.4	NA	4.09
Oxidation Reduction Potential (MV)	143	144	-78	NA	-78	158	135	129	-5	100	44	-176	-162	-110	-156
Ferrous Iron (MG/L)	0	0	0.8	NA	0.5	0	0.2	>ERR	1.2	1.8	1.8	NA	3	5	4.6
Gallons Purged (GAL)	4	3	4.5	NA	3.5	3.5	2.5	3.2	5	NA	5	5	4	4	5
pH (PH)	5.14	5.57	5.39	NA	6.63	5.31	6.05	4.89	5.63	4.87	5.72	7.56	6.83	6.21	6.54
Salinity (PCT)	0.01	0	0.04	NA	0	0.02	0	0.01	0	0.01	0	0.05	0.1	0.1	0.1
Specific Conductivity (MS/CM)	0.283	0.697	0.97	NA	0.9	0.441	0.996	0.192	0.641	0.154	0.624	1.07	1.87	1.81	2.11
Temperature (°C)	23.3	18.8	23.1	NA	18.5	22.1	17	20.9	18.4	21.9	20.7	14.61	19.21	18.79	19.1
Turbidity (NTU)	91.6	117	43.4	NA	135	222	1.1	278	71	81.4	162	30	161	40	5

Notes:

NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
K - Analyte present, value may be biased high, actual value may be lower
L - Analyte present, value may be biased low, actual value may be higher
U - The material was analyzed for, but not detected
UL - Analyte not detected, quantitation limit is probably higher
MG/L - Milligrams per liter
UG/L - Micrograms per liter
FT - Feet
MV - Millivolts
GAL - Gallons
PCT - Percent
MS/CM - Milli-siemens per centimeter
° Degree Celsius
NTU - Nephlometeric turbidity units

Appendix B
Complete Analytical and Field Data Table
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, VA

Station ID	LS11-MW38D		LS11-MW39D								LS11-MW40D				
Sample ID	LS11-MW38D-10A	LS11-MW38D-10B	LS11-MW39D-09A	LS11-MW39D-09B	LS11-MW39D-09C	LS11-MW39DP-09C	LS11-MW39D-09D	LS11-MW39D-10A	LS11-MW39DP-10A	LS11-MW39D-10B	LS11-MW40D-09A	LS11-MW40D-09B	LS11-MW40DP-09B	LS11-MW40D-09C	LS11-MW40D-09D
Sampling Round	9-Month	12-Month	Baseline	1-Month	3-Month	3-Month	6-Month	9-Month	9-Month	12-Month	Baseline	1-Month	1-Month	3-Month	6-Month
Sample Date	02/23/10	5/24/10	02/05/09	06/11/09	08/13/09	08/13/09	11/23/09	02/23/10	02/23/10	5/24/10	01/29/09	06/11/09	06/11/09	08/14/09	11/24/09
Chemical Name															
Volatile Organic Compounds (UG/L)															
1,1,1-Trichloroethane	51,000	71,000	890	1,400	570	560	97	27	28	15	10 U	1.4 J	1.4 J	1.6 J	2.5 U
1,1,2-Trichloroethane	1,000 U	1000 U	50 U	100 U	50 U	50 U	10 U	5 U	5 U	5 U	10 U	2.5 U	2.5 U	2.5 U	2.5 U
1,1-Dichloroethane	12,000	16,000	570	1,100	1,000	1,100	680	280	340	290	44	35	36	41	110
1,1-Dichloroethene	7,200	8,400	220	280	180	150	22	10	9.2	5 U	65	87	88	94	58
1,2-Dichloroethane	1,000 U	1000 U	50 U	100 U	50 U	50 U	10 U	5 U	5 U	5 U	10 U	2.5 U	2.5 U	2.5 U	2.5 U
1,2-Dichloropropane	1,000 U	1000 U	50 U	100 U	50 U	50 U	10 U	5 U	5 U	5 U	10 U	2.5 U	2.5 U	2.5 U	2.5 U
Carbon tetrachloride	1,000 U	1000 U	50 U	100 U	50 U	50 U	10 U	5 U	5 U	5 U	10 U	2.5 U	2.5 U	2.5 U	2.5 U
Chloroform	1,000 U	1000 U	50 U	100 U	50 U	50 U	10 U	5 U	5 U	5 U	10 U	2.5 U	0.53 J	2.5 U	2.5 U
