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Phase III Investigation Report for Material Disposal Area T at Technical Area 21

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EXECUTIVE SUMMARY

This Phase III investigation report presents the initial results from the 2009 to 2010 environmental investigation of Consolidated Unit 21-016(a)-99, also known as Material Disposal Area (MDA) T, within Technical Area 21 at Los Alamos National Laboratory. This investigation is being conducted to further evaluate potential subsurface vapor contamination beneath MDA T in accordance with the specific requirements outlined in the Phase III investigation work plan and associated New Mexico Environment Department approval correspondence. Estimated completion of all Phase III investigation activities is December 2010.

Specific objectives of the 2009–2010 investigation are to (1) establish the nature and extent of volatile organic compound (VOC) and tritium vapors beneath MDA T; (2) ascertain the source(s) for vapor-phase contamination; (3) project vapor-phase behavior beneath MDA T over time; and (4) confirm the nature and extent of specific inorganic, organic, and radioactive chemicals of potential concern (COPCs) in the MDA T subsurface identified by previous investigations.

The following 2009 investigation activities have been completed to date:

- drilling and sampling solid media in borehole (BH) 21-25262 to a total depth of ~695 ft below ground surface (bgs);
- installing a 9-port permanent vapor-monitoring system in BH 21-25262;
- monthly sampling of MDA T vapor-monitoring well 21-25262 for two rounds, June and July 2009; and
- sampling of MDA T vapor-monitoring wells 21-603058, 21-603059, and 21-25264 for an additional four rounds (February 2009, April 2009, June 2009, and July 2009).

The 2009 solid media analytical results confirm that nature and extent are defined for fluoride, sulfate, nitrate, perchlorate, acetone, and tritium, as determined by previous investigations.

The 2009 pore-gas analytical results also confirm the results of previous investigations: overall, MDA T subsurface vapor contains low concentrations of VOCs and low activities of tritium. Carbon tetrachloride, chloroform, methylene chloride, perchloroetylene, and trichloroethene are the only VOCs consistently observed at concentrations above their detection limits throughout the sampling period. Concentrations of these five COPCs clearly decrease with depth in vapor-monitoring well 21-25262, indicating the vertical extent of VOCs is defined for that well. Tritium data from vapor-monitoring well 21-25262 indicate the nature and extent of tritium are also defined for that well.

The maximum extent of vertical and lateral pore-gas contamination at MDA T, as well as precise contamination source(s), is not conclusively identified from the 2009 results. However, observed similarities between MDA T vapor-monitoring wells 21-25262 and 21-603059 suggest that vapor-monitoring well 21-25262 may prove to be a good indicator of VOC trends for vapor-monitoring well 21-603059 at depth.

The future addition of vapor-monitoring well 21-607955 along the North Perimeter Road, as well as continued monitoring of all current MDA T vapor-monitoring wells, will provide additional lateral extent information and will corroborate vertical extent and current hypotheses regarding potential contamination sources and time-dependent trends.

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1.0 INTRODUCTION

This Phase III investigation report presents the initial results from the 2009 to 2010 environmental investigation of Consolidated Unit 21-016(a)-99, also known as Material Disposal Area (MDA) T, within Technical Area 21 (TA-21) at Los Alamos National Laboratory (LANL or the Laboratory). This investigation is being conducted in accordance with the specific requirements defined in the Phase III investigation work plan and the associated New Mexico Environment Department (NMED) approval correspondence (LANL 2009, 105645; NMED 2009, 105691; NMED 2009, 106455), per recommendations of both the Laboratory and NMED to further evaluate potential subsurface vapor contamination beneath MDA T.

As a result of its operational history, MDA T contains both radioactive and hazardous components. The site includes 4 absorption beds that received treated radioactive liquid waste, 64 buried shafts used for the disposal of cement-treated radioactive mixtures, and the Retrievable Waste Storage Area (RWSA) used for the storage of cement-treated radioactive mixtures. The site also included two former industrial wastewater treatment plants (buildings 21-035 and 21-257) and associated subsurface piping and structures. Building 21-035 was demolished in 1967; building 21-257 remains on-site and still contains radioactive and hazardous constituents. 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 (DOE) policy.

Specific objectives of the Phase III investigation are to (1) establish the nature and extent of volatile organic compound (VOC) and tritium vapors beneath MDA T; (2) ascertain the source(s) for vapor-phase contamination; (3) project vapor-phase behavior beneath MDA T over time; and (4) confirm the nature and extent of specific inorganic, organic, and radioactive chemicals of potential concern (COPCs) in the MDA T subsurface identified by previous investigations. To fulfill these objectives, the Laboratory recommended the installation of three additional deeper pore-gas monitoring wells at MDA T (two at ~690 ft below ground surface [bgs] and one at ~950 ft bgs). Solid media samples collected from these wells as well as pore-gas samples will augment data collected from MDA T permanent vapor-monitoring wells 21-603058, 21-603059, and 21-25264 installed at depths of up to 380 ft bgs (LANL 2009, 105645).

Per agreement with NMED, this report does not contain results for all activities yet to be completed under the Phase III investigation objectives (LANL 2009, 106762; NMED 2009, 106833). To date, only one of the three new vapor-monitoring wells has been completed and sampled: borehole (BH) 21-25262, originally drilled as an exploratory characterization boring in 2005, was deepened to ~695 ft bgs in April 2009. Additional core samples were collected and a permanent vapor-monitoring well was installed. Since installation, two rounds of subsurface vapor samples (June and July 2009) have been collected and submitted for VOC and tritium analyses. All 2009 data (solid media and vapor samples) obtained from vapor-monitoring well 21-25262 are presented and evaluated in this report. In addition, pore-gas data collected since October 2007 from MDA T vapor-monitoring wells 21-603058, 21-603059, and 21-25264 are also presented and evaluated in this report. An additional report documenting results obtained from the additional two vapor-monitoring wells will be provided to NMED upon completion of all 2009–2010 activities.

This report is presented in nine sections with six supporting appendixes. Section 1 is the introduction. Section 2 summarizes MDA T operational and characterization history. Section 3 describes the scope of the field activities conducted to date; section 4 presents the results. Section 5 provides the regulatory criteria framework used for the identification of COPCs for the site as well as the methodology for the pore-gas screening evaluation. Section 6 presents all analytical results, identifies COPCs for the site, and evaluates the nature and extent of site contamination. Conclusions based on previous and new data are presented in section 7, and recommendations are provided in section 8. Section 9 cites all references supporting this report. Appendix A provides a list of all acronyms and abbreviations used within this report, metric conversion table, and data qualifier definitions; Appendix B covers field methods; Appendix C covers field documentation; Appendix D presents analytical results; Appendix E presents data validation; and Appendix F covers investigation-derived waste management.

2.0 BACKGROUND

MDA T is located within TA-21 on DP Mesa, east of building 21-286, north of buildings 21-005 and 21-150, and south of North Perimeter Road (Figure 2.0-1). DP Canyon lies immediately north of the consolidated unit and ranges in elevation from 7130 to 7040 ft above sea level.

MDA T is a fenced open field (approximately 2.2 acres) consisting of (1) influent-distribution pipes to four rock- and aggregate-filled absorption beds used historically to dispose of liquid wastes containing radioactive and hazardous materials, (2) a historical RWSA, and (3) a series of deep disposal shafts used historically to dispose of radioactive wastes mixed with Portland cement (Figure 2.0-2). Current vegetation at MDA T includes grasses, shrubs, and some young ponderosa pines near the fenceline. The top of the regional aquifer occurs approximately 1300 ft below MDA T, based on water-level information from regional well R-6 (Kleinfelder 2005, 091693).

Detailed descriptions of MDA T operational history, historical releases and discharges, and historical investigation activities (before 2007) are presented in the MDA T investigation work plan and Phase I investigation report (LANL 2004, 085641; LANL 2006, 094151) and are not repeated in this report. However, because these reports have focused primarily on the investigation of solid media contamination at MDA T and focus on subsurface vapor contamination, brief discussions are presented below of known MDA T processes/operations as they potentially relate to subsurface vapor contamination at MDA T, along with a summary of previous MDA T subsurface vapor investigations.

2.1 Disposal, Discharges, and Releases

Disposal, discharges, and releases at MDA T include (1) cement-treated radioactive sludge and wastewater in the shafts and RWSA-corrugated metal piping, (2) solid and other liquid wastes codisposed in the shafts, (3) treated and untreated contaminated wastewater, and (4) incineration of radioactive contaminated waste oils. In addition, there are eight areas of concern (AOCs) that are not part of MDA T but are within the footprint of the consolidated unit. The eight AOCs consist of four unintentional releases or one-time spills and four former storage and treatment tanks.

Liquid releases to absorption beds or water leaks from buried pipes may have caused large, temporary increases in mesa-top infiltration rates and enhanced fracture flow resulting from the creation of locally saturated conditions at MDA T. It is generally assumed that enhanced fracture transport occurred while the beds actively received liquid waste and that the contaminants associated with the fractures are remnants of previous fracture-flow episodes (LANL 2004, 085641). Historical data support the idea that fracture flow ceased once liquid mesa-top disposals stopped and that infiltration rates returned to near-predisposal levels when the mesa-top water balance returned to native conditions (Soll and Birdsell 1998, 070011). Thus, VOCs and tritium in pore gas may exist at depths below MDA T as a result of the cessation of historical liquid releases and elevated infiltration rates. No liquid-phase contaminants are currently known to exist in the vadose zone below MDA T, as supported by the 2006 investigation report (LANL 2006, 094151).

2.2 Previous Investigations

The first effort to characterize subsurface vapor contamination beneath MDA T was initiated during the 2005–2006 investigation (Phase I) of Consolidated Unit 21-016(a)-99 (LANL 2006, 094151). Between January 5, 2006, and May 23, 2006, two rounds of pore-gas sampling were conducted at three open boreholes (vapor-monitoring wells 21-25262, 21-25263, and 21-25264) and a total of 29 investigation samples were collected. The boreholes were located in accordance with the NMED-approved investigation work plan around the absorption bed complex not only to characterize subsurface tritium and VOC concentrations in pore gas but also to (1) define the vertical and lateral extent of contaminants from the absorption beds, disposal shafts, and the RWSA; (2) characterize fractures in the subsurface tuff (Qbt 2 and Qbt 3); and (3) collect geotechnical data (LANL 2004, 085641; LANL 2006, 094151) (Figure 2.0-2).

Pore-gas samples were collected from the open boreholes using a dual-packer system. In the first sampling round, six separate intervals were sampled at location 21-25262 and five separate intervals were sampled at locations 21-25263 and 21-25264. Sampled intervals corresponded to (1) total depth (TD), (2) base of the closest absorption bed or disposal unit, and (3) geologic characterization samples. All samples were submitted to off-site analytical laboratories for VOC analysis using U.S. Environmental Agency (EPA) Method TO-15 and for tritium analysis using EPA Method 906.0. Because of 30–50 ft of slough in all three boreholes, TD samples could not be collected during the second sampling event.

A review of the 2006 analytical results identified a total of 42 COPCs (41 VOCs plus 1 tritium) in the pore gas beneath MDA T. The greatest reported vapor concentration was for methylene chloride at 2200 $\mu g/m^3$, but the majority of the vapor concentrations was less than 500 $\mu g/m^3$. The data showed no consistent trends with depth. Results for tritium were similar to the VOC data but less consistent (with time as well as with depth) (LANL 2006, 094151).

The 2007 investigation (Phase II) continued vapor characterization beneath MDA T. Vapor-monitoring wells 21-603058, 21-603059, and 21-25264 were installed (Figure 2.0-2), and a four-quarter vapor monitoring plan was initiated in October 2007 (LANL 2007, 098944; NMED 2007, 098946; LANL 2008, 102182). The following samples were successfully collected from each vapor-monitoring well between October 2007 and September 2008 and submitted to off-site analytical laboratories for VOC and tritium analyses (LANL 2009, 105187):

- vapor-monitoring well 21-603058—four rounds of samples from four permanently installed stainless-steel ports (Ports 1 and 3–5); two rounds of samples from one permanently installed stainless-steel port (Port 2 stopped functioning after sampling round 2)
- vapor-monitoring well 21-603059—four rounds of samples from five permanently installed stainless-steel ports (Ports 1 and 3–6; Port 2 did not function on installation)
- vapor-monitoring well 21-25264—four rounds of samples from five permanently installed stainless-steel ports

Upon review of the 2007–2008 analytical results, a total of 37 COPCs (36 VOCs plus 1 tritium) were identified in the pore gas beneath MDA T (LANL 2009, 105187). VOC data indicated that concentration ranges and VOCs detected were similar to those previously observed in 2006. Several general trends for VOCs were also observed.

- Methylene chloride pore-gas concentrations consistently increased with depth, with the greatest concentrations observed in vapor-monitoring well 21-25264.

- Chloroform, carbon tetrachloride, and trichloroethene (TCE) pore-gas concentrations also generally increased with depth.
- Perchloroethylene (PCE) pore-gas concentrations consistently decreased with depth.

Tritium activities were less consistent. The greatest tritium activities were reported in vapor-monitoring well 21-25264 at approximately 150 ft bgs and decreased with depth. Tritium activities in vapor-monitoring wells 21-603058 and 21-603059 were markedly less than in vapor-monitoring well 21-25264 but overall appeared to slightly increase with depth.

3.0 SCOPE OF ACTIVITIES

Based on the 2007–2008 results, the nature and extent of VOC and tritium-contaminated vapor beneath MDA T were not defined and further evaluation was required. As a result, the following activities were completed/are scheduled to be completed in 2009–2010 at MDA T per the Phase III investigation work plan and associated NMED approval correspondence (LANL 2009, 105645; NMED 2009, 106455), as presented in the following section.

3.1 Field Activities

The following Phase III investigation activities have been completed to date:

- drilling and sampling of BH 21-25262 to a TD of ~695 ft bgs
- installation of a 9-port permanent vapor-monitoring system in BH 21-25262
- monthly sampling of MDA T vapor-monitoring well 21-25262 for two rounds (June and July 2009)
- sampling of MDA T vapor-monitoring wells 21-603058, 21-603059, and 21-25264 for an additional four rounds (February 2009, April 2009, June 2009, and July 2009).

As of July 2009, the following activities, as defined in the Phase III investigation work plan (LANL 2009, 105645), remain incomplete:

- drilling and solid media sampling of BH 21-607955 at the North Perimeter Road (target TD of 950 ft bgs)
- installation of an 11-port permanent vapor-monitoring system at BH 21-607955 (estimated completion date is December 2009)
- drilling and solid media sampling of a new borehole near building 21-257 (target TD of ~690 ft bgs; exact location and installation of the vapor-monitoring well remains contingent on completion of the corrective actions scheduled within the immediate area)
- installation of a 9-port permanent vapor-monitoring system at building 21-257 borehole
- monthly sampling of MDA T vapor-monitoring wells 21-607955 and at building 21-257 for 12 rounds (upon completion)
- continued sampling of MDA T vapor-monitoring well 21-25262 for an additional eight rounds (August 2009–June 2010).

Details regarding the 2009 field investigation results are presented in section 4.

3.2 Health, Safety, and Security

All investigation activities were conducted in accordance with a site-specific health and safety plan and an integrated work document, which detailed work steps, potential hazards, hazard controls, and required training to conduct the work.

3.3 Waste Management and Disposal

The investigation-derived waste (IDW) from the 2009 field activities included (1) drill cuttings; (2) contaminated personal protective equipment (PPE); and (3) other contact wastes, such as plastic sheeting, used sampling supplies, and other materials that came in contact with potential contaminants. IDW was generated only during the drilling, solid media sampling, and installation of vapor-monitoring well 21-25262; no IDW was generated during execution of MDA T vapor-sampling activities.

All wastes generated were characterized, stored, managed, and disposed of per the approved site-specific waste characterization strategy form and in accordance with applicable standard operating procedures (SOPs).

Drill cuttings generated during drilling and sampling activities were placed in 1-yd^3 waste containers and staged in an appropriate waste storage area. PPE and other contact waste were stored in a single 55-gal. drum. Waste containers were individually labeled with a unique identification number and with information regarding waste classification, item(s), associated samples, locations from which waste was generated, and date generated.

Final characterization of the drill cuttings was based on analytical results obtained by direct sampling of the waste stream. Drill cuttings were characterized as nonhazardous waste and approved for land application. PPE and other contact wastes were characterized as nonhazardous and are pending disposal at an off-site facility.

Details regarding IDW management are provided in Appendix F.

3.4 Deviations

Several deviations from the approved MDA T Phase III investigation work plan (LANL 2009, 105645) occurred during the execution of the 2009 field activities. These deviations are summarized below.

- BH 21-25262 core sample MD21-09-8973, collected at TD, was submitted for a full anion suite rather than the limited anion suite (chloride and nitrate only). The analytical results associated with these additional anions are presented in this report.
- Although planned for analysis, the BH 21-25262 core samples were inadvertently omitted from the chain-of-custody forms and therefore the following site-specific radionuclides were not analyzed: americium-241, cesium-137, plutonium-238, plutonium-239/240, and strontium-90. However, the analytical laboratory still has the archived core samples and will perform the radionuclide analyses. These results will be reported in a future report.

4.0 FIELD INVESTIGATION RESULTS

A summary of Phase III field methods and the field-screening results associated with implementation of the 2009–2010 investigation are presented in the following section. Further discussion of the field methods used during the investigation are presented in Appendix B. Associated chain-of-custody forms and sample collection logs are provided in Appendix D. Evaluation of the analytical results is presented in section 6 of this report.

4.1 Drilling and Sampling of Borehole 21-25262

Originally completed to a TD of 380 ft bgs in January 2006 as part of the first phase of the MDA T investigation, borehole 21-25262 was extended into the Puye Formation (Tp) in April 2009 to a TD of 695.1 ft bgs and a permanent vapor-monitoring well was installed.

4.1.1 Drilling, Field Screening, and Solid Media Sampling

Borehole 21-25262 was drilled and sampled in 2006 to 380 ft and remained an open borehole. The TD was tagged at 247 ft before drilling activities, indicating 133 ft of slough in the borehole. The extension of BH 21-25262 was initiated on March 17, 2009, and was completed on May 4, 2009. Drilling was conducted using a Delta Base track air-core rig and casing-advance methods. Two casing sizes were employed while advancing the borehole to TD. Slough was removed from the open borehole by hammer bit, and 140-mm-inside diameter (I.D.) casing landed at 390 ft bgs. A 115-mm-I.D. casing was then telescoped though the 140-mm-I.D. casing and advanced to 585 ft bgs. The remainder of the borehole was advanced using core tooling to TD. Core samples were collected at designated depths in the boring using a split-core barrel sampler and 94-mm-I.D. core tooling for sampling and retrieval.

Per the Phase III investigation work plan, the target TD was the top portion of the Guaje Pumice Bed (Qbog), estimated at approximately 690 ft bgs (LANL 2009, 105645, p. 2). The top of the Qbog was encountered at approximately 670 ft bgs. After consultation with NMED, drilling continued through the Qbog (the Qbog/Tp contact was encountered at 693.7 ft bgs) and terminated 1.4 ft into the Tp. Core from Tp was collected and submitted for laboratory analysis. BH 21-25262 was drilled to a TD of 695.1 ft bgs. A generalized stratigraphic column of the bedrock geologic units encountered during the drilling is provided in Figure 4.1-1.

Core was retrieved in 5-ft lengths from targeted intervals using a split-core barrel sampler. The split-core barrel sampler was lined with Lexan tubing (2.25-in.-I.D.) to retain core integrity and moisture. Immediately upon retrieval, core was screened for gross-alpha, beta-, and gamma-radiation for health and safety purposes. Radiation screening was performed by a Laboratory certified radiological control technician using an Eberline E-600/SHP380AB Portable Radiation Monitor and an ESP-1 rate meter with a 210 probe.

After radiological field-screening measurements established that core material was within background concentrations, the core was visually inspected, and field-screening and laboratory samples were collected, as required, for analysis of VOCs. Before the collection of samples for any analyses, core was logged in the field by a qualified geologist and classified in accordance with Unified Soil Classification System, American Society for Testing and Materials (ASTM) D2487 and D2488, or American Geological Institute Methods for Soil and Rock Classification. The following information was recorded on the borehole log: percent recovery; lithology and respective lithologic unit thickness; color (according to Munsell soil color chart); relative moisture content, grain size, and distribution; and other pertinent field observations. A completed lithologic log is presented in Appendix C.

Field screening of the core for VOCs was conducted using a hand-held MiniRae 2000 photoionization detector (PID) equipped with an 11.7-electronvolt (eV) lamp. Headspace VOC screening was performed by removing sample material from the core barrel and placing a portion of the sample in a glass container with a foil-sealed cover. The jar was gently shaken and allowed to equilibrate for 5 min, and then the PID probe was inserted into the glass jar to measure for VOCs. All readings were recorded in parts per million on the borehole log (Appendix C). Core material was screened for VOCs approximately every 5 ft from 390 to 420 ft bgs; at 470, 520, 570, and 620 ft bgs and approximately every 5 ft from 650 to 691 ft bgs. Evaluation of solid media field-screening results is presented in section 4.2.

