



CORRECTIVE ACTION MANAGEMENT UNIT REPORT OF POST-CLOSURE CARE ACTIVITIES CALENDAR YEAR 2019

**SANDIA NATIONAL LABORATORIES, NEW MEXICO
LONG-TERM STEWARDSHIP
POST-CLOSURE CARE**

MARCH 2020



**United States Department of Energy
Sandia Field Office**

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly-owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA-0003525.

CORRECTIVE ACTION MANAGEMENT UNIT REPORT OF POST-CLOSURE CARE ACTIVITIES

Facility: Corrective Action Management Unit (CAMU)

Location: Sandia National Laboratories
Kirtland Air Force Base
Albuquerque, New Mexico

EPA ID No.: NM5890110518

Permit Basis: Hazardous Waste Facility Operating Permit, Sandia National Laboratories,
EPA ID Number NM5890110518, February 26, 2015

Owner: United States Department of Energy
Sandia Field Office
Technical Contact: Mr. David Rast, General Engineer
U.S. Department of Energy, Sandia Field Office
P.O. Box 5400/MS 0184
Albuquerque, NM 87185-5400
(505) 845-5349
David.Rast@nnsa.doe.gov

Operator: National Technology & Engineering Solutions of Sandia, LLC
Technical Contact: Dr. Christi Leigh, Department Manager
Environmental Restoration and Stewardship
Department
Sandia National Laboratories
P.O. Box 5800/MS 1395
Albuquerque, NM 87185-1103
(505) 845-0407
cdleigh@sandia.gov

TABLE OF CONTENTS

LIST OF FIGURES	iv
LIST OF TABLES.....	vii
ACRONYMS AND ABBREVIATIONS	ix
EXECUTIVE SUMMARY	ES-1
1.0 INTRODUCTION.....	1-1
1.1 Purpose and Scope	1-1
1.2 Report Organization.....	1-2
2.0 CORRECTIVE ACTION MANAGEMENT UNIT DESCRIPTION.....	2-1
2.1 Containment Cell	2-1
2.2 Vadose Zone Monitoring System	2-1
2.2.1 Primary Subliner Monitoring Subsystem.....	2-1
2.2.2 Vertical Sensor Array Monitoring Subsystem.....	2-5
2.2.3 Chemical Waste Landfill Sanitary Sewer Monitoring Subsystem	2-5
2.3 Chemical Waste Landfill.....	2-9
3.0 VADOSE ZONE MONITORING SYSTEM MONITORING REQUIREMENTS.....	3-1
4.0 VADOSE ZONE MONITORING SYSTEM DATA COLLECTION EQUIPMENT AND METHODOLOGIES.....	4-1
4.1 Neutron Moisture Probe	4-1
4.1.1 Primary Subliner Neutron Moisture Probe	4-1
4.1.2 Chemical Waste Landfill Sanitary Sewer Neutron Moisture Probe.....	4-2
4.2 Time-Domain Reflectometry Moisture Probe.....	4-2
4.3 Thermocouple Temperature Probe	4-2
4.4 Active Soil Vapor Sampling Equipment.....	4-3
5.0 VADOSE ZONE MONITORING SYSTEM QUALITY ASSURANCE/QUALITY CONTROL MEASURES AND DATA MANAGEMENT	5-1
5.1 Data Collection Procedures	5-1
5.1.1 Measurement of Soil Moisture Using the Neutron Probe	5-2
5.1.2 Measurement of Soil Moisture Using Time-Domain Reflectometry Probe	5-2
5.1.3 Measurement of Temperature Using Thermocouple Temperature Probe	5-2
5.1.4 Collection and Analysis of Soil Vapor Samples.....	5-2

TABLE OF CONTENTS (Continued)

5.2	Data Management and Archiving	5-3
6.0	VADOSE ZONE MONITORING SYSTEM DATA ANALYSIS	6-1
6.1	Seasonal Temperature Variations in Soil Underlying the Containment Cell.....	6-1
6.2	Distribution of Soil Vapor Volatile Organic Compounds Underlying, and Adjacent to, the Containment Cell.....	6-1
6.2.1	Soil Vapor Volatile Organic Compounds Detected in the Vertical Sensor Array Monitoring Subsystem	6-1
6.2.2	Soil Vapor Volatile Organic Compounds Detected in the Chemical Waste Landfill Sanitary Sewer Monitoring Subsystem	6-16
6.2.3	Data Quality	6-20
6.2.4	Residual Volatile Organic Compound Soil Vapor Plume from the Chemical Waste Landfill	6-20
6.3	Soil Moisture Distribution and Trends.....	6-22
6.3.1	Lateral Distribution of Moisture Underlying the Containment Cell as Indicated by the Primary Subliner Monitoring Subsystem	6-22
6.3.2	Vertical Distribution of Moisture Along the Margins of the Containment Cell As Indicated by the Vertical Sensor Array Monitoring Subsystem	6-33
6.3.3	Distribution of Moisture Adjacent to the East Side of the Containment Cell as Indicated by the Chemical Waste Landfill Sanitary Sewer Monitoring Subsystem	6-38
7.0	LEACHATE COLLECTION AND REMOVAL SYSTEM.....	7-1
7.1	Description.....	7-1
7.2	Operation.....	7-1
7.3	Waste Management.....	7-1
7.4	Results.....	7-1
8.0	INSPECTION, MAINTENANCE, AND REPAIR RESULTS.....	8-1
8.1	Final Cover System Inspection/Maintenance/Repair Activities	8-1
8.2	Stormwater Diversion Structures System Inspection/Maintenance/Repair Activities	8-4
8.3	Security Fence Inspection/Maintenance/Repair Activities	8-4
8.4	Leachate Collection Removal System Inspection/Maintenance/Repair Activities	8-5
8.5	Vadose Zone Monitoring System Inspection/Maintenance/Repair Activities.....	8-6
8.6	Safety and Emergency Equipment/Maintenance/Repair Activities	8-6
8.7	Site Maintenance	8-6
9.0	SUMMARY AND CONCLUSIONS.....	9-1

TABLE OF CONTENTS (Concluded)

9.1	Vadose Zone Monitoring System	9-1
9.2	Inspections.....	9-1
9.3	Regulatory Activities	9-2
9.4	Conclusions	9-2
10.0	REFERENCES.....	10-1

LIST OF FIGURES

Figure	Page
Figure 2-1 Local Area Map of Corrective Action Management Unit Containment Cell.....	2-2
Figure 2-2 Plan View of Containment Cell and Vadose Zone Monitoring System.....	2-3
Figure 2-3 Block Diagram of Containment Cell and Vadose Zone Monitoring System	2-4
Figure 2-4 Cross-Sectional View of Containment Cell and Primary Subliner Monitoring Subsystem.....	2-6
Figure 2-5 Configuration of Vertical Sensor Array Monitoring Subsystem	2-7
Figure 2-6 Cross-Section of the Chemical Waste Landfill Sanitary Sewer Monitoring Subsystem.....	2-8
Figure 6-1 Graph of PSL Soil Moisture Monitoring Results for the West Vitrified Clay Pipe, Calendar Year 2019.....	6-24
Figure 6-2 Graph of PSL Soil Moisture Monitoring Results for the West Central Vitrified Clay Pipe, Calendar Year 2019.....	6-26
Figure 6-3 Graph of PSL Soil Moisture Monitoring Results for the Central Vitrified Clay Pipe, Calendar Year 2019.....	6-28
Figure 6-4 Graph of PSL Soil Moisture Monitoring Results for the East-Central Vitrified Clay Pipe, Calendar Year 2019.....	6-30
Figure 6-5 Graph of PSL Soil Moisture Monitoring Results for the East Vitrified Clay Pipe, Calendar Year 2019.....	6-32
Figure 6-6 Graph of VSA Soil Moisture Monitoring Results (5-Foot Monitoring Depth),5Calendar Year 2019	6-35
Figure 6-7 Graph of VSA Soil Moisture Monitoring Results (15-Foot Monitoring Depth), Calendar Year 2019.....	6-37
Figure 6-8 Graph of CSS Soil Moisture Monitoring Results (12-Foot Monitoring Depth), Calendar Year 2019.....	6-40
Figure 6-9 Graph of CSS Soil Moisture Monitoring Results (16-Foot Monitoring Depth), Calendar Year 2019.....	6-42
Figure 6-10 Graph of CSS-2 Soil Moisture Increase (12- and 16-Foot Monitoring Depth), October 2003 - December 2019.....	6-43

LIST OF FIGURES (Concluded)

Figure	Page
Figure 6-11 Graph of CSS-3 Soil Moisture Increase (12- and 16-Foot Monitoring Depth), October 2003 - December 2019.....	6-44
Figure 7-1 North-South Cross-Section of Leachate Collection and Removal System Sump	7-2
Figure 7-2 West-East Cross-Section of Containment Cell.....	7-3

LIST OF TABLES

Table		Page
Table 3-1	Monitoring Frequency, Parameters, and Methods for the Vadose Zone Monitoring System	3-1
Table 6-1	VSA Temperature Monitoring Results from 5-Foot Monitoring Depth Calendar Year 2019.....	6-2
Table 6-2	VSA Temperature Monitoring Results from 15-Foot Monitoring Depth Calendar Year 2019.....	6-2
Table 6-3	Summary of Detected Volatile Organic Compounds VSA Soil Vapor Monitoring Analytical Method TO-15, Sample Date - May 9, 2019	6-4
Table 6-4	Summary of Detected Volatile Organic Compounds CSS Soil Vapor Monitoring Analytical Method TO-15, Sample Date - May 9, 2019	6-17
Table 6-5	Summary of Detected Volatile Organic Compounds Trip Blank and Field Blank Sample Analytical Method TO-15, Sample Date - May 9, 2019.....	6-21
Table 6-6	PSL Soil Moisture Monitoring Results for the West Vitrified Clay Pipe, Calendar Year 2019.....	6-23
Table 6-7	PSL Soil Moisture Monitoring Results for the West-Central Vitrified Clay Pipe, Calendar Year 2019.....	6-25
Table 6-8	PSL Soil Moisture Monitoring Results for the Central Vitrified Clay Pipe, Calendar Year 2019.....	6-27
Table 6-9	PSL Soil Moisture Monitoring Results for the East-Central Vitrified Clay Pipe, Calendar Year 2019.....	6-29
Table 6-10	PSL Soil Moisture Monitoring Results for the East Vitrified Clay Pipe, Calendar Year 2019.....	6-31
Table 6-11	TDR Soil Moisture Monitoring Results for the VSA 5-Foot Monitoring Depth, Calendar Year 2019	6-34
Table 6-12	TDR Soil Moisture Monitoring Results for the VSA 15-Foot Monitoring Depth, Calendar Year 2019	6-36
Table 6-13	CSS Soil Moisture Monitoring Results 12-Foot Monitoring Depth Calendar, Year 2019.....	6-39
Table 6-14	CSS Soil Moisture Monitoring Results 16-Foot Monitoring Depth Calendar, Year 2019.....	6-41

LIST OF TABLES (Concluded)

Table		Page
Table 7-1	Gallons of Leachate Pumped from the Leachate Collection and Removal System Sump, Calendar Year 2019	7-1
Table 8-1	Inspection Frequency and Dates Performed, Calendar Year 2019.....	8-3

LIST OF ANNEXES

Annex

Annex A	Concentration Graphs of Frequently Detected Volatile Organic Compounds and Soil Temperatures Over Time for all Vertical Sensor Array Monitoring Locations, September 2002 through May 2019
Annex B	Concentration Graphs of Frequently Detected Volatile Organic Over Time for all Chemical Waste Landfill Sanitary Sewer Monitoring Locations, September 2002 through May 2019

This page intentionally left blank.

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
%	percent
Campbell	Campbell® Scientific, Inc.
CAMU	Corrective Action Management Unit
CPN	California Pacific Nuclear
CSS	CWL sanitary sewer
CWL	Chemical Waste Landfill
CY	calendar year
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FOP	Field Operating Procedure
HDPE	high-density polyethylene
LCRS	leachate collection and removal system
RL	reporting limit
MDL	method detection limit
NMED	New Mexico Environment Department
NTESS	National Technology & Engineering Solutions of Sandia, LLC
PCCP	Post-Closure Care Permit
Permit	Hazardous Waste Facility Operating Permit
PID	photoionization detector
ppbv	parts per billion by volume
ppmv	parts per million by volume
PSL	primary subliner
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RL	reporting limit
SNL	Sandia National Laboratories
SNL/NM	Sandia National Laboratories, New Mexico
TDR	time-domain reflectometry
VCM	voluntary corrective measure
VCP	vitrified clay pipe
VOC	volatile organic compound
VSA	vertical sensor array
VZMS	vadose zone monitoring system

This page intentionally left blank.

EXECUTIVE SUMMARY

The Corrective Action Management Unit (CAMU) at Sandia National Laboratories, New Mexico (SNL/NM) consists of a containment cell and ancillary systems that underwent closure in 2003 in accordance with the Closure Plan in Appendix D of the Class 3 Permit Modification (SNL/NM September 1997). The containment cell was closed with wastes in place. On January 27, 2015, the New Mexico Environment Department (NMED) issued the Hazardous Waste Facility Operating Permit (Permit) for Sandia National Laboratories (NMED January 2015) to the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) and its Management and Operating (M&O) contractor. The current M&O contractor is National Technology & Engineering Solutions of Sandia, LLC (NTESS). The Permit became effective February 26, 2015. The CAMU is undergoing post-closure care in accordance with the Permit, as revised and updated. This CAMU Report of Post-Closure Care Activities documents all activities and results for calendar year (CY) 2019, as required by the Permit.

The CAMU containment cell consists of wastes surrounded by engineered barriers, including a cover system, a bottom liner system with a leachate collection and removal system (LCRS), and a vadose zone monitoring system (VZMS). The cover system provides protection against surface water run-on and erosion of the cover and underlying wastes. The bottom liner system provides containment of the wastes together with management of leachate. The VZMS provides information on soil conditions under the cell for early leak detection. The VZMS consists of three monitoring subsystems, which include the primary subliner (PSL), a vertical sensor array (VSA), and the Chemical Waste Landfill (CWL) sanitary sewer (CSS) line. The PSL, VSA, and CSS monitoring subsystems are monitored quarterly for soil moisture concentration, the VSA is monitored quarterly for soil temperature, and the VSA and CSS monitoring subsystems are monitored annually for volatile organic compound (VOC) concentrations in the soil vapor at various depths.

The cover system continues to meet successful revegetation criteria and is in good condition with even coverage of mature, native perennial grasses. Maintenance was performed in CY 2019 in response to inspection results and to promote the growth and health of the desired native grass species on the cover system by reducing competition with weedy species for limited moisture and nutrients.

Four leachate pumping events, scheduled quarterly, were conducted in CY 2019. Approximately 238 gallons of leachate were generated. The leachate was containerized and sent to a permitted, off-site hazardous waste management facility.

Four VZMS soil moisture and soil temperature monitoring events, scheduled quarterly, were conducted in CY 2019. Monitoring results were consistent with previous years and no measurements exceeded the established trigger levels.

One annual VZMS soil vapor monitoring event was conducted in May 2019. The soil vapor data including VOC concentrations continue to indicate the presence of contamination from the residual soil vapor plume emanating from the CWL. VOC concentrations did not exceed the established trigger levels for the CY 2019 reporting period.

Inspections of the CAMU cover system, stormwater diversion structures, VZMS, security fence, and safety and emergency equipment were performed in accordance with post-closure care requirements. Required repairs were minor and made within 60 days of identification as is required by the Permit.

CY 2019 regulatory activities included the following:

- CAMU Report of Post-Closure Care Activities, Calendar Year 2018 (SNL/NM March 2019a).
- On April 22, 2019, the updated procedure Field Operating Procedure (FOP) 08-20 for use of the CPN neutron moisture probe (SNL/NM April 2019), went into effect. It was submitted to the NMED on May 13, 2019 within 30 days of the procedure's effective date.
- On July 31 the DOE/NNSA and NTESS requested modifications to the Permit consisting of changes to Attachment F, Training Plan, that allows for online training in addition to the methods already listed; and Attachment H, Post-Closure Care Plan for the Corrective Action Management Unit to revise sampling methods for consistency with similar methods, and to allow the monitoring equipment to be replaced or upgraded with equivalent equipment when it becomes commercially available. These changes went into effect upon NMED approval on October 24, 2019.
- On October 17, 2019, the updated procedure FOP 08-22, Soil Vapor Monitoring (SNL/NM October 2019), went into effect. It was submitted to the NMED on November 8, 2019 within 30 days of the procedure's effective date.

All post-closure care requirements were met for CY 2019. Based upon monitoring, inspection, and maintenance results, the containment cell including ancillary systems is functioning as designed and site conditions remain protective of human health and the environment.

1.0 INTRODUCTION

Sandia National Laboratories (SNL) is a multi-purpose engineering and science laboratory owned by the U.S. Department of Energy (DOE)/National Nuclear Security Administration, and operated and managed by National Technology & Engineering Solutions of Sandia, LLC (NTESS), a wholly owned subsidiary of Honeywell International Inc.

The Corrective Action Management Unit (CAMU) at SNL, New Mexico (SNL/NM) consisted of a containment cell, two treatment systems, four associated waste staging and storage areas, and support areas; all were used for management of treated soils excavated from the Chemical Waste Landfill (CWL) between 1997 and 2003. The CAMU operations were conducted in accordance with the requirements of:

- The Class 3 Permit Modification Request for the CAMU (SNL/NM September 1997, as amended); and
- Module IV of Permit NM5890110518, "Special Conditions Pursuant to the 1984 Hazardous and Solid Waste Amendments to Resource Conservation and Recovery Act (RCRA) for Sandia National Laboratory, U.S. Environmental Protection Agency (EPA) Identification Number NM5890110518," August 1993, (EPA 1993, as amended) and subsequently administered by the New Mexico Environment Department (NMED).

The CAMU underwent closure in 2003 in accordance with the Closure Plan in Appendix D of the Class 3 Permit Modification (SNL/NM September 1997, as amended). The containment cell was closed with wastes in place. Hazardous wastes were removed from all other CAMU systems and areas, and they underwent clean closure. The NMED approved completion of closure in May 2004 (Kieling May 2004). From May 2004 until February 2015, the containment cell underwent post-closure care (i.e., monitoring, inspections, maintenance, and repairs) in accordance with the Closure Plan.

On January 27, 2015, the NMED issued the Hazardous Waste Facility Operating Permit (Permit) for SNL (NMED January 2015). The Permit became effective February 26, 2015. The CAMU is undergoing post-closure care in accordance with the Permit, as revised and updated.

1.1 Purpose and Scope

The purpose and scope of this report is to describe post-closure care at the CAMU during calendar year (CY) 2019, in accordance with the requirements of the Permit, particularly Permit Part 7, Section 7.3.

Human health and the environment at the CAMU are protected through continued monitoring and maintenance of the containment cell and monitoring systems, which minimize the potential for exposure to the containment cell contents. This report documents the overall performance of the CAMU systems during CY 2019. Performance is based on the following:

- Maintaining the final cover's integrity and effectiveness. Permit Part 7, Section 7.3; Permit Attachment E, Sections E.3 and E.10; and Permit Attachment H detail the requirements.
- Using the monitoring systems to assess the vadose zone environment underlying the containment cell. Permit Attachment H, Section H.5 delineates the monitoring requirements. Monitored parameters include soil moisture, soil temperature, and concentrations of volatile organic compounds (VOCs) in the soil vapor.
- Operating the containment cell leachate collection and removal system (LCRS). Permit Attachment A, Section A.7.6.3, and Attachment E, Section E.10.4 delineate the requirements.
- Maintaining security measures to restrict access to the CAMU. Permit Attachment H, Section H.3 details the requirements.
- Other inspection, maintenance, and repair activities. Permit Attachment E, Sections E.3 and E.10 details the requirements.

1.2 Report Organization

This report is organized as follows:

- Chapter 2.0 provides a description of the CAMU, including the containment cell and each vadose zone monitoring system (VZMS) monitoring subsystem.
- Chapter 3.0 reviews the monitoring requirements for the VZMS.
- Chapter 4.0 describes the data collection equipment and the data collection methodologies for the VZMS.
- Chapter 5.0 discusses the quality assurance (QA)/quality control (QC) procedures employed as part of the data collection and management process for the VZMS.
- Chapter 6.0 presents the CY 2019 VZMS data together with an assessment of the distribution and trends noted in the VZMS data sets.
- Chapter 7.0 provides a description and summary of the LCRS.
- Chapter 8.0 provides a description and summary of all inspections, maintenance, and repair activities.
- Chapter 9.0 presents general conclusions concerning containment cell performance and post-closure care of the CAMU.
- Chapter 10.0 lists the references cited in this report.

Annex A includes concentration graphs of frequently detected VOCs and soil temperatures over time for all vertical sensor array monitoring subsystem monitoring locations, September 2002 through May 2019.

Annex B includes concentration graphs of frequently detected VOCs over time for all Chemical Waste Landfill (CWL) Sanitary Sewer (CSS) monitoring subsystem monitoring locations, September 2002 through May 2019.

2.0 CORRECTIVE ACTION MANAGEMENT UNIT DESCRIPTION

The CAMU consists of a containment cell and ancillary systems surrounded by a fence with two locking gates. It occupies a 3.75-acre site located in the southeastern portion of SNL/NM Technical Area III, directly north of the SNL/NM Radioactive and Mixed Waste Management Unit, and approximately 400 feet northwest of the CWL (Figure 2-1). The Radioactive and Mixed Waste Management Unit is used for storage and treatment of hazardous and mixed wastes under the Permit. The CWL is undergoing post-closure care and monitoring under a separate Post-Closure Care Permit (PCCP) (NMED October 2009, as revised and updated). Certain aspects of the CWL are relevant to post-closure care at the CAMU; therefore, Section 2.3 of this report describes the CWL in more detail.

2.1 Containment Cell

The CAMU containment cell was constructed with an engineered liner system on the bottom and sides. During closure, an engineered final cover system was installed. The components of the final cover system from bottom to top include the following: textured 60-mil (0.06 inches) high-density polyethylene (HDPE) membrane, bedding sand, pea gravel, filter sand, native soil blend, topsoil with gravel mulch, and native vegetation. The sides of the containment cell cover are sloped to minimize erosion and to minimize infiltration by directing precipitation away from the cell. The soil immediately around the cell is also sloped to direct precipitation away from the cell.

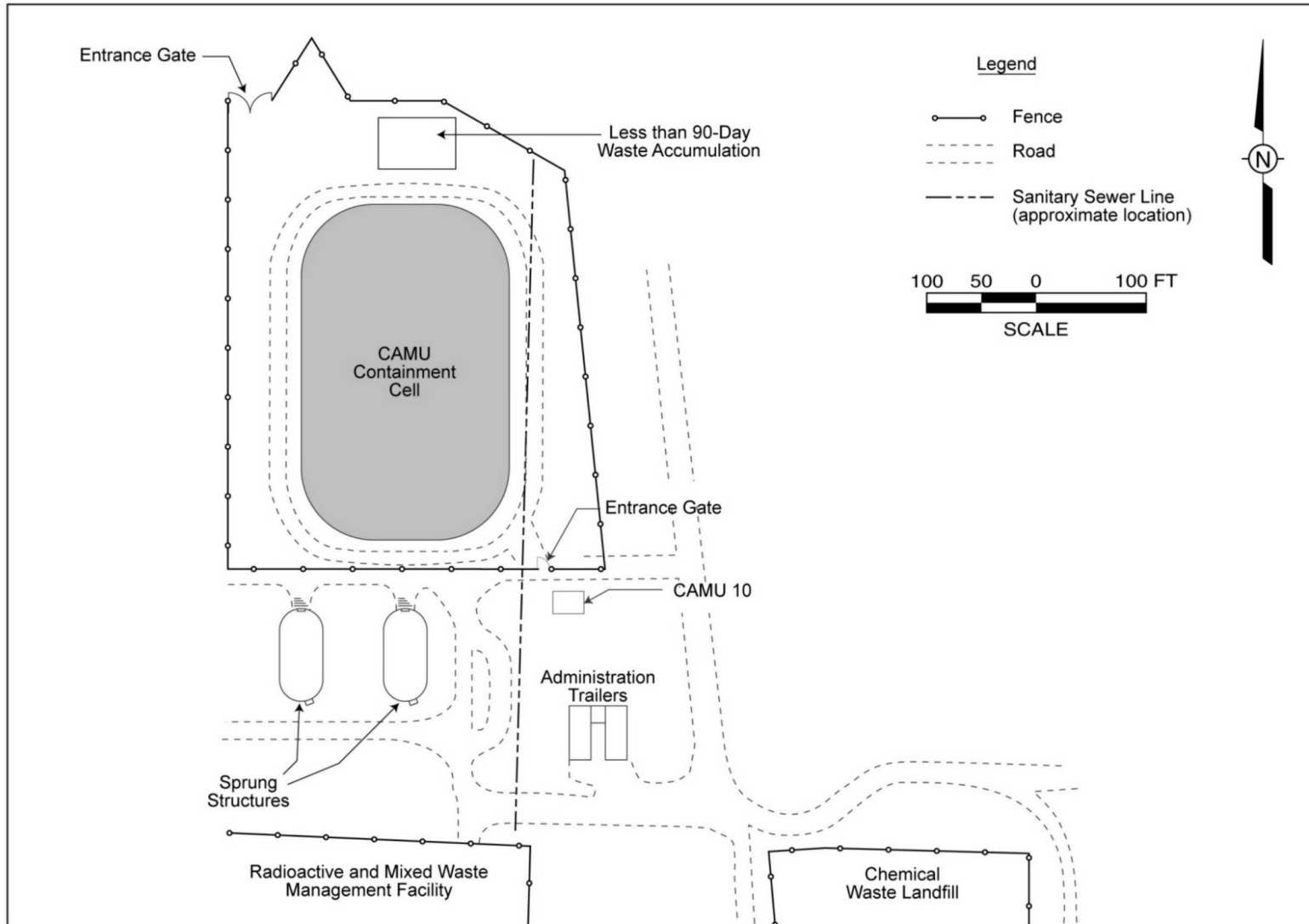
The engineered liner system on the bottom and sides of the containment cell consists of several layers installed over prepared subgrade. The layers include a geosynthetic clay layer overlain by an HDPE liner. The construction of the containment cell incorporated an LCRS; the LCRS is designed to collect and withdraw leachate from the closed cell during the post-closure care period.

2.2 Vadose Zone Monitoring System

Three subsystems for monitoring the condition of the vadose zone under the closed containment cell were installed during construction of the cell. The set of three monitoring subsystems comprise the VZMS; they are designed to provide real-time information on containment cell performance with respect to early detection of any leaks from the cell. They are located beneath and adjacent to the containment cell. As shown in Figures 2-2 and 2-3, each subsystem includes multiple surface locations. The following sections detail the subsystems.

2.2.1 Primary Subliner Monitoring Subsystem

The primary subliner (PSL) monitoring subsystem is the primary monitoring component of the VZMS. This subsystem is designed to detect increased moisture content immediately below the engineered liner system on the bottom of the containment cell.



146239_02012000_A1.ai

Figure 2-1
Local Area Map of Corrective Action Management Unit Containment Cell

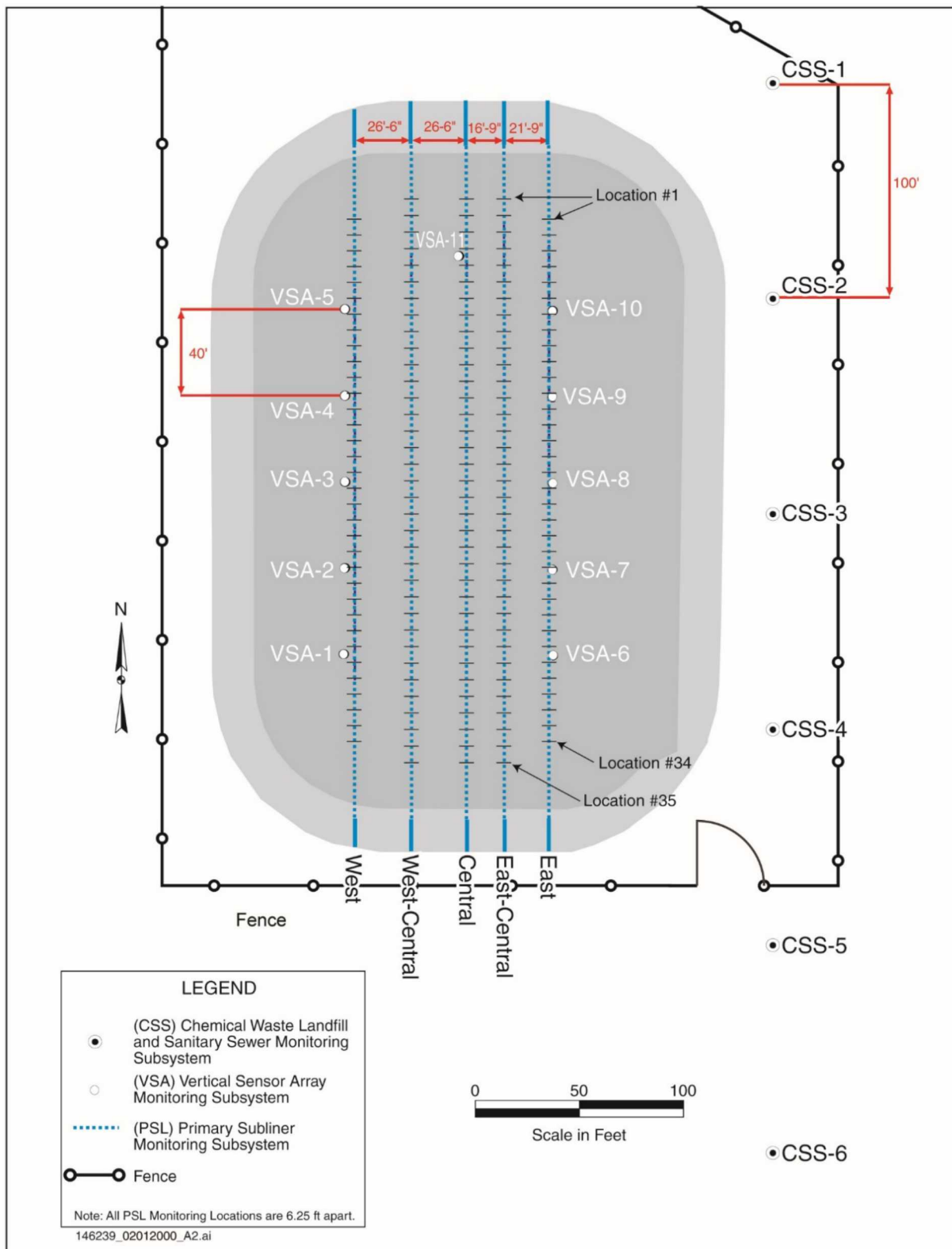


Figure 2-2
 Plan View of Containment Cell and Vadose Zone Monitoring System

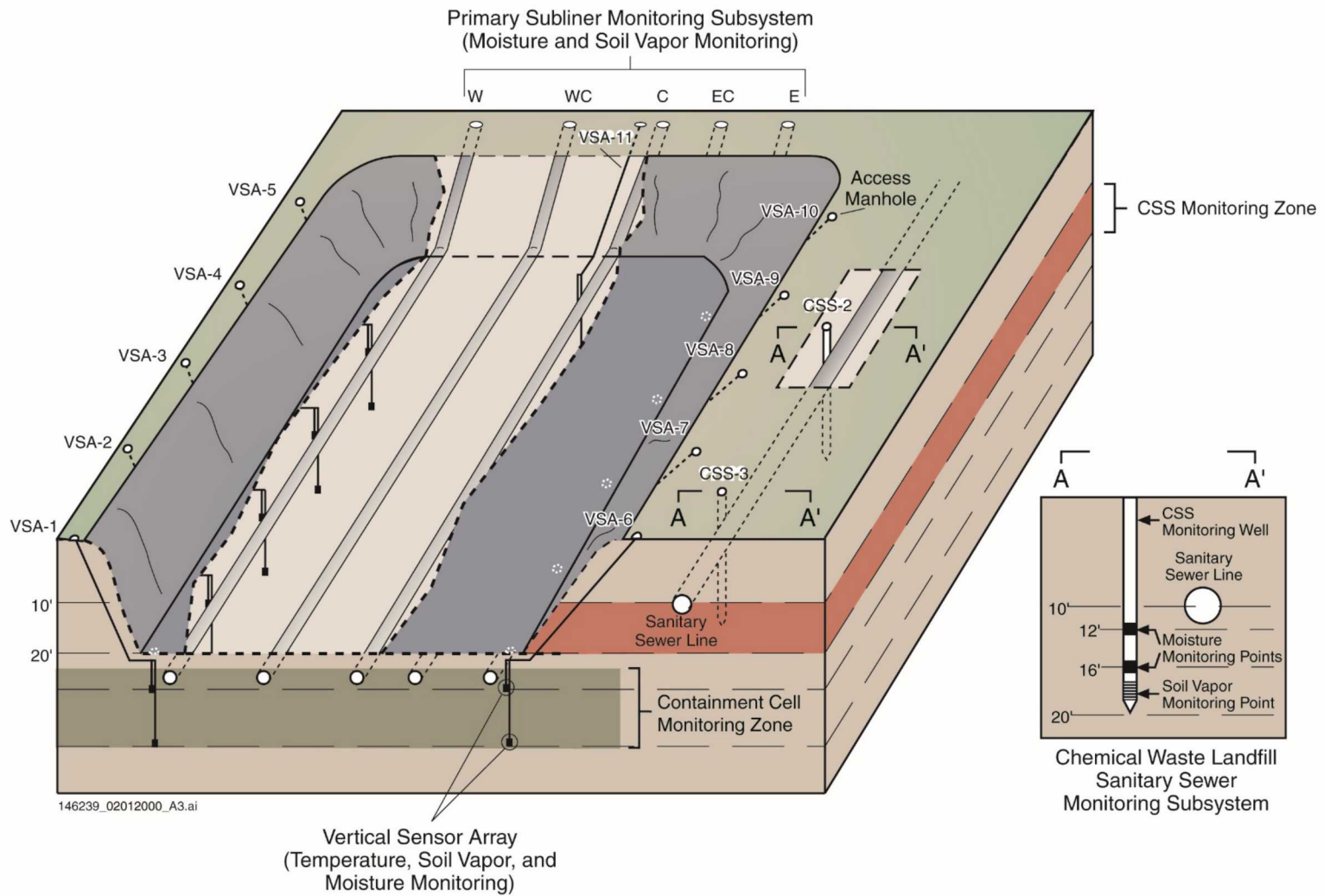


Figure 2-3
 Block Diagram of Containment Cell and Vadose Zone Monitoring System

Five vitrified clay pipes (VCPs) are located in trenches approximately 4 feet below the engineered liner system (Figure 2-4). The VCPs allow for detection of moisture in the soil beneath the containment cell. The pipes are spaced approximately 17 to 27 feet apart (Figures 2-2 and 2-3) and run along the north-south (long) axis of the containment cell. The VCP trenches are backfilled with a wicking material (Figure 2-4) consisting of native soil of a specified particle size distribution (i.e., silty sand). The bottom of the original cell excavation, between the VCP trenches, is covered with a HDPE cell subliner membrane underlying the engineered liner system. The wicking material and edges of the cell subliner membrane drape into each trench to facilitate transport of moisture to the VCP if the primary liner system fails (Figure 2-4).

Inclined sections of polyvinyl chloride (PVC) riser pipes are connected to each end of the VCPs to allow access for soil moisture measurements. A neutron moisture probe is deployed into the VCP to collect the soil moisture data. The probe reports neutron counts at preselected points along each pipe run. The neutron counts are then translated into soil moisture data by using a site-specific empirical formula (developed using site-specific properties described in Section 4.1) that relate count values to soil moisture content.

2.2.2 Vertical Sensor Array Monitoring Subsystem

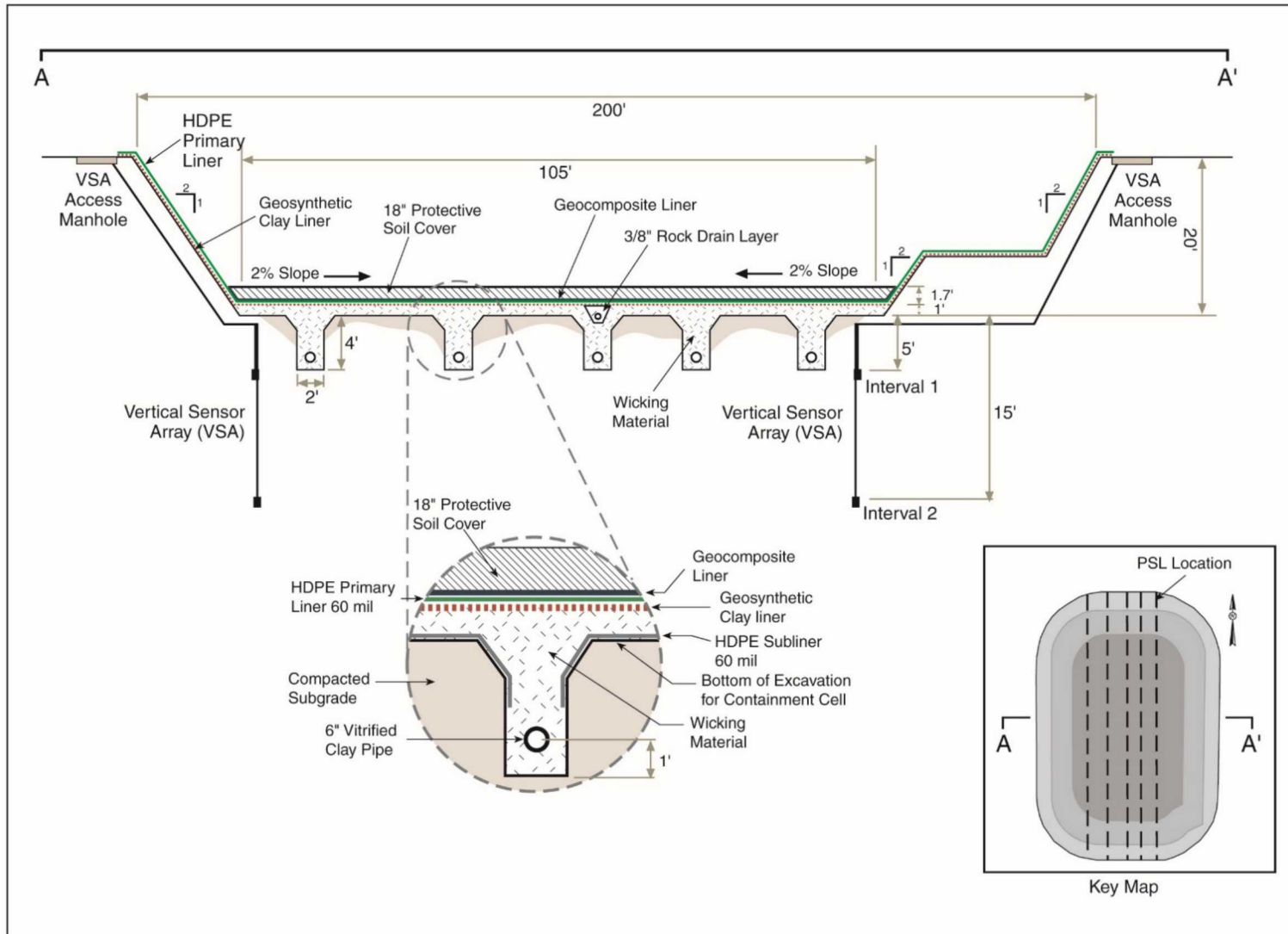
The VSA monitoring subsystem provides information on moisture content, temperature, and concentrations of VOCs in soil vapor beneath the edges of the containment cell. The soil moisture data may help determine whether increases are the result of containment cell leakage or related to a source adjacent to the cell.

This subsystem consists of eleven pairs of vertically oriented monitoring locations. Five are located on both the eastern and western margins of the containment cell (Figures 2-2 and 2-3). The eleventh monitoring location is situated at the northern end of the cell, beneath the LCRS sump. Each VSA location contains monitoring points at both 5 and 15 feet beneath the containment cell subliner. Each monitoring point contains the following three components: a time-domain reflectometry (TDR) soil moisture content probe, a soil temperature sensor, and a soil vapor sampling port (Figure 2-5).

2.2.3 Chemical Waste Landfill Sanitary Sewer Monitoring Subsystem

The CSS monitoring subsystem, located east of the containment cell, is designed to detect leaks emanating from the sanitary sewer line that could impact the PSL or VSA soil moisture monitoring subsystems (Figure 2-3). The sanitary sewer line runs from south to north approximately 45 feet east of the containment cell (Figures 2-1 and 2-2). Six vertical monitoring well points are positioned between the containment cell and the sanitary sewer line. The monitoring well points are approximately 20 feet deep and 100 feet apart. The bottom of each well contains a 2-foot section of galvanized steel screen to support soil vapor sampling. The remaining length is constructed of 2-inch diameter, galvanized steel pipe (Figure 2-6).