cis-1,2-Dichloroethene	130,000	200,000 L	6,200	9,600	5,000	5,100	800	320	300	19	160	120	120	140	320
Methylene chloride	2,700	3,800	16 J	100 U	50 U	50 U	10 U	5 U	5 U	5 U	10 U	2.5 U	2.5 U	2.5 U	2.5 U
trans-1,2-Dichloroethene	1,000 U	1000 U	22 J	64 J	25 J	26 J	5.6 J	3 J	4.5 J	5 U	10 U	2.5 U	2.5 U	4.7	2.2 J
Trichloroethene	86,000	92,000 L	71	100 U	50 U	50 U	10 U	5 U	5 U	5 U	250	340	350	350	110
Vinyl chloride	2,200	2,600	640	1,600	2,900	2,800	1,700	860	900	640	6.9 J	6.2	6.2	5.8	49
Dissolved Metals (UG/L)															
Arsenic, Dissolved	NA	50 U	10.6	NA	NA	NA	NA	NA	NA	48.3	10 U	NA	NA	NA	NA
Iron, Dissolved	NA	137,000	26,200	38,300	NA	NA	142,000	NA	NA	49,200	3,630	3,970	4,300	NA	14,900
Manganese, Dissolved	NA	8,420	2,220	2,740 K	NA	NA	2,560	NA	NA	1,630	472	449 K	446 K	NA	974
Wet Chemistry															
Acetate (mg/l)	210	340	20	55	130	NA	240	42	37	22	1 U	1 U	NA	1 U	1 U
Butyrate (mg/l)	4.2	9.2	2 U	2 U	2.1	NA	9.7	2 U	2 U	2 U	2 U	2 U	NA	2 U	2 U
Ethane (ug/l)	14	10 U	NA	2.3	10 U	NA	10 U	10 U	10 U	10 U	1 U	1 U	NA	10 U	10 U
Ethene (ug/l)	230	220	NA	110	360	NA	550	310	320	370	15	18	NA	33	120
Lactate (mg/l)	1 U	2 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U
Methane (ug/l)	1,200	4,300	NA	530	540	NA	7,200	4,300	4,100	2,100	490	610	NA	520	570
Propane (ug/l)	5 U	10 U	NA	1 U	10 U	NA	10 U	10 U	10 U	10 U	1 U	1 U	NA	10 U	10 U
Propionate (mg/l)	91	150	0.94 J	15	95	NA	120	6.9	5.4	3.5	1 U	1 U	NA	1 U	1 U
Pyruvate (mg/l)	0.5 U	1 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U
Sulfate (mg/l)	NA	2.8	13	5.4	NA	NA	2 UL	NA	NA	19.8	16.1	12.9	NA	NA	10.7 L
Sulfide (mg/l)	NA	1 U	1 U	1 U	NA	NA	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U
Total organic carbon (TOC) (mg/l)	811	901	108	254	381	NA	501	240	223	186	67.2	61.2	NA	57.7	194
Field Parameter															
Dissolved Oxygen (MG/L)	0	0.45	2.14	0	1.89	NA	0.77	0	NA	0.5	3.28	0.4	NA	1.7	1.33
Dissolved Oxygen by CHEMets® (MG/L)	0	0	NA	0	0.1	NA	0	0	NA	0	1	0.6	NA	0.6	0.1
Depth to Water (FT)	4.13	4.48	4.94	4.44	NA	NA	3.52	3.98	NA	4.33	6.6	6.2	NA	NA	5.41
Oxidation Reduction Potential (MV)	-142	-124	-177	-237	-166	NA	-215	-195	NA	-223	103	0	NA	21	-53
Ferrous Iron (MG/L)	4.2	4.2	2	2	2.2	NA	3.8	2.9	NA	2.2	0.1	2.4	NA	2.4	2.4
Gallons Purged (GAL)	4	3.5	9	5	5	NA	5	3.5	NA	NA	5	4	NA	4	4
pH (PH)	6.68	6.56	7.6	7.28	6.54	NA	6.91	7.12	NA	6.88	6.64	6.12	NA	5.6	6.02
Salinity (PCT)	0.2	0.1	0.01	0	0	NA	0.1	0	NA	0	NA	0	NA	0	0
Specific Conductivity (MS/CM)	0.369	2.04	0.07	0.9	0.88	NA	1.39	66.6	NA	0.9	NA	0.26	NA	0.22	0.532
Temperature (°C)	14.5	15.6	16.3	18.75	19.25	NA	19.3	14.5	NA	16.1	18.53	23.2	NA	22.58	21.5
Turbidity (NTU)	NA	14	27	24	3	NA	58	34	NA	148	0.0	31.3	NA	46.9	5