Chemical and geotechnical samples were collected for laboratory analyses every 50 ft at approximately the following target depths: 420 ft, 470 ft, 520 ft, 570 ft, 620 ft, 670 ft, 675 ft, and 691 ft (TD). All material was placed in appropriate sampling containers, labeled, documented, and preserved (as required) for transport to the Sample Management Office. Samples were submitted for off-site laboratory analysis for VOCs, general chemistry (nitrate, perchlorate, and chloride), and tritium. Field duplicates (FD) were submitted for the same suite of analyses as the investigation samples for quality assurance/quality control (QA/QC) purposes at a frequency of 1 FD for every 10 samples. Geotechnical samples were submitted for off-site laboratory analysis of dry density, percent moisture, and unsaturated hydraulic conductivity.

A total of nine samples (eight characterization and one FD) were collected for the analysis of specific inorganic chemicals, organic chemicals, and radionuclides and eight samples (seven characterization and one FD) for geotechnical analysis. A summary of all 2009 solid media samples collected and the requested analyses is presented in Table 4.1-1.

No groundwater was encountered during the drilling. Analytical results associated with geotechnical sampling are presented in Table 4.1-2; the associated depth profiles are presented in Figure 4.1-2. Analytical results associated with the sampling for specific inorganic chemicals, organic chemicals, and radionuclides are presented and evaluated in section 6.

4.1.2 Subsurface Vapor Sampling with a Single Packer System

To help ascertain the final TD for vapor-monitoring well 21-25262, a pore-gas sample was collected at ~10 ft into the Qbog (at ~680 ft bgs) on April 23, 2009. Two characterization/FD sample pairs were collected (one pair each for VOCs and tritium), as well as a field blank (FB), using a single inflatable packer system and were submitted for quick turn analysis. Analytical results were received by the Laboratory on April 27, 2009, and reviewed to confirm the presence and evaluate the concentration/activity levels of both VOCs and tritium at ~680 ft bgs. After consultation with NMED, it was determined that the Laboratory should advance BH 21-25262 into the Tp and collect a core sample. Drilling resumed on May 4, 2009, and BH 21-25262 was completed at a TD of 695.1 ft bgs on May 4, 2009 (section 4.1.1).

4.1.3 Vapor-Monitoring Well Installation

Installation of a permanent vapor-monitoring well began on May 5, 2009, and was completed by May 29, 2009. The vapor-monitoring well consists of nine individual strings of 0.25-diameter stainless-steel sample tubing connected with Swagelok fittings. Vapor ports of 0.25-in.-diameter stainless-steel screens, 6 in. long, were connected to the bottom of each individual stainless-steel tubing string and landed at the designated port depths. Each vapor port was isolated in a 5-ft-thick interval of 10/20 size silica sand. Bentonite chips were tremied into the borehole and hydrated to isolate each 5-ft-thick sampling interval that contained a vapor port.

The nine vapor-monitoring ports were installed at the following depths: 82, 117, 234, 297, 331.5, 377, 475, 574.5, and 687.8 ft bgs. Shallow ports (Ports 1, 3, and 4) were positioned to allow for data comparison with the adjacent MDA T vapor-monitoring well 21-603059, and Port 2 (at 115 ft bgs) was positioned to replace the equivalent port in vapor-monitoring well 21-603059, which has never operated. The as-built diagram for permanent vapor-monitoring well 21-25262 is presented in Figure 4.1-3.

4.2 Solid Media Field-Screening Results

All core samples were field screened for gross-alpha, beta-, and gamma-radiation and for VOCs. Radiological screening was performed for health and safety purposes to establish that the core activities were below background. VOC screening was performed to establish real-time measurements of potential VOCs emitting from the core. Table 4.2-1 presents a summary of all radiologic and VOC field-screening results obtained during the 2009 drilling and core sampling of MDA T BH 21-25262.

4.3 Subsurface Vapor Sampling from Permanent Vapor-Monitoring Wells

As summarized in section 2.2, subsurface vapor sampling from permanent vapor-monitoring wells installed at MDA T was initiated in October 2007 and continues to the present. At vapor-monitoring well 21-25262, two rounds have been completed to date per the Phase III investigation work plan (LANL 2009, 105645, p. 4). At vapor-monitoring wells 21-603058, 21-603059, and 21-25264, eight rounds have been completed to date per the approved MDA T vapor-monitoring plan (LANL 2007, 098944; NMED 2007, 098946) and the Phase III investigation work plan NMED approval (NMED 2009, 106455).

4.3.1 Vapor-Monitoring Well 21-25262

Two rounds of pore-gas sampling at vapor-monitoring well 21-25262 were completed on June 12–18, 2009, and on July 14–17, 2009. Before sample collection, all sampling intervals were purged while concentrations of carbon dioxide and oxygen were monitored continuously using a CES Lantec air analyzer. Once indicator gas concentrations were stable and proper purge of the sampling system was verified, vapor-sampling proceeded.

A total of 21 pore-gas samples (18 characterization and 3 QA/QC) were collected for VOC analysis and 20 samples (18 characterization and 2 QA/QC) for tritium analysis from vapor-monitoring well 21-25262. All samples were collected in accordance with the current version of SOP-5074, Sampling for Sub-Atmospheric Air, and submitted to off-site analytical laboratories for the analysis of VOCs using EPA Method TO-15 and for tritium analysis using EPA Method 906.0.

A summary of all pore-gas sampling depths and sample collection dates for vapor-monitoring well 21-25262 is presented in Table 4.3-1. A summary of all pore-gas samples collected at vapor-monitoring well 21-25262 and their respective analyses are presented in Table 4.3-2. Evaluation of 21-25262 pore-gas field-screening results is presented in section 4.4. Evaluation of vapor-monitoring well 21-25262 pore-gas analytical results is presented in section 6 of this report.

4.3.2 Vapor-Monitoring Wells 21-25264, 21-603058, and 21-603059

As directed by the NMED approval with modifications for the MDA T Phase III investigation work plan (NMED 2009, 105691), four additional rounds of pore-gas field screening and sampling have been completed to date at MDA T vapor-monitoring well locations 21-603058, 21-603059, and 21-25264 (Figure 2.0-2): February 2009 (round 5), April 2009 (round 6), June 2009 (round 7), and July 2009 (round 8).

Pore-gas characterization samples were collected at vapor-monitoring well 21-25264 from five separate sampling ports installed at the following intervals: (1) TD (sampling port 5, 349.5–354.5 ft bgs), (2) base elevation of the nearby disposal unit (sampling Port 1, 67.5–72.5 ft bgs), and (3) depths correlated to the 2005–2006 sampling port depths at locations 21-25262 and 21-25263 (sampling Ports 2–4). At vapor-monitoring well 21-603058, samples were collected from four separate sampling ports installed at the following intervals: (1) TD (sampling Port 5, 339.5–344.5 ft bgs), (2) base elevation of the nearby disposal unit (sampling Port 1, 67.5–72.5 ft bgs), and (3) Ports 3 and 4 at depth intervals of 217–222 ft bgs and 242.5–247.5 ft bgs. At well 21-603059, pore-gas characterization samples were collected from five separate sampling ports installed at the following intervals: (1) TD (sampling Port 6, 372.5–377.5 ft bgs), (2) base elevation of the nearby disposal unit (sampling Port 1, 77.5–82.5 ft bgs), and (3) depths correlated to the 2005–2006 sampling port depths at locations 21-25262 and 21-25263 (sampling Ports 3–5).

In 2009, a total of 76 pore-gas samples (57 characterization and 19 QA/QC) were collected for VOC analysis and 67 samples (57 characterization and 10 QA/QC) were collected for tritium analysis from the permanent vapor-monitoring wells. Samples were not collected from Port 2 from vapor-monitoring wells 21-603058 (160.5–165.5 ft bgs) and 21-603059 (112.5–117.5 ft bgs) because these ports stopped functioning during the 2007–2008 monitoring period and cannot be repaired (LANL 2009, 105187, p. 4).

A summary of all 2007–2009 pore-gas sampling depths and sample collection dates at vapor-monitoring wells 21-603058, 21-603059, and 21-25264 is presented in Table 4.3-1. A summary of all 2007–2009 samples collected at vapor-monitoring wells 21-603058, 21-603059, and 21-25264 and the requested analyses is presented in Tables 4.3-3–4.3-5.

Pore-gas field-screening and sample collection activities performed at vapor-monitoring wells 21-603058, 21-603059, and 21-25264 during the 2009 monitoring period were conducted in accordance with the same methods and requirements outlined in section 4.3.1.

4.4 Subsurface Vapor Field-Screening Results

Before each sampling event, field screening was performed in each vapor-monitoring well and targeted sampling interval to ensure percent carbon dioxide (%CO_2) and oxygen (%O_2) levels at each sample port had stabilized at values representative of subsurface pore-gas conditions. Table 4.4-1 presents a summary of all field-screening results obtained during the 2009 sampling events at vapor-monitoring wells 21-603058, 21-603059, 21-25264, and 21-25262 by sampling port and sampling round.

5.0 REGULATORY CRITERIA

This section describes the applicable criteria used for screening COPCs. Regulatory criteria identified by medium in the March 1, 2005, Compliance Order on Consent (the Consent Order) include cleanup standards, risk-based screening levels, and risk-based cleanup goals.

Typically, data obtained during the current investigation are evaluated to determine COPCs, their distribution in the environment, and the resulting potential human and ecological risks, as applicable. The results of the data assessment as well as the screening-level risk evaluations are used to help determine whether additional corrective actions are required at the site. Risk evaluations are based on exposure scenarios and are only applicable to depths of 1 ft bgs (industrial) or 10 ft bgs (residential and construction worker). Risk evaluations for the construction worker, residential, and industrial scenarios were completed for MDA T with the data collected during the first phase of the investigation, and the results were presented in the MDA T Phase I investigation report (LANL 2006, 094151, Appendix J). Subsequent updates to the risk evaluations were completed, as applicable, during the second phase of the MDA T investigation with the addition of new near-surface slope data (LANL 2008, 102182).

However, because the 2009–2010 investigation is the third phase of investigation to be completed at MDA T and the data objectives of the investigation are highly tailored, only pore gas and core samples greater than 380 ft bgs were collected; no new near-surface data have been collected. As a result, evaluations of potential risk to human and ecological receptors are not applicable and were not conducted, per agreement with NMED (LANL 2009, 106762; NMED 2009, 106833).

Although not applicable, soil screening levels (SSLs) for chemicals for the industrial, construction worker, and residential scenarios are provided for reference in the data assessment and evaluation tables presented in section 6. Unless otherwise indicated, the reported SSLs are from NMED guidance (NMED 2006, 092513). For chemicals for which NMED SSLs were not available, SSLs from the EPA regional screening tables (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm) (adjusted to a risk level of 10-5 for carcinogens) are provided. Screening action levels (SALs) for radionuclides were obtained from Laboratory guidance (2005, 088493).

Because the primary objective of the 2009–2010 investigation is characterizing the nature and extent of VOCs and tritium in subsurface vapor, a screening evaluation comparing maximum concentrations of VOCs in pore gas with screening levels (SLs), based on equilibrium Henry’s law partitioning with groundwater cleanup levels, is provided. This screening process evaluates the potential for the reported VOC concentrations to result in contamination of groundwater in excess of cleanup levels. Details regarding pore-gas screening evaluation criteria are presented in the following section. Results of the pore-gas screening evaluation are presented in section 6.

5.1 Pore-Gas Screening Evaluation

The Consent Order does not identify any cleanup standards, risk-based SLs, risk-based cleanup goals, or other regulatory criteria for pore gas. Therefore, an analysis was conducted to evaluate the potential for contamination of groundwater by VOCs in pore gas using SLs based on groundwater cleanup levels. The analysis evaluated the groundwater concentration that will be in equilibrium with the maximum concentrations of VOCs detected at MDA T during all eight sampling rounds (2007–2009). The equilibrium relationship between air and water concentrations is described by the following equation:

$$C_{water} = C_{air} / H' \qquad \textbf{Equation 5.1-1}$$

Where C_{water} = volumetric concentration of contaminant in water,

C_{air} = volumetric concentration of contaminant in air, and

H' = dimensionless form of Henry’s law constant.

If the predicted concentration of a particular VOC in groundwater is less than the SL, then there is no potential for contamination of the groundwater. The 2007–2009 MDA T VOC pore-gas data are discussed in section 6.

The screening evaluation is based on groundwater standards or tap water SLs and Henry’s law constant that describe the equilibrium relationship between vapor and water concentrations. The source of the Henry’s law constant is the NMED technical background document (NMED 2006, 092513) or the EPA regional screening tables (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm). The following dimensionless form of Henry’s law constant was used:

$$H' = \frac{C_{air}}{C_{water}} \qquad \textbf{Equation 5.1-2}$$

Equation 5.1-2 can be used to calculate the following screening value (SV):

$$SV = \frac{C_{air}}{1000 \times H' \times SL} \qquad \textbf{Equation 5.1-3}$$

where C_{air} is the concentration of a particular VOC in the pore-gas sample (µg/m^3), H' is the dimensionless Henry's law constant, SL is the screening level (µg/L), and 1000 is a conversion factor from L to m^3. The SLs are the standards or EPA regional tap water SLs. The groundwater standards are the EPA maximum contaminant level (MCL) or New Mexico Water Quality Control Commission (NMWQCC) groundwater standard, whichever is lower. If there is no MCL or NMWQCC standard, the EPA regional tap water SL (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm) (per the Consent Order) is used and adjusted to 10^{-5} risk for carcinogens. The numerator in Equation 5.1-3 is the actual concentration of the VOC in pore gas, and the denominator represents the pore-gas concentration needed to exceed the SL. Therefore, if the SV is less than 1, the concentration of the VOC in pore gas does not exceed the SL, even if the VOCs are in direct contact with groundwater. Table 5.1-1 presents the calculated concentrations of VOCs in pore gas corresponding to groundwater SLs.

6.0 SITE CONTAMINATION

The following section presents a detailed review and assessment of the analytical results obtained from the 2009–2010 investigation activities at MDA T completed to date: (1) drilling and solid media sampling of BH 21-25262 and (2) 2009 pore-gas monitoring activities at MDA T vapor-monitoring wells 21-603058, 21-603059, 21-25264, and 21-25262. The principal objectives of the data review and assessment are to identify COPCs for each medium sampled, evaluate the nature and extent of contamination at the site, and determine what additional action(s) may be required.

In addition, MDA T subsurface vapor data were also evaluated in the context of time, depth, and contaminant signature to ascertain potential source locations for vapor-phase contamination, project vapor-phase behavior beneath MDA T over time and to assess the potential to contaminate groundwater. The 2009 pore-gas analytical results obtained from vapor-monitoring wells 21-603058, 21-603059, and 21-25264 during rounds 5–8 (2009) are summarized and evaluated in conjunction with the 2007–2008 pore-gas analytical data obtained during rounds 1–4 (October 2007 [round 1], February 2008 [round 2], May 2008 [round 3], September 2008 [round 4]).

All analytical data were subject to extensive QA/QC and data validation reviews in accordance with Laboratory guidance and procedures. Only data determined to be decision-level following the data quality assessment (Appendix E) are included in the review; field-screening and rejected results (qualified as R) are not included in the data review nor are they included in any evaluation of nature and extent or assessment of the potential to contaminate groundwater. Geotechnical samples collected from BH 21-25262 during the investigation are also not included in this section because these results are not representative of potential site contaminants; these results are presented in section 4. Data quality issues and data validation results are discussed in Appendix E. All analytical results are presented in Appendix D (provided on CD).

6.1 Identification of COPCs

For a given sampling medium, COPCs are identified differently for inorganic chemicals, organic chemicals, and radionuclides.

An inorganic chemical is identified as a COPC if at least one result or the analytical detection limit exceeds the background value (BV). If additional comparisons with the background data set demonstrate inorganic chemical concentrations are within the range of background concentrations, the chemical is eliminated as a COPC (statistical comparisons were not conducted because there are fewer than 10 samples per medium). If there is no associated BV, the inorganic chemical is a COPC if it is detected in site samples.

Organic chemicals are identified as a COPC, based on detection status; if detected it is retained as a COPC.

Radionuclides are divided into fallout and naturally occurring radionuclides. Fallout radionuclides include tritium, strontium-90, cesium-137, plutonium-238, plutonium-239/240, and americium-241. Fallout values (FVs) exist for surface samples (i.e., the top 0–1 ft of soil and fill). If the activity of a fallout radionuclide exceeds the FV in a surface sample, it is identified as a COPC. If additional comparisons with the background data set demonstrate activities are within the range of background activities, the radionuclide is eliminated as a COPC. Fallout radionuclides detected in soil/fill samples collected at depths greater than 1 ft or detected in tuff are COPCs. Naturally occurring radionuclides detected at activities above their respective BVs are identified as COPCs. If there is no associated BV or FV and the radionuclide is detected, it is retained as a COPC.

Background data are available for soil (all soil horizons designated by the media code ALLH); sediment (media code SED); and multiple geologic units, including Bandelier Tuff (media codes Qbt 4, Qbt 3, Qbt 2, Qbt 1v, Qbt 1g, Qct, Qbo, and Qbog) (LANL 1998, 059730).

Because no background data are available for fill, soil BVs are used for fill (LANL 1998, 059730) and soil and fill samples are evaluated together.

There are no BVs for pore gas; any VOCs or tritium detected in pore gas is identified as a COPC.

6.1.1 Solid Media

Core samples from BH 21-25262 were collected in 2009 to confirm the nature and extent of specific inorganic, organic, and radioactive COPCs in the MDA T subsurface. As determined by previous investigations (LANL 2006, 094151; LANL 2008, 102182), data from the 2009–2010 investigation include only analytical results for the following: anions using EPA Method 300.0, perchlorate using EPA Method SW-846:6850, VOCs using EPA Method SW-846:8260B, and tritium using EPA Method 906.0. Therefore, the following data review discusses results (historical and current) only from analyses included in the 2009–2010 samples.

6.1.1.1 Inorganic Chemicals

Table 6.1-1 summarizes the analytical results for the inorganic chemicals detected in the 2009 core samples. Figure 6.1-1 depicts the spatial distribution of inorganic chemicals detected at BH 21-25262.

Previous investigations at MDA T (LANL 2006, 094151; LANL 2008, 102182) identified the following inorganic chemicals as COPCs: fluoride, nitrate, and perchlorate. These inorganic chemicals were also detected in the 2009 core samples: Fluoride was detected in a single sample at 3.48 mg/kg; nitrate was detected in six samples with a maximum detected concentration of 3.97 mg/kg; and perchlorate was detected in three samples with a maximum detected concentration of 0.0114 mg/kg. There are no BVs for these inorganic chemicals; therefore, they are retained as COPCs.

Chloride was detected in eight samples and sulfate was detected in one sample in 2009. BVs are available for both chloride and sulfate if the sample was collected in the Bandelier Tuff. Additional anions (bromide, fluoride, and sulfate) were analyzed only in a single core sample collected at a depth interval of 693.7–695.1 ft bgs (TD) in Tp (see section 3.4 for further explanation). There are no BVs available for the Tp; therefore, sulfate is retained as a COPC.

The maximum detected chloride concentration of 7.3 mg/kg was reported in a sample collected from the depth interval 675–680 ft bgs in the Qbog, which defines the base of the Otowi Member of the Bandelier Tuff (Qbo). Chloride was not detected in the Tp. The associated BV for chloride in the Qbog is 474 mg/kg; chloride, therefore, is not retained as a COPC.

Fluoride, nitrate, perchlorate, and sulfate are assessed further in the nature and extent evaluation presented in section 6.2.

6.1.1.2 Organic Chemicals

Table 6.1-2 summarizes the analytical results for organic chemicals detected in the 2009 core samples. Figure 6.1-1 depicts the spatial distribution of detected organic chemicals in solid media at BH 21-25262.

Previous investigations at MDA T (LANL 2006, 094151; LANL 2008, 102182) identified 17 VOCs as COPCs in solid media: acetone; benzene; 2-butanone; carbon disulfide; chloroform; 1,2-dibromo-3-chloropropane; 1,2-dichlorobenzene; 1,3-dichlorobenzene; 2-hexanone; 4-isopropyltoluene; 4-methyl-2-pentanone; methylene chloride; tetrachloroethene; toluene; trichloroethene; trichlorofluoromethane; and 1,3-xylene+1,4-xylene.

Only acetone was detected in the 2009 core samples collected from BH 21-25262. Acetone was detected at 0.00227 mg/kg in a single sample collected in the Qbog (675–680 ft bgs). Acetone is retained as a COPC and assessed further in the nature and extent evaluation.

6.1.1.3 Radionuclides

Table 6.1-3 summarizes the analytical results for tritium in the 2009 core samples. Figure 6.1-1 depicts the spatial distribution of tritium activity at BH 21-25262.