Each monitoring well is equipped for soil vapor sampling and is accessible by a neutron moisture probe to monitor soil moisture content. Soil vapor monitoring is used to detect VOCs within the vadose zone.



146239_02012000_A4.ai

Figure 2-4
 Cross-Sectional View of Containment Cell and Primary Subliner Monitoring Subsystem

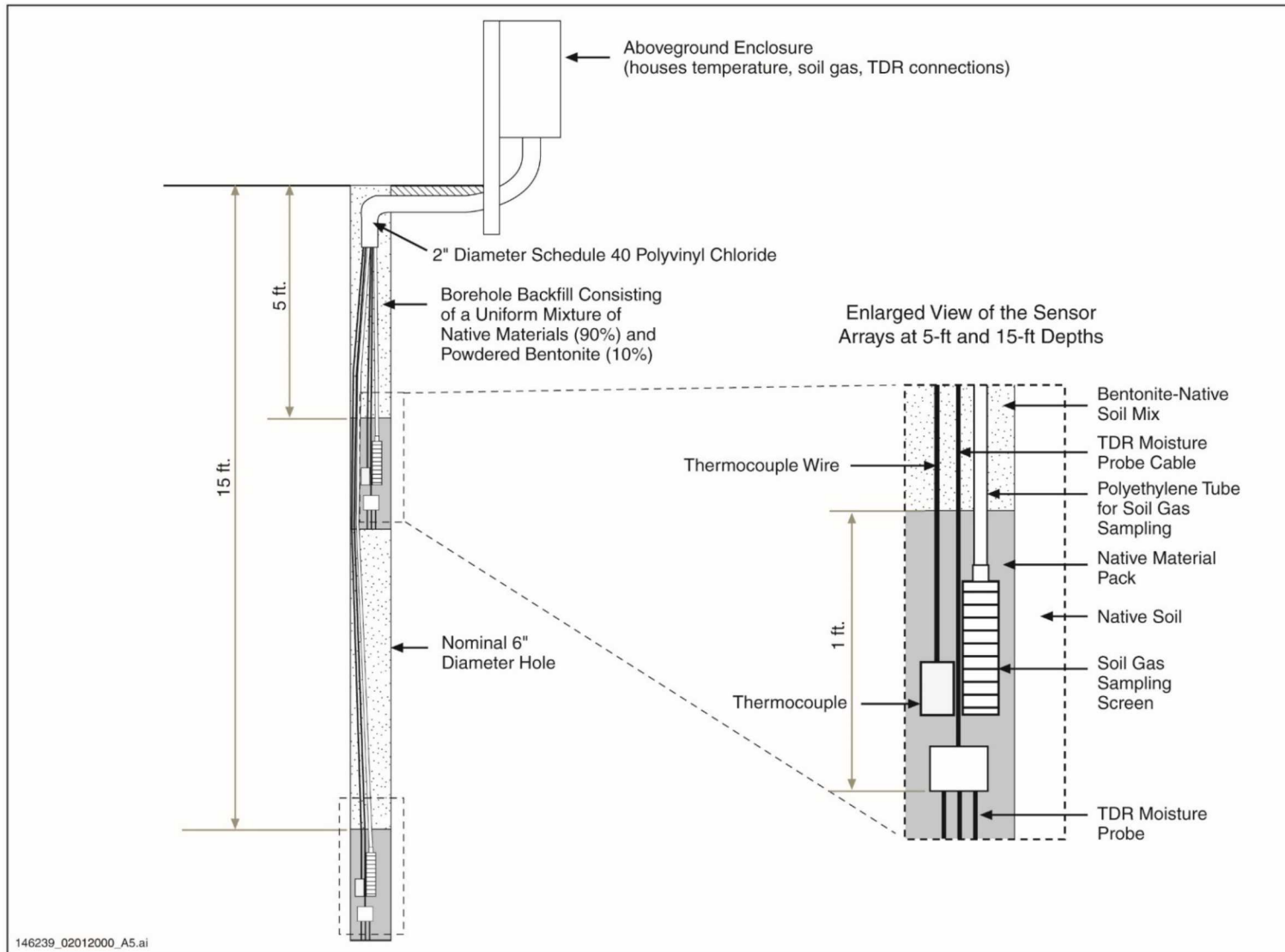


Figure 2-5
Configuration of Vertical Sensor Array Monitoring Subsystem

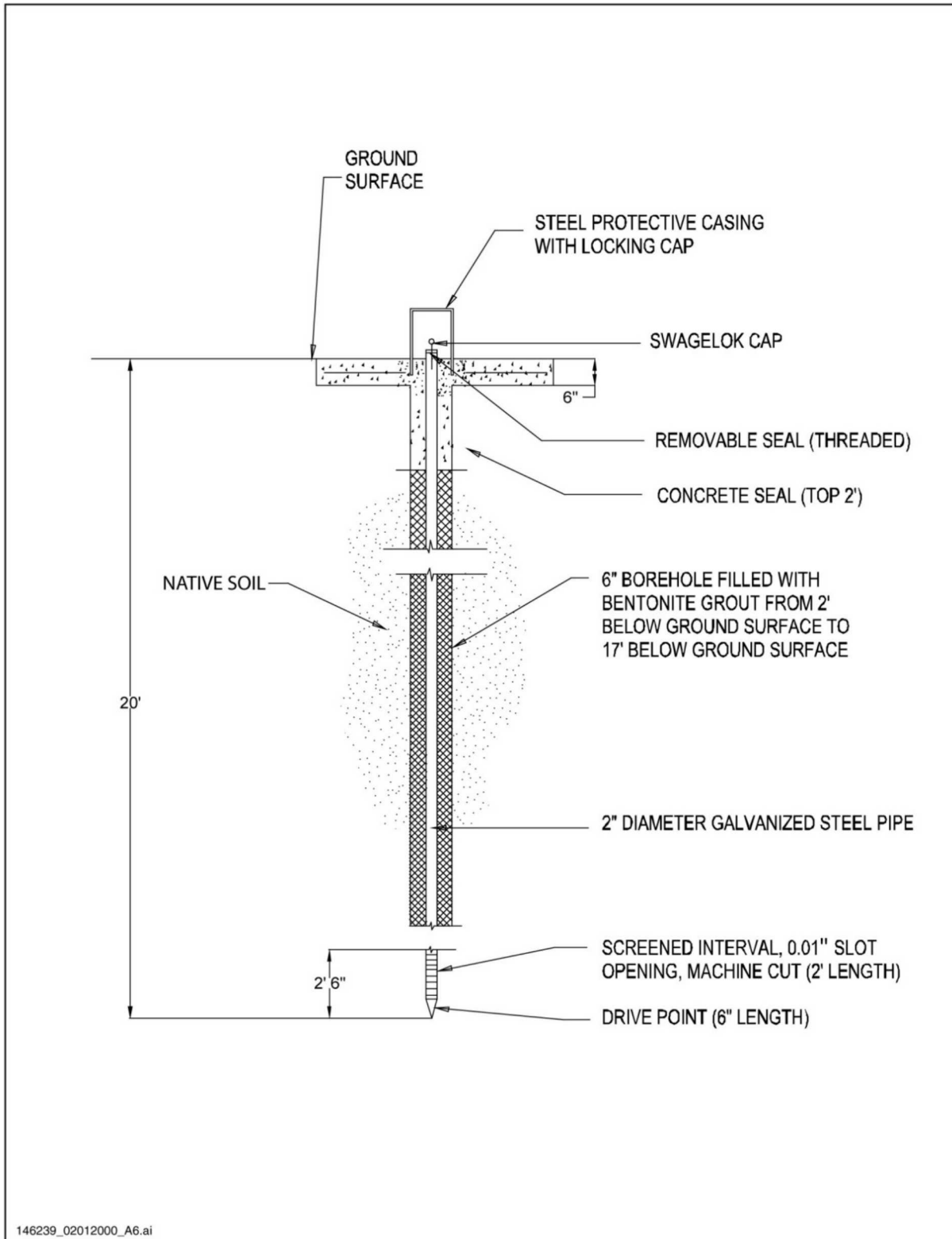


Figure 2-6
Cross-Section of the Chemical Waste Landfill Sanitary Sewer Monitoring Subsystem

2.3 Chemical Waste Landfill

The CWL, located southeast of the CAMU, is a remediated 1.9-acre hazardous waste landfill undergoing post-closure care. Background information on the CWL is summarized below and provides context for the CAMU soil vapor data that is discussed in Section 6.2

Two voluntary corrective measures (VCMs) were conducted at the CWL during closure. A soil vapor extraction VCM was conducted from 1997 through 1998 to reduce the concentrations of VOCs in soil vapor in the vadose zone, to control the VOC soil vapor plume, and to reduce trichloroethene concentrations in the groundwater below the landfill (SNL/NM May 2000). Following the soil vapor extraction VCM, a landfill excavation VCM was conducted from September 1998 through February 2002. All former disposal areas were excavated during the landfill excavation VCM. The excavation was backfilled and an evapotranspirative cover was constructed over the landfill.

Additional information on the VCMs, closure activities, and CWL current conditions can be found in the CWL Final RCRA Closure Report (SNL/NM September 2010), the PCCP (NMED October 2009, as revised and updated), and the CWL Corrective Measures Study Report (SNL/NM December 2004). Part 3, Section 3.1 and Table 3-1 of the PCCP details information on residual soil contamination at the CWL.

Post-closure care activities at the CWL include monitoring soil vapor concentrations of several chlorinated VOCs, and monitoring groundwater concentrations of selected chlorinated VOCs, chromium, and nickel. Annual reports document monitoring results submitted to the NMED in accordance with the PCCP.

Residual soil contamination is present in the vadose zone under the CWL. VOC vapors associated with the residual soil vapor plume are still present throughout the 500-foot vadose zone extending beneath the CWL to groundwater. The residual vapor plume also extends outward from the CWL in all directions.

The most common VOCs present in the residual soil vapor plume include:

- Dichlorodifluoromethane
- Tetrachloroethane
- 1,1,1-Trichloroethane
- 1,1,2-Trichloro-1,2,2-trifluoroethane
- Trichloroethene
- Trichlorofluoromethane

The conceptual model of the CWL residual VOC soil vapor plume, supported by annual CWL monitoring results, indicates it is controlled and slowly dissipating through diffusion and advection (SNL/NM December 2004).

This page intentionally left blank

3.0 VADOSE ZONE MONITORING SYSTEM MONITORING REQUIREMENTS

Section H.5 and Table H-1 in Permit Attachment H (NMED January 2015, as revised and updated) define the requirements for VZMS monitoring frequency, parameters, and methods. Table 3-1 presents these requirements.

Table 3-1
 Monitoring Frequency, Parameters, and Methods for the Vadose Zone Monitoring System

Monitoring Frequency	Monitoring Subsystems	Monitoring Parameter	Monitoring Method
Quarterly	PSL	Moisture content	Neutron Moisture Probe
	VSA	Moisture content	TDR Probe
		Temperature	Temperature Sensor
	CSS	Moisture content	Neutron Moisture Probe
Annually ^a	VSA	Active soil vapor	EPA Method TO-14A or equivalent, as revised and updated ^b
	CSS		

Notes:

^aActive soil vapor sampling will be conducted annually unless increased soil moisture (exceeding the trigger level) is detected, in which case active soil vapor sampling will be conducted on a quarterly basis.

^bEPA Method TO-14A (EPA January 1999a) or an equivalent method, such as TO-15 (EPA January 1999b), that includes the same analyte list, method detection limits equal to or lower than the TO-14A limits, and provides the same or higher level of data quality.

- CSS = CWL sanitary sewer.
- CWL = Chemical Waste Landfill.
- EPA = U.S. Environmental Protection Agency.
- PSL = Primary subliner.
- TDR = Time-domain reflectometry.
- VSA = Vertical sensor array.

This page intentionally left blank

4.0 VADOSE ZONE MONITORING SYSTEM DATA COLLECTION EQUIPMENT AND METHODOLOGIES

The following sections describe the equipment and methodologies used to collect data from the three monitoring subsystems that comprise the VZMS.

4.1 Neutron Moisture Probe

A neutron moisture probe manufactured by California Pacific Nuclear (CPN) is used to measure neutron counts in the PSL and CSS monitoring subsystems. The probe is a Model 503 Elite™ Hydroprobe that utilizes a neutron source (50-millicuries Americium-241/Beryllium) and a neutron detector. The source emits fast neutrons into the surrounding material. The fast neutrons interact with hydrogen atoms of water molecules and are slowed (thermalized). The detector measures the thermalized neutrons. The number of thermalized neutrons detected is a function of the hydrogen concentration, which is proportionally related to the soil moisture content. Neutron counts can be directly read and recorded from the CPN probe, which is queried at predetermined locations within the PSL and CSS monitoring subsystems.

In situ soil moisture content is determined by correlating neutron counts with known moisture values in accordance with Permit Attachment H, Section H.6.2. To develop the correlations, test fixtures were built (using native soil with known moisture content) that simulated the configuration of the PSL and CSS monitoring subsystems. Instrument measurements were taken within these fixtures to develop empirical formulas for the correlation between neutron counts and soil moisture content. These correlation formulas provide the basis for determining soil moisture values within the PSL and CSS monitoring subsystems.

4.1.1 Primary Subliner Neutron Moisture Probe

The neutron moisture probe data collection procedures are the same for each of the five VCPs. There are 34 data collection (count) locations in both the East and West VCPs, and 35 count locations in each of the East-Central, Central, and West-Central VCPs. Count locations are numbered consecutively from north to south along each of the VCPs and are spaced approximately 6.25 feet apart. The neutron moisture probe is stopped at each of the predefined count locations and a neutron count is obtained. The probe is positioned based upon the distance measured by a winch line counter.

At each count location, the probe measures hydrogen concentrations within a sphere that includes air space around the probe, the VCP wall, and a portion of the wicking material in the trench surrounding the pipe. The manufacturer of the CPN probe reports an effective radius measurement of 10 inches, or about 6 inches beyond the pipe wall into the wicking material and surrounding soil (under dry conditions). As moisture values surrounding the neutron moisture probe increase, the radius of detection decreases. Soil moisture content for the PSL subsystem is reported as a percentage of soil mass.

4.1.2 Chemical Waste Landfill Sanitary Sewer Neutron Moisture Probe

Neutron count measurements are collected at depths of approximately 12 and 16 feet below ground surface in each of the 6 CSS monitoring wells.

The monitoring environment of the CSS subsystem is different from that of the PSL. The neutron moisture probe is operating in a galvanized steel pipe that has no moisture-absorbing capacity. Material adjacent to the pipe consists of a 2-inch annular borehole space filled with bentonite grout. Native soil surrounds the grout (Figure 2-6). Because the galvanized pipe diameter is smaller than the diameter of the VCP, more of the surrounding material is measured. The effective radius measurement is approximately 8 inches from the outside pipe wall into the surrounding soil. Soil moisture content for the CSS subsystem is reported as percentage of soil mass.

4.2 Time-Domain Reflectometry Moisture Probe

TDR soil moisture measurements are made using a Campbell® Scientific, Inc. (Campbell) Model CS 610-L TDR probe connected by a coaxial cable to a TDR100 signal generator. The TDR100 sends a voltage signal to the probe. The signal travels from the TDR100 to the probe, then into the surrounding soil, back to the probe, and back to the TDR100. The delay between the initial signal and the return pulse is related to the moisture content of the soil. The TDR100 software uses a preprogrammed algorithm, Topp Equation (Campbell April 2002), to convert this distance into a volumetric soil moisture value.

The probes are positioned at 5 and 15 feet below the containment cell subliner at each of the 11 VSA locations. The probes have been repacked in native material to duplicate the effective pore size of the adjacent native materials. Soil moisture content is reported on a volumetric basis as a percentage of soil volume.

Occasionally, the TDR coaxial cables at the VSA-4 and VSA-5 locations experience interference from an outside, unidentified source at the 5-foot depth that affects the voltage signal waveform. When this occurs, the TDR100 software cannot read the waveform. Additional attempts are made until the software recognizes the waveform and can calculate a soil moisture value. Thus far, the soil moisture values calculated by the TDR100 have been consistent with baseline values.

4.3 Thermocouple Temperature Probe

Each VSA monitoring location has thermocouple temperature probes located at 5 and 15 feet below the containment cell subliner. Temperature measurements are obtained by connecting a Fluke® 52 II microprocessor-based, digital thermometer to the thermocouple temperature probes. The Fluke® 52 II converts the drop in voltage across the thermocouple junction to a temperature in degrees Celsius (°C) and displays the value.

Soil temperature does affect the TDR soil moisture values because the dielectric value of water is temperature dependent. However, the effect is negligible (i.e., for a 30°C change in temperature, the change in measured water content using the Topp Equation is

approximately 2 percent [%]). Temperature values at the VSA monitoring locations varied less than 2°C in CY 2019 (see Section 6.1).

4.4 Active Soil Vapor Sampling Equipment

The CSS and VSA monitoring subsystems are sampled for VOCs in soil vapor. The equipment consists of a vacuum pump, sampling manifold assembly, and photoionization detector (PID). The vacuum pump is used to draw soil vapor through the monitoring port, sampling tubing (VSA), or well casing (CSS), and the sampling screen until a minimum of three volumes are evacuated, and until VOC levels stabilized, as determined with the PID. The pump is turned off and a valve is opened on the manifold assembly that directs soil vapor flow to the SUMMA™ canister. Because the SUMMA™ canister is under vacuum, it draws the soil vapor sample into the canister. Section 6.2 contains the soil vapor VOC data.

This page intentionally left blank

5.0 VADOSE ZONE MONITORING SYSTEM QUALITY ASSURANCE/QUALITY CONTROL MEASURES AND DATA MANAGEMENT

This chapter summarizes the procedures and QA/QC measures used to collect the VZMS data and QA/QC requirements for characterizing the vadose zone underneath the containment cell in accordance with the Permit. The data flow process, from the initial instrument readings and sample collection through final archival data storage, is also presented.

5.1 Data Collection Procedures

The scope of CY 2019 monitoring includes the following activities:

- Measurement of soil moisture content using neutron counts at 185 locations within the PSL (173) and CSS (12) monitoring subsystems.
- Measurement of temperature and soil moisture content using TDR at 22 locations within the VSA monitoring subsystem.
- Collection of soil vapor samples from the VSA (22 samples) and CSS (6 samples) monitoring subsystems.

The QA/QC elements designed to minimize errors during data collection include the following:

- Use properly trained and experienced field personnel.
- Follow plans and procedures.
- Perform annual function checks or calibrations of instrumentation.
- Perform field function checks of instrumentation (if applicable).
- Perform initial data review.

The following Field Operating Procedures (FOPs) for the CAMU VZMS define operational and data collection procedures that ensure adherence to a standardized method of data collection:

- FOP 08-20 for use of the CPN neutron moisture probe (SNL/NM April 2016, SNL/NM April 2019).
- FOP 08-21 for data collection using TDR and temperature probes (SNL/NM August 2018).
- FOP 08-22 for soil vapor sampling procedures (SNL/NM October 2016).

The following sections provide a brief review of the field data collection procedures specified in the FOPs.

5.1.1 Measurement of Soil Moisture Using the Neutron Probe

A standard count is collected with the CPN probe prior to collecting field data to verify that it is operating properly. When collecting field data, the CPN probe is queried at each monitoring location via a control panel. The neutron count data are displayed on the control panel and recorded on the associated field forms.

An empirical coefficient equation is used to correlate neutron counts to soil moisture content (see Section 4.1). The neutron moisture probe is returned to the manufacturer annually for calibration and is adjusted to account for the decay of the Americium-241 source. This allows for continual use of the original coefficient equation.

5.1.2 Measurement of Soil Moisture Using Time-Domain Reflectometry Probe

The TDR waveforms are displayed on a laptop computer when running the TDR100 software. Software settings are selected ensuring the complete TDR waveform is measured during data collection. Calculated soil moisture content values are read directly from the software display window and recorded on the associated field forms.

The TDR100 signal generator is returned to the manufacturer annually where a QC check is performed to ensure that it is operating within the design specifications.

5.1.3 Measurement of Temperature Using Thermocouple Temperature Probe

The thermocouple temperature data are collected using a Fluke® 52 II microprocessor-based, digital thermometer that converts the voltage drop across the thermocouple junctions to a temperature in degrees Celsius (°C). The temperatures are read from the Fluke® 52 II display and recorded on the associated field forms.

The Fluke® 52 II digital thermometer undergoes an annual calibration to ensure it is functioning within the manufacturer's specifications.

5.1.4 Collection and Analysis of Soil Vapor Samples

The analytical laboratory provides certified clean SUMMA™ canisters to SNL/NM for soil vapor sample collection. To assure the integrity of soil vapor samples, the following steps are taken during sampling activities:

- SNL/NM personnel check the vacuum of each SUMMA™ canister and record the value prior to collecting a sample. The initial vacuum values are supplied to the laboratory with the samples.
- A PID is used to determine stabilized VOC levels in the soil vapor being purged prior to collection of the sample. These data are recorded on a field form. The PID undergoes an annual calibration to ensure it is functioning within the manufacturer's specifications.

- A vacuum gauge (part of the sampling manifold assembly) monitors the volume of soil vapor collected in the SUMMA™ canisters during the sampling process. With a vacuum of approximately 10 inches of mercury remaining in the SUMMA™ canister, sampling is completed by closing the valve on the canister. The ending vacuum values are recorded and supplied to the laboratory with the samples.
- Samples are assigned unique identification numbers. Sample labels with pertinent information (i.e., sample date, time, identification, and location; analysis required; and sampling crew) are attached to each SUMMA™ canister when the samples are collected. Completed analysis request/chain-of-custody forms accompany the samples from the collection point to the analytical laboratory.

Duplicate environmental sample pairs are collected to check the precision of the sampling process.

A trip blank is collected at the CAMU Field Office and a field blank is collected during the sampling event. They consist of SUMMA™ canisters filled with ultra-pure grade nitrogen, which are kept in the presence of the other SUMMA™ canisters during sampling, storage, and shipment to the analytical laboratory. The trip blank and field blank are used to confirm whether contamination of the samples may have resulted from ambient field conditions, and/or during shipment and analysis at the laboratory.

5.2 Data Management and Archiving

Field and analytical laboratory data are evaluated and retained in the Operating Record for the CAMU in accordance with Permit Part 2, Section 2.14.

All instrument field data (i.e., neutron counts and TDR soil moisture and temperature data) are entered into electronic spreadsheets for preliminary review. The electronic files and field form entries are transferred into a VZMS software program that creates a standardized data set. The program also incorporates the neutron count/soil moisture content correlation equations for the PSL and CSS monitoring subsystems and calculates in situ soil moisture values. The output files are downloaded into a database and retained in the CAMU Operating Record in accordance with Permit Part 2, Section 2.14.

SNL/NM personnel review the analytical results (including QA/QC documentation) from the analytical laboratory to determine conformance to established QA/QC criteria. Any discrepancies are resolved with the laboratory prior to finalizing the electronic results stored in the database. Corrective actions that may be required of the analytical laboratory include providing additional data, qualifying conditionally acceptable data, or reanalyzing samples. If these measures do not resolve data quality issues, resampling and reanalysis will be performed. Any corrections to the data are documented and included with the data archived in the CAMU Operating Record.

This page intentionally left blank.

6.0 VADOSE ZONE MONITORING SYSTEM DATA ANALYSIS

This chapter presents soil temperature, soil moisture, and soil vapor VOC results along with a discussion of the distribution and trends in the VZMS data collected during CY 2019.

6.1 Seasonal Temperature Variations in Soil Underlying the Containment Cell

Four monitoring events were conducted during CY 2019 fulfilling the quarterly monitoring requirements in Permit Attachment H. The VSA subsystem collected soil temperature data in February, May, August, and November of 2019. The results are summarized in Table 6-1 (5-foot monitoring depth) and Table 6-2 (15-foot monitoring depth). The soil temperature data exhibit minor seasonal variations. The thermal properties of the soil and the depth at which the soil temperature sensors are located causes a seasonal temperature change lag time of approximately six months. This lag time results in slightly warmer subsurface soil temperatures in the winter than in the summer months. During this reporting period, the maximum soil temperature variation at the 5-foot monitoring points was 2.2°C (Table 6-1) and 1.5°C (Table 6-2) at the 15-foot monitoring points. These temperature variations are not large enough to significantly affect the TDR soil moisture values (see Section 4.3).

6.2 Distribution of Soil Vapor Volatile Organic Compounds Underlying, and Adjacent to, the Containment Cell

The VSA and CSS monitoring subsystems were sampled on May 9, 2019 fulfilling the annual soil vapor monitoring requirements in Permit Attachment H. Soil vapor samples were submitted to Eurofins Test America for chemical analyses by EPA Method TO-15 (EPA January 1999b). EPA Method TO-15 provides equal or lower detection limits with improved QA/QC compared to EPA Method TO-14A (EPA January 1999a), which historically has been used to analyze soil vapor samples collected at the CAMU.

6.2.1 Soil Vapor Volatile Organic Compounds Detected in the Vertical Sensor Array Monitoring Subsystem

The VSA locations were sampled for VOCs in May 2019. The 27 VOCs listed below were detected above laboratory method detection limits (MDLs), compared to 38 VOCs detected above the laboratory MDLs in the May 2018 samples (SNL/NM March 2019a). Table 6-3 summarizes the results, including the MDLs and reporting limits (RLs).

Acetone	Chloromethane	Styrene
Benzene	Dichlorodifluoromethane	Tetrachloroethene
Benzyl chloride	1,1-Dichloroethane	Toluene
Bromodichloromethane	Trans-1,2-Dichloroethene	1,2,4-Trichlorobenzene
2-Butanone	Ethylbenzene	1,1,1-Trichloroethane
Carbon Disulfide	4-Ethyltoluene	1,1,2-Trichloro-1,2,2-Trifluoroethane
Carbon Tetrachloride	2-Hexanone	Trichloroethene
Chlorobenzene	Methylene Chloride	Trichlorofluoromethane
Chloroform	4-Methyl-2-Pentanone	m,p-Xylene

Table 6-1
 VSA Temperature Monitoring Results from 5-Foot Monitoring Depth
 Calendar Year 2019

Collection Dates	Instrument Location										
	VSA-1	VSA-2	VSA-3	VSA-4	VSA-5	VSA-6	VSA-7	VSA-8	VSA-9	VSA-10	VSA-11
	(Temperature in Degrees Celsius)										
February-26	18.8	18.6	18.5	18.3	18.2	20.1	20.0	19.6	18.5	18.4	17.8
May-8	16.6	17.1	17.4	17.5	17.5	18.2	18.4	18.3	18.3	17.8	17.2
August-12	16.6	16.6	16.9	16.8	16.9	17.9	17.8	17.6	17.7	17.7	16.7
November-5	17.3	17.3	17.5	17.5	17.1	17.9	17.9	17.8	17.6	17.8	17.2
Minimum	16.6	16.6	16.9	16.8	16.9	17.9	17.8	17.6	17.6	17.7	16.7
Maximum	18.8	18.6	18.5	18.3	18.2	20.1	20.0	19.6	18.5	18.4	17.8
Difference	2.2	2.0	1.6	1.5	1.3	2.2	2.2	2.0	0.9	0.7	1.1

Notes:
 VSA = Vertical sensor array.

Table 6-2
 VSA Temperature Monitoring Results from 15-Foot Monitoring Depth
 Calendar Year 2019

Collection Dates	Instrument Location										
	VSA-1	VSA-2	VSA-3	VSA-4	VSA-5	VSA-6	VSA-7	VSA-8	VSA-9	VSA-10	VSA-11
	(Temperature in Degrees Celsius)										
February-26	18.2	18.2	18.0	17.9	17.8	19.2	18.9	18.7	18.3	18.0	17.6
May-8	17.1	17.5	17.6	17.5	17.3	18.4	18.3	18.3	18.4	18.0	17.6
August-12	16.7	17.0	17.3	17.2	17.3	18.2	17.9	18.0	18.1	18.0	17.0
November-5	17.3	17.2	17.3	17.4	17.3	17.8	17.7	17.7	17.6	17.4	17.1
Minimum	16.7	17.0	17.3	17.2	17.3	17.8	17.7	17.7	17.6	17.4	17.0
Maximum	18.2	18.2	18.0	17.9	17.8	19.2	18.9	18.7	18.4	18.0	17.6
Difference	1.5	1.2	0.7	0.7	0.5	1.4	1.2	1.0	0.8	0.6	0.6

Notes:
 VSA = Vertical sensor array.

Of 27 VOCs, the following have been consistently detected at or above the RL since monitoring began, were detected at all 22 monitoring locations during this reporting period, and are primary constituents of the CWL residual soil vapor plume.

- Dichlorodifluoromethane
- Tetrachloroethene
- 1,1,2-Trichloro-1,2,2-Trifluoroethane
- 1,1,1-Trichloroethane
- Trichloroethene
- Trichlorofluoromethane

Charts showing the concentrations of these frequently detected VOCs and soil temperatures over time for each VSA monitoring location are provided in Annex A. These charts show that for all locations trichloroethene is the most prevalent VOC and that all VOCs occur at very low concentrations (i.e., low parts per billion by volume [ppbv]).

The following VOCs were detected at most or all the 22 monitoring locations during this reporting period but have not been consistently detected since monitoring began.

- Acetone (21 locations)
- 2-Butanone (20 locations)
- Carbon Disulfide (17 locations)
- Carbon Tetrachloride (21 locations)
- Chloroform (22 locations)
- Toluene (14 locations)

The results for these VOCs ranged from the MDL to low concentrations above the RL, and many of the carbon disulfide and toluene results were qualified as not detected during the data validation process (see Section 6.2.3). In addition, toluene and acetone are constituents of concern at the CWL, are common laboratory contaminants, and both occur at very low concentrations near the CAMU (i.e., low ppbv).

Total VOCs, or the sum of all validated detected VOCs, were reported for all sample locations at concentrations ranging from 0.04418 parts per million by volume (ppmv) (VSA-11) to 0.11182 ppmv (VSA-8) at the 5-foot monitoring depth (Table 6-3), and from 0.03727 ppmv (VSA-11) to 0.10087 ppmv (VSA-8) at the 15-foot monitoring depth (Table 6-3). All concentrations are well below the 20 ppmv trigger level.