Notes:

NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
K - Analyte present, value may be biased high, actual value may be lower
L - Analyte present, value may be biased low, actual value may be higher
U - The material was analyzed for, but not detected
UL - Analyte not detected, quantitation limit is probably higher
MG/L - Milligrams per liter
UG/L - Micrograms per liter
FT - Feet
MV - Millivolts
GAL - Gallons
PCT - Percent
MS/CM - Milli-siemens per centimeter
° Degree Celsius
NTU - Nephlometeric turbidity units

Appendix B
Complete Analytical and Field Data Table
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, VA

Station ID	LS11-MW40D			LS11-MW41D						LS11-MW42D					
Sample ID	LS11-MW40D-10A	LS11-MW40D-10B	LS11-MW40D-P-10B	LS11-MW41D-09A	LS11-MW41D-09B	LS11-MW41D-09C	LS11-MW41D-09D	LS11-MW41D-10A	LS11-MW41D-10B	LS11-MW42D-09A	LS11-MW42D-09B	LS11-MW42D-09C	LS11-MW42D-09D	LS11-MW42D-10A	LS11-MW42D-10B
Sampling Round	9-Month	12-Month	12-Month	Baseline	1-Month	3-Month	6-Month	9-Month	12-Month	Baseline	1-Month	3-Month	6-Month	9-Month	12-Month
Sample Date	02/23/10	5/26/10	5/26/10	01/30/09	06/11/09	08/14/09	11/24/09	02/23/10	5/26/10	02/05/09	06/11/09	08/14/09	11/24/09	02/23/10	5/26/10
Chemical Name															
Volatile Organic Compounds (UG/L)															
1,1,1-Trichloroethane	1 U	1 U	1 U	3	1 U	1 U	1 U	1 U	1 U	1 U	1.8	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	25	22	22	3	2.1	2.3	1.1	1.2	0.81 J	1.2	1.4	1.3	1.1	1.1	1.3
1,1-Dichloroethene	12	8.7	8	46	37	38	16	18	5.9	16	12	17	15	19	18
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1.1	0.82 J	0.87 J	0.44 J	0.38 J	0.36 J	1 U	0.47 J	0.54 J	0.49 J	0.49 J	0.53 J
Carbon tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	0.54 J	0.6 J	0.85 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	74	65	62	10	5.6	6.7	14	59	22	5.8	8.8	16	9	5.9	5.8
Methylene chloride	1 U	1 U	1 U	1 U	1 U	0.6 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	0.96 J	0.57 J	0.73 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	19	0.67 J	0.67 J	190	160	150	39	14	1.3	77	120	75	73	80	92
Vinyl chloride	28	30	30	1 U	1 U	1 U	1 U	3	35	1 U	1 U	1 U	1 U	1 U	1 U
Dissolved Metals (UG/L)															
Arsenic, Dissolved	NA	35.5	29.6	10 U	NA	NA	NA	NA	77.3	10 U	NA	NA	NA	NA	10 U
Iron, Dissolved	NA	144,000	138,000	158	386	NA	20,900	NA	109,000	100 U	689	NA	505	NA	168
Manganese, Dissolved	NA	3,670	3,660	144	191 K	NA	5,380	NA	10,900	229	380 K	NA	365	NA	325
Wet Chemistry															
Acetate (mg/l)	23	260	270	1 U	1 U	1 U	7.3	95	140	1 U	1 U	1 U	1 U	1 U	1 U
Butyrate (mg/l)	2 U	6.3	6.1	2 U	2 U	2 U	2 U	3.8	3.2	2 U	2 U	2 U	2 U	2 U	2 U
Ethane (ug/l)	10 U	10 U	10 U	1 U	1 U	2 U	5 U	100 U	2 U	1 U	1 U	10 U	5 U	2.5 U	1 U
Ethene (ug/l)	23	20	18	1 U	1 U	2 U	5 U	100 U	4.4	1 U	1 U	10 U	5 U	2.5 U	1 U
Lactate (mg/l)	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methane (ug/l)	3,700	19,000	17,000	47	150	170	260	7,400	22,000	2.5	700	540	360	210	97
Propane (ug/l)	10 U	10 U	10 U	1 U	1 U	2 U	5 U	100 U	2 U	1 U	1 U	10 U	5 U	2.5 U	1 U
Propionate (mg/l)	1 U	2.8	2.6	1 U	1 U	1 U	5	30	20	1 U	1 U	1 U	1 U	1 U	1 U
Pyruvate (mg/l)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sulfate (mg/l)	NA	2 U	2 U	36.2	35.8	NA	15.4 L	NA	2 U	37.7	34.7	NA	33.7 L	NA	30
Sulfide (mg/l)	NA	1 U	1.2	1 U	8.9	NA	1 U	NA	1.1	1 U	1 U	NA	1 U	NA	7.9
Total organic carbon (TOC) (mg/l)	50.9	193	179	1 U	1 U	1.7	13	75.3	91.9	1 U	1.6	1 U	1 U	1 U	1 UL
Field Parameter															
Dissolved Oxygen (MG/L)	0	0.54	NA	3.27	0.38	1.82	1.2	0	0.5	2.24	0.11	1.71	1.27	0	8.5
Dissolved Oxygen by CHEMets® (MG/L)	0.8	0	NA	1	1	0.8	0.5	0	0	1	1	1.5	1	1	2
Depth to Water (FT)	5.45	8.65	NA	5.84	5.57	NA	4.9	5.02	5.37	5.73	5.31	NA	4.7	4.82	5.56
Oxidation Reduction Potential (MV)	-170	-264	NA	137	148	148	-113	-172	-228	162	18	27	70	100	125
Ferrous Iron (MG/L)	2.6	5.8	NA	0.1	0.6	2.2	0	1	2.8	0	1	0.6	0.6	0.6	0.2
Gallons Purged (GAL)	3.5	NA	NA	4.5	4.5	7.5	NA	4.5	3.75	13	5	5.5	4.2	3.5	3
pH (PH)	6.85	6.96	NA	6.25	5.4	4.78	6.31	6.71	6.79	5.62	6.23	5.49	5.69	5.9	5.28
Salinity (PCT)	0	0.1	NA	NA	0	0	0	0	0	0.01	0	0	0	0	0
Specific Conductivity (MS/CM)	54.9	0.9	NA	NA	0.21	0.23	0.92	93.8	1.03	0.28	0.58	0.37	0.601	42.2	0.9
Temperature (°C)	16.6	18.9	NA	17.98	20.55	20.5	20.6	15.6	17.4	18.34	20.77	21.53	20.2	17	16.4
Turbidity (NTU)	11	535	NA	10	35	75.1	3.3	0.0	709.0	26.2	40.5	44.6	0	0	150

Notes:

NA - Not analyzed
J - Analyte present, value may or may not be accurate or precise
K - Analyte present, value may be biased high, actual value may be lower
L - Analyte present, value may be biased low, actual value may be higher
U - The material was analyzed for, but not detected
UL - Analyte not detected, quantitation limit is probably higher
MG/L - Milligrams per liter
UG/L - Micrograms per liter
FT - Feet
MV - Millivolts
GAL - Gallons
PCT - Percent
MS/CM - Milli-siemens per centimeter
° Degree Celsius
NTU - Nephlometeric turbidity units

Appendix C
COC and TOC Concentrations in Performance Monitoring Wells

Figure C- 1
Chlorinated Ethene and TOC Concentrations for MW38D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

