DEPARTMENT OF ENERGY
Environmental Management Los Alamos Field Office (EM-LA)
Los Alamos, New Mexico 87544

EMLA-2021-BF140-02-001

July 28, 2021

RECEIVED
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NMED Hazardous
Waste Bureau

Mr. Ricardo Maestas
Acting Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6313

Subject: Submittal of the Periodic Monitoring Report for 2020 Vapor-Sampling Activities at Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50

Dear Mr. Maestas:

Enclosed please find two hard copies with electronic files of the "Periodic Monitoring Report for 2020 Vapor-Sampling Activities at Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50." Submittal of this periodic monitoring report fulfills the New Mexico Environment Department requirement in the approval of the "Phase III Investigation Report for Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50" (December 2011) that vapor monitoring, which includes sampling for volatile organic compounds (VOCs) and tritium, be conducted semiannually from 80 sampling ports in 18 boreholes at Material Disposal Area C. This report includes presentation and analysis of subsurface vapor monitoring data for VOCs and tritium from two sampling rounds in 2020.

If you have any questions, please contact David Diehl at (505) 551-2496 (david.diehl@em-la.doe.gov) or Cheryl Rodriguez at (505) 414-0450 (cheryl.rodriguez@em.doe.gov).

Sincerely,

ARTURO DURAN
Digitally signed by ARTURO DURAN
Date: 2021.07.27 13:05:46 -06'00'

Arturo Q. Duran
Compliance and Permitting Manager
Environmental Management
Los Alamos Field Office

Enclosure(s):

1. Two hard copies with electronic files:
   Periodic Monitoring Report for 2020 Vapor-Sampling Activities at Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50 (EM2021-0343)

cc (letter with hard-copy enclosure[s]):
Cheryl Rodriguez, EM-LA

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July 2021
EM2021-0343

Periodic Monitoring Report for 2020 Vapor-Sampling Activities at Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50

N3B Los Alamos

EM2021-0343

Periodic Monitoring Report for 2020 Vapor-Sampling Activities at Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50

July 2021

Responsible program director:

Printed Name	Signature	Title	Organization	Date
Michael O. Erickson	[signature]	Program Director	RCRA Remediation Program	7/19/21

Responsible N3B representative:

Printed Name	Signature	Title	Organization	Date
Troy Thomson	[signature]	Acting Program Manager	N3B Environmental Remediation Program	7/19/21

Responsible DOE EM-LA representative:

Printed Name	Signature	Title	Organization	Date
Arturo Q. Duran	ARTURO DURAN Digitally signed by ARTURO DURAN Date: 2021.07.27 13:04:53 -06'00'	Compliance and Permitting Manager	Office of Quality and Regulatory Compliance	

EXECUTIVE SUMMARY

This periodic monitoring report (PMR) summarizes vapor-monitoring activities conducted for calendar year 2020 at Material Disposal Area (MDA) C, Solid Waste Management Unit 50-009, at Technical Area 50, at Los Alamos National Laboratory. Submittal of this PMR fulfills the New Mexico Environment Department (NMED) requirement that vapor monitoring be conducted semiannually from 80 sampling ports in 18 boreholes at MDA C. The objectives of the current vapor monitoring at MDA C are to (1) monitor for potential plume expansion and potential new releases and (2) collect additional vapor-monitoring data to support the updated corrective measures evaluation report that was submitted to NMED on June 30, 2021.

Vapor monitoring in 2020 included collecting 80 vapor samples from 80 sample ports within 18 boreholes in each of two sampling rounds. Vapor samples were submitted for laboratory analysis of volatile organic compounds (VOCs) and tritium.

Validated analytical results demonstrated the presence of 22 VOCs detected in subsurface pore gas. The VOC screening evaluation identified 4 VOCs in the first round and 2 VOCs in the second round in MDA C pore gas at concentrations exceeding Tier 1 screening levels (SLs), which are based on groundwater SLs. However, the only VOC consistently detected above its Tier 1 SL is trichloroethene (TCE).

Data trends in the MDA C VOC plumes for both total VOCs and TCE were evaluated based on vapor-monitoring activities from 2012 through 2020. VOC trends for TCE from 2012 through 2020 show that VOC concentrations at MDA C are consistent with a diffusive plume. Concentrations are decreasing slowly at the edges of the plume, both laterally and at depth. Concentrations in the center of the plume peak at depths of approximately 210–300 ft below ground surface, well below possible source areas, and appear to be either stable or decreasing slowly with time. Concentrations in the source area show no signs of significant continued releases of VOCs.

CONTENTS

Figures

Tables

Appendixes

Plates

1.0 INTRODUCTION

This periodic monitoring report (PMR) presents the results of vapor-monitoring activities conducted for calendar year (CY) 2020 at Material Disposal Area (MDA) C, Solid Waste Management Unit (SWMU) 50-009, in Technical Area 50 (TA-50) at Los Alamos National Laboratory (LANL or the Laboratory). Submittal of this PMR fulfills the New Mexico Environment Department (NMED) requirement that vapor monitoring be conducted semiannually from 80 sampling ports in 18 boreholes at MDA C and include sampling for volatile organic compounds (VOCs) and tritium (NMED 2011, 208797).

The objectives of the current vapor monitoring at MDA C are to (1) monitor for potential plume expansion and potential new releases, and (2) collect additional vapor-monitoring data to support the updated corrective measures evaluation (CME) submitted to NMED on June 30, 2021 (N3B 2021, 701508).

This report discusses the results obtained during the two 2020 vapor-monitoring rounds. However, for comparison, vapor-monitoring data from vapor-monitoring activities at MDA C from 2012 through 2020 are included in the data evaluation section of this report. All pore-gas samples were submitted for off-site analysis of VOCs and tritium.

In order to evaluate changes in plume concentrations over time, the trends in concentrations of both total VOCs and trichloroethene (TCE) are analyzed in the analytical data results section of this report and the VOC plume trend analysis appendix. The selection of TCE for the trend analysis was based on the information reported since the fiscal year (FY) 2012 MDA C CME report (LANL 2012, 222830). TCE was the most frequently detected VOC and was detected in 100% of the 2020 VOC vapor samples collected at MDA C. TCE was also the most frequently detected VOC above the Tier 1 groundwater screening levels (SLs), with 66% of all 2020 TCE sampling results exceeding the Tier 1 SLs.

No regulatory criteria exist for vapor-phase contaminants. This report therefore presents the results of a screening evaluation of the pore-gas VOC data. The maximum concentrations of VOCs in pore gas are used in a Henry's law calculation to determine the VOC concentration for the hypothetical case of the VOC pore gas being in contact with the groundwater.

Section IX of the Compliance Order on Consent (Consent Order) describes the role of data screening in the corrective action process. Screening values are used to identify the *potential* for unacceptable risk resulting from the presence of contaminants in groundwater. Screening values for evaluating pore-gas monitoring data include New Mexico Water Quality Control Commission (NMWQCC) groundwater standards, U.S. Environmental Protection Agency (EPA) maximum contaminant levels (MCLs), New Mexico Environment Department (NMED) SLs for tap water, and EPA regional SLs for tap water. Additional risk evaluation is required to determine the potential need for cleanup (corrective action) if results indicate that contaminants are present at concentrations above screening values. Tritium samples were collected during both 2020 sampling rounds. Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with U.S. Department of Energy policy.

This introductory section of the report includes a description of the site location. Section 2 describes the scope of the vapor-monitoring activities, and section 3 addresses regulatory criteria. Section 4 presents field screening results, and section 5 presents analytical data results. Section 6 summarizes the information presented in this report, and section 7 includes references and map data sources.

The appendixes include acronyms, a metric conversion table, and definitions of data qualifiers (Appendix A); field methods (Appendix B); analytical program descriptions and data-validation procedures (Appendix C); a VOC plume trend analysis (Appendix D); and analytical suites and results, field forms, and analytical reports (Appendix E on DVD included with this document).

1.1 Background

MDA C, also known as SWMU 50-009, is located within TA-50 at the head of Ten Site Canyon. TA-50 is bounded on the north by Effluent and Mortandad Canyons, on the east by the upper reaches of Ten Site Canyon, on the south by Twomile Canyon, and on the west by TA-55 (Figure 1.1-1).

MDA C is an inactive 11.8-acre landfill consisting of 6 solid waste disposal pits, a chemical disposal pit, and 108 shafts (Figure 1.1-2). The seven pits range in depth from 12 ft to 25 ft below the original ground surface. The shafts range in depth from 4 ft to 25 ft below the original ground surface. From 1948 to 1974, these pits and shafts received solid waste containing hazardous substances and radioactive waste. Descriptions of the waste are included in the updated CME report for MDA C (N3B 2021, 701508). The pits were filled with dirt as a temporary cover as they were being filled with waste, and with crushed tuff upon decommissioning. The shafts were sealed by being filled first with crushed tuff and then with concrete. All shafts except for Shafts 98 through 107 were unlined.

Data from pore-gas monitoring boreholes located within MDA C have been used to characterize the nature and extent of the subsurface vapor plume at the site since 2000. Figure 1.1-3 shows the pore-gas monitoring boreholes at MDA C. VOC concentrations in the subsurface plume decrease with depth from the plume maximum at approximately 250 ft below ground surface (bgs) to borehole total depth.

2.0 SCOPE OF ACTIVITIES

The following pore-gas monitoring activities were completed at MDA C for CY 2020. The first round of sampling occurred in mid-July to early August 2020.The second round of 2020 sampling occurred in October 2020. Table 2.0-1 lists the vapor-monitoring locations and their port depths, which correspond to sampling intervals for both sampling rounds. (For details of sampling protocols, see “Sampling Subsurface Vapor,” N3B-SOP-ER-2008).

- Before sampling, boreholes were field-screened using the MultiRAE Infrared (IR) photoionization detector to measure carbon dioxide (CO_2) concentration in ppm, percent oxygen (%O_2), and total VOC concentrations in ppm. In the first and second sampling rounds, a total of 80 ports in 18 vapor-monitoring boreholes were field-screened.
- Vapor monitoring in the first round of sampling was conducted from July 13 through August 5, 2020, and included collecting 80 vapor samples for VOC and tritium analysis, along with 8 field duplicate samples and 8 field blank samples from all 80 sample ports at the 18 wells. Vapor monitoring in the second round of sampling was conducted in October 2020 and included collecting 80 vapor samples for VOC and tritium analysis, along with 8 field duplicates and 8 field blanks (Figure 1.1-3).
- After collection, samples were submitted to the Newport News Nuclear BWXT-Los Alamos, LLC (N3B) Sample Management Office for shipment to analytical laboratories per N3B-SOP-SDM-1102, “Sample Receiving and Shipping by the Sample Management Office.” Vapor samples were submitted to off-site analytical laboratories in SUMMA canisters for VOC analysis using EPA Method TO-15 and in silica-gel columns for tritium analysis using EPA Method 906.0.
- All analytical data were subject to data-validation reviews in accordance with N3B guidance and procedures. Field duplicate samples and field blank samples were collected at a minimum frequency of 1 for every 10 samples. The data-validation process for reviews of MDA C pore-gas data is presented in Appendix C.

Waste generated from sampling activities was handled in accordance with the waste characterization strategy form for MDA C developed in accordance with N3B-ER-DIR-SOP-10021, “Characterization and Management of Environmental Programs Waste.”

Further discussion of the field methods used for pore-gas field screening and sample collection is presented in Appendix B. Field chain-of-custody forms and sample collection logs are provided in Appendix E (on DVD included with this document).

The pore-gas field-screening results are discussed in section 4, and the pore-gas analytical results are discussed in section 5. Any deviations from the NMED-required vapor-monitoring plan are discussed in section 2.1.

2.1 Deviations

There were no deviations from sampling requirements for this sampling event.

3.0 REGULATORY CRITERIA

VOCs present in wastes disposed of at MDA C may volatilize and be released into subsurface media (e.g., soil, tuff, fractured rock) as vapors. These vapor-phase contaminants may potentially be transported through the subsurface to the water table. Once in contact with the water table, vapor-phase VOCs might condense into the water. Vapor-phase contaminants are thus a potential source of groundwater contamination. For MDA C, monitoring of subsurface vapors is being performed to evaluate the potential for groundwater contamination and, if necessary, to evaluate the need for corrective actions to prevent possible groundwater contamination.

Under the Consent Order, results of environmental investigations and monitoring are compared with SLs, which are media-specific contaminant concentrations that indicate the potential for unacceptable risk. The Consent Order specifies that SLs for soil and groundwater developed by NMED be used to evaluate soil and groundwater contamination. Because the Consent Order does not identify SLs for subsurface vapor, N3B developed Tier 1 SLs to evaluate monitoring results.

The Tier 1 approach evaluates whether pore gas containing a VOC at the concentration detected in the vapor sample could contaminate groundwater above the groundwater SL. The approach assumes that pore gas containing VOCs at the concentrations detected in the pore-gas sample is in hypothetical contact with the water table in sufficient quantity to condense into groundwater in accordance with Henry’s law. If Tier 1 SLs are not exceeded, VOCs could not contaminate groundwater above cleanup levels even if the vapor plume is in direct contact with groundwater, and no further screening is necessary.

The Tier 1 screening approach for VOCs is described in more detail below in section 3.1.

Section 3.14.3 of the LANL Hazardous Waste Facility Permit (the Permit) requires that a subsurface vapor-monitoring system be installed in the vicinity of the buildings located within the Transuranic Waste Facility (TWF) to evaluate and report on a quarterly basis vapor-phase contaminants that may migrate from MDA C. The TWF subsurface vapor-monitoring network consists of five vapor-monitoring wells in or near the permitted storage unit as specified in Permit Section A.6.10. The TWF is located southeast of MDA C. LANL reported analytical data for the 14th quarter following the start of operations in October 2017. The sampling results indicate that vapor concentrations at the site do not exceed the soil-gas screening levels established by the Permit (LANL 2021, 603633).

3.1 Tier 1 Soil-Vapor Screening

The Tier 1 screening analysis evaluates the potential for contamination of groundwater by VOCs in pore gas using groundwater SLs equal to groundwater cleanup levels in the Consent Order. The analysis predicts the groundwater concentration that might be in equilibrium with the maximum pore-gas concentrations of VOCs detected if the pore-gas concentration were in contact and equilibrium with groundwater. This analysis is performed using VOC concentrations in the pore gas in calculations according to Henry's law partitioning. If the predicted concentration of a particular VOC in groundwater is less than the groundwater SL, then no potential exists for exceedances of groundwater SLs.

Because there are no SLs for soil vapor that address the potential for groundwater contamination, the screening evaluation is based on Consent Order groundwater cleanup levels and the Henry's law constant that describes the equilibrium between vapor and water concentrations. The source of Henry's law constants is the NMED "Risk Assessment Guidance for Site Investigations and Remediation Volume 1, Soil Screening Guidance for Human Health Risk Assessments", (NMED 2019, 700550) or the EPA regional screening tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables). The following dimensionless form of Henry's law constant is used:

$$H' = \frac{C_{air}}{C_{water}}$$ **Equation 3.1-1**

Where H' = the dimensionless Henry's law constant,

C_{water} = the volumetric concentration of the contaminant in water, and

C_{air} = the volumetric concentration of the contaminant in air (or soil vapor).

Equation 3.1-1 can be used to calculate the Tier 1 pore-gas SL (SL_{pgl}) as follows:

$$SL_{pgI} = H' \times SL_{gw} \times 1000$$ **Equation 3.1-2**

Where SL_{pgl} = the Tier 1 pore gas SL (µg/m^3),

SL_{gw} = the groundwater SL (µg/L), and

1000 = a conversion factor (to convert liters to cubic meters).

In accordance with Section IX of the Consent Order, the groundwater SLs used in Equation 3.1-2 are determined as follows.

For each individual substance, the lower concentration of the NMWQCC groundwater standard or EPA MCL is used as the screening value. If an NMWQCC groundwater standard or an MCL has not been established for a specific substance for which toxicological information is published, the NMED SL for tap water is used as the groundwater screening value. NMED SLs are established for either a cancer- or noncancerous-risk type; for the cancer-risk type, SLs are based on a 10^{-5} excess cancer risk. This report was prepared using the 2019 "NMED Risk Assessment Guidance for Site Investigations and Remediation Volume 1, Soil Screening Guidance for Human Health Risk Assessments" (NMED 2019, 700550). If an NMED SL for tap water has not been established for a specific substance for which toxicological information is published, the EPA regional SL for tap water (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables) is used as the groundwater screening value. The EPA SLs are established for either a cancer- or noncancerous-risk type. For the cancer-risk type, the Consent Order specifies screening at a 10^{-5} excess cancer risk. The EPA SLs for tap water are at 10^{-6} excess cancer risk.

If the hypothetical concentration of a VOC in groundwater (calculated using Equation 3.1-2) and the measured VOC concentration in a pore-gas sample are less than the groundwater SL, the concentration of the VOC in pore gas will not exceed the groundwater SL, even if the VOC plume were to be in direct contact with groundwater. An analysis of the MDA C data is presented in section 5.0 and Appendix D.

Table 3.1-1 presents the calculated concentrations of contaminants in pore gas corresponding to groundwater SLs (hereafter, Tier 1 SLs) for the Tier 1 screening. Table 3.1-2 presents the results of the Tier 1 screening for the first round of 2020 pore-gas data. Four VOCs were identified that exceeded Tier 1 SLs (methylene chloride; 2-propanol; 1,1,2-trichloroethane; and TCE). Table 3.1-3 presents the results of the Tier 1 screening for the second round of pore-gas data. Two VOCs were identified that exceeded the Tier 1 SLs (TCE and methylene chloride). Of these two VOCs, TCE was the only contaminant to consistently exceed its SL. Therefore, TCE is the primary contaminant of concern.

4.0 FIELD-SCREENING RESULTS

Before each sampling event, field screening was performed in each borehole at the targeted sampling interval to ensure CO_2 ppm, total VOC ppm and %O_2 levels at each sampling port had stabilized at values representative of subsurface pore-gas conditions. Field screening at MDA C also included field screening of subsurface vapor for methane, VOCs, and water vapor (for tritium samples). Subsurface vapor monitoring was conducted at the locations and depths described in section 2.0 and shown in Table 2.0-1. Before sampling, each interval was purged in accordance with N3B-SOP-ER-2008 "Sampling Subsurface Vapor," to ensure pore gas was being collected. The pore gas from each port was field-screened using a MultiRAE IR Multi-Gas Monitor. Each interval was purged until these readings stabilized. The stabilized percent methane, CO_2 ppm, %O_2, and total VOC ppm values from the 2020 monitoring rounds performed at each sampling location are shown in Appendix B.

5.0 ANALYTICAL DATA RESULTS

This section presents a summary of pore-gas VOC and tritium data for 2020 and an evaluation of the pore-gas VOC data.

All analytical data were subject to validation reviews in accordance with N3B guidance and procedures. Appendix C presents a description of these data-validation reviews for 2020 MDA C pore-gas data. All validated analytical results from 2020 monitoring rounds are presented in Appendix E (on DVD included with this document).

MDA C pore-gas data are also available at the Intellus New Mexico website (http://www.intellusnm.com/).

5.1 VOC Pore-Gas Results

Subsurface vapor samples were collected at MDA C from July 13 through August 5, 2020, and from October 13 through October 23, 2020. Samples were submitted in SUMMA canisters for laboratory analysis of VOCs using EPA Method TO-15 and in silica gel cartridges for laboratory analysis of tritium using EPA Method 906.0. Additional information on analytical methods used is included in Appendix C.

VOC analytical data from the first and second 2020 sampling rounds are presented in Table 5.1-1 and Plate 1, and Table 5.1-2 and Plate 2, respectively. The N3B Sample Data Management Program's methodology used to evaluate the data is presented in Appendix C. Analytical data and reports for the two sampling rounds are included in Appendix E (on DVD included with this document).

Validated analytical results demonstrated that 22 VOCs were detected in subsurface pore gas. The VOC screening evaluation identified 4 VOCs (methylene chloride; 2-propanol; 1,1,2-trichloroethane; and TCE) in MDA C pore gas at concentrations exceeding Tier 1 SLs. The data show that at depths of 600 ft bgs or greater, there was only one detection (TCE) above Tier 1 SLs in FY 2020 in borehole 50-24813. This shows that the bulk of the plume remains above the Tschicoma dacite (Tvt 2), which is approximately 600 ft above the regional groundwater aquifer.

During the two rounds of sampling, TCE was detected in all of the samples and was the VOC detected at the highest concentration. TCE was detected at a concentration of 64,000 $\mu g/m^3$ in borehole 50-24813 at 241 ft bgs during the first round and at 47,000 $\mu g/m^3$ in borehole 50-603471 at 288 ft bgs during the second round.

5.2 Tritium Results

Tritium analytical data from the first and second sampling rounds are presented in Table 5.2-1. Tritium was detected at activities ranging from 259.9 to 2,151,770 pCi/L. The maximum tritium activity was detected during the second round of sampling at borehole 50-603470 at a depth of 83 ft bgs. Historically, a decrease in activity has been occurring at a rate consistent with tritium's half-life. However, beginning in early 2020, a possible increasing trend can be seen. Continued monitoring will confirm this trend.

5.3 VOC Concentration Trends in Subsurface Vapor Over Time

The following concentration trends over time are discussed in detail in Appendix D.

VOC trends for TCE from 2012 through 2020 show that VOC concentrations at MDA C are consistent with a diffusive plume. Concentrations are increasing slowly at the edges of the plume, both laterally and at depth. Concentrations at the plume edges have gone up slowly but will go down as the plume spreads. Concentrations in the center of the plume peak at depths of approximately 210–300 ft bgs, well below possible source areas, and appear to be either stable or decreasing slowly with time. Concentrations in the source area show no signs of significant continued releases of VOCs.

5.4 Evaluation of VOC Pore-Gas Data as Related to Hypothetical Groundwater Contamination

The VOC results from the 2020 monitoring rounds were screened in a Tier 1 analysis to determine whether the concentrations of VOCs in the vapor would be a potential source of groundwater contamination if the vapor were in contact with the groundwater (section 3.1). Equation 3.1-2 was used to screen the maximum concentrations of VOCs detected in pore-gas samples at MDA C during the two sampling rounds. The evaluation was applied to the 22 VOCs that were detected for which there are MCLs, NMWQCC standards, or EPA regional tap water SLs.

Table 3.1-2 shows the four VOCs that exceeded Tier 1 SLs in the first sampling round: methylene chloride, 2-propanol, 1,1,2-trichloroethane, and TCE. Table 3.1-3 shows the two VOCs, methylene chloride and TCE, that exceeded Tier 1 SLs in the second sampling round. Methylene chloride was detected above Tier 1 once in the first round and twice in the second round in 2020. TCE is the only contaminant to consistently exceed its SL. TCE was detected above the Tier 1 SL in 55 of 80 samples in the first round and in 51 of 80 samples in the second round. Because some groundwater Tier 1 SLs were exceeded, further screening was performed using the concentrations from the deepest pore-gas sample (i.e., the sample collected closest to the regional aquifer). The deepest samples in which both methylene chloride and TCE were detected in the first sampling round were collected from boreholes 50-24813, 50-603470, 50-603472, and 50-613185, all at a depth interval of 450 ft bgs. The deepest samples in which both methylene chloride and TCE were detected in the second sampling round were collected from boreholes 50-24813 and 50-603471, both at a depth interval of 450 ft bgs. At this depth, TCE concentrations exceeded the Tier 1 SL in both sampling events.

Six boreholes were sampled for TCE at depths of 600 ft bgs or greater. In the first round of sampling, which occurred in July 2020, TCE concentrations exceeded the SL by a factor of 2.5 in borehole 50-24813. None of the samples from the second sampling round in October 2020 exceeded Tier 1 SLs at those depths.

6.0 SUMMARY

The purpose of monitoring VOC concentrations in pore gas at MDA C is to identify changes in the configuration of the VOC plumes, monitor changes in contaminant concentration distribution, and identify gaps in VOC data for future modeling or trend analyses.

The results from the two 2020 sampling rounds are summarized as follows:

- VOC concentrations at MDA C are consistent with a diffusive plume as described in Stauffer et al. (2005, 090537).
    - ❖ VOC concentrations increase from ground surface to the plume maximum at around 2250–300 ft bgs.
    - ❖ VOC concentrations decrease with depth from the plume maximum at approximately 250–300 ft bgs to borehole total depth.
    - ❖ VOC measurements over the last 10 yr show a decrease in contaminant concentrations near the source areas and an increase in contaminant concentrations at a distance from the source areas.
    - ❖ VOC concentrations close to the source continue to migrate toward lower concentration areas at the edges of the plume. As this happens, concentration gradients will decrease and outward plume growth will slow over time.
- There is no evidence of increased concentrations in the source region of MDA C, suggesting that VOC leakage is not happening at a significant rate.
- TCE is the primary constituent above Tier 1 SLs and was detected in every sample. The remaining VOCs are below Tier 1 SLs, with the exception of four VOCs detected in a few wells at concentrations less than a factor of 2 above their conservative SLs.
- VOC concentrations close to the source continue to migrate toward lower concentration areas at the edges of the plume. As this happens, concentration gradients will decrease and outward plume growth will slow over time.
- VOC concentrations measured in the deepest borehole ports below the central portion of the source area are below Tier 1 SLs.
- Tritium was detected at activities ranging from 259.9 to 2,151,700 pCi/L.

7.0 REFERENCES AND MAP DATA SOURCES

7.1 References

The following reference list includes documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. This information is also included in text citations. ERIDs were assigned by the Laboratory's Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above). IDs are used to locate documents in N3B's Records Management System and in the Master Reference Set. The NMED Hazardous Waste Bureau and N3B maintain copies of the Master Reference Set. The set ensures that NMED has the references to review documents. The set is updated when new references are cited in documents.

LANL (Los Alamos National Laboratory), September 2012. "Corrective Measures Evaluation Report for Material Disposal Area C, Solid Waste Management Unit 50-009 at Technical Area 50," Los Alamos National Laboratory document LA-UR-12-24944, Los Alamos, New Mexico. (LANL 2012, 222830)

LANL (Los Alamos National Laboratory), May 3, 2021. "Technical Area 63 (TA-63) Transuranic Waste Facility Soil Vapor Monitoring System Report, Quarter 14 March 2021, Los Alamos National Laboratory, EPA ID #NM0890010515," Los Alamos National Laboratory letter (EPC-DO-20-135) and enclosure to K. Pierard (NMED-HWB) from J. Payne (LANL) and Karen E. Armijo (NA-LA). (LANL 2021, 603633)

N3B (Newport News Nuclear BWXT-Los Alamos, LLC), June 2021. "Corrective Measures Evaluation Report for Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50, Revision 1," Newport News Nuclear BWXT-Los Alamos, LLC, document EM2021-0177, Los Alamos, New Mexico. (N3B 2021, 701508)

NMED (New Mexico Environment Department), December 8, 2011. "Approval, Phase III Investigation Report for Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 208797)

NMED (New Mexico Environment Department), June 19, 2019. "Risk Assessment Guidance for Site Investigations and Remediation, Volume 1, Soil Screening Guidance for Human Health Risk Assessments," February 2019 (Revision 2, 6/19/19), Hazardous Waste Bureau and Ground Water Quality Bureau, Santa Fe, New Mexico. (NMED 2019, 700550)

Stauffer, P.H., K.H. Birdsell, M.S. Witkowski, and J.K. Hopkins, 2005. "Vadose Zone Transport of 1,1,1-Trichloroethane: Conceptual Model Validation through Numerical Simulation," *Vadose Zone Journal,* Vol. 4, pp. 760–773. (Stauffer et al. 2005, 090537)

7.2 Map Data Sources

Data sources used in original figures created for this report are described below and identified by legend title.

Legend Item	Data Source
Disposal pit/ impoundment	Waste Storage Features; LANL, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007.
Disposal shaft	Waste Storage Features; LANL, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007.
Elevation contour	Hypsography, 10, 20, & 100 Foot Contour Intervals; LANL, ENV Environmental Remediation and Surveillance Program; 1991.
Fence	Security and Industrial Fences and Gates; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 10 September 2007.
LANL boundary	LANL Areas Used and Occupied; LANL, Site Planning & Project Initiation Group, Infrastructure Planning Division; 19 September 2008.
Material disposal area	Materials Disposal Areas; LANL, ENV Environmental Remediation and Surveillance Program; ER2004-0221; 1:2,500 Scale Data; 23 April 2004.
Paved road	Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 10 September 2007.
Structure	Structures; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 10 September 2007.
TA boundary	Technical Area Boundaries; LANL, Site Planning & Project Initiation Group, Infrastructure Planning Division; 19 September 2007.
Unpaved road	Dirt Road Arcs; LANL, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 10 September 2007.
Vapor-monitoring well	Point Feature Locations of the Environmental Restoration Project Database; LANL, Environment and Remediation Support Services Division, EP2007-0754; 30 November 2007.

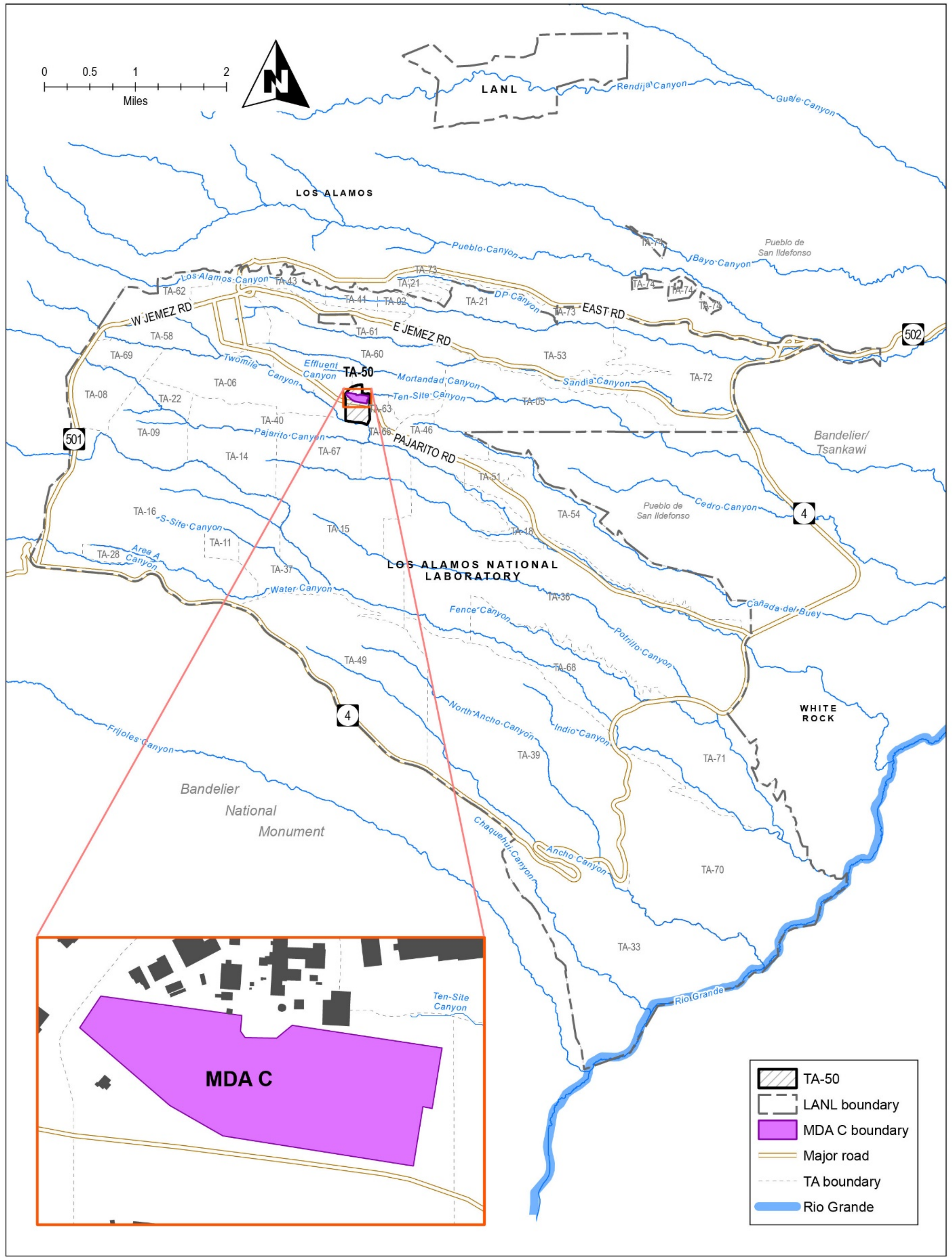

Figure 1.1-1 Location of MDA C in TA-50 with respect to Laboratory technical areas and surrounding landholdings

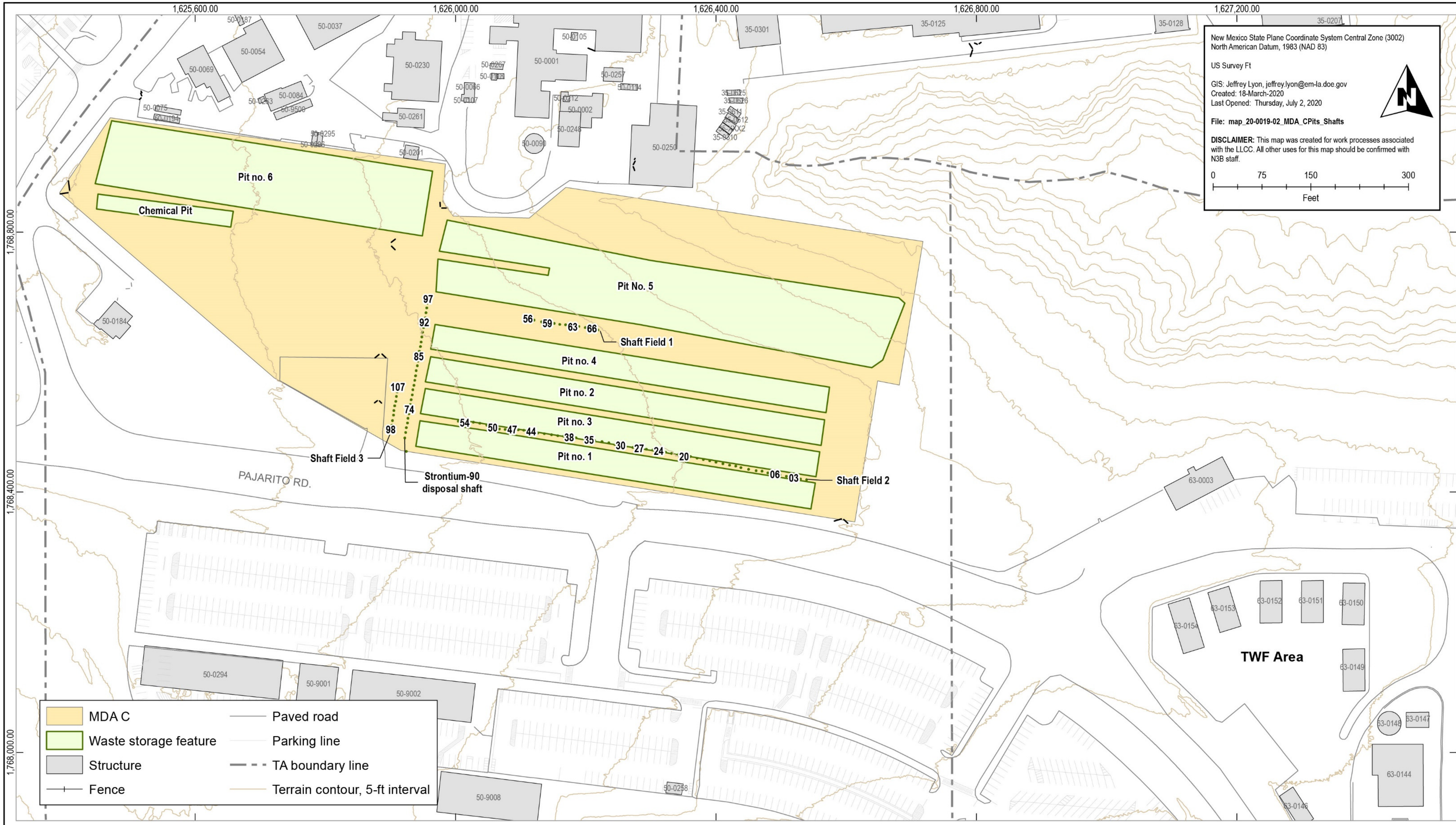

Figure 1.1-2 Location of MDA C pits and shafts

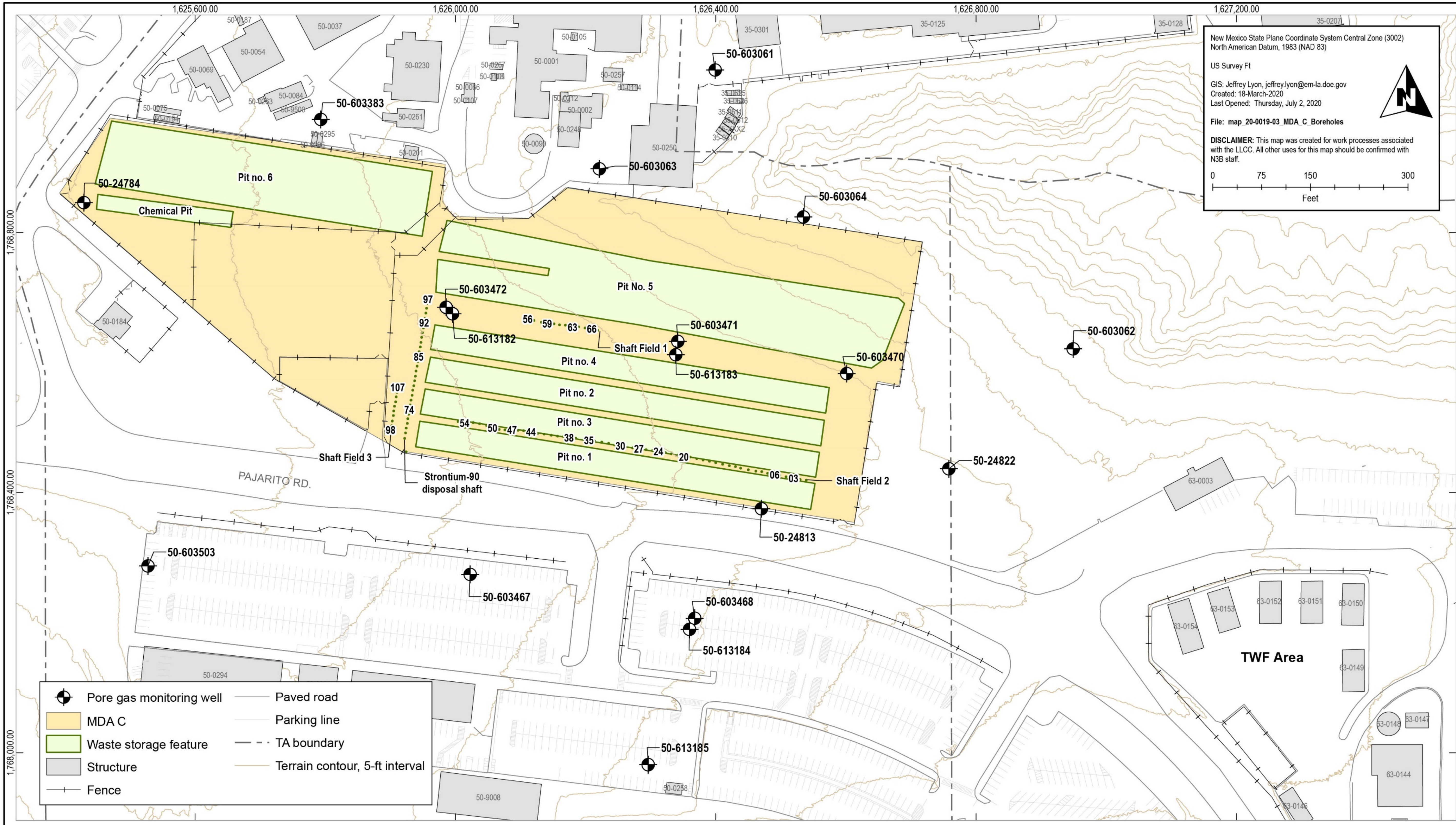

Figure 1.1-3 Location of MDA C monitoring boreholes

Table 2.0-1
2020 MDA C Subsurface Vapor-Monitoring Locations

Location ID	Screening Conducted	Pore Depth (vertical depth in ft)
50-24784	Yes	155, 244, 362, 450
50-24813	Yes	25, 150, 241, 358, 450, 600
50-24822	Yes	25, 142, 235, 351, 450
50-603061	Yes	25, 128, 228, 347 ,450
50-603062	Yes	122, 217, 337, 450
50-603063	Yes	25, 128, 228, 347, 450
50-603064	Yes	113, 214, 332, 500
50-603383	Yes	26, 139, 244, 359, 450
50-603467	Yes	143, 244, 360, 500, 600
50-603468/50-613184	Yes	142, 233, 354, 403, 500, 600, 664.5
50-603470	Yes	83, 203, 278,351 450, 650
50-603471/50-613183	Yes	90, 209, 288, 360, 450, 550, 642.5, and unknown port depth*
50-603472/50-613182	Yes	27, 146, 292, 364, 450, 550, 632.5
50-603503	Yes	133, 237, 347, 450
50-613185	Yes	145, 235, 350, 450, 600

* The unknown port depth could be at 30 ft or it could be at 90 ft, and the one labeled 90 ft could actually be the 30-ft port. During sampling, the sampling team was unable to determine the actual depth, which is why both ports were sampled.