Table 6-3
Summary of Detected Volatile Organic Compounds
VSA Soil Vapor Monitoring Analytical Method TO-15^a
Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
VSA-1 (5-foot)	Acetone	3.7	0.18	5.0	J	--
	Benzene	0.098	0.079	0.40	J	--
	2-Butanone	0.47	0.20	0.80	J	--
	Carbon disulfide	2.4	0.078	0.80	--	--
	Carbon tetrachloride	0.11	0.064	0.80	J	--
	Chlorobenzene	0.11	0.064	0.30	J	--
	Chloroform	0.36	0.095	0.30	--	--
	Chloromethane	0.25	0.20	0.80	J	--
	Dichlorodifluoromethane	1.1	0.15	0.40	--	--
	1,1-Dichloroethane	0.19	0.072	0.30	J	--
	Tetrachloroethene	8.2	0.051	0.40	--	--
	1,1,1-Trichloroethane	1.7	0.065	0.30	--	--
	Trichloroethene	32	0.11	0.40	--	--
	Trichlorofluoromethane	3.4	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	2.0	0.16	0.40	--	--
Total Organics ^c	56.088	NA	NA	NA	NA	
VSA-1 (15-foot)	Acetone	2.3	0.18	5.0	J	--
	Benzene	0.11	0.079	0.40	J	--
	2-Butanone	0.40	0.20	0.80	J	--
	Carbon disulfide	0.85	0.078	0.80	--	J+, B2
	Carbon tetrachloride	0.19	0.064	0.80	J	--
	Chloroform	0.48	0.095	0.30	--	--
	Chloromethane	0.38	0.20	0.80	J	--
	Dichlorodifluoromethane	1.6	0.15	0.40	--	--
	1,1-Dichloroethane	0.28	0.072	0.30	J	--
	trans-1,2-Dichloroethene	0.12	0.10	0.40	J	--
	Tetrachloroethene	9.5	0.051	0.40	--	--
	Toluene	0.14	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	2.2	0.065	0.30	--	--
	Trichloroethene	37	0.11	0.40	--	--
	Trichlorofluoromethane	5.5	0.20	0.40	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	4.0	0.16	0.40	--	--	
Total Organics ^c	64.91	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-3 (Continued)
 Summary of Detected Volatile Organic Compounds
 VSA Soil Vapor Monitoring
 Analytical Method TO-15^a
 Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
VSA-2 (5-foot)	Acetone	2.1	0.18	5.0	J	--
	Benzene	0.14	0.079	0.40	J	--
	Carbon disulfide	0.33	0.078	0.80	J	0.80U, B2
	Carbon tetrachloride	0.17	0.064	0.80	J	--
	Chloroform	0.50	0.095	0.30	--	--
	Dichlorodifluoromethane	1.5	0.15	0.40	--	--
	1,1-Dichloroethane	0.62	0.072	0.30	--	--
	trans-1,2-Dichloroethene	0.33	0.10	0.40	J	--
	Methylene chloride	0.10	0.072	0.40	J	--
	Tetrachloroethene	16	0.051	0.40	--	--
	1,1,1-Trichloroethene	2.4	0.065	0.30	--	--
	Trichloroethene	72	0.11	0.40	--	--
	Trichlorofluoromethane	5.1	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	2.6	0.16	0.40	--	--
Total Organics ^c	103.56	NA	NA	NA	NA	
VSA-2 (15-foot)	Acetone	1.3	0.18	5.0	J	--
	Benzene	0.15	0.079	0.40	J	--
	Benzyl chloride	0.24	0.16	0.80	J, B	0.80UJ, B, I5
	Bromodichloromethane	0.081	0.066	0.30	J	--
	2-Butanone	0.21	0.20	0.80	J	--
	Carbon tetrachloride	0.20	0.064	0.80	J	--
	Chloroform	0.53	0.095	0.30	--	--
	Dichlorodifluoromethane	1.5	0.15	0.40	--	--
	1,1-Dichloroethane	0.57	0.072	0.30	--	--
	trans-1,2-Dichloroethene	0.33	0.10	0.40	J	--
	4-Ethyltoluene	0.22	0.19	0.40	J	--
	Tetrachloroethene	11	0.051	0.40	--	--
	Toluene	0.055	0.051	0.40	J	0.40U, B1
	1,2,4-Trichlorobenzene	0.74	0.43	2.0	J	--
	1,1,1-Trichloroethane	2.0	0.065	0.30	--	--
	Trichloroethene	54	0.11	0.40	--	--
	Trichlorofluoromethane	4.6	0.20	0.40	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	2.9	0.16	0.40	--	--	
Total Organics ^c	80.331	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-3 (Continued)
 Summary of Detected Volatile Organic Compounds
 VSA Soil Vapor Monitoring
 Analytical Method TO-15^a
 Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
VSA-3 (5-foot)	Acetone	2.1	0.18	5.0	J	--
	Benzene	0.15	0.079	0.40	J	--
	2-Butanone	0.61	0.20	0.80	J	--
	Carbon tetrachloride	0.14	0.064	0.80	J	--
	Chloroform	0.54	0.095	0.30	--	--
	Dichlorodifluoromethane	1.4	0.15	0.40	--	--
	1,1-Dichloroethane	0.65	0.072	0.30	--	--
	trans-1,2-Dichloroethene	0.30	0.10	0.40	J	--
	Methylene chloride	0.35	0.072	0.40	J	--
	4-Methyl-2-pentanone	0.19	0.14	0.40	J	--
	Tetrachloroethene	14	0.051	0.40	--	--
	Toluene	0.25	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	2.4	0.065	0.30	--	--
	Trichloroethene	63	0.11	0.40	--	--
	Trichlorofluoromethane	5.1	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	2.1	0.16	0.40	--	--
m,p-Xylene	0.13	0.10	0.80	J	--	
Total Organics ^c	93.16	NA	NA	NA	NA	
VSA-3 (15-foot)	Acetone	3.1	0.18	5.0	J	--
	Benzene	0.14	0.079	0.40	J	--
	2-Butanone	0.47	0.20	0.80	J	--
	Carbon disulfide	1.2	0.078	0.80	--	--
	Carbon tetrachloride	0.16	0.064	0.80	J	--
	Chloroform	0.64	0.095	0.30	--	--
	Chloromethane	0.20	0.20	0.80	J	--
	Dichlorodifluoromethane	1.5	0.15	0.40	--	--
	1,1-Dichloroethane	0.68	0.72	0.30	--	--
	trans-1,2-Dichloroethene	0.28	0.10	0.40	J	--
	Methylene chloride	0.28	0.072	0.40	J	--
	Tetrachloroethene	14	0.051	0.40	--	--
	Toluene	0.13	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	2.4	0.065	0.30	--	--
	Trichloroethene	62	0.11	0.40	--	--
	Trichlorofluoromethane	5.6	0.20	0.40	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	2.7	0.16	0.40	--	--	
Total Organics ^c	95.48	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-3 (Continued)
 Summary of Detected Volatile Organic Compounds
 VSA Soil Vapor Monitoring
 Analytical Method TO-15^a
 Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
VSA-4 (5-foot)	Acetone	6.1	0.18	5.0	--	--
	Benzene	0.099	0.079	0.40	J	--
	2-Butanone	0.37	0.20	0.80	J	--
	Carbon tetrachloride	0.12	0.064	0.80	J	--
	Chloroform	0.66	0.095	0.30	--	--
	Dichlorodifluoromethane	1.6	0.15	0.40	--	--
	1,1-Dichloroethane	0.66	0.072	0.30	--	--
	trans-1,2-Dichloroethene	0.18	0.10	0.40	J	--
	Methylene chloride	0.20	0.072	0.40	J	--
	Tetrachloroethene	6.5	0.051	0.40	--	--
	1,1,1-Trichloroethane	2.6	0.065	0.30	--	--
	Trichloroethene	45	0.11	0.40	--	--
	Trichlorofluoromethane	6.0	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	2.2	0.16	0.40	--	--
Total Organics ^c	72.289	NA	NA	NA	NA	
VSA-4 (15-foot)	Acetone	4.1	0.18	5.0	J	--
	Benzene	0.12	0.079	0.40	J	--
	2-Butanone	1.0	0.20	0.80	--	--
	Carbon disulfide	1.1	0.078	0.80	--	--
	Carbon tetrachloride	0.12	0.064	0.80	J	--
	Chloroform	0.54	0.095	0.30	--	--
	Dichlorodifluoromethane	1.2	0.15	0.40	--	--
	1,1-Dichloroethane	0.63	0.072	0.30	--	--
	Methylene chloride	0.34	0.072	0.40	J	--
	Tetrachloroethene	11	0.051	0.40	--	--
	Toluene	0.40	0.051	0.40	--	0.40U, B1
	1,1,1-Trichloroethane	2.1	0.065	0.30	--	--
	Trichloroethene	52	0.11	0.40	--	--
	Trichlorofluoromethane	4.5	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	1.4	0.16	0.40	--	--
m,p-Xylene	0.13	0.10	0.80	J	--	
Total Organics ^c	80.28	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-3 (Continued)
 Summary of Detected Volatile Organic Compounds
 VSA Soil Vapor Monitoring
 Analytical Method TO-15^a
 Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
VSA-5 (5-foot)	Acetone	1.7	0.18	5.0	J	--
	2-Butanone	0.23	0.20	0.80	J	--
	Carbon disulfide	0.095	0.078	0.80	J	0.80U, B2
	Carbon tetrachloride	0.11	0.064	0.80	J	--
	Chloroform	0.50	0.095	0.30	--	--
	Dichlorodifluoromethane	1.2	0.15	0.40	--	--
	1,1-Dichloroethane	0.41	0.072	0.30	--	--
	trans-1,2-Dichloroethene	0.12	0.10	0.40	J	--
	Methylene chloride	0.072	0.072	0.40	J	--
	Tetrachloroethene	8.9	0.051	0.40	--	--
	1,1,1-Trichloroethane	2.4	0.065	0.30	--	--
	Trichloroethene	40	0.11	0.40	--	--
	Trichlorofluoromethane	5.4	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	1.4	0.16	0.40	--	--
Total Organics ^c	62.442	NA	NA	NA	NA	
VSA-5 (15-foot)	Acetone	2.0	0.18	5.0	J	--
	2-Butanone	0.42	0.20	0.80	J	--
	Carbon tetrachloride	0.13	0.064	0.80	J	--
	Chloroform	0.59	0.095	0.30	--	--
	Dichlorodifluoromethane	1.5	0.15	0.40	--	--
	1,1-Dichloroethane	0.40	0.072	0.30	--	--
	trans-1,2-Dichloroethene	0.15	0.10	0.40	J	--
	Styrene	0.083	0.059	0.40	J	--
	Tetrachloroethene	9.7	0.051	0.40	--	--
	Toluene	0.054	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	2.6	0.065	0.30	--	--
	Trichloroethene	42	0.11	0.40	--	--
	Trichlorofluoromethane	6.6	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	2.0	0.16	0.40	--	--
Total Organics ^c	68.173	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-3 (Continued)
 Summary of Detected Volatile Organic Compounds
 VSA Soil Vapor Monitoring
 Analytical Method TO-15^a
 Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
VSA-6 (5-foot)	Acetone	4.8	0.18	5.0	J	--
	Benzene	0.14	0.079	0.40	J	--
	2-Butanone	0.66	0.20	0.80	J	--
	Carbon disulfide	2.3	0.078	0.80	--	--
	Carbon tetrachloride	0.19	0.064	0.80	J	--
	Chloroform	0.15	0.095	0.30	J	--
	Chloromethane	0.32	0.20	0.80	J	--
	Dichlorodifluoromethane	1.6	0.15	0.40	--	--
	1,1-Dichloroethane	0.21	0.072	0.30	J	--
	2-Hexanone	0.12	0.087	0.40	J	--
	Tetrachloroethene	19	0.051	0.40	--	--
	Toluene	0.086	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	2.4	0.065	0.30	--	--
	Trichloroethene	50	0.11	0.40	--	--
	Trichlorofluoromethane	6.2	0.20	0.40	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	4.8	0.16	0.40	--	--	
Total Organics ^c	92.89	NA	NA	NA	NA	
VSA-6 (15-foot)	Acetone	2.6	0.18	5.0	J	--
	Benzene	0.10	0.079	0.40	J	--
	2-Butanone	0.38	0.20	0.80	J	--
	Carbon disulfide	0.13	0.078	0.80	J	0.80U, B2
	Chloroform	0.19	0.095	0.30	J	--
	Dichlorodifluoromethane	1.8	0.15	0.40	--	--
	1,1-Dichloroethane	0.25	0.072	0.30	J	--
	trans-1,2-Dichloroethene	0.16	0.10	0.40	J	--
	Tetrachloroethene	17	0.051	0.40	--	--
	1,1,1-Trichloroethane	2.3	0.065	0.30	--	--
	Trichloroethene	49	0.11	0.40	--	--
	Trichlorofluoromethane	7.1	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	6.5	0.16	0.40	--	--
Total Organics ^c	87.38	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-3 (Continued)
 Summary of Detected Volatile Organic Compounds
 VSA Soil Vapor Monitoring
 Analytical Method TO-15^a
 Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
VSA-7 (5-foot)	Benzene	0.12	0.079	0.40	J	--
	Benzyl chloride	0.22	0.16	0.80	J, B	0.80UJ, B, I5
	2-Butanone	0.34	0.20	0.80	J	--
	Carbon disulfide	0.17	0.078	0.80	J	0.80U, B2
	Carbon tetrachloride	0.15	0.064	0.80	J	--
	Chloroform	0.19	0.095	0.30	J	--
	Dichlorodifluoromethane	1.5	0.15	0.40	--	--
	1,1-Dichloroethane	0.39	0.072	0.30	--	--
	trans-1,2-Dichloroethene	0.24	0.10	0.40	J	--
	Tetrachloroethene	17	0.051	0.40	--	--
	Toluene	0.079	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	1.7	0.065	0.30	--	--
	Trichloroethene	60	0.11	0.40	--	--
	Trichlorofluoromethane	4.8	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	4.2	0.16	0.40	--	--
Total Organics ^c	90.63	NA	NA	NA	NA	
VSA-7 (15-foot)	Acetone	7.8	0.18	5.0	--	--
	Benzene	0.16	0.079	0.40	J	--
	2-Butanone	0.79	0.20	0.80	J	--
	Carbon disulfide	0.21	0.078	0.80	J	0.80U, B2
	Carbon tetrachloride	0.19	0.064	0.80	J	--
	Chloroform	0.21	0.095	0.30	J	--
	Dichlorodifluoromethane	1.5	0.15	0.40	--	--
	1,1-Dichloroethane	0.37	0.072	0.30	--	--
	trans-1,2-Dichloroethene	0.25	0.10	0.40	J	--
	2-Hexanone	0.11	0.087	0.40	J	--
	4-Methyl-2-pentanone	0.26	0.14	0.40	J	--
	Tetrachloroethene	16	0.051	0.40	--	--
	Toluene	0.080	0.051	0.40	J	0.40U, B1
	1,2,4-Trichlorobenzene	0.73	0.43	2.0	J, B	2.0U, B
	1,1,1-Trichloroethane	1.8	0.065	0.30	--	--
	Trichloroethene	59	0.11	0.40	--	--
	Trichlorofluoromethane	5.3	0.20	0.40	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	5.2	0.16	0.40	--	--	
Total Organics ^c	98.94	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-3 (Continued)
 Summary of Detected Volatile Organic Compounds
 VSA Soil Vapor Monitoring
 Analytical Method TO-15^a
 Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
VSA-8 (5-foot)	Acetone	2.9	0.18	5.0	J	--
	Benzene	0.16	0.079	0.40	J	--
	2-Butanone	0.55	0.20	0.80	J	--
	Carbon disulfide	3.0	0.078	0.80	--	--
	Carbon tetrachloride	0.15	0.064	0.80	J	--
	Chlorobenzene	0.072	0.064	0.30	J	--
	Chloroform	0.27	0.095	0.30	J	--
	Dichlorodifluoromethane	1.4	0.15	0.40	--	--
	1,1-Dichloroethane	0.45	0.072	0.30	--	--
	trans-1,2-Dichloroethene	0.27	0.10	0.40	J	--
	Tetrachloroethene	20	0.051	0.40	--	--
	Toluene	0.092	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	2.2	0.065	0.30	--	--
	Trichloroethene	71	0.11	0.40	--	--
	Trichlorofluoromethane	5.3	0.20	0.40	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	4.1	0.16	0.40	--	--	
Total Organics ^c	111.822	NA	NA	NA	NA	
VSA-8 (15-foot)	Acetone	3.0	0.18	5.0	J	--
	Benzene	0.13	0.079	0.40	J	--
	2-Butanone	1.1	0.20	0.80	--	--
	Carbon disulfide	1.5	0.078	0.80	--	--
	Carbon tetrachloride	0.17	0.064	0.80	J	--
	Chloroform	0.31	0.095	0.30	--	--
	Chloromethane	0.23	0.20	0.80	J	--
	Dichlorodifluoromethane	1.6	0.15	0.40	--	--
	1,1-Dichloroethane	0.38	0.072	0.30	--	--
	trans-1,2-Dichloroethene	0.22	0.10	0.40	J	--
	2-Hexanone	0.13	0.087	0.40	J	--
	Methylene chloride	0.21	0.072	0.40	J	--
	4-Methyl-2-pentanone	0.19	0.14	0.40	J	--
	Tetrachloroethene	17	0.051	0.40	--	--
	Toluene	0.26	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	2.2	0.065	0.30	--	--
	Trichloroethene	62	0.11	0.40	--	--
	Trichlorofluoromethane	5.7	0.20	0.40	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	4.8	0.16	0.40	--	--	
m,p-Xylene	0.10	0.10	0.80	J, B	0.80U, B	
Total Organics ^c	100.87	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-3 (Continued)
 Summary of Detected Volatile Organic Compounds
 VSA Soil Vapor Monitoring
 Analytical Method TO-15^a
 Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
VSA-9 (5-foot)	Acetone	2.9	0.18	5.0	J	--
	Benzene	0.082	0.079	0.40	J	--
	2-Butanone	0.26	0.20	0.80	J	--
	Carbon disulfide	1.9	0.078	0.80	--	--
	Carbon tetrachloride	0.16	0.064	0.80	J	--
	Chloroform	0.37	0.095	0.30	--	--
	Dichlorodifluoromethane	1.5	0.15	0.40	--	--
	1,1-Dichloroethane	0.14	0.072	0.30	J	--
	Methylene chloride	0.092	0.072	0.40	J	--
	Tetrachloroethene	11	0.051	0.40	--	--
	1,1,1-Trichloroethane	2.8	0.065	0.30	--	--
	Trichloroethene	34	0.11	0.40	--	--
	Trichlorofluoromethane	6.0	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	3.5	0.16	0.40	--	--
Total Organics ^c	64.704	NA	NA	NA	NA	
VSA-9 (5-foot) duplicate	Acetone	4.1	0.18	5.0	J	--
	Benzene	0.088	0.079	0.40	J	--
	2-Butanone	1.1	0.20	0.80	--	--
	Carbon disulfide	1.1	0.078	0.80	--	--
	Carbon tetrachloride	0.17	0.064	0.80	J	--
	Chloroform	0.38	0.095	0.30	--	--
	Chloromethane	0.21	0.20	0.80	J	--
	Dichlorodifluoromethane	1.7	0.15	0.40	--	--
	1,1-Dichloroethane	0.14	0.072	0.30	J	--
	Methylene chloride	0.15	0.072	0.40	J, B	0.40U, B
	Tetrachloroethene	12	0.051	0.40	--	--
	Toluene	0.051	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	3.1	0.065	0.30	--	--
	Trichloroethene	37	0.11	0.40	--	--
Trichlorofluoromethane	6.5	0.20	0.40	--	--	
1,1,2-Trichloro-1,2,2-trifluoroethane	3.8	0.16	0.40	--	--	
Total Organics ^c	71.388	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-3 (Continued)
 Summary of Detected Volatile Organic Compounds
 VSA Soil Vapor Monitoring
 Analytical Method TO-15^a
 Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
VSA-9 (15-foot)	Acetone	1.0	0.18	5.0	J	--
	Benzene	0.087	0.079	0.40	J	--
	Carbon disulfide	0.20	0.078	0.80	J	0.80U, B2
	Carbon tetrachloride	0.16	0.064	0.80	J	--
	Chloroform	0.45	0.095	0.30	--	--
	Dichlorodifluoromethane	1.7	0.15	0.40	--	--
	1,1-Dichloroethane	0.16	0.072	0.30	J	--
	Tetrachloroethene	12	0.051	0.40	--	--
	1,1,1-Trichloroethane	3.0	0.065	0.30	--	--
	Trichloroethene	39	0.11	0.40	--	--
	Trichlorofluoromethane	6.7	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	4.4	0.16	0.40	--	--
Total Organics ^c	68.657	NA	NA	NA	NA	
VSA-9 (15-foot) duplicate	Acetone	3.7	0.18	5.0	J	--
	Benzene	0.12	0.079	0.40	J	--
	2-Butanone	0.47	0.20	0.80	J	--
	Carbon disulfide	0.51	0.078	0.80	J	0.80U, B2
	Carbon tetrachloride	0.18	0.064	0.80	J	--
	Chloroform	0.45	0.095	0.30	--	--
	Dichlorodifluoromethane	1.7	0.15	0.40	--	--
	1,1-Dichloroethane	0.17	0.072	0.30	J	--
	2-Hexanone	0.10	0.087	0.40	J	--
	Tetrachloroethene	12	0.051	0.40	--	--
	1,1,1-Trichloroethane	3.1	0.065	0.30	--	--
	Trichloroethene	40	0.11	0.40	--	--
	Trichlorofluoromethane	6.7	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	4.4	0.16	0.40	--	--
Total Organics ^c	73.09	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-3 (Continued)
 Summary of Detected Volatile Organic Compounds
 VSA Soil Vapor Monitoring
 Analytical Method TO-15^a
 Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
VSA-10 (5-foot)	Acetone	2.1	0.18	5.0	J	--
	2-Butanone	0.20	0.20	0.80	J	--
	Carbon tetrachloride	0.16	0.064	0.80	J	--
	Chlorobenzene	0.072	0.064	0.30	J	--
	Chloroform	0.42	0.095	0.30	--	--
	Dichlorodifluoromethane	1.6	0.15	0.40	--	--
	Tetrachloroethene	13	0.051	0.40	--	--
	Toluene	0.058	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	3.8	0.065	0.30	--	--
	Trichloroethene	32	0.11	0.40	--	--
	Trichlorofluoromethane	7.9	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	3.6	0.16	0.40	--	--
Total Organics ^c	64.852	NA	NA	NA	NA	
VSA-10 (15-foot)	Acetone	7.5	0.18	5.0	--	--
	2-Butanone	2.5	0.20	0.80	--	--
	Carbon disulfide	7.3	0.078	0.80	--	--
	Carbon tetrachloride	0.16	0.064	0.80	J	--
	Chloroform	0.46	0.095	0.30	--	--
	Dichlorodifluoromethane	1.4	0.15	0.40	--	--
	1,1-Dichloroethane	0.078	0.072	0.30	J	--
	Ethylbenzene	0.066	0.063	0.40	J	--
	Tetrachloroethene	11	0.051	0.40	--	--
	Toluene	0.18	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	3.2	0.065	0.30	--	--
	Trichloroethene	32	0.11	0.40	--	--
	Trichlorofluoromethane	6.8	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	3.4	0.16	0.40	--	--
m,p-Xylene	0.15	0.10	0.80	J	--	
Total Organics ^c	76.014	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-3 (Concluded)
Summary of Detected Volatile Organic Compounds
VSA Soil Vapor Monitoring
Analytical Method TO-15^a
Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
VSA-11 (5-foot)	Acetone	1.6	0.18	5.0	J	--
	Benzyl chloride	0.23	0.16	0.80	J, B	0.80UJ, B, I5
	Carbon disulfide	0.52	0.078	0.80	J	0.80U, B2
	Carbon tetrachloride	0.12	0.064	0.80	J	--
	Chloroform	0.24	0.095	0.30	J	--
	Dichlorodifluoromethane	1.2	0.15	0.40	--	--
	1,1-Dichloroethane	0.094	0.072	0.30	J	--
	Tetrachloroethene	7.3	0.051	0.40	--	--
	1,2,4-Trichlorobenzene	0.73	0.43	2.0	J	--
	1,1,1-Trichloroethane	1.9	0.065	0.30	--	--
	Trichloroethene	24	0.11	0.40	--	--
	Trichlorofluoromethane	5.2	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	1.8	0.16	0.40	--	--
Total Organics ^c	44.184	NA	NA	NA	NA	
VSA-11 (15-foot)	Acetone	2.5	0.18	5.0	J	--
	Benzyl chloride	0.23	0.16	0.80	J, B	0.80UJ, B, I5
	2-Butanone	0.57	0.20	0.80	J	--
	Carbon disulfide	0.26	0.078	0.80	J	0.80U, B2
	Carbon tetrachloride	0.10	0.064	0.80	J	--
	Chloroform	0.20	0.095	0.30	J	--
	Dichlorodifluoromethane	1.1	0.15	0.40	--	--
	Tetrachloroethene	6.0	0.051	0.40	--	--
	1,1,1-Trichloroethane	1.8	0.065	0.30	--	--
	Trichloroethene	19	0.11	0.40	--	--
	Trichlorofluoromethane	4.5	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	1.5	0.16	0.40	--	--
	Total Organics ^c	37.27	NA	NA	NA	NA

Notes:

^aEPA January 1999b.

^bLaboratory/Validation Qualifier – If cell is blank (--), then all quality control samples met acceptance criteria with respect to submitted samples.

Laboratory Qualifier

B = Compound was found in blank and sample.

J = Result is less than the RL but greater than or equal to the MDL.

Validation Qualifier

B = Method blank contamination at concentration >MDL.

B1 = Trip blank contamination at concentration >MDL.

B2 = Field blank/equipment blank contamination at concentration >MDL.

I5 = Intercept too large.

J+ = The associated value is an estimated quantity with a suspected positive bias.

U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

UJ = The analyte was analyzed for but was not detected. The associated numerical value is an estimate and may be inaccurate or imprecise.

^cTotal Organics - sum of validated detected organic compounds (i.e., results for analytes reported as detections by the laboratory but qualified during data validation as not detected are not included in the Total Organics value).

EPA = U.S. Environmental Protection Agency.

MDL = Method detection limit. The minimum concentration that can be measured and reported with 99 percent confidence that the analyte is greater than zero, analyte is matrix specific.

NA = Not applicable.

ppbv = Parts per billion by volume.

RL = Reporting limit. The minimum concentration that can be reported with a specified degree of confidence.

VSA = Vertical sensor array.

6.2.2 Soil Vapor Volatile Organic Compounds Detected in the Chemical Waste Landfill Sanitary Sewer Monitoring Subsystem

The CSS locations were sampled for VOCs in May 2019. The 20 VOCs listed below were detected above laboratory MDLs, compared to 22 VOCs detected above laboratory MDLs in the May 2018 samples (SNL/NM March 2019a). Table 6-4 summarizes the results, including the MDLs and RLs.

Acetone	Methylene Chloride
Benzene	4-Methyl-2-Pentanone
Bromodichloromethane	Tetrachloroethene
2-Butanone	Toluene
Carbon Disulfide	1,2,4-Trichlorobenzene
Carbon Tetrachloride	1,1,1-Trichloroethane
Chlorobenzene	1,1,2-Trichloro-1,2,2-Trifluoroethane
Chloroform	Trichloroethene
Chloromethane	Trichlorofluoromethane
Dichlorodifluoromethane	m,p-Xylene

Of 20 VOCs, the following have been consistently detected at or above the RL since monitoring began, except for tetrachloroethene which has been consistently detected since the July 2007 through June 2008 reporting period (SNL/NM September 2008). All are primary constituents of the CWL residual soil vapor plume.

- Dichlorodifluoromethane
- Tetrachloroethene
- 1,1,2-Trichloro-1,2,2-Trifluoroethane
- Trichloroethene
- Trichlorofluoromethane

Charts showing the concentrations of these frequently detected VOCs over time for each CSS monitoring location are provided in Annex B. These charts show that for all locations trichloroethene and 1,1,2-trichloro-1,2,2-trifluoroethane are the most prevalent VOCs and that all VOCs occur at very low concentrations (i.e., ppbv). The following VOCs were detected at most or all six monitoring locations during this reporting period but have not been consistently detected since monitoring began.

- Acetone (6 locations)
- 2-Butanone (4 locations)
- Carbon Disulfide (5 locations)
- Chloroform (4 locations)
- Methylene Chloride (5 locations)
- 1,1,1-trichloroethane (6 locations)

The results ranged from the MDL to low concentrations above the RL, and some methylene chloride and carbon disulfide results were qualified as not detected during the data validation process (see Section 6.2.3).

Table 6-4
Summary of Detected Volatile Organic Compounds
CSS Soil Vapor Monitoring Analytical Method TO-15^a
Sample Date - May 9, 2019

CSS Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
CSS-1	Acetone	1.2	0.18	5.0	J	--
	Carbon disulfide	2.2	0.078	0.80	--	--
	Dichlorodifluoromethane	0.48	0.15	0.40	--	--
	Tetrachloroethene	0.65	0.051	0.40	--	--
	1,1,1-Trichloroethane	0.28	0.065	0.30	J	--
	Trichloroethene	1.2	0.11	0.40	--	--
	Trichlorofluoromethane	1.0	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	1.1	0.16	0.40	--	--
	Total Organics ^c	8.11	NA	NA	NA	NA
CSS-2	Acetone	2.0	0.18	5.0	J	--
	Carbon disulfide	0.20	0.078	0.80	J	0.80U, B2
	Carbon tetrachloride	0.10	0.064	0.80	J	--
	Chloroform	0.11	0.095	0.30	J	--
	Chloromethane	0.28	0.20	0.80	J	--
	Dichlorodifluoromethane	0.78	0.15	0.40	--	--
	Methylene chloride	0.084	0.072	0.40	J, B	0.40U, B
	Tetrachloroethene	2.4	0.051	0.40	--	--
	1,1,1-Trichloroethane	1.1	0.065	0.30	--	--
	Trichloroethene	7.2	0.11	0.40	--	--
	Trichlorofluoromethane	2.5	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	1.7	0.16	0.40	--	--
Total Organics ^c	18.17	NA	NA	NA	NA	
CSS-3	Acetone	4.1	0.18	5.0	J	--
	2-Butanone	0.86	0.20	0.80	--	--
	Carbon disulfide	0.18	0.078	0.80	J	0.80U, B2
	Carbon tetrachloride	0.088	0.064	0.80	J	--
	Chlorobenzene	1.2	0.064	0.30	--	--
	Chloroform	0.15	0.095	0.30	J	--
	Chloromethane	0.42	0.20	0.80	J	--
	Dichlorodifluoromethane	0.53	0.15	0.40	--	--
	Methylene chloride	0.25	0.072	0.40	J, B	0.40U, B
	Tetrachloroethene	0.77	0.051	0.40	--	--
	1,2,4-Trichlorobenzene	0.75	0.43	2.0	J, B	2.0U, B
	1,1,1-Trichloroethane	0.28	0.065	0.30	J	--
	Trichloroethene	4.1	0.11	0.40	--	--
	Trichlorofluoromethane	0.98	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	0.95	0.16	0.40	--	--
Total Organics ^c	14.428	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-4 (Continued)
Summary of Detected Volatile Organic Compounds
CSS Soil Vapor Monitoring
Analytical Method TO-15^a
Sample Date - May 9, 2019

CSS Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
CSS-4	Acetone	2.5	0.18	5.0	J	--
	2-Butanone	0.85	0.20	0.80	--	--
	Carbon disulfide	1.8	0.078	0.80	--	--
	Carbon tetrachloride	0.21	0.064	0.80	J	--
	Chloroform	0.11	0.095	0.30	J	--
	Dichlorodifluoromethane	1.1	0.15	0.40	--	--
	Tetrachloroethene	3.6	0.051	0.40	--	--
	1,1,1-Trichloroethane	0.92	0.065	0.30	--	--
	Trichloroethene	12	0.11	0.40	--	--
	Trichlorofluoromethane	4.3	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	7.0	0.16	0.40	--	--
Total Organics ^c	34.39	NA	NA	NA	NA	
CSS-4 duplicate	Acetone	2.5	0.18	5.0	J	--
	2-Butanone	0.62	0.20	0.80	J	--
	Carbon disulfide	0.080	0.078	0.80	J	0.80U, B2
	Chloroform	0.12	0.095	0.30	J	--
	Chloromethane	0.21	0.20	0.80	J	--
	Dichlorodifluoromethane	1.2	0.15	0.40	--	--
	Methylene chloride	0.41	0.072	0.40	B	J+, B
	4-Methyl-2-pentanone	0.26	0.14	0.40	J	--
	Tetrachloroethene	3.8	0.051	0.40	--	--
	Toluene	0.26	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	0.93	0.065	0.30	--	--
	Trichloroethene	12	0.11	0.40	--	--
	Trichlorofluoromethane	4.5	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	7.3	0.16	0.40	--	--
	m,p-Xylene	0.12	0.10	0.80	J	--
Total Organics ^c	33.97	NA	NA	NA	NA	
CSS-5	Acetone	8.1	0.18	5.0	--	--
	Benzene	0.087	0.079	0.40	J	--
	2-Butanone	1.4	0.20	0.80	--	--
	Carbon tetrachloride	0.12	0.064	0.80	J	--
	Chloromethane	0.48	0.20	0.80	J	--
	Dichlorodifluoromethane	0.95	0.15	0.40	--	--
	Methylene chloride	0.18	0.072	0.40	J	--
	Tetrachloroethene	0.55	0.051	0.40	--	--
	Toluene	0.086	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	0.14	0.065	0.30	J	--
	Trichloroethene	9.1	0.11	0.40	--	--
	Trichlorofluoromethane	3.0	0.20	0.40	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	6.5	0.16	0.40	--	--	
Total Organics ^c	30.607	NA	NA	NA	NA	

Refer to footnotes at end of table.

Table 6-4 (Concluded)
Summary of Detected Volatile Organic Compounds
CSS Soil Vapor Monitoring
Analytical Method TO-15^a
Sample Date - May 9, 2019

VSA Location	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
CSS-6	Acetone	6.9	0.18	5.0	--	--
	Benzene	0.087	0.079	0.40	J	--
	Bromodichloromethane	0.11	0.066	0.30	J	--
	2-Butanone	0.76	0.20	0.80	J	--
	Carbon disulfide	1.8	0.078	0.80	--	--
	Carbon tetrachloride	0.34	0.064	0.80	J	--
	Chloroform	0.66	0.095	0.30	--	--
	Dichlorodifluoromethane	1.5	0.15	0.40	--	--
	Methylene chloride	0.16	0.072	0.40	J	--
	Tetrachloroethene	0.94	0.051	0.40	--	--
	Toluene	0.096	0.051	0.40	J	0.40U, B1
	1,1,1-Trichloroethane	0.13	0.065	0.30	J	--
	Trichloroethene	29	0.11	0.40	--	--
	Trichlorofluoromethane	6.8	0.20	0.40	--	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	17	0.16	0.40	--	--
Total Organics ^c	66.187	NA	NA	NA	NA	

Notes:

^aEPA January 1999b.

^bLaboratory/Validation Qualifier – If cell is blank (--), then all quality control samples met acceptance criteria with respect to submitted samples.

Laboratory Qualifier

B = Compound was found in blank and sample.

J = Result is less than the RL but greater than or equal to the MDL.

Validation Qualifier

B = Method blank contamination at concentration >MDL.

B1 = Trip blank contamination at concentration >MDL.

B2 = Field blank/equipment blank contamination at concentration >MDL.

B3 = Calibration blank contamination at concentration >MDL.

J+ = The associated value is an estimated quantity with a suspected positive bias.

U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

^cTotal Organics - sum of validated detected organic compounds (i.e., results for analytes reported as detections by the laboratory but qualified during data validation as not detected are not included in the Total Organics value).

CSS = Chemical Waste Landfill sanitary sewer.

EPA = U.S. Environmental Protection Agency.

MDL = Method detection limit. The minimum concentration that can be measured and reported with 99 percent confidence that the analyte is greater than zero, analyte is matrix specific.

NA = Not applicable.

ppbv = Parts per billion by volume.

RL = Reporting limit. The minimum concentration that can be reported with a specified degree of confidence.

Total VOCs ranged from 0.00811 ppmv (CSS-1) to 0.06619 ppmv (CSS-6); all concentrations are well below the 20 ppmv trigger level (Table 6-4).

6.2.3 Data Quality

Field QC samples were previously discussed in Section 5.1.4. Environmental-duplicate sample pairs were collected from monitoring locations VSA-9 (5- and 15-foot monitoring depths) and CSS-4, and the results are summarized in Tables 6-1 and 6-2 respectively. Overall, the analytical results for the VSA and CSS environmental- duplicate sample pairs are very similar and demonstrate good precision.

For the May 2019 monitoring event a trip blank was collected at the CAMU Field Office prior to collecting samples from the VSA and CSS monitoring locations; this sample was stored and shipped with the environmental samples. One field blank sample was collected at the VSA-1 location prior to collecting samples from the VSA and CSS monitoring locations.

Table 6-5 summarizes the field QC trip blank and field blank sample results. Toluene was detected in the trip blank greater than or equal to the MDL. As a result, the associated toluene values for fifteen environmental and two environmental duplicate samples, and the field blank sample with concentrations less than or equal to the RL were qualified as not detected at the RL during data validation. Carbon disulfide was detected at concentrations less than or equal to the RL in the field blank sample. As a result, the associated carbon disulfide values for ten environmental and two environmental duplicate samples with concentrations less than or equal to the RL were qualified as not detected at the RL.

Internal laboratory QC samples were analyzed concurrently with all environmental samples in accordance with laboratory procedures and the EPA method. Laboratory blank samples were used to determine potential contamination introduced by the laboratory processes and methodologies and laboratory spike samples were used to determine the accuracy and precision of the analytical method. Two of the methylene chloride sample results were qualified during data validation as not detected due to contamination in the associated laboratory method blank greater than the MDL, and one result was estimated with a suspected positive bias based on laboratory spiked sample results.

The data were reviewed and qualified in accordance with administrative operating procedure AOP 00-03, "Data Validation Procedure for Chemical and Radiochemical Data" (SNL/NM June 2017). All sample results met analytical method requirements and indicated the field collection procedures and laboratory analytical method are producing representative data.

6.2.4 Residual Volatile Organic Compound Soil Vapor Plume from the Chemical Waste Landfill

The CAMU containment cell overlies the CWL residual VOC soil vapor plume, as demonstrated by the consistent low-concentration detections of the same VOCs. The VOC concentrations observed beneath the containment cell are generally well below those measured in the CWL soil vapor monitoring network and are consistent with the CWL conceptual model (i.e., the CAMU overlies the outer, very low-concentration portion of the CWL plume).

Table 6-5
 Summary of Detected Volatile Organic Compounds
 Trip Blank and Field Blank Sample
 Analytical Method TO-15^a
 Sample Date - May 9, 2019

Sample	Analyte	Result (ppbv)	MDL (ppbv)	RL (ppbv)	Laboratory Qualifier ^b	Validation Qualifier ^b
Trip Blank	Toluene	0.051	0.051	0.40	J	--
Field Blank	Carbon disulfide	0.18	0.078	0.80	J	--
	Toluene	0.055	0.051	0.40	J	0.40U, B1

Notes:

^aEPA January 1999b.

^bLaboratory/Validation Qualifier – If cell is blank (--), then all quality control samples met acceptance criteria with respect to submitted samples.

Laboratory Qualifier

J = Result is less than the RL but greater than or equal to the MDL.

Validation Qualifier

B1 = Trip blank contamination at concentration >MDL.

U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

EPA = U.S. Environmental Protection Agency.

MDL = Method detection limit. The minimum concentration that can be measured and reported with 99 percent confidence that the analyte is greater than zero, analyte is matrix specific.

ppbv = Parts per billion by volume.

RL = Reporting limit. The minimum concentration that can be reported with a specified degree of confidence.

It is expected that detections of VOCs will continue to occur, and may even increase, but will remain at very low concentrations near the containment cell. This will continue until the CWL VOC soil vapor plume completely dissipates by either one or both of the following mechanisms:

- Diffusion in three dimensions, including to the atmosphere
- Degradation by soil bacteria

Directly beneath the CAMU containment cell, VOC concentrations are expected to be higher relative to the immediate surrounding area. The slightly higher levels are a result of reduced soil vapor movement underneath the containment cell. The containment cell bottom liner system (e.g., geosynthetic clay liner and HDPE liners) prevents the soil vapors from venting directly to the surface as the residual soil vapor plume slowly diffuses underneath the containment cell. Over time, the VOC soil vapors will diffuse laterally around the containment cell and dissipate by the mechanisms listed above.

Subsurface soil conditions (i.e., grain size, pore space, moisture content) around the containment cell, as well as the residual VOC soil vapor plume, are not homogeneous, which causes variations in the observed trends. VOC concentrations tend to be higher in the CSS locations closest to the CWL and decrease as the distance from the CWL increases. This is demonstrated in the Annex B, Figures B-1 through B-6, with the CSS-6 location being the closest to, and the CSS-1 location the farthest from, the CWL.

VOC concentrations appear to correlate with soil temperature variations. The VOC results generally demonstrate increases in concentration when the soil temperature is warmer and decreases in concentration when the soil temperature is cooler (Annex A, Figures A-1 through A-22).

Based upon the analysis of the existing data, the containment cell is not a source of VOCs in the vadose zone. The residual VOC soil vapor plume centered beneath the CWL is the source of VOCs identified in the CAMU containment cell area. Monitoring of the residual CWL soil vapor plume is being performed in accordance with the CWL PCCP (NMED October 2009, as revised and updated) and the results are provided to the NMED annually.

6.3 Soil Moisture Distribution and Trends

Four monitoring events were conducted during CY 2019 fulfilling the quarterly monitoring requirement (NMED January 2015, as revised and updated). Soil moisture data were collected from the VZMS in February/March, May/June, August, and November 2019. Sections 6.3.1 through 6.3.3 present the soil moisture distribution and trends for the PSL, VSA, and CSS monitoring subsystems respectively. Each of the sections includes data tables and corresponding figures. Each figure shows a graph with the following six plots for each subsystem:

- The four quarterly soil moisture results for each monitoring location.
- Baseline soil moisture – defined as data collected monthly for one year after the closure of the containment cell in October 2003. The data are averaged at each monitoring location.
- Trigger level – defined as the baseline soil moisture plus 4%. An unexplained increase of 4% in soil moisture will trigger a secondary assessment and confirmation/rejection phase. If the 4% moisture value increase is confirmed, the NMED will be notified and an appropriate course of action determined in accordance with the requirements of Permit Attachment H, Section H.5.2.1.

6.3.1 Lateral Distribution of Moisture Underlying the Containment Cell as Indicated by the Primary Subliner Monitoring Subsystem

Tables 6-6 through 6-10 present soil moisture values (% by mass) recorded during this reporting period for each PSL VCP monitoring location. The quarterly monitoring results were compared to the trigger level, which is 4% above the established baseline soil moisture. The quarterly monitoring results track very closely to the soil moisture baseline for the five PSL VCPs and do not exceed the trigger level at any location. The soil moisture for all monitoring locations averaged 7.6% for this reporting period, which is consistent with the baseline average of 7.8%.

The historical trend of lateral variability in soil moisture levels in the West-Central, Central, East-Central, and East VCPs continued during CY 2019. The levels were consistently lower in the northern portion of these VCPs, which is consistent with the baseline average. The zone of lower soil moisture values is attributed to a temporary construction ramp that shielded the area from water infiltration during a significant precipitation event that occurred in November 1998 (before the bottom liner system was installed) (SNL/NM April 1999).

Figures 6-1 through 6-5 present soil moisture (% by mass) graphically for each PSL VCP monitoring location. The data in the tables and graphs demonstrate stable soil moisture values during this reporting period.

Table 6-6
 PSL Soil Moisture Monitoring Results for the West Vitrified Clay Pipe
 Calendar Year 2019

Monitoring Location	Collection Dates				Reporting Period Minimum	Reporting Period Maximum	Reporting Period Average	Baseline Average (10/2003-9/2004)	Difference between Baseline Average & Reporting Period Average	Trigger Level (Baseline Average plus 4%)
	March-5	June-5	August-28	November-14						
	Moisture (% by mass)									
1	7.0	7.0	7.0	6.8	6.8	7.0	7.0	7.9	-0.9	11.9
2	7.5	7.5	7.7	7.4	7.4	7.7	7.5	8.1	-0.6	12.1
3	8.0	7.9	8.3	7.9	7.9	8.3	8.0	8.4	-0.4	12.4
4	8.2	8.1	8.1	8.0	8.0	8.2	8.1	8.2	-0.1	12.2
5	8.3	8.3	8.3	8.2	8.2	8.3	8.3	8.5	-0.2	12.5
6	8.2	8.2	8.1	8.2	8.1	8.2	8.2	8.3	-0.1	12.3
7	8.1	8.1	7.9	7.9	7.9	8.1	8.0	8.2	-0.2	12.2
8	7.9	7.8	7.8	8.0	7.8	8.0	7.9	8.0	-0.1	12.0
9	7.9	7.8	7.9	7.9	7.8	7.9	7.9	8.1	-0.2	12.1
10	7.9	8.0	7.9	8.0	7.9	8.0	8.0	8.1	-0.1	12.1
11	8.0	8.0	7.9	8.0	7.9	8.0	8.0	8.1	-0.1	12.1
12	7.9	7.9	7.8	8.0	7.8	8.0	7.9	8.0	-0.1	12.0
13	8.0	7.9	7.9	7.8	7.8	8.0	7.9	8.0	-0.1	12.0
14	8.1	8.1	7.9	8.1	7.9	8.1	8.1	8.1	0.0	12.1
15	7.8	7.9	7.6	7.8	7.6	7.9	7.8	7.8	0.0	11.8
16	8.2	8.2	8.0	8.1	8.0	8.2	8.1	8.1	0.0	12.1
17	7.8	7.9	7.6	7.9	7.6	7.9	7.8	7.9	-0.1	11.9
18	8.0	7.9	7.6	7.8	7.6	8.0	7.8	7.8	0.0	11.8
19	7.8	7.7	7.7	7.7	7.7	7.8	7.7	7.8	-0.1	11.8
20	7.8	8.0	7.7	7.9	7.7	8.0	7.9	7.7	0.2	11.7
21	7.8	7.8	7.7	7.7	7.7	7.8	7.8	7.8	0.0	11.8
22	7.9	8.1	7.7	7.5	7.5	8.1	7.8	7.7	0.1	11.7
23	7.7	7.9	7.7	7.7	7.7	7.9	7.8	7.8	0.0	11.8
24	7.8	7.7	7.5	7.6	7.5	7.8	7.7	7.7	0.0	11.7
25	7.7	7.7	7.8	7.7	7.7	7.8	7.7	7.8	-0.1	11.8
26	8.0	8.1	7.8	7.9	7.8	8.1	8.0	8.0	0.0	12.0
27	7.9	7.9	7.9	7.7	7.7	7.9	7.9	8.0	-0.1	12.0
28	7.8	8.0	7.8	7.8	7.8	8.0	7.9	8.0	-0.1	12.0
29	7.9	7.8	7.8	7.8	7.8	7.9	7.8	7.8	0.0	11.8
30	8.0	8.1	7.9	7.9	7.9	8.1	8.0	8.1	-0.1	12.1
31	8.0	7.9	8.0	7.9	7.9	8.0	8.0	8.1	-0.1	12.1
32	7.8	7.8	7.8	7.8	7.8	7.8	7.8	8.0	-0.2	12.0
33	7.8	7.8	7.8	7.8	7.8	7.8	7.8	8.2	-0.4	12.2
34	7.9	7.7	7.9	7.8	7.7	7.9	7.8	8.2	-0.4	12.2
Average	7.9	7.9	7.8	7.8		Average	7.9	8.0		

Notes: % = Percent.

PSL = Primary subliner.