Tritium activity was detected in core samples collected in 2005–2006 and in two 2009 core samples collected in the Qbo: at depth interval 420–425 ft bgs (0.59 pCi/g) and at depth interval 570–575 ft bgs (0.074 pCi/g). Tritium is retained as a COPC and assessed further in the nature and extent evaluation.

6.1.2 Subsurface Vapor

Analytical results for VOCs in pore gas were produced from laboratory analyses of vapor collected in SUMMA canisters and analyzed using EPA Method TO-15. Analytical results for tritium were produced from laboratory analysis of moisture extracted from silica–gel columns and analyzed using EPA Method 906.0.

A systematic low bias in previously reported tritium pore-vapor measurements has been identified (Whicker et al. 2009, 106429); tritium data presented in this report have been corrected for this bias (Marczak 2009, 106500). The bias resulted from the properties of silica gel, the medium used to collect water vapor from pore-gas samples. Silica gel contains water bound to the silica–gel molecules that cannot be completely removed by drying before it is used in sampling without degrading the silica–gel properties. Thus, when water vapor is collected from the pore gas, the tritiated water vapor is diluted into the water bound to the silica–gel molecules. The tritium results were corrected using the percent moisture value determined by the analytical laboratory.

6.1.2.1 VOCs

Tables 6.1 through 4–6.1-7 summarize, by vapor-monitoring well, the analytical results for VOCs detected in MDA T subsurface vapor during the monitoring period from October 2007 to July 2009. Figures 6.1-2 through 6.1-9 depict, by sampling round, the spatial distribution of detected VOCs in pore gas at MDA T.

Throughout the MDA T monitoring period, a total of 38 VOCs have been detected in one or more samples in the subsurface vapor: acetone; benzene; bromodichloromethane; bromoform; 1,3-butadiene; 1-butanol; 2-butanone; carbon disulfide; carbon tetrachloride; chlorodibromomethane; chloroform; cyclohexane; 1,2-dichlorobenzene; 1,4-dichlorobenzene; dichlorodifluoromethane; 1,2-dichloroethane; 1,1-dichloroethene; cis-1,2-dichloroethene; ethanol; ethylbenzene; 4-ethyltoluene; hexane; 2-hexanone; 4-methyl-2-pentanone; methylene chloride; n-heptane; 2-propanol; propylene; tetrachloroethene; tetrahydrofuran; toluene; 1,1,2-trichloro-1,2,2-trifluoroethane; 1,1,1-trichloroethane; 1,1,2-trichloroethane; trichloroethene; 1,3,5-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene.

These VOCs are retained as COPCs and assessed further in the nature and extent evaluation.

6.1.2.2 Tritium

Tables 6.1-8–6.1-11 summarize, by vapor-monitoring well location, the analytical results for tritium in MDA T subsurface vapor during the monitoring period from October 2007 to July 2009. Figures 6.1-2 through 6.1-9 depict, by sampling round, the spatial distribution of tritium in pore gas at MDA T.

6.2 Nature and Extent of Contamination

Data for all COPCs identified in the 2009 core samples and the 2007–2009 pore-gas samples collected at MDA T were further evaluated in the context of defining nature and extent. The extent of a COPC is defined if the concentrations or activities show an apparent decrease with depth or distance. Organic chemicals detected at or near the standard quantitation limit (SQL) for the analysis are considered present at “trace” concentrations; these low concentration levels are more likely representative of analytical variability than of true spatial chemical distributions. Similarly, small detected concentrations of certain naturally occurring inorganic chemicals (e.g., anions) that do not have an assigned BV are most likely reflective of naturally occurring concentrations and not of a contaminant release. An evaluation of the nature and extent of contamination for all COPCs identified at MDA T during the 2009–2010 investigation is presented in the following sections.

6.2.1 Solid Media

Analytical results of the 2009–2010 investigation identified a total of six COPCs in the solid media core collected from BH 21-25262: fluoride, sulfate, nitrate, perchlorate, acetone, and tritium.

Fluoride and sulfate, both naturally occurring inorganic chemicals, were analyzed for in a single 2009 solid media core sample and collected at TD in the Tp. The reported fluoride and sulfate concentrations were 3.48 mg/kg and 5.36 mg/kg, respectively. Both fluoride and sulfate were previously detected at 18.2 mg/kg and 8.52 mg/kg, respectively, in a 2006 solid media core sample collected from BH 21-25262 at a depth interval of 235–238 ft bgs in the Tshirege Member of the Bandelier Tuff (Qbt). In both instances, the reported concentrations are low. In addition, the concentrations show an apparent decrease with depth; therefore, extent of both is defined.

Nitrate was detected in six of eight 2009 solid media core samples, with a maximum concentration of 3.97 mg/kg reported at depth interval 420–425 ft bgs in Qbo. Nitrate is also a naturally occurring inorganic chemical, and the reported concentrations at BH 21-25262 are low. In addition, nitrate was not detected in the Tp (at TD) at this location. The extent of nitrate is defined.

Perchlorate was detected in three of eight 2009 solid media core samples, with a maximum concentration of 0.0114 mg/kg reported at depth interval 420–425 ft bgs, the shallowest sample collected during the 2009 investigation. Perchlorate was not detected in the Tp (at TD). The extent of perchlorate is defined.

Acetone was detected in only one of eight 2009 solid media core samples at a trace concentration of 0.00227 mg/kg reported at depth interval 675–680 ft bgs in the Qbog. Acetone was not detected in the deeper sample in Tp (at TD). The extent of acetone is defined.

Tritium was detected in two of eight 2009 core samples at activities of 0.59 pCi/g at depth interval 420–425 ft bgs and at 0.074 pCi/g at depth interval 570–575 ft bgs, both in the Qbo. Tritium was not detected in the deeper sample in Tp (at TD) at this location. The extent of tritium is defined.

6.2.2 Subsurface Vapor

A total of 38 VOCs and tritium were identified as COPCs in the 2007–2009 MDA T pore-gas samples. Thirty-three VOCs were detected infrequently at very low or trace concentrations (concentrations at or near the SQL) or showed marked variability in detected concentrations throughout the stratigraphic column and/or across sampling events. These VOCs are acetone; benzene; bromodichloromethane; bromoform; 1,3-butadiene; 1-butanol; 2-butanone; carbon disulfide; chlorodibromomethane; cyclohexane; 1,2-dichlorobenzene; 1,4-dichlorobenzene; dichlorodifluoromethane; 1,2-dichloroethane; 1,1-dichloroethene; cis-1,2-dichloroethene; ethanol; ethylbenzene; 4-ethyltoluene; hexane; 2-hexanone; 4-methyl-2-pentanone; n-heptane; 2-propanol; propylene; tetrahydrofuran; toluene; 1,1,2-trichloro-1,2,2-trifluoroethane; 1,1,1-trichloroethane; 1,1,2-trichloroethane; 1,3,5-trimethylbenzene; 1,2-xylene; and 1,3-xylene+1,4-xylene.

Five VOCs (carbon tetrachloride, chloroform, methylene chloride, PCE, and TCE), however, were consistently detected throughout the MDA T monitoring period at the greatest concentrations relative to the other detected VOCs (Tables 6.1-4 through 6.1-7). These five VOCs illustrate a wide range of pore-gas distributions at MDA T:

- a consistent increase in concentrations with depth to a maximum followed by a marked decrease to much lower concentrations at TD (e.g., methylene chloride and carbon tetrachloride)
- a consistent decrease in concentrations with depth to TD (e.g., PCE)
- an “S”-shaped depth profile (e.g., TCE and chloroform), whereby concentrations observed at Ports 1 and 3–7 (well-dependent) are greater than concentrations observed at Ports 2 and/or 3 (well dependent) and at TD

Carbon tetrachloride, chloroform, methylene chloride, PCE, and TCE are considered representative of the VOCs in pore gas beneath MDA T and are evaluated further to examine trends in subsurface vapor concentrations as well as to determine the extent of vapor contamination beneath MDA T.

Because vapor data are systematically collected from the same well and port during every sampling event, a certain degree of time-dependent scatter becomes inherent in the data set. With the addition of more data (i.e., sampling events), filtering out time-independent information (e.g., the general concentration profile of a certain constituent with depth) may become increasingly cumbersome. Therefore, time-averaged concentration plots (i.e., averaged over all sampling rounds completed to date in a given well) are provided in addition to pore-gas vertical trend plots (i.e., concentration versus depth for all eight sampling rounds) to help aid in illustrating and evaluating vapor nature and extent at MDA T, independent of time.

The nature and extent of carbon tetrachloride, chloroform, methylene chloride, PCE, TCE, and tritium are discussed in detail in the following sections.

6.2.2.1 VOCs

Pore-gas vertical trend plots for methylene chloride, carbon tetrachloride, PCE, chloroform, and TCE from all eight sampling rounds are presented in Figures 6.2-1 through 6.2-5. Figure 6.2-6 presents time-averaged concentrations by monitoring well of methylene chloride, carbon tetrachloride, PCE, chloroform, and TCE versus depth.

Throughout the 2007–2009 monitoring period, methylene chloride concentrations consistently increase with depth to TD (345–380 ft bgs) in the shallower vapor-monitoring wells 21-25264, 21-603058, and 21-603059. In vapor-monitoring well 21-25262, however, the maximum methylene chloride concentration of 2100 µg/m^3 is at 475 ft bgs in the Qbo. Below 475 ft bgs, methylene chloride concentrations decrease; below ~575 ft bgs, methylene chloride concentrations substantially decrease, with 77 µg/m^3 and 140 µg/m^3 reported at TD (691 ft bgs) in June and July 2009, respectively. The decreasing concentrations with depth for methylene chloride indicate that the vertical extent of methylene chloride at vapor-monitoring well 21-25262 is defined.

Similar to methylene chloride, reported carbon tetrachloride concentrations on average are less at the near surface and consistently increase with depth in all four vapor-monitoring wells; however, the depth at which the maximum carbon tetrachloride concentration is observed varies with each vapor-monitoring well. For each of the MDA T vapor-monitoring wells, the maximum averaged carbon tetrachloride concentration is at the following depths: ~250 ft bgs (Port 4) at vapor-monitoring well 21-603058; ~300 ft bgs (Port 5) at vapor-monitoring well 21-603059, 290 and ~330 ft bgs (Ports 4 and 5) at vapor-monitoring well 21-25262, and TD (354.5 ft bgs) in vapor-monitoring well 21-25264. However, as with methylene chloride, carbon tetrachloride concentrations in vapor-monitoring well 21-25262 show a definitive decrease with depth below ~330 ft bgs to TD. The vertical extent of carbon tetrachloride in MDA T vapor-monitoring well 21-25262 is defined.

PCE is the only VOC of the five representative COPCs whose concentrations consistently decrease with depth from Port 1 to TD in all four vapor-monitoring wells. An exception is a minor spike at Port 5 (331.5 ft bgs) in vapor-monitoring well 21-25262, which is located in the Cerro Toledo Interval of the Bandelier Tuff (Qct). PCE is not detected in vapor-monitoring well 21-25262 at TD (691 ft bgs). The vertical extent of PCE in MDA T subsurface vapor is defined.

At shallower depths, chloroform in vapor-monitoring wells 21-25264 and 21-603058 shows a different depth profile than in vapor-monitoring wells 21-603059 and 21-25262. In vapor-monitoring wells 21-25264 and 21-603058, chloroform concentrations on average decrease slightly with depth to ~150 ft bgs, followed by a general increase to TD, whereas in vapor-monitoring wells 21-603059 and 21-25262 chloroform concentrations show a marked decrease to a depth of ~225 ft bgs before increasing again, followed by a decrease to TD (i.e., an S-shaped profile). This difference is partly because chloroform concentrations reported in vapor-monitoring wells 21-603059 and 21-25262 (1100 µg/m^3 and 930 µg/m^3, respectively) are much greater at the near surface than in vapor-monitoring wells 21-25264 and 21-603058 (500 µg/m^3 and 630 µg/m^3, respectively).

The maximum chloroform concentration at depth is at TD in all three shallow vapor-monitoring wells (21-25264, 21-603058, and 21-603059), whereas in vapor-monitoring well 21-25262, the maximum chloroform concentration of 1400 µg/m^3 is at a depth of 475 ft bgs; below 475 ft bgs, chloroform concentrations decrease to TD. The decreasing concentrations with depth in vapor-monitoring well 21-25262 indicate that the vertical extent of chloroform in MDA T vapor-monitoring well 21-25262 is defined.

TCE concentrations show similar trends to both carbon tetrachloride and chloroform. The TCE concentration maxima are in samples collected at different intermediate depths from each of the four vapor-monitoring wells (in approximately the same order). However, similar to chloroform, TCE concentrations exhibit an S-shaped profile with depth. TCE concentrations on average are greater in samples collected from the near surface (Port 1), less in samples collected at Ports 2 and/or 3, greater than the preceding ports in samples collected at Ports 3–7 (well-dependent) and less in samples collected at TD (except vapor-monitoring well 21-25264). Again, the pore-gas data indicate that vertical extent of TCE in vapor-monitoring well 21-25262 is defined.

Pore-gas data obtained from vapor-monitoring well 21-25262 clearly show that all five representative COPCs decrease to low concentrations at depth and extent is defined. However, as these COPCs do not show, a decreasing trend (with the exception of PCE) in the shallower vapor-monitoring wells, especially in well 21-25264, vertical extent of these constituents cannot be conclusively defined for the MDA T site as a whole. Although the shallower vapor-monitoring wells at MDA T are not deep enough to illustrate the maxima and subsequent decrease with depth, it is likely that similar trends with depth exist in these vapor-monitoring wells, as demonstrated in vapor-monitoring well 21-25262. The addition of analytical data from the next vapor-monitoring well on North Perimeter Road (location 21-607955) will aid in confirming the vertical extent of these VOCs, as well as provide additional support for defining the lateral extent of subsurface VOC vapor contamination at MDA T.

6.2.2.2 Tritium

Pore-gas vertical trend plots for tritium from all eight sampling rounds are presented in Figure 6.2-7; Figure 6.2-8 shows the time-averaged concentrations by vapor-monitoring well of tritium versus depth.

Tritium activities in pore gas are much less consistent than what was observed for VOCs; however, the following general trends are found.

- The maximum detected tritium activities are at the following depths: ~150 ft bgs in vapor-monitoring well 21-25264, ~220 ft bgs in vapor-monitoring well 21-603058, at TD (~375) in vapor-monitoring well 21-603059, and at ~377 ft bgs in vapor-monitoring well 21-25262.
- The detected tritium activities are greatest in vapor-monitoring well 21-25264 and the least in vapor-monitoring wells 21-603058 and 21-603059.
- Tritium activity profiles for vapor-monitoring wells 21-603058, 21-25262, and 21-25264 show on average similar trends with depth, illustrating one or two peaks of tritium activity at a particular port, followed by a marked decrease to TD. The ports at which these peaks are observed, however, vary with location as well as with time but are generally observed at Port 2 (~150 ft bgs) in vapor-monitoring well 21-25264; Port 3 (~220 ft bgs) or Port 4 (~245 ft bgs) in vapor-monitoring well 21-603058; and Ports 3 and/or 6 (234 ft bgs and 377 ft bgs, respectively) in vapor-monitoring well 21-25262.

- Tritium activities in vapor-monitoring well 21-603059 are the least consistent. During some sampling rounds, a tritium peak is observed either at Port 4 (~232 ft bgs) or at Port 5 (~295 ft bgs). In other sampling rounds, no tritium peak is observed and the activities show a general increase with depth to a maximum at TD.
- Tritium peaks in vapor-monitoring well 21-25262 appear to correlate with some of the irregular trends observed in vapor-monitoring well 21-603059. Maximum tritium activities are at a similar depth range in both vapor-monitoring wells (370–380 ft bgs). Periodic peaks of tritium have also been observed at shallower depths in both vapor-monitoring wells during some sampling events within the same depth range (230–237 ft bgs).

Tritium activities decrease with depth to TD in vapor-monitoring well 21-25262; therefore, the extent of tritium is defined in vapor-monitoring well 21-25262. The completion and sampling of vapor-monitoring well 21-607955 will provide additional information about tritium contamination at MDA T that should confirm these results.

6.3 Potential Sources of Subsurface Vapor Contamination

No process knowledge exists regarding the source(s) of VOC contamination at MDA T because VOCs were not known to be an integral part of the tritium processing (LANL 2004, 085641, Appendix B). However, as discussed in section 2.1, the current MDA T conceptual site model proposes that liquid releases to the former MDA T absorption beds or water leaks from former buried pipes may have caused temporary increases in mesa-top infiltration rates and enhanced fracture flow, potentially capturing organic vapors and tritium in water vapor at depths below MDA T (LANL 2009, 105645). The main MDA T structures that may have contributed to the infiltration of contaminated liquid into the vadose zone include the following:

- MDA T absorption beds
- former influent distribution piping (immediately south of MDA T) that conveyed liquid wastes from the plutonium-, uranium-, and tritium-processing buildings in DP West to waste-processing buildings 21-035 (historical) and 21-257, located immediately south and southeast of MDA T, respectively
- former building 21-257 treatment plant outfall, formerly located immediately east of the absorption beds

Once the surface liquid contamination source(s) were discontinued, it is likely that transport of contaminated vapors within the vadose zone beneath MDA T would have predominately continued via diffusion (LANL 2005, 092591, Appendix G). The general diffusive migration of contaminants from areas of high concentration to areas of low concentration (i.e., the surface and deeper geologic units) would result in a vertical distribution that is lowest at the surface and at depth, with the maximum concentration in the middle.

Lateral diffusion, which may be affected by exchange of air into and out of the canyon walls or occur preferentially though more permeable lithology, may also affect contaminant distribution profiles. Significant exchanges of vapors laterally may cause interference between disparate vapor contamination sources (e.g., concentration differences laterally between wells at equivalent depths are not as apparent), thereby making interpretations of lateral distribution more difficult.

As part of the Phase III investigation objectives, the 2007–2009 pore-gas monitoring results were analyzed to assess whether the spatial distribution of VOCs and tritium in pore-gas support the current MDA T conceptual site model relating to potential sources. While precise contamination source(s) cannot be determined from the data, vapor-monitoring wells 21-25264, 21-603058, 21-603059, and 21-25262 are compared with one another for consistencies and variances that may point to alternate contamination sources for some chemicals. For comparative purposes, only the data obtained during the last two sampling events of 2009 (rounds 7 and 8) are used in the evaluation of the four vapor-monitoring wells because no earlier data are available for vapor-monitoring well 21-25262.

6.3.1 VOCs

In an attempt to determine contamination source(s), profiles of average total and individual VOC concentrations for the four vapor-monitoring wells, as presented in Figures 6.3-1 and 6.3-2, were generated to assist in assessing overall spatial variability in VOC concentration in MDA T vapor. Total VOC concentrations are calculated by summing the concentrations, in micrograms per cubic meter, of all chemicals analyzed for in the pore gas; nondetections are assigned the value of their respective SQL. The June and July total concentrations are then averaged to compare overall trends. Other sampling events are not included because no earlier data are available for vapor-monitoring well 21-25262.

Although the June and July 2009 data from the four MDA T vapor-monitoring wells indicate variability in the distributions and concentrations of particular VOCs (as illustrated in the nature and extent discussion above) the data illustrate, on average, similar total VOC concentration profiles (Figure 6.3-1). The total VOC concentration profile of vapor-monitoring well 21-603058 at Port 1 deviates from other well total VOC concentration profiles at Port 1 due to comparatively low PCE and TCE concentrations.

However, when the distribution signatures of the five representative COPCs are evaluated individually, differences between the four vapor-monitoring wells become more apparent, and two sets of VOC concentration trends are dominant: concentration trends illustrated by vapor-monitoring wells 21-603059 and 21-25262 and concentration trends illustrated by vapor-monitoring wells 21-603058 and 21-25264 (Figure 6.3-2).

Total VOC concentrations are generally greater in vapor-monitoring wells 21-603058 and 21-25264 as compared with vapor-monitoring wells 21-603059 and 21-25262. In vapor-monitoring wells 21-603059 and 21-25262, the concentrations are slightly greater in vapor-monitoring well 21-603059 at shallower depths but greater in vapor-monitoring well 21-25262 at deeper depths. Furthermore, as illustrated by Figure 6.3-2, the June–July time-averaged concentrations of chloroform, carbon tetrachloride, and methylene chloride in vapor-monitoring wells 21-603059 and 21-25262 show similar concentration trends with depth and sampling event to each other as do vapor-monitoring wells 21-603058 and 21-25264. The similarity observed between VOC concentration trends in vapor-monitoring wells 21-603059 and 21-25262 and between VOC concentration trends in vapor-monitoring wells 21-603058 and 21-25264 is also illustrated by TCE and PCE concentrations but is less apparent.