Table 3.1-1
MDA C Tier 1 Screening Calculations

VOC	Henry's Law Constant[a] (dimensionless)	Groundwater SL	Source of Groundwater SL	Tier 1 Pore-Gas Concentrations Corresponding to Groundwater Standard (µg/m³)
Acetone	0.00144	14,100	NMED Tap Water[b]	20,300
Benzene	0.228	5	EPA MCL[c]	1140
Bromodichloromethane	0.0869	80	EPA MCL	6950
Carbon disulfide	0.59	810	NMED Tap Water	478,000
Carbon tetrachloride	1.13	5	NMWQCC[d]	5650
Chloroform	0.15	80	EPA MCL	12,000
Dichloroethene[cis1,2-]	0.167	70	NMWQCC	11,700
Dichlorodifluoromethane	14.1	197	NMED Tap Water	2,780,000
Dichloroethane[1,1-]	0.23	25	NMWQCC	5750
Dichloroethane[1,2-]	0.0484	5	NMWQCC	242
Dichloroethene[1,1-]	1.07	7	NMWQCC	7490
Dichloropropane[1,2-]	0.116	5	NMWQCC	580
Ethanol	na[e]	na	na	na
Methylene chloride	0.133	5	NMWQCC	665
n-Hexane	73.8	319	EPA Tap Water	23,500,000
Propanol[2-]	0.000331	410	EPA Tap Water	136
Tetrachloroethene	0.726	5	NMWQCC	3630
Trichloro-1,2,2-trifluoroethane[1,1,2-]	21.6	55,000	NMED Tap Water	1,190,000,000
Trichloroethane[1,1,1-]	0.705	200	NMWQCC	141,000

Table 3.1-1 (continued)

VOC	Henry's Law Constant[a] (dimensionless)	Groundwater SL	Source of Groundwater SL	Tier 1 Pore-Gas Concentrations Corresponding to Groundwater Standard (µg/m³)
Trichloroethane[1,1,2-]	0.0338	5	NMWQCC	169
Trichloroethene	0.404	5	NMWQCC	2020
Trichlorofluoromethane	3.98	1140	NMED Tap Water	4,540,000
Xylene [1,2-]	0.212	620	NMWQCC	131,000
Xylene[1,3-]+1,4-]	0.212[f]	620[g]	NMWQCC	131,000

Note: Tier 1 screening concentration is the calculated concentration in pore gas exceeding groundwater standard derived from Equation 3.1-2.

[a] The source of Henry's law constants is the NMED "NMED Risk Assessment Guidance for Site Investigations and Remediation Volume 1, Soil Screening Guidance for Human Health Risk Assessments" (NMED 2019, 700550) or the EPA regional screening tables (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables).

[b] NMED tap water screening level (NMED 2019, 700550, Appendix A).

[c] MCL for organic contaminants (40 Code of Federal Regulations [CFR] 141.61)

[d] NMWQCC standard (20.6.2.3103 New Mexico Administrative Code)

[e] na = not available.

[f] Henry's Law constant for xylenes.

[g] Screening level is for total xylenes.

Table 3.1-2
VOC Tier 1 Screening First-Round Sampling 2020

VOC	Maximum Pore Gas Concentration ($\mu g/m^3$)	Tier 1 Screening Level Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard ($\mu g/m^3$)	Tier 1 Potential for Groundwater Impact[a]
Acetone	200	20,300	No
Benzene	14 (J)[b]	1140	No
Carbon disulfide	17 (J)	478,000	No
Carbon tetrachloride	1100	5650	No
Chloroform	2000	12,000	No
Dichlorodifluoromethane	940	2,780,000	No
Dichloroethane[1,1-]	97	5750	No
Dichloroethane[1,2-]	80	242	No
Dichloroethene[1,1-]	1500	7490	No
Dichloroethene[cis-1,2-]	550	11,700	No
Dichloropropane[1,2-]	500	580	No
Methylene chloride	800	665	Yes
n-Hexane	14(J)	23,500,000	No
Propanol[2-]	270	136	Yes
Tetrachloroethene	1600	3630	No
Trichloro-1,2,2-trifluoroethane[1,1,2-]	25,000	1,190,000,000	No
Trichloroethane[1,1,1-]	6,500	141,000	No
Trichloroethane[1,1,2-]	190	169	Yes
Trichloroethene	64,000	2020	Yes
Trichlorofluoromethane	79 (J)	4,540,000	No

Notes: Tier 1 screening concentration is the calculated concentration in pore gas exceeding groundwater standard derived from Equation 3.1-2. Shaded cells indicate VOCs that did not pass the Tier 1 screen.

[a] If concentration of a VOC measured in a pore-gas sample is less than the pore-gas SL, the concentration of the VOC in soil vapor will not exceed the groundwater SL, even if the VOC plume is in direct contact with groundwater.

[b] (J) = The analyte was positively identified and the associated numerical value is estimated to be more uncertain than would normally be expected for that result.

Table 3.1-3
VOC Tier 1 Screening Second-Round Sampling 2020

VOC	Maximum Pore-Gas Concentration ($\mu g/m^3$)	Tier 1 Screening Level Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard ($\mu g/m^3$)	Tier 1 Potential for Groundwater Impact[a]
Acetone	74(J)[b]	20,300	No
Benzene	14(J)	1140	No
Carbon disulfide	56(J)	478,000	No
Carbon tetrachloride	1000	5650	No
Chloroform	1400	12,000	No
Dichlorodifluoromethane	840	2,780,000	No
Dichloroethane[1,1-]	30 (J)	5750	No
Dichloroethane[1,2-]	130	242	No
Dichloroethene[1,1-]	1900	7490	No
Dichloroethene[cis-1,2-]	370	11,700	No
Dichloropropane[1,2-]	140	580	No
Ethanol	68 (J)	na[c]	No
Methylene chloride	1200	665	Yes
Propanol[2-]	100 (J)	136	No
Tetrachloroethene	950	3630	No
Trichloro-1,2,2-trifluoroethane[1,1,2-]	30,000	1,190,000,000	No
Trichloroethane[1,1,1-]	4,000	141,000	No
Trichloroethane[1,1,2-]	100	169	No
Trichloroethene	47,000	2020	Yes
Trichlorofluoromethane	62 (J)	4,540,000	No
Xylene [1,2-]	10 (J)	131,000	No
Xylene [1,3-]+[1,4-]	36 (J)	131,000	No

Notes: Tier 1 screening concentration is the calculated concentration in pore gas exceeding groundwater standard derived from Equation 3.1-2. Shaded cells indicate VOCs that did not pass the Tier 1 screen.

[a] If concentration of a VOC measured in a pore-gas sample is less than the pore-gas SL, the concentration of the VOC in pore gas will not exceed the groundwater SL, even if the VOC plume is in direct contact with groundwater.

[b] (J) = The analyte was positively identified and the associated numerical value is estimated to be more uncertain than would normally be expected for that result.

[c] na = Not available.

Table 5.1-1
2020 First-Round VOC Pore-Gas Detected Results at MDA C

Field Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloropropane[1,2-]
Groundwater Tier 1 SL			**20,300**	**1140**	**478,000**	**5650**	**12,000**	**2,780,000**	**5750**	**242**	**7490**	**11,700**	**580**
MD50-20-204971	50-24784	155	—[a]	—	—	31 (J)[b]	83	18 (J)	—	—	—	—	21 (J)
MD50-20-204972	50-24784	244	—	—	—	48 (J)	30 (J)	21 (J)	—	—	—	—	—
MD50-20-204973	50-24784	362	—	—	—	69 (J)	—	39 (J)	—	—	—	—	—
MD50-20-204974	50-24784	450	—	—	—	—	—	—	—	—	—	—	—
MD50-20-204979	50-24813	25	—	—	—	750	780	110	—	—	—	30 (J)	—
MD50-20-204980	50-24813	150	69 (J)	—	—	1100	2000	380	—	73	14 (J)	440	83
MD50-20-204981	50-24813	241	76 (J)	—	—	1000	2000	840	—	26 (J)	15 (J)	550	60 (J)
MD50-20-204982	50-24813	358	—	—	—	750	680	940	—	—	—	230	—
MD50-20-204983	50-24813	450	—	—	—	450	170	640	—	—	—	71	—
MD50-20-204984	50-24813	600	—	—	—	160	—	340	—	—	—	—	—
MD50-20-204991	50-24822	25	—	—	—	52 (J)	160	64 (J)	—	—	—	—	—
MD50-20-204992	50-24822	142	57 (J)	—	—	180	460	310	—	—	—	99	—
MD50-20-204993	50-24822	235	—	11 (J)	—	300	470	540	—	—	12 (J)	130	—
MD50-20-204994	50-24822	351	—	—	—	230	170	500	—	—	—	48 (J)	—
MD50-20-204995	50-24822	450	—	—	—	130	41 (J)	380	—	—	—	10 (J)	—
MD50-20-205095	50-603061	25	—	—	—	—	15 (J)	280	—	—	140	—	—
MD50-20-205096	50-603061	128	—	—	—	69 (J)	78	310	20 (J)	—	1200	9.5 (J)	—
MD50-20-206177	50-603061	228	—	14 (J)	—	140	110	340	97	80	1500	14 (J)	500
MD50-20-205098	50-603061	347	—	—	—	120	15 (J)	260	—	—	400	—	—
MD50-20-205099	50-603061	450	—	—	—	62 (J)	—	150	—	—	100	—	—
MD50-20-205105	50-603062	122	—	—	—	35 (J)	59 (J)	100	—	—	—	11 (J)	—
MD50-20-205106	50-603062	217	—	—	—	45 (J)	59 (J)	230	—	—	18 (J)	13 (J)	—
MD50-20-205107	50-603062	337	—	—	—	40 (J)	11 (J)	180	—	—	—	—	—
MD50-20-205108	50-603062	450	—	—	—	—	—	110	—	—	—	—	—
MD50-20-205001	50-603063	25	—	—	—	—	32 (J)	110	—	—	—	—	—
MD50-20-205002	50-603063	128	—	—	—	140 (J)	280	300	57 (J)	—	210	37 (J)	—

Table 5.1-1 (continued)

Field Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloropropane[1,2-]
Groundwater Tier 1 SL			**20,300**	**1140**	**478,000**	**5650**	**12,000**	**2,780,000**	**5750**	**242**	**7490**	**11,700**	**580**
MD50-20-205003	50-603063	228	—	—	—	330	590	470	65 (J)	—	340	110	55 (J)
MD50-20-205004	50-603063	347	—	—	—	300	350	380	28 (J)	—	100	67	27 (J)
MD50-20-205005	50-603063	450	120 (J)	10 (J)	—	190	140	270	23 (J)	—	23 (J)	—	—
MD50-20-205011	50-603064	113	—	—	—	140	730	320	—	—	480	170	50 (J)
MD50-20-205012	50-603064	214	—	9.6 (J)	—	330	630	640	—	—	710	240	36 (J)
MD50-20-205013	50-603064	332	—	—	—	230	100	500	—	—	220	40 (J)	—
MD50-20-205014	50-603064	500	—	—	—	—	—	9.4 (J)	—	—	—	—	—
MD50-20-205019	50-603383	26	—	—	—	55 (J)	45 (J)	180	—	—	—	—	—
MD50-20-205020	50-603383	139	—	—	—	160	180	300	22 (J)	—	59	35 (J)	200
MD50-20-205021	50-603383	244	—	—	—	330	190	300	29 (J)	—	67	59	420
MD50-20-205022	50-603383	359	200	—	—	300	63 (J)	200	—	—	37 (J)	31 (J)	120
MD50-20-205023	50-603383	450	—	—	—	230	19 (J)	230	—	—	28 (J)	—	20 (J)
MD50-20-205029	50-603467	143	66 (J)	—	—	230	420	140	—	—	—	75	25 (J)
MD50-20-205030	50-603467	244	—	—	—	490	630	280	—	—	—	170	—
MD50-20-205031	50-603467	360	130 (J)	—	—	420	480	200	—	—	—	130	—
MD50-20-205032	50-603467	500	76 (J)	—	—	240	78	240	—	—	—	21 (J)	—
MD50-20-205033	50-603467	600	—	8.6 (J)	—	55 (J)	21 (J)	49 (J)	13 (J)	27 (J)	—	—	79
MD50-20-205039	50-603468	142	—	—	—	26 (J)	73	18 (J)	—	—	—	16 (J)	—
MD50-20-205040	50-603468	233	26 (J)	—	—	94	93	69	—	—	—	20 (J)	—
MD50-20-205041	50-603468	354	—	—	—	69 (J)	59 (J)	69	—	—	—	20 (J)	—
MD50-20-205042	50-603468	403	52 (J)	—	—	88	46 (J)	89	—	—	—	14 (J)	—
MD50-20-205053	50-603470	83	—	—	—	140	630	89	—	—	—	91	31 (J)
MD50-20-205054	50-603470	203	—	—	—	270	830	420	—	—	34 (J)	210	28 (J)
MD50-20-205055	50-603470	278	—	11 (J)	—	400	730	590	—	—	34 (J)	240	24 (J)
MD50-20-205056	50-603470	351	—	8.3 (J)	—	370	360	690	—	—	25 (J)	130	—
MD50-20-205057	50-603470	450	—	—	—	230	88	480	—	—	14 (J)	38 (J)	—
MD50-20-205058	50-603470	650	—	—	—	—	—	48 (J)	—	—	—	—	—

Table 5.1-1 (continued)

Field Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloropropane[1,2-]
Groundwater Tier 1 SL			**20,300**	**1140**	**478,000**	**5650**	**12,000**	**2,780,000**	**5750**	**242**	**7490**	**11,700**	**580**
MD50-20-205065	50-603471	depth not available[c]	—	—	—	550	830	79	—	—	—	99	51 (J)
MD50-20-205066	50-603471	90	—	—	—	210	380	31 (J)	—	30 (J)	—	29 (J)	—
MD50-20-205067	50-603471	209	—	—	—	340	590	180	—	38 (J)	12 (J)	150	38 (J)
MD50-20-205068	50-603471	288	81 (J)	—	—	230	330	190	—	—	—	95	22 (J)
MD50-20-205069	50-603471	360	—	—	—	160	130	180	—	—	—	37 (J)	—
MD50-20-205070	50-603471	450	—	—	—	110	130	120	—	—	—	40 (J)	—
MD50-20-205081	50-603472	27	—	—	—	22 (J)	170	25 (J)	—	—	—	11 (J)	—
MD50-20-205082	50-603472	146	—	—	—	140	450	100	—	38 (J)	—	91	83
MD50-20-205083	50-603472	292	—	10 (J)	—	470	590	330	—	—	16 (J)	170	79
MD50-20-205084	50-603472	364	—	6.7 (J)	—	450	250	400	—	—	—	83	—
MD50-20-205085	50-603472	450	—	—	—	300	88	350	—	—	8.7 (J)	29 (J)	—
MD50-20-205113	50-603503	133	—	—	—	36 (J)	59 (J)	28 (J)	—	—	—	—	20 (J)
MD50-20-205114	50-603503	237	26 (J)	—	—	82 (J)	100	54 (J)	—	—	—	16 (J)	17 (J)
MD50-20-205115	50-603503	347	—	—	—	69 (J)	39 (J)	54 (J)	—	—	—	—	—
MD50-20-205116	50-603503	450	—	—	—	47 (J)	15 (J)	42 (J)	—	—	—	—	—
MD50-20-205091	50-613182	550	—	—	—	140	12 (J)	210	—	—	—	—	—
MD50-20-205092	50-613182	632.5	—	—	—	—	12 (J)	13 (J)	—	—	—	—	—
MD50-20-205077	50-613183	550	—	—	—	38 (J)	—	69	—	—	—	—	—
MD50-20-205078	50-613183	642.5	57 (J)	—	—	—	—	—	—	—	—	—	—
MD50-20-205047	50-613184	500	—	—	—	28 (J)	—	36 (J)	—	—	—	—	—
MD50-20-205048	50-613184	600	—	—	—	—	—	8.9 (J)	—	—	—	—	—
MD50-20-205049	50-613184	664.5	—	—	—	—	—	—	—	—	—	—	—
MD50-20-205121	50-613185	145	—	—	—	—	—	33 (J)	—	—	—	—	—

Table 5.1-1 (continued)

Field Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloropropane[1,2-]
Groundwater Tier 1 SL			**20,300**	**1140**	**478,000**	**5650**	**12,000**	**2,780,000**	**5750**	**242**	**7490**	**11,700**	**580**
MD50-20-205122	50-613185	235	—	—	—	180	110	180	—	—	—	23 (J)	—
MD50-20-205123	50-613185	350	—	—	—	130	26 (J)	160	—	—	—	—	—
MD50-20-205124	50-613185	450	31 (J)	—	17 (J)	100	11 (J)	150	—	—	—	—	—
MD50-20-205125	50-613185	600	31 (J)	—	—	33 (J)	—	74	—	—	—	—	—

Table 5.1-1 (continued)

Field Sample ID	Location ID	Depth (ft)	Ethanol	Hexane	Methylene Chloride	Propanol[2-]	Tetrachloroethene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane
Groundwater Tier 1 SL			**na[d]**	**na**	**665**	**136**	**3630**	**1,190,000,000**	**141,000**	**169**	**2020**	**4,540,000**
MD50-20-204971	50-24784	155	—	—	—	—	460	—	8.7 (J)	—	810	—
MD50-20-204972	50-24784	244	—	—	—	—	350	—	—	—	700	—
MD50-20-204973	50-24784	362	—	—	—	—	280	—	—	—	640	—
MD50-20-204974	50-24784	450	—	—	—	—	—	—	—	—	81 (J)	—
MD50-20-204979	50-24813	25	—	—	—	—	320	—	—	35 (J)	8100	—
MD50-20-204980	50-24813	150	—	—	140 (J)	—	540	44 (J)	—	190	34,000	—
MD50-20-204981	50-24813	241	—	—	490	—	810	100 (J)	20 (J)	36 (J)	64,000	33 (J)
MD50-20-204982	50-24813	358	—	—	—	—	620	80 (J)	9.8 (J)	—	53,000	39 (J)
MD50-20-204983	50-24813	450	—	—	150 (J)	—	280	40 (J)	—	—	28,000	32 (J)
MD50-20-204984	50-24813	600	—	—	-	—	60 (J)	—	—	—	5000	17 (J)
MD50-20-204991	50-24822	25	—	—	-	—	81 (J)	39 (J)	9.3 (J)	—	4100	—
MD50-20-204992	50-24822	142	—	—	140 (J)	—	170	140	22 (J)	—	17,000	15 (J)
MD50-20-204993	50-24822	235	—	—	270	—	210	210	31 (J)	—	31,000	23 (J)
MD50-20-204994	50-24822	351	—	—	120 (J)	—	130	120	11 (J)	—	20,000	27 (J)
MD50-20-204995	50-24822	450	—	—	—	—	53 (J)	51 (J)	—	—	10,000	19 (J)
MD50-20-205095	50-603061	25	—	—	—	—	160	7400	650	—	500	—
MD50-20-205096	50-603061	128	—	—	—	—	330	22,000	2500	—	2700	24 (J)
MD50-20-206177	50-603061	228	—	—	—	—	450	25,000	6500	—	5900	79 (J)
MD50-20-205098	50-603061	347	—	—	—	—	160	9200	600	—	2300	24 (J)
MD50-20-205099	50-603061	450	—	—	—	—	49 (J)	3000	82	—	1000	19 (J)
MD50-20-205105	50-603062	122	—	—	—	39 (J)	38 (J)	470	46 (J)	—	5200	12 (J)
MD50-20-205106	50-603062	217	—	—	—	—	41 (J)	760	50 (J)	—	7500	13 (J)
MD50-20-205107	50-603062	337	—	—	—	—	—	260	—	—	2600	11 (J)
MD50-20-205108	50-603062	450	—	—	—	—	—	84 (J)	—	—	910	—
MD50-20-205001	50-603063	25	—	—	—	—	290	1700	150	—	1000	—
MD50-20-205002	50-603063	128	—	—	—	—	880	4300	400	—	7500	26 (J)

Table 5.1-1 (continued)

Field Sample ID	Location ID	Depth (ft)	Ethanol	Hexane	Methylene Chloride	Propanol[2-]	Tetrachloroethene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane
Groundwater Tier 1 SL			**na[d]**	**na**	**665**	**136**	**3630**	**1,190,000,000**	**141,000**	**169**	**2020**	**4,540,000**
MD50-20-205003	50-603063	228	—	—	—	—	1600	5400	600	—	22,000	47 (J)
MD50-20-205004	50-603063	347	—	—	—	—	950	1800	98	—	18,000	43 (J)
MD50-20-205005	50-603063	450	—	—	—	270	380	480	18 (J)	—	9100	25 (J)
MD50-20-205011	50-603064	113	—	—	120 (J)	—	550	8400	1400	—	22,000	28 (J)
MD50-20-205012	50-603064	214	—	—	420	—	700	13,000	1900	—	39,000	51 (J)
MD50-20-205013	50-603064	332	—	—	—	—	250	4900	260	—	17,000	41 (J)
MD50-20-205014	50-603064	500	—	—	—	—	—	74 (J)	—	—	310	—
MD50-20-205019	50-603383	26	—	—	—	—	430	490	65 (J)	—	1100	20 (J)
MD50-20-205020	50-603383	139	—	—	—	—	1100	1100	140	—	4000	31 (J)
MD50-20-205021	50-603383	244	—	—	83 (J)	—	1600	1100	170	—	7000	38 (J)
MD50-20-205022	50-603383	359	—	—	—	—	880	510	50 (J)	—	4000	30 (J)
MD50-20-205023	50-603383	450	—	—	—	—	430	660	52 (J)	—	2200	26 (J)
MD50-20-205029	50-603467	143	—	—	—	—	260	—	—	—	8600	—
MD50-20-205030	50-603467	244	—	—	130 (J)	—	640	—	—	—	24,000	17 (J)
MD50-20-205031	50-603467	360	—	—	—	—	650	—	—	—	24,000	18 (J)
MD50-20-205032	50-603467	500	—	—	—	—	320	—	—	—	10,000	15 (J)
MD50-20-205033	50-603467	600	—	14 (J)	—	—	130	120	460	—	2000	—
MD50-20-205039	50-603468	142	—	—	—	—	48 (J)	—	—	—	2100	—
MD50-20-205040	50-603468	233	—	—	73 (J)	—	64 (J)	—	—	—	3700	—
MD50-20-205041	50-603468	354	—	—	—	—	59 (J)	—	—	—	3900	—
MD50-20-205042	50-603468	403	—	12 (J)	42 (J)	—	66 (J)	—	—	—	3900	—
MD50-20-205053	50-603470	83	—	—	—	—	540	200	32 (J)	76 (J)	8100	—
MD50-20-205054	50-603470	203	—	—	300	—	390	640	71 (J)	20 (J)	28,000	22 (J)
MD50-20-205055	50-603470	278	—	—	590	—	430	800	71 (J)	—	39,000	33 (J)
MD50-20-205056	50-603470	351	—	—	300	—	280	730	39 (J)	—	33,000	43 (J)
MD50-20-205057	50-603470	450	—	—	90 (J)	—	150	340	9.8 (J)	—	17,000	23 (J)
MD50-20-205058	50-603470	650	—	—	—	—	—	—	—	—	150	—

Table 5.1-1 (continued)

Field Sample ID	Location ID	Depth (ft)	Ethanol	Hexane	Methylene Chloride	Propanol[2-]	Tetrachloroethene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane
Groundwater Tier 1 SL			**na[d]**	**na**	**665**	**136**	**3630**	**1,190,000,000**	**141,000**	**169**	**2020**	**4,540,000**
MD50-20-205065	50-603471	depth not available[c]	—	—	97 (J)	—	450	140	23 (J)	50 (J)	8100	—
MD50-20-205066	50-603471	90	230	—	—	—	160	57 (J)	8.2 (J)	—	2300	—
MD50-20-205067	50-603471	209	—	—	420	—	350	200	26 (J)	—	16,000	11 (J)
MD50-20-205068	50-603471	288	—	—	300	—	200	180	20 (J)	—	10,000	—
MD50-20-205069	50-603471	360	—	—	110 (J)	—	120	110	—	—	5000	13 (J)
MD50-20-205070	50-603471	450	—	—	—	—	100	70 (J)	—	—	6400	12 (J)
MD50-20-205081	50-603472	27	—	—	—	—	350	44 (J)	28 (J)	—	1800	—
MD50-20-205082	50-603472	146	—	—	280	—	600	100 (J)	17 (J)	27 (J)	9700	11 (J)
MD50-20-205083	50-603472	292	—	—	800	—	1600	180	34 (J)	—	30,000	39 (J)
MD50-20-205084	50-603472	364	—	—	380	—	1200	120	19 (J)	—	24,000	38 (J)
MD50-20-205085	50-603472	450	—	—	110 (J)	—	700	61 (J)	—	—	14,000	29 (J)
MD50-20-205113	50-603503	133	—	—	—	—	190	31 (J)	—	—	1200	—
MD50-20-205114	50-603503	237	—	—	73 (J)	17 (J)	310	40 (J)	13 (J)	—	3000	—
MD50-20-205115	50-603503	347	—	—	—	—	260	—	—	—	2800	—
MD50-20-205116	50-603503	450	—	—	—	—	100	—	—	—	1500	—
MD50-20-205091	50-613182	550	—	—	—	—	180	—	—	—	3700	19 (J)
MD50-20-205092	50-613182	632.5	—	—	—	—	—	—	—	—	120	—
MD50-20-205077	50-613183	550	—	—	—	—	33 (J)	—	—	—	970	—
MD50-20-205078	50-613183	642.5	—	—	—	—	—	—	—	—	33 (J)	—
MD50-20-205047	50-613184	500	—	—	—	—	—	—	—	—	750	—
MD50-20-205048	50-613184	600	—	—	—	—	—	—	—	—	110	—
MD50-20-205049	50-613184	664.5	—	—	—	—	—	—	—	—	30 (J)	—
MD50-20-205121	50-613185	145	—	—	—	—	—	—	—	—	750	—

Table 5.1-1 (continued)

Field Sample ID	Location ID	Depth (ft)	Ethanol	Hexane	Methylene Chloride	Propanol[2-]	Tetrachloroethene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane
Groundwater Tier 1 SL			**na[d]**	**na**	**665**	**136**	**3630**	**1,190,000,000**	**141,000**	**169**	**2020**	**4,540,000**
MD50-20-205122	50-613185	235	—	—	73 (J)	—	120	—	—	—	7500	—
MD50-20-205123	50-613185	350	—	—	—	—	88 (J)	—	—	—	4600	—
MD50-20-205124	50-613185	450	—	—	26 (J)	—	47 (J)	—	—	—	2300	—
MD50-20-205125	50-613185	600	—	—	—	—	—	—	—	—	300	—

Notes: Concentrations are in µg/m³. Shading means the value exceeds groundwater screening levels for the analyte listed.

[a] — = Not detected.

[b] (J) = The analyte was positively identified and the associated numerical value is estimated to be more uncertain than would normally be expected for that result.

[c] Port was not labeled with the port depth.

[d] na = Not available.

Table 5.1-2
2020 Second-Round VOC Pore-Gas Detected Results at MDA C

Field Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloropropane[1,2-]
Groundwater Tier 1 SL			**20,300**	**1140**	**478,000**	**5650**	**12,000**	**2,780,000**	**5750**	**242**	**7490**	**11,700**	**580**
MD50-21-206882	50-24784	155	—[a]	—	—	88	190	48 (J)[b]	—	—	—	—	40 (J)
MD50-21-206883	50-24784	244	74 (J)	—	56 (J)	100	63 (J)	59 (J)	—	—	—	—	25 (J)
MD50-21-206884	50-24784	362	—	—	—	190	20 (J)	100	—	—	—	—	—
MD50-21-206885	50-24784	450	—	—	—	100	—	79	—	—	—	—	—
MD50-21-206892	50-24813	25	—	—	—	200	180	30 (J)	—	—	—	—	—
MD50-21-206893	50-24813	150	—	—	—	690	1400	210	—	53	11 (J)	230	37 (J)
MD50-21-206894	50-24813	241	—	—	—	750	1100	470	—	19 (J)	—	290	28 (J)
MD50-21-206895	50-24813	358	—	—	—	590	430	590	—	—	—	150	—
MD50-21-206896	50-24813	450	—	—	—	360	130	480	—	—	—	48 (J)	—
MD50-21-206897	50-24813	600	—	—	—	69 (J)	—	100	—	—	—	—	—
MD50-21-206913	50-24822	25	—	—	—	69 (J)	230	100	—	—	—	—	—
MD50-21-206914	50-24822	142	—	7.7 (J)	—	270	630	430	—	—	—	110	—
MD50-21-206915	50-24822	235	50 (J)	9.9 (J)	—	450	680	840	—	—	11 (J)	190	—
MD50-21-206916	50-24822	351	—	—	—	110	83	240	—	—	—	25 (J)	—
MD50-21-206917	50-24822	450	—	—	—	230	63 (J)	590	—	—	—	24 (J)	—
MD50-21-206927	50-603061	25	—	—	—	—	15 (J)	330	—	—	200	—	—
MD50-21-206928	50-603061	128	—	—	—	56 (J)	68	240	17 (J)	—	1100	—	—
MD50-21-206929	50-603061	228	—	—	—	180	88	430	30 (J)	—	1900	18 (J)	—
MD50-21-206930	50-603061	347	—	—	—	180	24 (J)	370	—	—	550	—	—
MD50-21-206931	50-603061	450	—	—	—	60 (J)	12 (J)	170	—	—	130	—	—
MD50-21-206936	50-603062	122	—	—	—	—	19 (J)	49 (J)	—	—	—	—	—
MD50-21-206937	50-603062	217	—	—	—	—	20 (J)	74	—	—	—	—	—
MD50-21-206938	50-603062	337	—	—	—	—	—	64	—	—	—	—	—
MD50-21-206939	50-603062	450	—	—	—	—	—	31 (J)	—	—	—	—	—
MD50-21-206945	50-603063	25	—	—	—	—	18 (J)	50 (J)	—	—	—	—	—

Table 5.1-2 (Continued)

Field Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloropropane[1,2-]
Groundwater Tier 1 SL			**20,300**	**1140**	**478,000**	**5650**	**12,000**	**2,780,000**	**5750**	**242**	**7490**	**11,700**	**580**
MD50-21-206946	50-603063	128	—	—	—	—	31 (J)	38 (J)	—	—	25 (J)	—	—
MD50-21-206947	50-603063	228	—	—	—	110	200	160	23 (J)	—	100	48 (J)	18 (J)
MD50-21-206948	50-603063	347	—	—	—	150	160	180	—	—	52 (J)	21 (J)	—
MD50-21-206949	50-603063	450	—	—	—	75 (J)	54 (J)	110	—	—	—	—	—
MD50-21-206954	50-603064	113	—	—	—	170	780	300	—	—	520	190	42 (J)
MD50-21-206955	50-603064	214	—	7.7 (J)	—	400	730	690	15 (J)	—	800	250	33 (J)
MD50-21-206956	50-603064	332	—	—	—	210	93	480	—	—	190	34 (J)	—
MD50-21-206957	50-603064	500	—	—	—	69 (J)	—	240	—	—	13 (J)	—	—
MD50-21-206963	50-603383	26	—	—	—	69 (J)	59 (J)	180	—	—	13 (J)	—	27 (J)
MD50-21-206964	50-603383	139	—	—	—	69 (J)	63	89	—	—	20 (J)	—	88
MD50-21-206965	50-603383	244	—	—	—	130	68	110	—	—	26 (J)	19 (J)	140
MD50-21-206966	50-603383	359	—	—	—	94	15 (J)	94	—	—	—	—	19 (J)
MD50-21-206967	50-603383	450	—	—	—	61 (J)	—	64 (J)	—	—	—	—	—
MD50-21-206973	50-603467	143	—	—	—	280	430	140	—	—	—	71	—
MD50-21-206974	50-603467	244	—	—	—	480	590	260	—	—	—	150	22 (J)
MD50-21-206975	50-603467	360	—	—	—	360	300	210	—	—	—	71	—
MD50-21-206976	50-603467	500	—	—	—	240	73	210	—	—	—	19 (J)	—
MD50-21-206977	50-603467	600	—	—	—	58 (J)	33 (J)	150	—	—	—	—	—
MD50-21-206990	50-603468	142	—	—	—	200	230	190	—	—	—	75	—
MD50-21-206991	50-603468	233	66 (J)	—	—	230	250	200	—	—	—	71	—
MD50-21-206992	50-603468	354	—	—	—	300	180	230	—	—	—	55 (J)	—
MD50-21-206993	50-603468	403	—	—	—	210	100	230	—	—	—	44 (J)	—
MD50-21-207006	50-603470	83	—	—	—	110	460	79	—	14 (J)	—	59	—
MD50-21-207007	50-603470	203	—	—	—	100	340	170	—	—	13 (J)	91	—
MD50-21-207008	50-603470	278	—	—	—	180	310	260	—	—	14 (J)	87	—

Table 5.1-2 (Continued)

Field Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloropropane[1,2-]
Groundwater Tier 1 SL			**20,300**	**1140**	**478,000**	**5650**	**12,000**	**2,780,000**	**5750**	**242**	**7490**	**11,700**	**580**
MD50-21-207009	50-603470	351	—	—	—	140	130	250	—	—	—	55	—
MD50-21-207010	50-603470	450	—	—	—	59 (J)	26 (J)	120	—	—	—	—	—
MD50-21-207011	50-603470	650	—	—	—	—	—	20 (J)	—	—	—	—	—
MD50-21-207109	50-603471	depth not available[c]	—	—	—	880	1400	120	—	110	15 (J)	150	55 (J)
MD50-21-207017	50-603471	90	—	—	—	580	1400	69	—	130	—	83	43 (J)
MD50-21-207018	50-603471	209	—	8.3 (J)	—	290	1300	50 (J)	—	80	—	250	74
MD50-21-207019	50-603471	288	—	14 (J)	—	1000	1300	640	—	44 (J)	33 (J)	370	69
MD50-21-207020	50-603471	360	—	12 (J)	—	750	680	690	—	—	24 (J)	210	18 (J)
MD50-21-207021	50-603471	450	—	—	—	520	540	500	—	—	15 (J)	150	—
MD50-21-207031	50-603472	27	—	—	—	—	78	—	—	—	—	—	—
MD50-21-207032	50-603472	146	—	—	—	75 (J)	260	46 (J)	—	28 (J)	—	52 (J)	39 (J)
MD50-21-207033	50-603472	292	—	—	—	170	260	130	—	—	—	75	28 (J)
MD50-21-207034	50-603472	364	—	—	—	120	68	100	—	—	—	19 (J)	—
MD50-21-207035	50-603472	450	—	—	—	160	54 (J)	160	—	—	—	—	—
MD50-21-207044	50-603503	133	—	—	—	—	34 (J)	17 (J)	—	—	—	—	—
MD50-21-207045	50-603503	237	—	—	—	31 (J)	35 (J)	20 (J)	—	—	—	—	—
MD50-21-207046	50-603503	347	—	—	—	—	—	—	—	—	—	—	—
MD50-21-207047	50-603503	450	—	—	—	—	—	13 (J)	—	—	—	—	—
MD50-21-207038	50-613182	550	—	—	—	94	—	130	—	—	—	—	—
MD50-21-207039	50-613182	632.5	—	—	—	—	—	—	—	—	—	—	—
MD50-21-207024	50-613183	550	—	—	—	200	—	360	—	—	—	—	—
MD50-21-207025	50-613183	642.5	—	—	—	—	—	14 (J)	—	—	—	—	—
MD50-21-206997	50-613184	500	—	—	—	75 (J)	—	120	—	—	—	—	—
MD50-21-206998	50-613184	600	—	—	—	23 (J)	—	59 (J)	—	—	—	—	—
MD50-21-206999	50-613184	664.5	—	—	—	—	—	17 (J)	—	—	—	—	—