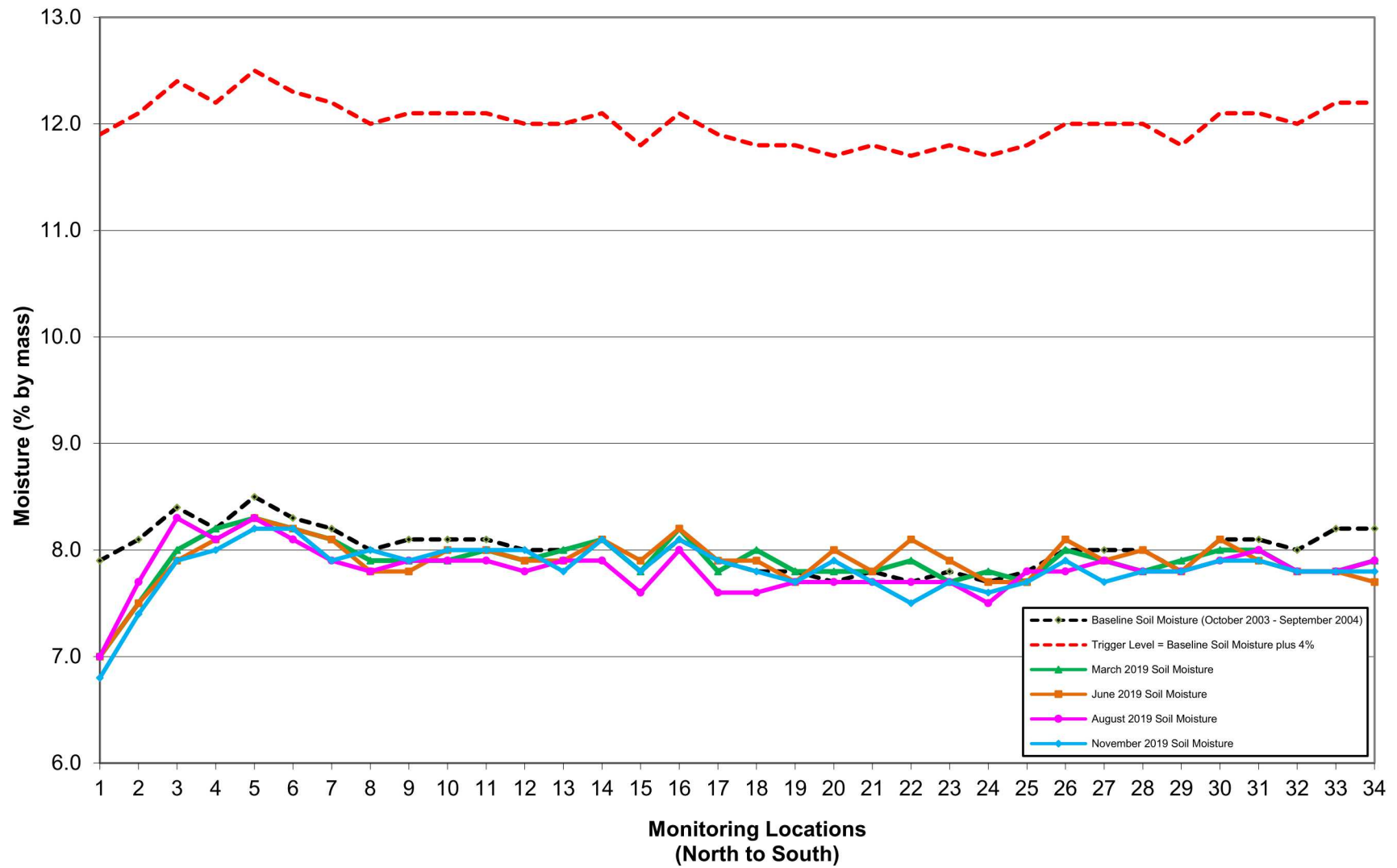


Figure 6-1
 Graph of PSL Soil Moisture Monitoring Results for the West Vitrified Clay Pipe
 Calendar Year 2019

Table 6-7
 PSL Soil Moisture Monitoring Results for the West-Central Vitrified Clay Pipe
 Calendar Year 2019

Monitoring Location	Collection Dates				Reporting Period Minimum	Reporting Period Maximum	Reporting Period Average	Baseline Average (10/2003-9/2004)	Difference between Baseline Average & Reporting Period Average	Trigger Level (Baseline Average plus 4%)
	February-28	May-6	August-28	November-14						
	Moisture (% by mass)							Moisture (% by mass)		
1	7.3	7.4	6.2	7.2	6.2	7.4	7.0	7.6	-0.6	11.6
2	5.7	5.7	5.3	5.6	5.3	5.7	5.6	7.5	-1.9	11.5
3	5.1	4.9	5.0	4.9	4.9	5.1	5.0	7.1	-2.1	11.1
4	5.2	5.0	5.1	4.8	4.8	5.2	5.0	6.6	-1.6	10.6
5	5.3	5.1	5.8	4.9	4.9	5.8	5.3	6.8	-1.5	10.8
6	6.7	6.6	7.2	6.2	6.2	7.2	6.7	7.2	-0.5	11.2
7	7.2	7.3	7.4	7.1	7.1	7.4	7.3	7.5	-0.2	11.5
8	7.6	7.6	7.5	7.3	7.3	7.6	7.5	7.5	0.0	11.5
9	7.6	7.9	7.5	7.9	7.5	7.9	7.8	7.8	0.0	11.8
10	7.7	7.9	8.1	8.1	7.7	8.1	8.0	8.1	-0.1	12.1
11	7.8	7.8	7.8	8.1	7.8	8.1	7.9	8.0	-0.1	12.0
12	8.2	8.2	8.0	8.1	8.0	8.2	8.1	8.2	-0.1	12.2
13	8.0	7.8	8.0	8.1	7.8	8.1	8.0	8.2	-0.2	12.2
14	8.0	8.0	8.1	8.0	8.0	8.1	8.0	8.1	-0.1	12.1
15	8.0	8.0	7.8	8.1	7.8	8.1	8.0	8.1	-0.1	12.1
16	7.9	7.8	7.8	8.1	7.8	8.1	7.9	8.0	-0.1	12.0
17	7.6	7.8	8.0	7.7	7.6	8.0	7.8	7.8	0.0	11.8
18	8.0	8.0	7.9	8.4	7.9	8.4	8.1	8.1	0.0	12.1
19	7.7	7.8	8.1	7.7	7.7	8.1	7.8	7.8	0.0	11.8
20	7.8	7.8	8.2	7.8	7.8	8.2	7.9	8.0	-0.1	12.0
21	7.8	8.1	8.1	7.9	7.8	8.1	8.0	8.0	0.0	12.0
22	7.8	7.8	7.9	7.7	7.7	7.9	7.8	8.0	-0.2	12.0
23	7.6	7.7	7.7	7.7	7.6	7.7	7.7	7.8	-0.1	11.8
24	7.8	7.9	7.8	7.9	7.8	7.9	7.9	8.0	-0.1	12.0
25	8.0	7.7	7.7	7.7	7.7	8.0	7.8	7.8	0.0	11.8
26	7.6	7.7	7.8	7.6	7.6	7.8	7.7	7.8	-0.1	11.8
27	8.0	7.8	7.6	7.7	7.6	8.0	7.8	7.9	-0.1	11.9
28	7.7	7.8	7.7	7.8	7.7	7.8	7.8	7.9	-0.1	11.9
29	8.1	7.8	7.9	7.7	7.7	8.1	7.9	7.9	0.0	11.9
30	7.6	7.6	7.8	7.6	7.6	7.8	7.7	7.7	0.0	11.7
31	8.0	8.1	8.0	7.9	7.9	8.1	8.0	8.0	0.0	12.0
32	7.9	8.1	8.0	8.2	7.9	8.2	8.1	8.1	0.0	12.1
33	8.2	8.3	7.7	7.9	7.7	8.3	8.0	8.1	-0.1	12.1
34	7.8	7.8	8.0	7.9	7.8	8.0	7.9	8.1	-0.2	12.1
35	7.6	7.9	7.6	7.6	7.6	7.9	7.7	8.0	-0.3	12.0
Average	7.5	7.5	7.5	7.5		Average	7.5	7.5		

Notes: % = Percent. PSL = Primary subliner.

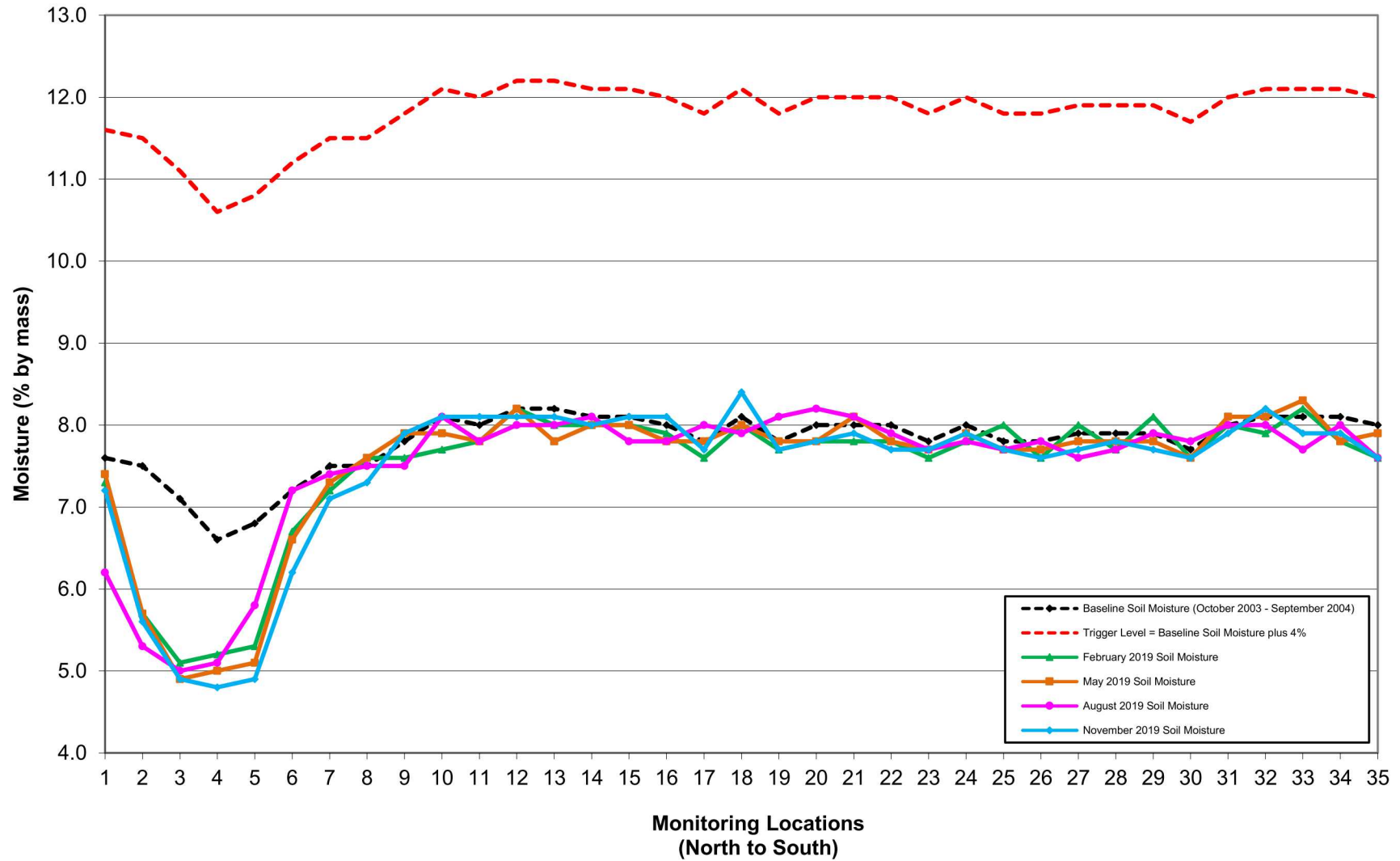


Figure 6-22
 Graph of PSL Soil Moisture Monitoring Results for the West Central Vitrified Clay Pipe
 Calendar Year 2019

Table 6-8
 PSL Soil Moisture Monitoring Results for the Central Vitrified Clay Pipe
 Calendar Year 2019

Monitoring Location	Collection Dates				Reporting Period Minimum	Reporting Period Maximum	Reporting Period Average	Baseline Average (10/2003-9/2004)	Difference between Baseline Average & Reporting Period Average	Trigger Level (Baseline Average plus 4%)
	February-27	June-3	August-22	November-7						
	Moisture (% by mass)									
1	7.0	7.4	5.7	6.2	5.7	7.4	6.6	8.2	-1.6	12.2
2	8.3	8.3	8.1	8.3	8.1	8.3	8.3	8.6	-0.3	12.6
3	7.2	7.1	7.2	6.4	6.4	7.2	7.0	8.3	-1.3	12.3
4	7.3	7.4	7.3	7.0	7.0	7.4	7.3	8.2	-0.9	12.2
5	7.4	7.4	7.3	7.3	7.3	7.4	7.4	7.7	-0.3	11.7
6	7.8	7.8	7.6	7.7	7.6	7.8	7.7	7.7	0.0	11.7
7	7.4	7.6	7.9	7.5	7.4	7.9	7.6	7.5	0.1	11.5
8	7.7	7.8	7.8	7.9	7.7	7.9	7.8	7.9	-0.1	11.9
9	8.1	8.2	8.3	8.2	8.1	8.3	8.2	8.2	0.0	12.2
10	8.1	8.1	8.1	8.2	8.1	8.2	8.1	8.0	0.1	12.0
11	7.8	8.0	7.9	7.8	7.8	8.0	7.9	7.8	0.1	11.8
12	8.0	7.9	7.9	7.9	7.9	8.0	7.9	8.0	-0.1	12.0
13	7.8	8.2	7.9	8.0	7.8	8.2	8.0	7.9	0.1	11.9
14	7.9	7.9	7.9	8.0	7.9	8.0	7.9	8.0	-0.1	12.0
15	8.0	7.7	7.8	8.0	7.7	8.0	7.9	7.8	0.1	11.8
16	7.8	7.6	7.7	7.8	7.6	7.8	7.7	7.8	-0.1	11.8
17	8.0	7.7	8.0	8.1	7.7	8.1	8.0	7.9	0.1	11.9
18	8.0	7.9	8.1	7.9	7.9	8.1	8.0	8.0	0.0	12.0
19	7.9	8.1	7.8	7.7	7.7	8.1	7.9	7.8	0.1	11.8
20	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	0.0	11.7
21	7.7	7.5	7.6	7.8	7.5	7.8	7.7	7.8	-0.1	11.8
22	7.7	7.6	7.5	7.7	7.5	7.7	7.6	7.6	0.0	11.6
23	7.7	7.6	7.7	7.6	7.6	7.7	7.7	7.8	-0.1	11.8
24	7.7	7.6	7.6	7.7	7.6	7.7	7.7	7.9	-0.2	11.9
25	7.8	7.6	7.9	7.8	7.6	7.9	7.8	7.8	0.0	11.8
26	7.8	7.7	7.8	7.7	7.7	7.8	7.8	7.9	-0.1	11.9
27	7.8	7.9	7.8	7.9	7.8	7.9	7.9	8.0	-0.1	12.0
28	7.7	7.8	7.7	7.6	7.6	7.8	7.7	7.8	-0.1	11.8
29	7.9	7.7	7.7	7.7	7.7	7.9	7.8	7.9	-0.1	11.9
30	7.7	7.7	7.7	7.8	7.7	7.8	7.7	7.9	-0.2	11.9
31	7.7	7.7	7.7	7.6	7.6	7.7	7.7	7.8	-0.1	11.8
32	7.8	7.7	7.8	7.8	7.7	7.8	7.8	7.7	0.1	11.7
33	8.0	7.8	7.9	7.7	7.7	8.0	7.9	8.0	-0.1	12.0
34	7.8	7.6	7.9	7.8	7.6	7.9	7.8	7.8	0.0	11.8
35	7.7	7.8	7.7	7.7	7.7	7.8	7.7	7.9	-0.2	11.9
Average	7.8	7.7	7.7	7.7		Average	7.7	7.9		

Notes: % = Percent. PSL = Primary subliner.

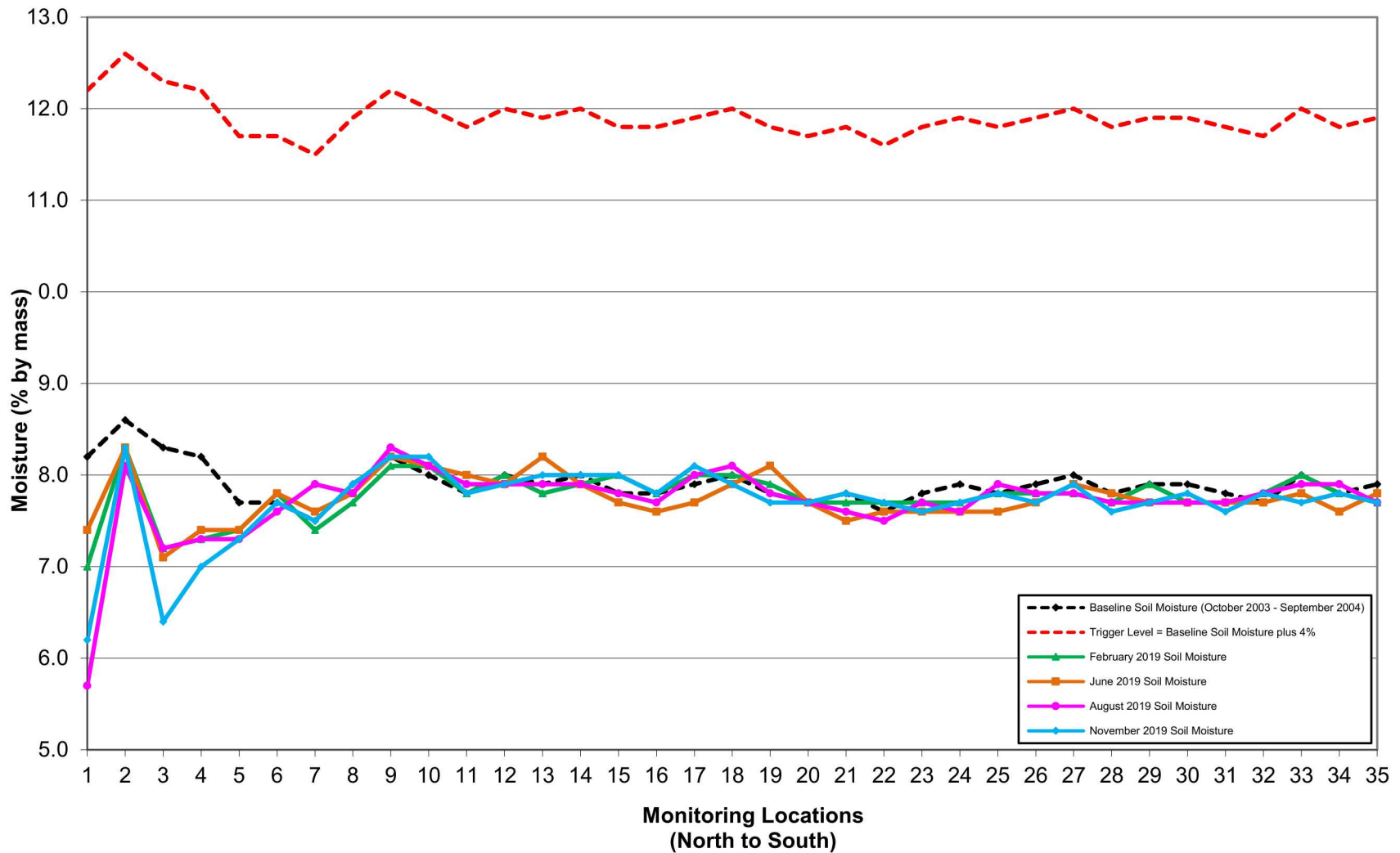


Figure 6-3
 Graph of PSL Soil Moisture Monitoring Results for the Central Vitrified Clay Pipe
 Calendar Year 2019

Table 6-9
 PSL Soil Moisture Monitoring Results for the East-Central Vitrified Clay Pipe
 Calendar Year 2019

Monitoring Location	Collection Dates				Reporting Period Minimum	Reporting Period Maximum	Reporting Period Average	Baseline Average (10/2003-9/2004)	Difference between Baseline Average & Reporting Period Average	Trigger Level (Baseline Average plus 4%)
	February-27	June-3	August-21	November-7						
	Moisture (% by mass)							Moisture (% by mass)		
1	8.1	7.9	8.0	8.0	7.9	8.1	8.0	8.2	-0.2	12.2
2	7.5	7.5	7.7	7.4	7.4	7.7	7.5	8.1	-0.6	12.1
3	6.2	6.2	6.4	6.3	6.2	6.4	6.3	6.7	-0.4	10.7
4	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	0.0	10.6
5	7.2	7.1	7.1	7.2	7.1	7.2	7.2	7.5	-0.3	11.5
6	7.4	7.3	7.5	7.5	7.3	7.5	7.4	7.5	-0.1	11.5
7	7.2	7.1	7.1	7.2	7.1	7.2	7.2	7.5	-0.3	11.5
8	7.5	7.4	7.4	7.5	7.4	7.5	7.5	7.6	0.0	11.6
9	7.3	7.4	7.3	7.3	7.3	7.4	7.3	7.6	-0.3	11.6
10	8.1	7.8	7.7	8.0	7.7	8.1	7.9	7.8	0.1	11.8
11	8.1	8.0	8.0	8.0	8.0	8.1	8.0	8.2	-0.2	12.2
12	8.2	7.8	7.9	8.0	7.8	8.2	8.0	8.0	0.0	12.0
13	7.8	7.7	7.6	7.6	7.6	7.8	7.7	8.0	-0.3	12.0
14	7.9	7.8	7.9	7.8	7.8	7.9	7.9	8.0	-0.1	12.0
15	7.8	7.9	7.8	7.8	7.8	7.9	7.8	7.9	-0.1	11.9
16	7.7	7.7	7.9	7.7	7.7	7.9	7.8	7.7	0.1	11.7
17	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.9	-0.1	11.9
18	7.7	7.9	8.0	7.7	7.7	8.0	7.8	7.9	-0.1	11.9
19	7.6	7.4	7.6	7.6	7.4	7.6	7.6	7.7	-0.1	11.7
20	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	0.0	11.7
21	7.6	7.6	7.7	7.6	7.6	7.7	7.6	7.7	-0.1	11.7
22	7.5	7.8	7.6	7.6	7.5	7.8	7.6	7.7	-0.1	11.7
23	7.6	7.4	7.6	7.5	7.4	7.6	7.5	7.6	-0.1	11.6
24	7.7	7.8	7.5	7.5	7.5	7.8	7.6	7.6	0.0	11.6
25	7.5	7.5	7.4	7.5	7.4	7.5	7.5	7.6	-0.1	11.6
26	7.4	7.5	7.2	7.3	7.2	7.5	7.4	7.5	-0.1	11.5
27	7.4	7.4	7.2	7.5	7.2	7.5	7.4	7.5	-0.1	11.5
28	7.4	7.5	7.5	7.3	7.3	7.5	7.4	7.4	0.0	11.4
29	7.7	7.6	7.6	7.7	7.6	7.7	7.7	7.6	0.1	11.6
30	7.4	7.6	7.5	7.4	7.4	7.6	7.5	7.4	0.1	11.4
31	7.8	7.5	7.6	7.9	7.5	7.9	7.7	7.5	0.2	11.5
32	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.9	-0.1	11.9
33	8.2	8.0	7.8	8.0	7.8	8.2	8.0	8.1	-0.1	12.1
34	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	0.0	12.0
35	8.0	8.0	7.9	7.9	7.9	8.0	8.0	8.2	-0.2	12.2
Average	7.6	7.6	7.6	7.6		Average	7.6	7.7		

Notes: % = Percent. PSL = Primary subliner.

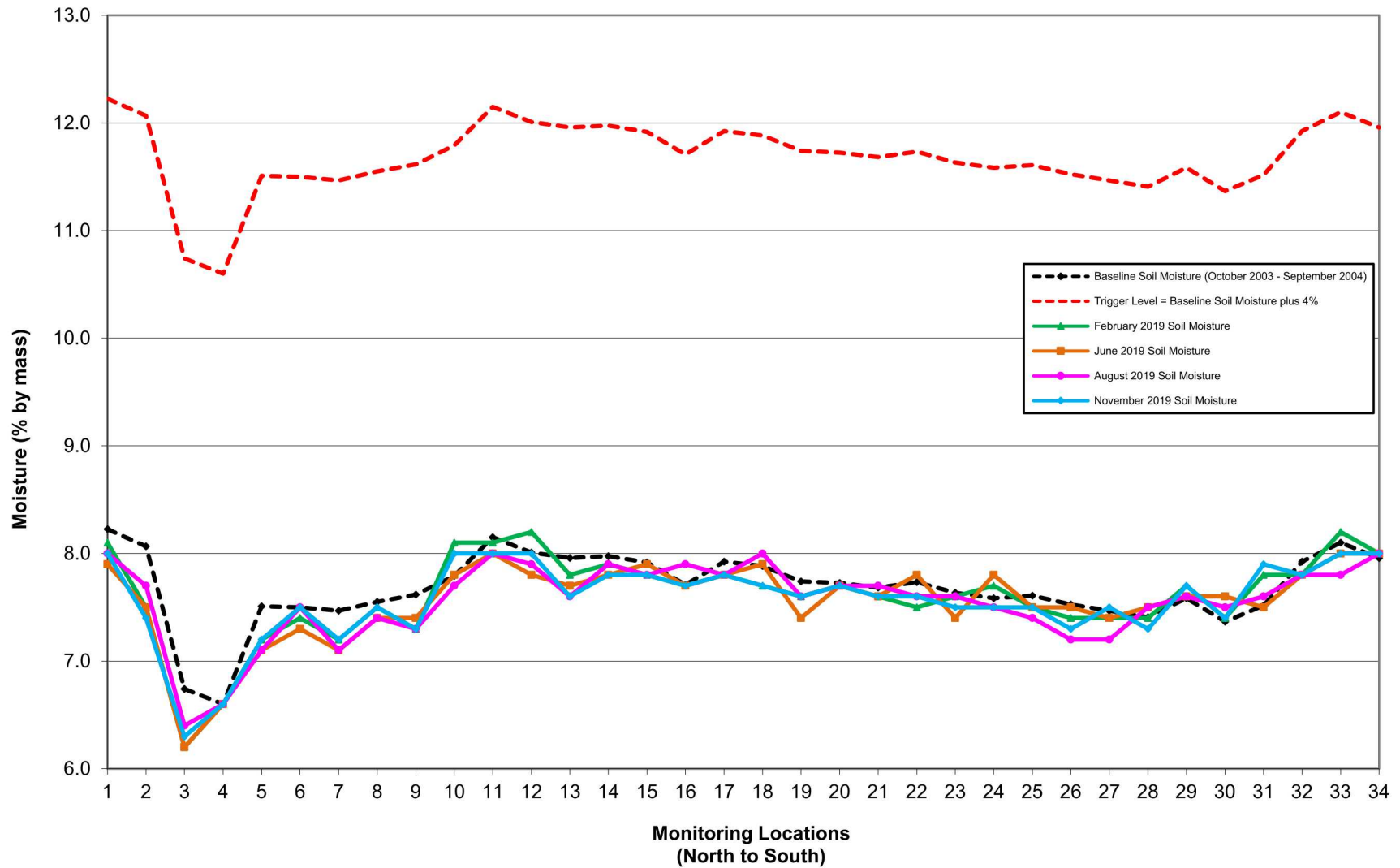


Figure 6-4
 Graph of PSL Soil Moisture Monitoring Results for the East-Central Vitrified Clay Pipe
 Calendar Year 2019

Table 6-10
 PSL Soil Moisture Monitoring Results for the East Vitrified Clay Pipe
 Calendar Year 2019

Monitoring Location	Collection Dates				Reporting Period Minimum	Reporting Period Maximum	Reporting Period Average	Baseline Average (10/2003-9/2004)	Difference between Baseline Average & Reporting Period Average	Trigger Level (Baseline Average plus 4%)
	February-27	May-6	August-21	November-7						
	Moisture (% by mass)									
1	6.9	7.0	7.0	6.7	6.7	7.0	6.9	7.9	-1.0	11.9
2	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.9	-0.9	11.9
3	6.2	6.2	6.2	6.0	6.0	6.2	6.2	7.4	-1.2	11.4
4	6.5	6.5	6.6	6.4	6.4	6.6	6.5	6.8	-0.3	10.8
5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.6	-0.1	10.6
6	6.9	6.8	6.9	6.8	6.8	6.9	6.9	7.1	-0.2	11.1
7	7.0	6.9	6.8	6.9	6.8	7.0	6.9	6.7	0.2	10.7
8	6.8	6.8	7.0	6.8	6.8	7.0	6.9	6.9	0.0	10.9
9	7.2	7.3	7.0	7.1	7.0	7.3	7.2	7.2	0.0	11.2
10	7.5	7.4	7.4	7.4	7.4	7.5	7.4	7.7	-0.3	11.7
11	7.5	7.4	7.4	7.3	7.3	7.5	7.4	7.5	-0.1	11.5
12	7.6	7.7	7.6	7.5	7.5	7.7	7.6	8.1	-0.5	12.1
13	7.6	7.7	7.9	7.7	7.6	7.9	7.7	8.0	-0.3	12.0
14	8.0	7.9	8.0	8.0	7.9	8.0	8.0	8.4	-0.4	12.4
15	8.1	8.1	8.3	8.1	8.1	8.3	8.2	8.2	0.0	12.2
16	8.2	8.3	8.3	8.1	8.1	8.3	8.2	8.4	-0.2	12.4
17	7.6	7.7	7.7	7.5	7.5	7.7	7.6	7.8	-0.2	11.8
18	7.4	7.6	7.6	7.5	7.4	7.6	7.5	7.7	-0.2	11.7
19	7.7	7.6	7.8	7.6	7.6	7.8	7.7	7.7	0.0	11.7
20	7.6	7.7	7.7	7.7	7.6	7.7	7.7	7.9	-0.2	11.9
21	7.8	7.7	8.1	7.7	7.7	8.1	7.8	7.8	0.0	11.8
22	7.7	7.8	7.7	7.6	7.6	7.8	7.7	7.9	-0.2	11.9
23	7.6	7.5	7.9	7.7	7.5	7.9	7.7	7.7	0.0	11.7
24	8.1	8.1	7.9	7.9	7.9	8.1	8.0	7.9	0.1	11.9
25	7.7	7.6	7.8	7.8	7.6	7.8	7.7	7.7	0.0	11.7
26	7.6	7.5	7.5	7.5	7.5	7.6	7.5	7.9	-0.4	11.9
27	7.7	7.8	8.1	8.0	7.7	8.1	7.9	7.8	0.1	11.8
28	7.9	7.7	7.8	7.6	7.6	7.9	7.8	8.0	-0.2	12.0
29	7.8	8.0	8.1	8.1	7.8	8.1	8.0	7.9	0.1	11.9
30	7.8	7.9	7.8	7.7	7.7	7.9	7.8	8.2	-0.4	12.2
31	7.9	8.3	8.1	8.1	7.9	8.3	8.1	8.1	0.0	12.1
32	8.2	8.0	8.1	8.0	8.0	8.2	8.1	8.4	-0.3	12.4
33	8.0	8.2	8.2	8.3	8.0	8.3	8.2	8.2	0.0	12.2
34	7.9	7.7	7.8	7.7	7.7	7.9	7.8	8.2	-0.4	12.2
Average	7.5	7.5	7.6	7.5		Average	7.5	7.8		

Notes: % = Percent.

PSL = Primary subliner.

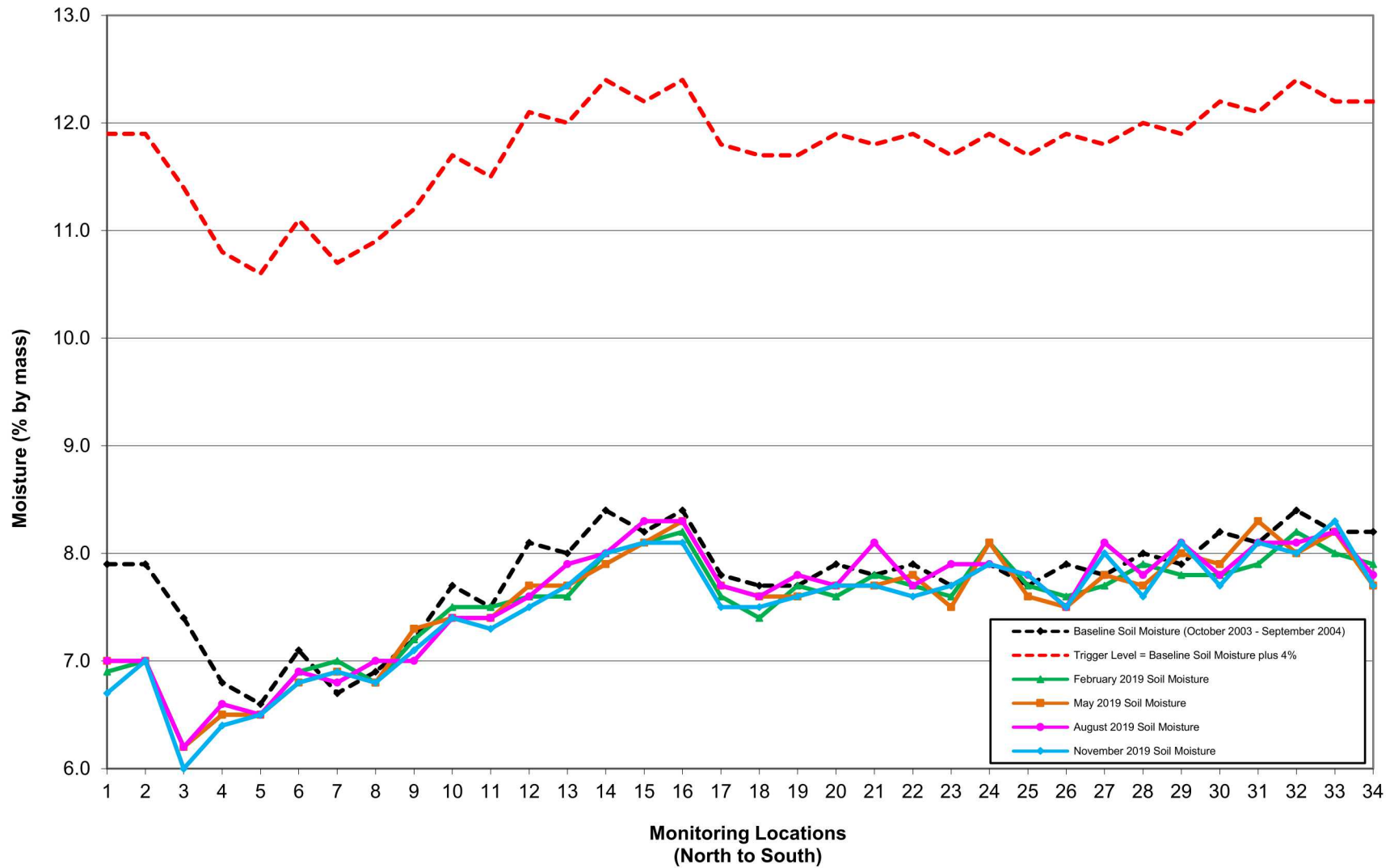


Figure 6-5
 Graph of PSL Soil Moisture Monitoring Results for the East Vitrified Clay Pipe
 Calendar Year 2019

6.3.2 Vertical Distribution of Moisture Along the Margins of the Containment Cell As Indicated by the Vertical Sensor Array Monitoring Subsystem

Tables 6-11 and 6-12 present soil moisture values (% by volume) recorded during this reporting period for each VSA monitoring location. Soil moisture content was determined using TDR monitoring points at depths of 5 and 15 feet below the containment cell. The quarterly monitoring results were compared to the trigger level, which is 4% above the established baseline soil moisture.

Average soil moisture values range from 5.8% to 13.1% at the 5-foot monitoring depth (Table 6-11) which is consistent with the baseline average range of 5.2% to 14.6%. Average soil moisture values range from 5.0% to 8.4% at the 15-foot depth (Table 6-12), which is consistent with the baseline average range of 4.9% to 8.2%.

Figures 6-6 and 6-7 present soil moisture (% by volume) graphically for the 5- and 15-foot depths, respectively, for each VSA monitoring location. The VSA data presented in the tables and graphs demonstrate stable soil moisture values during the CY 2019 reporting period.

Table 6-11
 TDR Soil Moisture Monitoring Results for the VSA
 5-Foot Monitoring Depth
 Calendar Year 2019

Collection Date	Instrument Location (5-Foot Monitoring Depth)										
	VSA-1	VSA-2	VSA-3	VSA-4	VSA-5	VSA-6	VSA-7	VSA-8	VSA-9	VSA-10	VSA-11
	Moisture (% by volume)										
February-26	11.5	8.7	8.3	12.7	13.3	8.8	7.6	6.3	8.9	5.7	7.6
May-8	11.6	8.7	8.4	13.0	12.7	8.6	7.5	6.1	9.0	5.8	7.5
August-12	11.6	8.7	8.2	13.4	13.3	8.7	7.7	6.3	8.9	5.9	7.5
November-5	11.5	8.7	8.1	12.6	13.2	8.6	7.5	6.1	8.8	5.8	7.7
Reporting Period Minimum	11.5	8.7	8.1	12.6	12.7	8.6	7.5	6.1	8.8	5.7	7.5
Reporting Period Maximum	11.6	8.7	8.4	13.4	13.3	8.8	7.7	6.3	9.0	5.9	7.7
Reporting Period Average	11.6	8.7	8.3	13.0	13.1	8.7	7.6	6.2	8.9	5.8	7.6
Baseline Average (10/2003-9/2004)	12.4	7.8	6.5	14.0	14.6	9.4	6.8	5.9	7.7	5.2	8.4
Difference between Baseline Average & Reporting Period Average	-0.8	0.9	1.8	-1.0	-1.5	-0.7	0.8	0.3	1.2	0.6	-0.8
Trigger Level (Baseline Average plus 4%)	16.4	11.8	10.5	18.0	18.6	13.4	10.8	9.9	11.7	9.2	12.4

Notes:

- % = Percent.
- TDR = Time-domain reflectometry.
- VSA = Vertical sensor array.

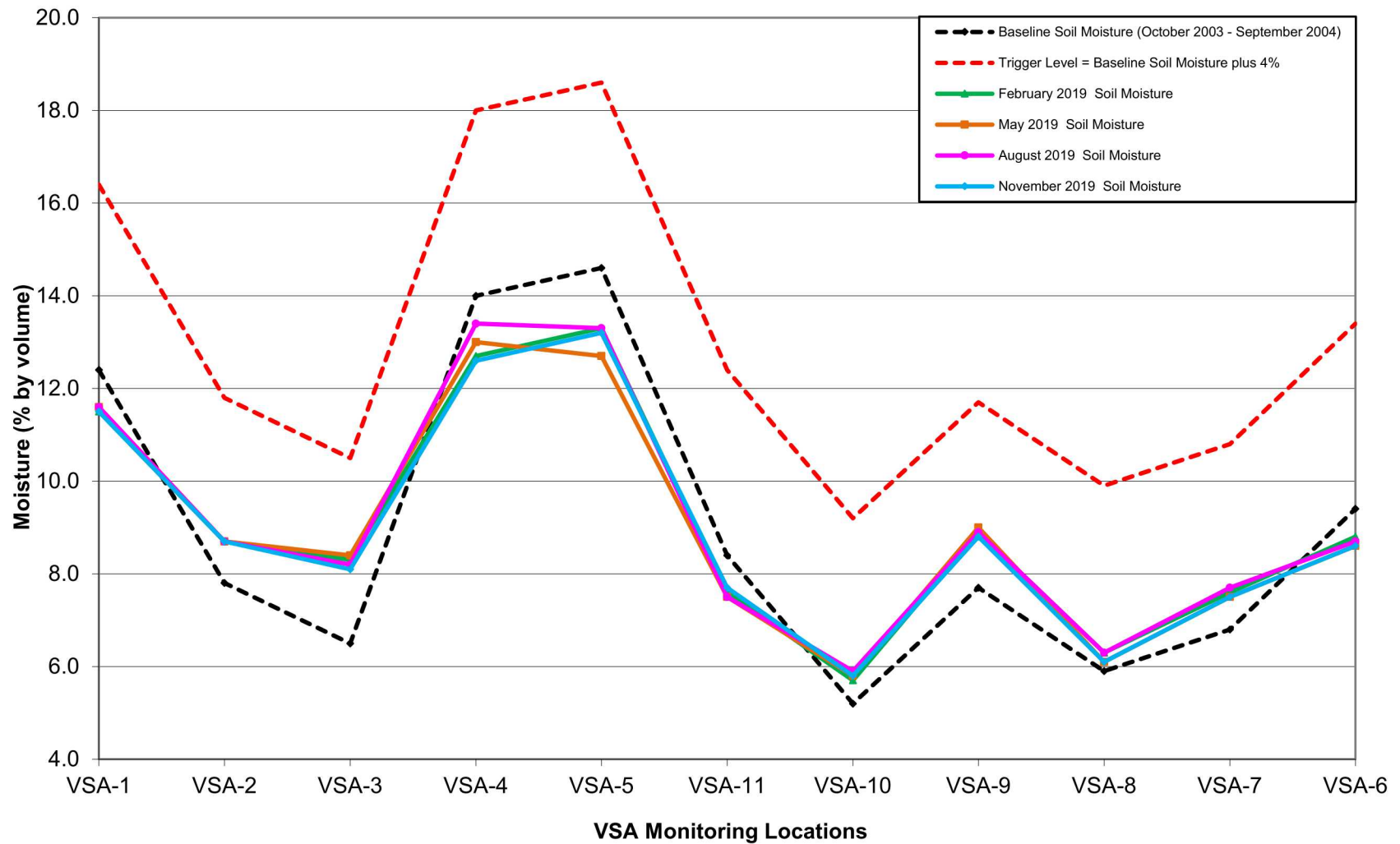


Figure 6-6
 Graph of VSA Soil Moisture Monitoring Results (5-foot Monitoring Depth)
 Calendar Year 2019

Table 6-12
 TDR Soil Moisture Monitoring Results for the VSA
 15-Foot Monitoring Depth
 Calendar Year 2019

Collection Date	Instrument Location (15-Foot Monitoring Depth)										
	VSA-1	VSA-2	VSA-3	VSA-4	VSA-5	VSA-6	VSA-7	VSA-8	VSA-9	VSA-10	VSA-11
	Moisture (% by volume)										
February-26	8.4	6.7	6.7	7.7	8.0	7.9	6.7	6.6	5.0	7.3	5.4
May-8	8.5	6.4	6.9	7.7	8.1	7.9	6.8	6.5	5.0	7.3	5.3
August-12	8.4	6.2	6.7	7.6	7.9	8.0	6.8	6.6	5.0	7.3	5.4
November-5	8.4	6.5	6.9	7.7	8.1	8.0	6.8	6.6	5.1	7.2	5.3
Reporting Period Minimum	8.4	6.2	6.7	7.6	7.9	7.9	6.7	6.5	5.0	7.2	5.3
Reporting Period Maximum	8.5	6.7	6.9	7.7	8.1	8.0	6.8	6.6	5.1	7.3	5.4
Reporting Period Average	8.4	6.5	6.8	7.7	8.0	8.0	6.8	6.6	5.0	7.3	5.4
Baseline Average (10/2003-9/2004)	8.2	7.7	6.7	7.5	7.6	7.7	6.6	6.5	4.9	7.2	5.7
Difference between Baseline Average & Reporting Period Average	0.2	-1.2	0.1	0.2	0.4	0.3	0.2	0.1	0.1	0.1	-0.3
Trigger Level (Baseline Average plus 4%)	12.2	11.7	10.7	11.5	11.6	11.7	10.6	10.5	8.9	11.2	9.7

Notes:

- % = Percent.
- TDR = Time-domain reflectometry.
- VSA = Vertical sensor array.