These observations are most likely reflective of the relative spatial proximity of the vapor-monitoring wells to each other. Vapor-monitoring wells 21-603059 and 21-25262 are located ~35 ft apart on the south side of the MDA T facility; vapor-monitoring wells 21-603058 and 21-25264 are located ~215 ft apart on the north side of the MDA T facility. However, the similarities observed between vapor-monitoring wells 21-603059 and 21-25262 and vapor-monitoring wells 21-603058 and 21-25264 may also reflect different source(s) of contamination. The hypothesis that different VOCs may have had slightly different sources is most illustrated by chloroform (Figure 6.3-2).

Unlike most other VOCs detected at MDA T, time-averaged chloroform concentrations observed in samples collected from Port 1 in vapor-monitoring wells 21-603059 and 21-25262 are distinctly higher than in vapor-monitoring wells 21-603058 and 21-25264, resulting in the S-shaped distribution with depth previously discussed in section 6.2 above. This distribution may indicate that chloroform may be derived from a different source (a source nearer to vapor-monitoring wells 21-603059 and 21-25262 such as the former building 21-035 influent pipes) than the other representative VOCs identified at MDA T. The other VOCs are generally more consistent with a source located nearer to vapor-monitoring well 21-25264, such as the former treatment plant outfall at building 21-257.

The former treatment plant outfall at building 21-257 located immediately east of MDA T has been identified as a potential source of subsurface vapor contaminants for MDA T (LANL 2009, 105645). This potential is partially based on the consistently higher concentrations of VOCs (with the exception of chloroform) in vapor-monitoring well 21-25264. Also, the maximum concentrations of VOCs (e.g., carbon tetrachloride, chloroform, and TCE) in vapor-monitoring well 21-25264 are, overall, at deeper depths than the other three vapor-monitoring wells (although this is clearly observed only for the VOCs with peaks within the depth of the shallower wells). In vapor-monitoring well 21-603058, concentration maxima occur most frequently at shallower depths compared with the other three vapor-monitoring wells.

In addition, the VOC data from the MDA T wells also support diffusion, both vertical and lateral, as the dominant transport mechanism for subsurface VOCs beneath MDA T, as proposed by the current conceptual model. VOC contaminant distribution profiles for methylene chloride and carbon tetrachloride in deep vapor-monitoring well 21-25262 clearly show a vertical distribution that is lowest at the surface and at depth, with the maximum concentration in the middle. The maximum concentrations for chloroform and TCE in vapor-monitoring well 21-25262 are also observed in vapor collected at intermediate depths, but high concentrations are also reported in near-surface vapor. Differences in contaminant concentrations between wells at equivalent depths are much less apparent than the vertical differences within wells. Laterally, concentrations are within the same order of magnitude and generally within a factor of 2. Vertically, there are several order of magnitude differences between maximums and minimums, suggesting that lateral diffusion may also provide some component to the VOC concentration trends observed at the MDA T wells.

Regardless of whether the data conclusively identify subsurface vapor contaminant sources and/or vapor transport mechanisms at MDA T, the similarities between vapor-monitoring wells 21-603059 and 21-25262 indicate that vapor-monitoring well 21-25262 (TD of 695 ft) might be a good representation of VOC trends for vapor-monitoring well 21-603059 (TD of 360 ft) at deeper depths. However, further sampling of both vapor-monitoring wells will yield additional data that may help confirm these observations.

6.3.2 Tritium

Overall, tritium in the various MDA T vapor-monitoring wells reflects the trends observed for VOCs. Figure 6.3-3 shows tritium activities with depth in all four wells for samples collected during rounds 7 and 8.

Tritium activities were greater in vapor-monitoring well 21-25264 than in vapor-monitoring wells 21-603058, 21-603059, and 21-25262. At 155.5 ft bgs, a maximum tritium activity of 173,113 pCi/L was recorded in vapor-monitoring well 21-25264 in July 2009, almost 5 times the maximum activity recorded in vapor-monitoring well 21-25262 (37,413 pCi/L at ~380 ft bgs). Tritium activities in vapor-monitoring wells 21-603059 and 21-25262 show similar trends to each other, overall, with depth and sampling event. Except for the tritium spike in vapor-monitoring well 21-25262 at 234 ft bgs in June 2009, tritium activities in both vapor-monitoring wells consistently increase with depth to approximately 380 ft bgs, which is the TD of vapor-monitoring well 21-603059. Tritium activities then decrease with depth to TD in well 21-25262. Tritium activities in vapor-monitoring wells 21-603058 and 21-25264 both show tritium spikes at near-surface depths, similar to the June 2009 spike in vapor-monitoring well 21-25262.

6.4 Time-Dependent Vapor Analysis

To determine whether trends observed for the nature and extent of vapor contamination remain consistent with time, data obtained during eight rounds of vapor sampling in vapor-monitoring wells 21-25264, 21-603058, and 21-603059 were evaluated for temporal variability. Data obtained from vapor-monitoring well 21-25262 are not included in this evaluation because only two sampling rounds are completed to date.

Although scatter is seen in the time sequences of concentrations of all VOCs in vapor-monitoring wells 21-25264, 21-603058, and 21-603059, few trends are apparent. Correlations are found between changes in concentration for the five representative VOCs. These correlations and trends are discussed for both VOCs and tritium in the sections below.

6.4.1 VOCs

In general, time-averaged concentrations of the five representative VOCs remained relatively stable with time from round 1 to round 8, with average concentrations fluctuating by factors of 2.4 in vapor-monitoring well 21-25264, 2.5 in vapor-monitoring well 21-603058, and 1.8 in vapor-monitoring well 21-603059. As illustrated in Figures 6.4-1 through 6.4-3, no overall consistently increasing or decreasing concentration trend is observed in any of the vapor-monitoring wells with more than two sampling events, with the possible exceptions of PCE and TCE in vapor-monitoring well 21-25264. In vapor-monitoring well 21-25264, PCE and TCE concentrations increase with sampling event in samples collected at the shallowest ports (Figure 6.4-1). These are the only apparent monotonic trends observed for any VOC in any port for the MDA T vapor-monitoring well network.

For any given port in a particular vapor-monitoring well, the VOC concentration changes with time are well correlated among the five representative VOCs. To illustrate this correlation, three examples are provided in Figure 6.4-4 for three ports (shallow, medium, and deep) in vapor-monitoring well 21-25264. In general, the concentration changes with time among the five representative VOCs were least correlated at the shallower depths, as noted in the PCE/TCE concentration trends discussed above.

Further, the correlation between the average concentrations for each of the five representative VOCs over time remains relatively consistent, regardless of depth, as illustrated in Figure 6.4-5. This correlation between VOCs in any given well over time may indicate either (1) VOC vapors undergo physical changes in concentration with time that are identical for each the five representative VOCs identified or (2) these variations with time represent a systematic change in ambient conditions in and around the vapor-monitoring wells, such as seasonal variability.

Each MDA T vapor-monitoring well (Figure 6.4-5) shows a different pattern of VOC concentration through time, implying that the observed systematic variations with time are most likely caused by factor(s) that are well-dependent and less likely by sitewide conditions. The sum of the average VOC concentrations for the five representative analytes are presented in Figure 6.4-6.

Finally, to illustrate time-dependent trends between individual ports, the total VOC concentrations with depth over time for vapor-monitoring wells 21-25264, 21-603058, and 21-603059 are presented in Figure 6.4-7. Total VOC concentrations are calculated by summing the concentrations in micrograms per cubic meter of all chemicals analyzed for in the pore gas; nondetections are assigned the value of their respective SQL. The data indicate that VOC concentrations beneath MDA T are relatively stable; there are no clear trends that indicate any marked changes in either VOC concentration or movement over time.

6.4.2 Tritium

Tritium activities vary widely over time, increasing by as much as a factor of 60 between adjacent sampling events for a given port and vapor-monitoring well. Plots of tritium activity versus time from each port for vapor-monitoring wells 21-25264, 21-603058, and 21-603059 are provided in Figure 6.4-8. Total average tritium activity versus time for each vapor-monitoring well is shown in Figure 6.4-9.

No overall monotonic trends are observed in tritium activities, with the possible exception of tritium activities in vapor-monitoring well 21-25264. In vapor-monitoring well 21-25264, average well tritium activities generally appear to illustrate an overall increase with time, independent of depth, as illustrated in Figure 6.4-8.

6.5 VOC Screening Evaluation

All VOC pore-gas results from MDA T were screened to evaluate whether the concentrations of VOCs are a potential source of groundwater contamination. Because no SLs for pore gas address the potential for groundwater contamination, the screening evaluation was based on groundwater standards or tap water SLs and Henry's law constant that govern the equilibrium relationship between vapor and aqueous concentrations. All pore-gas data collected from vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059 from October 2007 to July 2009 were included in the evaluation.

Equation 5.1-3 was used to calculate SVs for the maximum concentrations of 33 out of 38 VOCs detected in MDA T pore gas. Ethanol, 4-ethyltoluene, 2-hexanone, 2-propanol, and propylene were also detected in MDA T pore gas, but these VOCs do not have MCLs, NMWQCC standards, or EPA SLs and therefore were not included in the evaluation.

Table 6.5-1 presents the results of the pore-gas screening. SVs were less than 1.0 for all detected VOCs except for three VOCs. The concentration of PCE in 1 out of 134 samples resulted in an SV equal to 1.0. The concentration of methylene chloride in 43 out of 134 samples collected resulted in an SV greater than 1.0, with a maximum value of 3.85. The concentration of 1,1,2-trichloroethane in 1 out of 134 samples resulted in an SV greater than 1.0, a value of 1.18.

Previous screening evaluations performed for MDA T pore gas identified only methylene chloride at concentrations that resulted in an SV greater than or equal to 1.0 (LANL 2009, 105187; LANL 2009, 106665). PCE and 1,1,2-trichloroethane concentrations resulting in SVs greater than or equal to 1.0 are a result of recently revised Henry's law constant (NMED 2009, 106420).

Table 6.5-2 presents the results of a screening evaluation performed for methylene chloride, PCE, and 1,1,2-trichloroethane at the deepest sample collected at MDA T (691 ft bgs in vapor-monitoring well 21-25262). At this depth, methylene chloride had a maximum concentration of 140 $\mu g/m^3$, resulting in an SV of 0.22; PCE had a maximum concentration of 7.2 $\mu g/m^3$, resulting in an SV of 0.002; and 1,1,2-trichloroethane had a maximum concentration of 21 $\mu g/m^3$, resulting in an SV of 0.12.

7.0 CONCLUSIONS

Specific objectives of the Phase III investigation are to (1) establish the nature and extent of VOC and tritium vapors beneath MDA T, (2) ascertain the source(s) for vapor-phase contamination, (3) project vapor-phase behavior beneath MDA T over time, and (4) confirm the nature and extent of specific inorganic, organic, and radioactive COPCs in the MDA T subsurface identified by previous investigations. The following sections describe progress toward meeting these objectives.

7.1 Summary of Investigations

The following 2009–2010 investigation activities have been completed to date.

- BH 21-25262 was advanced to a TD of ~695 ft bgs, with core samples taken between 390 ft bgs and TD. A single packer sample for pore gas was obtained at ~680 ft bgs; a permanent vapor-monitoring system was installed; and pore gas was sampled for two rounds (June and July 2009).
- Permanent vapor-monitoring wells 21-25264, 21-603058, and 21-603059 were sampled for an additional four rounds in 2009 (February, April, June, and July).

The 2009 analytical results identified a total of four inorganic, one organic, one radionuclide (tritium) COPCs in solid media and 29 organic COPCs plus tritium in pore gas. Since 2007, a total of 38 organic COPCs have been identified in MDA T pore gas.

7.1.1 Solid Media

Six COPCs were identified in 2009 core samples (fluoride, sulfate, nitrate, perchlorate, acetone, and tritium). The nature and extent of these COPCs is defined either because the COPC shows an apparent decrease with depth (e.g., fluoride and sulfate) or because the COPC is not detected at TD (nitrate, perchlorate, acetone, and tritium).

7.1.2 Subsurface Vapor

Of the 38 VOCs identified in pore gas at MDA T, only 5 (carbon tetrachloride, chloroform, methylene chloride, PCE, and TCE) are consistently detected above trace concentrations in each sampling round; therefore, these 5 VOCs were chosen to analyze vertical, lateral, and temporal trends at MDA T. Concentrations of the five representative VOCs decrease with depth in vapor-monitoring well 21-25262; therefore, the vertical extent at vapor-monitoring well 21-25262 is defined. However, the maximum vertical and lateral extent of VOC contamination in pore gas for the MDA T site as a whole as well as precise contamination source(s) were not conclusively identified. The addition of the North Perimeter Road borehole (location 21-607955) will provide additional lateral extent information and will provide data to corroborate the vertical extent; therefore, additional evaluation of nature and extent of pore gas at MDA T will be presented in a report following completion of all planned vapor-monitoring activities.

The extent of tritium in the subsurface at MDA T is defined. However, the completion and sampling of the North Perimeter Road borehole (location 21-607955) will provide additional information about tritium activities at MDA T that may confirm current results.

A screening evaluation was performed on VOC pore-gas data to determine the potential contamination of groundwater. Of the 38 VOC COPCs identified, 2 (methylene chloride and 1,1,2-trichloroethane) had maximum concentrations resulting in an SV greater than 1.0, and PCE had a maximum concentration resulting in an SV of 1.0 in one sample. At the greatest depth sampled (691 ft bgs in vapor-monitoring well 21-25262) these three COPCs had concentrations resulting in SVs well below 1.0.

The concentration trends in pore gas, particularly of the VOC data, may also provide additional insight on the current conceptual site model for vapor migration at MDA T. At vapor-monitoring well 21-25262, the concentrations of the five representative VOCs decrease with depth to TD (vapor Port 9; 691 ft bgs). Vapor Port 9 is installed in the well-sorted, nonwelded Guaje Pumice Bed, whereas the shallower ports (except for vapor Port 6 in Qct) are installed either in the poorly welded ash-flows of Qbo or in the variably welded ash-flow units of Qbt. It is possible that the relatively higher effective permeability of the Guaje

Pumice Bed bounds the continued downward migration of chemicals in subsurface vapor beneath MDA T by providing a preferred vapor migration pathway via lateral diffusion.

8.0 RECOMMENDATIONS

Data collected from 2007 to 2009 at MDA T have characterized the nature and extent of COPCs in the subsurface for solid media; characterization of the nature and extent of COPCs in pore gas remains incomplete. The completion and sampling of the North Perimeter Road borehole (location 21-607955) will provide additional data on the COPC distribution in MDA T subsurface vapor. Based on analytical results obtained from current and past investigations, the recommended course of action at MDA T is to continue with Phase III investigation work plan activities as follows:

- complete the North Perimeter Road borehole (location 21-607955) to a TD of ~950 ft bgs, install a permanent vapor-monitoring system, and collect monthly samples for up to 1 yr
- continue monthly monitoring in permanent vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059 through June 2010

Upon the completion of all Phase III activities, analytical results will be (re)evaluated to determine if it is necessary to continue sample collection from vapor-monitoring wells 21-25264, 21-603058, and 21-603059. After data have been collected from future vapor monitoring well 21-607955, in conjunction with the other four vapor-monitoring wells at MDA T, a more comprehensive distribution pattern may emerge.

9.0 REFERENCES AND MAP DATA SOURCES

9.1 References

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

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9.2 Map Data Sources

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

Legend Item/Type	Data Source
Rio Grande	Drainage Arcs; Los Alamos National Laboratory; Water Quality and Hydrology Group; 03 June 2003
LANL boundary	LANL Areas Used and Occupied; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 19 September 2007.
TA boundary	Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 19 September 2007.
NES boundary	Nuclear Environmental Sites; Los Alamos National Laboratory, EP Environment and Remediation Support Services Division, EP2006-1092; 1:2,500 Scale Data; 11 January 2007.
Major paved road	New Mexico roads; Earth Data Analysis Center, Albuquerque, NM; 01 December1995.
Paved road	Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 January 2008.
Dirt road	Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 January 2008.
Structure	Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 January 2008.
Former structure	Former Structures; Los Alamos National Laboratory, Waste and Environmental Services Division, EP2008-0441; 1:2,500 Scale Data; 08 August 2008.
Waste storage features	Waste Storage Features; Los Alamos National Laboratory, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007.

Legend Item/Type	Data Source
Contours	Hypsography, 100, 20, and 10 Foot Contour Intervals; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.
Fence	Security and Industrial Fences and Gates; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Revised MDA T fence	Revised MDA T Fencing; Los Alamos National Laboratory, Waste and Environmental Services Division, unpublished data, personal communication with N. Plannerer.
Gas line	Primary Gas Distribution Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Water line	Water Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Electric line	Primary Electric Grid; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Sewer line	Sewer Line System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Steam line	Steam Line Distribution System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Communication line	Communication Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 08 August 2002; as published 28 May 2009.
Building-associated features /structures	Primary Landscape Features; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Sampling locations	Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, Waste and Environmental Services Division, EP2008-0109; 4 June 2009.