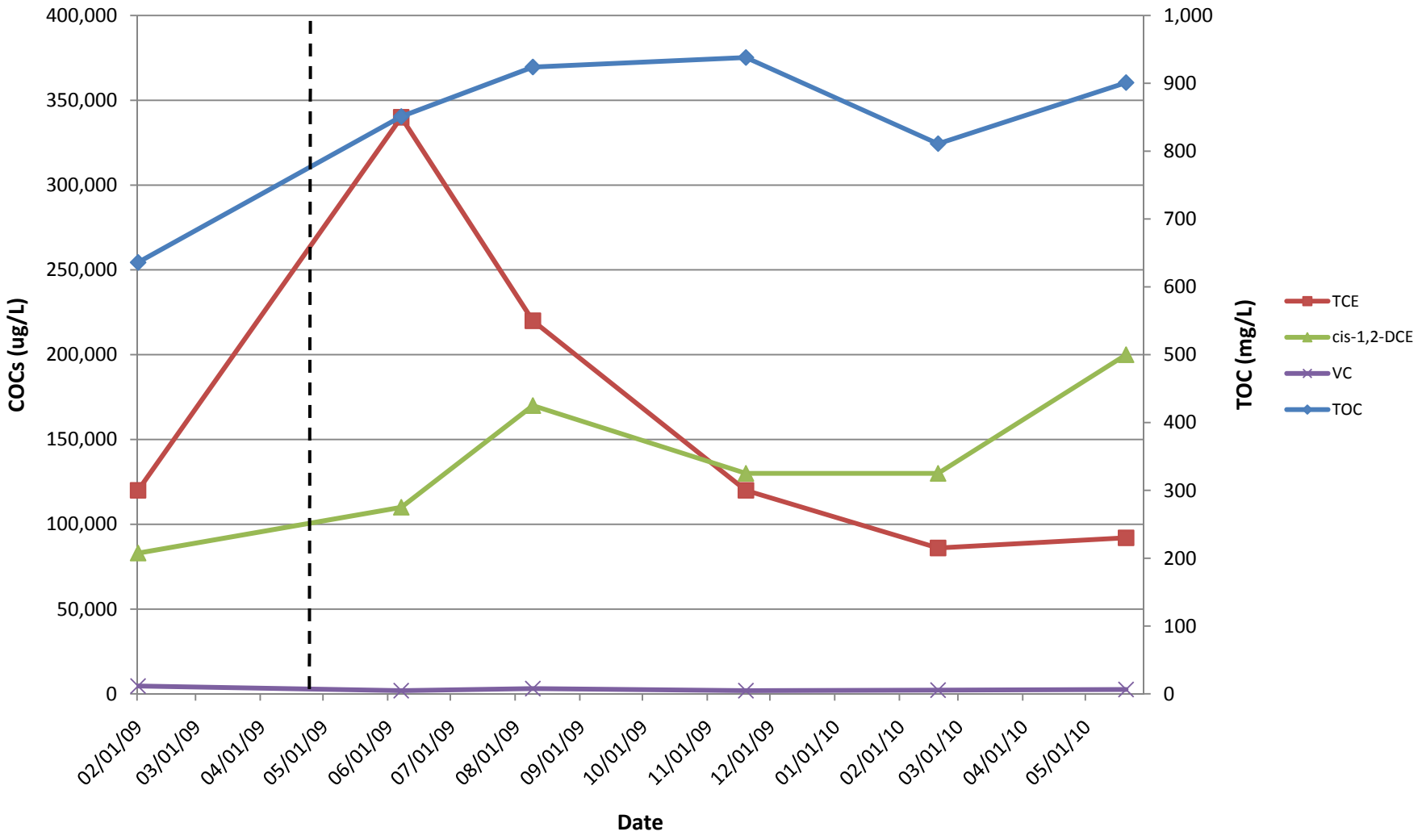


Figure C-2
Chlorinated Ethane, Chlorinated Methane and TOC Concentrations for MW38D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

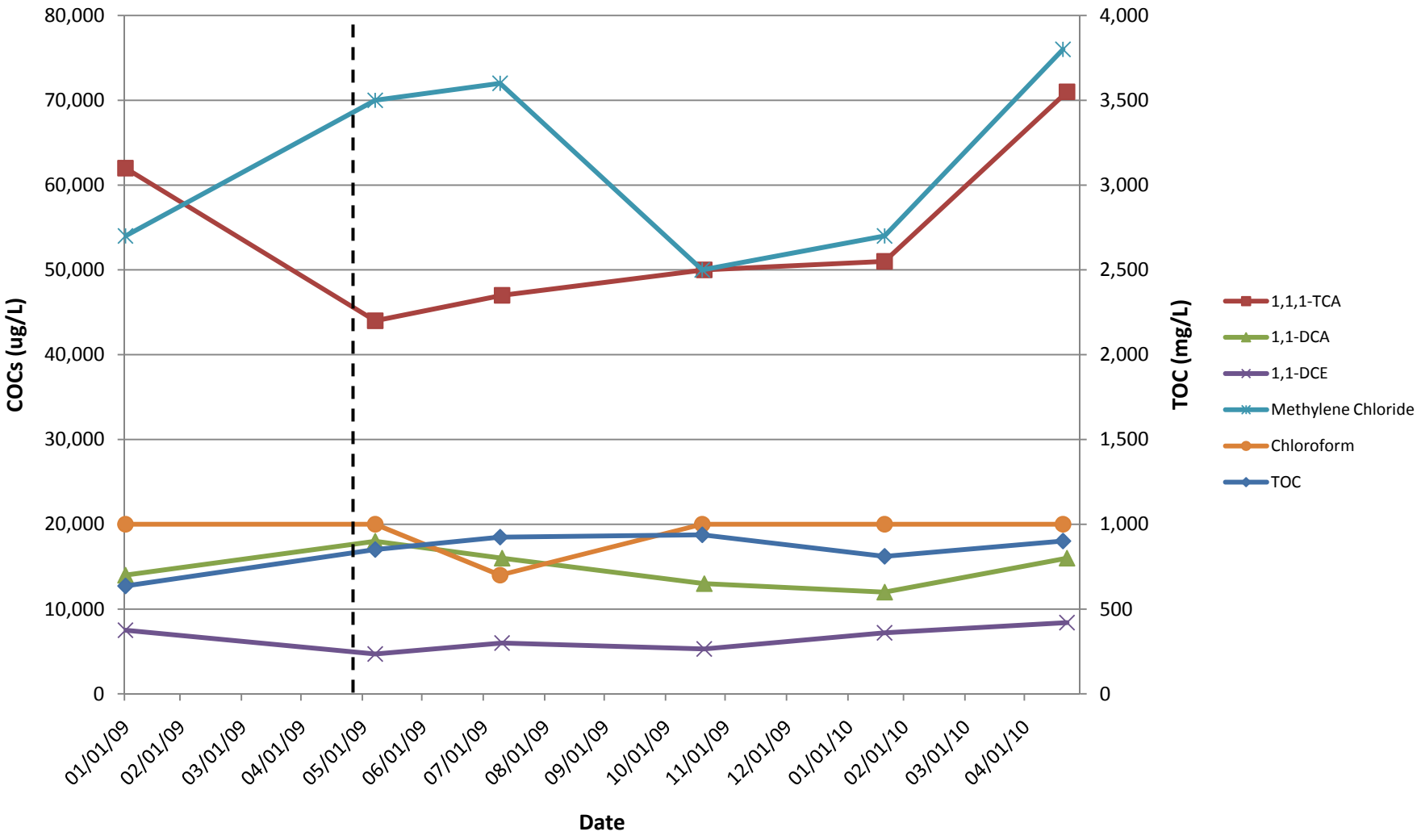


Figure C-3
Chlorinated Ethene and TOC Concentrations for MW39D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