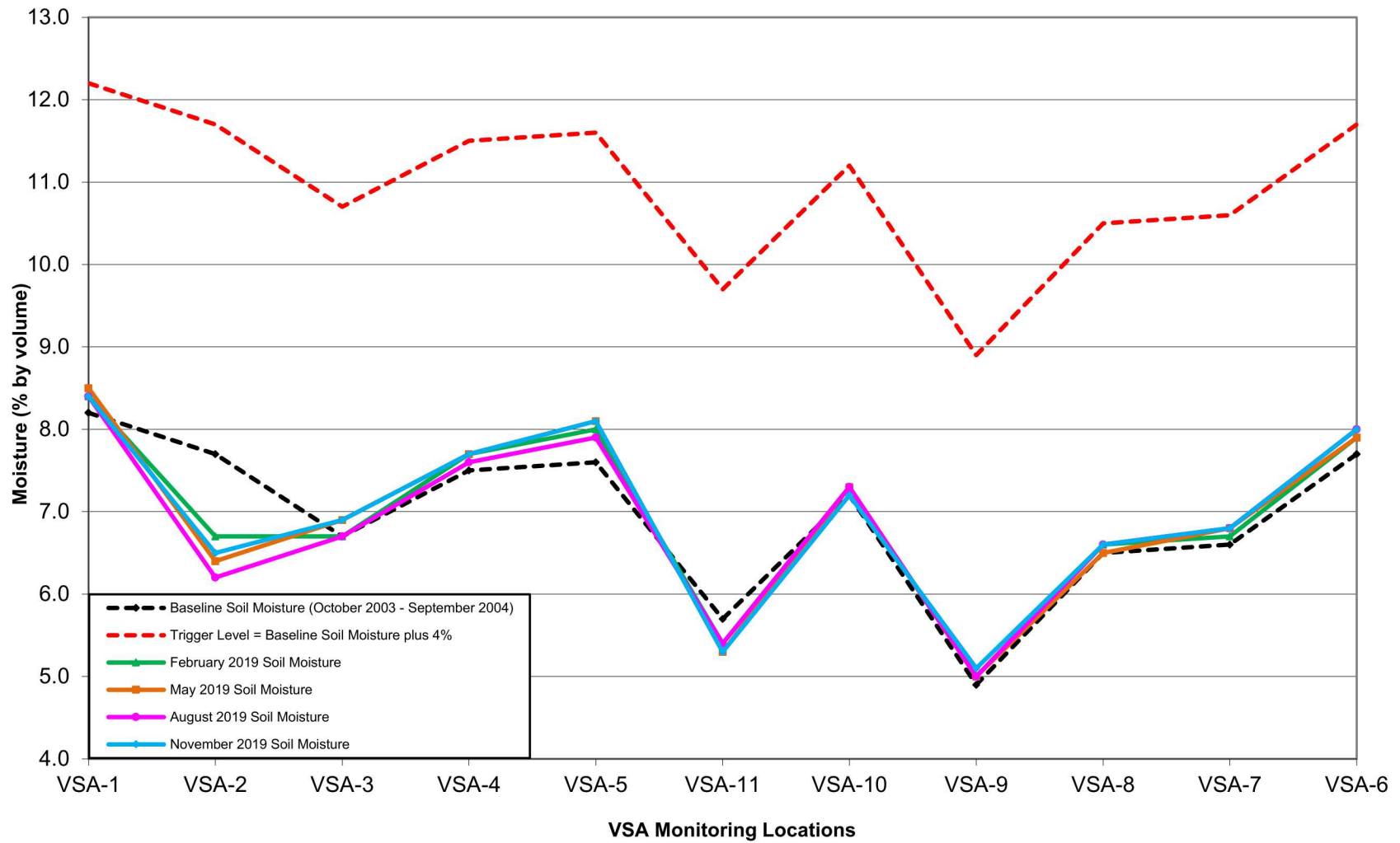


Figure 6-7
 Graph of VSA Soil Moisture Monitoring Results (15-Foot Monitoring Depth)
 Calendar Year 2019

6.3.3 Distribution of Moisture Adjacent to the East Side of the Containment Cell as Indicated by the Chemical Waste Landfill Sanitary Sewer Monitoring Subsystem

Tables 6-13 and 6-14 present soil moisture values (% by mass) recorded during this reporting period for each CSS monitoring location. The CSS locations were established to monitor potential leakage from the sewer line located east of the CAMU facility. Figures 6-8 and 6-9 present soil moisture (% by mass) graphically for the 12- and 16-foot depths, respectively, for each CSS monitoring location.

The quarterly monitoring results were compared to the trigger level, which is 4% above the established baseline soil moisture. Soil moisture values did not exceed the trigger level at any CSS locations. The quarterly monitoring results track very closely to the soil moisture baseline for CSS-1, CSS-4, and CSS-5. For these three locations, average soil moisture values range from 2.1% to 3.2% at the 12-foot depth (Table 6-13), which is consistent with the baseline average range of 2.1% to 2.3%. At these three locations, the average soil moisture values range from 2.8% to 3.1% at the 16-foot depth (Table 6-14), which is consistent with the baseline average of 2.7% to 3.1%.

Average soil moisture values of 3.6% and 3.8% were recorded for CSS-2 at the 12- and 16-foot depths, respectively, compared to baseline averages of 2.2% and 2.3%. Soil moisture values began increasing at the CSS-2 location in September 2005, continued to increase through September 2008, and now appear stabilized with just minor fluctuations occurring since September 2008. Figure 6-10 graphically shows the soil moisture (% by mass) upward and stabilization trends that occurred at the 12- and 16-foot monitoring depths of location CSS-2.

Average soil moisture values of 4.0% and 3.2% were recorded for CSS-3 at the 12- and 16-foot depths, respectively, compared to baseline averages of 3.0% and 2.6%. Figure 6-11 graphically shows the soil moisture values at the 12-foot and 16-foot monitoring depths of location CSS-3. Soil moisture values began increasing at the 12-foot depth in March 2007, continued to increase through March 2012, fluctuated during the 2013 reporting period (July 2012 to June 2013, (SNL/NM September 2013), and now appear stabilized with only minor fluctuations occurring since June 2013. Soil moisture values have remained relatively stable at the 16-foot depth.

Quarterly soil moisture monitoring results at the CSS-6 location for the 12- and 16-foot depths track very closely to the soil moisture baseline but are higher compared to the other CSS locations. Average soil moisture values were 4.8% and 5.9% at the 12- and 16-foot depths, respectively, compared to the baseline averages of 4.4% and 5.8%. Originally, CSS-6 was situated in a slight topographic depression. The suspected likely explanation is that surface water runoff accumulated in the depression after heavy rainfall and infiltrated, causing the higher soil moisture values at this location. In May 2002, the area was graded to direct runoff away from the CSS-6 wellhead.

Initially, the increased values below the sanitary sewer line were attributed to a suspected leak in the sewer line near the CSS-2 and CSS-3 monitoring locations. SNL/NM personnel conducted a camera survey of the sewer line adjacent to the CSS monitoring wells in September 2006. The camera survey showed no obvious evidence of potential leakage near the CSS-2 and CSS-3 locations.

The soil moisture continued to increase, and the levels remained consistently higher at the CSS-2 and CSS-3 locations after September 2006; therefore, SNL/NM personnel performed another camera survey of the sewer line in August 2010. The camera survey showed no obvious evidence for potential leakage near the CSS-2 and CSS-3 locations. However, the soil moisture data indicated otherwise, and there was no other explanation for the soil moisture increases. Therefore, SNL/NM personnel relined approximately 895 feet of sewer line in September 2010. A dual-tube, polyester felt, cured-in-place pipe lining tube system with a coated resin-carrying tube and coated, stay-in-place, calibration hose were used to reline the sewer line from approximately 255 feet north of CSS-1 to 140 feet south of CSS-6. The soil moisture trends at CSS-2 and CSS-3 appear to have stabilized; however, it may take some time to discern the overall effect of the liner insert.

Table 6-13
 CSS Soil Moisture Monitoring Results
 12-Foot Monitoring Depth
 Calendar Year 2019

Collection Date	Monitoring Location					
	CSS-1	CSS-2	CSS-3	CSS-4	CSS-5	CSS-6
February-21	2.1	3.6	4.4	2.4	3.1	4.3
May-2	2.1	3.6	4.3	2.5	3.1	4.4
August-20	2.1	3.6	4.4	2.4	3.2	4.9
November-5	2.1	3.6	3.2	2.4	3.4	5.5
Reporting Period Minimum	2.1	3.6	3.2	2.4	3.1	4.3
Reporting Period Maximum	2.1	3.6	4.4	2.5	3.4	5.5
Reporting Period Average	2.1	3.6	4.0	2.4	3.2	4.8
Baseline Average (10/2003-9/2004)	2.1	2.2	3.0	2.3	2.2	4.4
Difference between Baseline Average & Reporting Period Average	0.0	1.4	1.0	0.1	1.0	0.4
Trigger Level (Baseline Average plus 4%)	6.1	6.2	7.0	6.3	6.2	8.4

Notes:

- % = Percent.
- CSS = CWL sanitary sewer.
- CWL = Chemical Waste Landfill.

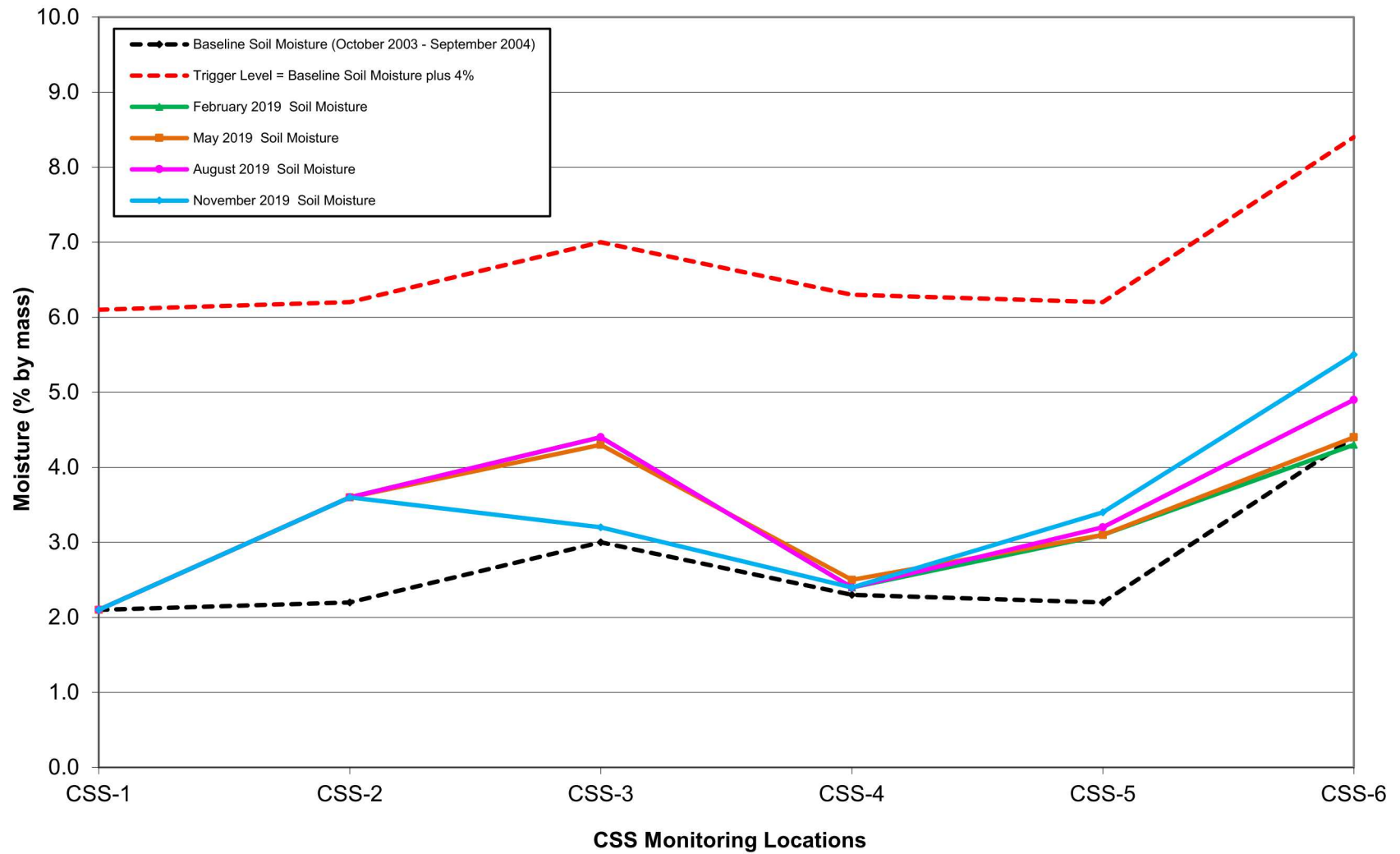


Figure 6-8
 Graph of CSS Soil Moisture Monitoring Results (12-Foot Monitoring Depth)
 Calendar Year 2019

Table 6-14
 CSS Soil Moisture Monitoring Results
 16-Foot Monitoring Depth
 Calendar Year 2019

Collection Date	Monitoring Location					
	CSS-1	CSS-2	CSS-3	CSS-4	CSS-5	CSS-6
	Moisture (% by mass)					
February-21	3.1	3.7	3.1	2.8	2.8	5.9
May-2	3.1	3.8	3.1	2.6	2.8	5.8
August-20	3.1	3.9	3.2	2.7	2.8	5.9
November-5	3.1	3.9	3.2	2.9	2.9	5.8
Reporting Period Minimum	3.1	3.7	3.1	2.6	2.8	5.8
Reporting Period Maximum	3.1	3.9	3.2	2.9	2.9	5.9
Reporting Period Average	3.1	3.8	3.2	2.8	2.8	5.9
Baseline Average (10/2003-9/2004)	3.1	2.3	2.6	2.7	2.7	5.8
Difference between Baseline Average & Reporting Period Average	0.0	1.5	0.6	0.1	0.1	0.1
Trigger Level (Baseline Average plus 4%)	7.1	6.3	6.6	6.7	6.7	9.8

Notes:

- % = Percent.
- CSS = CWL sanitary sewer.
- CWL = Chemical Waste Landfill.

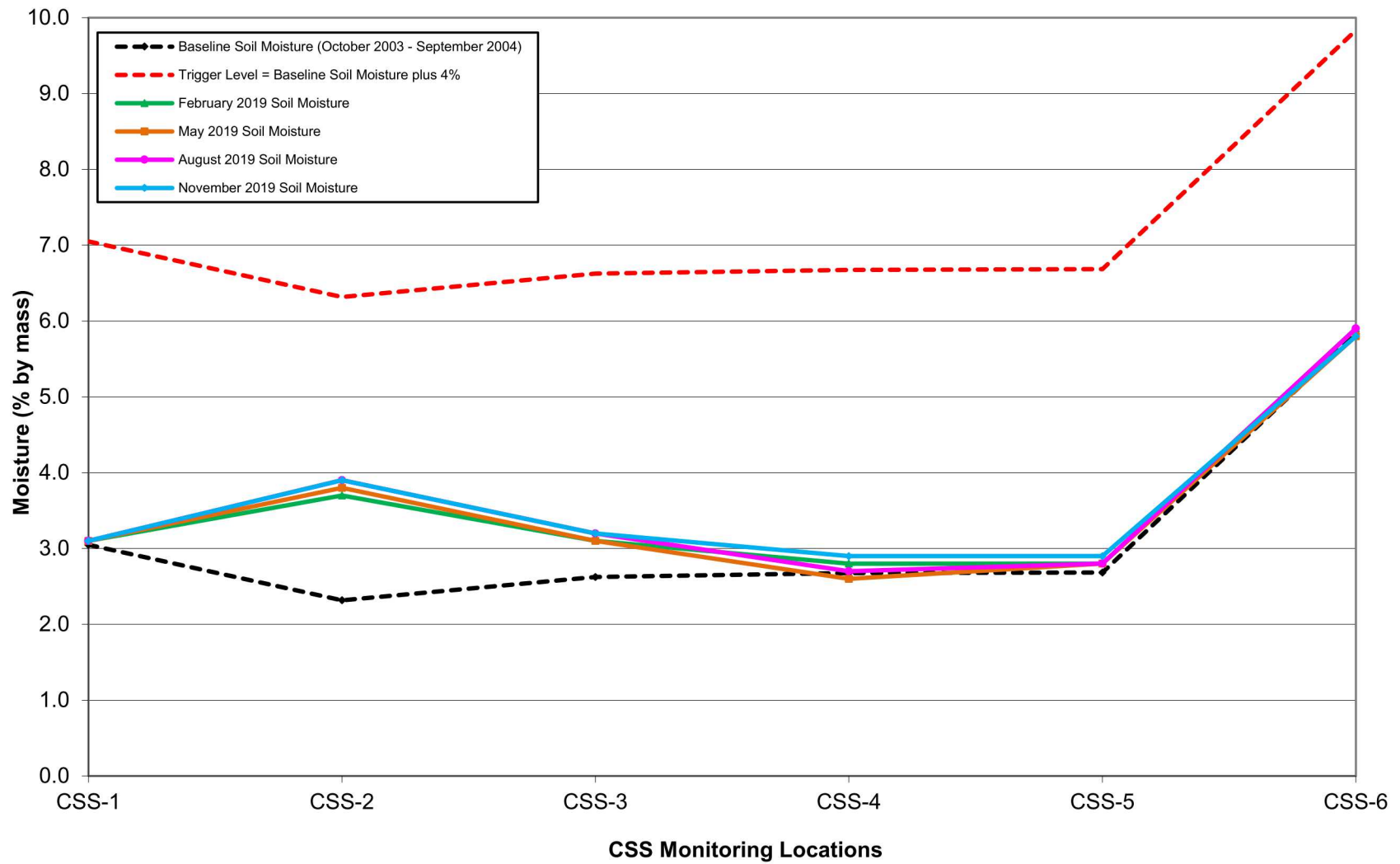


Figure 6-9
 Graph of CSS Soil Moisture Monitoring Results (16-Foot Monitoring Depth)
 Calendar Year 2019

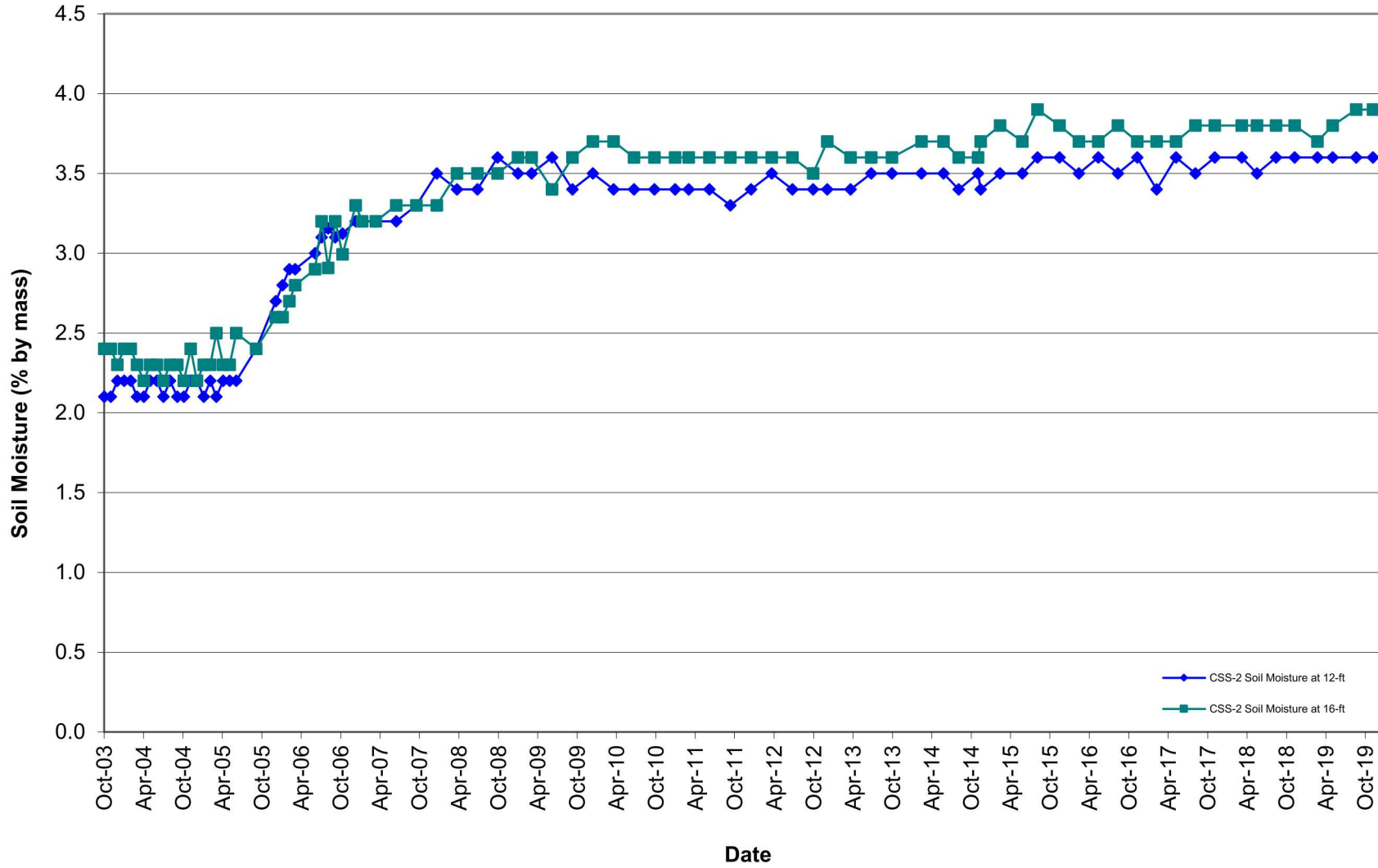


Figure 6-10
Graph of CSS-2 Soil Moisture Increase (12- and 16-Foot Monitoring Depth)
October 2003 - December 2019

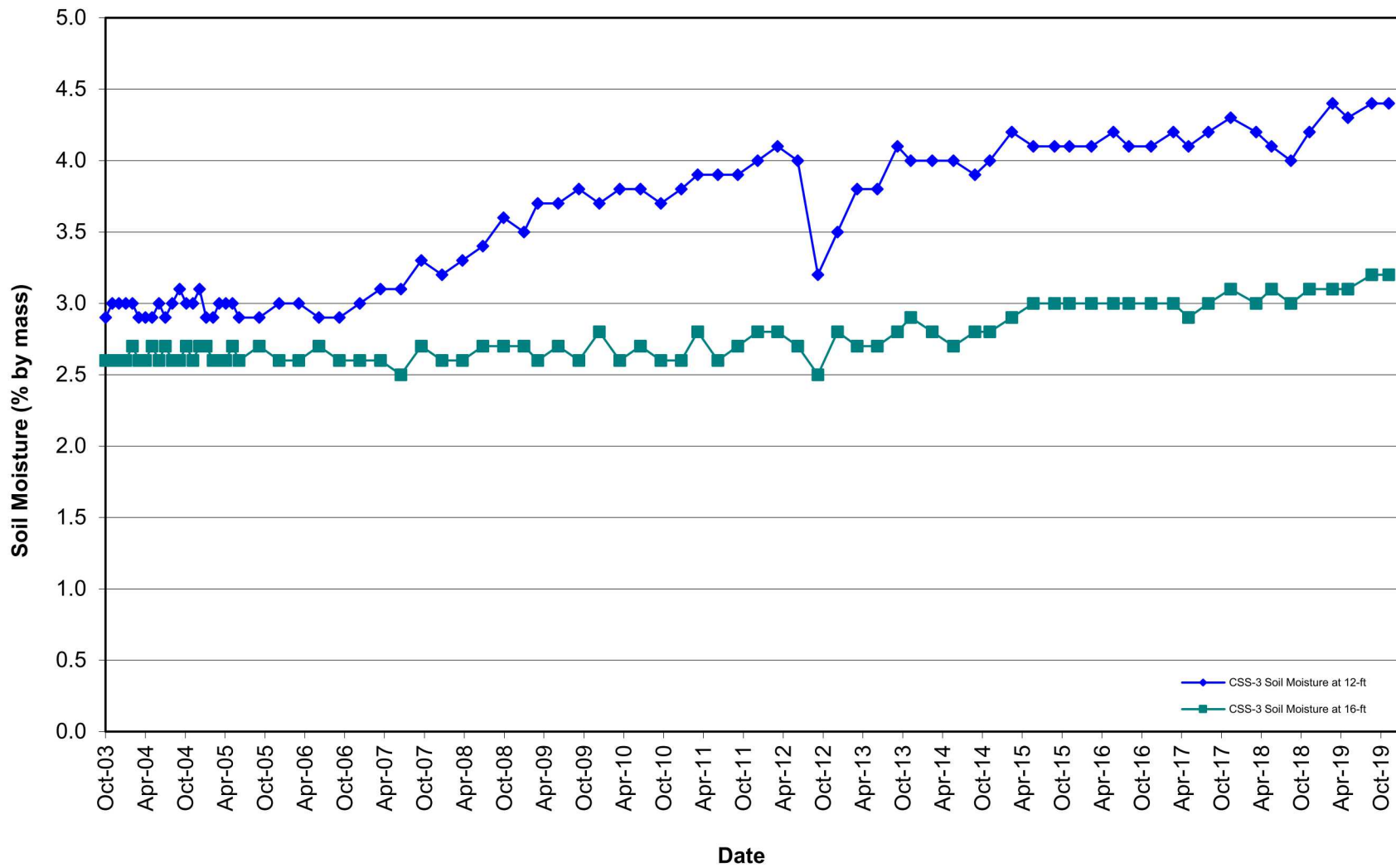


Figure 6-4
 Graph of CSS-3 Soil Moisture Increase (12- and 16-Foot Monitoring Depth)
 October 2003 - December 2019

7.0 LEACHATE COLLECTION AND REMOVAL SYSTEM

7.1 Description

The LCRS is designed to collect and withdraw leachate from the containment cell at the CAMU during the post-closure care period. The LCRS includes a lined sump at the northern end of the containment cell, a collection pipe in a central trench located above the geomembrane liner, a dedicated pump, and a geocomposite drainage layer (Figure 7-1). The central trench extends the length of the bottom of the containment cell from the south to the north and is sloped approximately 1% toward the north. The bottom of the containment cell is sloped approximately 2% to drain toward the central trench (Figure 7-2). The trench receives leachate from the geocomposite drainage layer. The collection pipe in the bottom of the trench is a slotted, 4-inch diameter, PVC pipe. A sloped, 10-inch diameter, PVC pipe (Figure 7-1) provides pump access to the LCRS sump from the northern end of the containment cell cover. The pump is turned on manually to deliver leachate to aboveground, portable polyethylene containers.

7.2 Operation

Operation of the LCRS was reduced from weekly to quarterly pumping of leachate after January 15, 2015, in accordance with Permit Part E, Section E.10.4 (NMED January 2015).

7.3 Waste Management

The leachate is pumped directly into portable polyethylene containers, which are closed, labeled, and placed on secondary containment pallets in a hazardous waste less than 90-day accumulation area adjacent to the containment cell. The containers of leachate are sent to a permitted, off-site hazardous waste management facility.

Solid waste includes nitrile gloves generated during the leachate pumping process, which are packaged and disposed at a permitted, off-site hazardous waste management facility.

7.4 Results

Approximately 238 gallons of leachate were generated during the CY 2019 reporting period. Table 7-1 provides the quarterly quantities.

Table 7-1
 Gallons of Leachate Pumped from the Leachate Collection and Removal System Sump
 Calendar Year 2019

Collection Dates	Leachate Volume (gallons)
March 6, 2019	67
June 26, 2019	63
September 11, 2019	55
December 5, 2019	53
Total Volume (gallons)	238

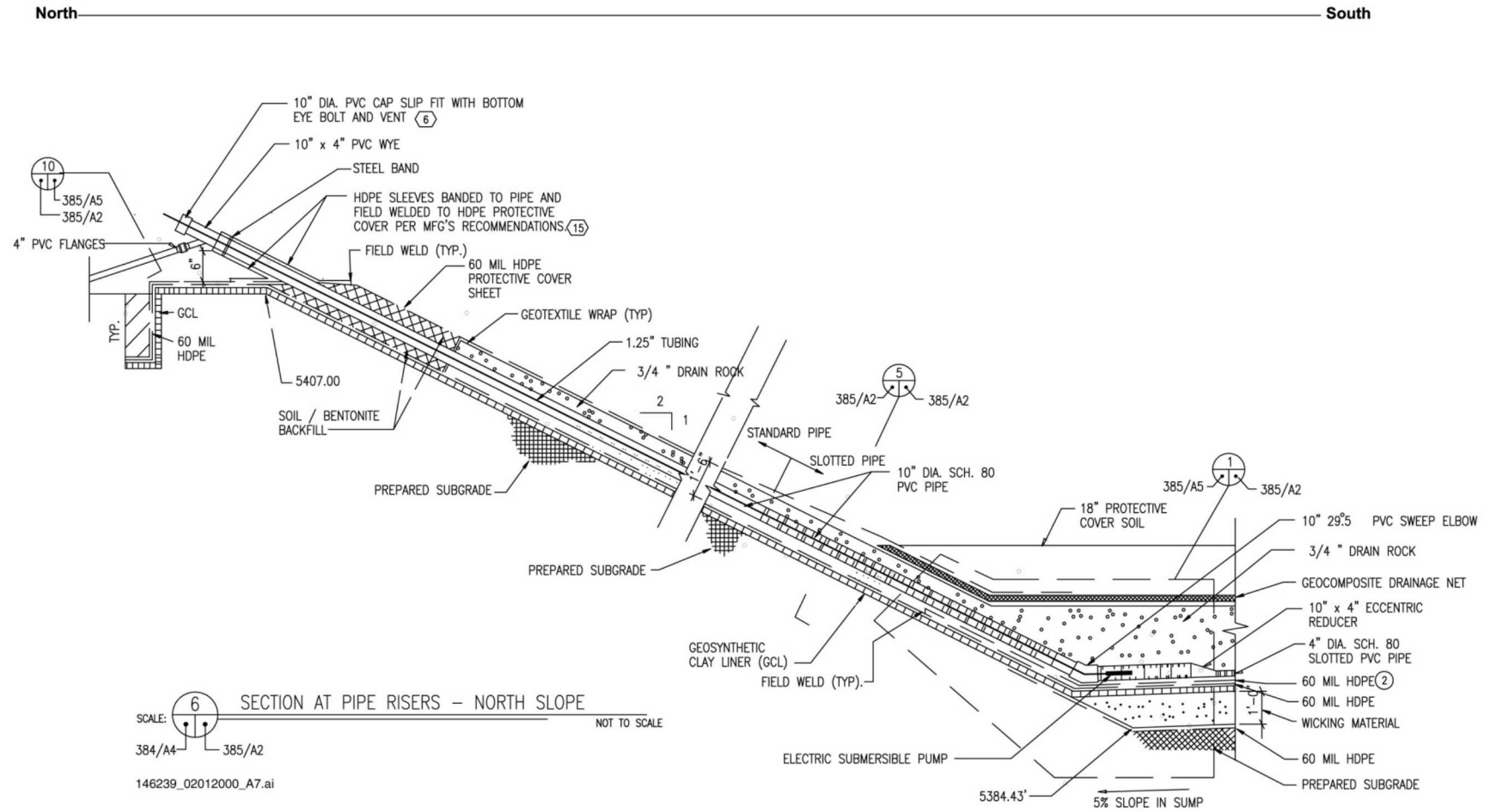


Figure 7-1
 North-South Cross-Section of Leachate Collection and Removal System Sump

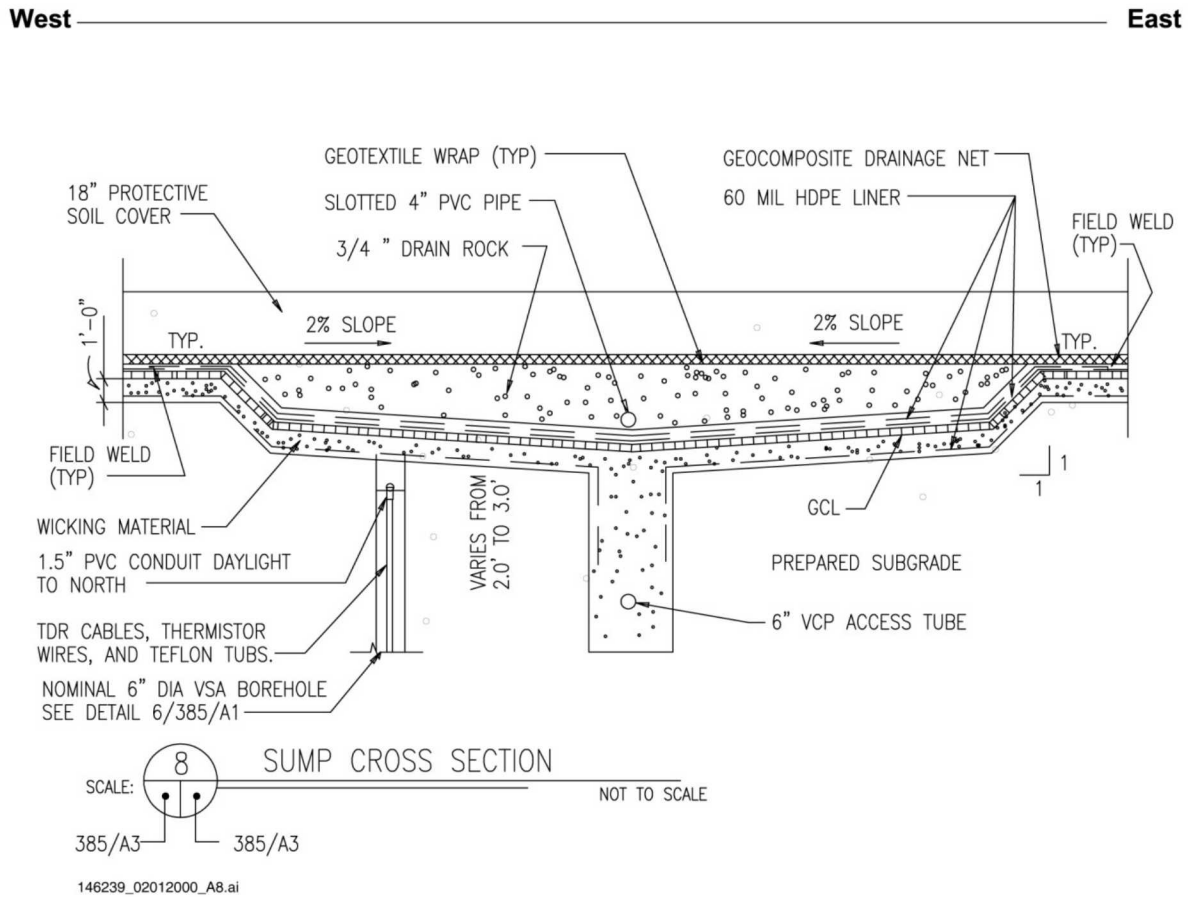


Figure 7-2
 West-East Cross-Section of Containment Cell

This page intentionally left blank

8.0 INSPECTION, MAINTENANCE, AND REPAIR RESULTS

Permit Attachment E, Section E.10 details inspection requirements for the final cover system, stormwater diversion structures, LCRS, VZMS, security fence, and safety and emergency equipment. Personnel meeting the qualification and training requirements of Permit, Attachment F performed all inspections. Permit Attachment E, Table E-6 provides the schedule for implementing inspections and prescribed maintenance and/or repairs. Table 8-1 of this report summarizes the inspection date, type, frequency, and documentation form for inspections performed during the CY 2019 reporting period.

8.1 Final Cover System Inspection/Maintenance/Repair Activities

Inspection of the cover system is divided into two parts. Part I is a quarterly inspection performed by a field technician. The quarterly inspections were performed in March, June, September, and December 2019, and included the following parameters:

- Visible settlement of the soil cover in excess of 6 inches.
- Erosion of the soil cover in excess of 6 inches deep.
- Identifying, for removal, plant species that can develop a deep-root system of 8 feet or greater at maturity.
- Animal burrows more than 4 inches in diameter or burrows that appear to be of a species able to burrow to a depth of 6 feet or greater.
- Contiguous areas of no vegetation greater than 200 square feet.

The results are provided below.

March 4, 2019 Inspection

No conditions were identified that required maintenance or repairs.

June 3, 2019 Inspection

No conditions were identified that required maintenance or repairs.

September 9, 2019 Inspection

One *atriplex canescens* (commonly known as four-wing saltbush) plant was identified on the cover system. The plant was removed by the field technician during the inspection. One animal burrow more than 4 inches in diameter was identified on the cover system. It was backfilled by the field technician on September 16, 2019 after it was determined to be inactive by a staff biologist. No other conditions were identified that required repair or maintenance.

December 4, 2019 Inspection

No conditions were identified that required maintenance or repairs.

Part II of the cover system inspection included a staff biologist performing an annual biology inspection on September 5, 2019; and included the following inspection parameters:

- Approximate percentage vegetative coverage (actively photosynthesizing or living plants as determined during the growing season).
- Of the total vegetative cover, the approximate percentage native vegetation.
- Main plant species growing on the cover and the approximate percentage of the cover populated by each species.

Approximately 38% of the vegetative cover was identified as actively photosynthesizing, primarily comprised of galleta grass (27%), mesa dropseed (8%), blue grama (2%), and side-oats grama (1%). Approximately 97% of the actively photosynthesizing plants were identified as native vegetation.

Table 8-1
Inspection Frequency and Dates Performed
Calendar Year 2019

Inspection Type	Frequency ^a	Inspection Documentation Form	Date Performed
Final Cover System – Part I Stormwater Diversion Structures Security Fence	Quarterly	CAMU Post-Closure Quarterly Inspection Form Final Cover System/Stormwater Diversion Structures/Security Fence	March 4, 2019
			June 3, 2019
			September 9, 2019
			December 4, 2019
Final Cover System – Part II (vegetative cover)	Annually ^b	CAMU Post-Closure Inspection Form Final Cover Biology System	September 5, 2019
LCRS	Quarterly	CAMU Post-Closure Quarterly Inspection Form LCRS	March 6, 2019
			June 26, 2019
			September 11, 2019
			December 5, 2019
VZMS	Quarterly	CAMU Post-Closure Quarterly Inspection Form VZMS CSS Soil Moisture/Soil Vapor Monitoring Locations & Equipment	February 21, 2019
			May 2, 2019
			August 20, 2019
			November 5, 2019
		CAMU Post-Closure Quarterly Inspection Form VZMS PSL Soil Moisture Monitoring Locations & Equipment	February 27 & 28, 2019; March 5, 2019
			May 6, 2019; June 3 & 5, 2019
			August 21, 22, & 23, 2019
			November 7 & 14, 2019
		CAMU Post-Closure Quarterly Inspection Form VZMS VSA Soil Moisture Monitoring Locations & Equipment	February 26, 2019
			May 8, 2019
			August 12, 2019
			November 5, 2019
Safety and Emergency Equipment	Monthly	CAMU Post-Closure Monthly Inspection Form Safety and Emergency Equipment	January 3, 2019
			February 6, 2019
			March 6, 2019
			April 3, 2019
			May 1, 2019
			June 5, 2019
			July 3, 2019
			August 1, 2019
			September 4, 2019
			October 9, 2019
			November 6, 2019
			December 4, 2019

Notes:

^aInspection frequency and criteria taken from Permit Attachment E, Table E-6.

^bChanged from quarterly to annually after meeting successful revegetation criteria as determined by the staff biologist during the September 2015 growing season inspection. Revegetation criteria specified in Permit Attachment E, Section E.10.2.

CAMU = Corrective Action Management Unit.
 CSS = Chemical Waste Landfill sanitary sewer.
 LCRS = Leachate collection and removal system.
 PSL = Primary subliner.

VSA = Vertical sensor array.
 VZMS = Vadose zone monitoring system.

8.2 Stormwater Diversion Structures System Inspection/Maintenance/Repair Activities

A field technician performed inspections of the stormwater diversion structures system in March, June, September, and December 2019; and included the following parameters:

- Channel or sidewall erosion in excess of 6 inches deep.
- Channel sediment accumulation in excess of 6 inches deep.
- Debris that blocks more than one-third of the channel width.

The results are provided below.

March 4, 2019 Inspection

Wind-blown plant debris was identified in the north catch basin. The plant debris was removed by the cover system maintenance contractor as of April 4, 2019, within 60 days of the inspection. No other conditions were identified that required repair or maintenance.

June 3, 2019 Inspection

Wind-blown plant debris was identified on the north drainage grate and in the north catch basin. The plant debris was removed by the field technician during the inspection. No other conditions were identified that required repair or maintenance.

September 9, 2019 Inspection

No conditions were identified that required maintenance or repairs.

December 4, 2019 Inspection

Wind-blown plant debris was identified on the north drainage grate and in the north catch basin. The plant debris was removed by the field technician during the inspection. No other conditions were identified that required repair or maintenance.

8.3 Security Fence Inspection/Maintenance/Repair Activities

A field technician performed an inspection of the security fence in March, June, September, and December 2019. The inspections included the following parameters:

- Accumulation of wind-blown plants and debris.
- Fence wires and posts in need of repair/maintenance.
- Gates in need of oiling/repair/maintenance.
- Locks in need of cleaning or replacement.
- Warning signs in need of repair or replacement.