Table 5.1-2 (Continued)

Field Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Dichlorodifluoromethane	Dichloroethane[1,1-]	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Dichloropropane[1,2-]
Groundwater Tier 1 SL			**20,300**	**1140**	**478,000**	**5650**	**12,000**	**2,780,000**	**5750**	**242**	**7490**	**11,700**	**580**
MD50-21-207053	50-613185	145	—	—	—	88	88	89	—	—	—	16 (J)	—
MD50-21-207054	50-613185	235	—	—	—	160	110	150	—	—	—	30 (J)	—
MD50-21-207055	50-613185	350	—	—	—	140	24 (J)	170	—	—	—	—	—
MD50-21-207056	50-613185	450	—	—	—	21 (J)	—	29 (J)	—	—	—	—	—
MD50-21-207057	50-613185	600	—	—	—	36 (J)	—	69	—	—	—	—	—

Table 5.1-2 (continued)

Field Sample ID	Location ID	Depth (ft)	Ethanol	Hexane	Methylene Chloride	Propanol[2-]	Tetrachloroethene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane	Xylene [1,2-]	Xylene [1,3-]+Xylene[1,4-]
Groundwater Tier 1 SL			**na[d]**	**na**	**665**	**136**	**3630**	**1,190,000,000**	**141,000**	**169**	**2020**	**4,540,000**	**40,916**	**54,619**
MD50-21-206882	50-24784	155	—	—	—	—	950	64 (J)	17 (J)	—	1700	—	—	—
MD50-21-206883	50-24784	244	—	—	—	100 (J)	810	48 (J)	14 (J)	—	2000	—	—	—
MD50-21-206884	50-24784	362	—	—	—	—	750	47 (J)	9.3 (J)	—	1700	14 (J)	—	—
MD50-21-206885	50-24784	450	—	—	—	—	290	—	—	—	640	—	—	—
MD50-21-206892	50-24813	25	—	—	—	—	88 (J)	—	—	—	1900	—	—	—
MD50-21-206893	50-24813	150	—	—	100 (J)	—	300	25 (J)	—	100	19,000	11 (J)	—	—
MD50-21-206894	50-24813	241	—	—	260	—	420	50 (J)	12 (J)	—	37,000	24 (J)	—	—
MD50-21-206895	50-24813	358	—	—	—	—	390	46 (J)	-	—	37,000	29 (J)	—	—
MD50-21-206896	50-24813	450	—	—	100 (J)	—	220	—	—	—	21,000	28 (J)	—	—
MD50-21-206897	50-24813	600	—	—	—	—	31 (J)	—	—	—	2000	12 (J)	—	—
MD50-21-206913	50-24822	25	—	—	—	—	110	45 (J)	13 (J)	—	5000	—	—	—
MD50-21-206914	50-24822	142	—	—	190	—	220	200	40 (J)	23 (J)	25,000	21 (J)	—	—
MD50-21-206915	50-24822	235	—	—	300	—	300	320	46 (J)	—	40,000	46 (J)	—	—
MD50-21-206916	50-24822	351	—	—	—	—	59 (J)	64 (J)	7.6 (J)	—	9700	16 (J)	—	—
MD50-21-206917	50-24822	450	—	—	—	—	81 (J)	92 (J)	—	—	14,000	32 (J)	—	—
MD50-21-206927	50-603061	25	—	—	—	—	120	7600	760	—	590	19 (J)	—	—
MD50-21-206928	50-603061	128	—	—	—	—	290	18,000	2100	—	2300	22 (J)	—	—
MD50-21-206929	50-603061	228	—	—	—	—	450	30,000	4000	—	6400	52 (J)	—	—
MD50-21-206930	50-603061	347	—	—	—	—	210	13,000	930	—	3300	44 (J)	—	—
MD50-21-206931	50-603061	450	—	—	—	—	58 (J)	3100	76	—	1100	19 (J)	—	—
MD50-21-206936	50-603062	122	—	—	—	—	—	160	15 (J)	—	1700	—	—	—
MD50-21-206937	50-603062	217	—	—	—	—	—	210	15 (J)	—	2400	—	—	—
MD50-21-206938	50-603062	337	—	—	—	—	—	80 (J)	—	—	860	—	—	—
MD50-21-206939	50-603062	450	—	—	—	—	—	—	—	—	330	—	—	—
MD50-21-206945	50-603063	25	—	—	—	—	160	920	82	—	700	—	—	—

Table 5.1-2 (continued)

Field Sample ID	Location ID	Depth (ft)	Ethanol	Hexane	Methylene Chloride	Propanol[2-]	Tetrachloroethene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane	Xylene [1,2-]	Xylene [1,3-]+Xylene[1,4-]
Groundwater Tier 1 SL			**na**[d]	**na**	**665**	**136**	**3630**	**1,190,000,000**	**141,000**	**169**	**2020**	**4,540,000**	**40,916**	**54,619**
MD50-21-206946	50-603063	128	—	—	—	—	120	410	51 (J)	—	860	—	—	—
MD50-21-206947	50-603063	228	—	—	—	—	490	1800	180	—	7500	25 (J)	—	—
MD50-21-206948	50-603063	347	—	—	—	—	450	800	45 (J)	—	8600	22 (J)	—	—
MD50-21-206949	50-603063	450	—	—	—	—	160	180	—	—	3300	10 (J)	—	—
MD50-21-206954	50-603064	113	—	—	120 (J)	—	600	8400	1500	—	23,000	31 (J)	—	12 (J)
MD50-21-206955	50-603064	214	—	—	450	—	700	14,000	2100	—	40,000	62 (J)	—	—
MD50-21-206957	50-603064	500	—	—	—	—	48 (J)	480	—	—	2300	24 (J)	—	—
MD50-21-206963	50-603383	26	—	—	—	—	500	490	71 (J)	—	1300	24 (J)	—	—
MD50-21-206964	50-603383	139	—	—	—	—	410	340	48 (J)	—	1800	18 (J)	—	—
MD50-21-206965	50-603383	244	—	—	—	—	580	340	50 (J)	—	2600	18 (J)	—	—
MD50-21-206966	50-603383	359	—	—	—	—	250	120	20 (J)	—	1100	11 (J)	—	—
MD50-21-206967	50-603383	450	—	—	—	—	130	56 (J)	—	—	530	—	—	—
MD50-21-206973	50-603467	143	—	—	—	—	260	—	—	—	9700	—	—	—
MD50-21-206974	50-603467	244	—	—	120 (J)	—	600	—	8.2 (J)	—	23,000	14 (J)	—	—
MD50-21-206975	50-603467	360	—	—	—	—	420	—	—	—	16,000	13 (J)	—	—
MD50-21-206976	50-603467	500	—	—	—	—	300	—	—	—	9700	15 (J)	—	—
MD50-21-206977	50-603467	600	—	—	—	—	—	—	—	—	970	12 (J)	—	—
MD50-21-206990	50-603468	142	—	—	—	—	180	—	—	—	13,000	—	—	—
MD50-21-206991	50-603468	233	—	—	200 (J)	—	180	—	—	—	11,000	—	—	—
MD50-21-206992	50-603468	354	—	—	120 (J)	—	180	—	—	—	12,000	—	—	—
MD50-21-206993	50-603468	403	—	—	94 (J)	—	150	—	—	—	9700	11 (J)	—	—
MD50-21-207006	50-603470	83	—	—	—	—	410	110	20 (J)	—	5900	—	—	—
MD50-21-207007	50-603470	203	—	—	160 (J)	—	180	260	34 (J)	—	12,000	12 (J)	—	—
MD50-21-207008	50-603470	278	—	—	240	—	180	310	31 (J)	—	20,000	19 (J)	—	—

Table 5.1-2 (continued)

Field Sample ID	Location ID	Depth (ft)	Ethanol	Hexane	Methylene Chloride	Propanol[2-]	Tetrachloroethene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane	Xylene [1,2-]	Xylene [1,3-]+Xylene[1,4-]
Groundwater Tier 1 SL			**na**[d]	**na**	**665**	**136**	**3630**	**1,190,000,000**	**141,000**	**169**	**2020**	**4,540,000**	**40,916**	**54,619**
MD50-21-207009	50-603470	351	—	—	140 (J)	—	120	210	11 (J)	-	12,000	16 (J)	—	—
MD50-21-207010	50-603470	450	—	—	—	—	40 (J)	80 (J)	—	—	4200	—	—	—
MD50-21-207011	50-603470	650	—	—	—	—	—	—	—	—	70	—	—	—
MD50-21-207109	50-603471	—	—	—	120 (J)	—	750	210	38 (J)	76	14,000	13 (J)	—	—
MD50-21-207017	50-603471	90	—	—	—	—	520	110 (J+)	25 (J)	—	6400	12 (J+)	—	—
MD50-21-207018	50-603471	209	—	—	180 (J)	—	810	60 (J)	15 (J)	32 (J)	33,000	—	10 (J)	36 (J)
MD50-21-207019	50-603471	288	—	—	1200	—	950	600	50 (J)	—	47,000	45 (J)	—	—
MD50-21-207020	50-603471	360	—	—	730	—	880	500	28 (J)	—	42,000	53 (J)	—	—
MD50-21-207021	50-603471	450	—	—	240	—	750	250	19 (J)	—	34,000	43 (J)	—	—
MD50-21-207031	50-603472	27	—	—	—	—	140	—	15 (J)	—	810	—	—	—
MD50-21-207032	50-603472	146	—	—	180 (J)	—	330	51 (J)	11 (J)	17 (J)	5000	—	—	—
MD50-21-207033	50-603472	292	—	—	300	—	600	58 (J)	16 (J)	—	11,000	14 (J)	—	—
MD50-21-207034	50-603472	364	—	—	100 (J)	—	280	30 (J)	—	—	5900	12 (J)	—	—
MD50-21-207035	50-603472	450	—	—	—	—	330	—	—	—	6400	20 (J)	—	—
MD50-21-207044	50-603503	133	—	—	—	—	100	27 (J)	—	—	500	—	—	—
MD50-21-207045	50-603503	237	—	—	—	—	140	—	—	—	1300	—	—	—
MD50-21-207046	50-603503	347	—	—	—	—	—	—	—	—	53 (J)	—	—	—
MD50-21-207047	50-603503	450	—	—	—	—	37 (J)	—	—	—	510	—	—	—
MD50-21-207038	50-613182	550	—	—	—	—	130	—	—	—	2300	12 (J)	—	—
MD50-21-207039	50-613182	632.5	—	—	—	—	—	—	—	—	45 (J)	—	—	—
MD50-21-207024	50-613183	550	—	—	—	—	120	—	—	—	4900	32 (J)	—	—
MD50-21-207025	50-613183	642.5	—	—	—	—	—	—	—	—	120	—	—	—
MD50-21-206997	50-613184	500	—	—	—	—	39 (J)	—	—	—	2300	—	—	—
MD50-21-206998	50-613184	600	—	—	—	—	—	—	—	—	470	—	—	—
MD50-21-206999	50-613184	664.5	-	—	—	—	—	—	—	—	230	—	—	—

Table 5.1-2 (continued)

Field Sample ID	Location ID	Depth (ft)	Ethanol	Hexane	Methylene Chloride	Propanol[2-]	Tetrachloroethene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Trichlorofluoromethane	Xylene [1,2-]	Xylene [1,3-]+Xylene[1,4-]
Groundwater Tier 1 SL			**na[d]**	**na**	**665**	**136**	**3630**	**1,190,000,000**	**141,000**	**169**	**2020**	**4,540,000**	**40,916**	**54,619**
MD50-21-207053	50-613185	145	68 (J)	—	—	—	81 (J)	—	—	—	4100	—	—	—
MD50-21-207054	50-613185	235	—	—	—	—	100	—	—	—	8100	—	—	—
MD50-21-207055	50-613185	350	—	—	—	—	88 (J)	—	—	—	5000	—	—	—
MD50-21-207056	50-613185	450	—	—	—	—	—	—	—	—	510	—	—	—
MD50-21-207057	50-613185	600	—	—	—	—	—	—	—	—	270	—	—	—

Notes: Concentrations are in µg/m^3. Shading means the value exceeds groundwater screening levels for the analyte listed.

[a] — = Not detected.

[b] (J) = The analyte was positively identified and the associated numerical value is estimated to be more uncertain than would normally be expected for that result.

[c] Port was not labeled with the port depth.

[d] na = Not available.

Table 5.2-1
2020 Detected Tritium Results in
Pore-Gas Samples at MDA C Vapor-Monitoring Wells

Borehole ID	Sample Depth (ft)	Analytical Result (pCi/L) July 2020	Analytical Result (pCi/L) October 2020
50-24784	155	909.964	1383.99
50-24784	244	421.826	660.877
50-24784	362	401.113	1287.21
50-24784	450	456.833	503.453
50-24813	25	287.816	3417.55
50-24813	150	48,079.5	61,709.6
50-24813	241	1028.74	1022.86
50-24813	358	—[a]	448.907
50-24813	450	—	261.677
50-24822	142	—	285.118
50-24822	235	—	24,065.7
50-24822	351	—	29,086.4
50-603061	128	—	270.188
50-603061	228	—	811.518
50-603061	347	882.758	741.36
50-603063	128	—	472.509
50-603063	228	—	669.51
50-603063	347	329.404	738.926
50-603063	450	—	668.888
50-603064	214	—	290.339
50-603064	332	812.407	2208.96
50-603064	500	—	567.574
50-603383	266	120,313	141,487
50-603383	139	309,680	393,564
50-603383	244	187,248	154,776
50-603383	359	117,330	156,458
50-603383	450	137,096	109,552
50-603467	244	—	435.548
50-603468	142	—	406.398
50-603468	233	—	284.943
50-603468	354	—	—
50-603470	83	1.70781E+06	2.15177E+06
50-603470	203	274.333	354.624
50-603470	278	293.195	380.957
50-603470	351	—	408.923

Table 5.2-1 (continued)

Borehole ID	Sample Depth (ft)	Analytical Result (pCi/L) Jul-20	Analytical Result (pCi/L) Oct-20
50-603470	450	—	—
50-603470	650	—	18,002.6
50-603471	depth not available[b]	31,016.5	28,494.3
50-603471	90	8030.95	8186.04
50-603471	209	1852.53	2631.34
50-603471	288	4406.35	2429.28
50-603471	360	6943.1	4676.47
50-603471	450	6772.34	4024.37
50-603472	27	1.08192E+06	974126
50-603472	146	664.983	688.677
50-603472	292	1879.76	1537.22
50-603472	364	1280.52	849.864
50-603472	450	1158.22	3040.18
50-603503	133	—	517.62
50-603503	237	—	296.502
50-613182	550	3295.71	5854.48
50-613182	632.5	4139.03	16,558.4
50-613184	500	—	—
50-613184	600	—	—
50-613184	664.5	—	—
50-613185	145	—	—
50-613185	350	—	—
50-613185	450	—	—
50-613185	600	—	—

[a] — = Not detected.

[b] Port was not labeled with the port depth.

Appendix A

Acronyms and Abbreviations,
Metric Conversion Table, and Data Qualifier Definitions

A-1.0 ACRONYMS AND ABBREVIATIONS

ADR	automated data review (EIM module)
bgs	below ground surface
CFR	Code of Federal Regulations
CME	corrective measures evaluation
CO_2	carbon dioxide
COC	chain of custody
Consent Order	Compliance Order on Consent
CY	calendar year
DOE	Department of Energy (U.S.)
DQO	data quality objective
EDD	electronic data deliverable
EIM	Environmental Information Management (database)
EPA	Environmental Protection Agency (U.S.)
FB	field blank
FD	field duplicate
FY	fiscal year
IR	infrared
LANL	Los Alamos National Laboratory
MCL	maximum contaminant level
MDA	material disposal area
N3B	Newport News Nuclear BWXT-Los Alamos, LLC
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
$\%O_2$	percent oxygen
Permit	Hazardous Waste Facility Permit
PID	photoionization detector
PMR	periodic monitoring report
QA	quality assurance
QC	quality control
SCL	sample collection log
SL	screening level
slpm	standard liters per minute
SMO	Sample Management Office
SOP	standard operating procedure

SVE	soil-vapor extraction
SWMU	solid waste management unit
TA	technical area
TCE	trichloroethene
TWF	Transuranic Waste Facility
VOC	volatile organic compound

A-2.0 METRIC CONVERSION TABLE

Multiply SI (Metric) Unit	by	To Obtain U.S. Customary Unit
kilometers (km)	0.622	miles (mi)
kilometers (km)	3281	feet (ft)
meters (m)	3.281	feet (ft)
meters (m)	39.37	inches (in.)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.394	inches (in.)
millimeters (mm)	0.0394	inches (in.)
micrometers or microns (µm)	0.0000394	inches (in.)
square kilometers (km^2)	0.3861	square miles (mi^2)
hectares (ha)	2.47	Acres
square meters (m^2)	10.764	square feet (ft^2)
cubic meters (m^3)	35.31	cubic feet (ft^3)
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter (g/cm^3)	62.422	pounds per cubic foot (lb/ft^3)
milligrams per kilogram (mg/kg)	1	parts per million by mass (ppmm)
micrograms per gram (µg/g)	1	parts per million (ppm)
liters (L)	0.26	gallons (gal.)
milligrams per liter (mg/L)	1	parts per million by volume (ppmv)
degrees Celsius (°C)	9/5 + 32	degrees Fahrenheit (°F)

A-3.0 DATA QUALIFIER DEFINITIONS

Data Qualifier	Definition
U	The analyte was analyzed for but not detected.
J	The analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.
J+	The analyte was positively identified, and the result is likely to be biased high.
J-	The analyte was positively identified, and the result is likely to be biased low.
UJ	The analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific detection or quantitation limit.
R	The data are rejected as a result of major problems with quality assurance/quality control parameters.

Appendix B

Field Methods

B-1.0 INTRODUCTION

This appendix summarizes the field methods used during the calendar year 2020 sampling activities at Material Disposal Area (MDA) C, Solid Waste Management Unit 50-009, in Technical Area 50 at Los Alamos National Laboratory (LANL or the Laboratory). All activities were conducted in accordance with the applicable standard operating procedures (SOPs), quality procedures, and Newport News Nuclear BWXT-Los Alamos, LLC (N3B) implementation and procedural requirements. Table B-1.0-1 summarizes the field methods used, Table B-1.0-2 lists the applicable procedures, and Table B-1.0-3 lists the field-screening data.

B-2.0 FIELD METHODS

All work was conducted according to site-specific health and safety documents and an integrated work document. The field activities conducted according to SOPs are discussed below.

B-2.1 Volatile Organic Compound Pore-Gas Sample Collection

Samples were collected following purging of the sample port and stabilization of field parameters. Monitored field parameters include static pressure of port, purge flow rate, methane, carbon dioxide (CO_2), oxygen (O_2), and volatile organic compounds (VOCs). Each port was purged for a minimum of 10 min, after which CO_2, O_2, and VOCs were monitored to ensure levels were stable before sample collection. A minimum sample purge flow rate of 0.3 standard liters per minute (slpm) is required for collection. Ports with purge flow rates of less than 0.3 slpm were considered plugged and not sampled. A MultiRAE gas detector was used to screen for CO_2, O_2, and VOCs. Once stabilization occurred, the sample was collected in a SUMMA canister. Field crews noted the pressure measurements of the SUMMA canister before and after the sample was taken and noted all field parameters. Field duplicates (FDs) were collected immediately following the original sample. Field blanks (FBs) were collected with the use of ultrapure nitrogen gas (99.9%). Information was recorded on the appropriate sample collection logs (SCLs). Field chain-of-custody (COC) forms and SCLs are provided in Appendix E (on CD included with this document).

All VOC samples were collected in accordance with the current version of N3B-SOP-ER-2008, “Sampling Subsurface Vapor.”

All samples were submitted to the N3B Sample Management Office (SMO) for processing and transport to off-site contract analytical laboratories.

B-2.2 Volatile Organic Compound Pore-Gas Field Screening

All VOC samples were field-screened in accordance with the current version of N3B-SOP-ER-2008, “Sampling Subsurface Vapor.” This procedure covers the use of the MultiRAE infrared (IR) multi-gas monitor. All field-screening results were recorded on the appropriate SCLs in the field logbook and/or in tables and are provided in Appendix E (on CD included with this document).

Before each sampling event, each sampling port was purged of stagnant air and then monitored with a MultiRAE IR Multi-Gas Monitor until the percent carbon dioxide (%CO_2) and percent oxygen (%O_2) levels stabilized at values representative of subsurface pore-gas conditions. In addition, VOC concentrations were estimated in parts per million using the MultiRAE IR multi-gas monitor equipped with an 11.7-electronvolt lamp photoionization detector (PID). Each rented instrument was shipped factory-calibrated to the subcontractor, and the calibration was checked daily.

Oxygen values should be near the zero point for O_2. The CO_2 reading should be near zero as well. Readings deviating from the zero points for O_2 and CO_2 may be caused by subsurface conditions or a need for calibration.

Drawing sufficient air from the sampling interval through the line ensured that the vapor-sample tubing was purged of stagnant air. To ensure that the sample collected was representative of the subsurface air at depth, every sampling activity included a purge cycle.

The $\%CO_2$ and $\%O_2$ screening levels are presented in Table B.1-0.3.

B-2.3 Tritium Pore-Gas Sample Collection

All tritium samples were collected in accordance with the current version of N3B-SOP-ER-2008. Silica gel was the medium used to collect moisture from pore-gas samples. To collect water vapor intended for tritium analysis from pore gas, a pore-gas sample was pulled through a canister of silica gel (silica-gel column), and the sample information was recorded on the appropriate SCL in Appendix E (on CD included with this document). The moisture was analyzed for tritium by means of liquid scintillation counting. Silica-gel column FD samples were planned to be collected at a frequency greater than or equal to 10% per sampling event in accordance with the current version of N3B- SOP-SDM-1100, “Sample Containers, Preservation, and Field Quality Control.” During the second round of sampling, four tritium FDs were planned for collection. Because of a sampling field crew error, the valve on one tee fitting for the duplicate was left closed and the FD was canceled, leaving only three FDs collected.

Silica gel was prepared for sampling by drying at a temperature above 100°C. Drying removes moisture from the silica gel but does not remove bound water, as demonstrated when the bound water percentage in each batch of silica gel is measured. Before sample collection, the amount of silica gel used in each sample was weighed (typically about 135 g). The sample canister with silica gel was also weighed before sampling. N3B-SOP-ER-2008 requires that at least 5 g of moisture be collected. After sampling, the sample canister with silica gel was weighed again to verify that 5 g of water vapor had been collected.

The sample (canister plus silica gel) was shipped to the analytical laboratory where it was weighed again. The silica gel was emptied into a distillation apparatus and heated to 110°C, driving moisture off the silica gel. This moisture was collected and analyzed for tritium by liquid scintillation. The analytical laboratory also weighed the empty canister and calculated the percent moisture of the sample as the amount of moisture collected divided by the calculated weight of the wet silica gel. The value of the tritium activity and the calculated percent moisture were reported to N3B in the analytical data package and the electronic data deliverable.

Table B-1.0-1
Summary of Field Methods

Method	Summary
General Instructions for Field Investigations	General instructions for field investigations (e.g., pre-work briefings, plan-of-the-day meetings, tail gate meetings) provide an overview of instructions regarding activities performed before, during, and after field investigations. Field investigations are assumed to involve standard sampling equipment, personal protective equipment, waste management, and site-control equipment/materials; and general fieldwork guidance covers premobilization activities, mobilization to the site, documentation and sample collection activities, sample media evaluation, surveillance, and completion of lessons learned.
Sample Containers and Preservation	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on the U.S. Environmental Protection Agency guidance for environmental sampling, preservation, and quality assurance. Specific requirements were met for each sample and were printed in the SCLs provided by N3B's SMO (size and type of container, preservatives, etc.).
Handling, Packaging, and Transporting Field Samples	Field team members sealed and labeled samples before packing to ensure sample and transport containers were free of external contamination. All environmental samples were collected, preserved, packaged, and transported to the SMO under COC (N3B-ER-SOP 10094, "Sample Receiving and Shipping by the N3B Sample Management Office"). The SMO arranged for shipping of the samples to analytical laboratories. Any levels of radioactivity (i.e., action-level or limited-quantity ranges) were documented in SCLs submitted to the SMO.
Sample Control and Field Documentation	The collection, screening, and transport of samples were documented in standard forms generated by the SMO. These forms include SCLs, COC forms, sample container labels, and custody seals. Collection logs were completed at the time of sample collection and were signed by the sampler and a reviewer who verified the logs for completeness and accuracy. Corresponding labels were initialed and applied to each sample container, and custody seals were placed around container lids or openings. COC forms were completed and signed to verify that the samples were not left unattended.
Field Quality Control Samples	Field quality control samples were collected as follows: FDs for VOCs were collected at a frequency of 10% and at the same time as a regular sample and submitted for the same analyses. In the second round of sampling, four tritium FDs were planned for collection. Because of a sampling field crew error, the valve on one tee fitting for the duplicate was left closed and the FD was canceled, leaving only three FDs collected. FBs required for all field events that include collecting samples for VOC analyses were collected. FBs were kept with the other sample containers during the sampling process and were submitted for laboratory analyses.
Sampling Subsurface Vapor	Vapor sampling was performed at 18 monitoring wells in accordance with the current version of N3B-SOP-ER-2008, and samples were analyzed for VOCs and tritium. This SOP describes the process of sampling subsurface air from vapor ports in monitoring wells and boreholes. The procedure covers pre-sampling activities, sampling to detect and quantify gaseous organic concentration in air, SUMMA sampling (a passive collection and containment system of laboratory-quality air samples), adsorbent column sampling, sampling through the packer system (a sampling system that uses inflatable bladders to seal off a desired interval in an open borehole or at the end of a drill casing to obtain a sample from a discrete section), and post-sampling activities.

Table B-1.0-2
List of Procedures Used for MDA C Pore-Gas Monitoring Activities

Document Number	N3B Procedure Title
N3B-AP-ER-1002	Environmental Remediation (ER) Field Work Requirements
N3B- SOP-SDM-1100	Sample Containers, Preservation, and Field Quality Control
N3B- SOP-SDM-1101	Sample Control and Field Documentation
N3B-SOP-ER-2002	Field Decontamination of Equipment
N3B-SOP-ER-2008	Sampling Subsurface Vapor
N3B-P101-6	Personal Protective Equipment
N3B-AP-SDM-1200	Requesting and Managing Data Sets
N3B-POL-QAT-0019	Investigation of Abnormal Events
N3B-AP-SDM-1103	Preparation and Storage of Final Records Packages for Analytical Data
N3B-SOP-SDM-1102	Sample Receiving and Shipping by the N3B Sample Management Office
N3B-AP-ER-1001	Environmental Remediation Project Preparedness Review
N3B-EP-DIR-SOP-10021	Characterization and Management of Environmental Programs Waste

Table B-1.0-3
Field-Screening Results with MultiRAE IR Multi-Gas Monitor for 2020 Sampling

Borehole ID	Sampling Port Depth (ft bgs[a])	Analyte	Result First Round	Result Second Round
50-24784	155	CO_2 (ppm)	7800	9100
		O_2 (%)	20.4	20.5
		VOC (ppm)[b]	0.1	0.5
	244	CO_2 (ppm)	6100	8200
		O_2 (%)	20.4	20.4
		VOC (ppm)	0.2	0.6
	362	CO_2 (ppm)	5100	5900
		O_2 (%)	20.5	20.0
		VOC (ppm)	0.1	1.0
	450	CO_2 (ppm)	3300	3900
		O_2 (%)	20.5	20.2
		VOC (ppm)	0.3	0

Table B-1.0-3 (continued)

Borehole ID	Sampling Port Depth (ft bgs[a])	Analyte	Result First Round	Result Second Round
50-24813	25	CO_2 (ppm)	22,300	13,600
		O_2 (%)	20.4	20.9
		VOC (ppm)	1.7	0.3
	150	CO_2 (ppm)	18,900	17,000
		O_2 (%)	20.4	20.9
		VOC (ppm)	5.6	4.6
	241	CO_2 (ppm)	12,900	9700
		O_2 (%)	20.4	20.9
		VOC (ppm)	13	6.6
	358	CO_2 (ppm)	8900	2200
		O_2 (%)	20.5	20.9
		VOC (ppm)	7.9	6.5
	450	CO_2 (ppm)	6300	6000
		O_2 (%)	20.5	20.9
		VOC (ppm)	4.4	4.2
	600	CO_2 (ppm)	3700	3600
		O_2 (%)	20.5	20.9
		VOC (ppm)	1.2	0.9
50-24822	25	CO_2 (ppm)	18,200	19,500
		O_2 (%)	20.5	21.2
		VOC (ppm)	1.0	0.7
	142	CO_2 (ppm)	11,800	13,300
		O_2 (%)	20.5	20.9
		VOC (ppm)	2.2	2.6
	235	CO_2 (ppm)	10,200	11,400
		O_2 (%)	20.4	20.9
		VOC (ppm)	3.3	4.6
	351	CO_2 (ppm)	7000	3100
		O_2 (%)	20.5	20.9
		VOC (ppm)	2.9	1.7
	450	CO_2 (ppm)	5200	5900
		O_2 (%)	20.5	20.9
		VOC (ppm)	1.6	1.8

Table B-1.0-3 (continued)

Borehole ID	Sampling Port Depth (ft bgs[a])	Analyte	Result First Round	Result Second Round
50-603061	25	CO_2 (ppm)	49,999	49,999
		O_2 (%)	18.8	14.2
		VOC (ppm)	0.5	0.1
	128	CO_2 (ppm)	37,900	43,600
		O_2 (%)	19.7	18.0
		VOC (ppm)	0.9	0.6
	228	CO_2 (ppm)	19,600	19,600
		O_2 (%)	19.3	18.9
		VOC (ppm)	0.3	1.0
	347	CO_2 (ppm)	9300	10,200
		O_2 (%)	20.3	19.1
		VOC (ppm)	0.6	0.6
	450	CO_2 (ppm)	5800	6200
		O_2 (%)	20.4	19.3
		VOC (ppm)	0.5	0.4
50-603062	122	CO_2 (ppm)	11,100	11,500
		O_2 (%)	20.1	19.9
		VOC (ppm)	1.0	0.1
	217	CO_2 (ppm)	8200	8700
		O_2 (%)	20.2	20.0
		VOC (ppm)	1.1	0.3
	337	CO_2 (ppm)	5200	5600
		O_2 (%)	20.2	20.3
		VOC (ppm)	0.4	1.0
	450	CO_2 (ppm)	3900	4300
		O_2 (%)	20.1	20.0
		VOC (ppm)	0.3	0
50-603063	25	CO_2 (ppm)	37,800	39,400
		O_2 (%)	17.8	19.1
		VOC (ppm)	0.3	0
	128	CO_2 (ppm)	28,800	22,900
		O_2 (%)	18.8	20.1
		VOC (ppm)	1.3	0.5
	228	CO_2 (ppm)	22,500	19,400
		O_2 (%)	18.8	20.2
		VOC (ppm)	3.4	1.7
	347	CO_2 (ppm)	11,100	10,200
		O_2 (%)	19.9	20.4
		VOC (ppm)	2.6	1.6

Table B-1.0-3 (continued)

Borehole ID	Sampling Port Depth (ft bgs[a])	Analyte	Result First Round	Result Second Round
50-603063 (cont.)	450	CO_2 (ppm)	7800	6700
		O_2 (%)	20.2	20.5
		VOC (ppm)	1.3	0.8
50-603064	113	CO_2 (ppm)	17,500	17,600
		O_2 (%)	20.5	21.2
		VOC (ppm)	2.7	3.0
	214	CO_2 (ppm)	16,300	16,200
		O_2 (%)	20.5	21.2
		VOC (ppm)	5.1	5.6
	332	CO_2 (ppm)	10,200	9600
		O_2 (%)	20.4	21.1
		VOC (ppm)	2.4	1.6
	500	CO_2 (ppm)	0	5000
		O_2 (%)	20.9	20.8
		VOC (ppm)	0.4	0.5
50-603383	26	CO_2 (ppm)	32,500	37,000
		O_2 (%)	19.5	7.8
		VOC (ppm)	0.1	0.1
	139	CO_2 (ppm)	25,500	24,300
		O_2 (%)	19.8	12.2
		VOC (ppm)	0.4	0.4
	244	CO_2 (ppm)	16,800	1600
		O_2 (%)	20.1	14.6
		VOC (ppm)	0.7	0.5
	359	CO_2 (ppm)	8000	6100
		O_2 (%)	20.3	16.6
		VOC (ppm)	0.3	0.2
	450	CO_2 (ppm)	8900	4400
		O_2 (%)	20.3	17.1
		VOC (ppm)	0.2	0.1

Table B-1.0-3 (continued)

Borehole ID	Sampling Port Depth (ft bgs[a])	Analyte	Result First Round	Result Second Round
50-603467	143	CO_2 (ppm)	16,900	14,600
		O_2 (%)	17.1	19.0
		VOC (ppm)	1.2	1.4
	244	CO_2 (ppm)	10,900	11,500
		O_2 (%)	17.8	18.9
		VOC (ppm)	3.3	3.9
	360	CO_2 (ppm)	9500	8000
		O_2 (%)	18.4	19.1
		VOC (ppm)	3.3	3.7
	500	CO_2 (ppm)	3800	4400
		O_2 (%)	19.4	19.4
		VOC (ppm)	1.7	1.6
	600	CO_2 (ppm)	8000	4000
		O_2 (%)	20.1	19.4
		VOC (ppm)	0.9	1.1
50-603468	142	CO_2 (ppm)	10,900	7800
		O_2 (%)	20.3	19.8
		VOC (ppm)	0.9	2.2
	233	CO_2 (ppm)	13,800	11,100
		O_2 (%)	19.9	19.4
		VOC (ppm)	2.4	2.6
	354	CO_2 (ppm)	9100	7800
		O_2 (%)	20.1	19.7
		VOC (ppm)	2.4	2.0
	403	CO_2 (ppm)	6800	5600
		O_2 (%)	20.1	19.9
		VOC (ppm)	2.8	1.8
50-603470	83	CO_2 (ppm)	11,400	11,100
		O_2 (%)	20.2	20.0
		VOC (ppm)	1.5	1.1
	203	CO_2 (ppm)	9700	9100
		O_2 (%)	20.3	20.1
		VOC (ppm)	5.6	3.0
	278	CO_2 (ppm)	10,200	9300
		O_2 (%)	20.3	20.0
		VOC (ppm)	7.0	3.0
	351	CO_2 (ppm)	8900	7200
		O_2 (%)	20.3	20.2
		VOC (ppm)	5.9	1.0

Table B-1.0-3 (continued)

Borehole ID	Sampling Port Depth (ft bgs[a])	Analyte	Result First Round	Result Second Round
50-603470 (cont.)	450	CO_2 (ppm)	6400	5800
		O_2 (%)	20.5	20.2
		VOC (ppm)	3.1	2.0
	650	CO_2 (ppm)	1800	1700
		O_2 (%)	21.1	20.4
		VOC (ppm)	0.5	0
50-603471	90	CO_2 (ppm)	4100	15,500
		O_2 (%)	20.9	19.8
		VOC (ppm)	0.6	2.0
	209	CO_2 (ppm)	3200	2200
		O_2 (%)	20.9	20.1
		VOC (ppm)	2.1	5.0
	288	CO_2 (ppm)	2300	10,600
		O_2 (%)	21.2	19.9
		VOC (ppm)	0.6	4.0
	360	CO_2 (ppm)	600	10,200
		O_2 (%)	20.8	19.9
		VOC (ppm)	1.9	7.0
	450	CO_2 (ppm)	1300	8100
		O_2 (%)	20.8	20.0
		VOC (ppm)	0.4	6.0
	Unknown[c]	CO_2 (ppm)	4600	13,000
		O_2 (%)	20.9	20.0
		VOC (ppm)	0.6	2.0
50-603472	27	CO_2 (ppm)	6600	6000
		O_2 (%)	20.9	20.9
		VOC (ppm)	0.9	0
	146	CO_2 (ppm)	7700	6900
		O_2 (%)	20.9	20.9
		VOC (ppm)	2.0	0.8
	292	CO_2 (ppm)	10,900	10,300
		O_2 (%)	20.5	20.2
		VOC (ppm)	4.6	3.8
	364	CO_2 (ppm)	8700	8600
		O_2 (%)	20.5	20.2
		VOC (ppm)	3.3	3.0
	450	CO_2 (ppm)	6600	6700
		O_2 (%)	20.8	20.2
		VOC (ppm)	2.0	1.6

Table B-1.0-3 (continued)

Borehole ID	Sampling Port Depth (ft bgs[a])	Analyte	Result First Round	Result Second Round
50-603503	133	CO_2 (ppm)	8900	6800
		O_2 (%)	18.4	20.3
		VOC (ppm)	0.3	0
	237	CO_2 (ppm)	6300	5400
		O_2 (%)	18.7	20.5
		VOC (ppm)	0.7	0
	347	CO_2 (ppm)	3700	3000
		O_2 (%)	19.1	20.0
		VOC (ppm)	0.7	1.0
	450	CO_2 (ppm)	2800	2100
		O_2 (%)	19.7	20.0
		VOC (ppm)	0.5	0
50-613182	500	CO_2 (ppm)	3700	3900
		O_2 (%)	20.9	20.9
		VOC (ppm)	1.2	0.8
	632.5	CO_2 (ppm)	1200	800
		O_2 (%)	20.9	20.6
		VOC (ppm)	0.7	0
50-613183	550	CO_2 (ppm)	0	4100
		O_2 (%)	21.4	20.1
		VOC (ppm)	0.3	1.0
	642.5	CO_2 (ppm)	600	3000
		O_2 (%)	21.5	19.9
		VOC (ppm)	0.4	1.0
50-613184	500	CO_2 (ppm)	3400	3100
		O_2 (%)	20.4	20.2
		VOC (ppm)	1.1	0.5
	600	CO_2 (ppm)	2800	2200
		O_2 (%)	20.5	20.2
		VOC (ppm)	0.7	0
	664.5	CO_2 (ppm)	2100	1700
		O_2 (%)	20.9	20.3
		VOC (ppm)	0.6	0

Table B-1.0-3 (continued)

Borehole ID	Sampling Port Depth (ft bgs[a])	Analyte	Result First Round	Result Second Round
50-613185	145	CO_2 (ppm)	23,200	23,300
		O_2 (%)	19.7	18.3
		VOC (ppm)	0.7	0.6
	235	CO_2 (ppm)	10,500	11,100
		O_2 (%)	20.1	18.9
		VOC (ppm)	1.0	1.3
	350	CO_2 (ppm)	4600	4800
		O_2 (%)	20.4	19.5
		VOC (ppm)	0.7	1.0
	450	CO_2 (ppm)	2200	500
		O_2 (%)	20.5	20.9
		VOC (ppm)	0.7	0.3
	600	CO_2 (ppm)	2700	3000
		O_2 (%)	20.5	19.9
		VOC (ppm)	0.6	0.2

[a] bgs = Below ground surface.