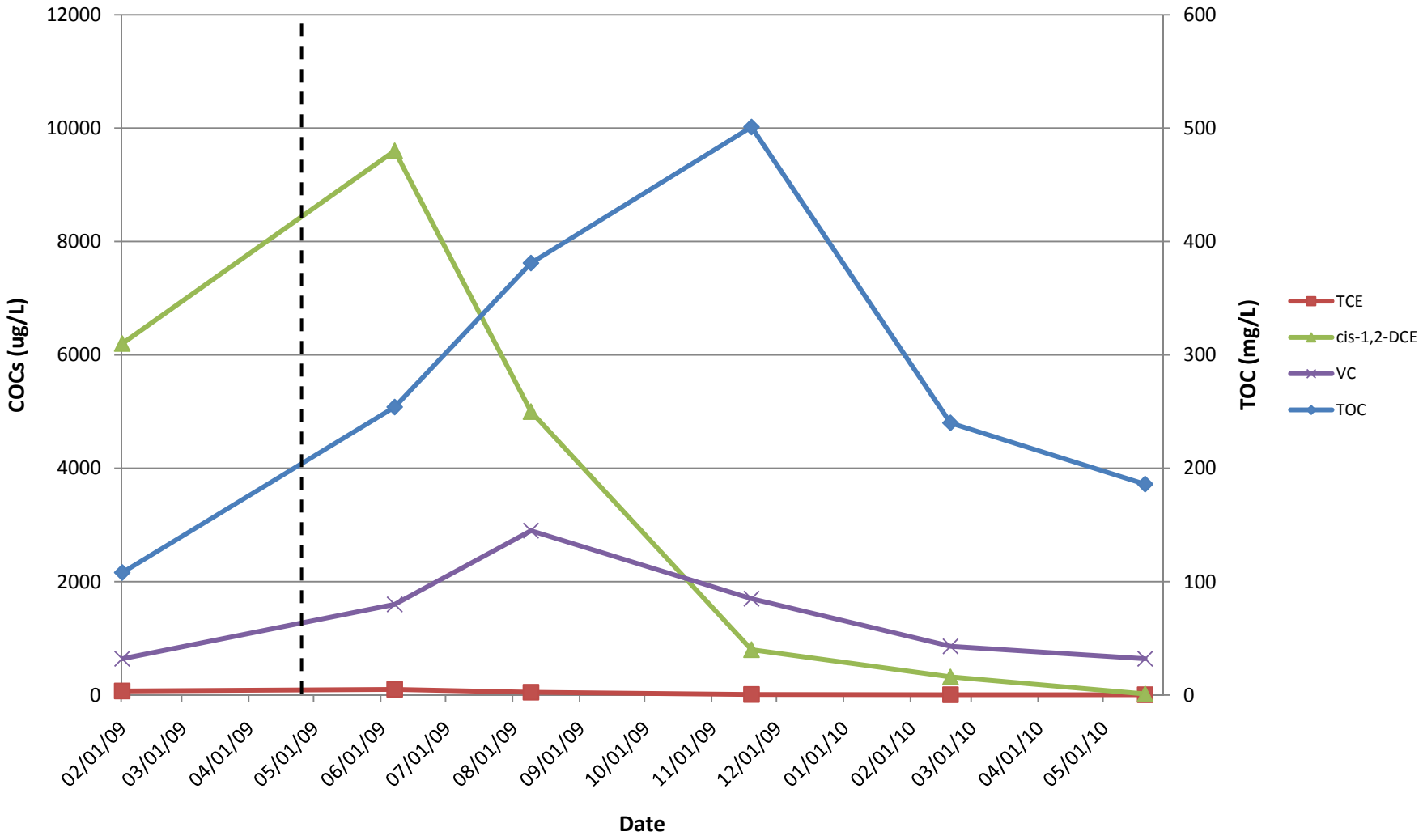


Figure C-4
Chlorinated Ethane and TOC Concentrations for MW39D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