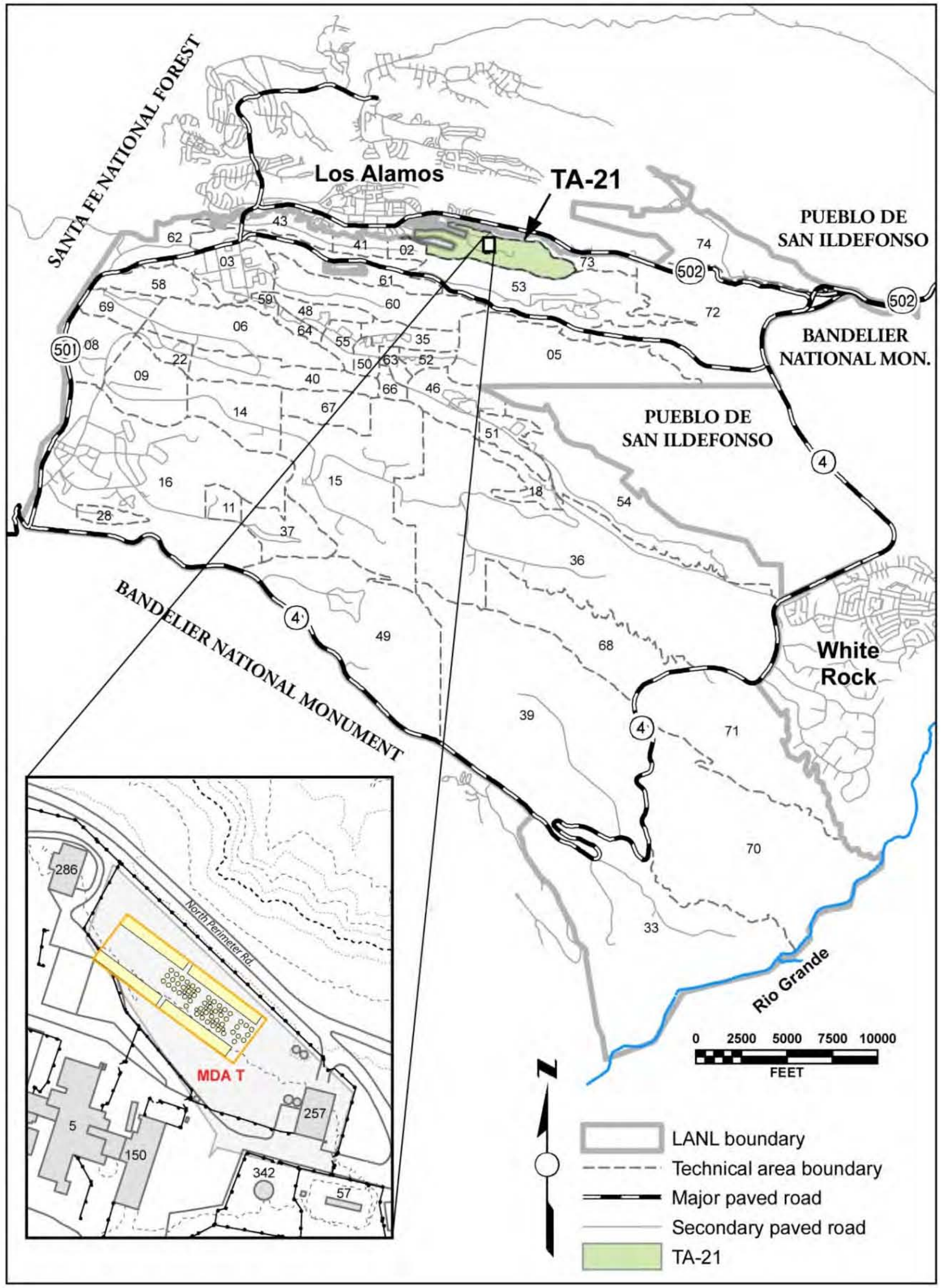


Figure 2.0-1 Location of MDA T at TA-21

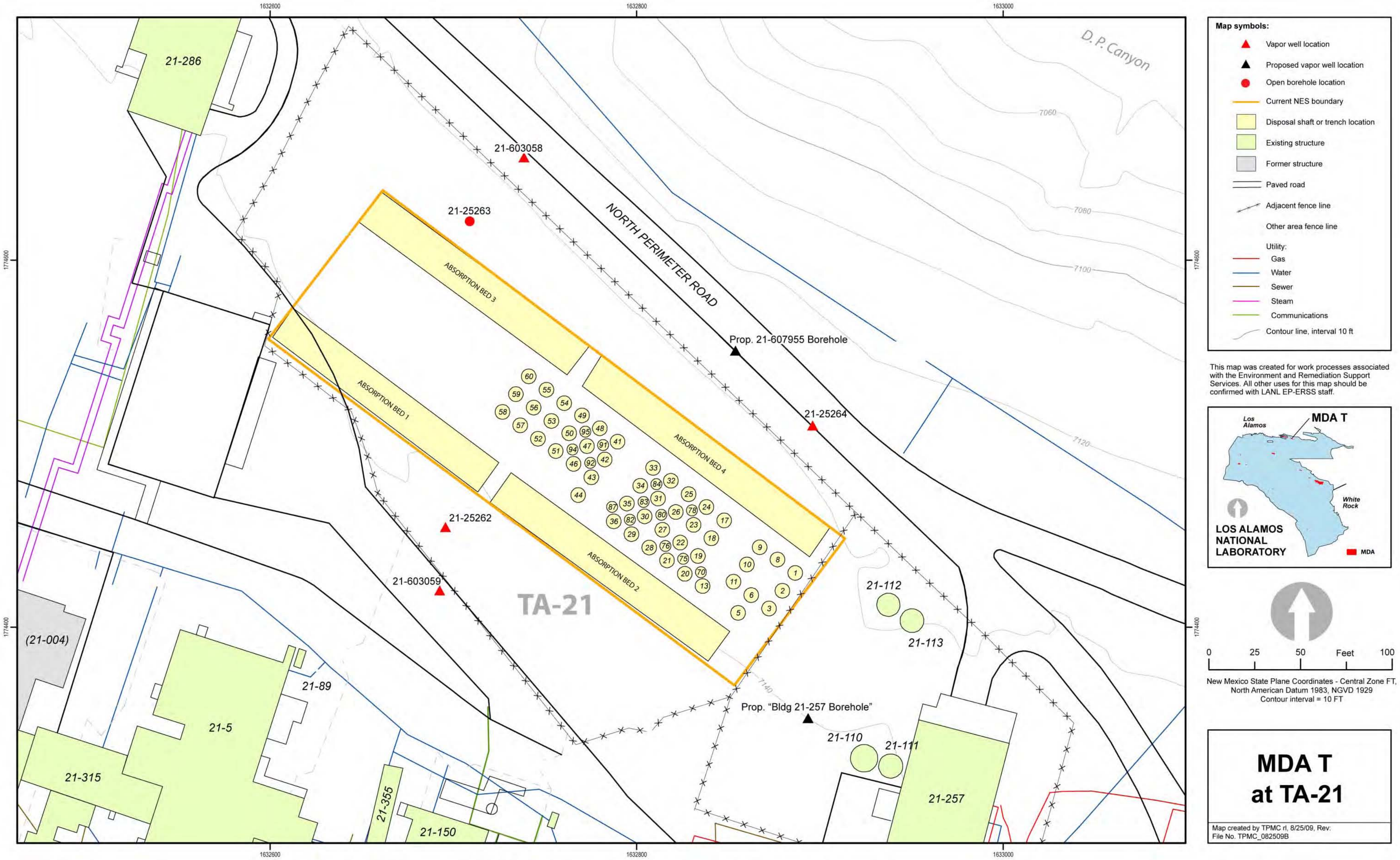


Figure 2.0-2 Location of MDA T vapor-monitoring wells and associated structures and features

Bandelier Tuff	Tshirege Member (Qbt)	Qbt 4	Ash-Flow Units
		Qbt 3	
		Qbt 2	
		Qbt 1v	
		Qbt 1g	
		Tsankawi Pumice Bed	
Cerro Toledo Interval (Qct)		Volcaniclastic Sediments and Ash-Falls	
Bandelier Tuff	Otowi Member (Qbo)	Ash-Flow Units	
		Guaje Pumice Bed (Qbog)	
Puye Formation (Tp)	Fanglomerate	Fanglomerate Facies includes sand, gravel, conglomerate, and tuffaceous sediments	
	Basalt and Andesite	Cerros del Rio Basalts intercalated within the Puye Formation, includes up to four interlayered basaltic flows. Andesites of the Tschicoma Formation present in western part of plateau	
	Fanglomerate	Fanglomerate Facies includes sand, gravel, conglomerate, and tuffaceous sediments; includes “Old Alluvium”	
	Axial facies deposits of the ancestral Rio Grande	Totavi Lentil	
Santa Fe Group	Coarse Sediments	Coarse-Grained Upper Facies (formerly called the “Chaquehui Formation” by Purtymun 1995, 045344)	
	Basalt		
	Coarse Sediments		
	Basalt		
	Coarse Sediments		
	Basalt		
	Coarse Sediments		
	Arkosic clastic sedimentary deposits	Undivided Santa Fe Group (includes Chamita[?] and Tesuque Formations)	

Adapted from (LANL 1999, 064617).

Figure 4.1-1 Generalized stratigraphy of bedrock geologic units of the Pajarito Plateau

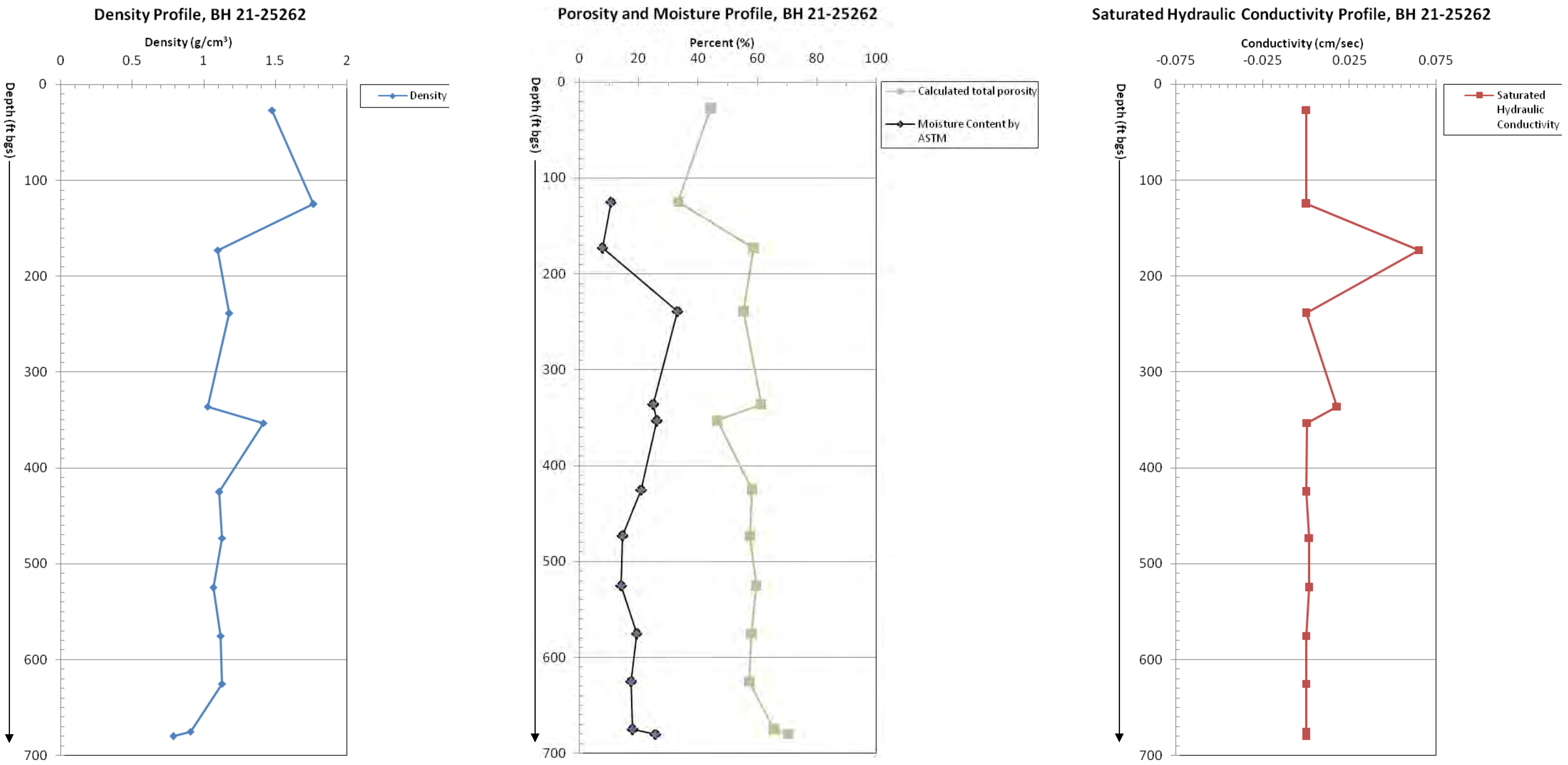
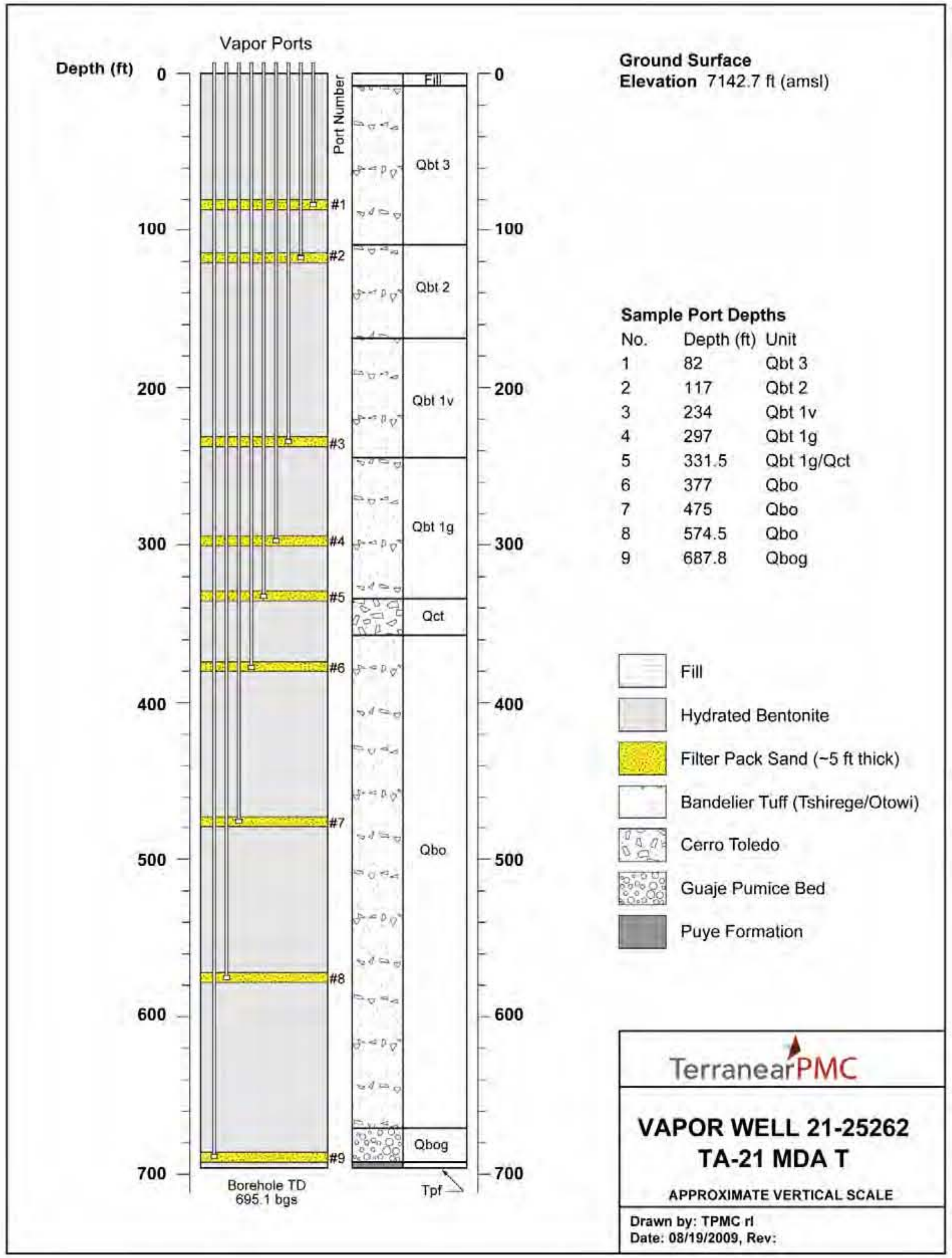


Figure 4.1-2 Depth profiles of reported density, calculated porosity, moisture, and saturated hydraulic conductivity for BH 21-25262



Sample Port Depths

No.	Depth (ft)	Unit
1	82	Qbt 3
2	117	Qbt 2
3	234	Qbt 1v
4	297	Qbt 1g
5	331.5	Qbt 1g/Qct
6	377	Qbo
7	475	Qbo
8	574.5	Qbo
9	687.8	Qbog

Figure 4.1-3 **Well 21-25262 as-built well construction diagram**

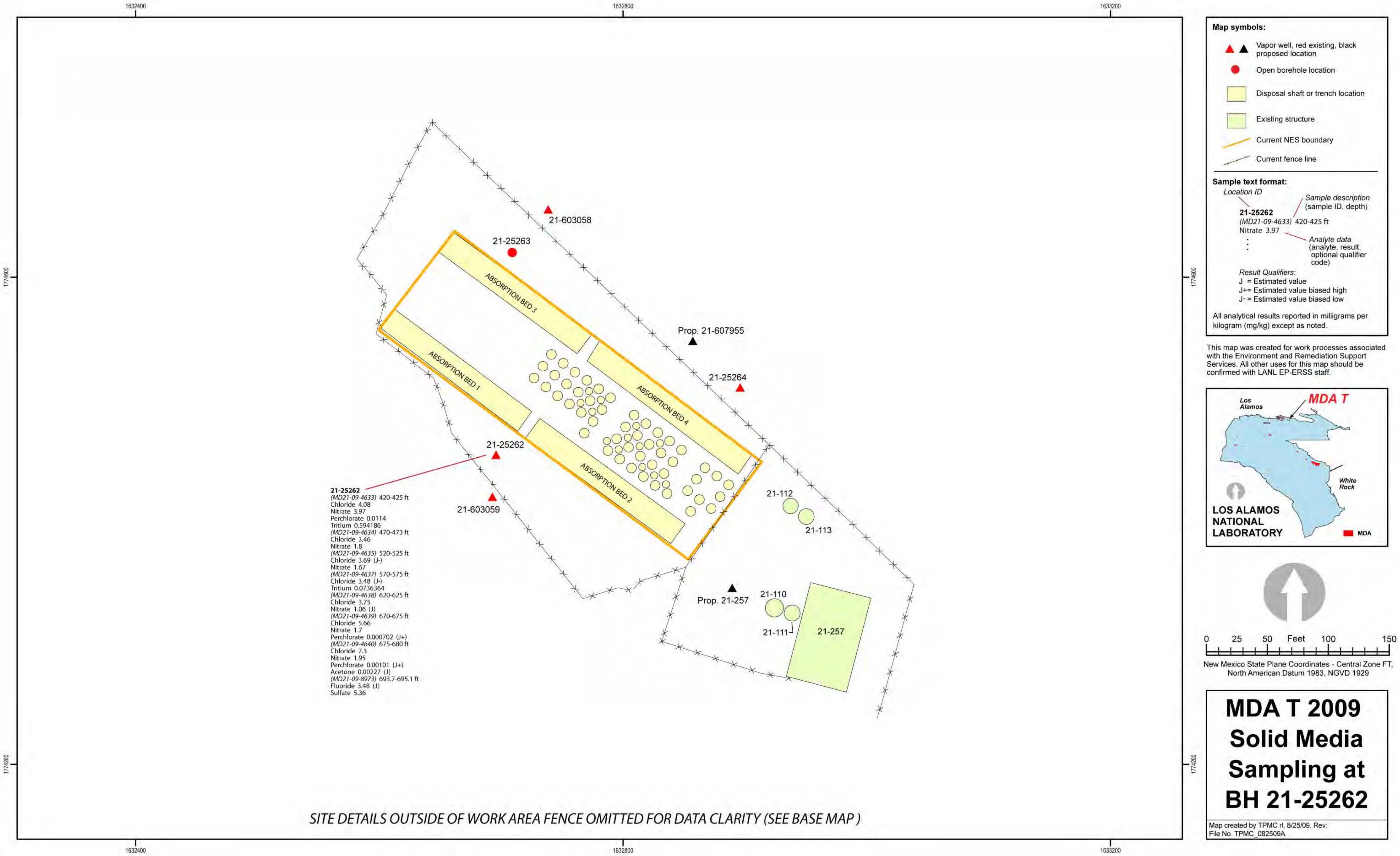
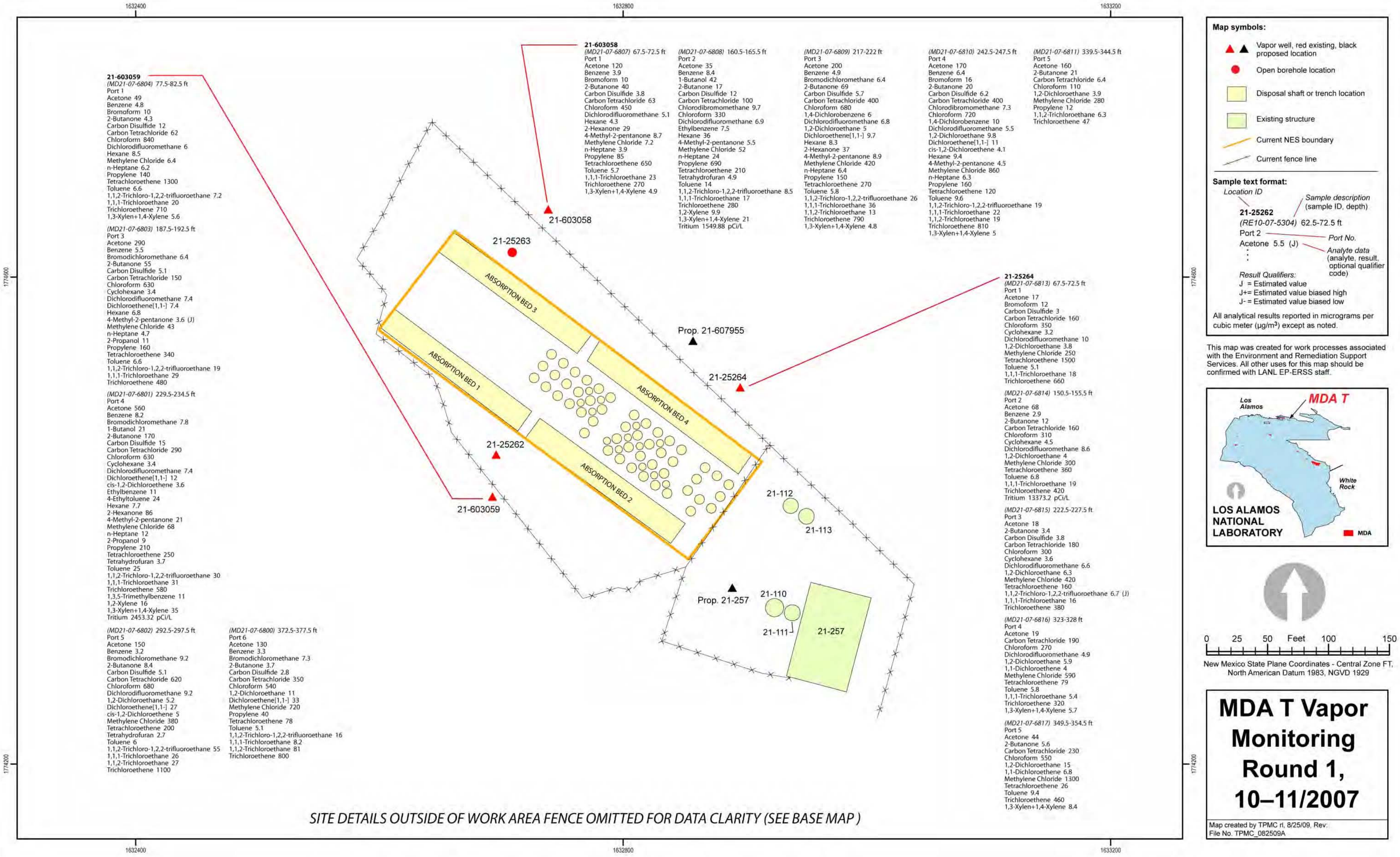


Figure 6.1-1 VOCs, tritium, and inorganic chemicals detected in the 2009 core samples collected at MDA T