[b] VOC (ppm) = PID used.

[c] During the two sampling rounds, the depth of two unlabeled ports in borehole 50-603471 was unclear. The ports are known to be at 30 ft and 90 ft and both were sampled, but because the ports were not labeled, it is not possible to assign the data to a specific depth.

Appendix C

Analytical Data Management and Evaluation Process

C-1.0 INTRODUCTION

This appendix discusses the analytical methods and data-quality review for samples collected during pore-gas sampling activities at Material Disposal Area (MDA) C, Solid Waste Management Unit (SWMU) 50-009, at Technical Area 50 at Los Alamos National Laboratory (LANL or the Laboratory).

Newport News Nuclear BWXT-Los Alamos, LLC (N3B) uses the Environmental Information Management (EIM) database for data management. This is a cloud-based data management platform used for managing sampling events, tracking the collection, packaging, and transportation of samples, and storing the resultant data and data qualifications. In addition to N3B, Triad National Security, LLC, and the U.S. Department of Energy (DOE) Oversight Bureau of the New Mexico Environment Department (NMED) share EIM for all LANL environmental analytical data. EIM interfaces with Intellus New Mexico, a fully searchable database available to the public through the Intellus website (http://www.intellusnm.com).

The system, written and maintained by Locus Technologies, consists of a cloud-based Structured Query Language server database platform coupled with a web-based user interface. It is a comprehensive sample and data management application, designed to manage the process from sample planning through data review and reporting. It includes modules for sample planning, sample tracking, manual and electronic field data upload, electronic data deliverables (EDD) upload, automated data review (ADR) routines, notification emails, and reporting tools.

The analytical data are submitted in EDDs by the analytical laboratory and are uploaded to the N3B EIM database. The received data are then independently validated through the N3B data-validation process, per the data quality objectives (DQOs) described in section C-2.1, to qualify the data. The laboratory also submits pdfs that detail the entire analytical process for each sample analysis.

The entire data-validation process includes a description of the reasons for any failure to meet method, procedural, or contractual requirements and an evaluation of the impact of such failure on the associated data or data set.

C-2.0 ANALYTICAL DATA

Data evaluated in this report come from the analysis of vapor samples that were collected during semiannual vapor sampling activities at MDA C. All investigation samples were submitted to and analyzed by approved off-site analytical laboratories. These data are determined to be of sufficient quality for decision-making purposes and have been reviewed and revalidated to current quality assurance/quality control (QA/QC) standards as described in section C-2.1.

In the first 2020 sampling round, a total of 96 samples (80 regular samples, 8 field blanks [FBs], and 8 field duplicates [FDs]) were collected and analyzed for volatile organic compounds (VOCs) and tritium. In the second 2020 sampling round, a total of 96 samples (80 regular samples, 8 FBs, and 8 FDs) were collected and analyzed for VOCs were collected and analyzed for tritium. The analytical methods used are listed in Table C-2.0-1.

These samples were planned using the EIM Sample Request module, and sample collection logs (SCLs) were created and printed to serve as chain of custody (COC) documents and analytical request forms.

The sampling events include collection of FB and FD field QA/QC samples. Detection of analytes in FBs may indicate contamination resulting from sample collection, transportation, or the analytical laboratory processes. Differences in analytical results between an FD and its regular sample may indicate the samples were not uniform or that significant variation in analysis occurred between the two samples.

The VOC FBs are SUMMA canisters filled with pure nitrogen (99.9%) that are subjected to the same conditions as regular samples. The tritium FBs are silica gel cartridges with 5 g of deionized water that are subjected to the same conditions as regular samples. FBs are collected at a minimum frequency of 10% of all VOC samples and 10% of all tritium samples during the monitoring event. FBs are collected from locations where the regular samples are collected.

FDs are collected at a rate of 10% of all VOC samples and 10% of all tritium samples collected during the monitoring event. FDs are split samples collected from locations where the regular samples are collected.

Following sample collection, sampling personnel deliver the samples and the SCLs to sample management personnel at the N3B Sample Management Office (SMO). An analytical COC is then created, which includes the field sample identification number, the date and time of field sample collection, the analytical parameters group code(s), and the number of bottles for each analytical parameter group. The N3B SMO then ships the samples to the appropriate laboratory for analysis.

In addition to analyzing the field samples and field QA/QC samples, laboratories also employ laboratory batch QA/QC samples. These include matrix spikes, duplicates, method blanks, and laboratory control samples that are prepared and analyzed by the laboratories to monitor their analytical process quality. The laboratory QA/QC process is defined in the appropriate analytical method (Table C-2.0-1) and the external laboratory statement of work.

Tables within the main text of this MDA C vapor-sampling periodic monitoring report summarize the analytical results from all samples collected at MDA C for calendar year 2020. All VOCs and tritium analytical results are provided in Appendix E (on CD included with this document). Analytical, chemical, and radiological data presented in this report can also be found in the public Intellus database at http://www.intellusnm.com.

C-2.1 Data Validation Definitions and Procedures

Analytical results meet the N3B minimum DQOs as outlined in N3B-PLN-SDM-1000: "Sample and Data Management Plan." N3B-PLN-SDM-1000 sets the validation frequency criteria at 100% Level 1 examination and Level 2 verification of data and at 10% minimum Level 3 validation of data. A Level 1 examination assesses the completeness of the data as delivered from the analytical laboratory, identifies any reporting errors, and checks the usability of the data based on the analytical laboratory's evaluation of the data. A Level 2 verification evaluates the data to determine the extent to which the laboratory met the analytical method and the contract-specific quality control and reporting requirements. A Level 3 validation includes Level 1 and 2 criteria and determines the effect of potential anomalies encountered during analysis and possible effects on data quality and usability. A Level 3 validation is performed manually with method-specific data-validation procedures. Laboratory analytical data are validated by N3B personnel as outlined in N3B-PLN-SDM-1000; N3B-AP-SDM-3000, "General Guidelines for Data Validation"; N3B-AP-SDM-3014, "Examination and Verification of Analytical Laboratory Data"; and additional method-specific analytical data-validation procedures. All associated validation procedures have been developed, where applicable, from the U.S. Environmental Protection Agency (EPA) QA/G-8 Guidance on Environmental Data Verification and Data Validation, the Department of Defense/Department of Energy Consolidated Quality Systems Manual for Environmental Laboratories, the EPA National Functional Guidelines for Data Validation, and the American National Standards Institute/American Nuclear Society 41.5: Verification and Validation of Radiological Data.

N3B data validation is performed externally from the analytical laboratory and end-users of the data. Data validation provides a level of assurance, based on this technical evaluation, of the data quality.

Validation qualifiers and reason codes applied during this process are also reviewed and approved by an N3B chemist to assess data usability and quality. The EIM data are then made available to the public in the Intellus New Mexico database (https://intellusnm.com).

Validated data are qualified as accepted or rejected. Data that are accepted per the validation criteria have one of the following qualifiers: not detected (U), estimated but not detected (UJ), estimated (J), or detected without data qualification (NQ). Accepted data can then be used as needed, assuming that no problems occurred during the sampling events. Data that are qualified as rejected (R) per the validation criteria are unusable. In addition, the analytical results can also be further labeled with data-validation reason codes that explain the reason for the qualification. (See Appendix A of this report, which includes data qualifier definitions.)

The analytical data, laboratory report, and data-validation reports are provided in Appendix E (on CD included with this report). In addition to the laboratory analytical data, SCLs and COC forms are also provided in Appendix E.

Table C-2.0-1
Volatile Organic Chemical and Radionuclide
Analytical Methods for Samples Collected at SWMU 50-009

Analytical Method	Analytical Description	Analytical Suite
VOCs		
EPA Air Method Toxic Organics (TO15)	Determination of VOCs in air collected in specially prepared canisters and analyzed by gas chromatography/mass spectrometry	VOCs
Radionuclides		
EPA 906.0	Tritium in water (liquid scintillation)	Tritium

Appendix D

Volatile Organic Compound Plume Trend Analysis

D-1.0 INTRODUCTION

This appendix summarizes data from the Material Disposal Area (MDA) C volatile organic compound (VOC) plume at Technical Area 50, Los Alamos National Laboratory (LANL). Figure D-1.0-1 shows the pore-gas monitoring boreholes at MDA C. The data were collected as part of an ongoing corrective measures evaluation (CME). In December 2011, the New Mexico Environment Department (NMED) approved the Phase III MDA C investigation report (NMED 2011, 208797) and directed vapor monitoring that replaced the monitoring recommended in the Phase III investigation report. NMED's approval requires semiannual monitoring from 80 sampling ports at 18 locations, with all samples analyzed for VOCs and tritium. Table D-1.0-1 lists all 18 boreholes analyzed, with the final column showing whether a given borehole (in map view) is in the core of the plume (6 boreholes), intermediate part of the plume (7 boreholes), or outer edge of the plume (5 boreholes). In Figure D-1.0-2, the core of the plume is defined as being in the highest concentration region (yellow, orange, and red) while the outer-edge boreholes are in the blue region. Data from these three regions (plume core, plume intermediate, plume outer edge) are broken out in separate sections of this appendix.

For each section of this appendix (plume core, plume intermediate, plume outer edge), data from each borehole are presented first with a plot of trichloroethene (TCE) concentration with depth, followed by a selection of histograms at different depths showing how total VOC concentration and the TCE fraction of the total vary over time, where generally the VOC plume consists of mostly TCE on a consistent basis. All plots showing TCE concentration versus depth also include a red dashed vertical line that is the Tier 1 groundwater screening level of 2020 $\mu g/m^3$. On the TCE-versus-depth plots, this is a vertical dashed red line; on the histograms of TCE and total VOCs, this is a horizontal red dashed red line.

Vapor monitoring in the two rounds of 2020 sampling included collecting 80 vapor samples from 80 sample ports within 18 boreholes for VOC and tritium analysis. Vapor samples were submitted for laboratory analysis of VOCs and tritium. Validated analytical results demonstrate the presence of 22 VOCs detected in subsurface vapor. The VOC screening evaluation identified VOCs in MDA C pore gas at concentrations exceeding Tier 1 screening levels (SLs), which are based on groundwater SLs. Four VOCs (TCE, 1,1,2-trichloroethane, 2-propanol, and methylene chloride) were identified in the first round of screening, and two VOCs (TCE and methylene chloride) in the second round. Of these VOCs, only TCE and methylene chloride exceeded their SLs, with only TCE consistently exceeding its SL. Therefore, TCE is the primary contaminant of concern.

The data show that at depths of 600 ft below ground surface (bgs) or greater, there has been only one detection above Tier 1 screening levels in borehole 50-24813. This shows that the bulk of the plume remains above the Tschicoma dacite (Tvt 2) and is consistent with the conceptual model favoring diffusive transport in the Bandelier Tuff over migration into the wetter Tschicoma dacite and underlying Puye formations.

VOC concentration trends from MDA C vapor-monitoring activities from 2012 through 2020 are analyzed in this appendix. VOC trends, including TCE, from 2012 through 2020 show that VOC concentrations at MDA C are consistent with a diffusive plume. Concentrations are increasing slowly at the edges of the plume, both laterally and at depth. Concentrations in the center of the plume peak at depths of approximately 200–300 ft bgs for a given well, are well below possible source areas, and appear to be either stable or decreasing slowly with time. Concentrations in the source area show no signs of significant continued releases of VOCs.

D-2.0 PLUME CORE BOREHOLE DATA

The trend analysis begins with a discussion of six boreholes in the core of the VOC plume with measurements to 650 ft bgs: 50-24813, 50-24822, 50-603061, 50-603064, 50-603471, and 50-613183. The core of the plume is defined as samples having concentrations of greater than 30,000 μg/m^3 of total VOCs. While peak concentrations in the core of the VOC plume have decreased since 2011, increases in borehole 50-603061 indicate that the core of the plume has shifted to the north, with potential commingling of a separate plume in the vicinity of 50-603061. Any trend analyses at depths of less than 550 ft bgs do not apply to borehole 50-613183, since no soil-vapor data are available. Data from November 2011 to October 2020 for boreholes 50-24813 (Figures D-2.0-1 through D-2.0-6); 50-24822 (Figures D-2.0-7 through D-2.0-10); 50-603061 (Figures D-2.0-11 through D-2.0-13); 50-603064 (Figures D-2.0-14 through D-2.0-16); 50-603471 (Figures D-2.0-17 through D-2.0-19); and 50-613183 (Figures D-2.0-20 through D-2.0-22) share several common aspects:

- Shallow ports (less than 100 ft bgs) in borehole 50-24813 and 50-603471 continue to drop in concentration and show no evidence for continued leakage in the source region.
- The highest concentrations of TCE (Figures D-2.0-1, D-2.0-7, D-2.0-11, and D-2.0-17) are on the order of 50,000 μg/m^3 (up to 64,000 μg/m^3).
- The peak concentrations measured are consistently at a depth between 200 and 300 ft bgs.
- The concentrations at depths showing total VOCs greater than 10,000 μg/m^3 are not showing marked increases with time, and in many cases are beginning to show decreases, as shown in Figures D-2.0-2, D-2.0-3, D-2.0-18, and D-2.0-19. Boreholes 50-603471 (Figures D-2.0-18 and D-2.0-19) and 50-613183 (Figures D-2.0-21 and D-2.0-22) had unusually low concentrations of TCE in July 2020, but October 2020 concentrations returned to historical levels. Figures D-2.0-5 and D-2.0-19 show concentrations at a depth of 450 ft bgs, which is below the peak in boreholes 50-24813 and 50-603471, respectively. In both these sets of data, the histograms show variability in the range of 20,000 to 40,000 μg/m^3. While there was a clear trend in borehole 50-603471 at 450 ft bgs toward lower concentrations with time until July 2020, the TCE concentration increased in October 2020 to 37,000 μg/m^3. No clear trend exists at 450 ft bgs in borehole 50-24813, where concentrations show minimum total VOCs in April 2016 of near 20,000 μg/m^3 followed by increases to between 21,000 and 34,000 μg/m^3 for all subsequent measurements.
- The deepest ports in the map-view center of the plume at depths of 550 to 650 ft bgs, with detected concentrations in the 90–2200 μg/m^3 total VOC range, show decreasing concentrations with time (Figures D-2.0-6, D-2.0-21, and D-2.0-22).
- Borehole 50-24822 has two ports at 235 and 450 ft bgs (Figure D-2.0-9 and D-2.0-10) where TCE concentrations generally decreased from 2011 to 2014 and then leveled off before starting to increase again in 2016. The port at 142 ft bgs in borehole 50-24822 followed a similar trend with an initial decrease that leveled off. However, total VOC concentration from October 2020 increased. Further monitoring will confirm this increasing trend.
- TCE concentrations are generally either stable or decreasing. However, at borehole 50-603061 TCE concentration is increasing. Borehole 50-603061 at 228 ft bgs is also showing an increasing trend in total VOC concentrations, with a maximum of 37,000 μg/m^3 in October 2020 (Figure D-2.0-12).

Data from borehole 50-603061, and many measurements from deep in the plume, show very low TCE/total VOC ratios, suggesting a separate plume that has reached the top of the Tschicoma dacite (Tvt 2) along a pathway near borehole 50-603061 and has then spread laterally. This potential contribution of a separate plume can be seen on the total VOC plume in Figure D-2.0-23. However, despite the higher fraction of other VOCs in this borehole, the only contaminant that exceeded its SL was TCE. Therefore, a plume map showing only the concentration of TCE is presented in Figure D-2.0-24. If only the TCE plume is examined, the apparent shift of the core of the plume to the north from 2011 to 2020 is reduced.

D-2.1 Borehole 50-24813

The highest concentrations in borehole 50-24813 can be seen at a depth of 241 ft in Figures D-2.0-1 (TCE) and D-2.0-3 (total VOCs).

D-2.2 Borehole 50-24822

October 2017 data from this borehole are unexplained because of the one-time shift of the plume maximum from 235 ft bgs to 351 ft bgs. Continued monitoring has indicated these data are anomalous.

D-2.3 Borehole 50-603061

The deepest port (450 ft bgs) at this northernmost borehole shows VOC concentrations increasing with time (Figure D-2.0-13).

D-2.4 Borehole 50-603064

This borehole shows a slight decrease in total VOC concentration at 113 ft bgs, consistent with gradual diffusion away from higher concentrations toward lower concentrations (Figure D-2.0-15). At 500 ft bgs, total VOC concentrations appear to be increasing gradually through time (Figure D-2.0-16).

D-2.5 Boreholes 50-603471 and 50-613183

Borehole 50-603471 is centrally located in the core of the plume between Pit 4 and Pit 5 (Figure D-1.0-1). This borehole also shows the highest concentrations between 200 and 300 ft bgs with a TCE concentration of over 100,000 µg/m^3 in 2011 (Figure D-2.0-17). Subsequent measurements show a trend toward lower peak values of TCE, with the most recent concentrations on the order of 50,000 µg/m^3 TCE.

Total VOCs in the high-concentration region (288 ft bgs) of this borehole are also trending downward through time (Figure D-2.0-18), with high ratios of TCE/total VOCs that are consistent with the majority of observations at all but the deepest depths in borehole 50-603471 (Figure D-2.0-17), and consistent with observations in borehole 50-603061 (Figures D-2.0-12 and D-2.0-13). At the deepest port (450 ft bgs), there is a clear trend toward both lower TCE and total VOC concentrations with time (Figure D-2.0-19). Borehole 50-613183 is located within 10 ft of borehole 50-603471 and serves as an extension to greater depths. Concentrations of TCE at borehole 50-613183 (Figure D-2.0-20) appear to be nearly stable through time at 642.5 ft bgs (Figure D-2.0-21), while increases in concentrations are seen at 550 ft bgs (Figure D-2.0-22). Ratios of TCE/total VOCs are lower in both ports of borehole 50-613183, with very little TCE present in the deepest port at 642.5 ft bgs.

D-3.0 PLUME INTERMEDIATE BOREHOLE DATA

Data from plume intermediate boreholes (50-603063, 50-603467, 50-603468, 50-603470, 50-603472, 50-613182, and 50-613184) are shown in Figures D-3.0-1 through D-3.0-23. The intermediate portion of the plume is defined as samples having concentrations greater than 10,000 μg/m^3 of total VOCs but less than 30,000 μg/m^3.

The plume intermediate boreholes share the following characteristics with the plume core boreholes:

- Shallow ports (less than 100 ft bgs) continue to drop in concentration and show no evidence for continued leakage in the source region.
- Maximum concentrations are generally at depths between 200 and 250 ft bgs.
- Deep ports in the intermediate portion of the plume with concentrations of less than 10,000 μg/m^3 show mixed trends. Total VOC concentrations in borehole 50-603467 at 600 ft bgs are decreasing, with concentrations near or below 2020 μg/m^3 for the last three sampling events (Figure D-3.0-6), while concentrations at 500 ft bgs show an increasing trend (Figure D-3.0-5). Note that the January 2020 data for the port at 500 ft bgs is unexplained as the VOC concentrations are below historical and subsequent measurements.
- Concentrations in borehole 50-603470 at 650 ft bgs are relatively stable (Figure D-3.0-14). Concentrations in borehole 50-613182 at 550 and 632 ft bgs, and in borehole 50-613184 at 500 and 664.5 ft bgs, had been gradually increasing, but this trend reversed itself in the last two sampling events (Figures D-3.0-19, D-3.0-20, D-3.0-22, D-3.0-23). Continued monitoring will confirm if this trend continues.

D-3.1 Borehole 50-603063

This borehole shows a tentative increase in concentrations from diffusion moving mass from the bulge at 228 ft bgs downward to 347 ft bgs. Very little evidence of change is seen at 450 ft bgs. However, the lowest concentration of TCE (3300 μg/m^3) was found in the October 2020 sampling event (Figure D-3.0-3). October 2017 data from this borehole are unexplained because of the one-time shift of the plume maximum from 228 ft bgs to 347 ft bgs.

D-3.2 Borehole 50-603467

Borehole 50-603467 shows no clear trend at any depth. January 2020 data for the port at 500 ft bgs are anomalous because they are not following previous data trends and there is not a known reason for changes observed during this sampling event. Continued monitoring has further indicated this data is anomalous.

D-3.3 Borehole 50-603468

This is a borehole on the south side of the plume with concentrations at 233 and 403 ft bgs showing little obvious trend through time (Figures D-3.0-9 and D-3.0-10). However, TCE concentrations at these depths were at or below 11,000 μg/m^3 during the first and second sampling events in 2020. Shallow measurements at 142 ft bgs show a trend toward lower concentrations with time (Figure D-3.0-8). Note that the July 2020 concentrations are unexplained as they do not follow previous data trends. Continued monitoring will confirm if this data is truly anomalous.

D-3.4 Borehole 50-603470

Borehole 50-603470 is located at the southeast corner of Pit 5 (Figure D-1.0-1). Historically, this borehole has had some of the highest VOC concentrations found at the site, although they have been decreasing with time. Figure D-3.0-11 shows that concentrations of TCE reach a maximum in the borehole between 200 and 300 ft bgs. In this depth range, concentrations have decreased from over 80,000 µg/m^3 in 2011 to approximately 20,000 µg/m^3 in the October 2020 sampling event. Continued monitoring will confirm if this decreasing trend continues.

Total VOCs in this borehole (Figures D-3.0-12 to D-3.0-14) show a decrease with time at both 83 ft bgs and 278 ft bgs, while at 650 ft bgs there is a tentative trend toward higher values of total VOCs. At this deepest port, the ratios of TCE/total VOCs are quite low through time, consistent with deep values throughout the plume, and also consistent with ratios found in borehole 50-603061 (Figures D-2.0-12 and D-2.0-13). Values of TCE in the deepest port are well below the Tier 1 SL of 2020 µg/m^3.

D-3.5 Borehole 50-603472

This borehole on the west side of the plume shows little change in concentration with time and only a minor trend to decreasing concentrations at 146 ft bgs (Figure D-3.0-16).

D-3.6 Borehole 50-613182

This deep borehole, associated with borehole 50-603472, had been exhibiting a gradually increasing trend in ports at 550 and 632 ft bgs, but this trend reversed itself in the last two sampling events (Figures D-3.0-19 and D-3.0-20). Continued monitoring will confirm if this trend continues.

D-3.7 Borehole 50-613184

This deep borehole, associated with borehole 50-603468, had been exhibiting a gradually increasing trend in ports at 500 and 664.5 ft bgs, but this trend reversed itself in the last two sampling events (Figures D-3.0-22 and D-3.0-23). Continued monitoring will confirm if this trend continues.

D-4.0 PLUME OUTER-EDGE BOREHOLE DATA

Data from the boreholes on the outer edge of the plume (50-24784, 50-603062, 50-603383, 50-603503, and 50-613185) are shown in Figures D-4.0-1 through D-4.0-15. The outer edge of the plume is defined by samples having concentrations of less than 10,000 µg/m^3 of total VOCs.

Boreholes on the outer edge of the plume have the following characteristics:

- Total VOCs show a trend toward higher concentrations through time, consistent with diffusion from higher-concentration areas in the plume toward the plume edges.

D-4.1 Borehole 50-24784

Deeper ports in this western borehole show gradually increasing total VOC concentrations consistent with diffusion from higher-concentration areas in the plume toward the plume edges (Figures D-4.0-2 and D-4.0-3). Outlier points in January 2020 at 155 ft bgs and July 2020 at all depths show little relationship to previous measurements at these depths (Figure D-4.0-1). Continued monitoring will confirm if this data is anomalous.

D-4.2 Borehole 50-603062

Total VOC concentrations in this easternmost borehole do not show a clear trend over time at the deepest ports (Figures D-4.0-5 and D-4.0-6).

D-4.3 Borehole 50-603383

Concentrations of total VOCs in this borehole are increasing with time, especially at depth (Figures D-4.0-8 and D-4.0-9). Note that the TCE and total VOC concentrations are unusually low in October 2020 at depths greater than 100 ft bgs compared with previous sampling events. Continued monitoring will confirm if these data are anomalous.

D-4.4 Borehole 50-603503

Concentrations of TCE and total VOCs in this borehole are generally stable but have decreased from 2019 to 2020 (Figures D-4.0-11 and D-4.0-12). Note that the TCE and total VOC concentrations are unusually low in October 2020 at depths greater than 150 ft bgs compared with previous sampling events. Continued monitoring will confirm if these data are anomalous.

D-4.5 Borehole 50-613185

Concentrations of TCE in this southernmost borehole are increasing with time at both 350 and 600 ft bgs (Figures D-4.0-14 and D-4.0-15).

D-5.0 PLUME TRENDS

Changes in plume concentrations through time from 2011 to 2020 support a conceptual model of VOC and, more importantly, TCE migration from higher concentration areas directly under the source region toward lower concentration regions around the edge of the plume, both laterally and vertically. Concentrations in wells at the outer lateral edge of the plume generally show increasing concentrations with time. Concentrations in the deepest ports (500–650 ft bgs) are also showing gradual increases with time. These regions have been shaded red in Figure D-5.0-1.

In Figure D-5.0-1, the deepest ports (450–650 ft bgs) show very low TCE as a percentage of the total VOCs (Figures D-2.0-13, D-2.0-21, D-3.0-14, D-3.0-20, D-3.0-23, D-4.0-6, and D-4.0-15). Note that Figure D-2.0-12 shows similar behavior in borehole 50-603061 at 228 ft bgs. However, concentrations in this borehole are high: total VOC concentration in February 2019 was over 40,000 μg/m^3 and 1,2,2-trichloro-1,1,2-trifluoroethane had concentrations in all ports of up to 22,976.6 μg/m^3 at 228 ft bgs and 22,210.8 μg/m^3 at 128 ft bgs. Because the ratio of TCE/total VOCs is so low in these locations, it indicates that the plume composition on the north side of MDA C has a source region with a low ratio of TCE/total VOCs that has reached the top of the Tschicoma dacite (Tvt 2) along a pathway near borehole 50-603061 and then spread laterally. For comparison, concentrations in the central plume in borehole 50-603470 range from only 100 to 1000 μg/m^3 for 1,2,2-trichloro1,1,2 trifluoroethane while TCE in this borehole ranges from 10,000 to 40,000 μg/m^3 for all but the deepest port, where TCE/total VOCs is more closely aligned with values from borehole 50-603061. However, despite its low fraction comparatively, TCE is the only contaminant in this borehole to exceed its SL. For this reason, a plume map showing only the concentration of TCE is presented in Figure D-1.0-2. If only the TCE plume is examined, the apparent shift of the core of the plume to the north from 2011 to 2020 is reduced.

As with most field data collected by different teams over many years, the data at MDA C show a few cases of odd behaviors that are likely related to data collection and/or laboratory analysis inconsistencies. For example, data from October 2017 in Figure D-3.0-2 and Figure D-3.0-3 show shifts in the depth of peak concentrations that are not persistent. Such sudden shifts in surface data cannot be explained by processes known to be acting on the movement of gas-phase chemicals in the Bandelier Tuff (Stauffer et al. 2005, 090537; Stauffer et al. 2011, 255584; Behar et al. 2019, 700854) and are thus most likely explained by issues with data collection and/or analysis.

D-6.0 CONCLUSIONS

The 2012 MDA C CME report (LANL 2012, 222830) estimated the total mass of TCE in the subsurface to be in the range of 134 to 239 kg (equivalent to 24 to 43 gal. as liquid). Given that many of the highest-concentration ports in the center of the plume have not changed greatly through 2020, it is logical to assume that the total mass in the subsurface has remained about the same as previously estimated. This means that most of the TCE mass is still present in the upper stratigraphic units (i.e., above the Cerro Toledo interval). The distribution of mass and slow increases at the edge of the plume (red areas in Figure D-5.0-1) are consistent with the conceptual model of vapor diffusion, with the added benefit of diffusion through the lower units (the Tschicoma dacite [Tvt 2] and Puye [Tpf] shown in Figure D-5.0-1) being impeded by the relatively higher moisture content of these units. The purpose of field screening and monitoring at MDA C is to identify changes in the configuration of the plumes, monitor changes in contaminant concentration distribution, and identify data-gap needs for future modeling or trend analyses.

D-7.0 REFERENCES

The following reference list includes documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. This information is also included in text citations. ERIDs were assigned by the Laboratory's Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by Newport News Nuclear BWXT-Los Alamos, LLC (N3B) (IDs 700000 and above). IDs are used to locate documents in N3B's Records Management System and in the Master Reference Set. The NMED Hazardous Waste Bureau and N3B maintain copies of the Master Reference Set. The set ensures that NMED has the references to review documents. The set is updated when new references are cited in documents.

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LANL (Los Alamos National Laboratory), September 2012. "Corrective Measures Evaluation Report for Material Disposal Area C, Solid Waste Management Unit 50-009 at Technical Area 50," Los Alamos National Laboratory document LA-UR-12-24944, Los Alamos, New Mexico. (LANL 2012, 222830)

NMED (New Mexico Environment Department), December 8, 2011. "Approval, Phase III Investigation Report for Material Disposal Area C, Solid Waste Management Unit 50-009, at Technical Area 50," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 208797)

Stauffer, P., K. Birdsell, and W. Rice, March 7–11, 2011. "3-D Model Validation in Support of Site Closure, Material Disposal Area L, Los Alamos, NM," Paper 11545, Waste Management 2011 Conference, March 7–11, 2011, Phoenix, AZ. (Stauffer et al. 2011, 255584)

Stauffer, P.H., K.H. Birdsell, M.S. Witkowski, and J.K. Hopkins, 2005. "Vadose Zone Transport of 1,1,1-Trichloroethane: Conceptual Model Validation through Numerical Simulation," *Vadose Zone Journal,* Vol. 4, pp. 760–773. (Stauffer et al. 2005, 090537)

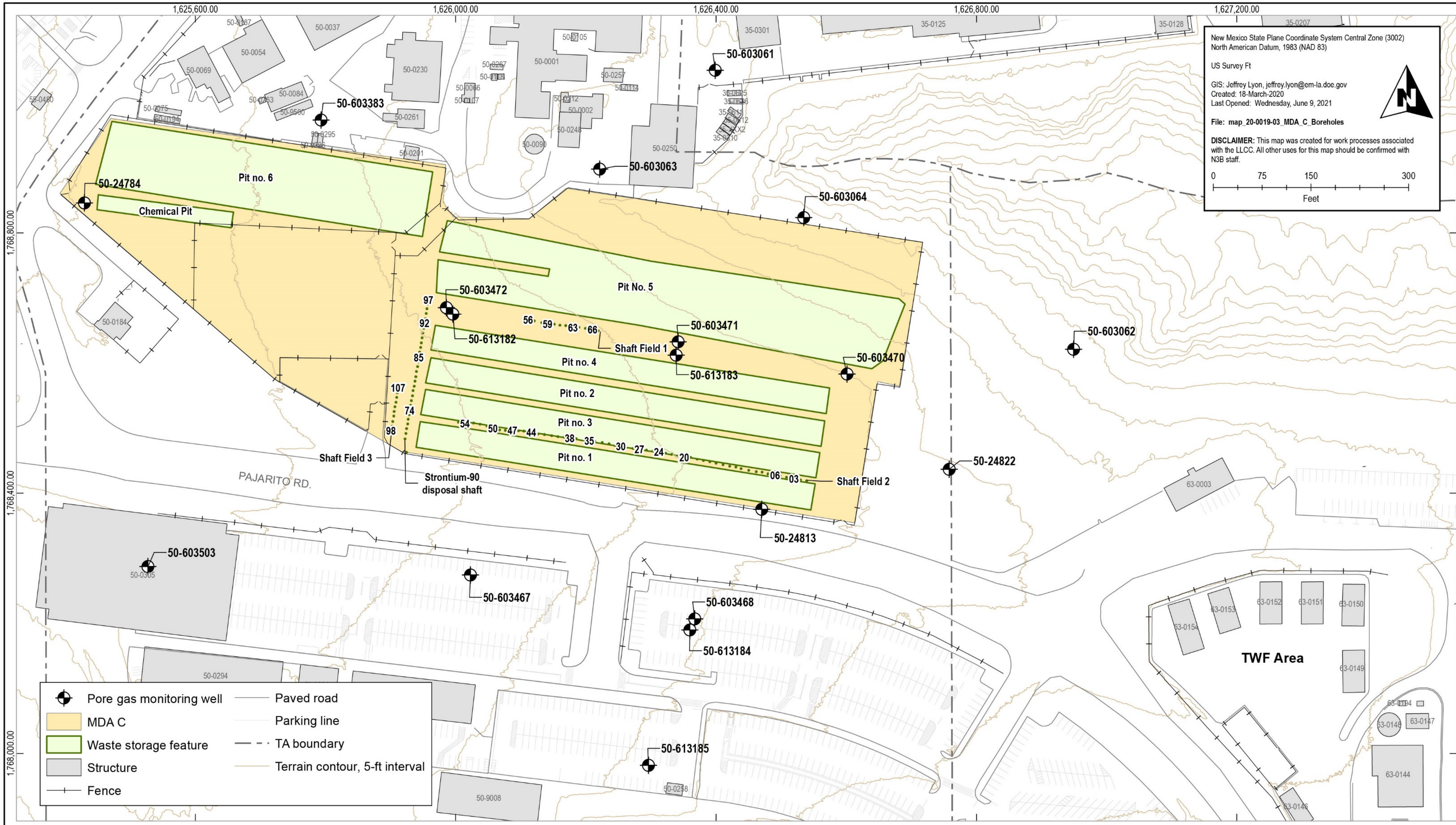


Figure D-1.0-1 Location of MDA C monitoring boreholes

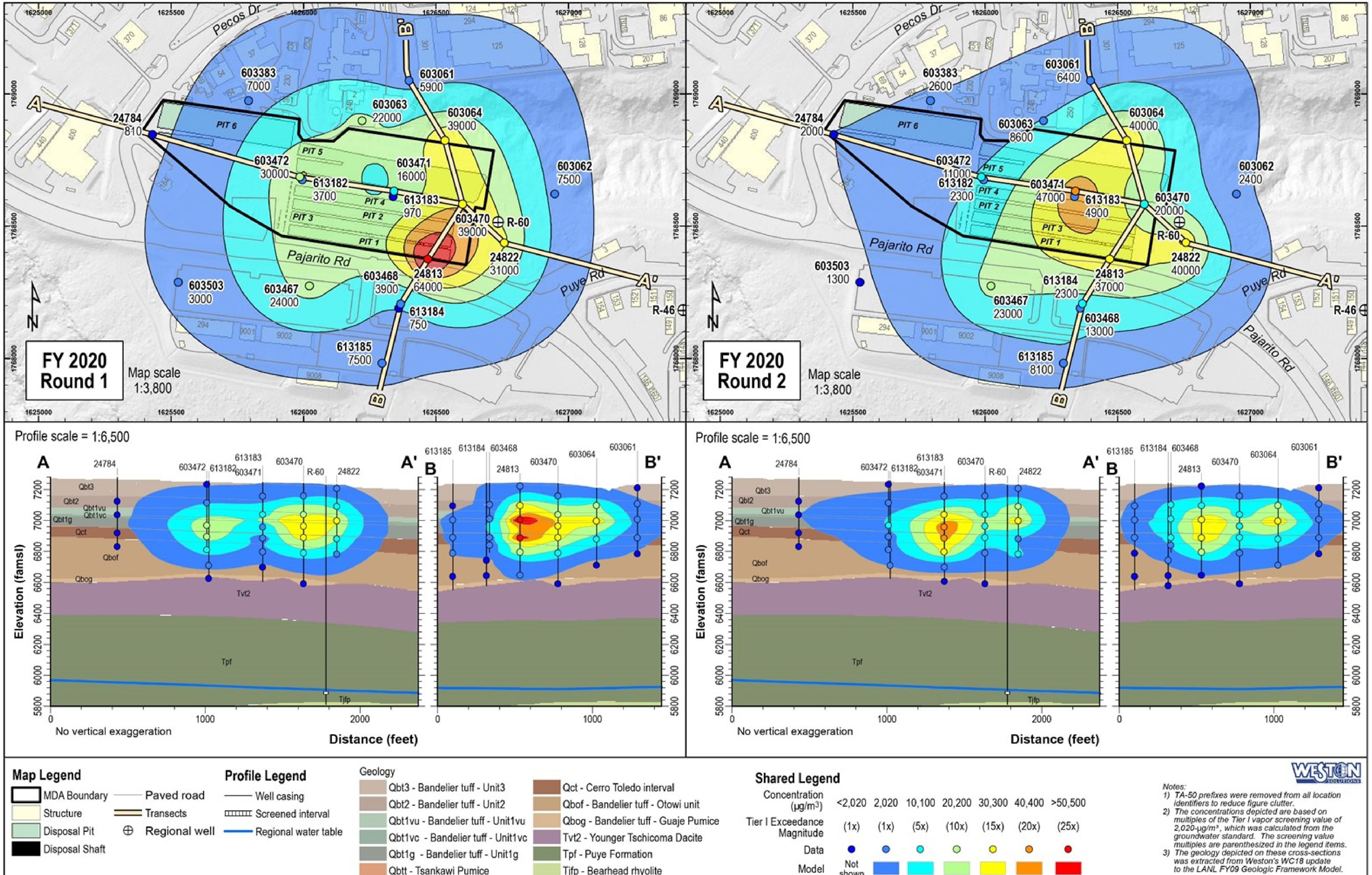
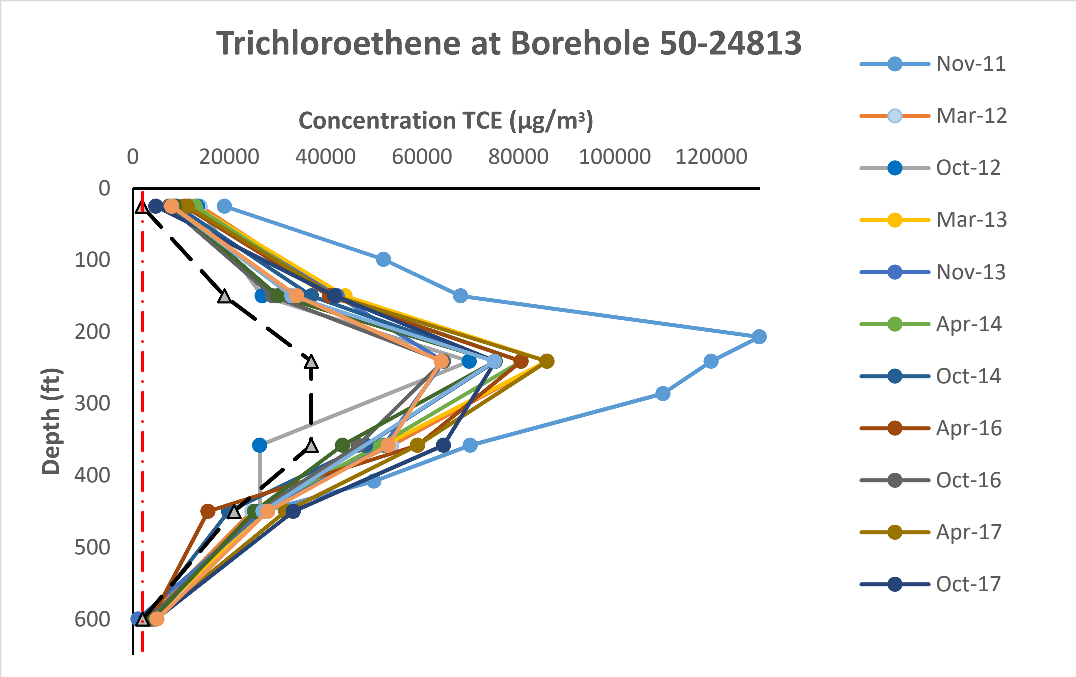
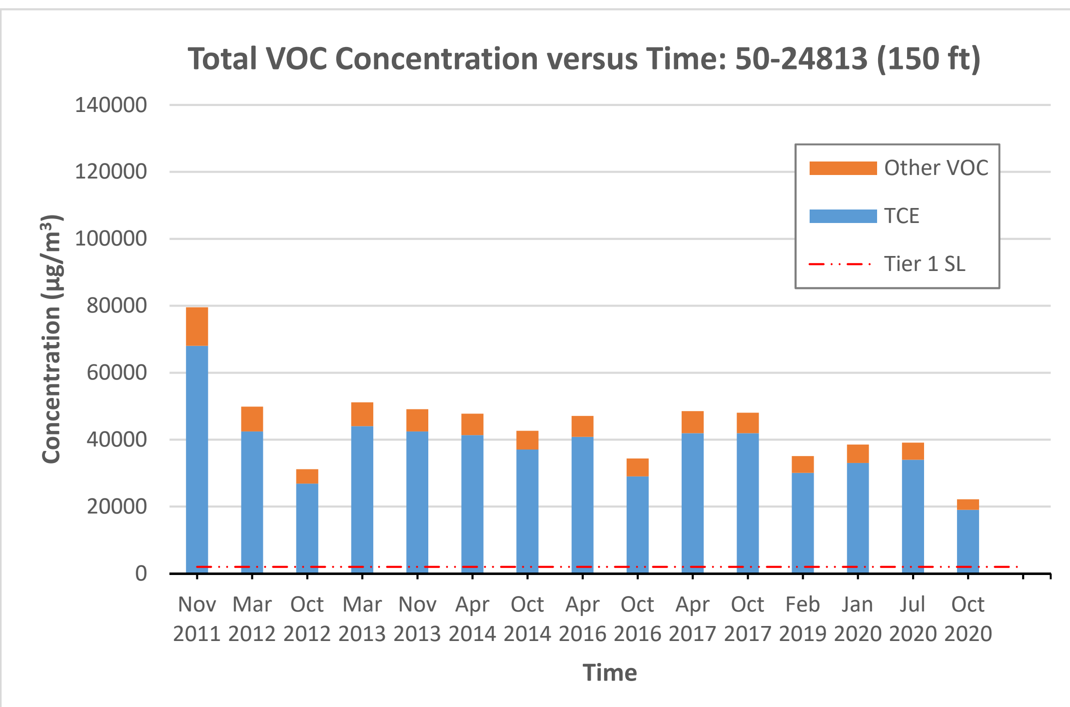