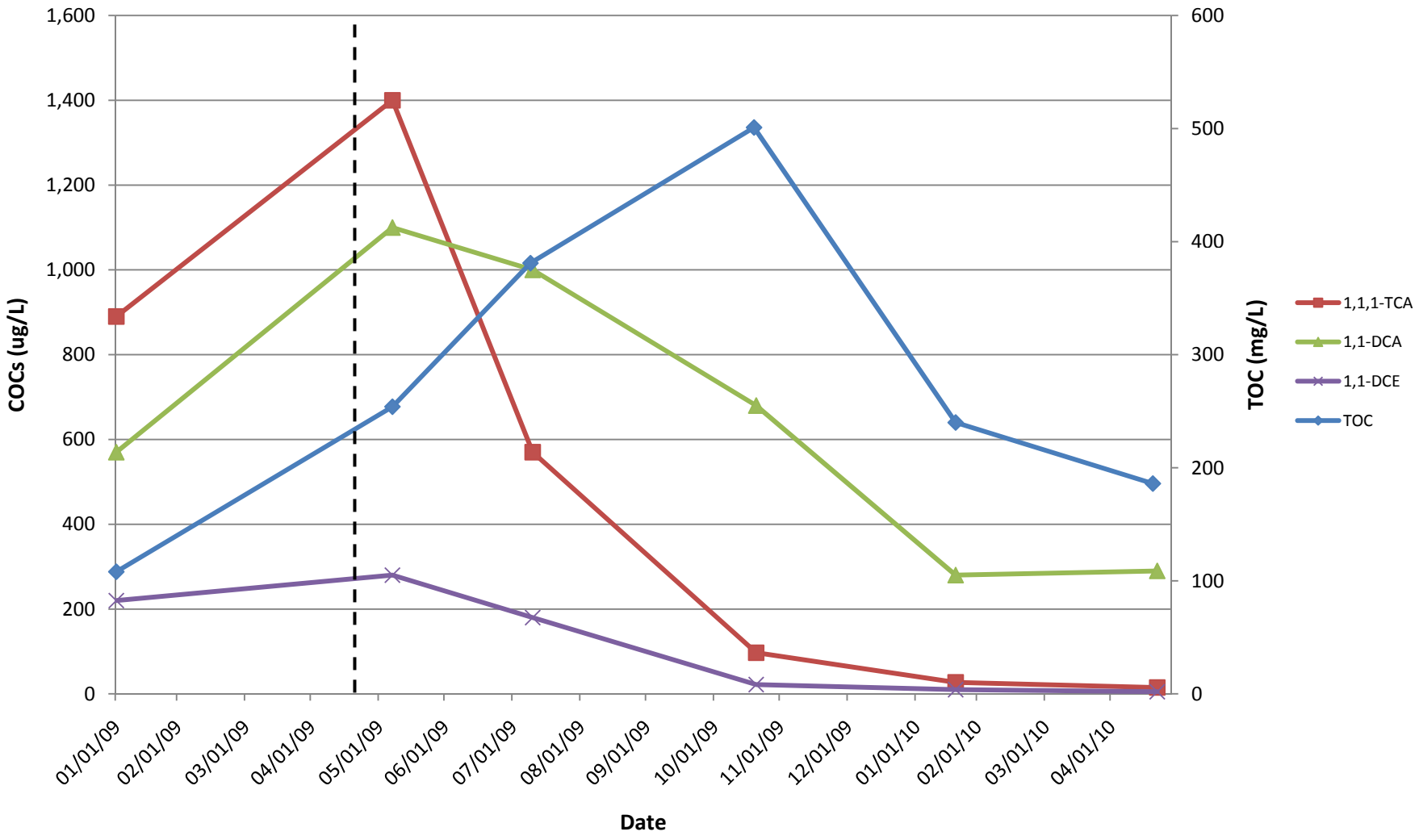


Figure C-5
Chlorinated Ethane and TOC Concentrations for MW09D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

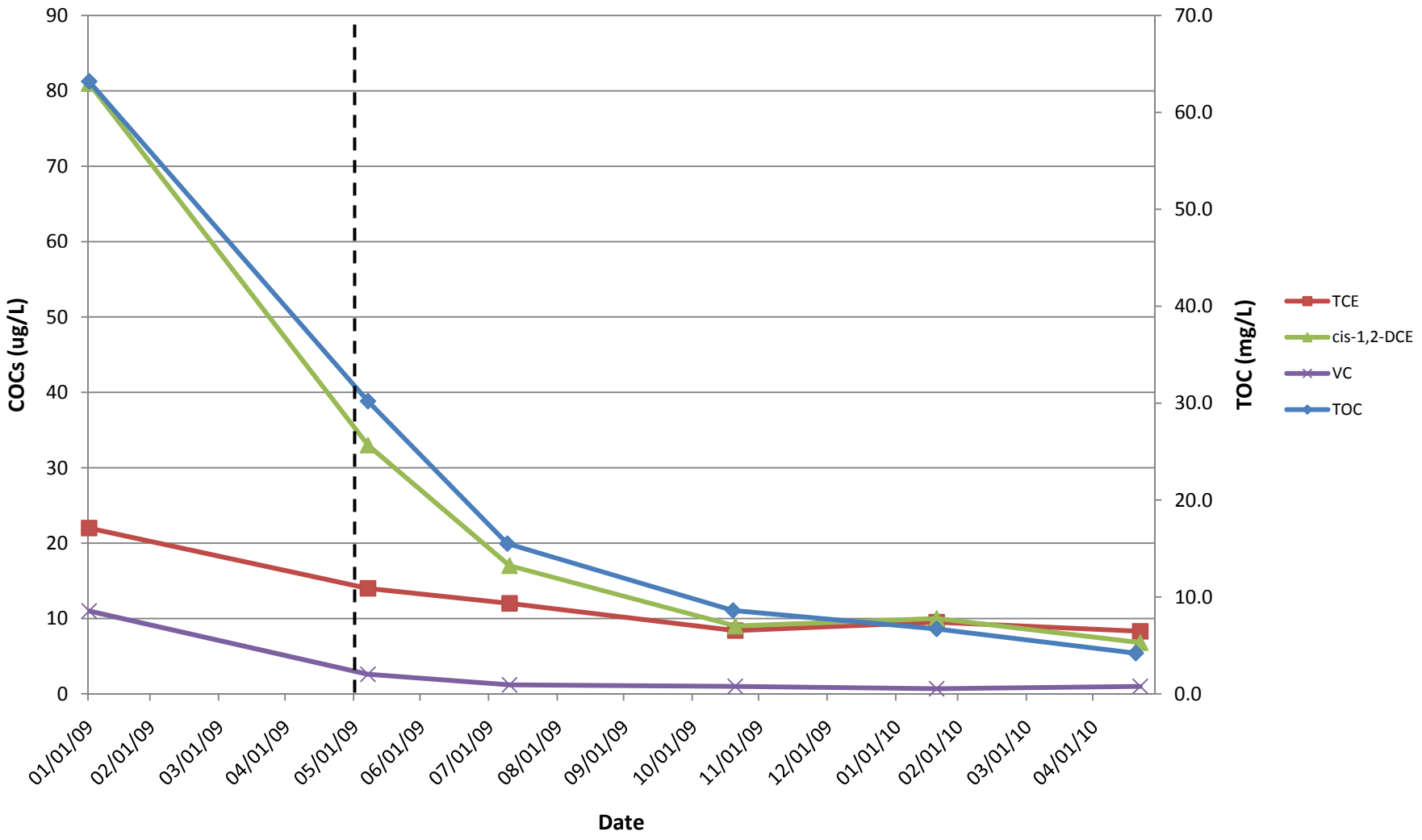


Figure C-6
Chlorinated Ethene and TOC Concentrations for MW40D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