21-603059
(MD21-07-6804) 77.5-82.5 ft
Port 1
Acetone 49
Benzene 4.8
Bromoform 10
2-Butanone 4.3
Carbon Disulfide 12
Carbon Tetrachloride 62
Chloroform 840
Dichlorodifluoromethane 6
Hexane 8.5
Methylene Chloride 6.4
n-Heptane 6.2
Propylene 140
Tetrachloroethene 1300
Toluene 6.6
1,1,2-Trichloro-1,2,2-trifluoroethane 7.2
1,1,1-Trichloroethane 20
Trichloroethene 710
1,3-Xylen+1,4-Xylene 5.6

(MD21-07-6803) 187.5-192.5 ft
Port 3
Acetone 290
Benzene 5.5
Bromodichloromethane 6.4
2-Butanone 55
Carbon Disulfide 5.1
Carbon Tetrachloride 150
Chloroform 630
Cyclohexane 3.4
Dichlorodifluoromethane 7.4
Dichloroethene[1,1-] 7.4
Hexane 6.8
4-Methyl-2-pentanone 3.6 (J)
Methylene Chloride 43
n-Heptane 4.7
2-Propanol 11
Propylene 160
Tetrachloroethene 340
Toluene 6.6
1,1,2-Trichloro-1,2,2-trifluoroethane 19
1,1,1-Trichloroethane 29
Trichloroethene 480

(MD21-07-6801) 229.5-234.5 ft
Port 4
Acetone 560
Benzene 8.2
Bromodichloromethane 7.8
1-Butanol 21
2-Butanone 170
Carbon Disulfide 15
Carbon Tetrachloride 290
Chloroform 630
Cyclohexane 3.4
Dichlorodifluoromethane 7.4
Dichloroethene[1,1-] 12
cis-1,2-Dichloroethene 3.6
Ethylbenzene 11
4-Ethyltoluene 24
Hexane 7.7
2-Hexanone 86
4-Methyl-2-pentanone 21
Methylene Chloride 68
n-Heptane 12
2-Propanol 9
Propylene 210
Tetrachloroethene 250
Tetrahydrofuran 3.7
Toluene 25
1,1,2-Trichloro-1,2,2-trifluoroethane 30
1,1,1-Trichloroethane 31
Trichloroethene 580
1,3,5-Trimethylbenzene 11
1,2-Xylene 16
1,3-Xylen+1,4-Xylene 35
Tritium 2453.32 pCi/L

(MD21-07-6802) 292.5-297.5 ft
Port 5
Acetone 150
Benzene 3.2
Bromodichloromethane 9.2
2-Butanone 8.4
Carbon Disulfide 5.1
Carbon Tetrachloride 620
Chloroform 680
Dichlorodifluoromethane 9.2
1,2-Dichloroethane 5.2
Dichloroethene[1,1-] 27
cis-1,2-Dichloroethene 5
Methylene Chloride 380
Tetrachloroethene 200
Tetrahydrofuran 2.7
Toluene 6
1,1,2-Trichloro-1,2,2-trifluoroethane 55
1,1,1-Trichloroethane 26
1,1,2-Trichloroethane 27
Trichloroethene 1100

(MD21-07-6800) 372.5-377.5 ft
Port 6
Acetone 130
Benzene 3.3
Bromodichloromethane 7.3
2-Butanone 3.7
Carbon Disulfide 2.8
Carbon Tetrachloride 350
Chloroform 540
1,2-Dichloroethane 11
Dichloroethene[1,1-] 33
Methylene Chloride 720
Propylene 40
Tetrachloroethene 78
Toluene 5.1
1,1,2-Trichloro-1,2,2-trifluoroethane 16
1,1,1-Trichloroethane 8.2
1,1,2-Trichloroethane 81
Trichloroethene 800

21-603058
(MD21-07-6807) 67.5-72.5 ft
Port 1
Acetone 120
Benzene 3.9
Bromoform 10
2-Butanone 40
Carbon Disulfide 3.8
Carbon Tetrachloride 63
Chloroform 450
Dichlorodifluoromethane 5.1
Hexane 4.3
2-Hexanone 29
4-Methyl-2-pentanone 8.7
Methylene Chloride 7.2
n-Heptane 3.9
Propylene 85
Tetrachloroethene 650
Toluene 5.7
1,1,1-Trichloroethane 23
Trichloroethene 270
1,3-Xylen+1,4-Xylene 4.9

(MD21-07-6808) 160.5-165.5 ft
Port 2
Acetone 35
Benzene 8.4
1-Butanol 42
2-Butanone 17
Carbon Disulfide 12
Carbon Tetrachloride 100
Chlorodibromomethane 9.7
Chloroform 330
Dichlorodifluoromethane 6.9
Ethylbenzene 7.5
Hexane 36
4-Methyl-2-pentanone 5.5
Methylene Chloride 52
n-Heptane 24
Propylene 690
Tetrachloroethene 210
Tetrahydrofuran 4.9
Toluene 14
1,1,2-Trichloro-1,2,2-trifluoroethane 8.5
1,1,1-Trichloroethane 17
Trichloroethene 280
1,2-Xylene 9.9
1,3-Xylen+1,4-Xylene 21
Tritium 1549.88 pCi/L

(MD21-07-6809) 217-222 ft
Port 3
Acetone 200
Benzene 4.9
Bromodichloromethane 6.4
2-Butanone 69
Carbon Disulfide 5.7
Carbon Tetrachloride 400
Chloroform 680
1,4-Dichlorobenzene 6
Dichlorodifluoromethane 6.8
1,2-Dichloroethane 5
Dichloroethene[1,1-] 9.7
Hexane 8.3
2-Hexanone 37
4-Methyl-2-pentanone 8.9
Methylene Chloride 420
n-Heptane 6.4
Propylene 150
Tetrachloroethene 270
Toluene 5.8
1,1,2-Trichloro-1,2,2-trifluoroethane 26
1,1,1-Trichloroethane 36
1,1,2-Trichloroethane 13
Trichloroethene 790
1,3-Xylen+1,4-Xylene 4.8

(MD21-07-6810) 242.5-247.5 ft
Port 4
Acetone 170
Benzene 6.4
Bromoform 16
2-Butanone 20
Carbon Disulfide 6.2
Carbon Tetrachloride 400
Chlorodibromomethane 7.3
Chloroform 720
1,4-Dichlorobenzene 10
Dichlorodifluoromethane 5.5
1,2-Dichloroethane 9.8
Dichloroethene[1,1-] 11
cis-1,2-Dichloroethene 4.1
Hexane 9.4
4-Methyl-2-pentanone 4.5
Methylene Chloride 860
n-Heptane 6.3
Propylene 160
Tetrachloroethene 120
Toluene 9.6
1,1,2-Trichloro-1,2,2-trifluoroethane 19
1,1,1-Trichloroethane 22
1,1,2-Trichloroethane 19
Trichloroethene 810
1,3-Xylen+1,4-Xylene 5

(MD21-07-6811) 339.5-344.5 ft
Port 5
Acetone 160
2-Butanone 21
Carbon Tetrachloride 6.4
Chloroform 110
1,2-Dichloroethane 3.9
Methylene Chloride 280
Propylene 12
1,1,2-Trichloroethane 6.3
Trichloroethene 47

21-25264
(MD21-07-6813) 67.5-72.5 ft
Port 1
Acetone 17
Bromoform 12
Carbon Disulfide 3
Carbon Tetrachloride 160
Chloroform 350
Cyclohexane 3.2
Dichlorodifluoromethane 10
1,2-Dichloroethane 3.8
Methylene Chloride 250
Tetrachloroethene 1500
Toluene 5.1
1,1,1-Trichloroethane 18
Trichloroethene 660

(MD21-07-6814) 150.5-155.5 ft
Port 2
Acetone 68
Benzene 2.9
2-Butanone 12
Carbon Tetrachloride 160
Chloroform 310
Cyclohexane 4.5
Dichlorodifluoromethane 8.6
1,2-Dichloroethane 4
Methylene Chloride 300
Tetrachloroethene 360
Toluene 6.8
1,1,1-Trichloroethane 19
Trichloroethene 420
Tritium 13373.2 pCi/L

(MD21-07-6815) 222.5-227.5 ft
Port 3
Acetone 18
2-Butanone 3.4
Carbon Disulfide 3.8
Carbon Tetrachloride 180
Chloroform 300
Cyclohexane 3.6
Dichlorodifluoromethane 6.6
1,2-Dichloroethane 6.3
Methylene Chloride 420
Tetrachloroethene 160
1,1,2-Trichloro-1,2,2-trifluoroethane 6.7 (J)
1,1,1-Trichloroethane 16
Trichloroethene 380

(MD21-07-6816) 323-328 ft
Port 4
Acetone 19
Carbon Tetrachloride 190
Chloroform 270
Dichlorodifluoromethane 4.9
1,2-Dichloroethane 5.9
1,1-Dichloroethene 4
Methylene Chloride 590
Tetrachloroethene 79
Toluene 5.8
1,1,1-Trichloroethane 5.4
Trichloroethene 320
1,3-Xylen+1,4-Xylene 5.7

(MD21-07-6817) 349.5-354.5 ft
Port 5
Acetone 44
2-Butanone 5.6
Carbon Tetrachloride 230
Chloroform 550
1,2-Dichloroethane 15
1,1-Dichloroethene 6.8
Methylene Chloride 1300
Tetrachloroethene 26
Toluene 9.4
Trichloroethene 460
1,3-Xylen+1,4-Xylene 8.4

SITE DETAILS OUTSIDE OF WORK AREA FENCE OMITTED FOR DATA CLARITY (SEE BASE MAP)

Map symbols:
▲ ▲ Vapor well, red existing, black proposed location
● Open borehole location
🟨 Disposal shaft or trench location
🟩 Existing structure
Current NES boundary
Current fence line

Sample text format:
Location ID
Sample description (sample ID, depth)
21-25262
(RE10-07-5304) 62.5-72.5 ft
Port 2 — Port No.
Acetone 5.5 (J) — Analyte data (analyte, result, optional qualifier code)
⋮
Result Qualifiers:
J = Estimated value
J+= Estimated value biased high
J- = Estimated value biased low

All analytical results reported in micrograms per cubic meter (µg/m³) except as noted.

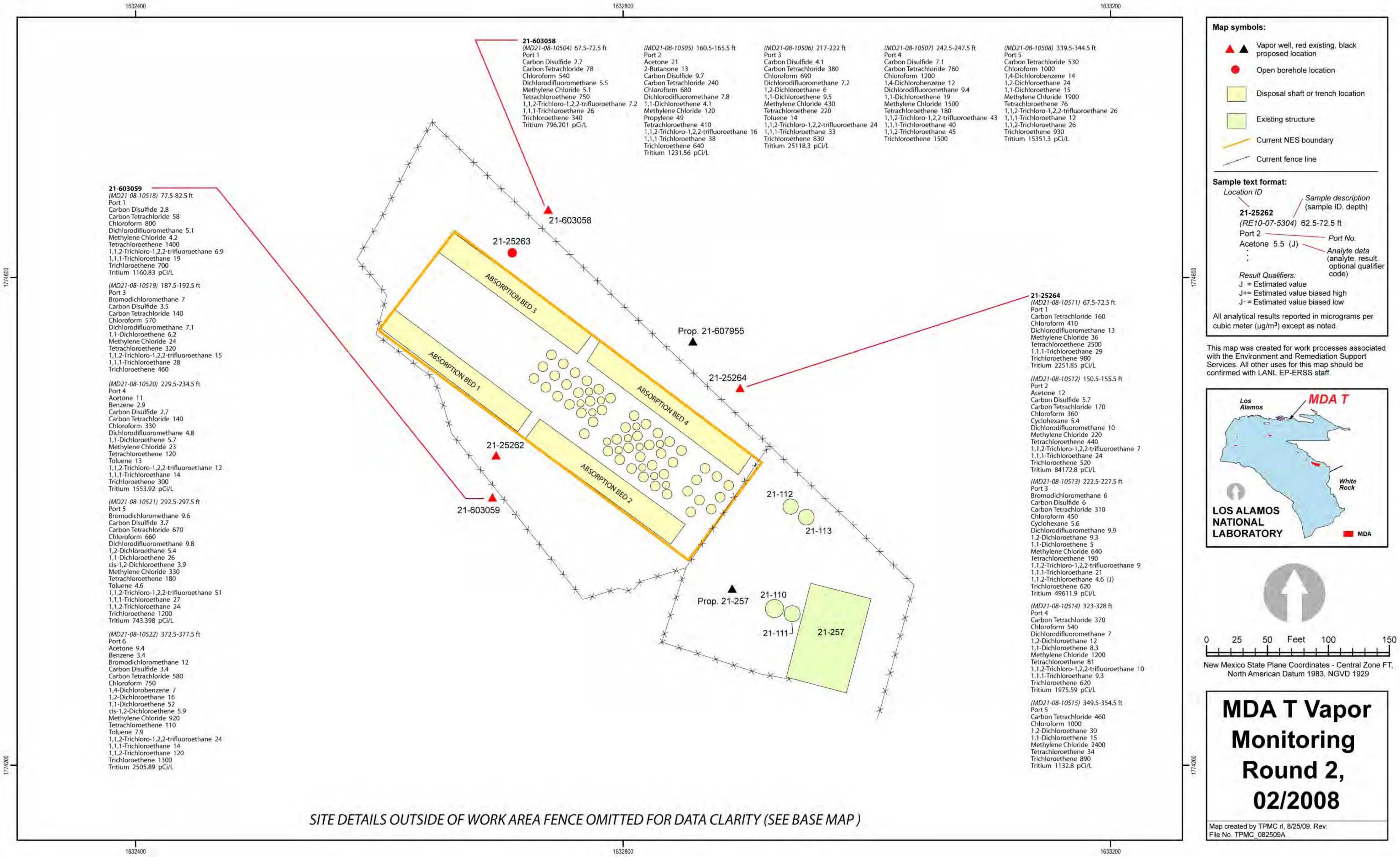
This map was created for work processes associated with the Environment and Remediation Support Services. All other uses for this map should be confirmed with LANL EP-ERSS staff.

New Mexico State Plane Coordinates - Central Zone FT, North American Datum 1983, NGVD 1929

MDA T Vapor Monitoring Round 1, 10–11/2007

Map created by TPMC rl, 8/25/09, Rev:
File No. TPMC_082509A

Figure 6.1-2 Tritium and VOCs detected in MDA T pore gas round 1, October 2007



21-603058
(MD21-08-10504) 67.5-72.5 ft
Port 1
Carbon Disulfide 2.7
Carbon Tetrachloride 78
Chloroform 540
Dichlorodifluoromethane 5.5
Methylene Chloride 5.1
Tetrachloroethene 750
1,1,2-Trichloro-1,2,2-trifluoroethane 7.2
1,1,1-Trichloroethane 26
Trichloroethene 340
Tritium 796.201 pCi/L

(MD21-08-10505) 160.5-165.5 ft
Port 2
Acetone 21
2-Butanone 13
Carbon Disulfide 9.7
Carbon Tetrachloride 240
Chloroform 680
Dichlorodifluoromethane 7.8
1,1-Dichloroethene 4.1
Methylene Chloride 120
Propylene 49
Tetrachloroethene 410
1,1,2-Trichloro-1,2,2-trifluoroethane 16
1,1,1-Trichloroethane 38
Trichloroethene 640
Tritium 1231.56 pCi/L

(MD21-08-10506) 217-222 ft
Port 3
Carbon Disulfide 4.1
Carbon Tetrachloride 380
Chloroform 690
Dichlorodifluoromethane 7.2
1,2-Dichloroethane 6
1,1-Dichloroethene 9,5
Methylene Chloride 430
Tetrachloroethene 220
Toluene 14
1,1,2-Trichloro-1,2,2-trifluoroethane 24
1,1,1-Trichloroethane 33
Trichloroethene 830
Tritium 25118.3 pCi/L

(MD21-08-10507) 242.5-247.5 ft
Port 4
Carbon Disulfide 7.1
Carbon Tetrachloride 760
Chloroform 1200
1,4-Dichlorobenzene 12
Dichlorodifluoromethane 9.4
1,1-Dichloroethene 19
Methylene Chloride 1500
Tetrachloroethene 180
1,1,2-Trichloro-1,2,2-trifluoroethane 43
1,1,1-Trichloroethane 40
1,1,2-Trichloroethane 45
Trichloroethene 1500

(MD21-08-10508) 339.5-344.5 ft
Port 5
Carbon Tetrachloride 530
Chloroform 1000
1,4-Dichlorobenzene 14
1,2-Dichloroethane 24
1,1-Dichloroethene 15
Methylene Chloride 1900
Tetrachloroethene 76
1,1,2-Trichloro-1,2,2-trifluoroethane 26
1,1,1-Trichloroethane 12
1,1,2-Trichloroethane 26
Trichloroethene 930
Tritium 15351.3 pCi/L

21-603059
(MD21-08-10518) 77.5-82.5 ft
Port 1
Carbon Disulfide 2.8
Carbon Tetrachloride 58
Chloroform 800
Dichlorodifluoromethane 5.1
Methylene Chloride 4.2
Tetrachloroethene 1400
1,1,2-Trichloro-1,2,2-trifluoroethane 6.9
1,1,1-Trichloroethane 19
Trichloroethene 700
Tritium 1160.83 pCi/L

(MD21-08-10519) 187.5-192.5 ft
Port 3
Bromodichloromethane 7
Carbon Disulfide 3.5
Carbon Tetrachloride 140
Chloroform 570
Dichlorodifluoromethane 7.1
1,1-Dichloroethene 6.2
Methylene Chloride 24
Tetrachloroethene 320
1,1,2-Trichloro-1,2,2-trifluoroethane 15
1,1,1-Trichloroethane 28
Trichloroethene 460

(MD21-08-10520) 229.5-234.5 ft
Port 4
Acetone 11
Benzene 2.9
Carbon Disulfide 2.7
Carbon Tetrachloride 140
Chloroform 330
Dichlorodifluoromethane 4.8
1,1-Dichloroethene 5.7
Methylene Chloride 23
Tetrachloroethene 120
Toluene 13
1,1,2-Trichloro-1,2,2-trifluoroethane 12
1,1,1-Trichloroethane 14
Trichloroethene 300
Tritium 1553.92 pCi/L

(MD21-08-10521) 292.5-297.5 ft
Port 5
Bromodichloromethane 9.6
Carbon Disulfide 3.7
Carbon Tetrachloride 670
Chloroform 660
Dichlorodifluoromethane 9.8
1,2-Dichloroethane 5.4
1,1-Dichloroethene 26
cis-1,2-Dichloroethene 3.9
Methylene Chloride 330
Tetrachloroethene 180
Toluene 4.6
1,1,2-Trichloro-1,2,2-trifluoroethane 51
1,1,1-Trichloroethane 27
1,1,2-Trichloroethane 24
Trichloroethene 1200
Tritium 743.398 pCi/L

(MD21-08-10522) 372.5-377.5 ft
Port 6
Acetone 9.4
Benzene 3.4
Bromodichloromethane 12
Carbon Disulfide 3.4
Carbon Tetrachloride 580
Chloroform 750
1,4-Dichlorobenzene 7
1,2-Dichloroethane 16
1,1-Dichloroethene 52
cis-1,2-Dichloroethene 5.9
Methylene Chloride 920
Tetrachloroethene 110
Toluene 7.9
1,1,2-Trichloro-1,2,2-trifluoroethane 24
1,1,1-Trichloroethane 14
1,1,2-Trichloroethane 120
Trichloroethene 1300
Tritium 2505.89 pCi/L

21-25264
(MD21-08-10511) 67.5-72.5 ft
Port 1
Carbon Tetrachloride 160
Chloroform 410
Dichlorodifluoromethane 13
Methylene Chloride 36
Tetrachloroethene 2500
1,1,1-Trichloroethane 29
Trichloroethene 980
Tritium 2251.85 pCi/L