Figure D-1.0-2 **Lateral and vertical extent of the MDA C trichloroethene plume, fiscal year (FY) 2020. First sampling round shown on the left (Quarter 1, 80 samples) and second sampling round shown on the right (Quarter 4, 80 samples).**



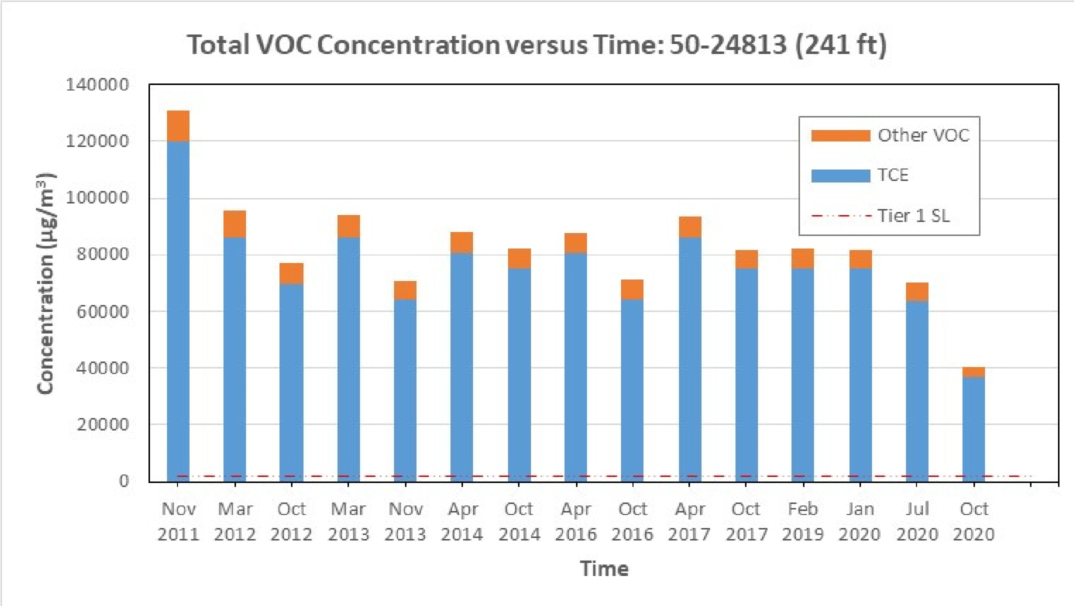
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-1 TCE concentration versus depth and time at borehole 50-24813



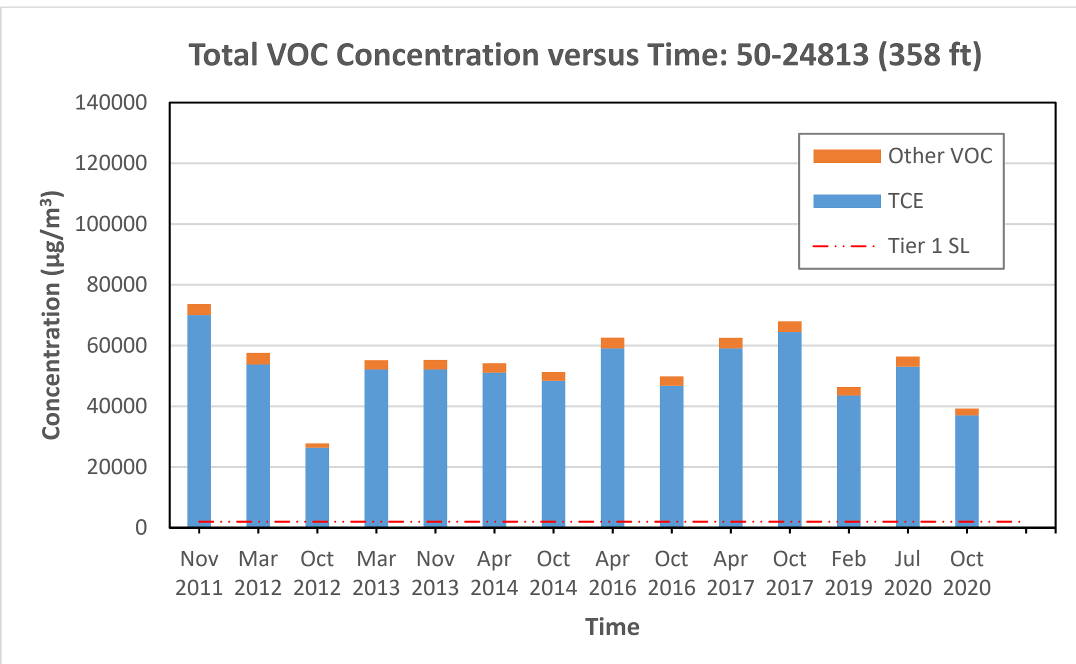
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-2 Total VOC concentration at 150 ft bgs at borehole 50-24813 over time



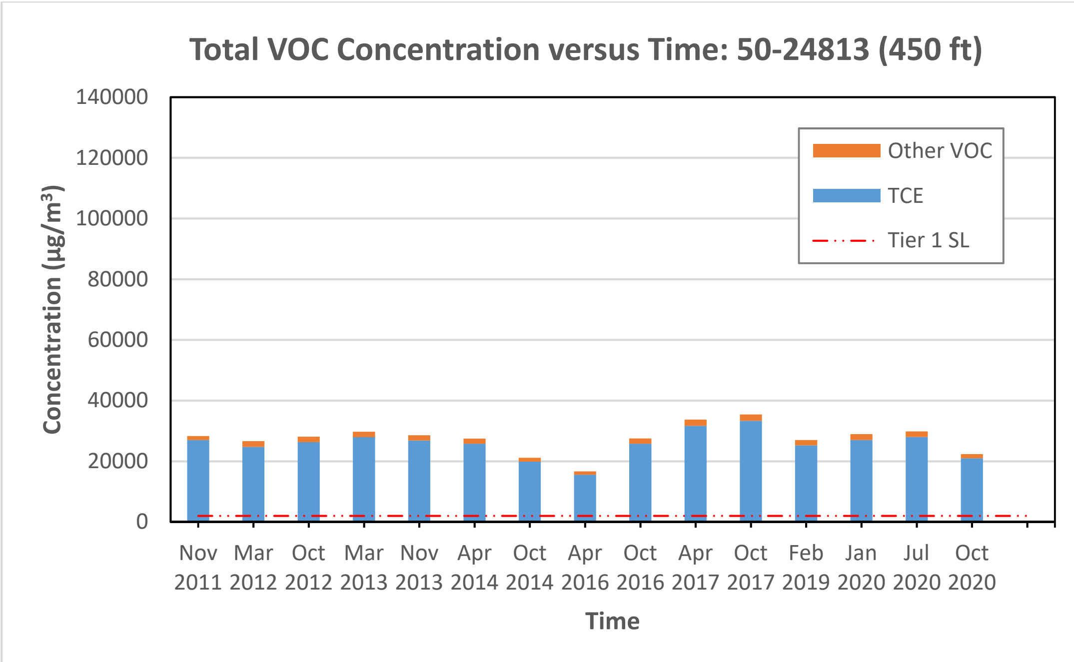
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-3 Total VOC concentration at 241 ft bgs at borehole 50-24813 over time



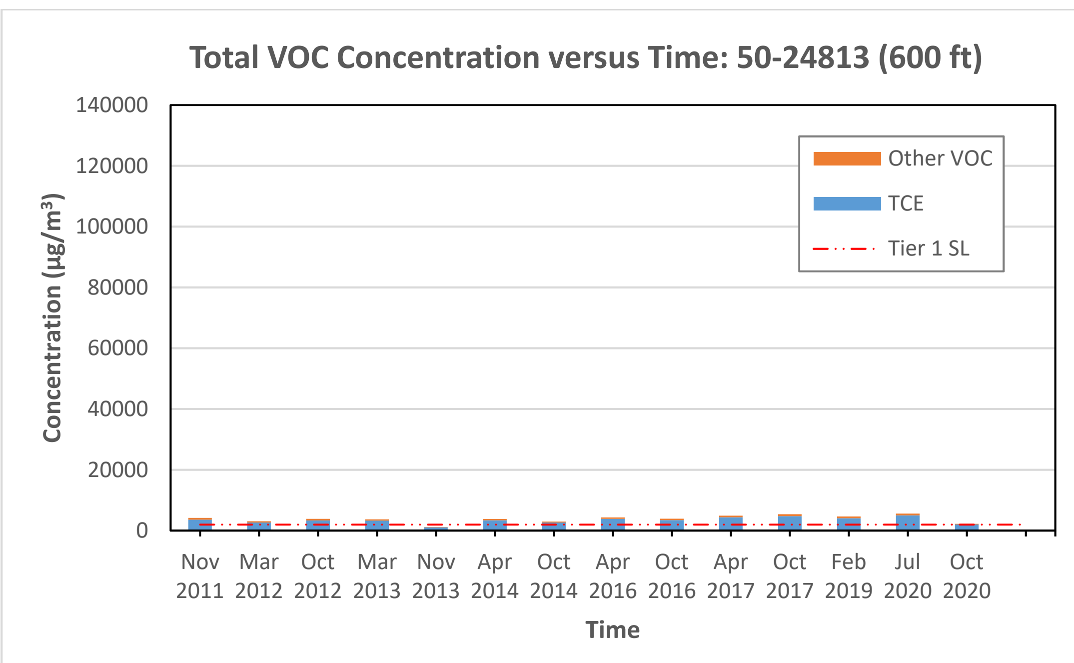
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-4 Total VOC concentration at 358 ft bgs at borehole 50-24813 over time



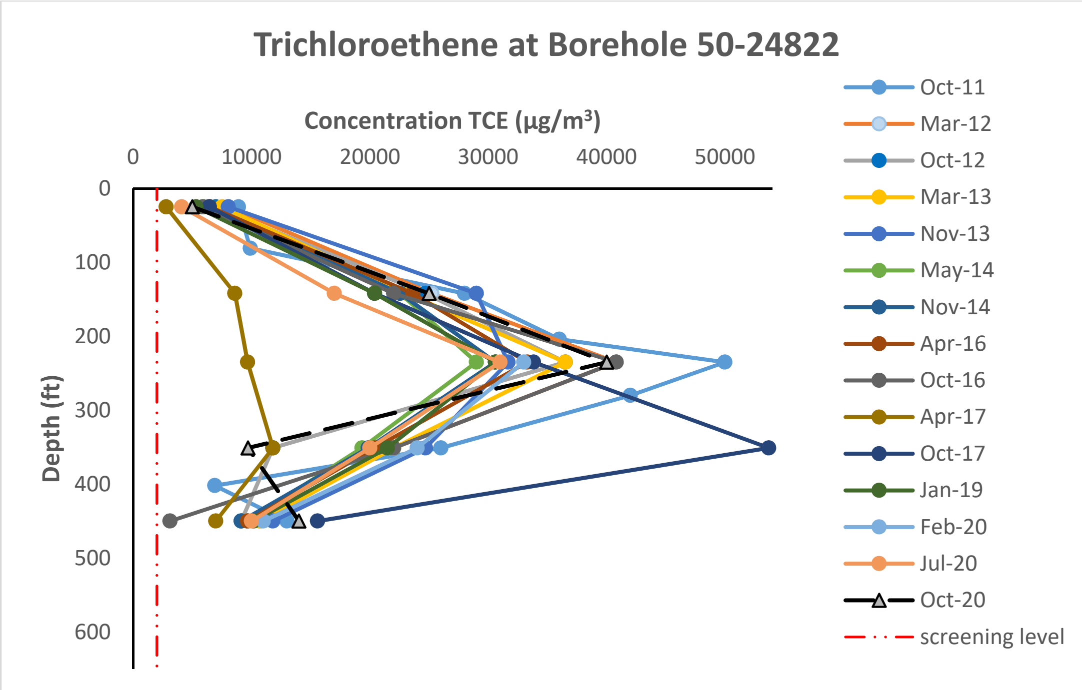
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-2.0-5 Total VOC concentration at 450 ft bgs at borehole 50-24813 over time



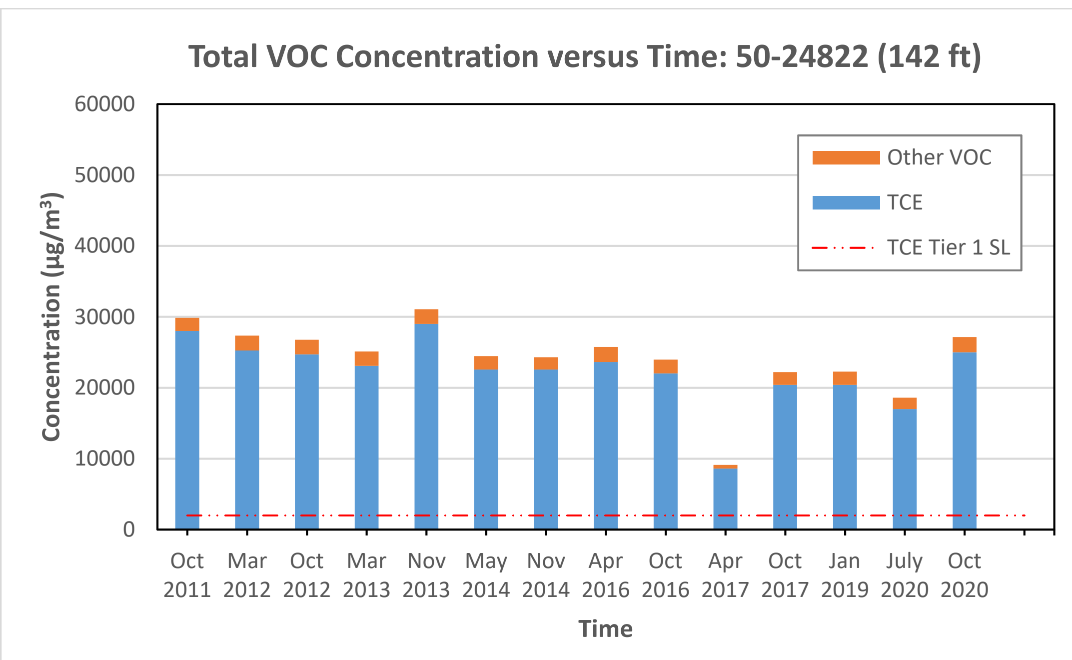
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-2.0-6 Total VOC concentration at 600 ft bgs at borehole 50-24813 over time



Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-7 TCE concentration versus depth and time at borehole 50-24822



Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-8 Total VOC concentration at 142 ft bgs at borehole 50-24822 over time

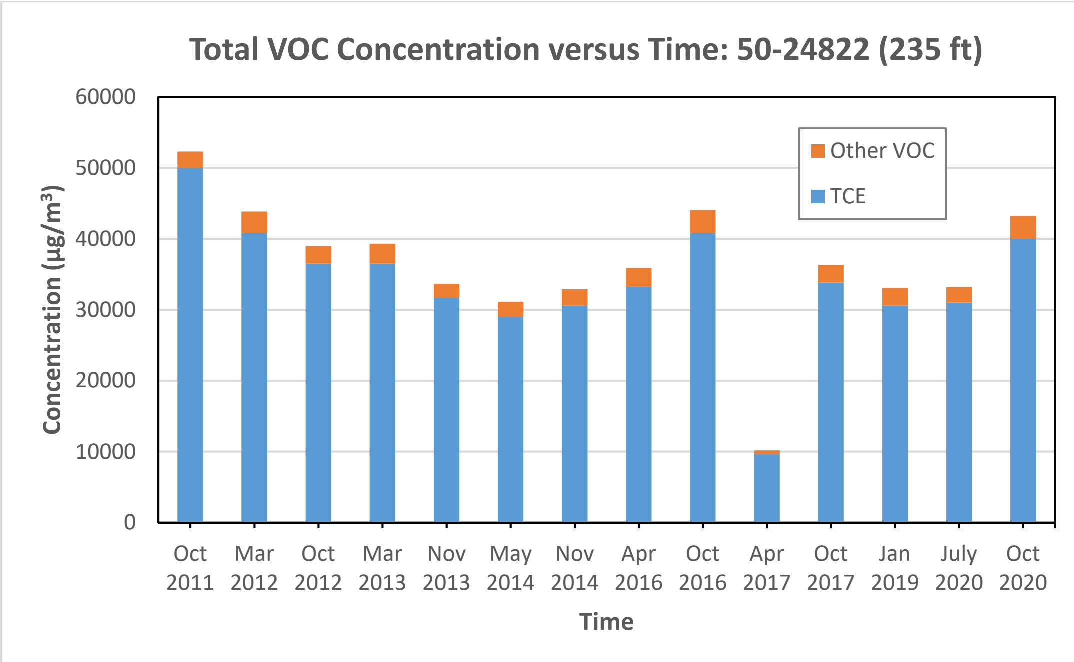
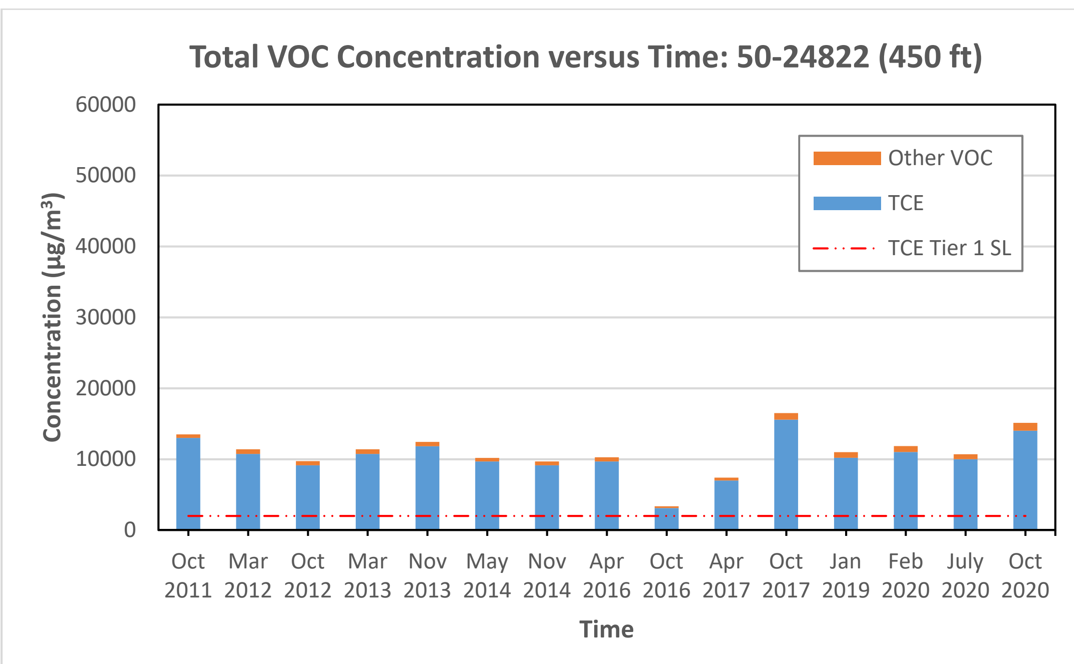
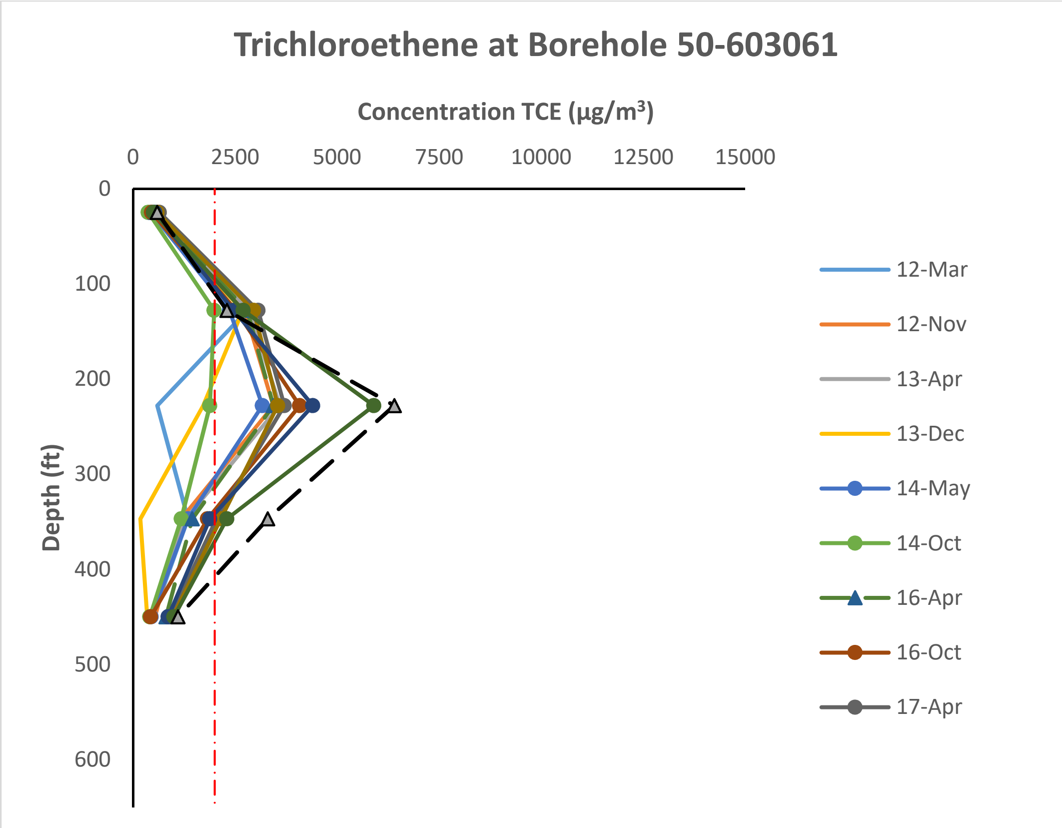


Figure D-2.0-9 Total VOC concentration at 235 ft bgs at borehole 50-24822 over time



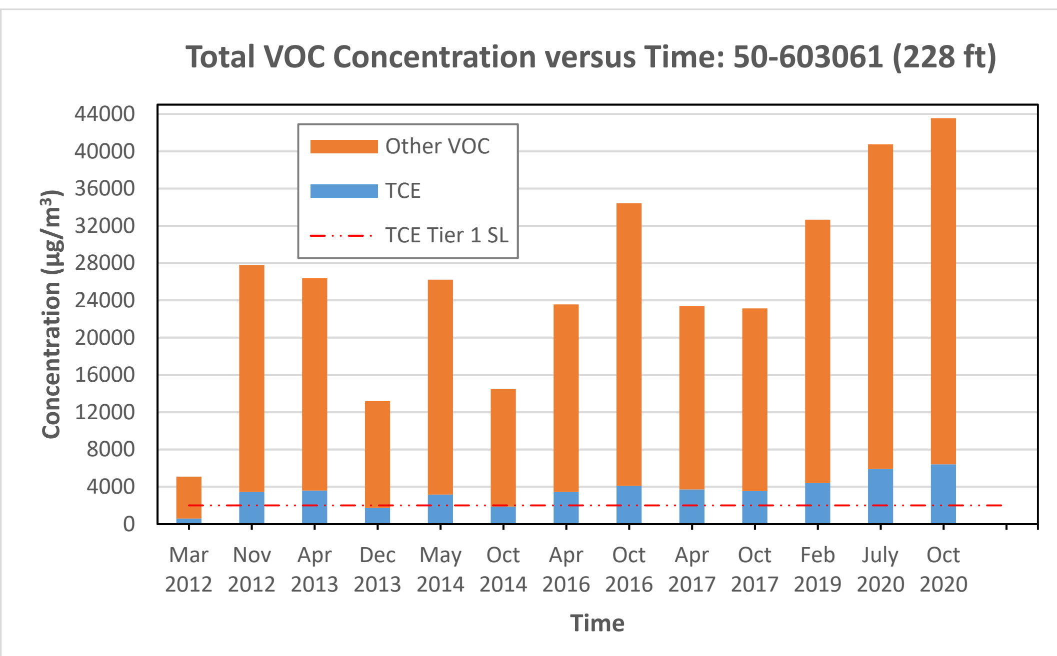
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-2.0-10 Total VOC concentration at 450 ft bgs at borehole 50-24822 over time



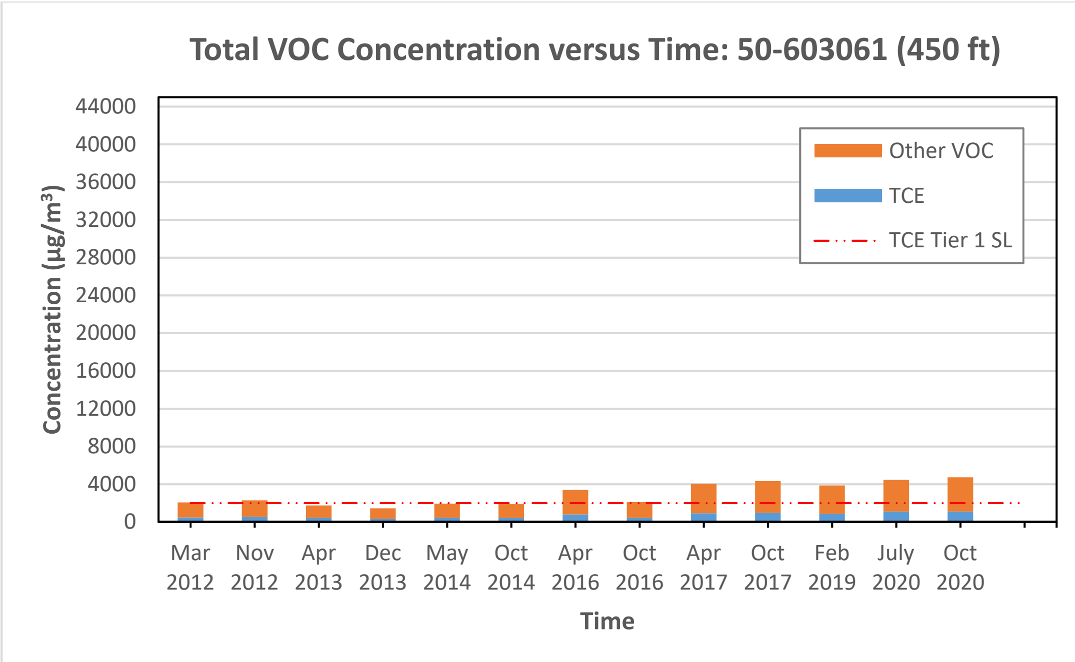
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-11 TCE concentration versus depth and time at borehole 50-603061



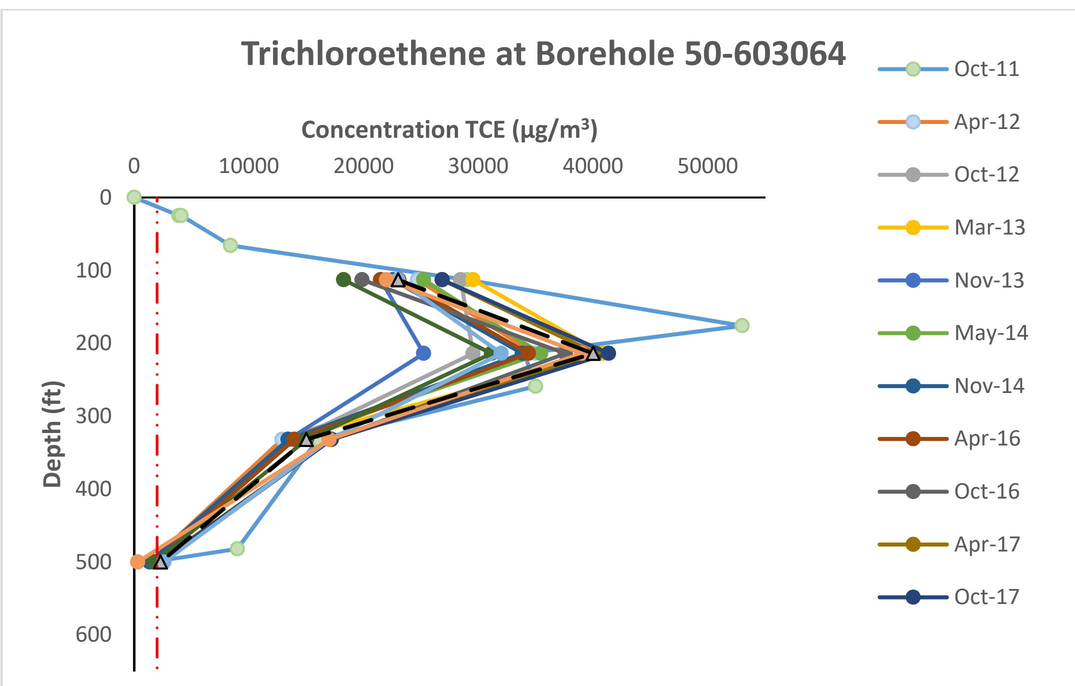
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-12 Total VOC concentration at 228 ft bgs at borehole 50-603061 over time



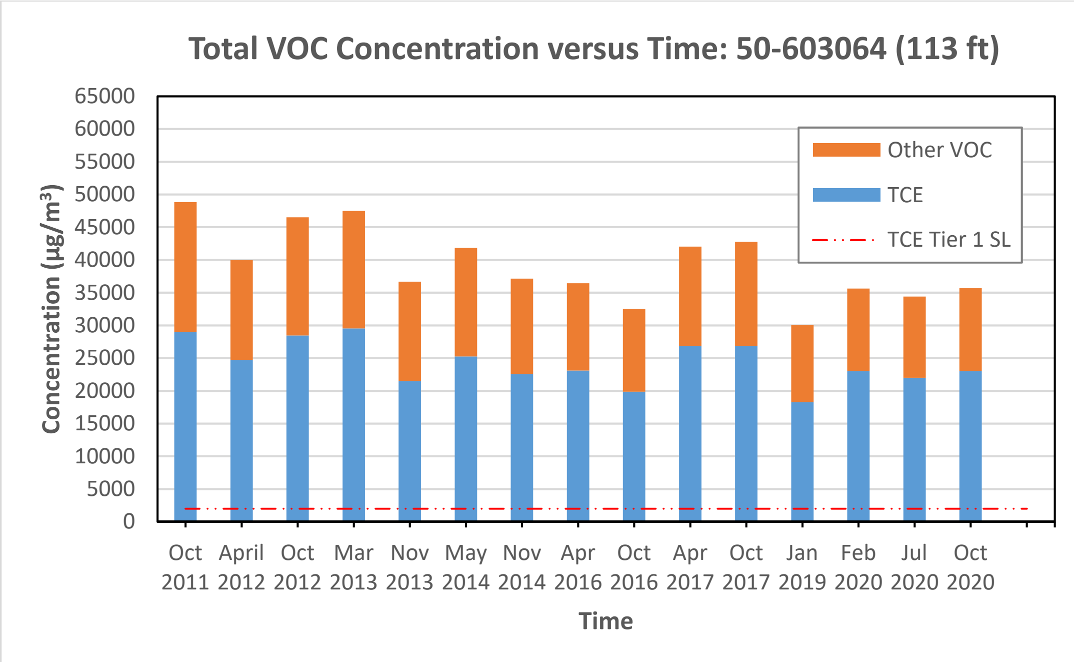
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-13 Total VOC concentration at 450 ft bgs at borehole 50-603061 over time



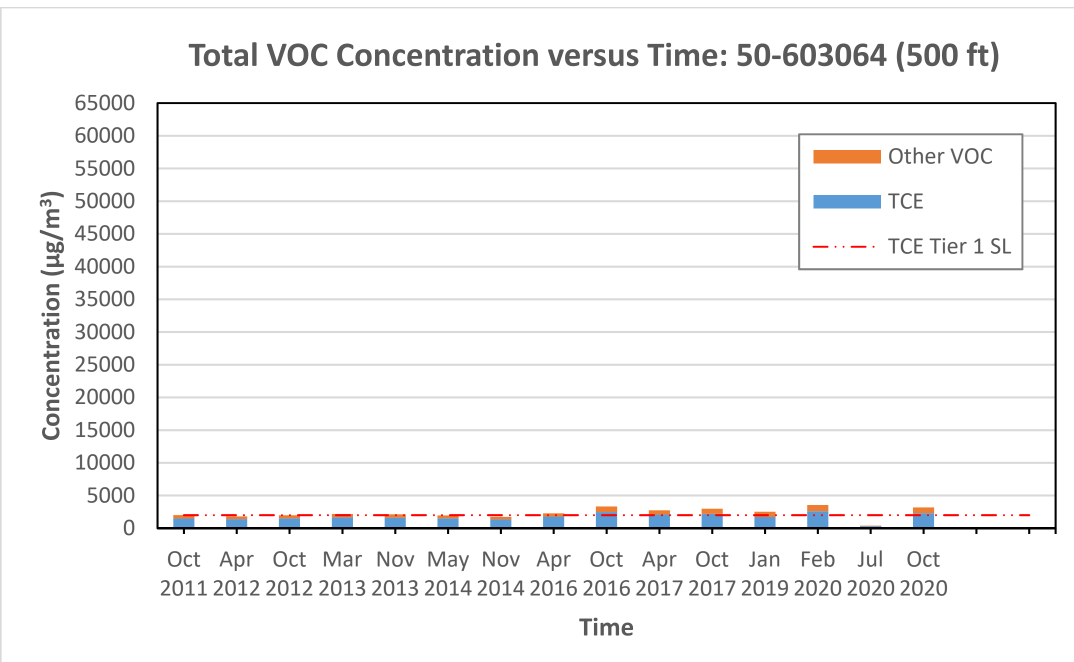
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-14 TCE concentration versus depth and time at borehole 50-603064