The results are provided below.

March 4, 2019 Inspection

Wind-blown plant debris was identified along the security fence. The plant debris was removed by the cover system maintenance contractor as of April 4, 2019, within 60 days of the inspection. No other conditions were identified that required repair or maintenance.

June 3, 2019 Inspection

A loose warning sign was identified on the security fence. The warning sign was reattached to the fence by the field technician during the inspection. Wind-blown plant debris was identified along the security fence. The plant debris was removed by the field technician during the inspection. No other conditions were identified that required repair or maintenance.

September 9, 2019 Inspection

No conditions were identified that required maintenance or repairs.

December 4, 2019 Inspection

Wind-blown plant debris was identified along the security fence. The plant debris was removed by the field technician the same day as the inspection. No other conditions were identified that required repair or maintenance.

8.4 Leachate Collection Removal System Inspection/Maintenance/Repair Activities

A field technician performed an inspection of the LCRS during the leachate removal operation. The inspections were performed in March, June, September, and December 2019; and included the following parameters:

- Visual inspection of the dedicated hose and fittings (i.e., connections and end caps).
- Testing of the ground fault circuit interrupter used to power the submersible pump.
- Audible check to verify the pump is operational. If there is no audible sound and/or the pump fails to extract leachate from the sump, it is pulled from the sump and inspected. If determined that the pump is functioning properly, yet no leachate was removed, a visual inspection is made of the sump with a down-hole video camera to determine the leachate level.

No conditions were identified that required maintenance or repairs during CY 2019.

8.5 Vadoso Zone Monitoring System Inspection/Maintenance/Repair Activities

A field technician performed an inspection of the VZMS (i.e., CSS, PSL, and VSA monitoring subsystems) in conjunction with VZMS monitoring. Inspections were performed in February/March, May/June, August, and November 2019; and included the following parameters:

- Protective casings, access covers and doors, instrumentation access boxes, and compression caps (repair/maintenance or replacement).
- Locks (cleaning or replacement).
- Electronic monitoring system (calibration/repair/maintenance).
- Aboveground VZMS components exposed to weather (general condition).
- Monitoring equipment, such as pump, tubing, gauges, valves, etc. (repair/maintenance or replacement).

Sediment accumulation was identified on the concrete pads at all six CSS monitoring locations during the February 21, 2019 inspection. The sediment was removed by the field technician during the inspection.

Sediment accumulation was identified on the concrete pads at the CSS-3 and CSS-4 locations during the August 20, 2019 inspection. The sediment was removed by the field technician during the inspection.

No other conditions were identified that required maintenance or repair during CY 2019.

8.6 Safety and Emergency Equipment/Maintenance/Repair Activities

A field technician performed monthly inspections of the following safety and emergency equipment:

- Spill control materials, including sorbent material, brooms and shovels are present, accessible, and in good condition.
- Fire extinguisher is present, charged, accessible, and in good condition.
- Portable eyewash station is operational and in good condition.
- Fire hydrant is operational, accessible, and in good condition.

No conditions were identified that required repair or maintenance during CY 2019.

8.7 Site Maintenance

Site maintenance activities were performed by the cover system maintenance contractor four times during CY 2019 to address issues identified during inspections and as best practice to reduce growth of invasive weeds and promote the health of the desired native grasses on the containment cell cover.

March 26 through April 4, 2019

Wind-blown plant debris was removed from the security fence, the perimeter drainage feature, the north catch basin, and the containment cell cover. A sterilant (Hyvar-water mixture) was applied to the area starting 2 feet from the containment cell cover toe to the security fence, excluding the north catch basin. This work was performed as best practice to prevent unwanted vegetative growth (e.g., Russian thistle invasive weeds) in the areas where the sterilant was applied.

May 17, 2019

Live vegetation and/or wind-blown plant debris was removed from the security fence, the perimeter drainage feature, the north catch basin, and the containment cell cover.

August 7 through August 8, 2019

Live vegetation and/or wind-blown plant debris was removed from security fence, the perimeter drainage feature, the north catch basin, and the containment cell cover.

December 4, 2019

A pre-emergent herbicide (Prodiamine-water mixture) was applied to the 3-foot area along the outer edge of the containment cell cover toe (drainage area). The herbicide-water mixture was also applied to the southern slope and containment cell cover surface, extending 50 feet north from the southern containment cell cover toe. This work was recommended by the staff biologist as a preventive measure to reduce the late winter/early spring invasive weed growth without harming the desired native grass species. The southern end of the containment cell cover was targeted due to this area being more prone to Russian thistle weed growth in previous years.

This page intentionally left blank

9.0 SUMMARY AND CONCLUSIONS

This chapter provides a summary of CY 2019 activities and results, along with conclusions.

9.1 Vadose Zone Monitoring System

The VZMS results provide information about the subsurface environment and indicate the containment cell system is performing as designed. The data analysis completed as part of this annual evaluation confirms that the monitoring equipment is functioning properly and providing results that are representative of conditions in the subsurface near the containment cell.

The increasing soil moisture trend at the CSS-2 location (12- and 16-foot depths) was first observed in September 2005. An increasing soil moisture trend at the CSS-3 location (12-foot depth) was first observed in March 2007. During the same periods, the PSL and VSA monitoring locations have remained stable indicating the containment cell is not the source of the moisture. The source of the soil moisture increase was the sanitary sewer line that was repaired with a liner in September 2010. The soil moisture trends at CSS-2 and CSS-3 appear to have stabilized since the line repair was completed.

The moisture in the soil beneath the containment cell liner is the result of historic residual water and water added for soil compaction during containment cell construction activities. The soil and soil moisture content are not homogeneous. Slight soil moisture fluctuations are expected as the post-construction soil moisture levels continue to equilibrate and stabilize. The soil moisture monitoring results show no significant changes and are consistent with those presented in the most recent report of CAMU post-closure care activities (SNL/NM March 2019a). The results at all monitoring locations are significantly below the soil moisture trigger level. These trends indicate that the containment cell is performing as designed and there are no leaks in the system.

One annual soil vapor monitoring event was conducted in May 2019. Analytical results are consistent with previous years. Total VOC results for all sample locations were well below the 20-ppmv trigger level. VOC concentrations continue to correlate with seasonal soil temperature variations, increasing when the soil temperature is warmer and decreasing when soil temperature is cooler. The soil vapor data reflect VOC contamination from the residual VOC soil vapor plume emanating from the CWL. This is consistent with the conceptual model of the CWL residual soil vapor plume (SNL/NM December 2004) based on more than 20 years of VOC soil vapor monitoring at the CWL and 20 years of VOC soil vapor monitoring at the CAMU. Detections of the CWL residual VOC soil vapor plume in the VZMS are expected to continue until the residual VOC plume completely dissipates (see Section 6.2.4).

9.2 Inspections

Inspections of the CAMU cover system, stormwater diversion structures, LCRS, VZMS, security fence, and safety and emergency equipment were performed in accordance with Permit requirements. CY 2019 maintenance and repair activities were minor and generally performed during the inspections. Repairs included removal of wind-blown plant debris from the storm-

water diversion structures and perimeter fence; removing sediment from concrete pads at the CSS monitoring locations; repairing a loose hanging warning sign on the security fence; and removing one four-wing saltbush plant from the containment cell cover. Best practice maintenance was also performed to reduce invasive weed growth and promote the health of the desired native grasses on the containment cell cover surface.

9.3 Regulatory Activities

CY 2019 regulatory activities included submittal of the following to the NMED:

- CAMU Report of Post-Closure Care Activities, Calendar Year 2018 (SNL/NM March 2019a).
- On April 22, 2019, the updated procedure FOP 08-20 for use of the CPN neutron moisture probe (SNL/NM April 2019), went into effect. It was submitted to the NMED on May 13, 2019 within 30 days of the procedure's effective date.
- On July 31 the DOE/NNSA and NTESS requested modifications to the Permit consisting of changes to Attachment F, Training Plan, to allow for online training in addition to the methods already listed; and Attachment H, Post-Closure Care Plan for the Corrective Action Management Unit to revise sampling methods for consistency with similar methods, and to allow the monitoring equipment to be replaced or upgraded with equivalent equipment when it becomes commercially available. These changes went into effect upon NMED approval on October 24, 2019.
- On October 17, 2019, the updated procedure FOP 08-22, Soil Vapor Monitoring (SNL/NM October 2019), went into effect. It was submitted to the NMED on November 8, 2019 within 30 days of the procedure's effective date.

9.4 Conclusions

All CAMU post-closure monitoring, inspection, and maintenance/repair requirements have been met for CY 2019, as required by Permit Part 7, Section 7.3. Specifically, SNL/NM personnel monitored, inspected and maintained the following as discussed in this report:

- The integrity and effectiveness of the final cover, including engineering controls to minimize erosion damage.
- The LCRS, VZMS, fencing, security signs, and locks.

SNL/NM personnel also maintained records of personnel training, operations, inspections, and monitoring activities. This CAMU Report of Post-Closure Care Activities documents all activities and results.

10.0 REFERENCES

Campbell® Scientific, Inc. (Campbell). April 2002. "TDR100 Instruction Manual."

EPA, see U.S. Environmental Protection Agency.

Kieling, J. (New Mexico Environment Department). May 2004. Letter to P. Wagner (U.S. Department of Energy) and P. Davies (SNL/NM), "Re: Approval: Closure Certification and Closure Report for the Corrective Action Management Unit (CAMU), Including Low Temperature Thermal Desorption Unit and Temporary Unit, Technical Area III, Sandia National Laboratories, EPA ID No. NM5890110518 HWB-SNL-SNL-03-026," May 10, 2004.

New Mexico Environment Department (NMED). October 2009. "Resource Conservation and Recovery Act, Post-Closure Care Permit, EPA ID No. NM5890110518, to the U.S. Department of Energy/Sandia Corporation, for the Sandia National Laboratories Chemical Waste Landfill," New Mexico Environment Department Hazardous Waste Bureau, Santa Fe, New Mexico. October 15, 2009.

New Mexico Environment Department (NMED). January 2015. Resource Conservation and Recovery Act Facility Operating Permit, EPA ID No. NM5890110518, to the U.S. Department of Energy/Sandia Corporation, for the Sandia National Laboratories Hazardous and Mixed Waste Treatment and Storage Units and Post-Closure Care of the Corrective Action Management Unit," New Mexico Environment Department Hazardous Waste Bureau, Santa Fe, New Mexico. January 27, 2015.

New Mexico Environment Department (NMED). October 2019. "Approval of Class 1 Permit Modification (Without Prior Approval), Sandia National Laboratories/New Mexico, NM5890110518, HWB-SNL-19-016" October 24, 2019.

NMED, see New Mexico Environment Department.

Sandia National Laboratories, New Mexico (SNL/NM). September 1997. Reprinted June 2002. "Class III Permit Modification Request for the Management of Hazardous Remediation Waste in the Corrective Action Management Unit, Technical Area III." Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico (as amended).

Sandia National Laboratories, New Mexico (SNL/NM). April 1999. "CAMU Containment Cell Construction Quality Assurance Report–Phase II Subsurface Components." Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM). May 2000. "Chemical Waste Landfill Vapor Extraction Voluntary Corrective Measures Final Report." Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM). December 2004. "Chemical Waste Landfill Corrective Measures Study Report." Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories (SNL/NM). September 2008. "Corrective Action Management Unit Vadose Zone Monitoring System Annual Monitoring Results Report." Long-Term Stewardship Post-Closure Care, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM). September 2010. "Chemical Waste Landfill Final Resource Conservation and Recovery Act Closure Report." Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories (SNL/NM). September 2013. "Corrective Action Management Unit Vadose Zone Monitoring System Annual Monitoring Results Report." Long-Term Stewardship Post-Closure Care, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM). April 2016. "Field Operating Procedure Utilizing Neutron Logging, Revision 03." SNL/NM FOP 08-20, Environmental Programs and Assurance Department, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM). October 2016. "Field Operating Procedure, Soil Vapor Monitoring, Revision 04." SNL/NM FOP 08-22, Long-Term Stewardship Department, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM). June 2017. "Data Validation Procedure for Chemical and Radiochemical Data, Issue No: 05." SNL/NM AOP 00-03, Sample Management Office, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM). August 2018. "Field Operating Procedure, Soil Moisture Monitoring Using Time-Domain Reflectometry, Revision 04." SNL/NM FOP 08-21, Long-Term Stewardship Department, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM). March 2019a. "Corrective Action Management Unit Report of Post-Closure Care Activities, Calendar Year 2018." Long-Term Stewardship, Post-Closure Care, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM). April 2019. "Field Operating Procedure Utilizing Neutron Logging, Revision 03." SNL/NM FOP 08-20, Environmental Programs and Assurance Department, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories, New Mexico (SNL/NM). October 2019. "Field Operating Procedure, Soil Vapor Monitoring, Revision 05." SNL/NM FOP 08-22, Long-Term Stewardship Department, Sandia National Laboratories, Albuquerque, New Mexico.

SNL/NM, see Sandia National Laboratories, New Mexico.

U.S. Environmental Protection Agency (EPA). 1993. "Module IV. Special Conditions Pursuant to the 1984 Hazardous and Solid Waste Amendments (HSWA) to RCRA for Sandia National Laboratory, EPA ID Number NM5890110518." August 1993, Region 6, U.S. Environmental Protection Agency, Dallas, Texas.

U.S. Environmental Protection Agency (EPA). January 1999a. "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-14A." Center for Environmental Research Information, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio.

U.S. Environmental Protection Agency (EPA). January 1999b. "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15." Center for Environmental Research Information, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio.

This page intentionally left blank.

ANNEX A
Concentration Graphs of Frequently Detected Volatile Organic Compounds and Soil
Temperatures Over Time for all Vertical Sensor Array Monitoring Locations, September
2002 through May 2019

This page intentionally left blank.

LIST OF FIGURES

Figure		Page
Figure A-1	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-1 (5-ft), September 2002 through May 2019	1
Figure A-2	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-1 (15-ft), September 2002 through May 2019	2
Figure A-3	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-2 (5-ft), September 2002 through May 2019	3
Figure A-4	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-2 (15-ft), September 2002 through May 2019	4
Figure A-5	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-3 (5-ft), September 2002 through May 2019	5
Figure A-6	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-3 (15-ft), September 2002 through May 2019	6
Figure A-7	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-4 (5-ft), September 2002 through May 2019	7
Figure A-8	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-4 (15-ft), September 2002 through May 2019	8
Figure A-9	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-5 (5-ft), September 2002 through May 2019	9
Figure A-10	Concentration Graph of Most Frequently Detected Volatile Organic Compounds VSA-5 (15-ft), September 2002 through May 2019	10
Figure A-11	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-6 (5-ft), September 2002 through May 2019	11
Figure A-12	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-6 (15-ft), September 2002 through May 2019	12
Figure A-13	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-7 (5-ft), September 2002 through May 2019	13
Figure A-14	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-7 (15-ft), September 2002 through May 2019	14
Figure A-15	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-8 (5-ft), September 2002 through May 2019	15
Figure A-16	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-8 (15-ft), September 2002 through May 2019	16

LIST OF FIGURES(Concluded)

Figure	Page
Figure A-17 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-9 (5-ft), September 2002 through May 2019	17
Figure A-18 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-9 (15-ft), September 2002 through May 2019	18
Figure A-19 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-10 (5-ft), September 2002 through May 2019	19
Figure A-20 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-10 (15-ft), September 2002 through May 2019	20
Figure A-21 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-11 (5-ft), September 2002 through May 2019	21
Figure A-22 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-11 (15-ft), September 2002 through May 2019	22

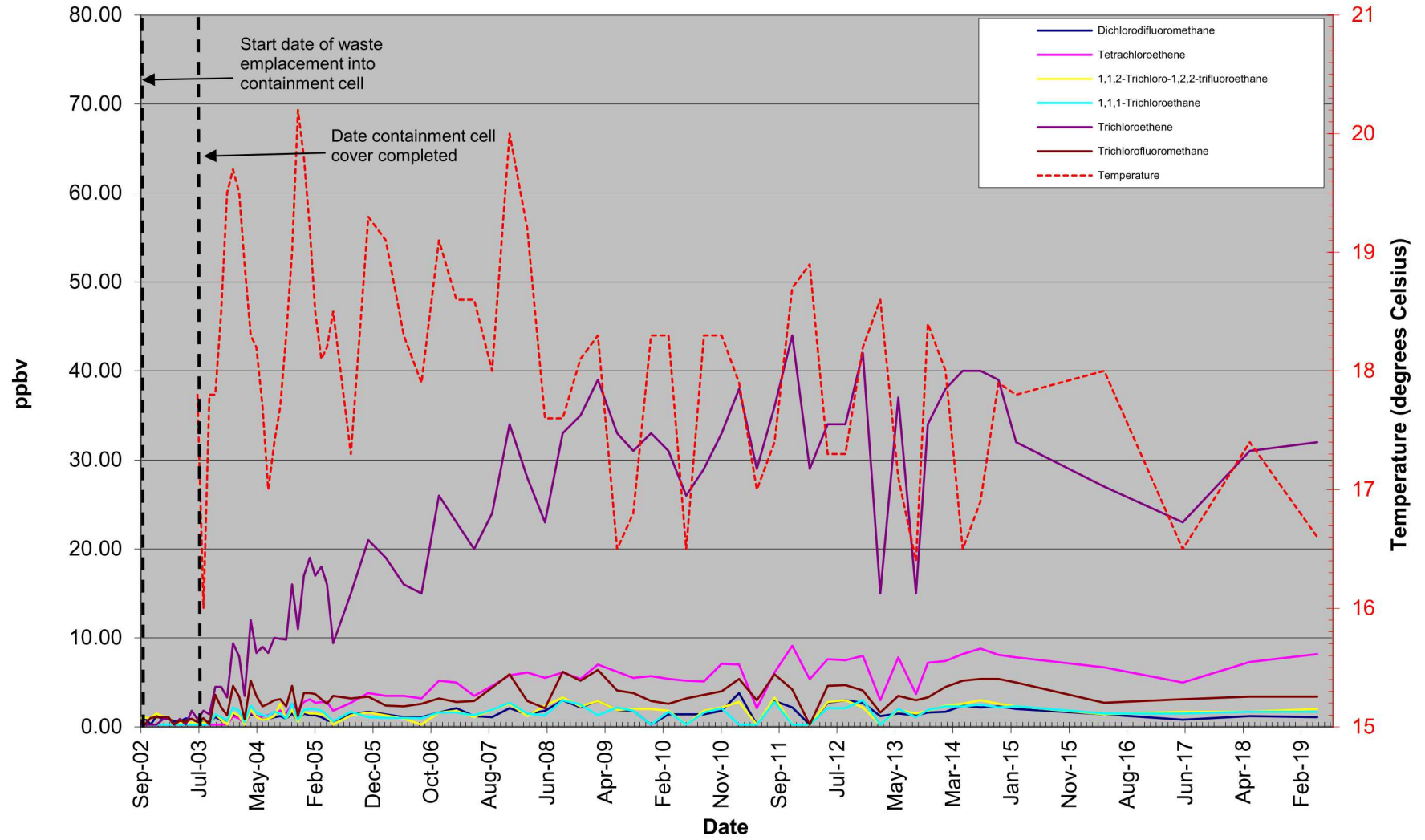


Figure A-1
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-1 (5-ft)
September 2002 through May 2019

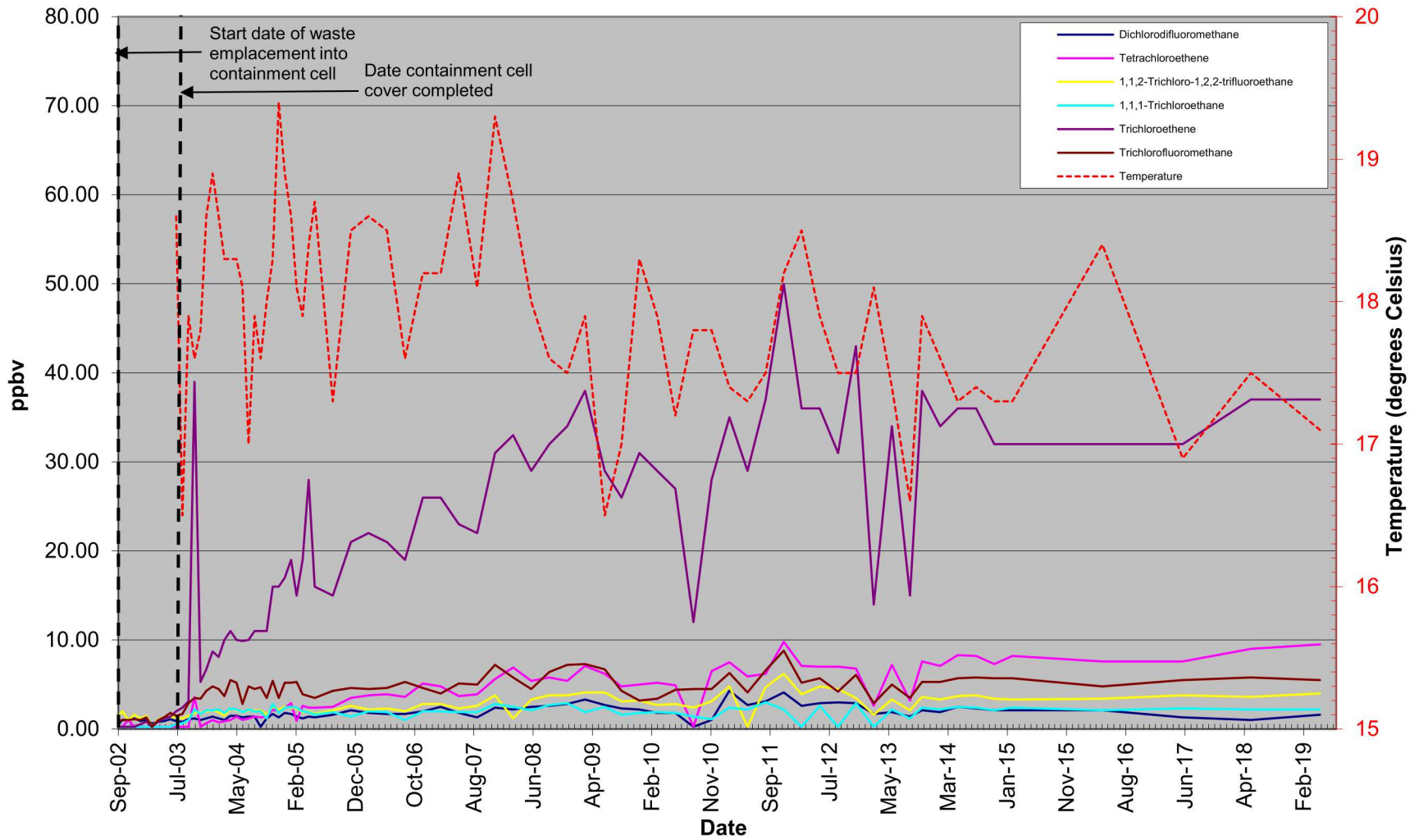


Figure A-2
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-1 (15-ft)
September 2002 through May 2019

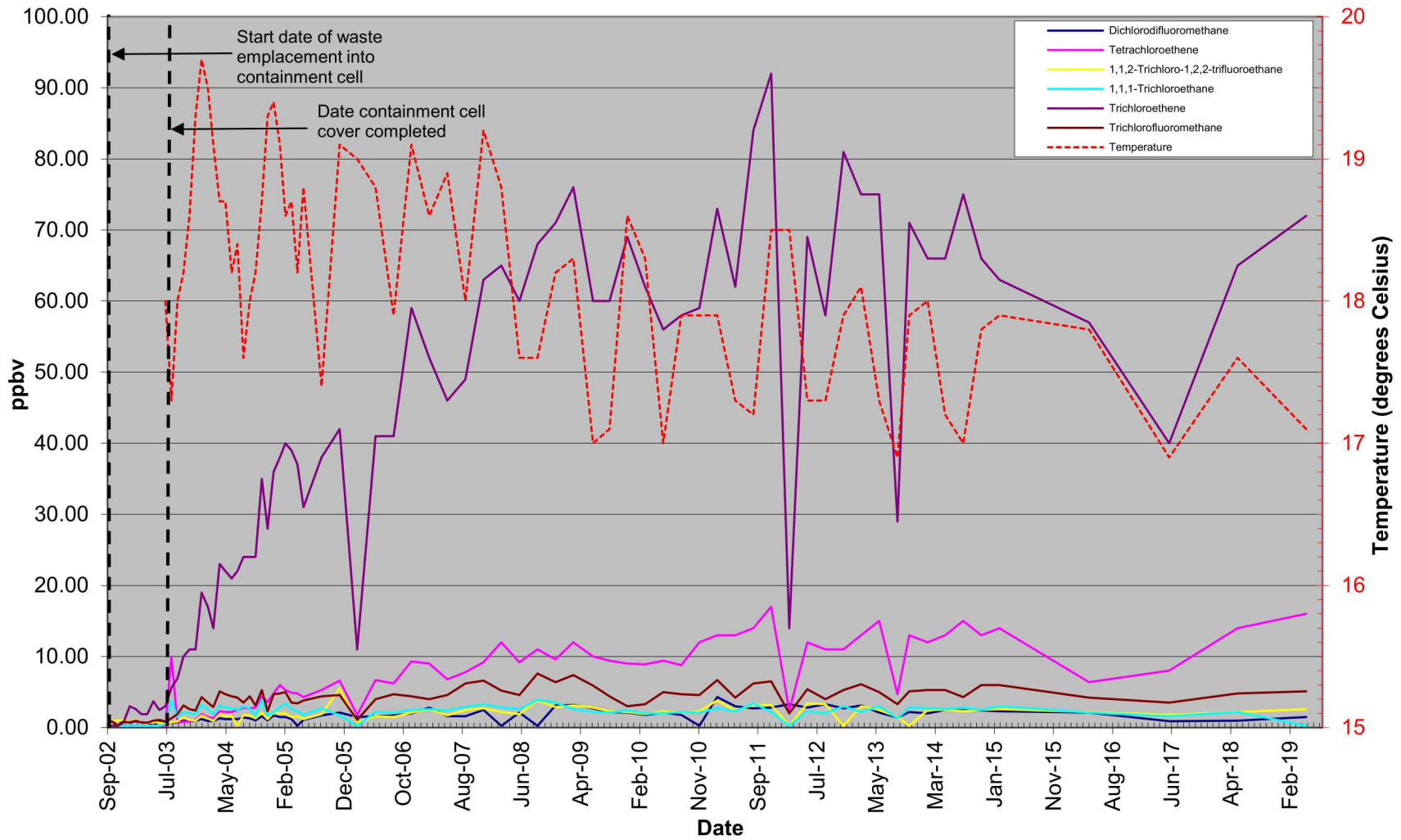


Figure A-3
 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-2 (5-ft)
 September 2002 through May 2019

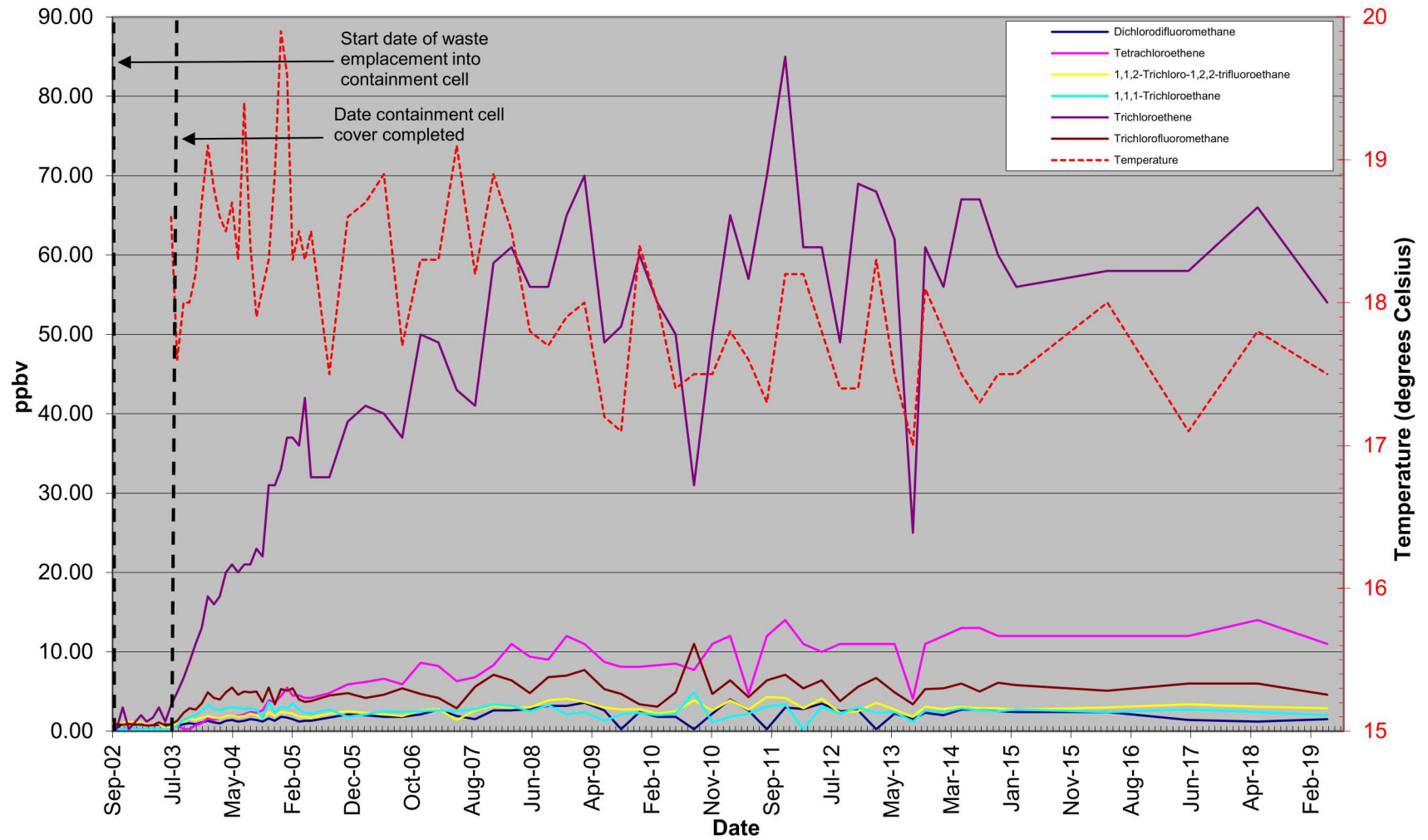


Figure A-4
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-2 (15-ft)
September 2002 through May 2019

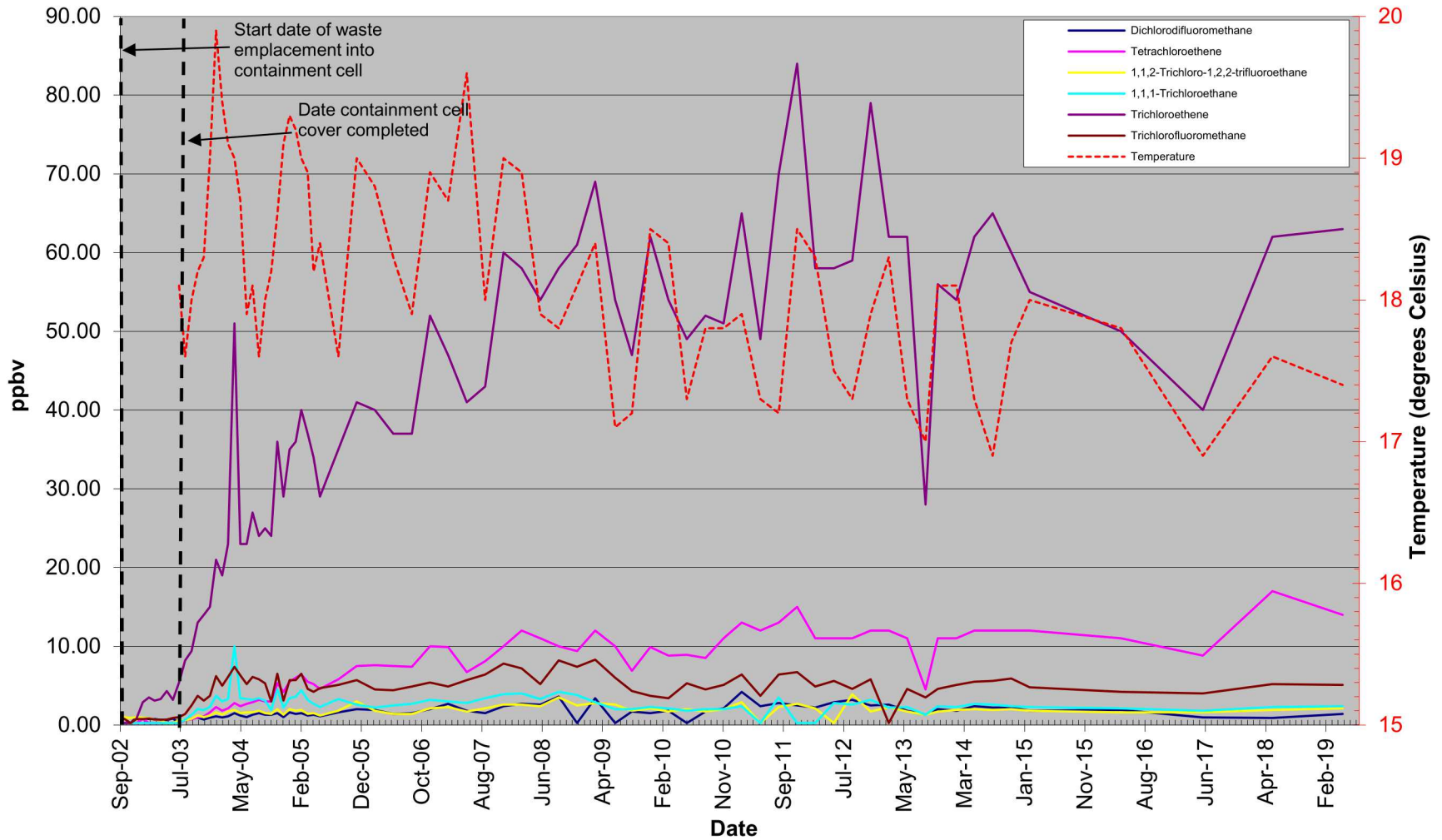


Figure A-5
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-3 (5-ft)
September 2002 through May 2019

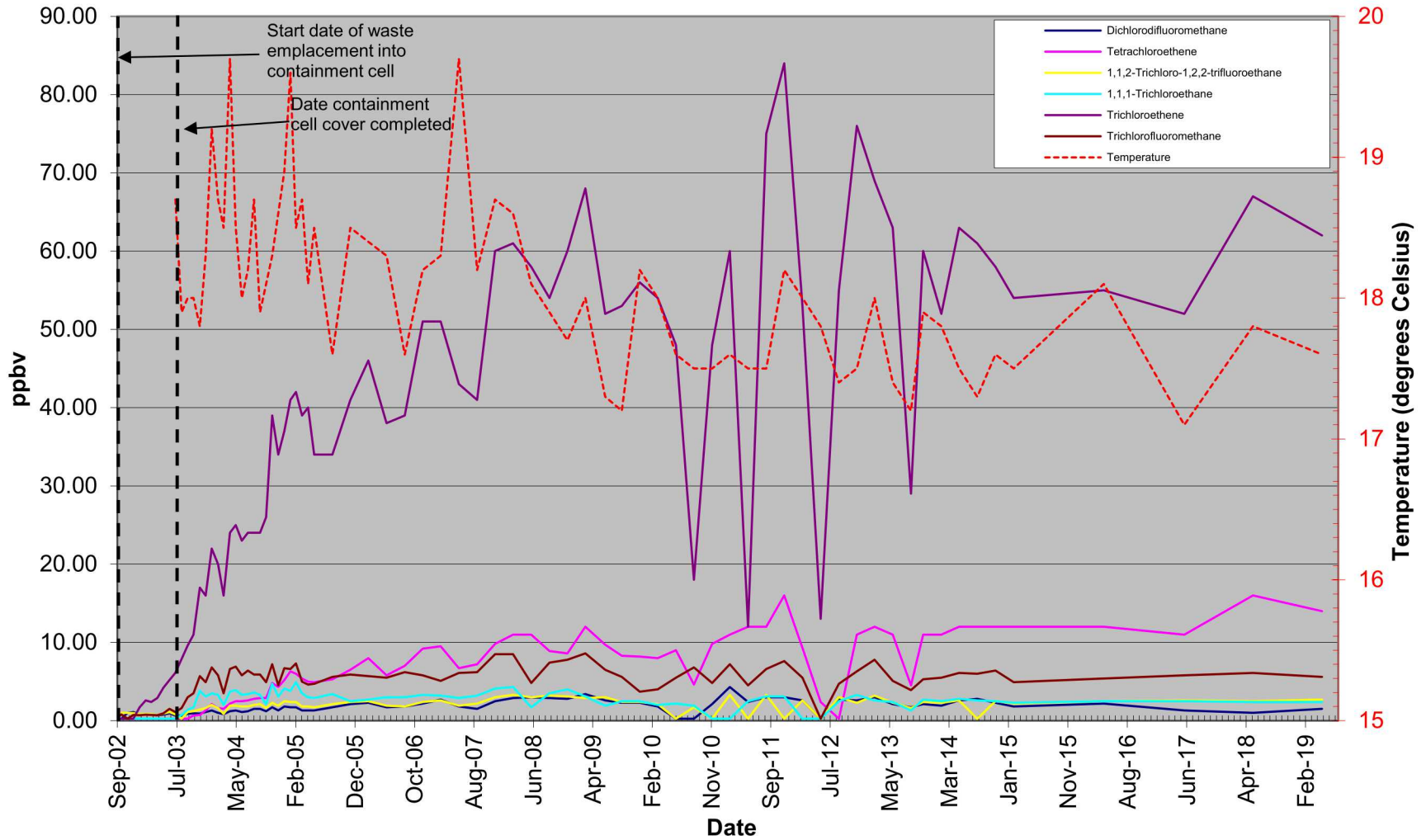


Figure A-6
 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-3 (15-ft)
 September 2002 through May 2019

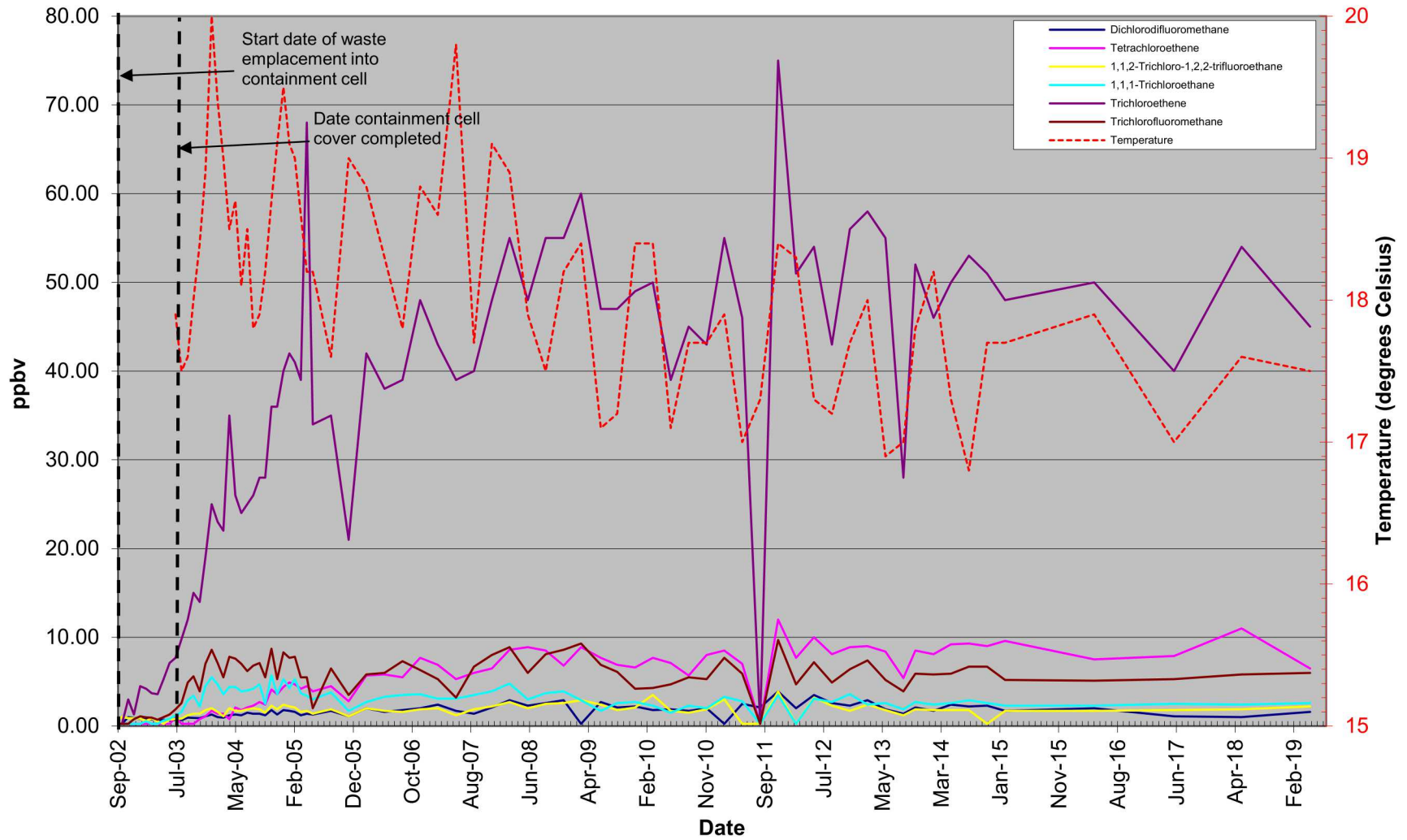


Figure A-7
 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-4 (5-ft)
 September 2002 through May 2019