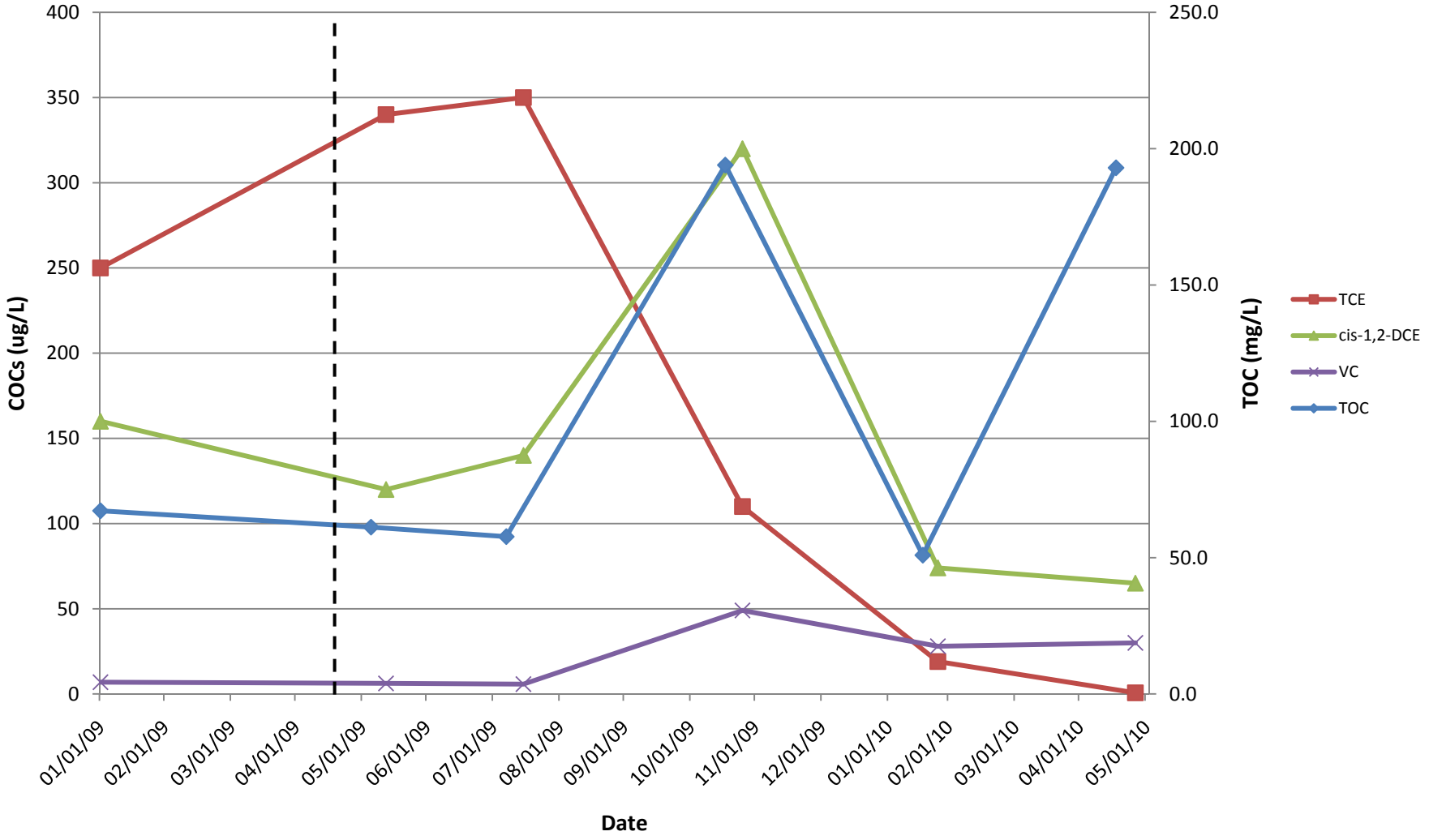


Figure C-7
Chlorinated Ethene and TOC Concentrations for MW41D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia