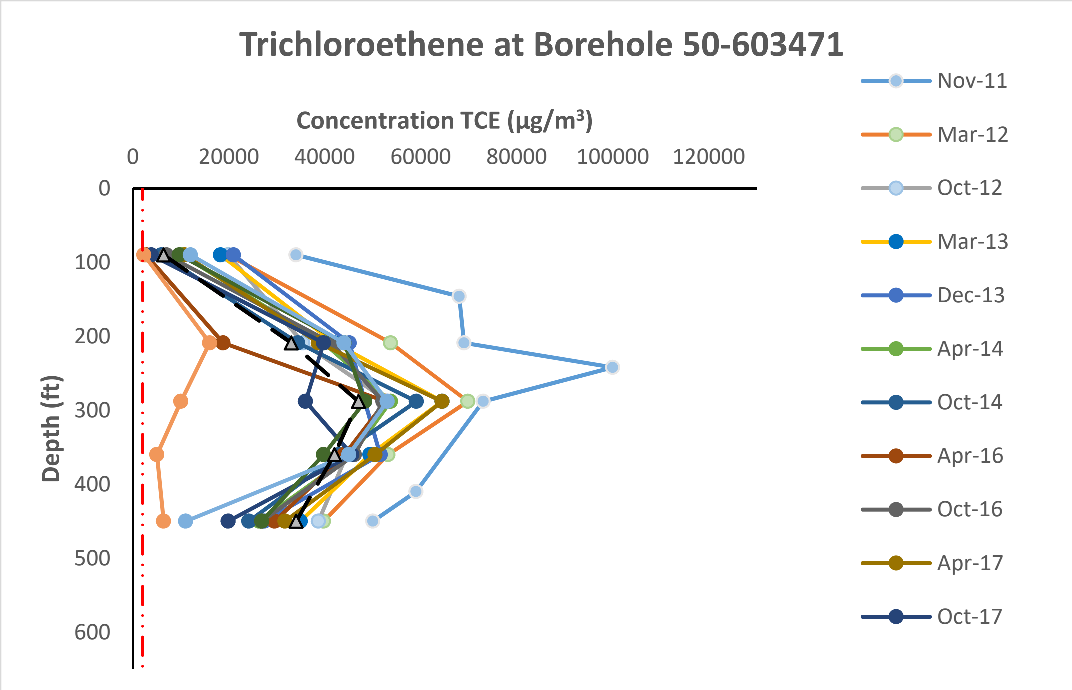
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-2.0-15 Total VOC concentration at 113 ft bgs at borehole 50-603064 over time



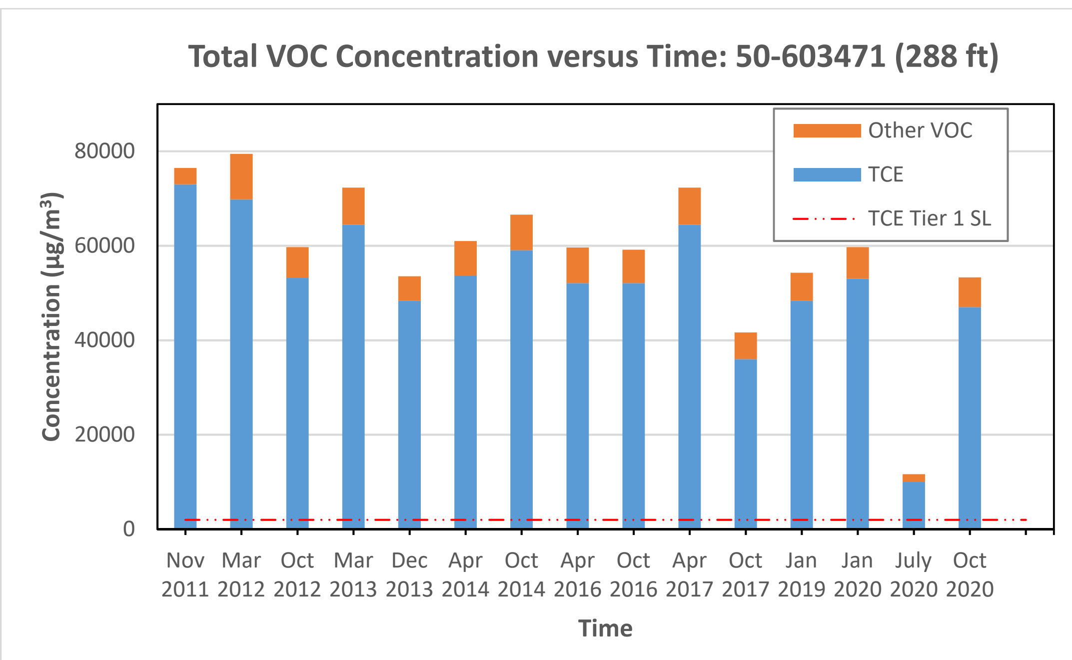
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-2.0-16 Total VOC concentration at 500 ft bgs at borehole 50-603064 over time



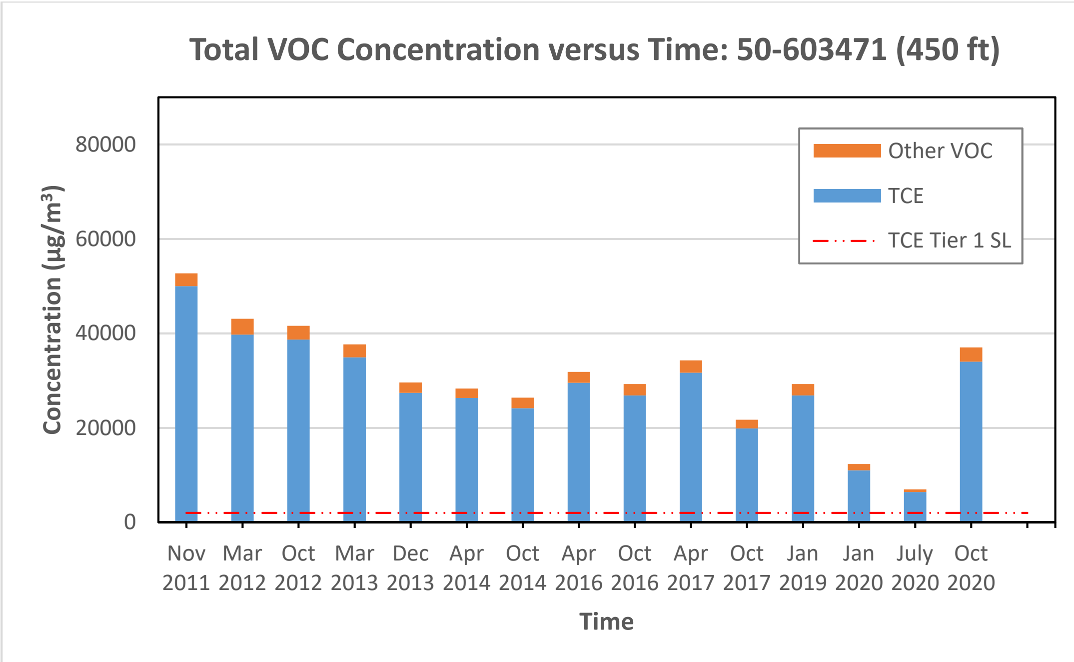
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-17 TCE concentration versus depth and time at borehole 50-603471



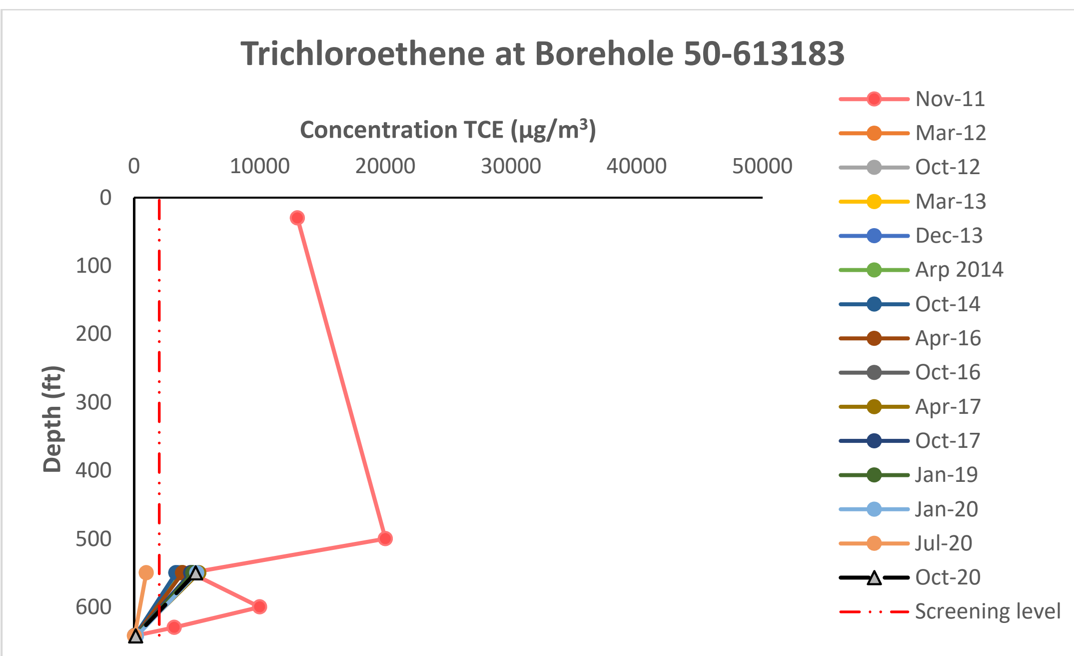
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-18 Total VOC concentration at 288 ft bgs at borehole 50-603471 over time



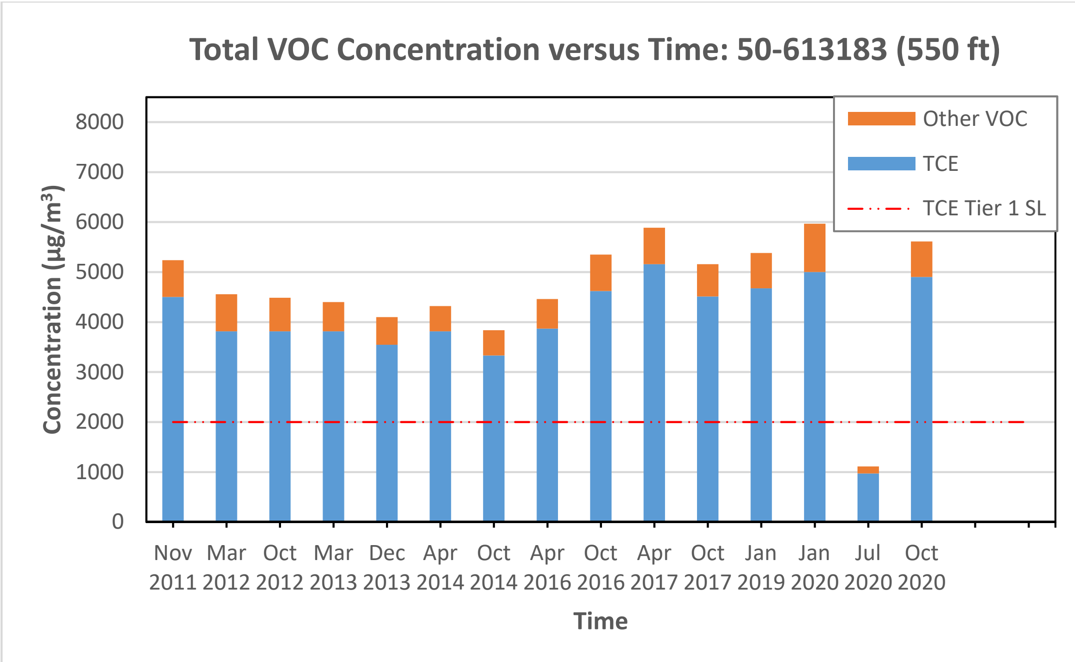
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-19 Total VOC concentration at 450 ft bgs at borehole 50-603471 over time



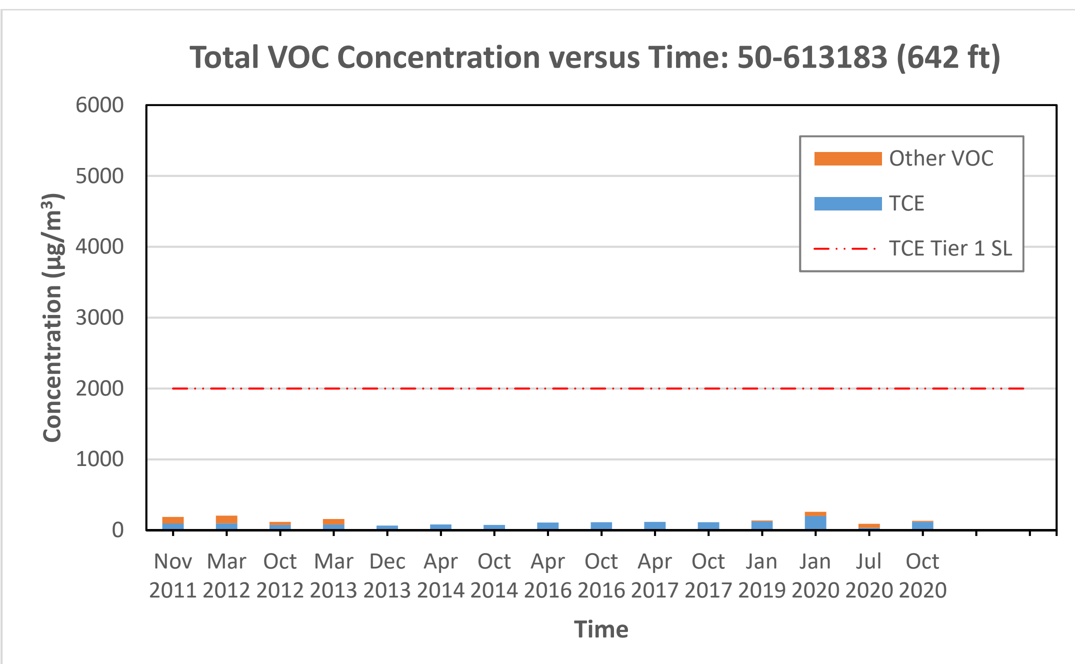
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-20 TCE concentration versus depth and time at borehole 50-613183



Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-21 Total VOC concentration at 550 ft bgs at borehole 50-613183 over time



Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-2.0-22 Total VOC concentration at 642.5 ft bgs at borehole 50-613183 over time

Figure D-2.0-23 MDA C map view with contours of total VOC plume showing maximum concentrations in October 2020

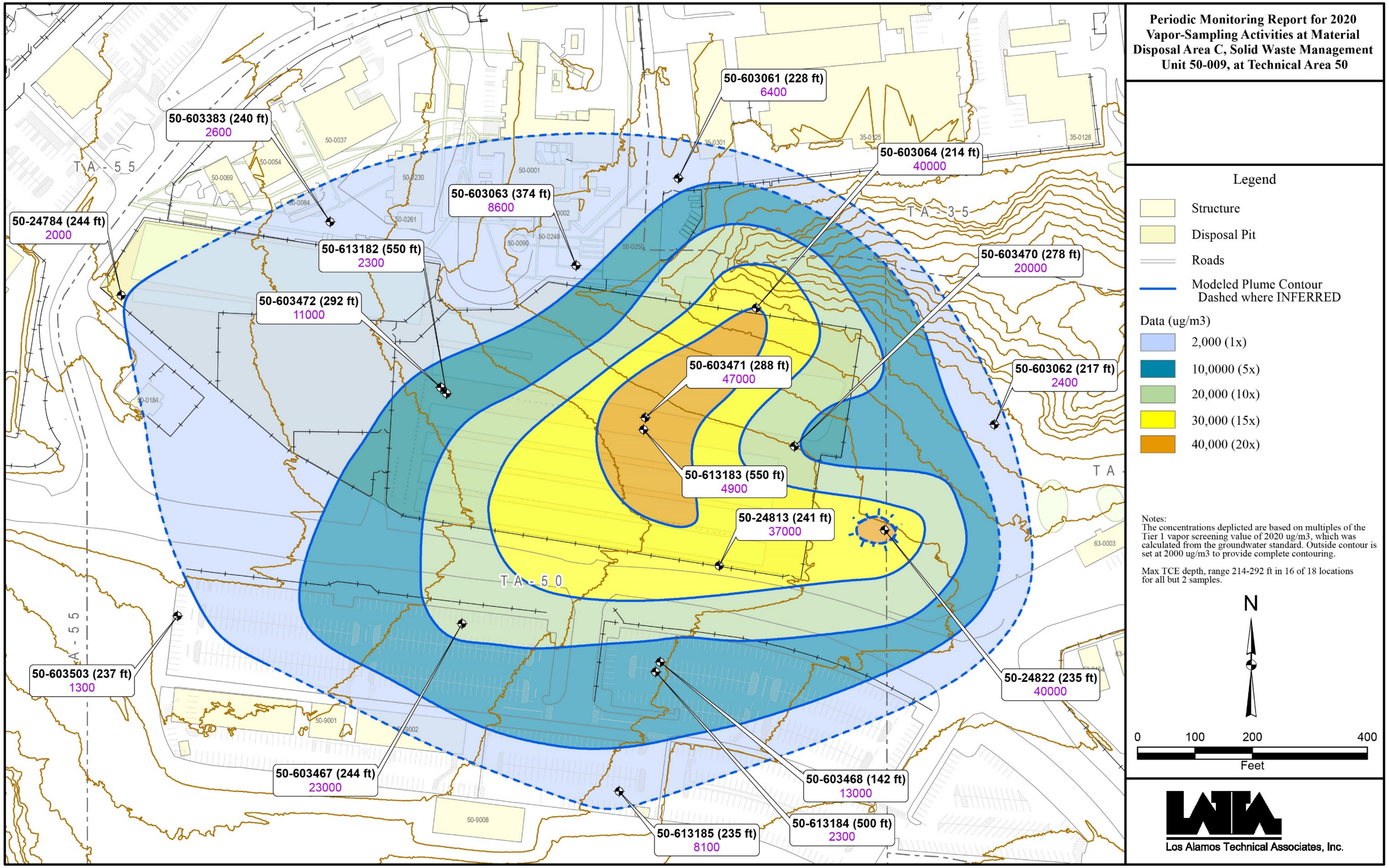
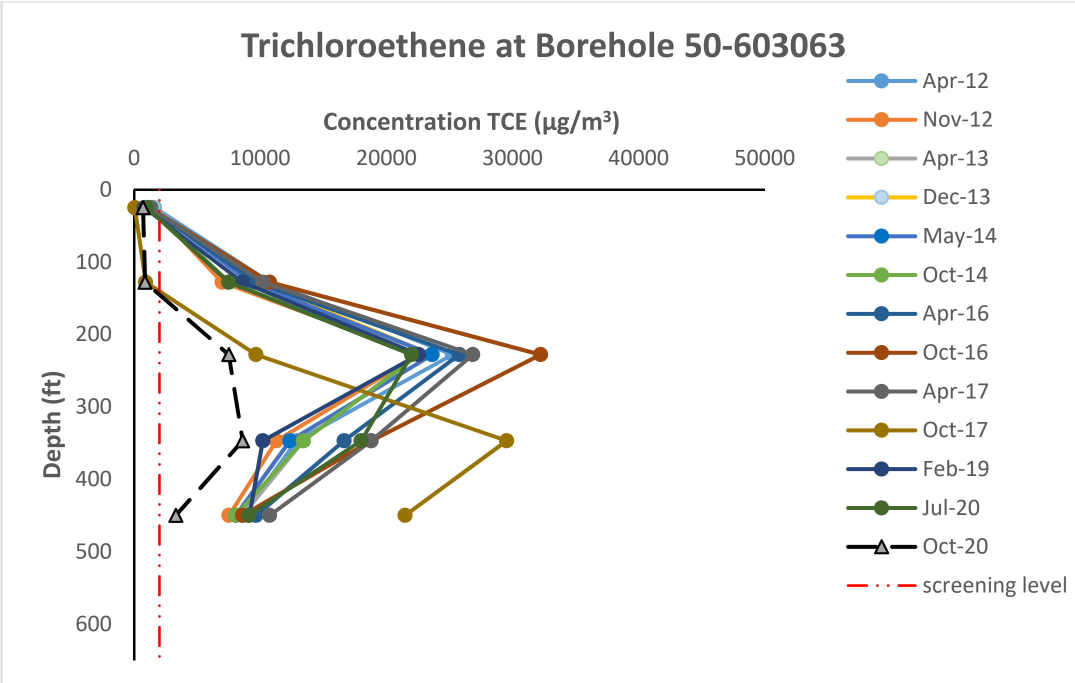
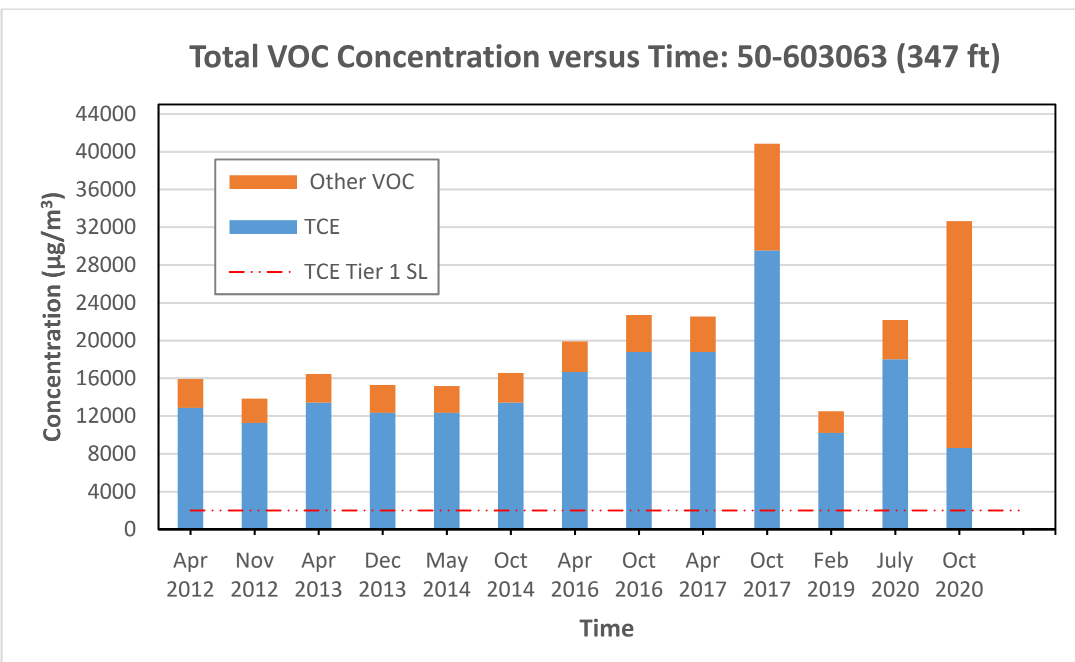


Figure D-2.0-24   MDA C map view with contours of TCE plume showing maximum concentrations in October 2020



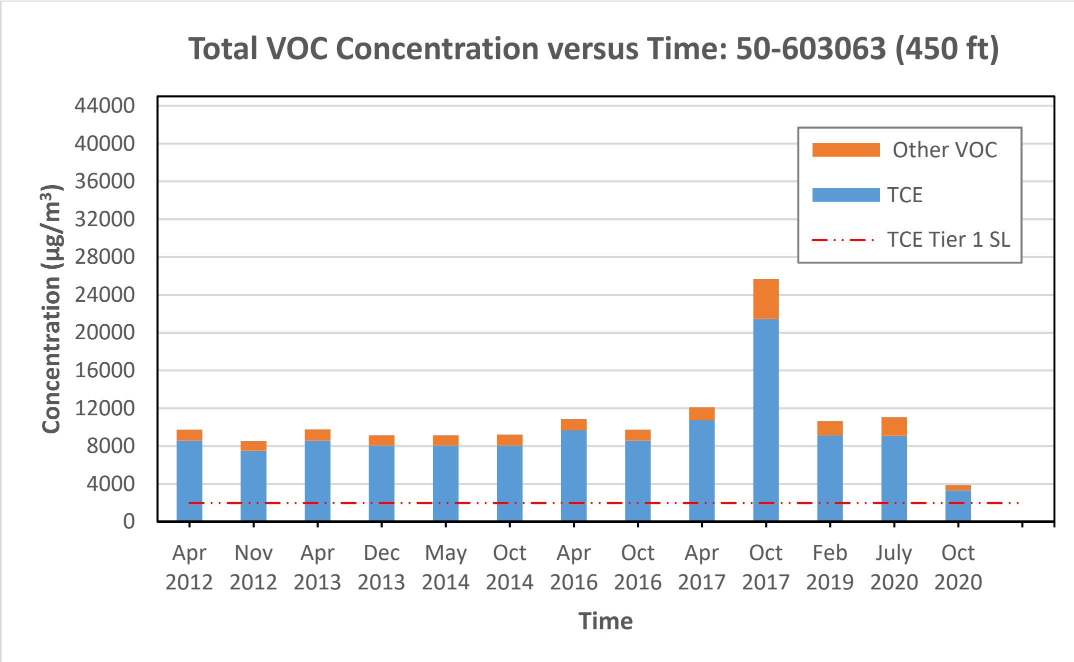
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-1 TCE concentration versus depth and time at borehole 50-603063



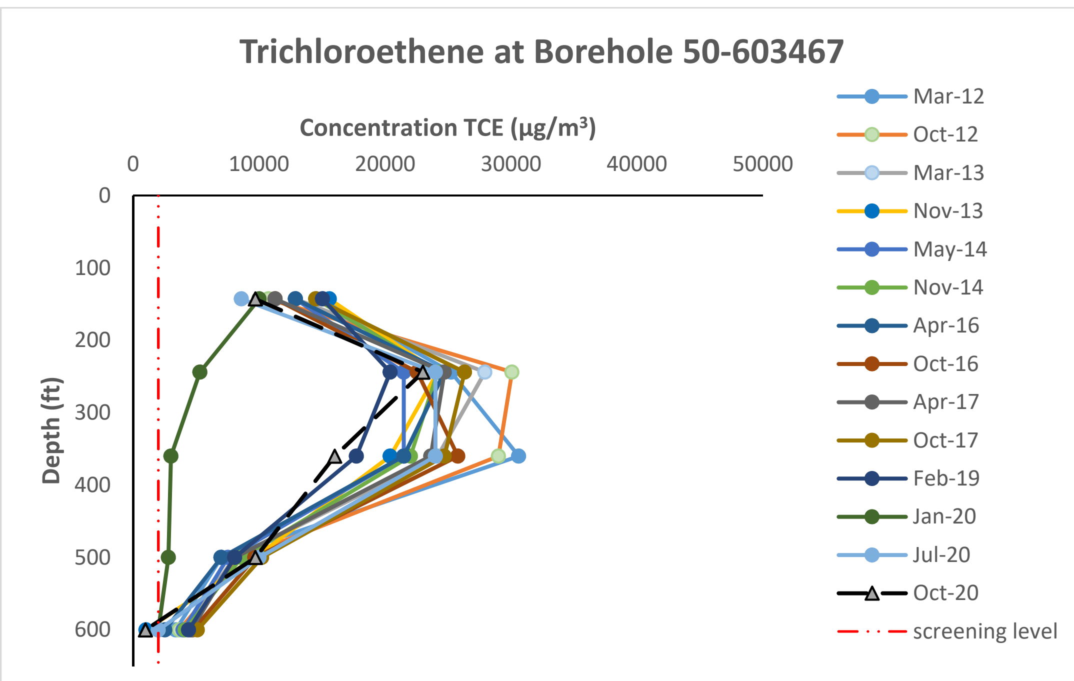
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-2 Total VOC concentration at 347 ft bgs at borehole 50-603063 over time



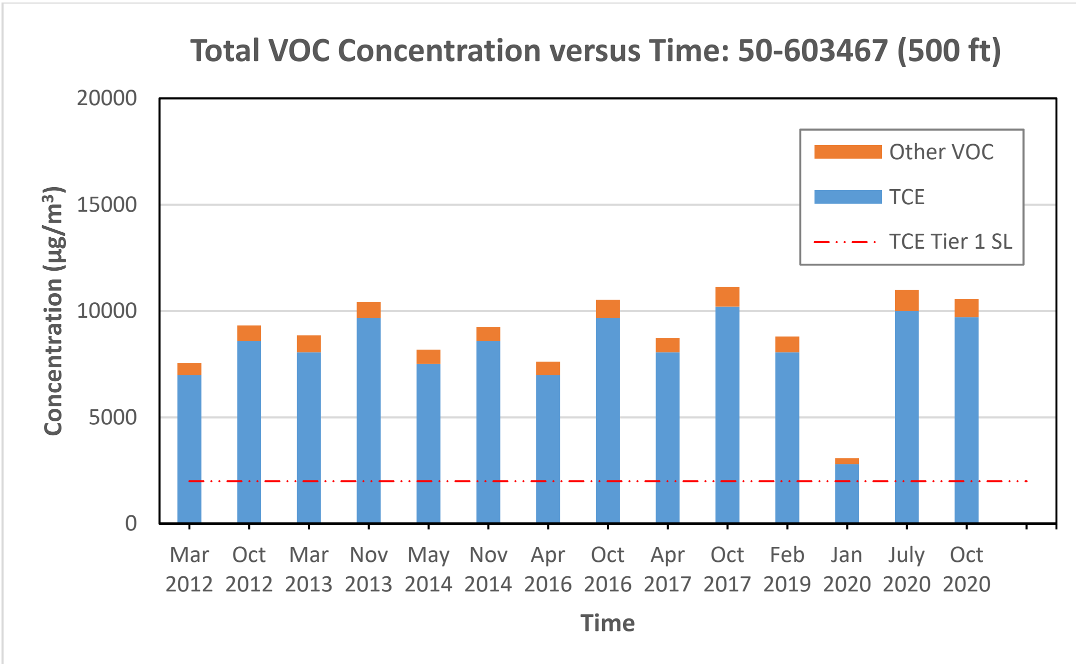
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-3.0-3 Total VOC concentration at 450 ft bgs at borehole 50-603063 over time



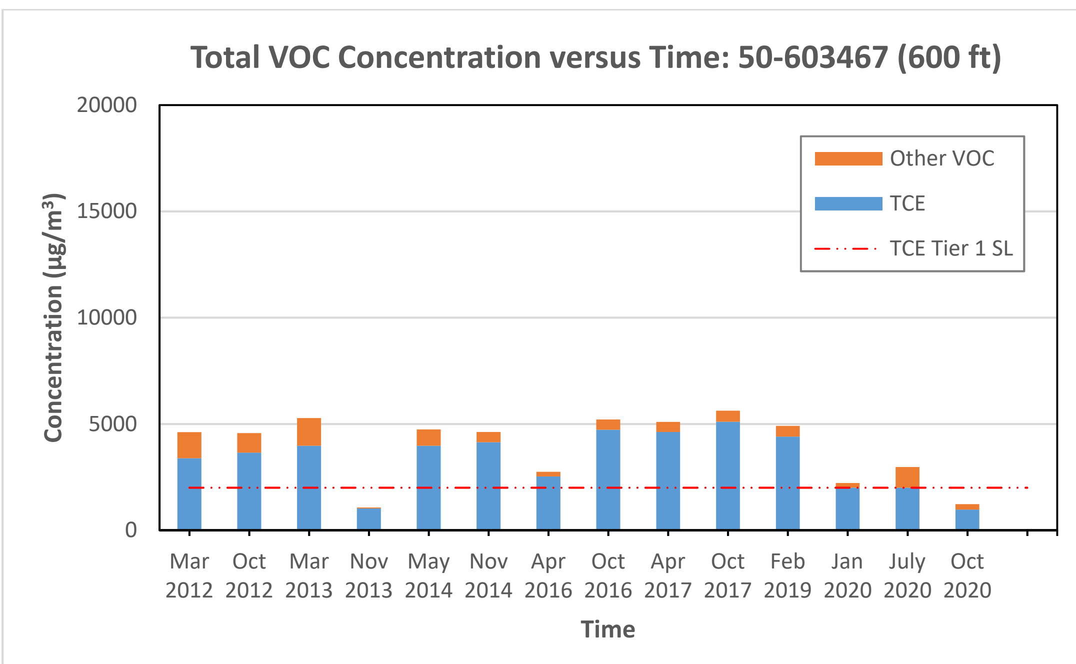
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-3.0-4 TCE concentration versus depth and time at borehole 50-603467



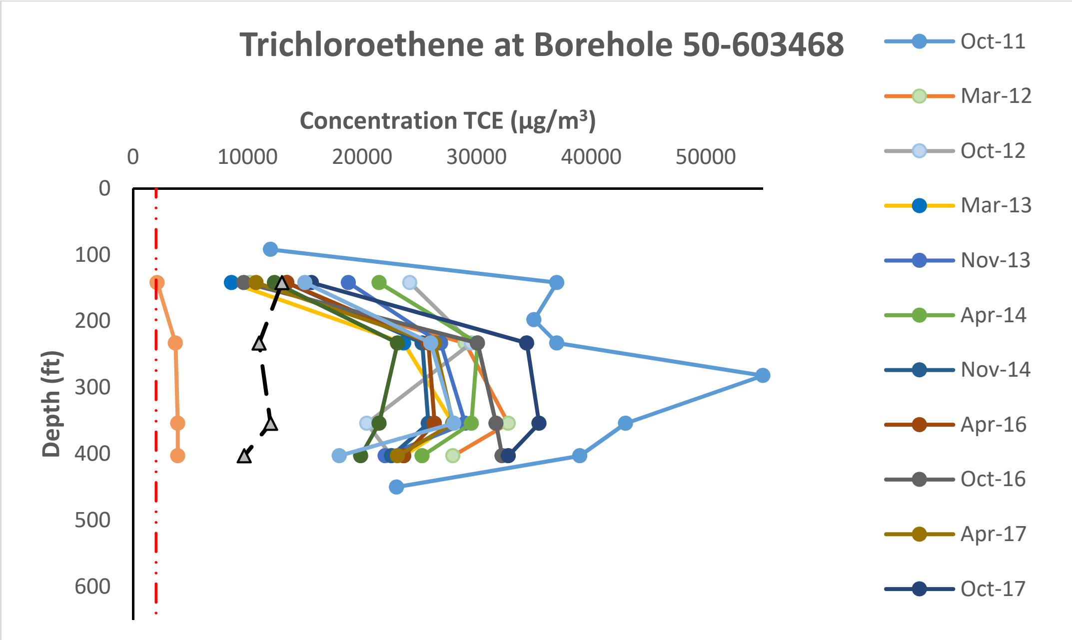
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-5 Total VOC concentration at 500 ft bgs at borehole 50-603467 over time



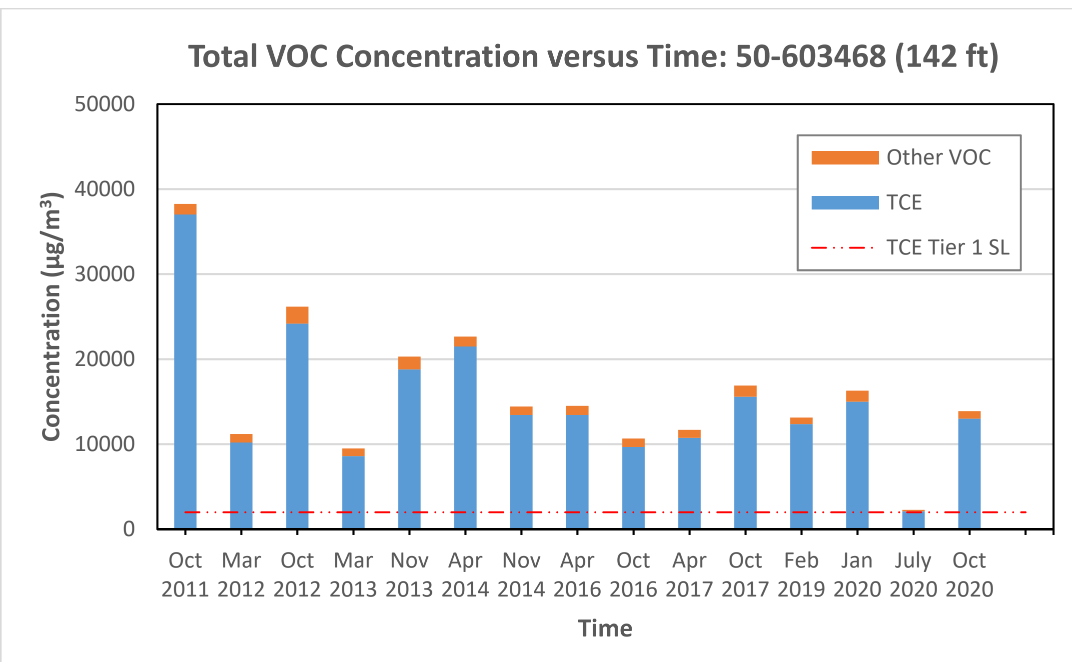
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-6 Total VOC concentration at 600 ft bgs at borehole 50-603467 over time