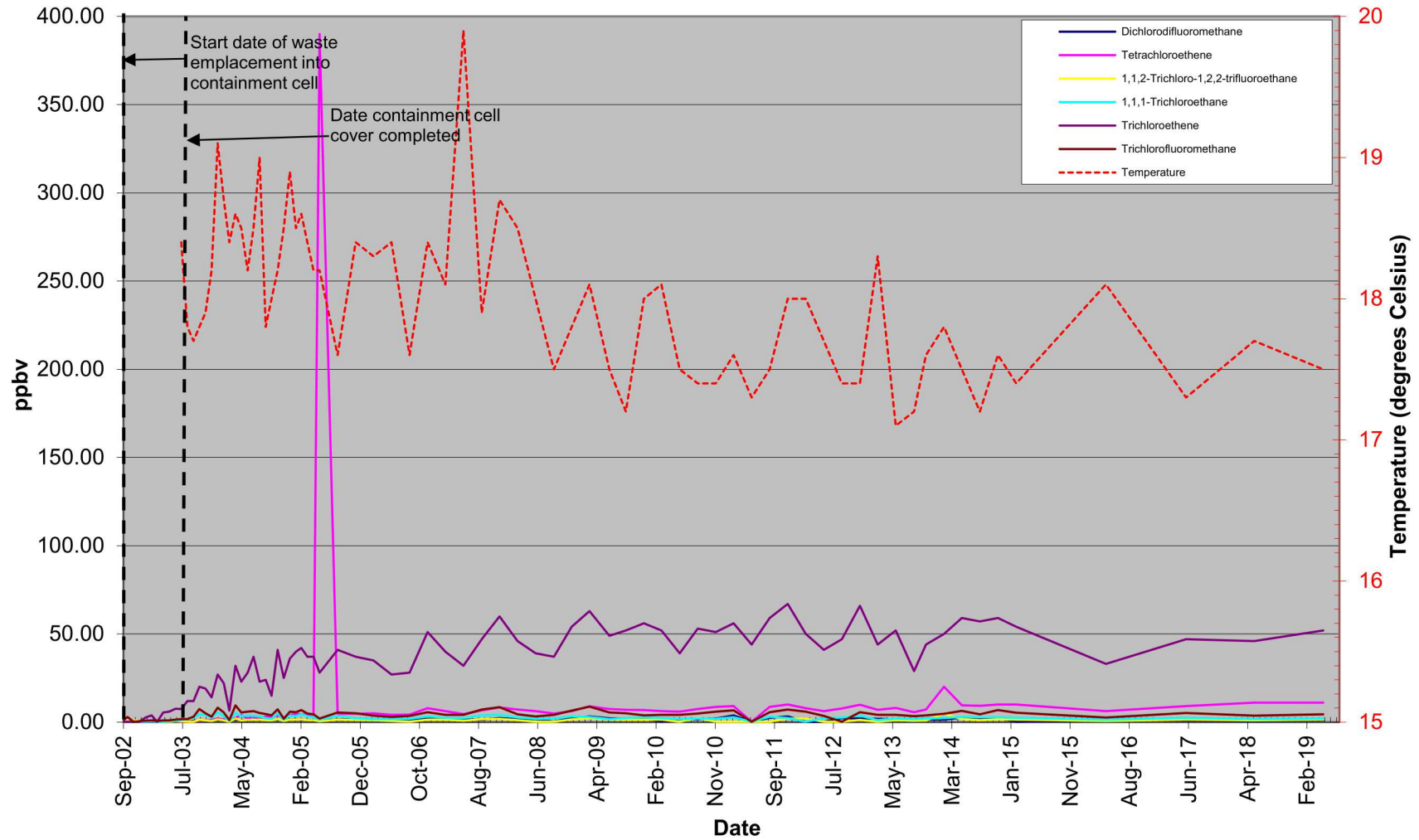


Figure A-8
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-4 (15-ft)
September 2002 through May 2019

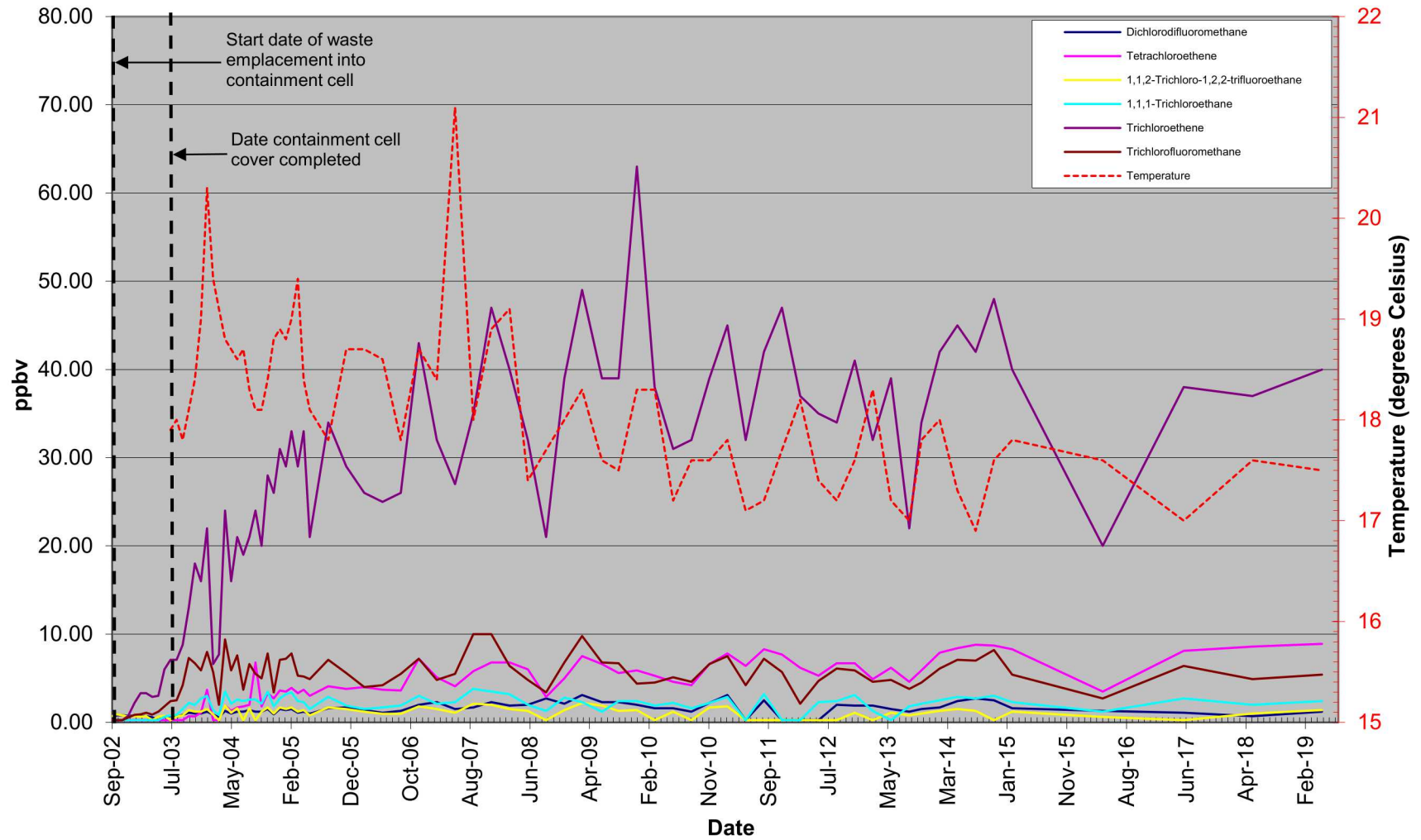


Figure A-9
 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-5 (5-ft)
 September 2002 through May 2019

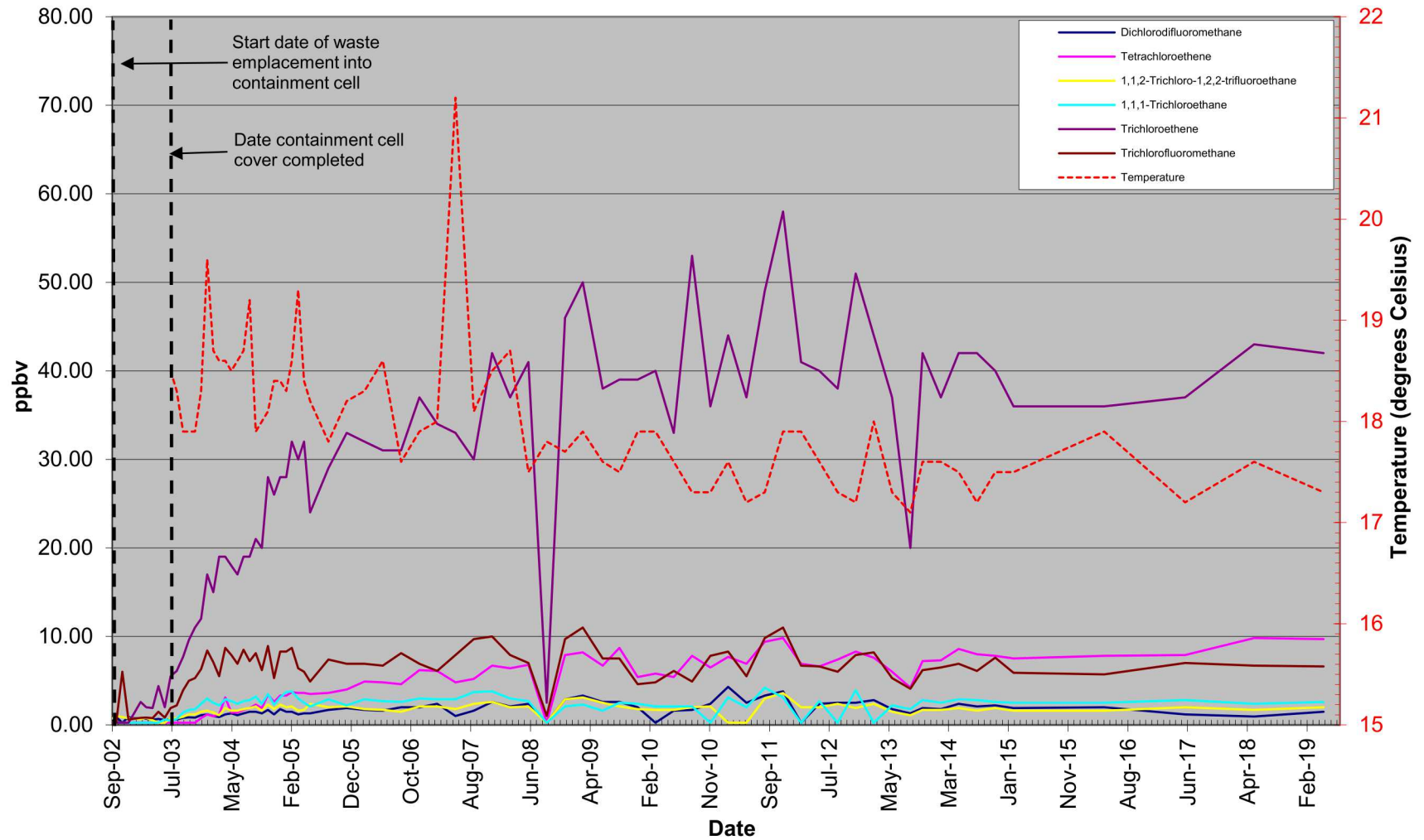


Figure A-10
Concentration Graph of Most Frequently Detected Volatile Organic Compounds VSA-5 (15-ft)
September 2002 through May 2019

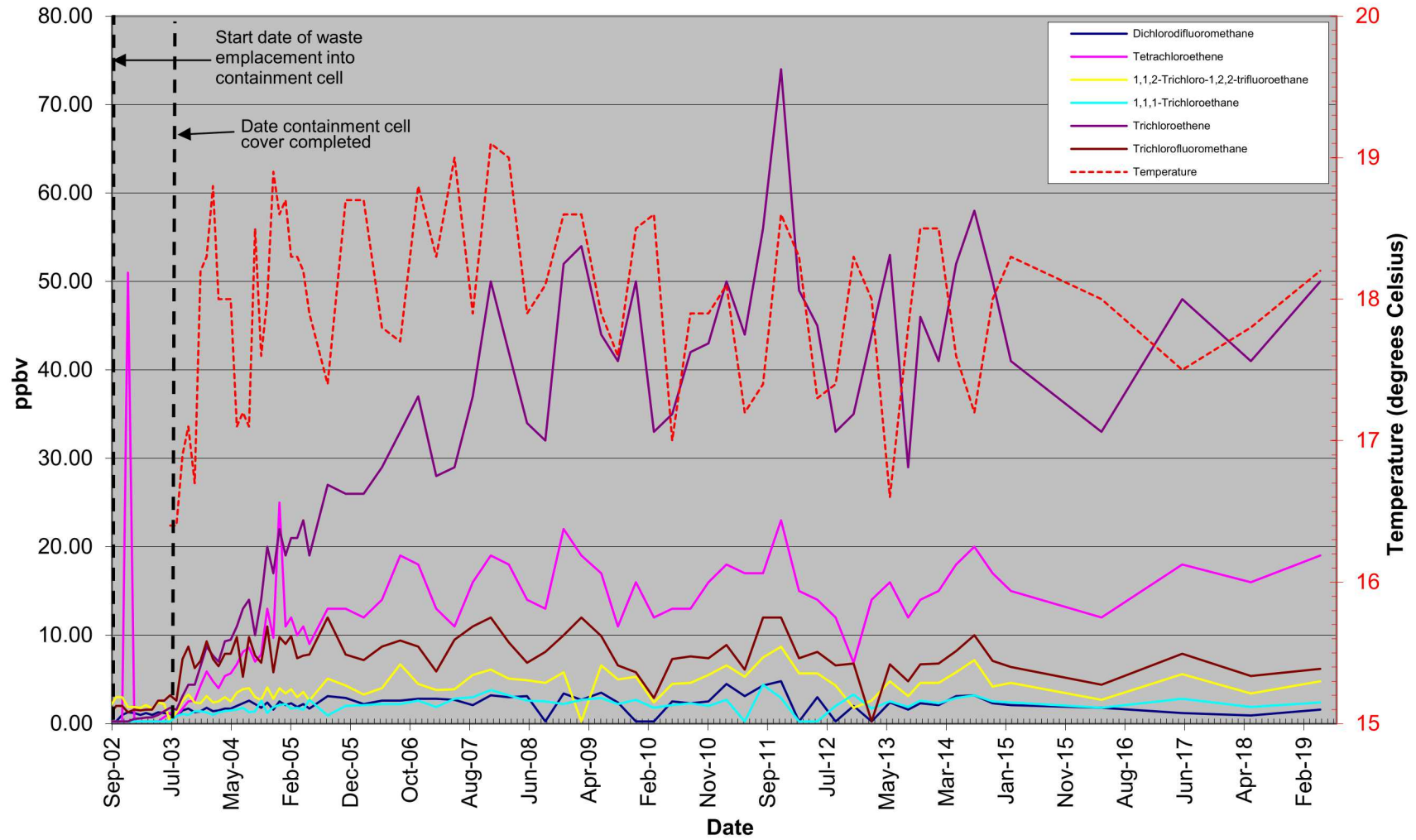


Figure A-11
 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-6 (5-ft)
 September 2002 through May 2019

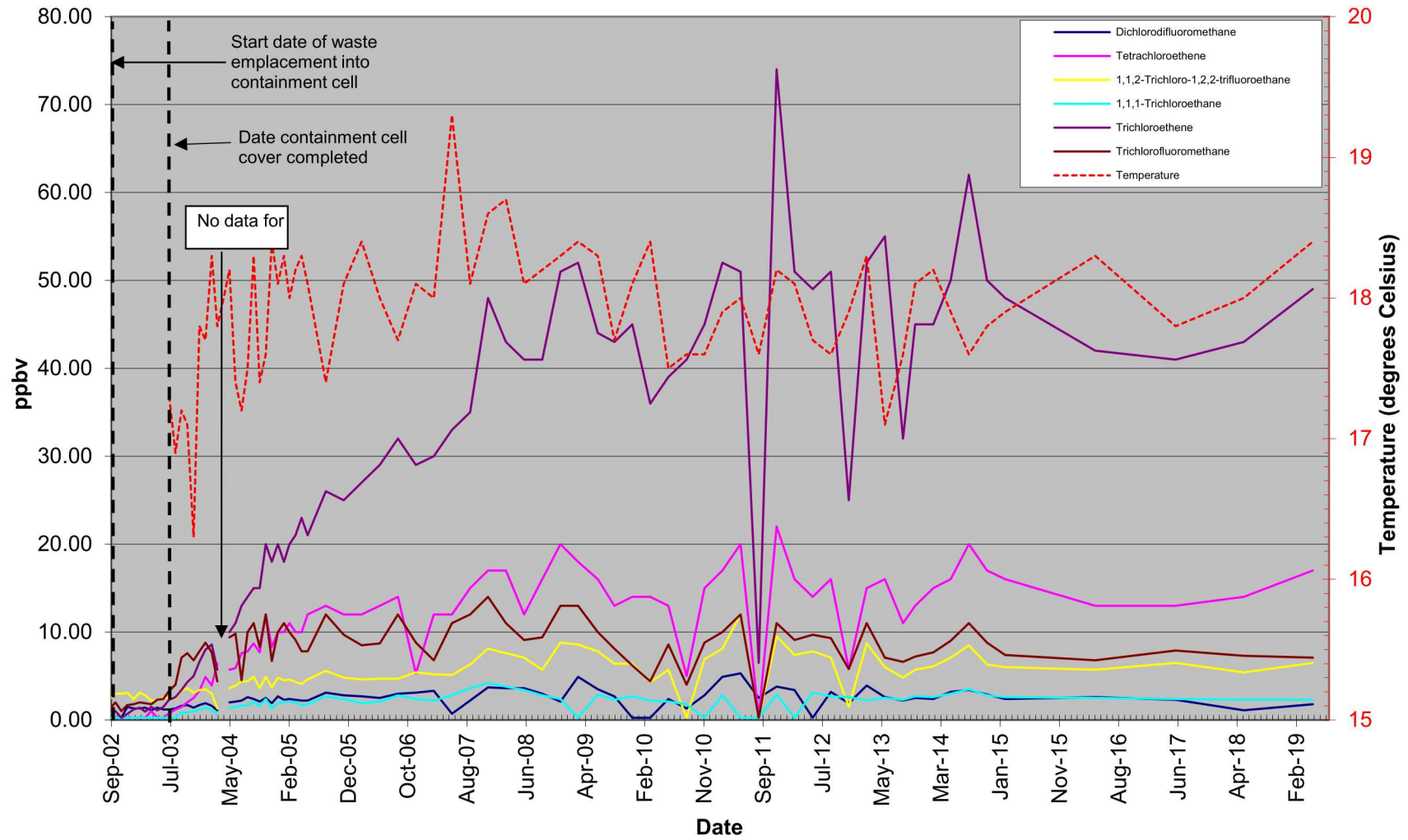


Figure A-12
 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-6 (15-ft)
 September 2002 through May 2019

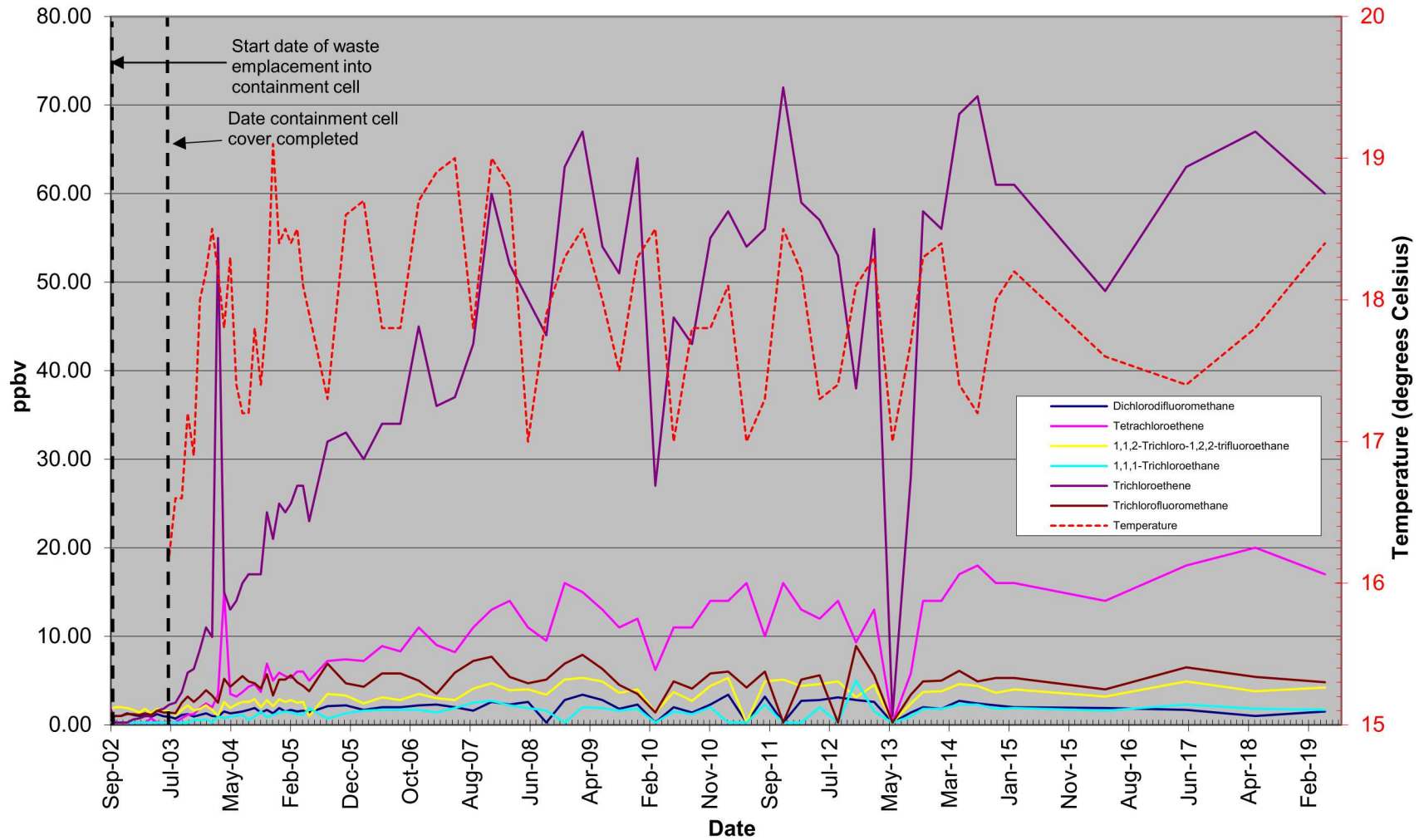


Figure A-13
 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-7 (5-ft)
 September 2002 through May 2019

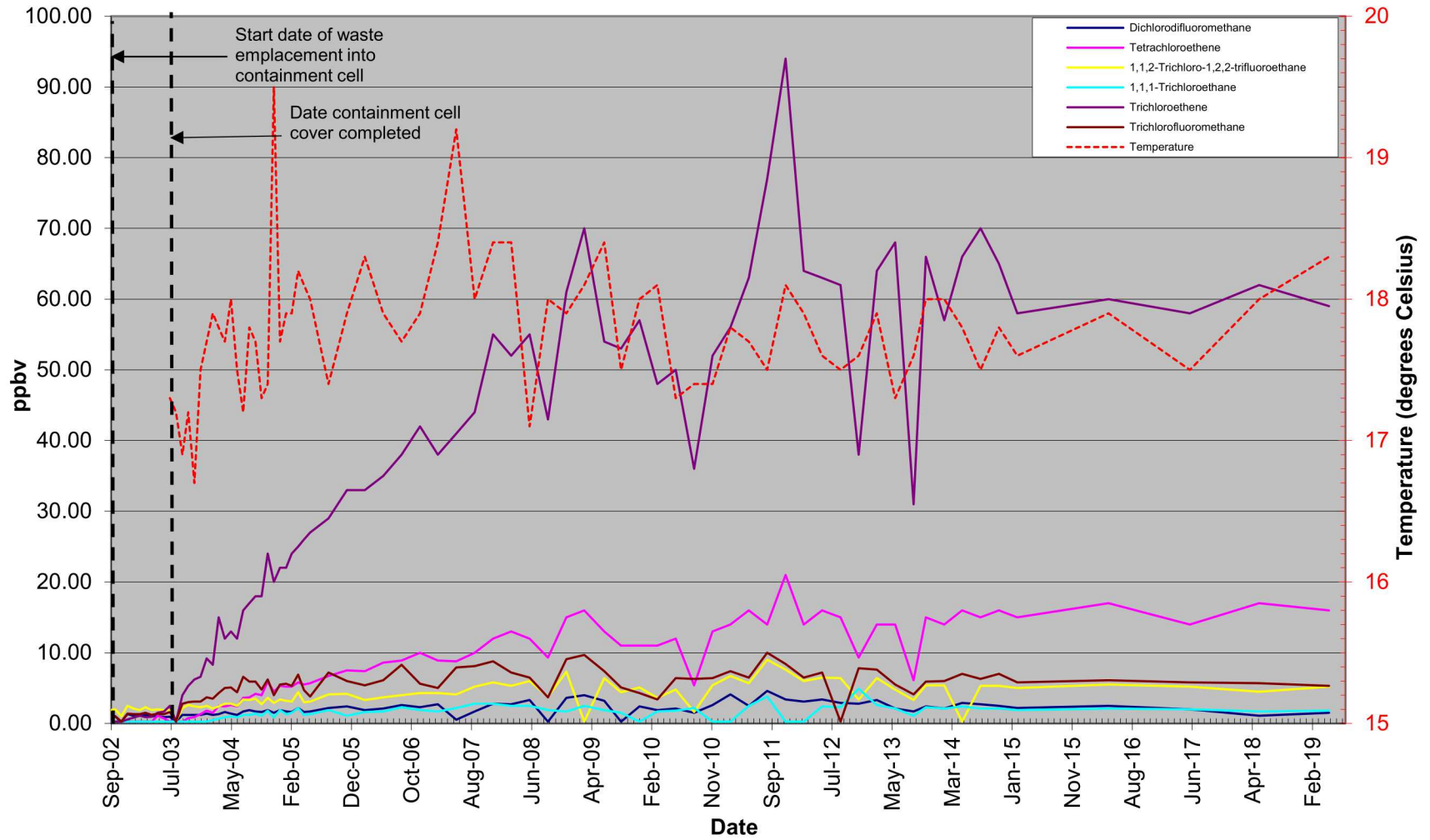


Figure A-14
 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-7 (15-ft)
 September 2002 through May 2019

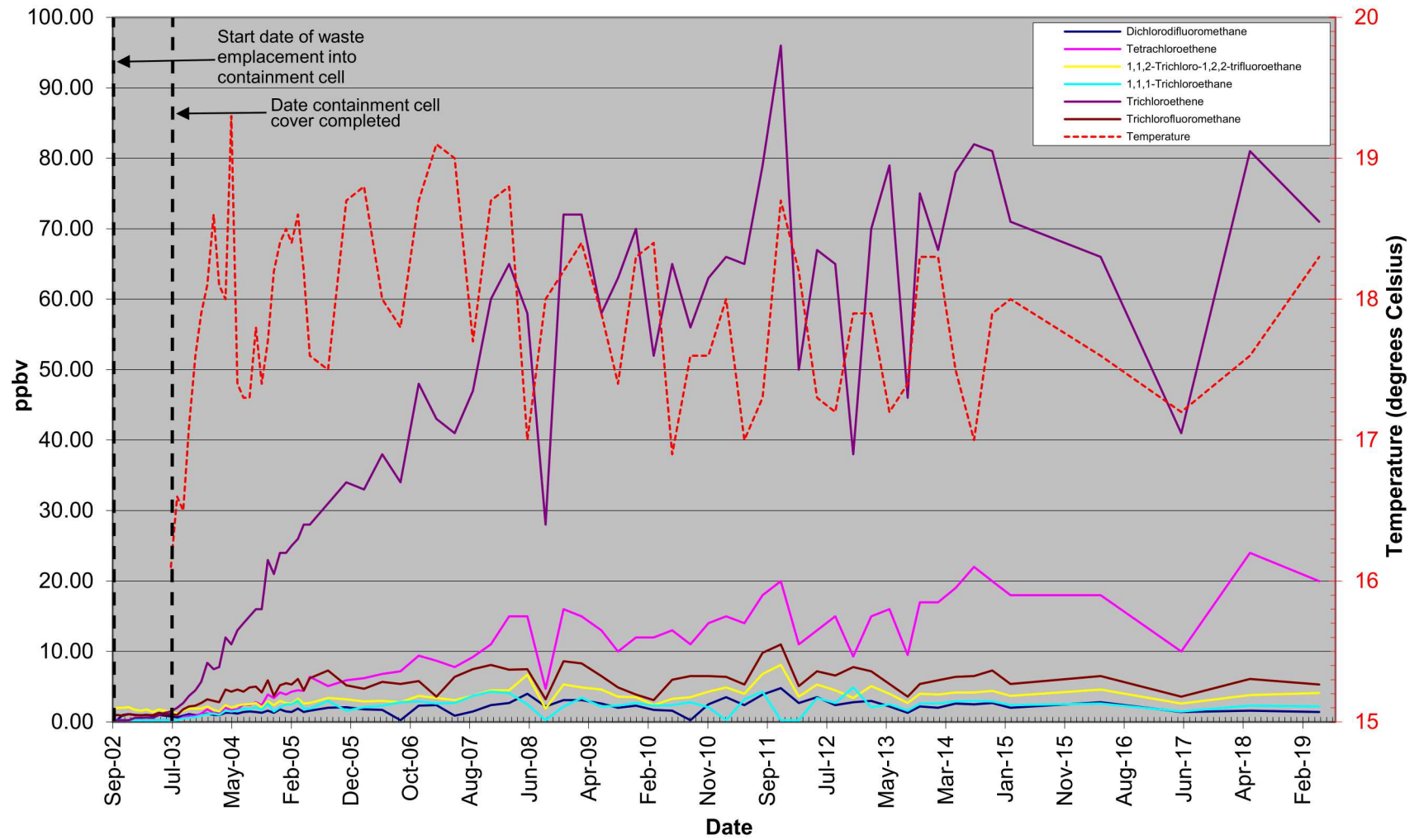


Figure A-15
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-8 (5-ft)
September 2002 through May 2019

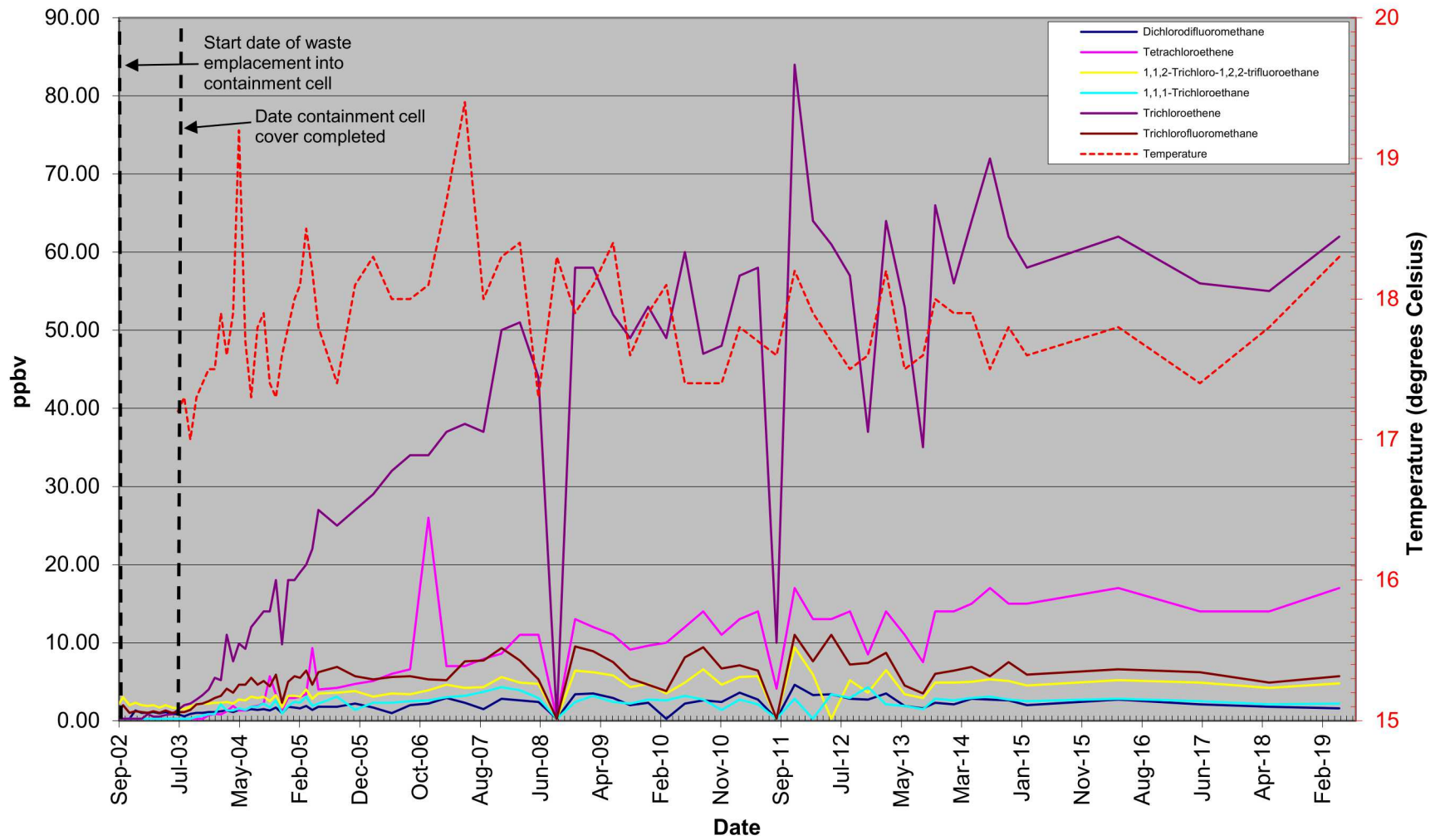


Figure A-16
 Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-8 (15-ft)
 September 2002 through May 2019

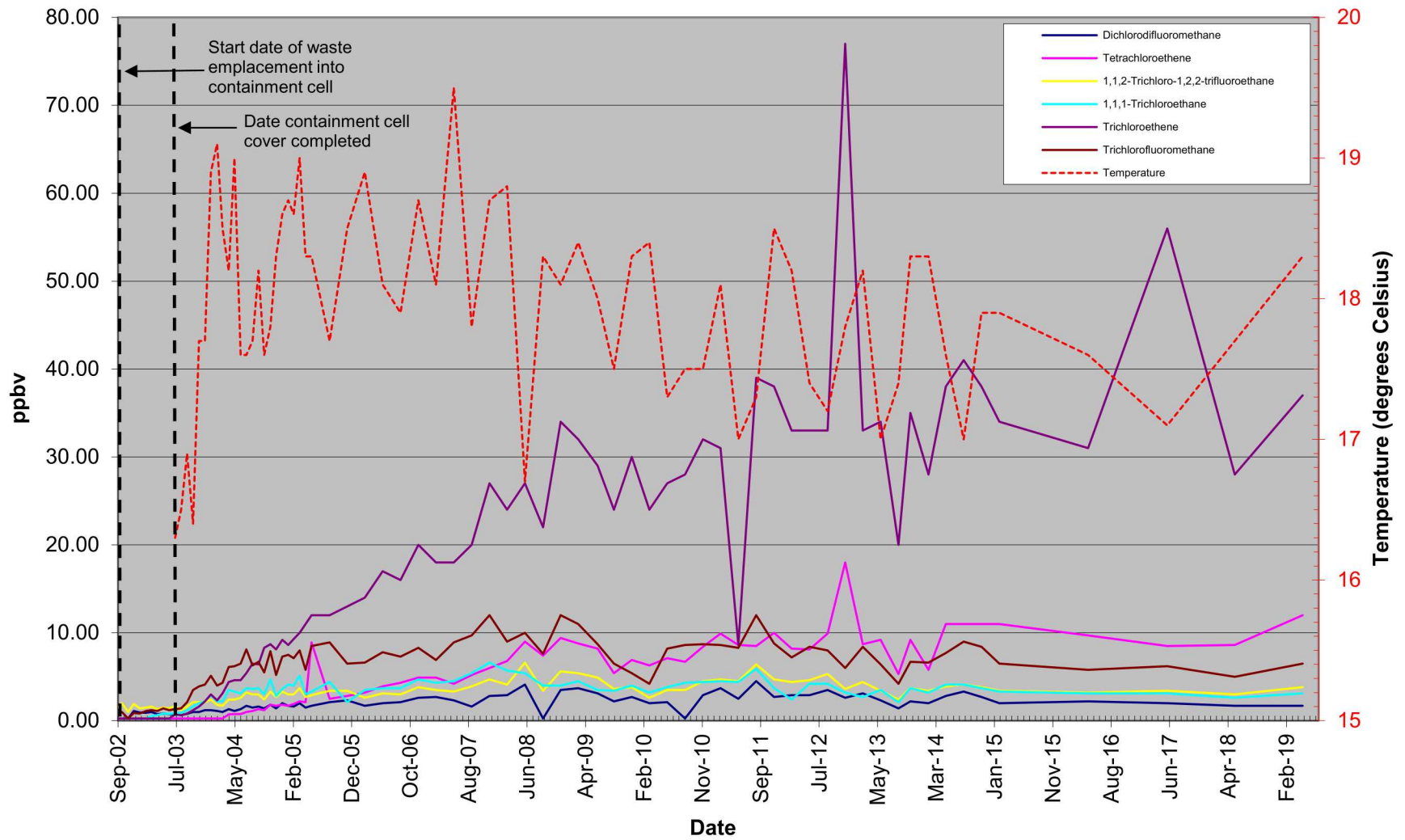


Figure A-17
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-9 (5-ft)
September 2002 through May 2019