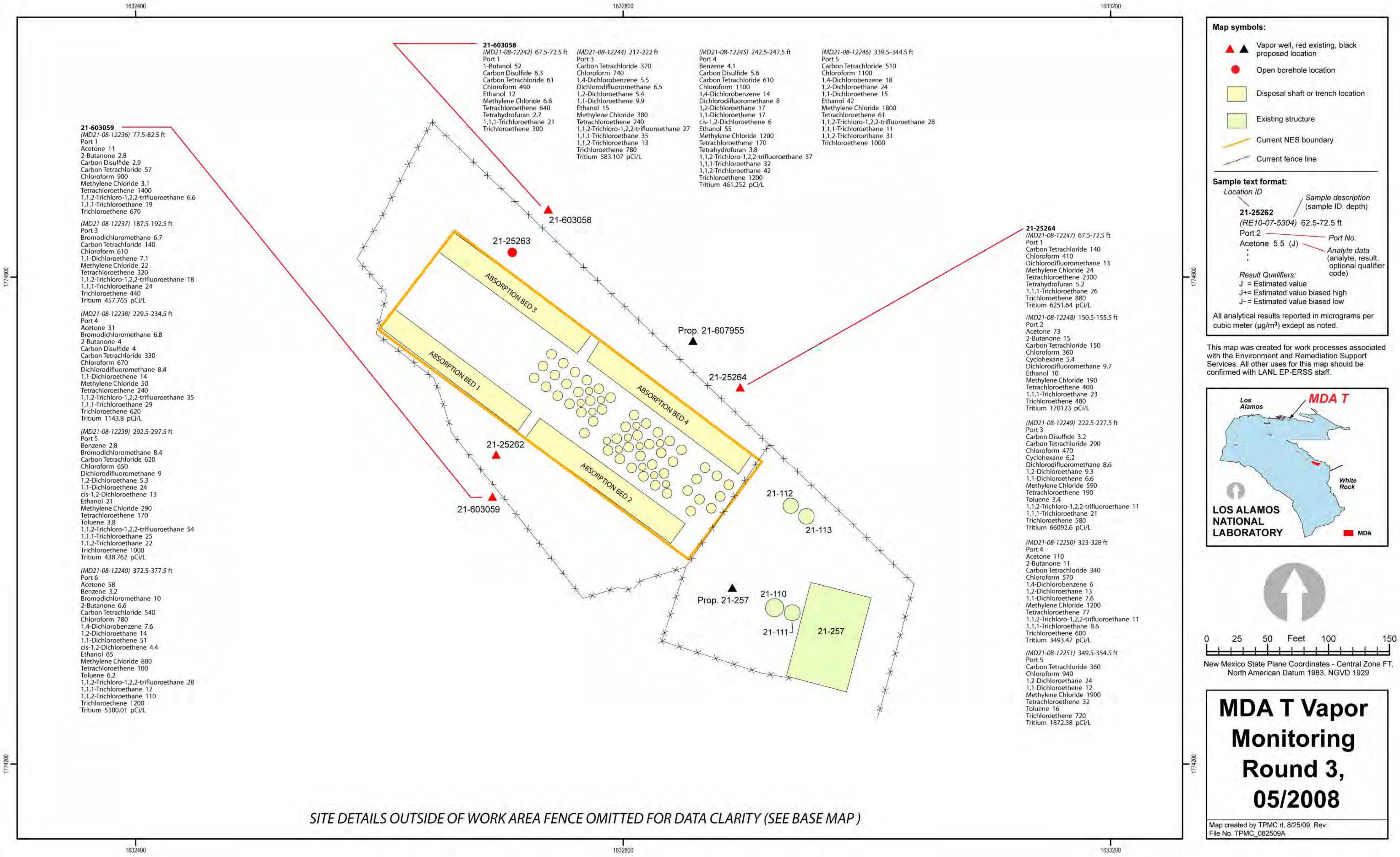
(MD21-08-10512) 150.5-155.5 ft
Port 2
Acetone 12
Carbon Disulfide 5.7
Carbon Tetrachloride 170
Chloroform 360
Cyclohexane 5.4
Dichlorodifluoromethane 10
Methylene Chloride 220
Tetrachloroethene 440
1,1,2-Trichloro-1,2,2-trifluoroethane 7
1,1,1-Trichloroethane 24
Trichloroethene 520
Tritium 84172.8 pCi/L

(MD21-08-10513) 222.5-227.5 ft
Port 3
Bromodichloromethane 6
Carbon Disulfide 6
Carbon Tetrachloride 310
Chloroform 450
Cyclohexane 5.6
Dichlorodifluoromethane 9.9
1,2-Dichloroethane 9.3
1,1-Dichloroethene 5
Methylene Chloride 640
Tetrachloroethene 190
1,1,2-Trichloro-1,2,2-trifluoroethane 9
1,1,1-Trichloroethane 21
1,1,2-Trichloroethane 4.6 (J)
Trichloroethene 620
Tritium 49611.9 pCi/L

(MD21-08-10514) 323-328 ft
Port 4
Carbon Tetrachloride 370
Chloroform 540
Dichlorodifluoromethane 7
1,2-Dichloroethane 12
1,1-Dichloroethene 8.3
Methylene Chloride 1200
Tetrachloroethene 81
1,1,2-Trichloro-1,2,2-trifluoroethane 10
1,1,1-Trichloroethane 9.3
Trichloroethene 620
Tritium 1975.59 pCi/L

(MD21-08-10515) 349.5-354.5 ft
Port 5
Carbon Tetrachloride 460
Chloroform 1000
1,2-Dichloroethane 30
1,1-Dichloroethene 15
Methylene Chloride 2400
Tetrachloroethene 34
Trichloroethene 890
Tritium 1132.8 pCi/L

Figure 6.1-3 Tritium and VOCs detected in MDA T pore gas round 2, February 2008



All analytical results reported in micrograms per cubic meter ($\mu g/m^3$) except as noted.

This map was created for work processes associated with the Environment and Remediation Support Services. All other uses for this map should be confirmed with LANL EP-ERSS staff.

21-603059
(MD21-08-12236) 77.5-82.5 ft
Port 1
Acetone 11
2-Butanone 2.8
Carbon Disulfide 2.9
Carbon Tetrachloride 57
Chloroform 900
Methylene Chloride 3.1
Tetrachloroethene 1400
1,1,2-Trichloro-1,2,2-trifluoroethane 6.6
1,1,1-Trichloroethane 19
Trichloroethene 670

(MD21-08-12237) 187.5-192.5 ft
Port 3
Bromodichloromethane 6.7
Carbon Tetrachloride 140
Chloroform 610
1,1-Dichloroethene 7.1
Methylene Chloride 22
Tetrachloroethene 320
1,1,2-Trichloro-1,2,2-trifluoroethane 18
1,1,1-Trichloroethane 24
Trichloroethene 440
Tritium 457.765 pCi/L

(MD21-08-12238) 229.5-234.5 ft
Port 4
Acetone 31
Bromodichloromethane 6.8
2-Butanone 4
Carbon Disulfide 4
Carbon Tetrachloride 330
Chloroform 670
Dichlorodifluoromethane 8.4
1,1-Dichloroethene 14
Methylene Chloride 50
Tetrachloroethene 240
1,1,2-Trichloro-1,2,2-trifluoroethane 35
1,1,1-Trichloroethane 29
Trichloroethene 620
Tritium 1143.8 pCi/L

(MD21-08-12239) 292.5-297.5 ft
Port 5
Benzene 2.8
Bromodichloromethane 8.4
Carbon Tetrachloride 620
Chloroform 650
Dichlorodifluoromethane 9
1,2-Dichloroethane 5.3
1,1-Dichloroethene 24
cis-1,2-Dichloroethene 13
Ethanol 21
Methylene Chloride 290
Tetrachloroethene 170
Toluene 3.8
1,1,2-Trichloro-1,2,2-trifluoroethane 54
1,1,1-Trichloroethane 25
1,1,2-Trichloroethane 22
Trichloroethene 1000
Tritium 438.762 pCi/L

(MD21-08-12240) 372.5-377.5 ft
Port 6
Acetone 58
Benzene 3.2
Bromodichloromethane 10
2-Butanone 6.6
Carbon Tetrachloride 540
Chloroform 780
1,4-Dichlorobenzene 7.6
1,2-Dichloroethane 14
1,1-Dichloroethene 51
cis-1,2-Dichloroethene 4.4
Ethanol 65
Methylene Chloride 880
Tetrachloroethene 100
Toluene 6.2
1,1,2-Trichloro-1,2,2-trifluoroethane 28
1,1,1-Trichloroethane 12
1,1,2-Trichloroethane 110
Trichloroethene 1200
Tritium 5380.01 pCi/L

21-603058
(MD21-08-12242) 67.5-72.5 ft
Port 1
1-Butanol 52
Carbon Disulfide 6.3
Carbon Tetrachloride 61
Chloroform 490
Ethanol 12
Methylene Chloride 6.8
Tetrachloroethene 640
Tetrahydrofuran 2.7
1,1,1-Trichloroethane 21
Trichloroethene 300

(MD21-08-12244) 217-222 ft
Port 3
Carbon Tetrachloride 370
Chloroform 740
1,4-Dichlorobenzene 5.5
Dichlorodifluoromethane 6.5
1,2-Dichloroethane 5.4
1,1-Dichloroethene 9.9
Ethanol 15
Methylene Chloride 380
Tetrachloroethene 240
1,1,2-Trichloro-1,2,2-trifluoroethane 27
1,1,1-Trichloroethane 35
1,1,2-Trichloroethane 13
Trichloroethene 780
Tritium 583.107 pCi/L

(MD21-08-12245) 242.5-247.5 ft
Port 4
Benzene 4.1
Carbon Disulfide 5.6
Carbon Tetrachloride 610
Chloroform 1100
1,4-Dichlorobenzene 14
Dichlorodifluoromethane 8
1,2-Dichloroethane 17
1,1-Dichloroethene 17
cis-1,2-Dichloroethene 6
Ethanol 55
Methylene Chloride 1200
Tetrachloroethene 170
Tetrahydrofuran 3.8
1,1,2-Trichloro-1,2,2-trifluoroethane 37
1,1,1-Trichloroethane 32
1,1,2-Trichloroethane 42
Trichloroethene 1200
Tritium 461.252 pCi/L

(MD21-08-12246) 339.5-344.5 ft
Port 5
Carbon Tetrachloride 510
Chloroform 1100
1,4-Dichlorobenzene 18
1,2-Dichloroethane 24
1,1-Dichloroethene 15
Ethanol 42
Methylene Chloride 1800
Tetrachloroethene 61
1,1,2-Trichloro-1,2,2-trifluoroethane 28
1,1,1-Trichloroethane 11
1,1,2-Trichloroethane 31
Trichloroethene 1000

21-25264
(MD21-08-12247) 67.5-72.5 ft
Port 1
Carbon Tetrachloride 140
Chloroform 410
Dichlorodifluoromethane 13
Methylene Chloride 24
Tetrachloroethene 2300
Tetrahydrofuran 5.2
1,1,1-Trichloroethane 26
Trichloroethene 880
Tritium 6251.64 pCi/L

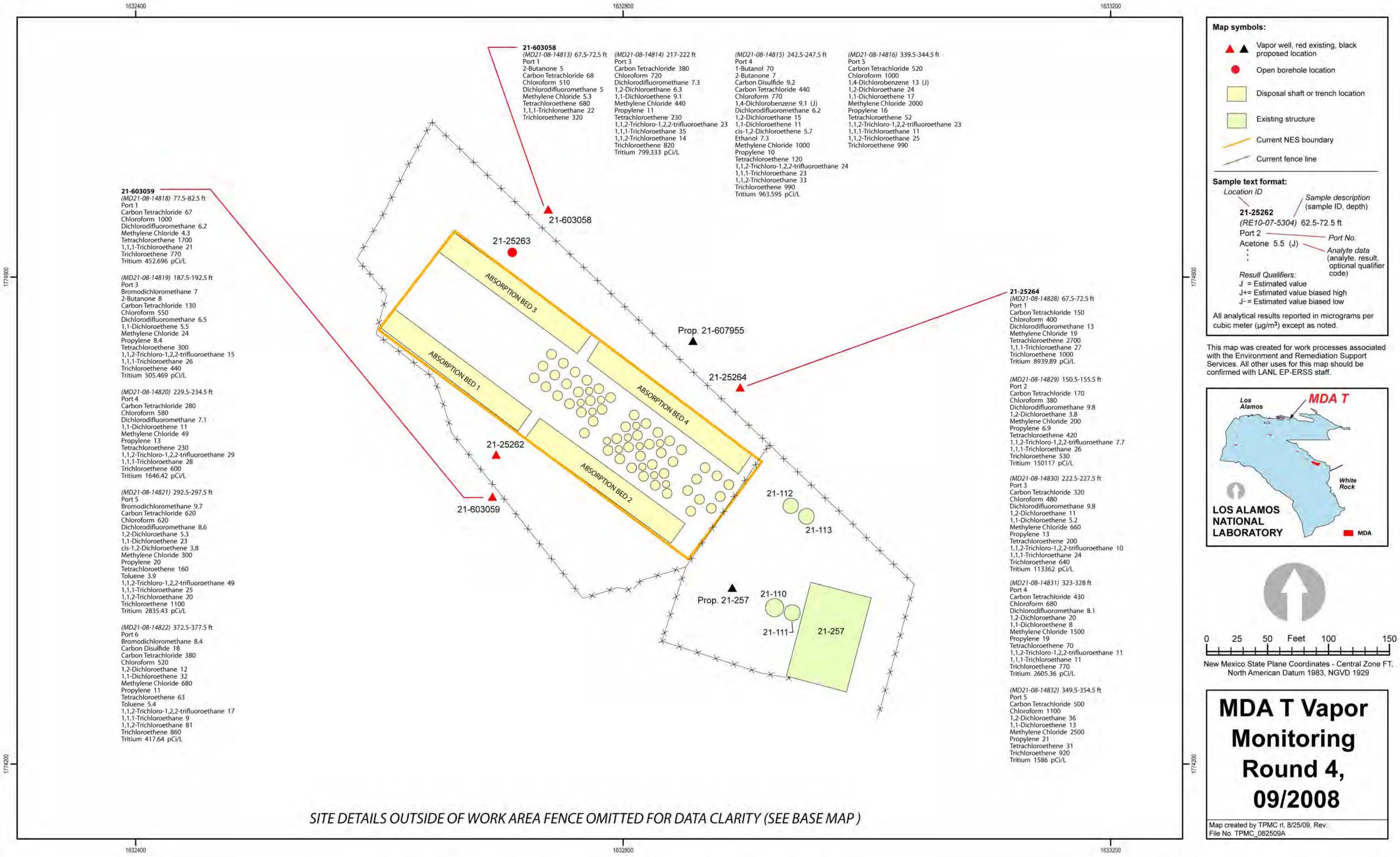
(MD21-08-12248) 150.5-155.5 ft
Port 2
Acetone 73
2-Butanone 15
Carbon Tetrachloride 150
Chloroform 360
Cyclohexane 5.4
Dichlorodifluoromethane 9.7
Ethanol 10
Methylene Chloride 190
Tetrachloroethene 400
1,1,1-Trichloroethane 23
Trichloroethene 480
Tritium 170123 pCi/L

(MD21-08-12249) 222.5-227.5 ft
Port 3
Carbon Disulfide 3.2
Carbon Tetrachloride 290
Chloroform 470
Cyclohexane 6.2
Dichlorodifluoromethane 8.6
1,2-Dichloroethane 9.3
1,1-Dichloroethene 6.6
Methylene Chloride 590
Tetrachloroethene 190
Toluene 3.4
1,1,2-Trichloro-1,2,2-trifluoroethane 11
1,1,1-Trichloroethane 21
Trichloroethene 580
Tritium 66092.6 pCi/L

(MD21-08-12250) 323-328 ft
Port 4
Acetone 110
2-Butanone 11
Carbon Tetrachloride 340
Chloroform 570
1,4-Dichlorobenzene 6
1,2-Dichloroethane 13
1,1-Dichloroethene 7.6
Methylene Chloride 1200
Tetrachloroethene 77
1,1,2-Trichloro-1,2,2-trifluoroethane 11
1,1,1-Trichloroethane 8.6
Trichloroethene 600
Tritium 3493.47 pCi/L

(MD21-08-12251) 349.5-354.5 ft
Port 5
Carbon Tetrachloride 360
Chloroform 940
1,2-Dichloroethane 24
1,1-Dichloroethene 12
Methylene Chloride 1900
Tetrachloroethene 32
Toluene 16
Trichloroethene 720
Tritium 1872.38 pCi/L

Figure 6.1-4 Tritium and VOCs detected in MDA T pore gas round 3, May 2008



This map was created for work processes associated with the Environment and Remediation Support Services. All other uses for this map should be confirmed with LANL EP-ERSS staff.

21-603058
(MD21-08-14813) 67.5-72.5 ft
Port 1
2-Butanone 5
Carbon Tetrachloride 68
Chloroform 510
Dichlorodifluoromethane 5
Methylene Chloride 5.3
Tetrachloroethene 680
1,1,1-Trichloroethane 22
Trichloroethene 320

(MD21-08-14814) 217-222 ft
Port 3
Carbon Tetrachloride 380
Chloroform 720
Dichlorodifluoromethane 7.3
1,2-Dichloroethane 6.3
1,1-Dichloroethene 9.1
Methylene Chloride 440
Propylene 11
Tetrachloroethene 230
1,1,2-Trichloro-1,2,2-trifluoroethane 23
1,1,1-Trichloroethane 35
1,1,2-Trichloroethane 14
Trichloroethene 820
Tritium 799.333 pCi/L

(MD21-08-14815) 242.5-247.5 ft
Port 4
1-Butanol 70
2-Butanone 7
Carbon Disulfide 9.2
Carbon Tetrachloride 440
Chloroform 770
1,4-Dichlorobenzene 9.1 (J)
Dichlorodifluoromethane 6.2
1,2-Dichloroethane 15
1,1-Dichloroethene 11
cis-1,2-Dichloroethene 5.7
Ethanol 7.3
Methylene Chloride 1000
Propylene 10
Tetrachloroethene 120
1,1,2-Trichloro-1,2,2-trifluoroethane 24
1,1,1-Trichloroethane 23
1,1,2-Trichloroethane 33
Trichloroethene 990
Tritium 963.595 pCi/L

(MD21-08-14816) 339.5-344.5 ft
Port 5
Carbon Tetrachloride 520
Chloroform 1000
1,4-Dichlorobenzene 13 (J)
1,2-Dichloroethane 24
1,1-Dichloroethene 17
Methylene Chloride 2000
Propylene 16
Tetrachloroethene 52
1,1,2-Trichloro-1,2,2-trifluoroethane 23
1,1,1-Trichloroethane 11
1,1,2-Trichloroethane 25
Trichloroethene 990

21-603059
(MD21-08-14818) 77.5-82.5 ft
Port 1
Carbon Tetrachloride 67
Chloroform 1000
Dichlorodifluoromethane 6.2
Methylene Chloride 4.3
Tetrachloroethene 1700
1,1,1-Trichloroethane 21
Trichloroethene 770
Tritium 452.696 pCi/L

(MD21-08-14819) 187.5-192.5 ft
Port 3
Bromodichloromethane 7
2-Butanone 8
Carbon Tetrachloride 130
Chloroform 550
Dichlorodifluoromethane 6.5
1,1-Dichloroethene 5.5
Methylene Chloride 24
Propylene 8.4
Tetrachloroethene 300
1,1,2-Trichloro-1,2,2-trifluoroethane 15
1,1,1-Trichloroethane 26
Trichloroethene 440
Tritium 505.469 pCi/L

(MD21-08-14820) 229.5-234.5 ft
Port 4
Carbon Tetrachloride 280
Chloroform 580
Dichlorodifluoromethane 7.1
1,1-Dichloroethene 11
Methylene Chloride 49
Propylene 13
Tetrachloroethene 230
1,1,2-Trichloro-1,2,2-trifluoroethane 29
1,1,1-Trichloroethane 28
Trichloroethene 600
Tritium 1646.42 pCi/L

(MD21-08-14821) 292.5-297.5 ft
Port 5
Bromodichloromethane 9.7
Carbon Tetrachloride 620
Chloroform 620
Dichlorodifluoromethane 8.6
1,2-Dichloroethane 5.3
1,1-Dichloroethene 23
cis-1,2-Dichloroethene 3.8
Methylene Chloride 300
Propylene 20
Tetrachloroethene 160
Toluene 3.9
1,1,2-Trichloro-1,2,2-trifluoroethane 49
1,1,1-Trichloroethane 25
1,1,2-Trichloroethane 20
Trichloroethene 1100
Tritium 2835.43 pCi/L

(MD21-08-14822) 372.5-377.5 ft
Port 6
Bromodichloromethane 8.4
Carbon Disulfide 18
Carbon Tetrachloride 380
Chloroform 520
1,2-Dichloroethane 12
1,1-Dichloroethene 32
Methylene Chloride 680
Propylene 11
Tetrachloroethene 63
Toluene 5.4
1,1,2-Trichloro-1,2,2-trifluoroethane 17
1,1,1-Trichloroethane 9
1,1,2-Trichloroethane 81
Trichloroethene 860
Tritium 417.64 pCi/L

21-25264
(MD21-08-14828) 67.5-72.5 ft
Port 1
Carbon Tetrachloride 150
Chloroform 400
Dichlorodifluoromethane 13
Methylene Chloride 19
Tetrachloroethene 2700
1,1,1-Trichloroethane 27
Trichloroethene 1000
Tritium 8939.89 pCi/L

(MD21-08-14829) 150.5-155.5 ft
Port 2
Carbon Tetrachloride 170
Chloroform 380
Dichlorodifluoromethane 9.8
1,2-Dichloroethane 3.8
Methylene Chloride 200
Propylene 6.9
Tetrachloroethene 420
1,1,2-Trichloro-1,2,2-trifluoroethane 7.7
1,1,1-Trichloroethane 26
Trichloroethene 530
Tritium 150117 pCi/L