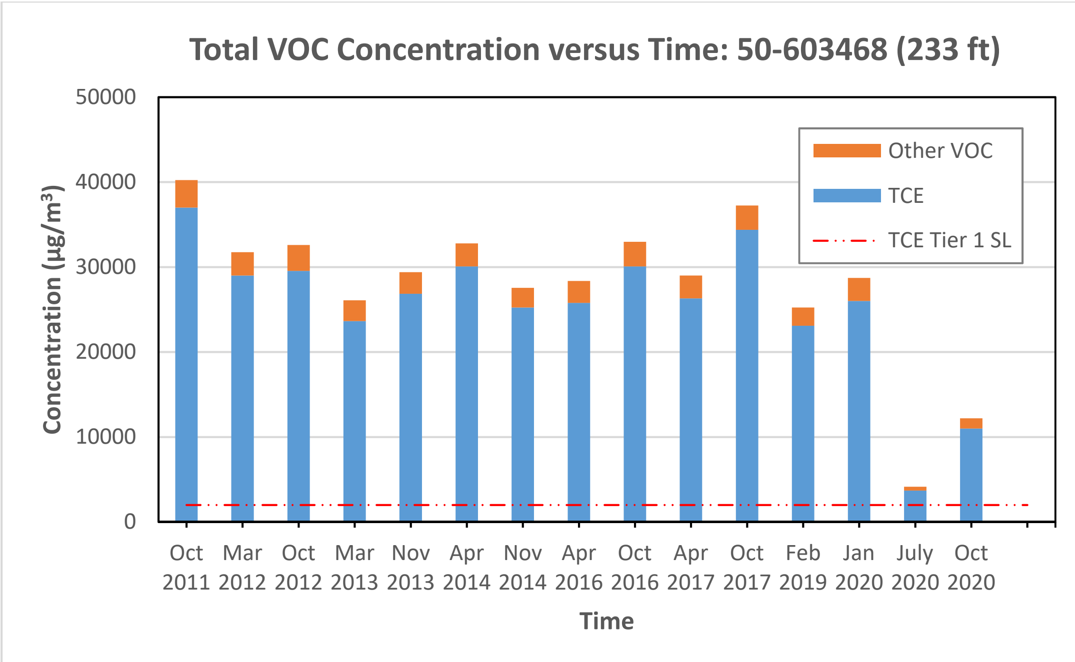
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-7 TCE concentration versus depth and time at borehole 50-603468



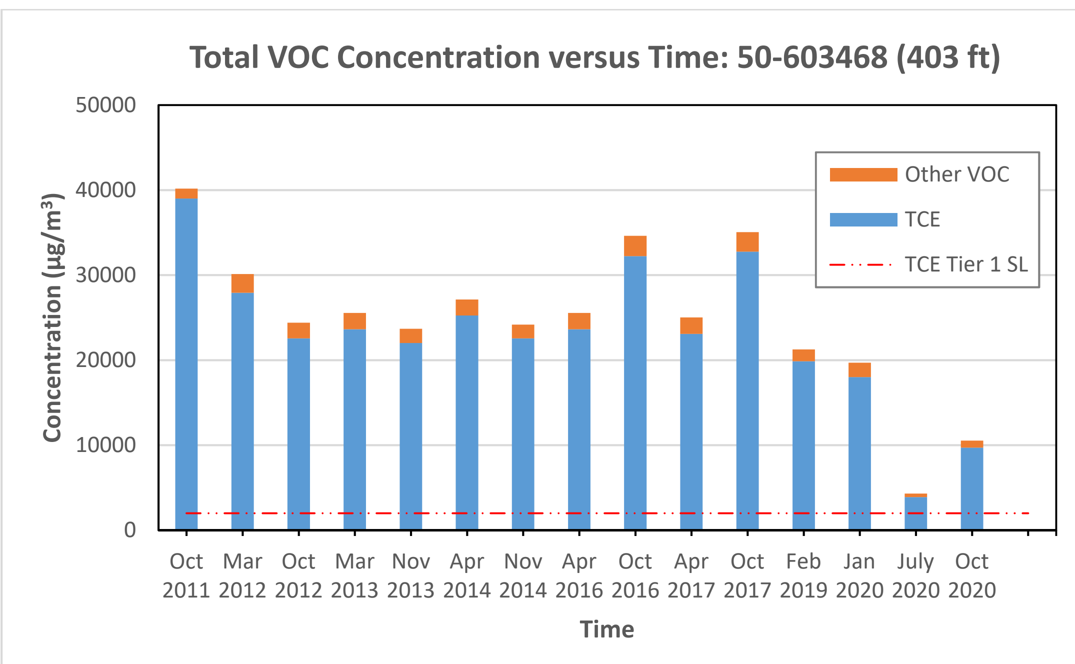
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-8 Total VOC concentration at 142 ft bgs at borehole 50-603468 over time



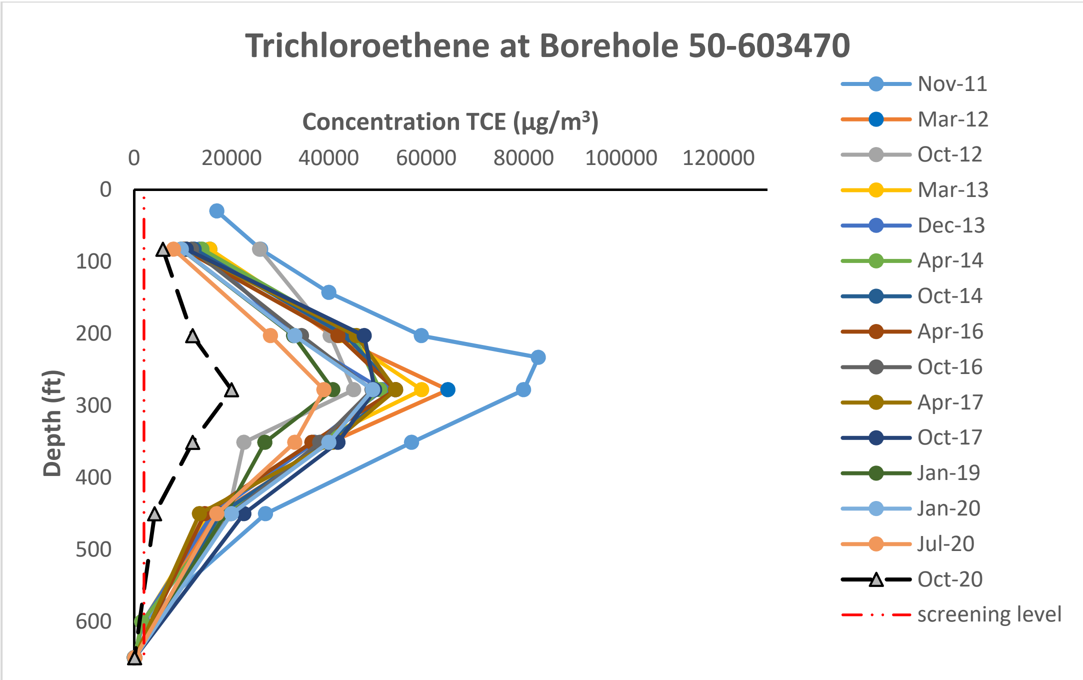
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-9 Total VOC concentration at 233 ft bgs at borehole 50-603468 over time



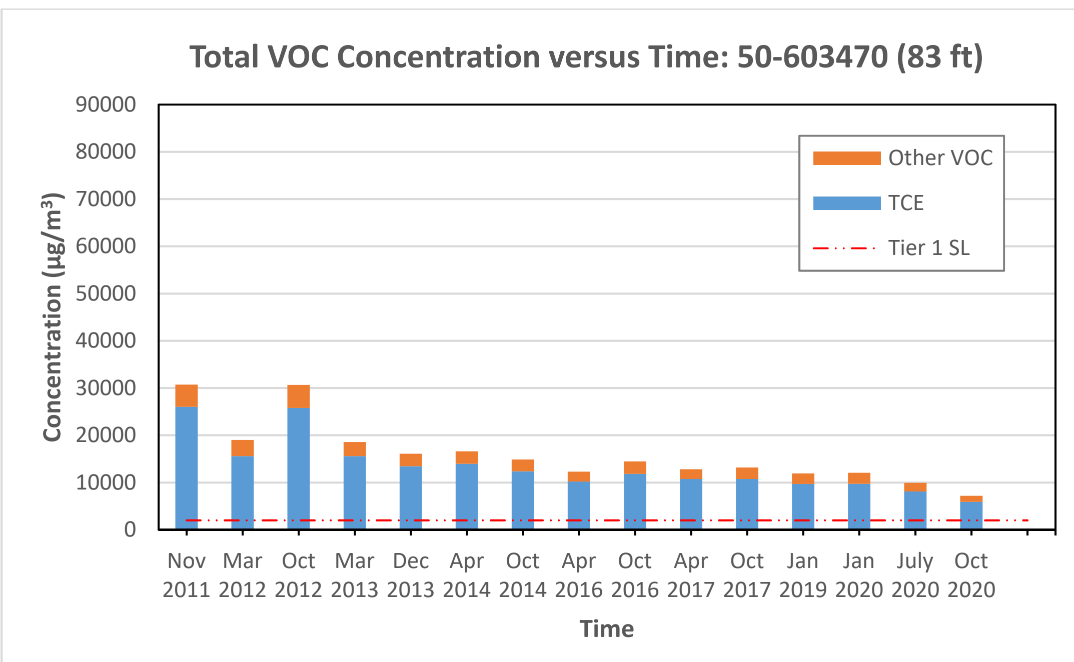
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-10 Total VOC concentration at 403 ft bgs at borehole 50-603468 over time



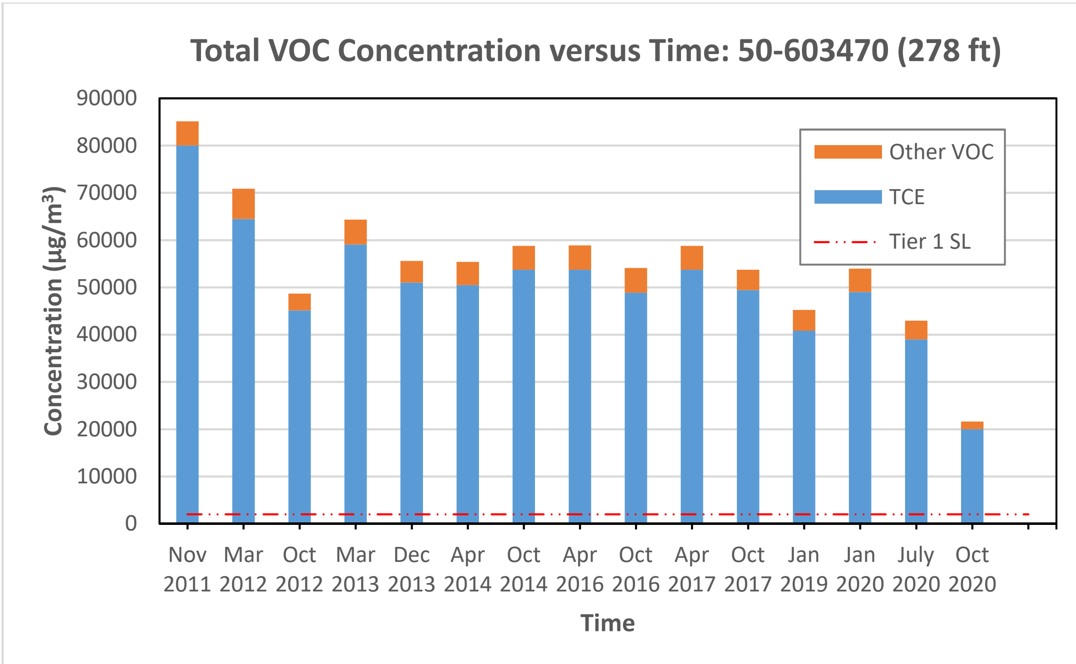
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-11 TCE concentration versus depth and time at borehole 50-603470



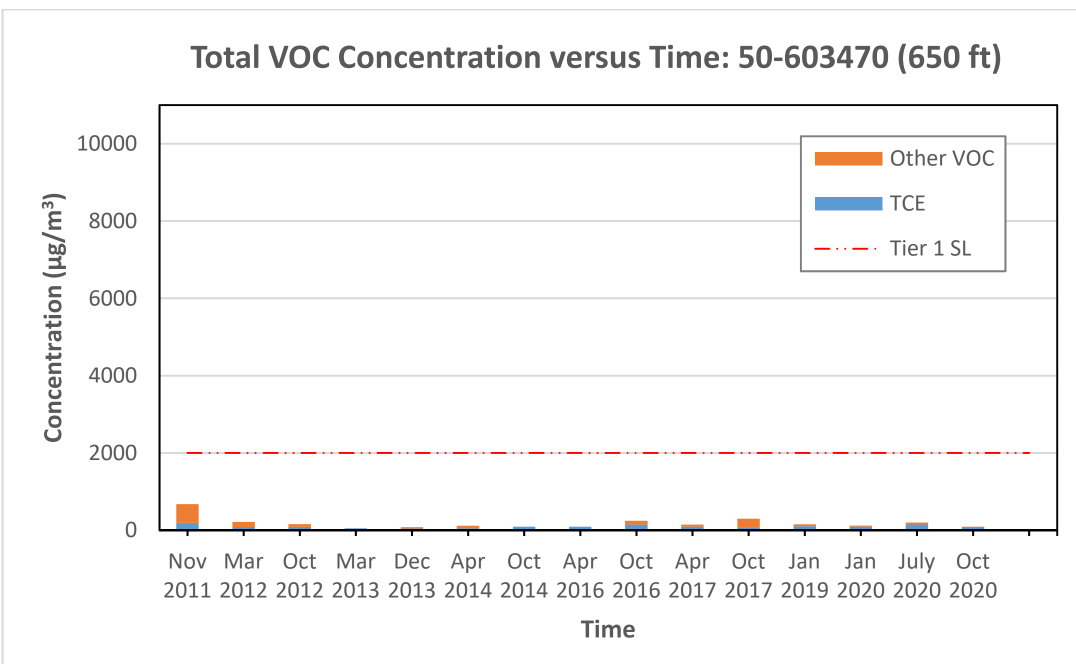
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-12 Total VOC concentration at 83 ft bgs at borehole 50-603470 over time



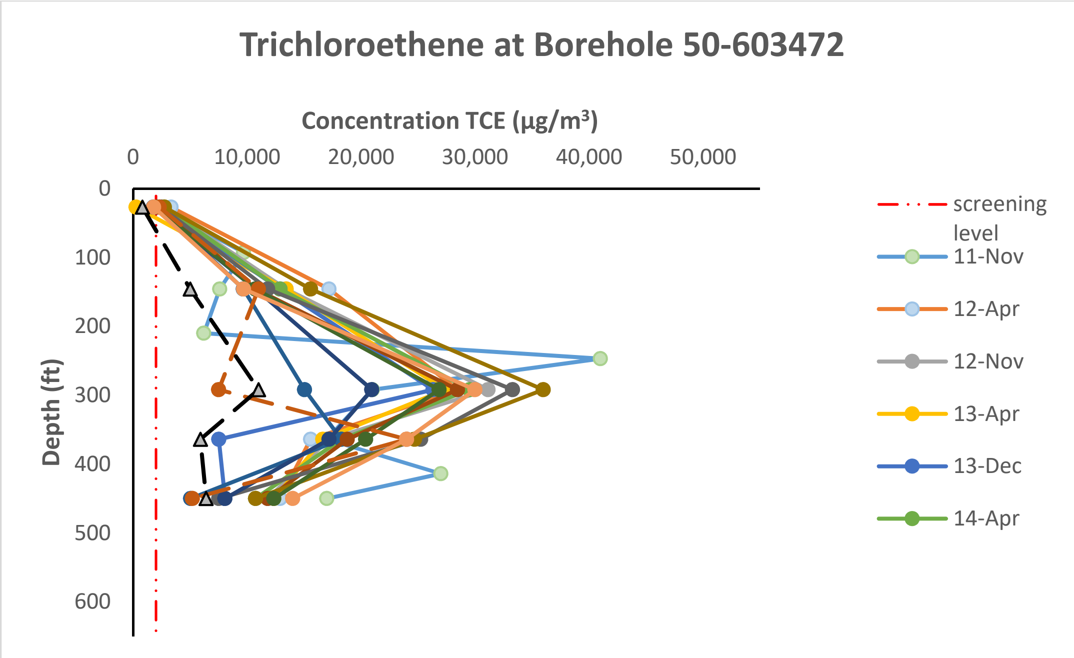
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-3.0-13 Total VOC concentration at 278 ft bgs at borehole 50-603470 over time



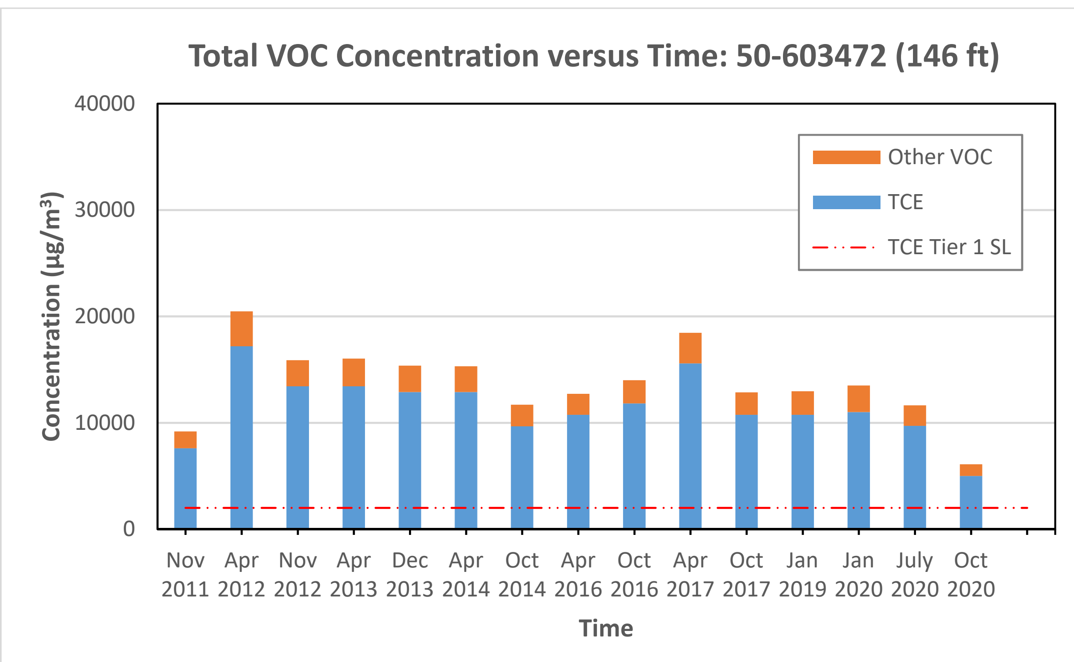
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-3.0-14 Total VOC concentration at 650 ft bgs at borehole 50-603470 over time



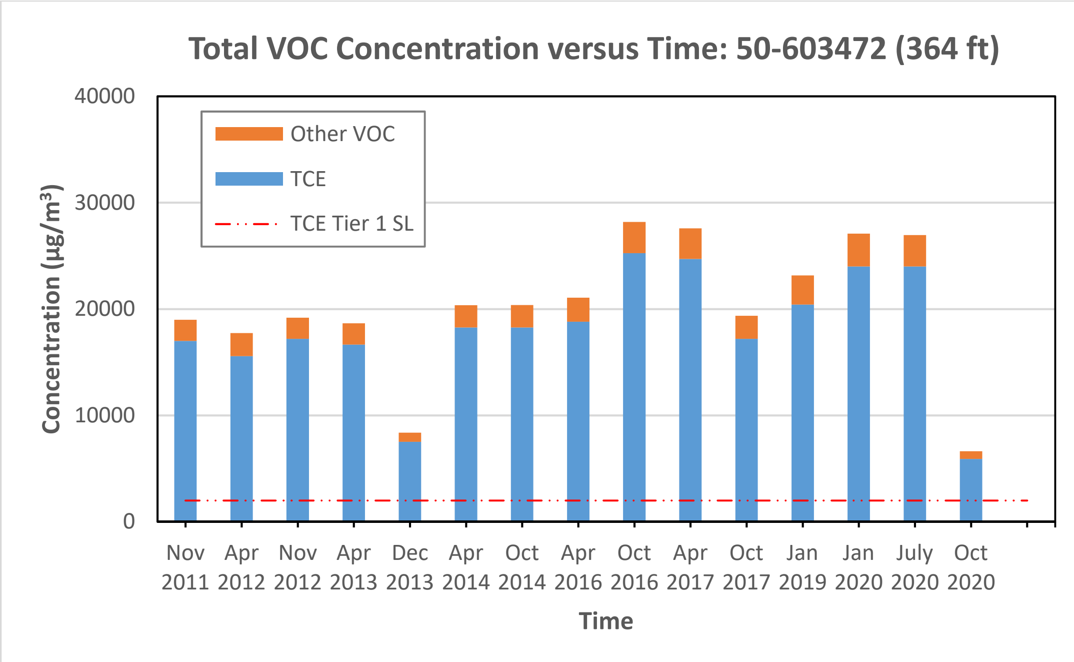
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-15 TCE concentration versus depth and time at borehole 50-603472



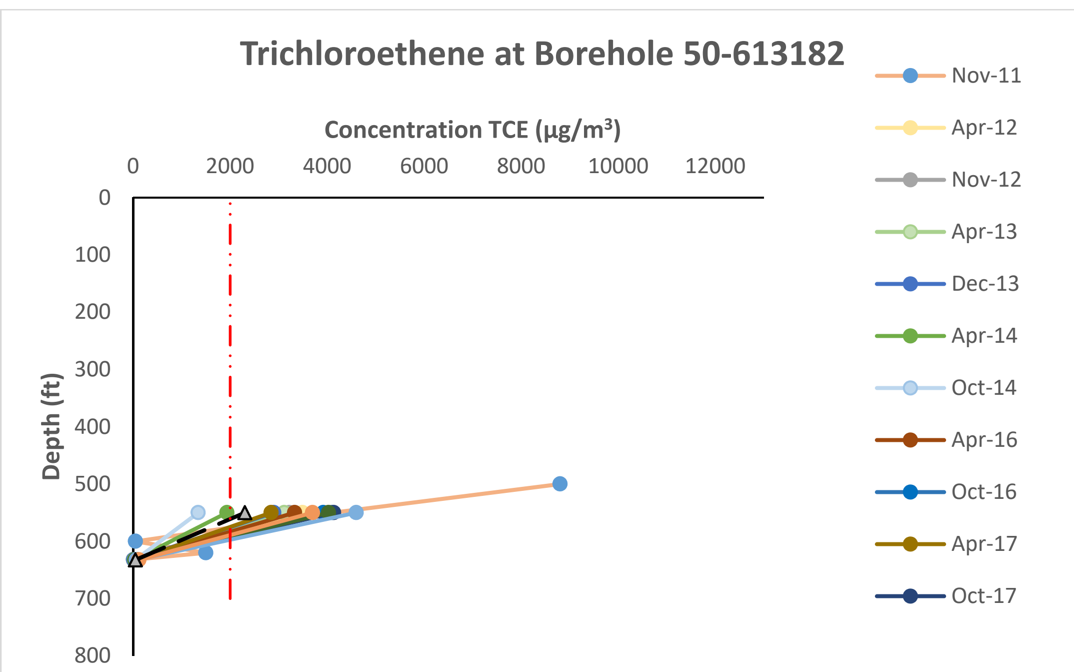
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-16 Total VOC concentration at 146 ft bgs at borehole 50-603472 over time



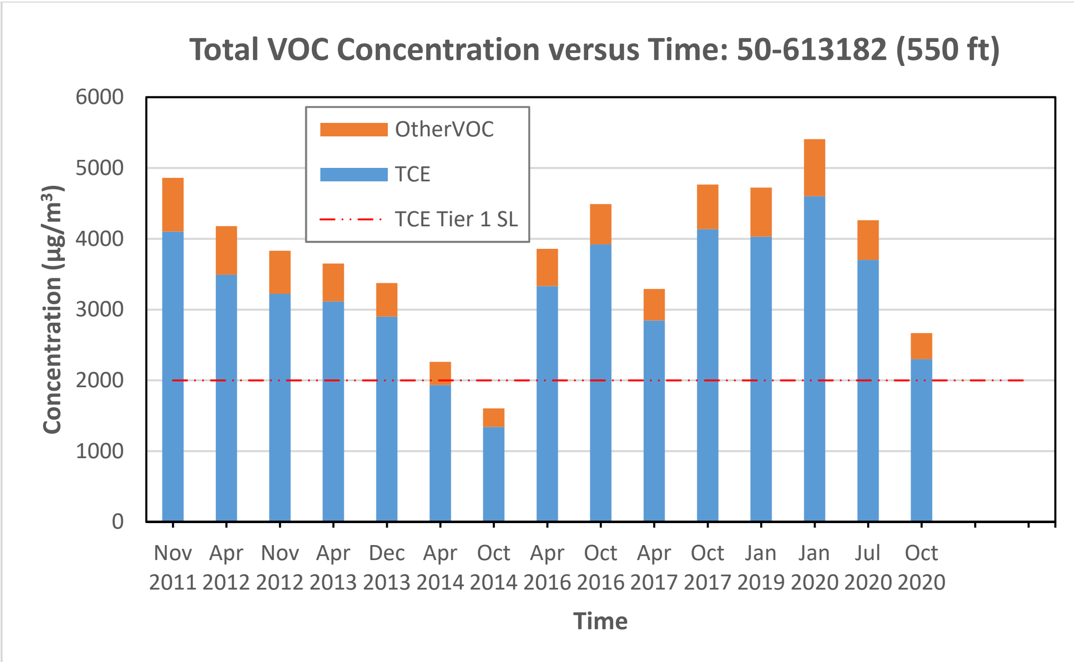
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-3.0-17 Total VOC concentration at 364 ft bgs at borehole 50-603472 over time



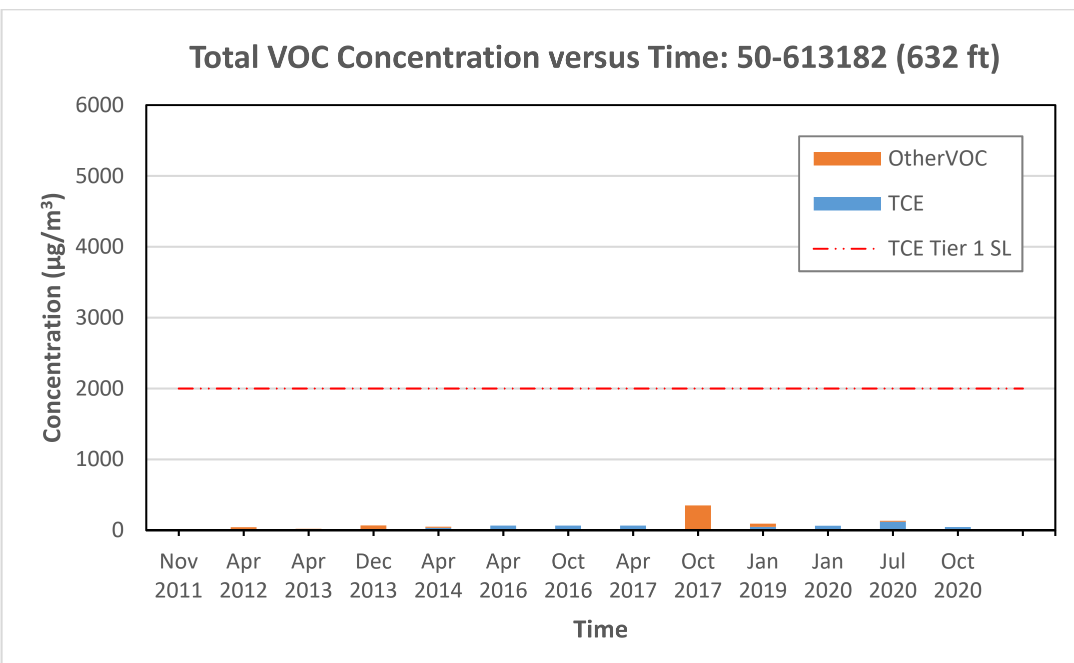
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-3.0-18 TCE concentration versus depth and time at borehole 50-613182



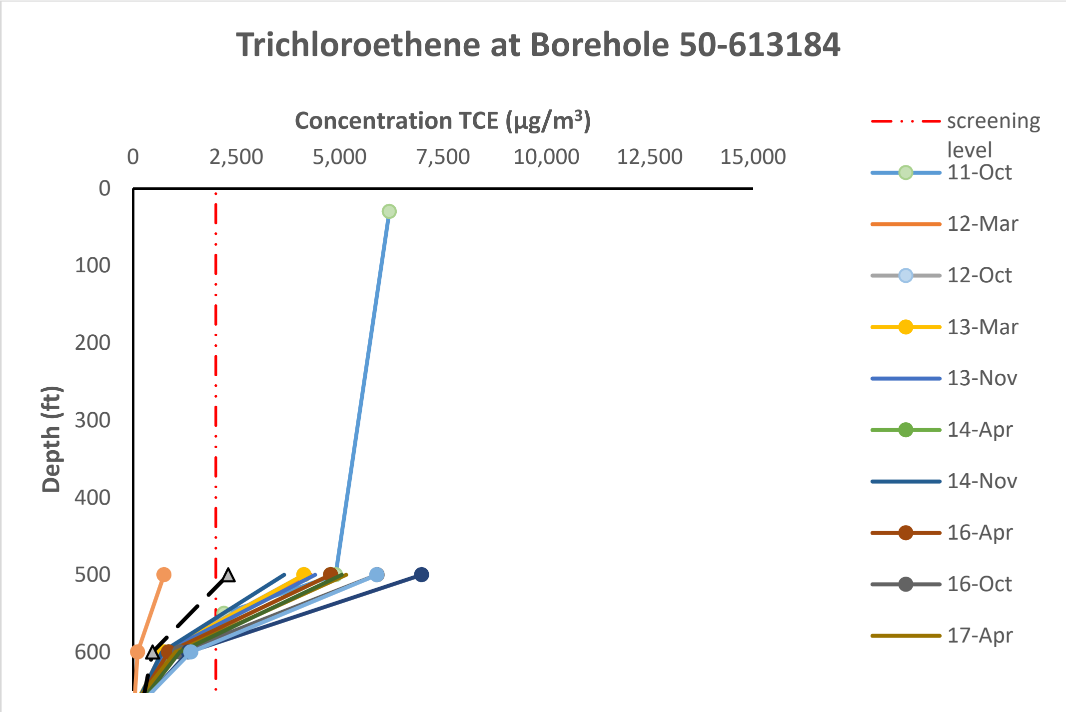
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-19 Total VOC concentration at 550 ft bgs at borehole 50-613182 over time



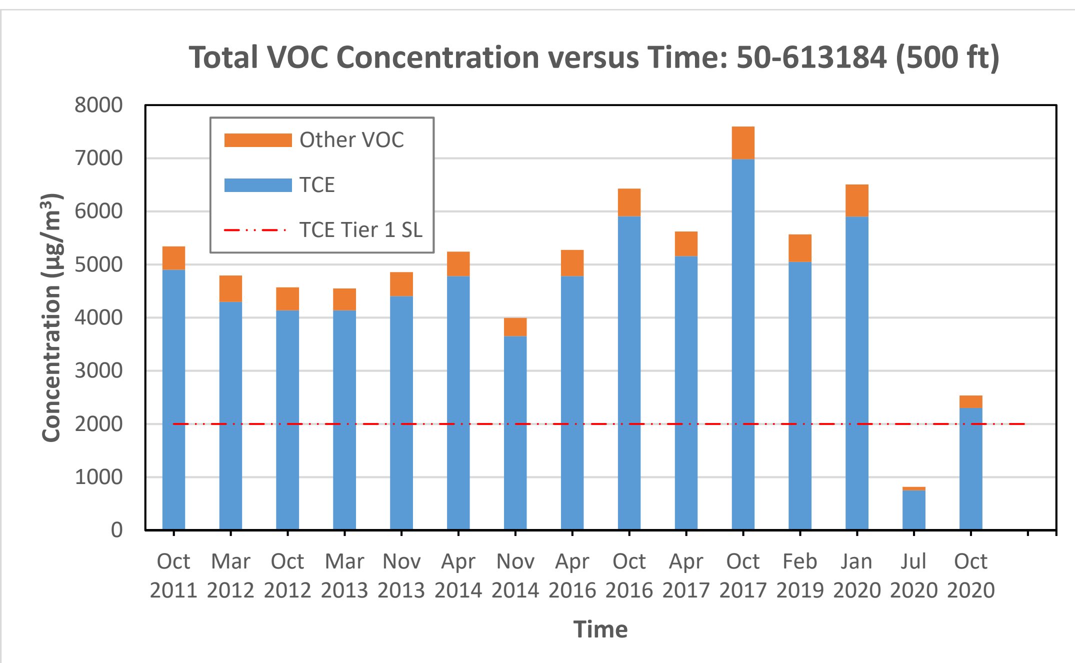
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-20 Total VOC concentration at 632 ft bgs at borehole 50-613182 over time



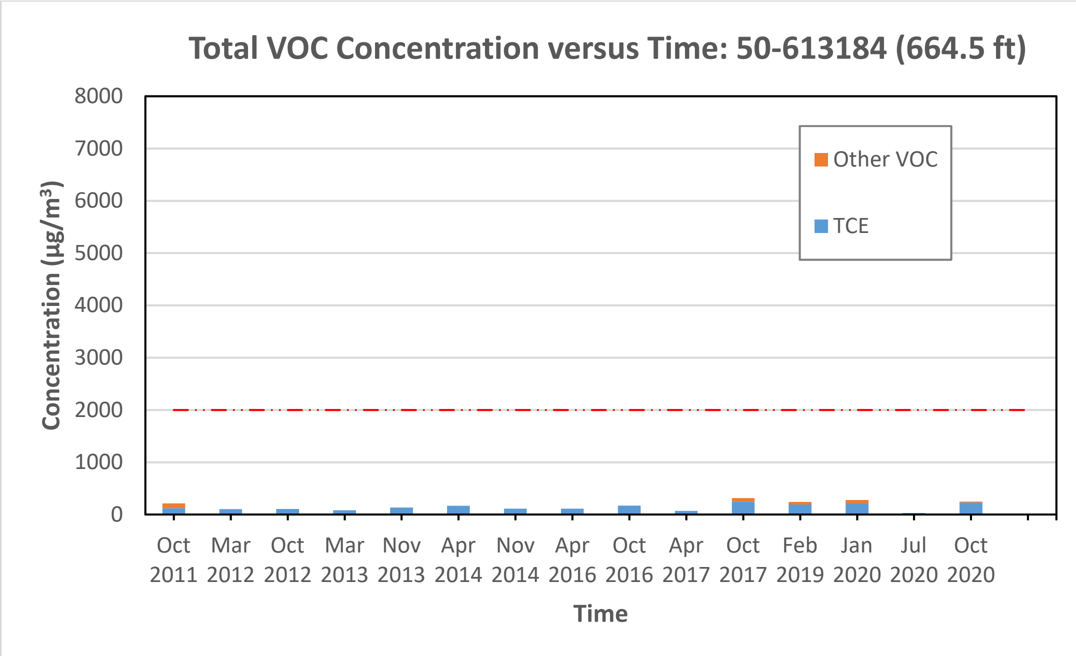
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-21 TCE concentration versus depth and time at borehole 50-613184



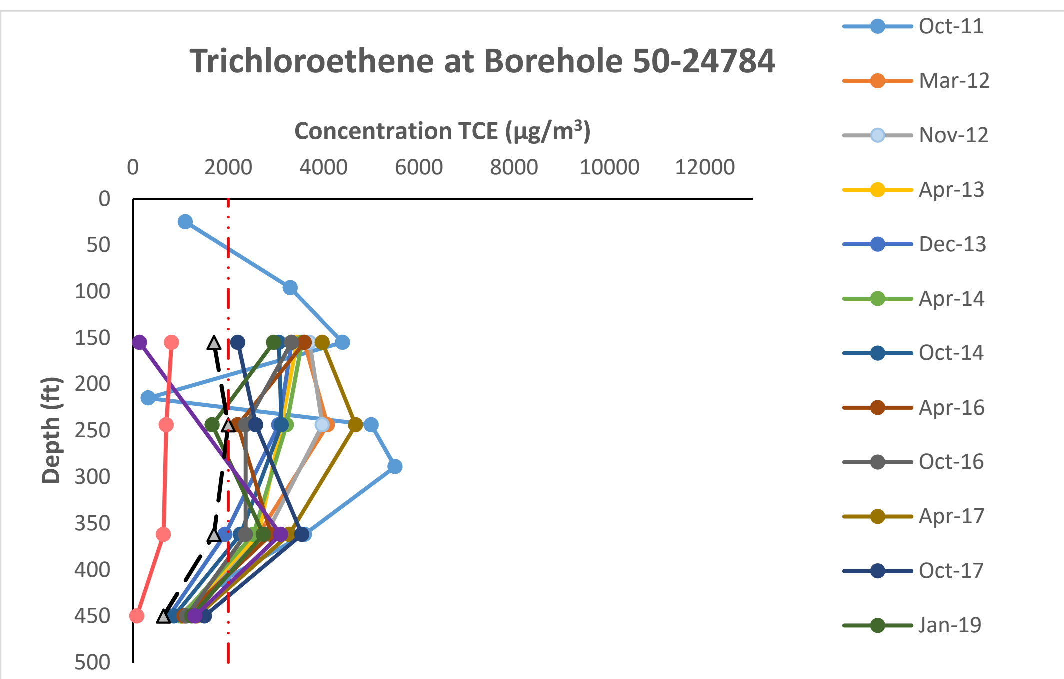
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-22 Total VOC concentration at 500 ft bgs at borehole 50-613184 over time