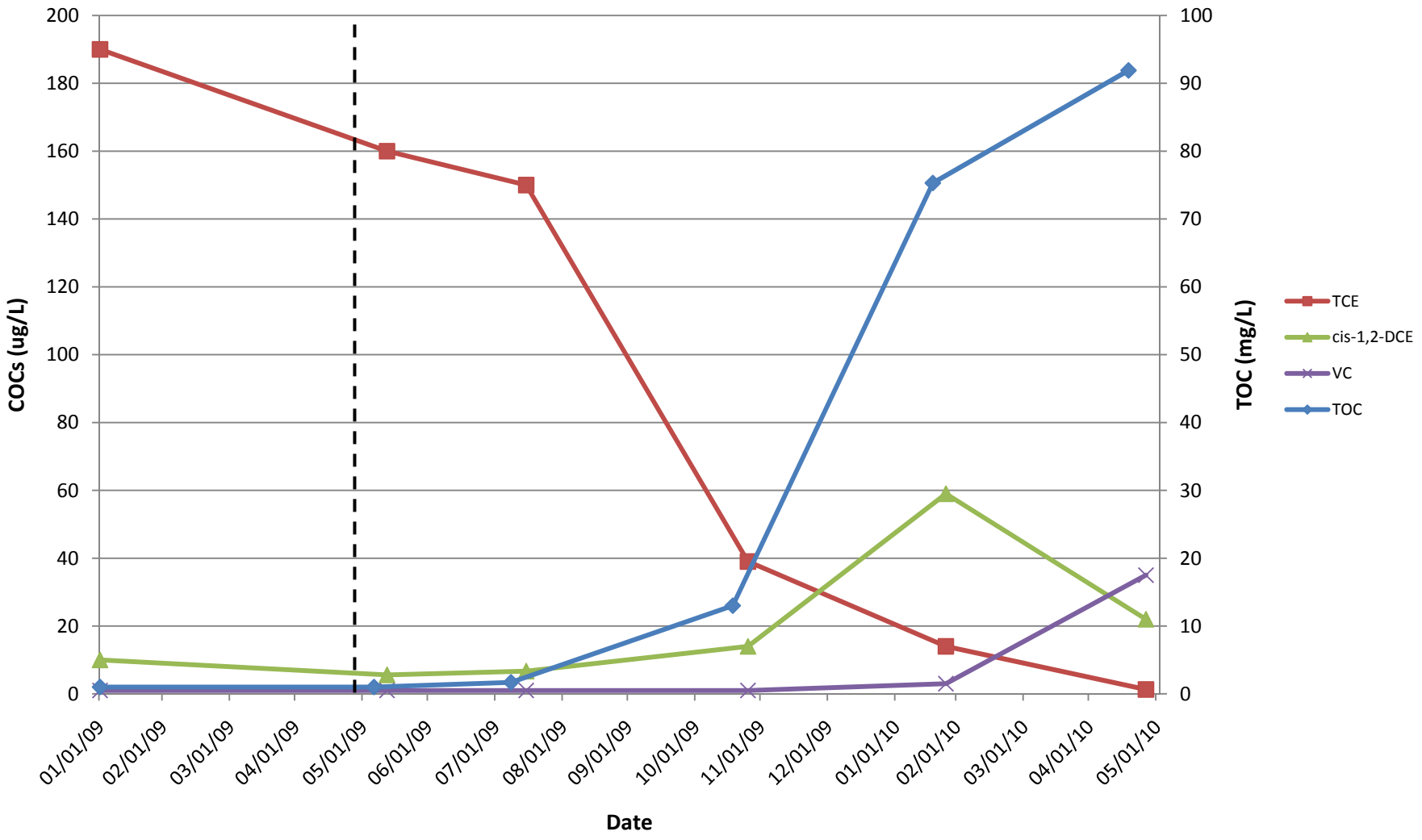
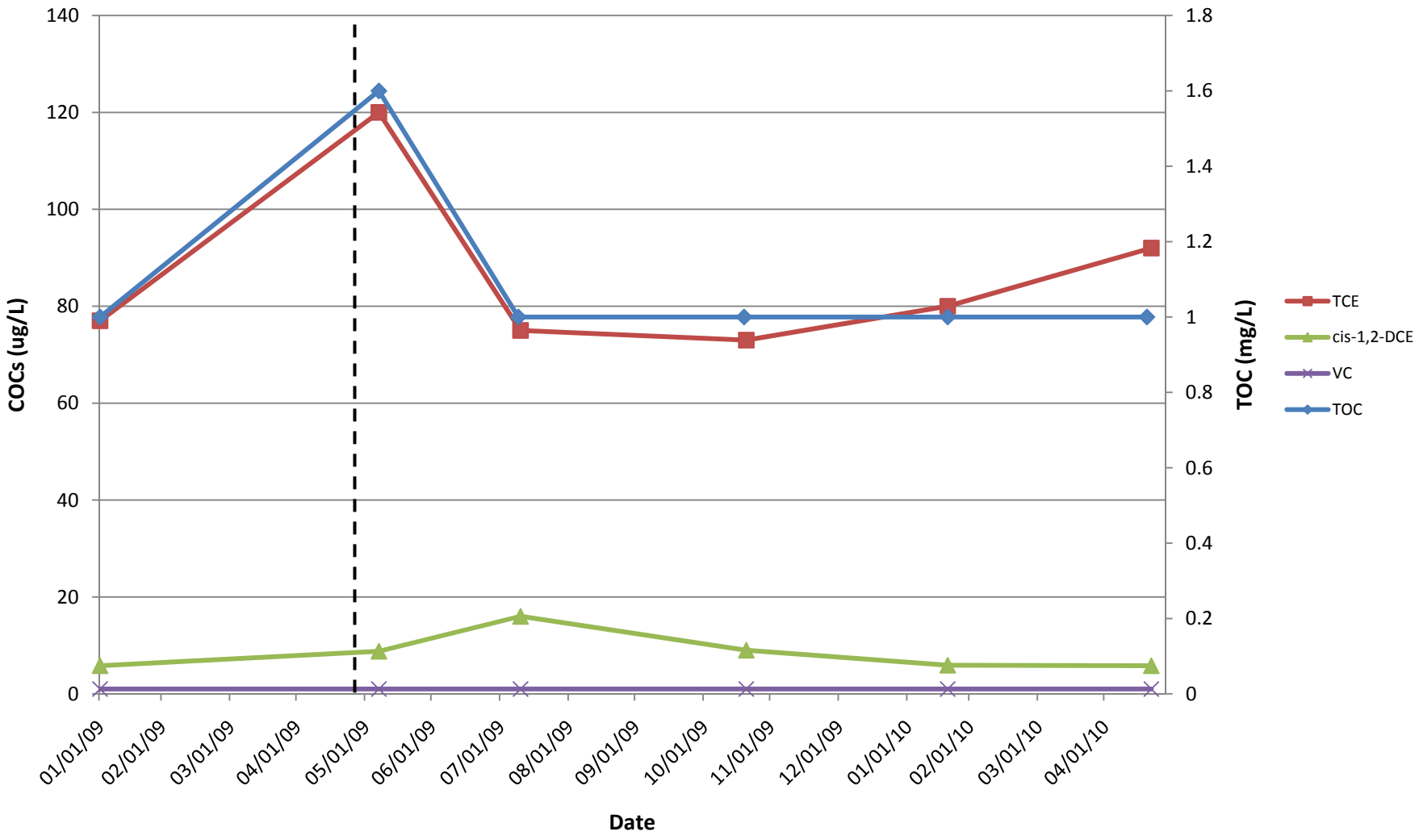



Figure C-8
Chlorinated Ethene and TOC Concentrations for MW42D
ERD Groundwater Monitoring Summary
Site 11-School of Music Plating Shop
JEB Little Creek
Virginia Beach, Virginia