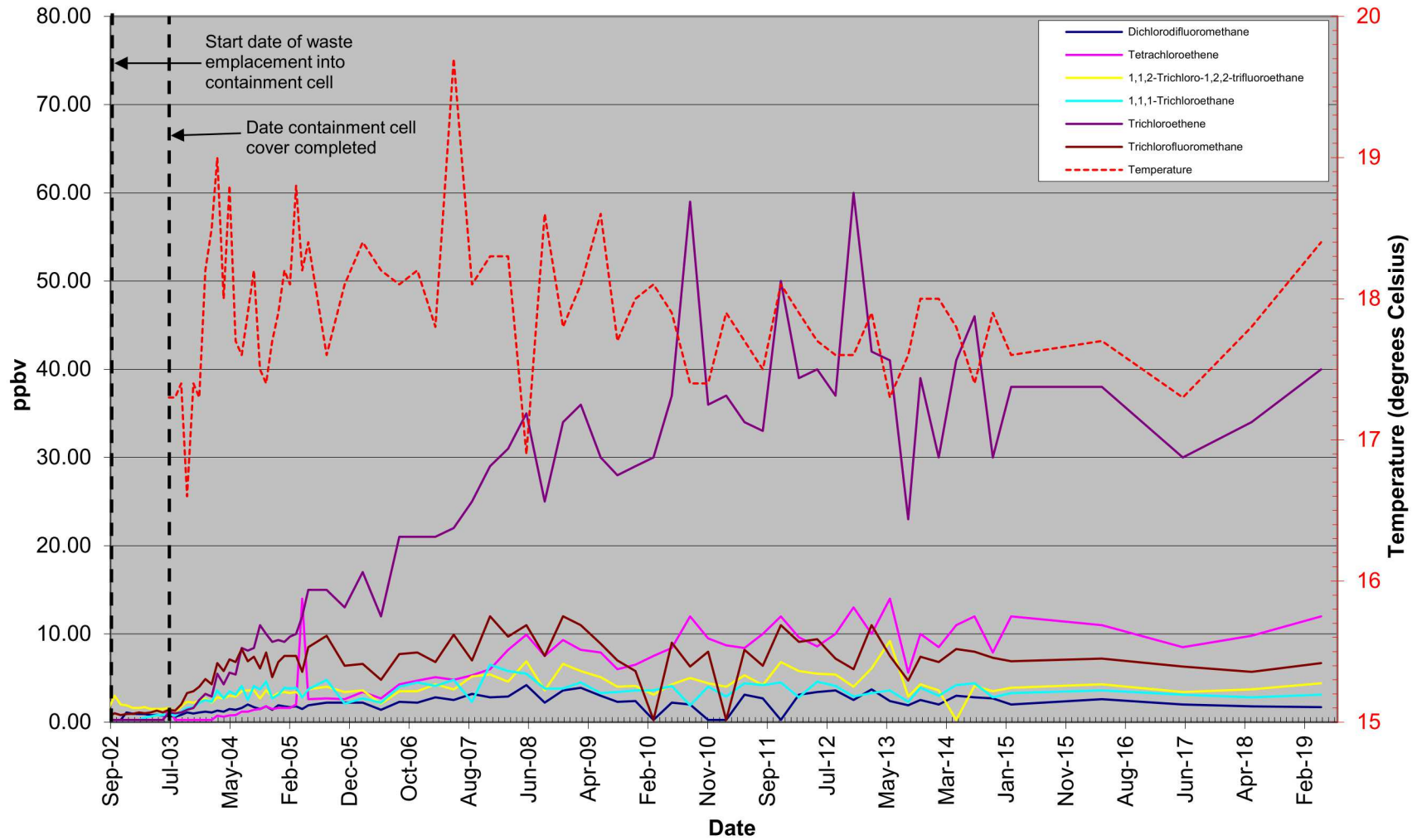


Figure A-18
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-9 (15-ft)
September 2002 through May 2019

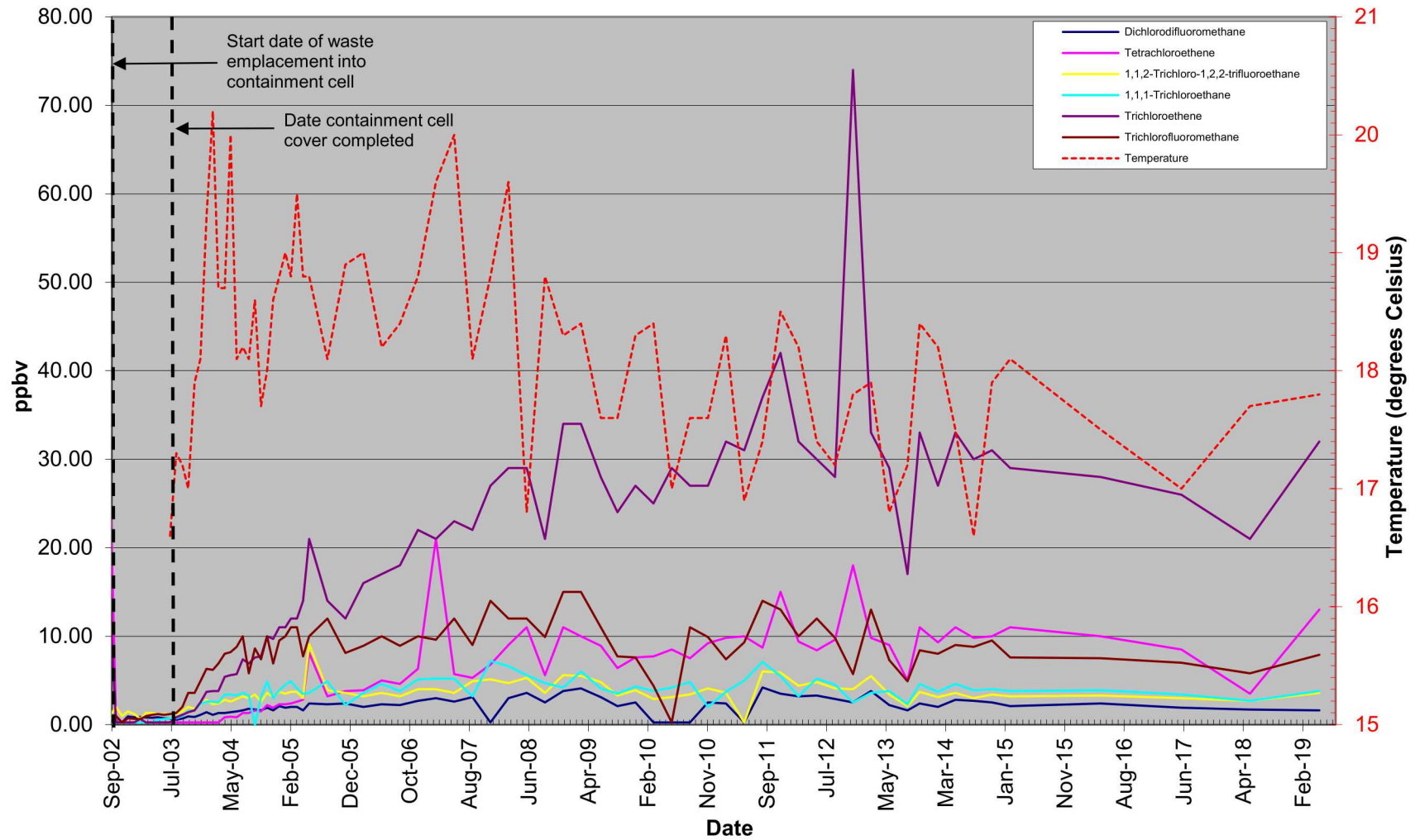


Figure A-19
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-10 (5-ft)
September 2002 through May 2019

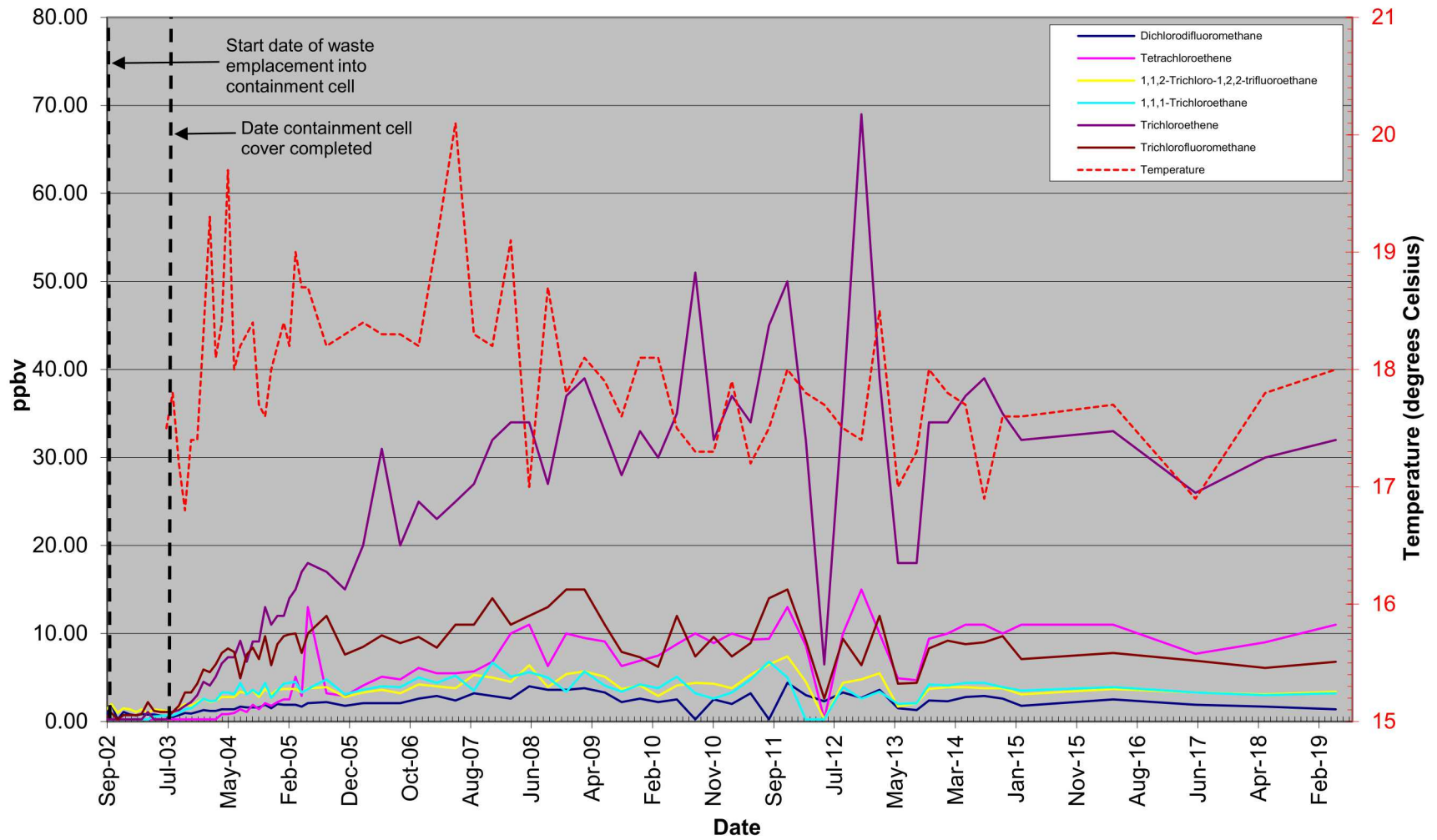


Figure A-20
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-10 (15-ft)
September 2002 through May 2019

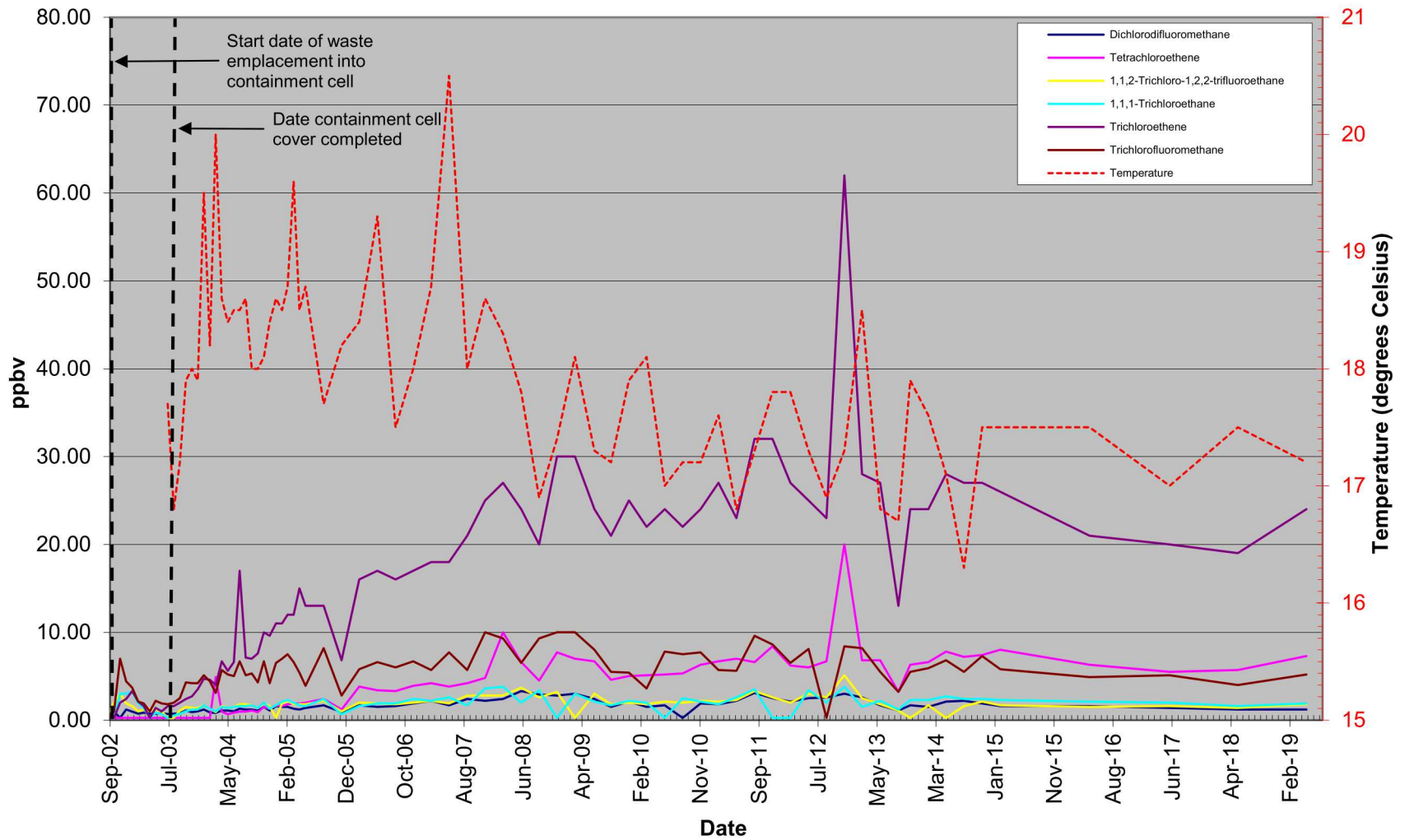


Figure A-21
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-11 (5-ft)
September 2002 through May 2019

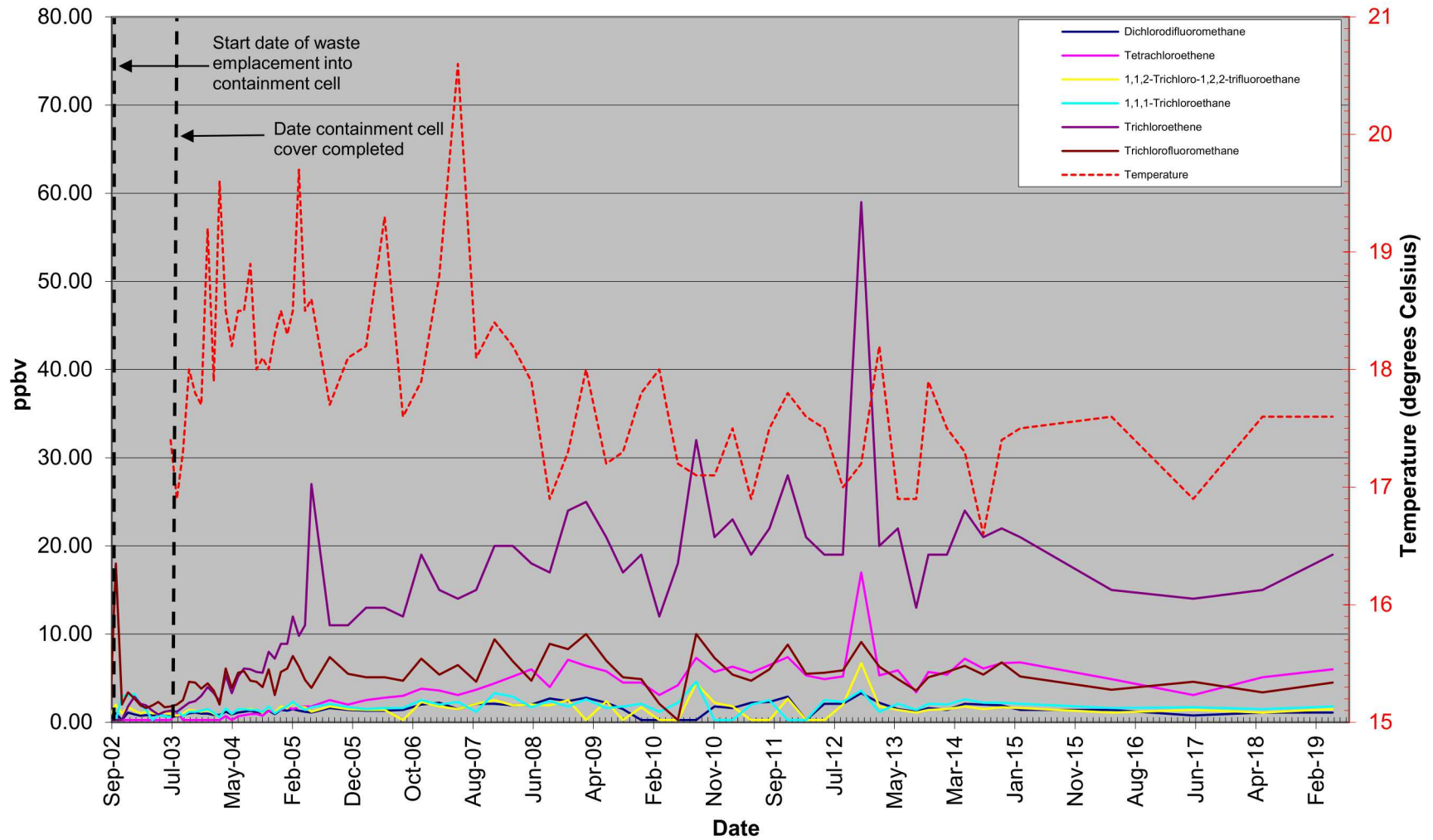


Figure A-22
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at VSA-11 (15-ft)
September 2002 through May 2019

ANNEX B
Concentration Graphs of Frequently Detected Volatile Organic Compounds Over Time for
all Chemical Waste Landfill Sanitary Sewer Monitoring Locations, September 2002
through May 2019

This page intentionally left blank.

LIST OF FIGURES

Figure		Page
Figure B-1	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at CSS-1, September 2002 through May 2019	1
Figure B-2	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at CSS-2, September 2002 through May 2019	2
Figure B-3	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at CSS-3, September 2002 through May 2019	3
Figure B-4	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at CSS-4, September 2002 through May 2019	4
Figure B-5	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at CSS-5, September 2002 through May 2019	5
Figure B-6	Concentration Graph of Most Frequently Detected Volatile Organic Compounds at CSS-6, September 2002 through May 2019	6

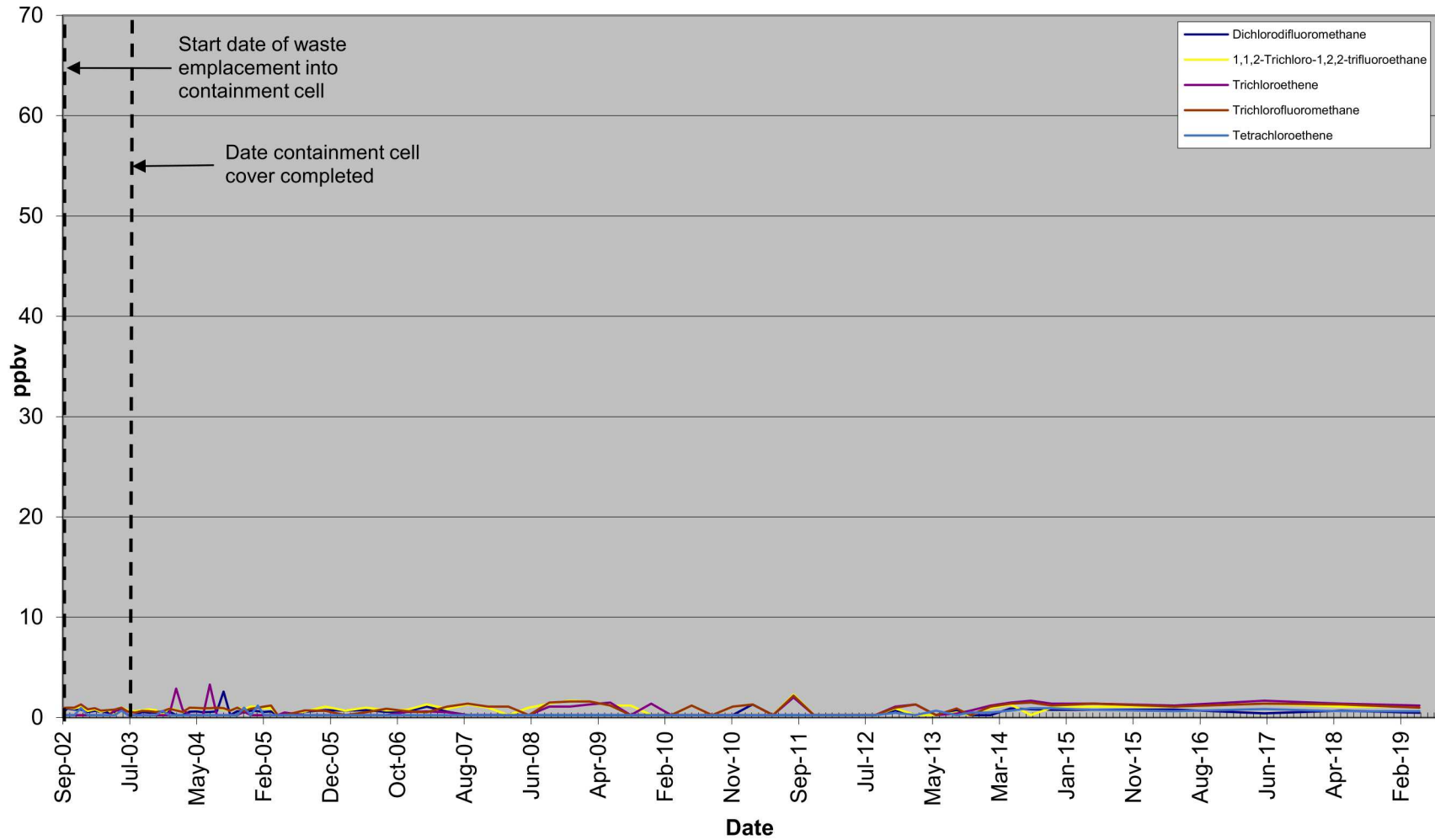


Figure B-1
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at CSS-1
September 2002 through May 2019

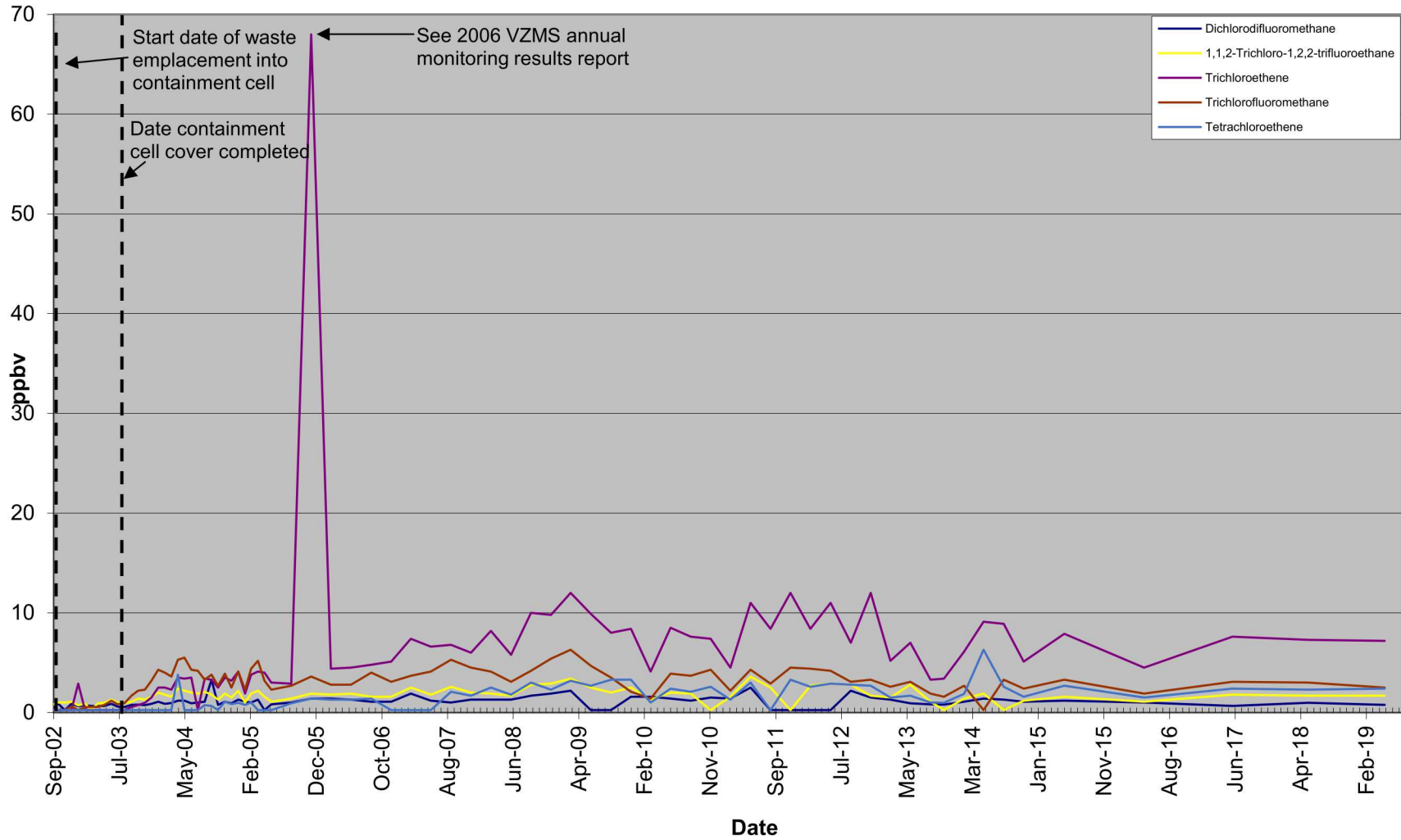


Figure B-2
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at CSS-2
September 2002 through May 2019

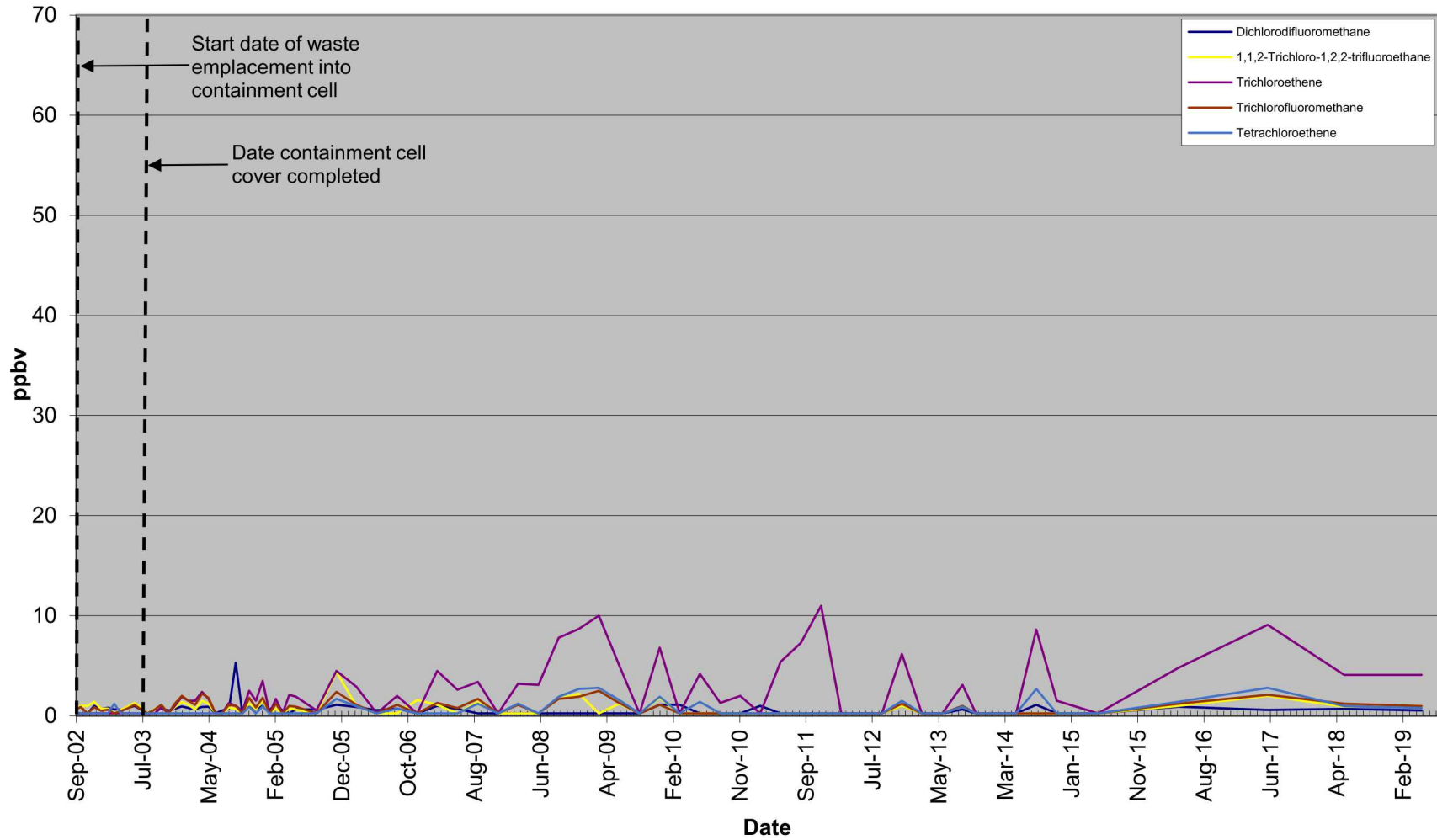


Figure B-3
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at CSS-3
September 2002 through May 2019

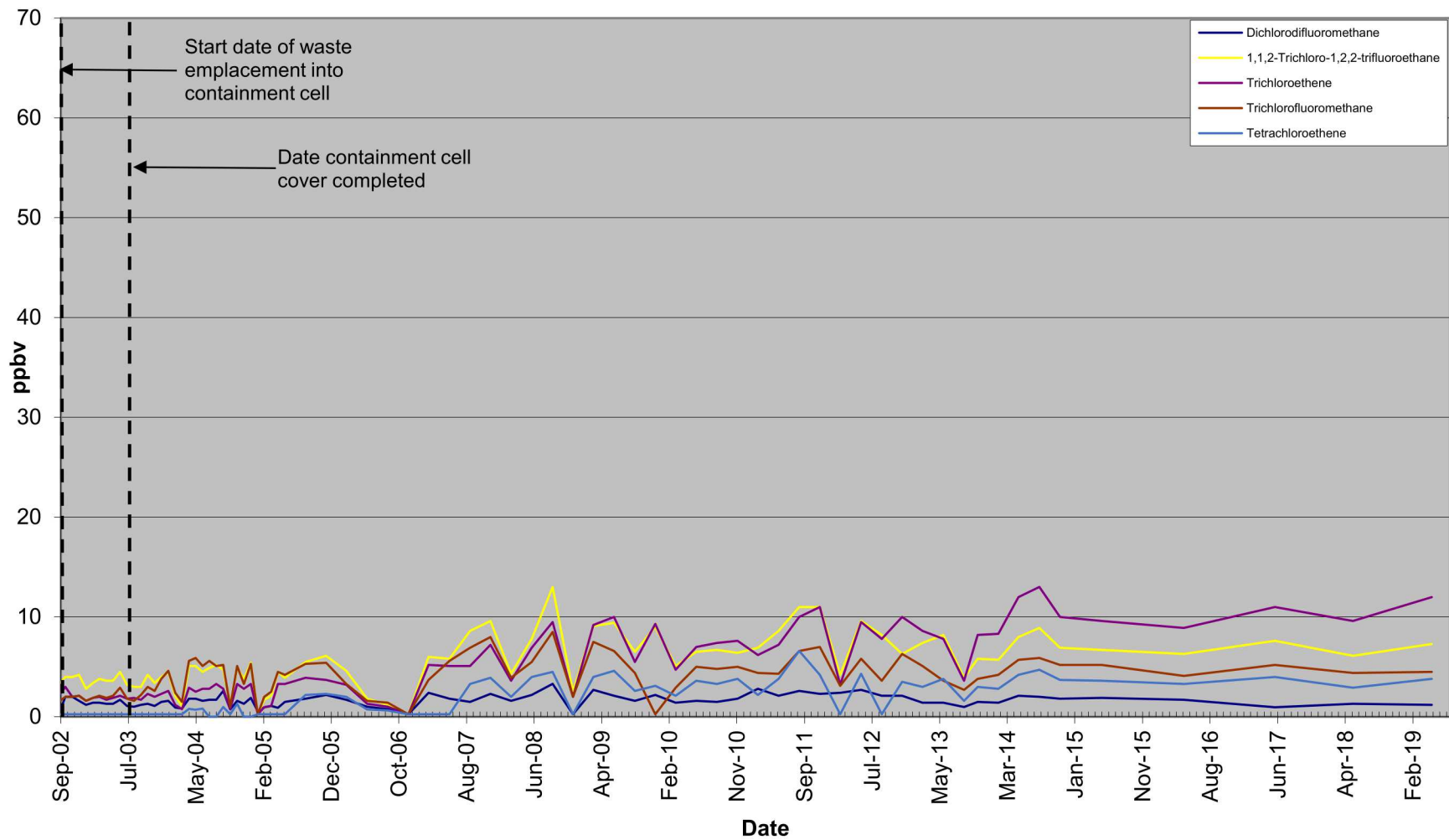


Figure B-4
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at CSS-4
September 2002 through May 2019

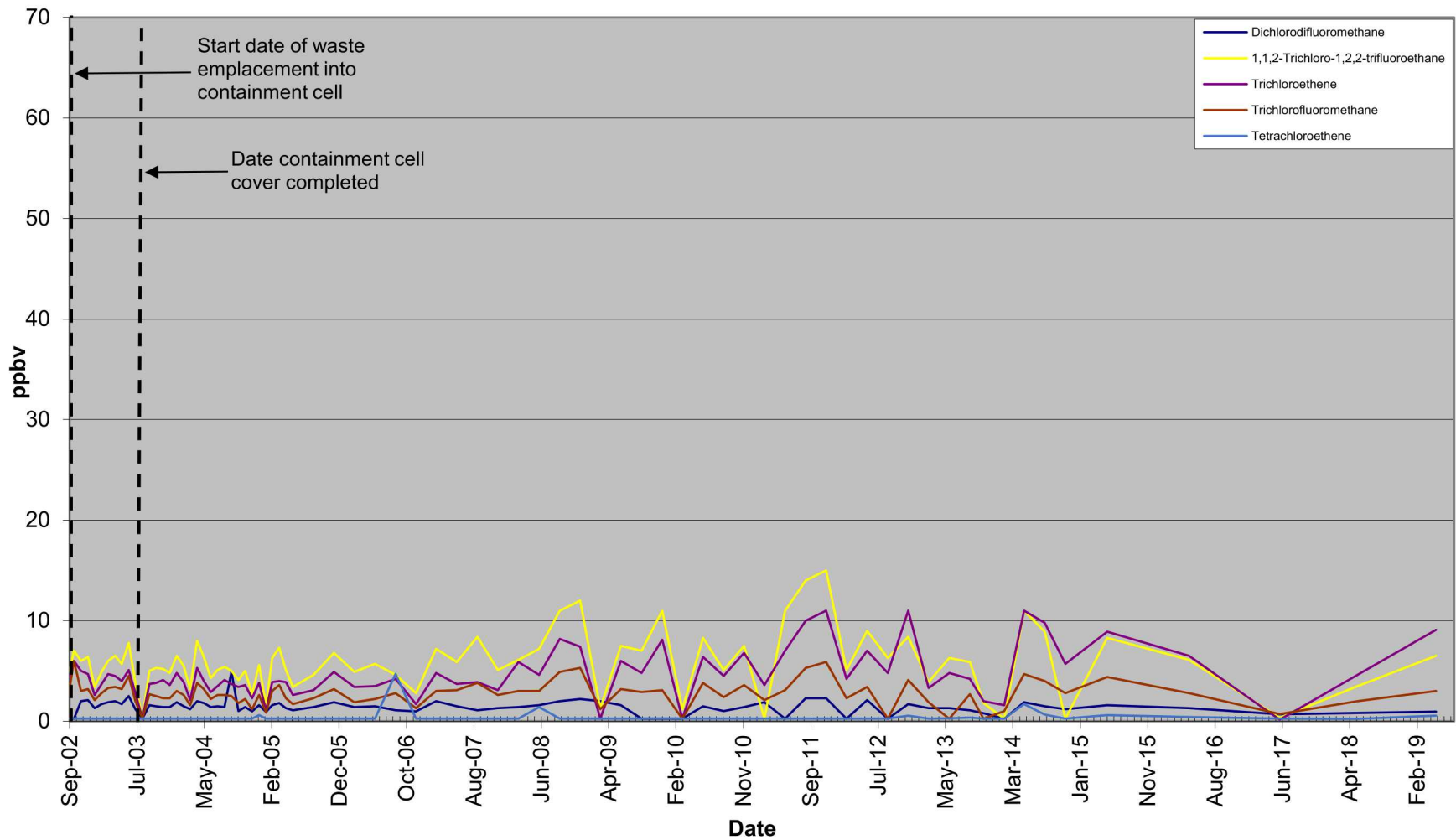


Figure B-5
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at CSS-5
September 2002 through May 2019

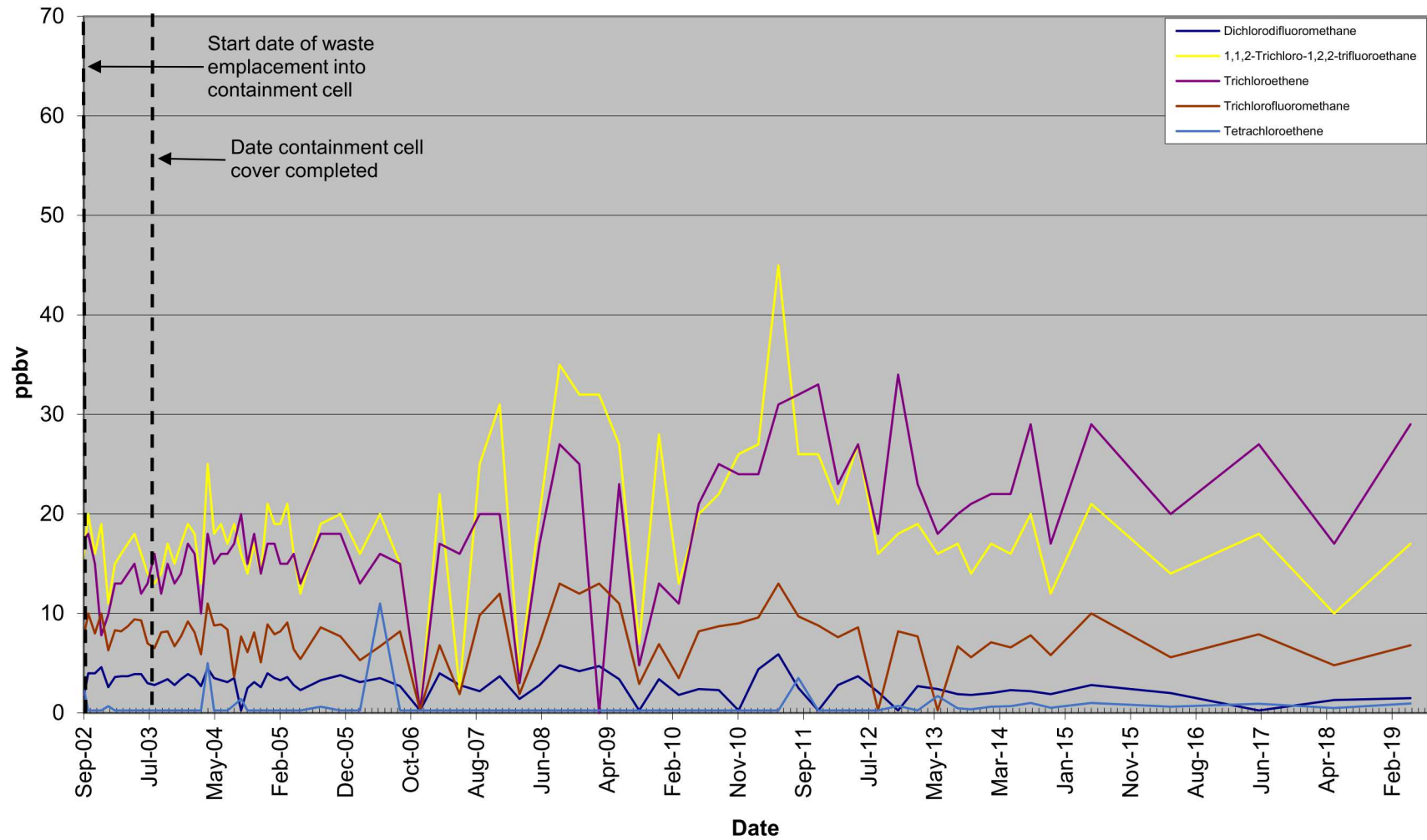


Figure B-6
Concentration Graph of Most Frequently Detected Volatile Organic Compounds at CSS-6
September 2002 through May 2019