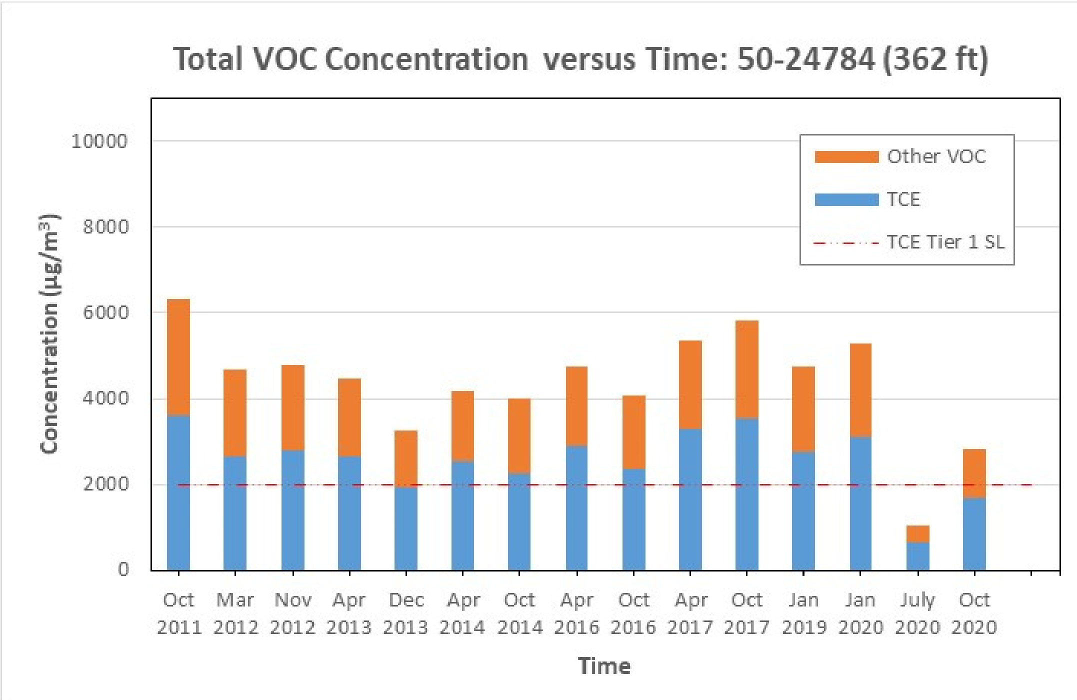
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-3.0-23 Total VOC concentration at 664.5 ft bgs at borehole 50-613184 over time



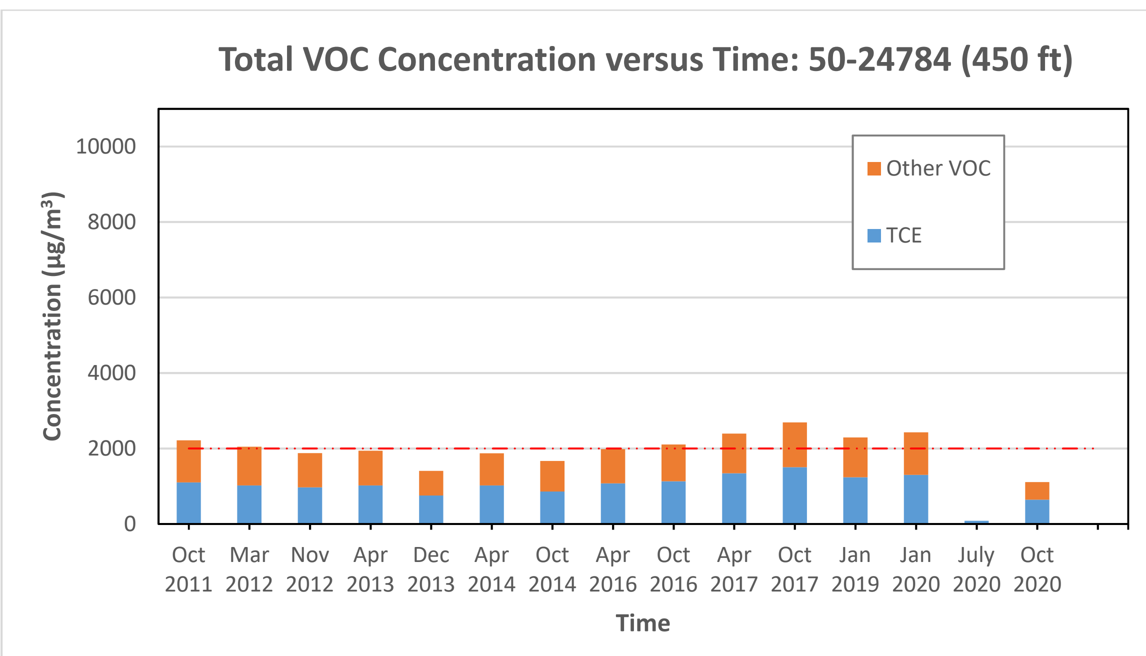
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-4.0-1 TCE concentration versus depth and time at borehole 50-24784



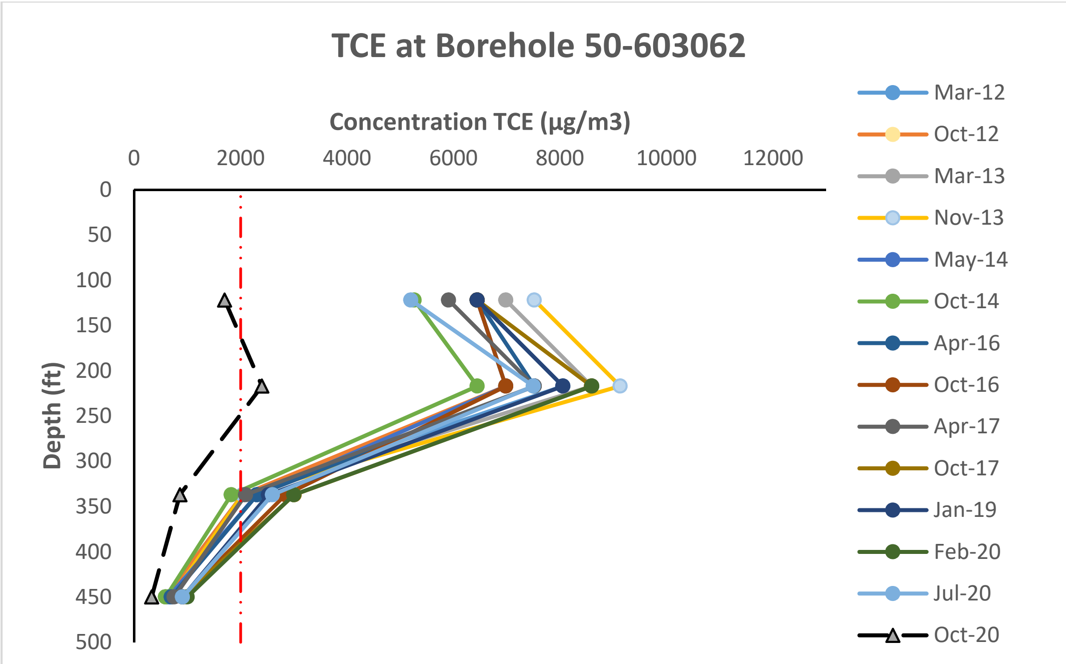
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-4.0-2 Total VOC concentration at 362 ft bgs at borehole 50-24784 over time



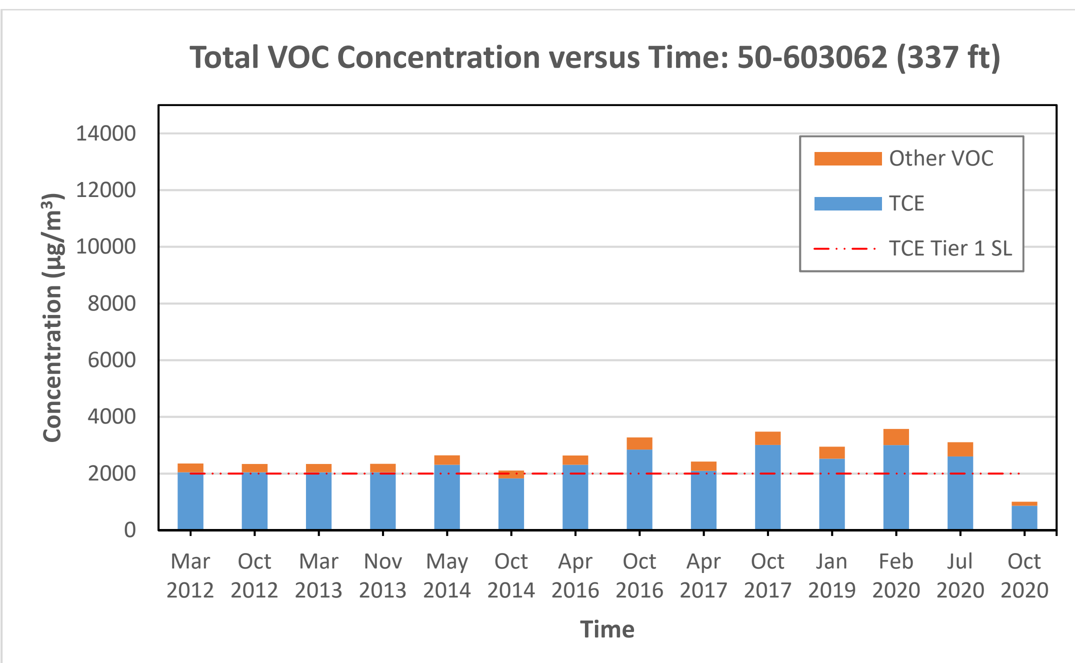
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-4.0-3 Total VOC concentration at 450 ft bgs at borehole 50-24784 over time



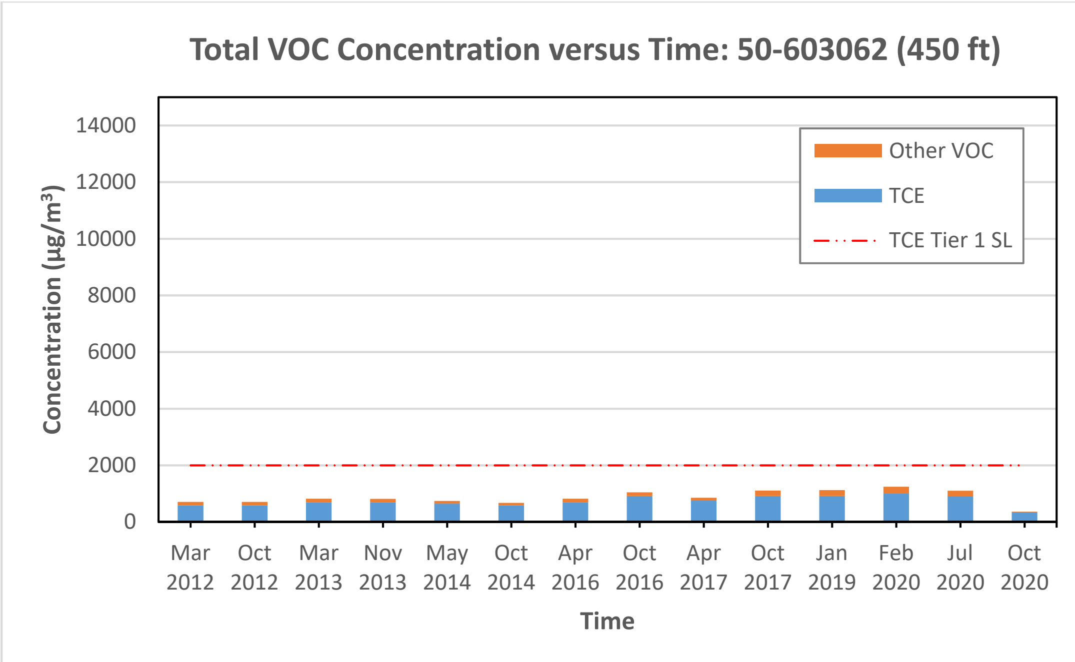
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-4.0-4 TCE concentration versus depth and time at borehole 50-603062



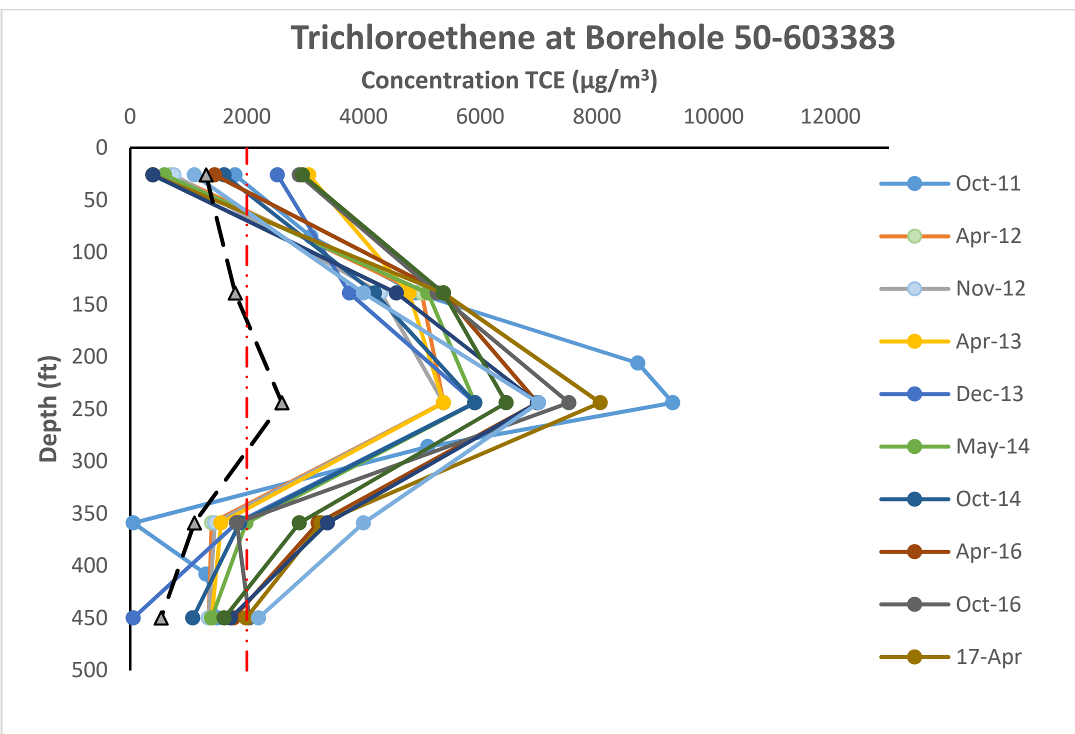
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1 screening level.

Figure D-4.0-5 Total VOC concentration at 337 ft bgs at borehole 50-603062 over time



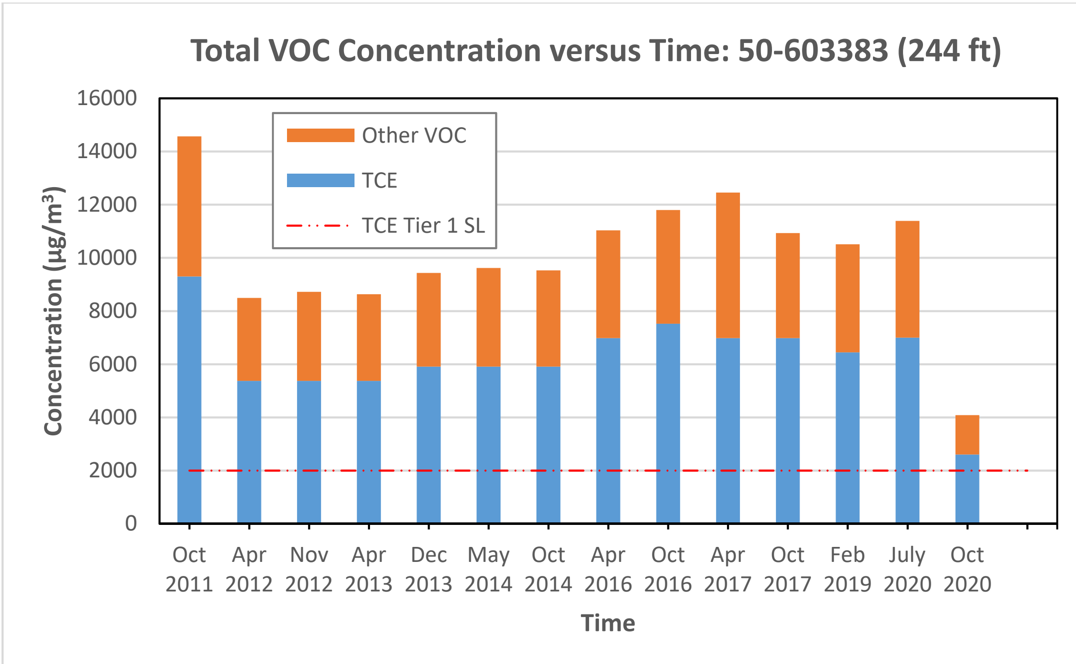
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-4.0-6 Total VOC concentration at 450 ft bgs at borehole 50-603062 over time



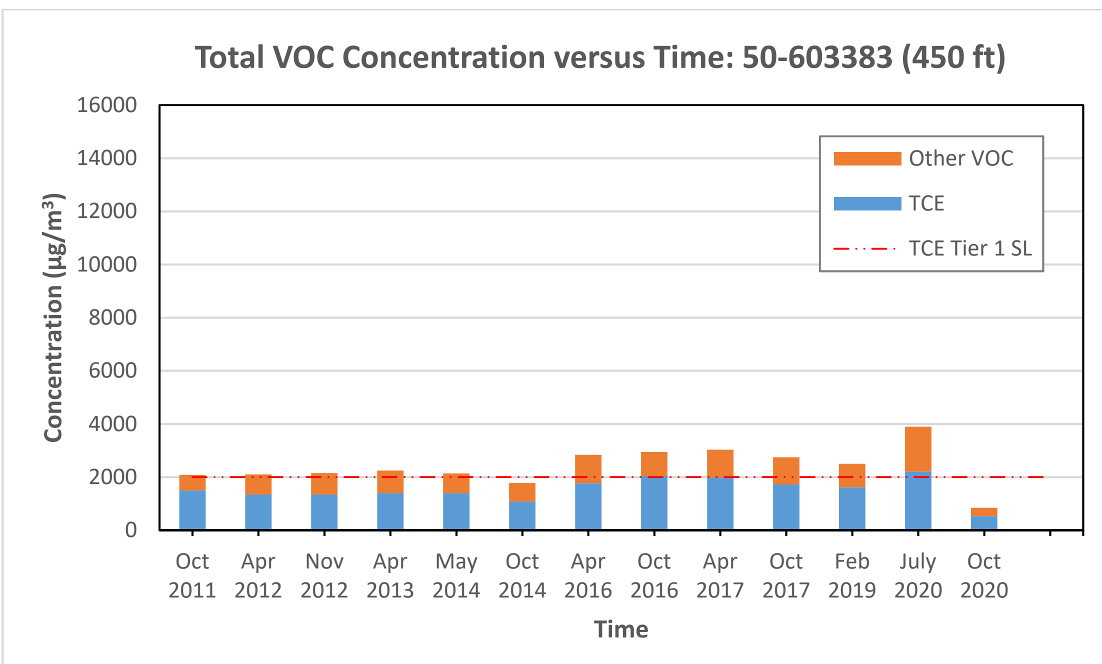
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-4.0-7 TCE concentration versus depth and time at borehole 50-603383



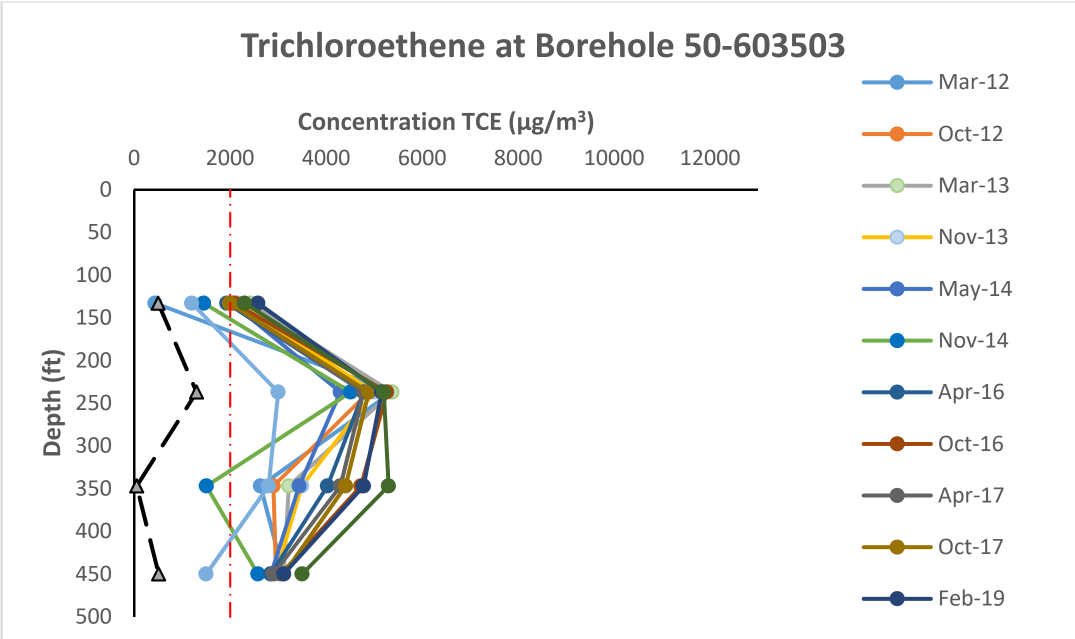
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1I screening level.

Figure D-4.0-8 Total VOC concentration at 244 ft bgs at borehole 50-603383 over time



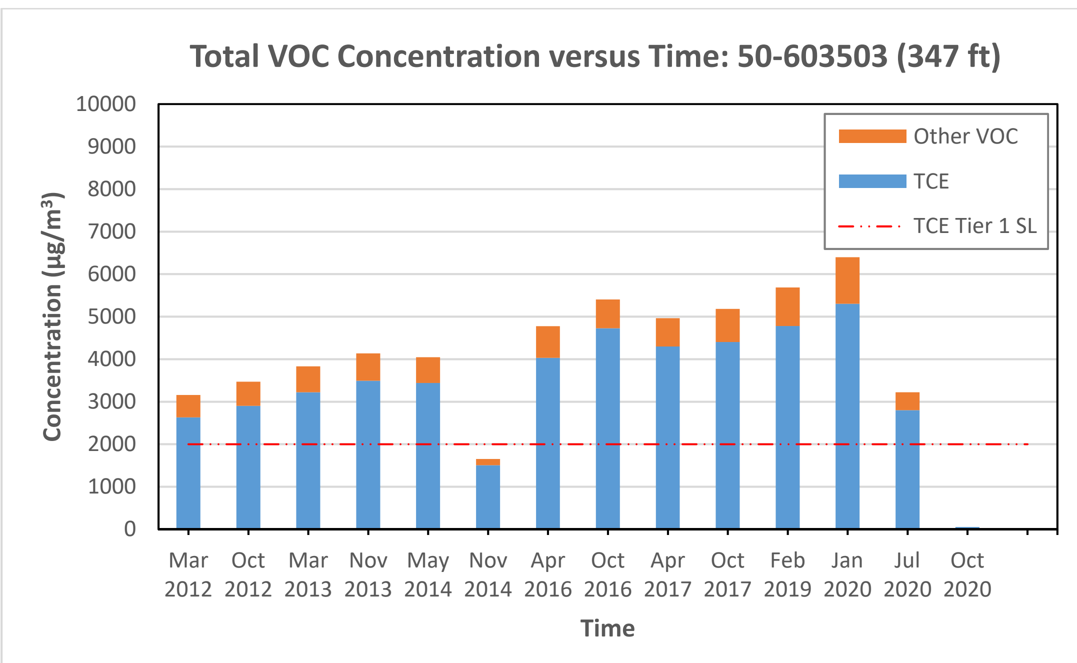
Note: Red dashed line is the 2,020-µg/m^3 TCE Tier 1I screening level.

Figure D-4.0-9 Total VOC concentration at 450 ft bgs at borehole 50-603383 over time



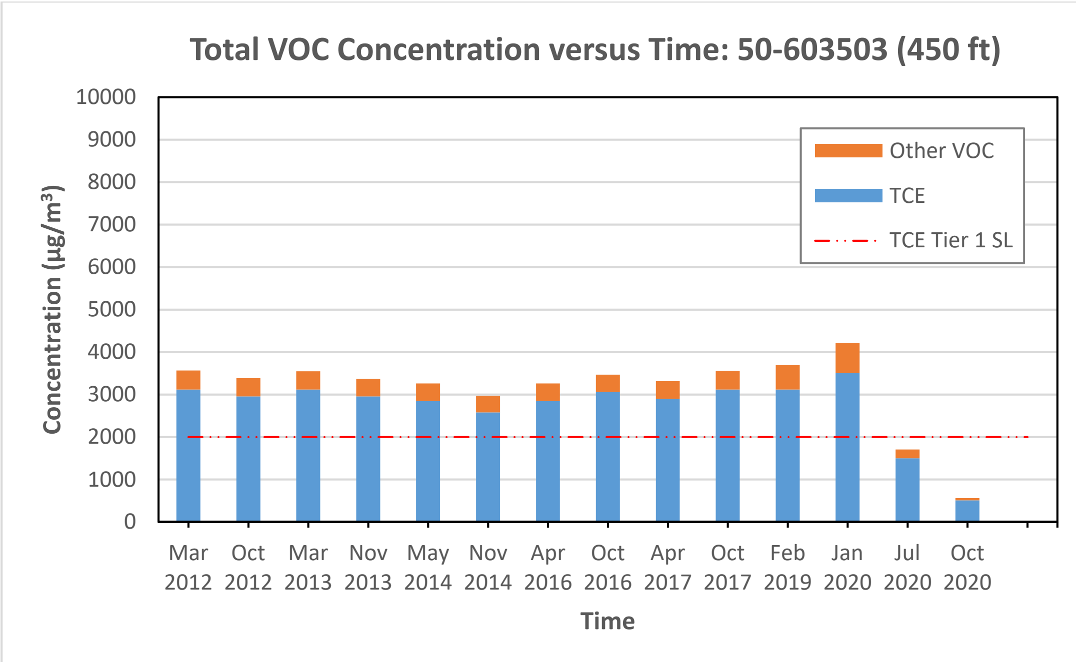
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-4.0-10 TCE concentration versus depth and time at borehole 50-603503



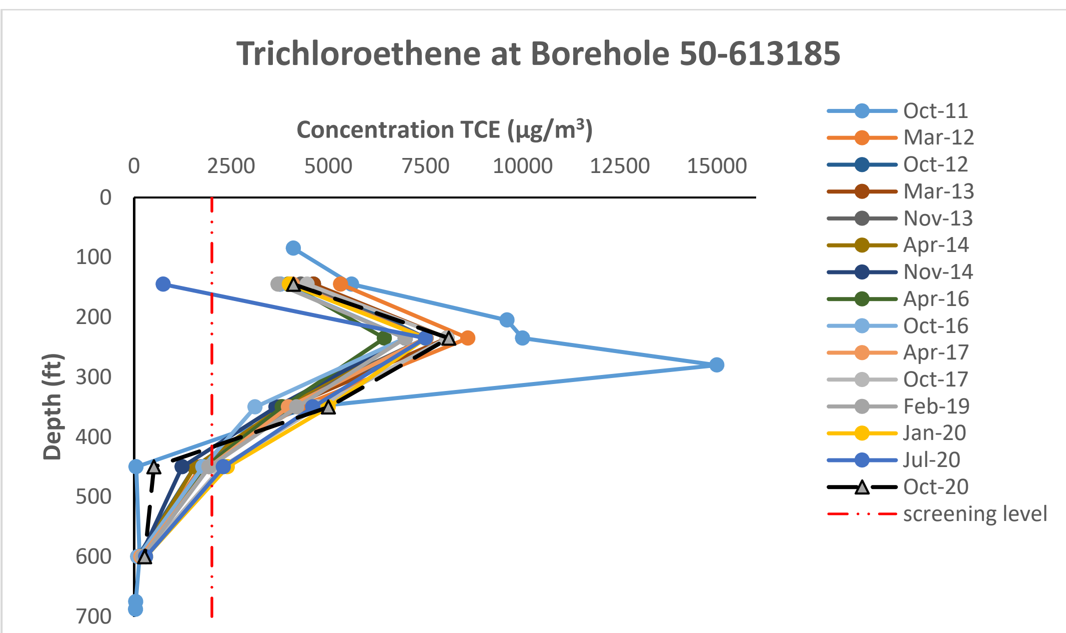
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-4.0-11 Total VOC concentration at 347 ft bgs at borehole 50-603503 over time



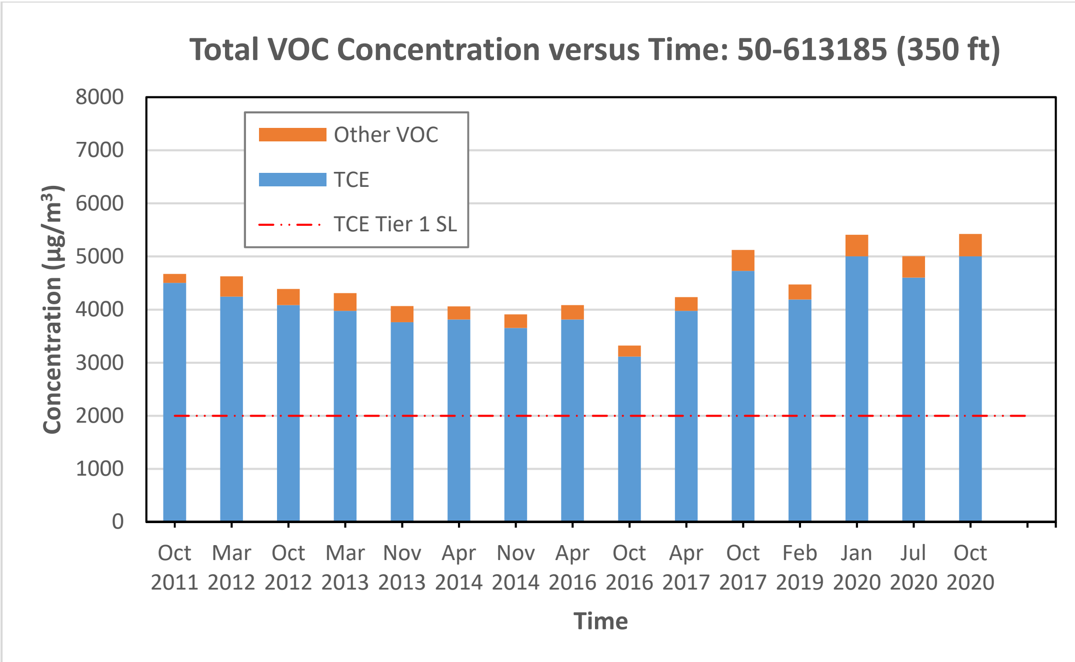
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-4.0-12 Total VOC concentration at 450 ft bgs at borehole 50-603503 over time



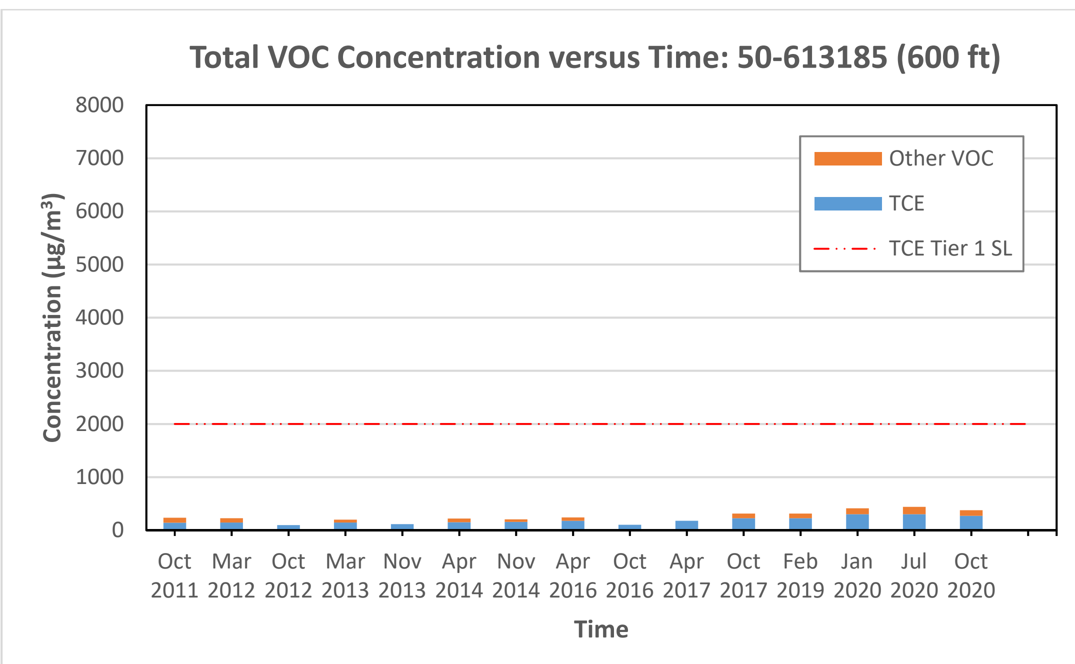
Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-4.0-13 TCE concentration versus depth and time at borehole 50-613185



Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-4.0-14 Total VOC concentration at 350 ft bgs at borehole 50-613185 over time



Note: Red dashed line is the 2,020-µg/m³ TCE Tier 1 screening level.

Figure D-4.0-15 Total VOC concentration at 600 ft bgs at borehole 50-613185 over time

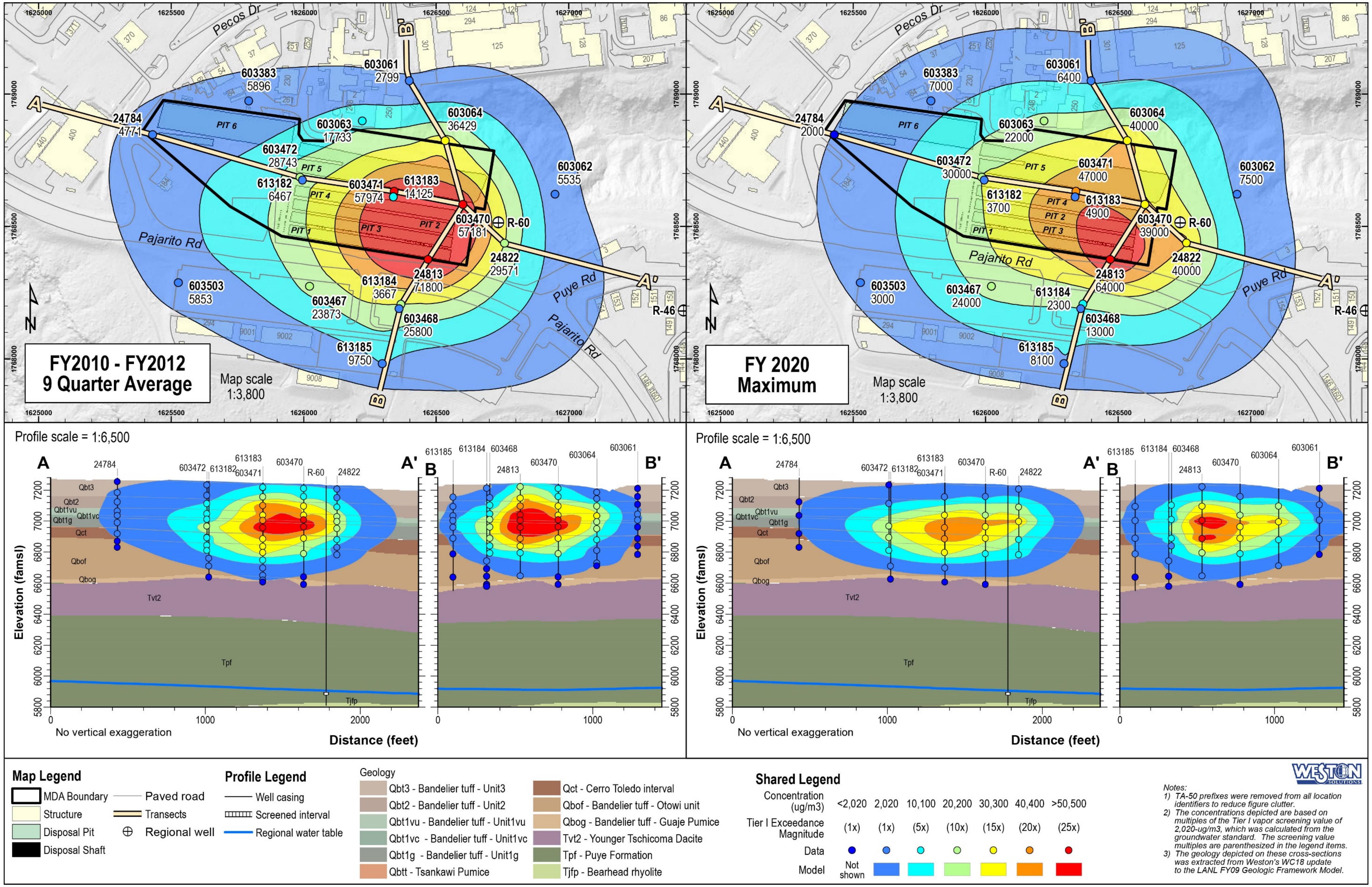


Figure D-5.0-1 Lateral and vertical extent of the MDA C TCE plume, baseline (2010–2012 average) versus 2020 maximum measured concentration at each sample port

Table D-1.0-1
Boreholes at MDA C

Sentry Borehole	Deepest port (ft)	Plume Core/ Intermediate/Periphery
50-24784	450	Edge
50-24813	600	Core
50-24822	450	Core
50-603061	450	Core
50-603062	450	Edge
50-603063	450	Intermediate
50-603064	500	Core
50-603383	450	Edge
50-603467	600	Intermediate
50-603468/50-613184	664.5	Intermediate
50-603470	650	Intermediate
50-603471/50-613183	642.5	Core
50-603472/50-613182	632.5	Intermediate
50-603503	450	Edge
50-613185	600	Edge

Appendix E

Analytical Suites and Results, Field Forms, and
Analytical Reports (on DVD included with this document)