(MD21-08-14830) 222.5-227.5 ft
Port 3
Carbon Tetrachloride 320
Chloroform 480
Dichlorodifluoromethane 9.8
1,2-Dichloroethane 11
1,1-Dichloroethene 5.2
Methylene Chloride 660
Propylene 13
Tetrachloroethene 200
1,1,2-Trichloro-1,2,2-trifluoroethane 10
1,1,1-Trichloroethane 24
Trichloroethene 640
Tritium 113362 pCi/L

(MD21-08-14831) 323-328 ft
Port 4
Carbon Tetrachloride 430
Chloroform 680
Dichlorodifluoromethane 8.1
1,2-Dichloroethane 20
1,1-Dichloroethene 8
Methylene Chloride 1500
Propylene 19
Tetrachloroethene 70
1,1,2-Trichloro-1,2,2-trifluoroethane 11
1,1,1-Trichloroethane 11
Trichloroethene 770
Tritium 2605.36 pCi/L

(MD21-08-14832) 349.5-354.5 ft
Port 5
Carbon Tetrachloride 500
Chloroform 1100
1,2-Dichloroethane 36
1,1-Dichloroethene 13
Methylene Chloride 2500
Propylene 21
Tetrachloroethene 31
Trichloroethene 920
Tritium 1586 pCi/L

Figure 6.1-5 Tritium and VOCs detected in MDA T pore gas round 4, September 2008

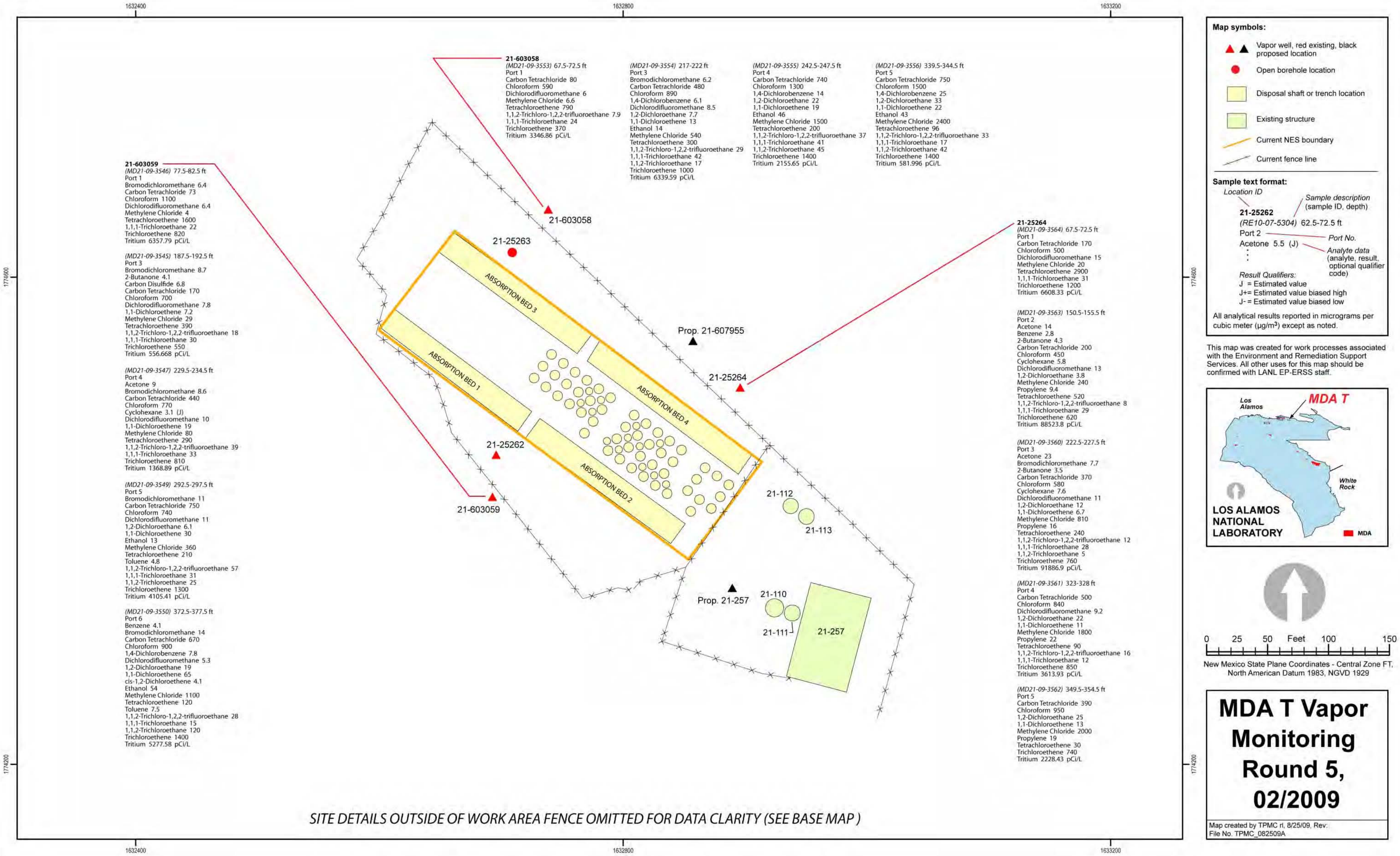


Figure 6.1-6 Tritium and VOCs detected in MDA T pore gas round 5, February 2009

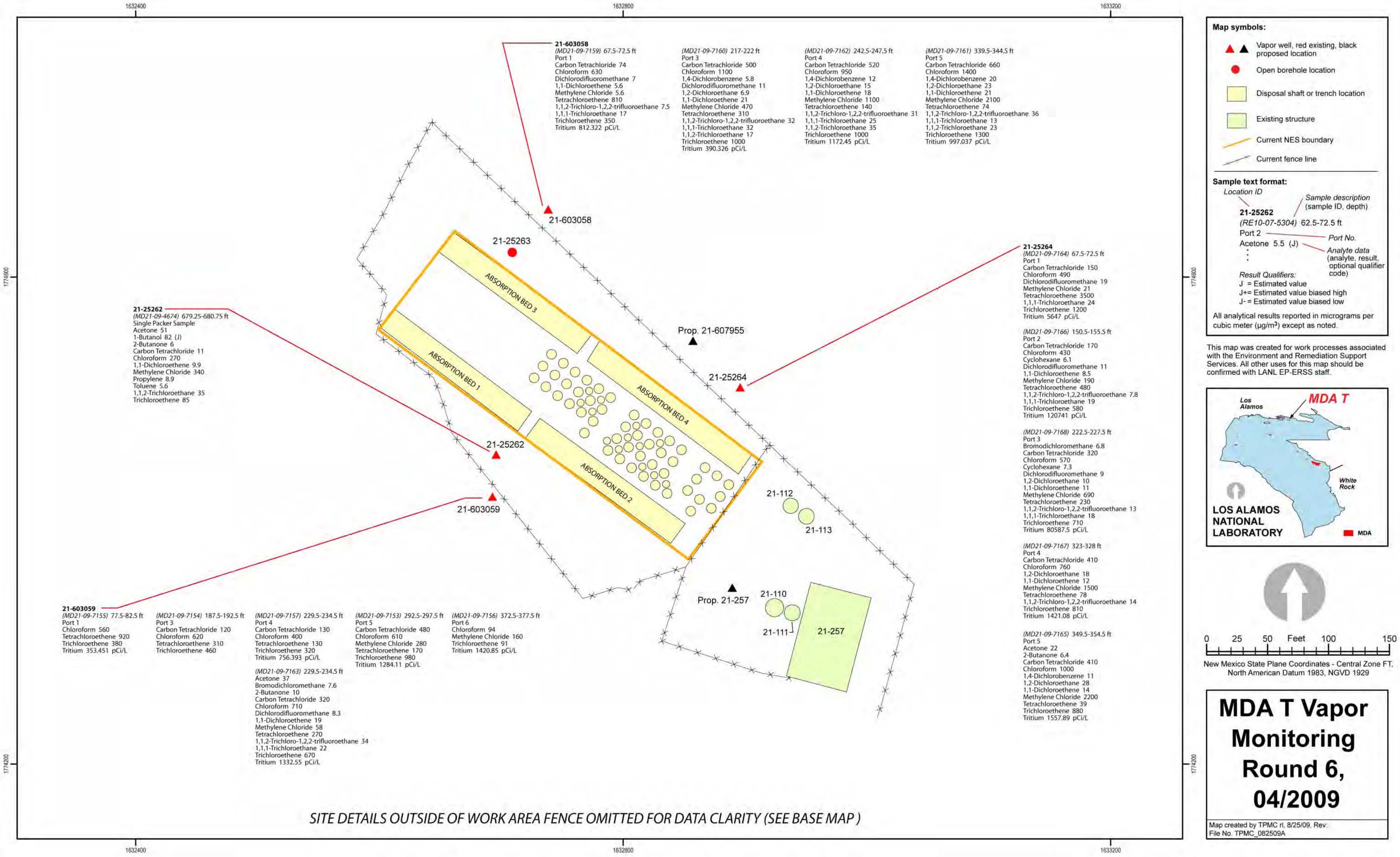


Figure 6.1-7 Tritium and VOCs detected in MDA T pore gas round 6, April 2009

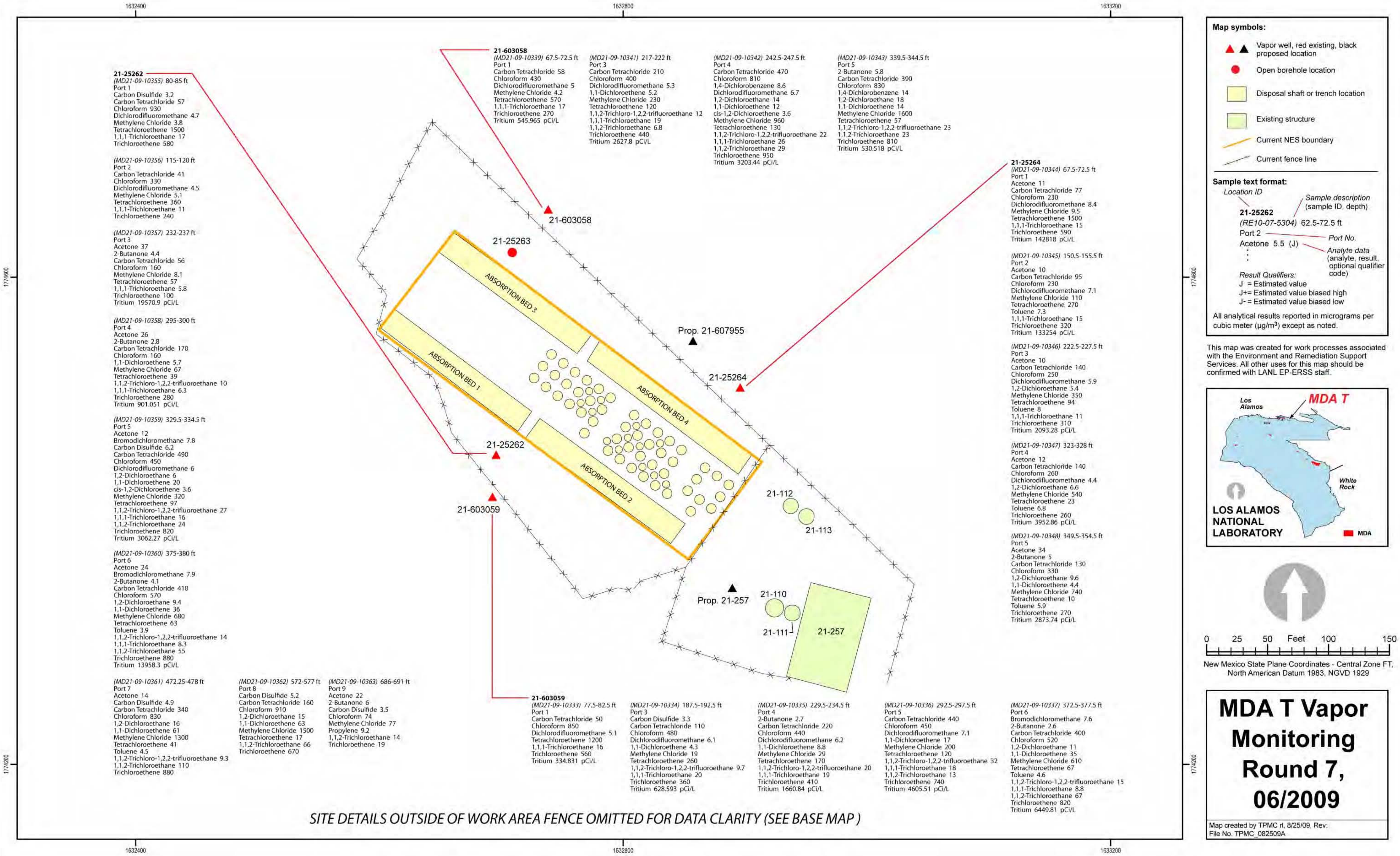


Figure 6.1-8 Tritium and VOCs detected in MDA T pore gas round 7, June 2009

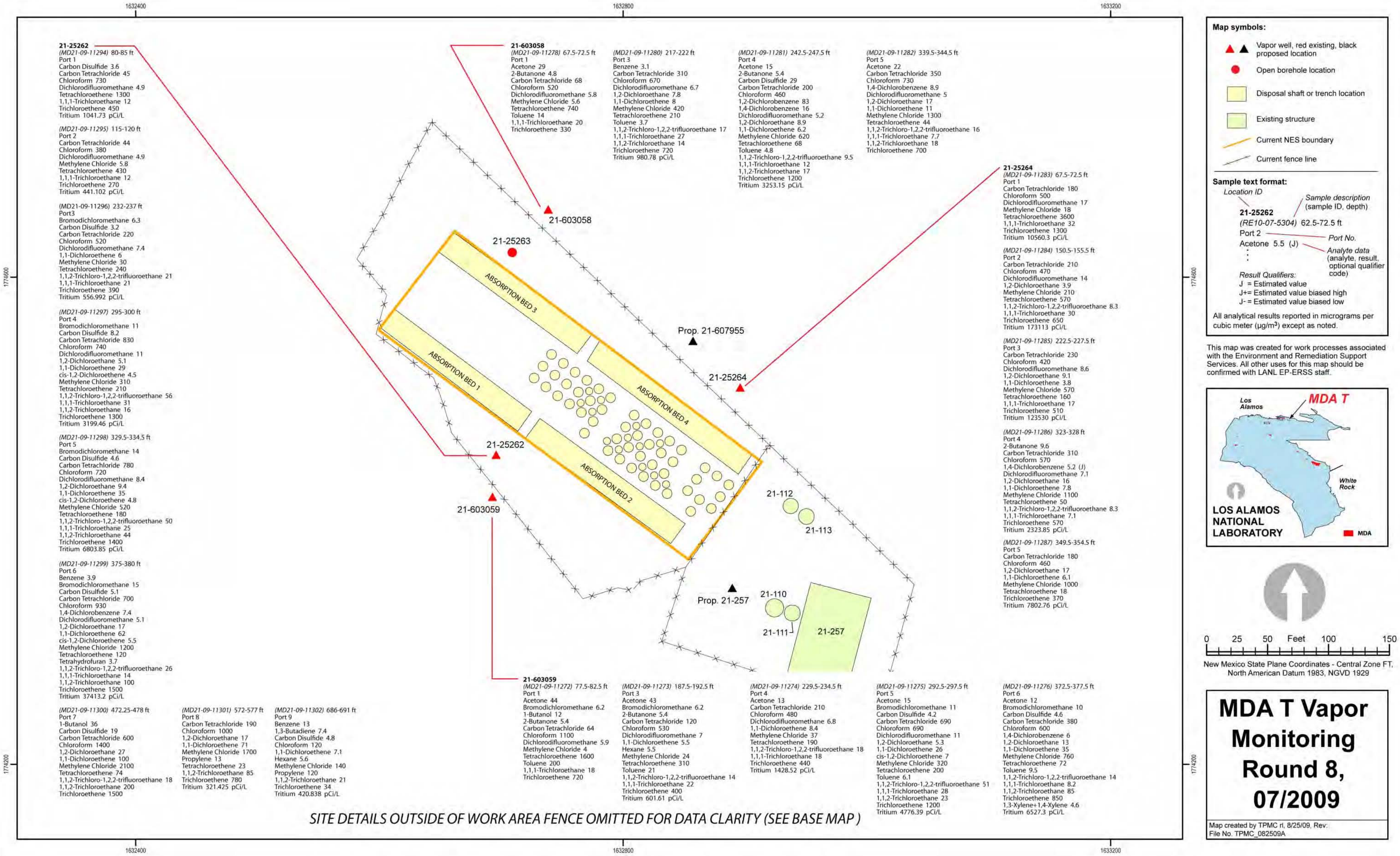


Figure 6.1-9 Tritium and VOCs detected in MDA T pore gas round 8, July 2009

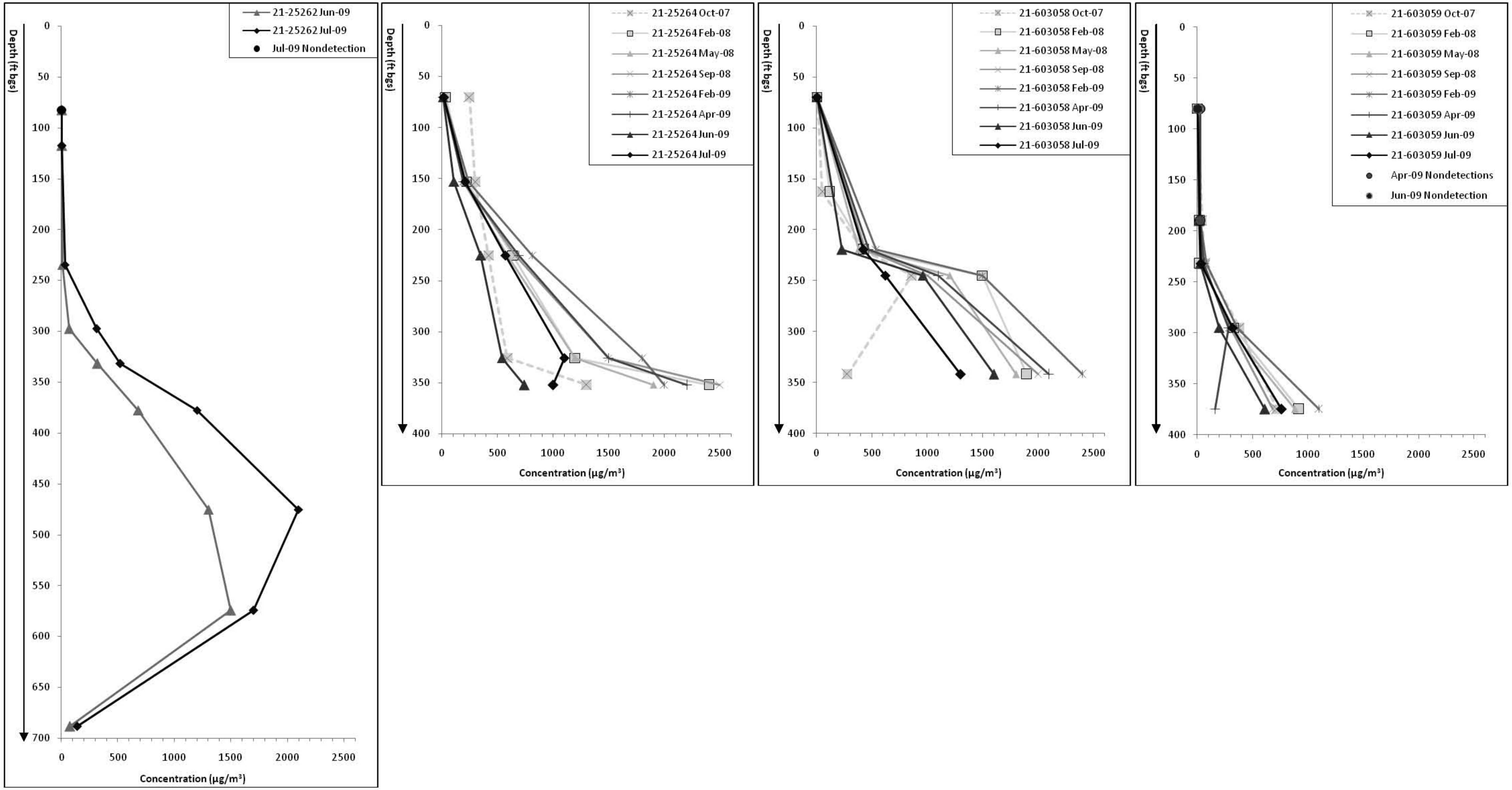


Figure 6.2-1 Vertical profile of methylene chloride in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059, October 2007–July 2009

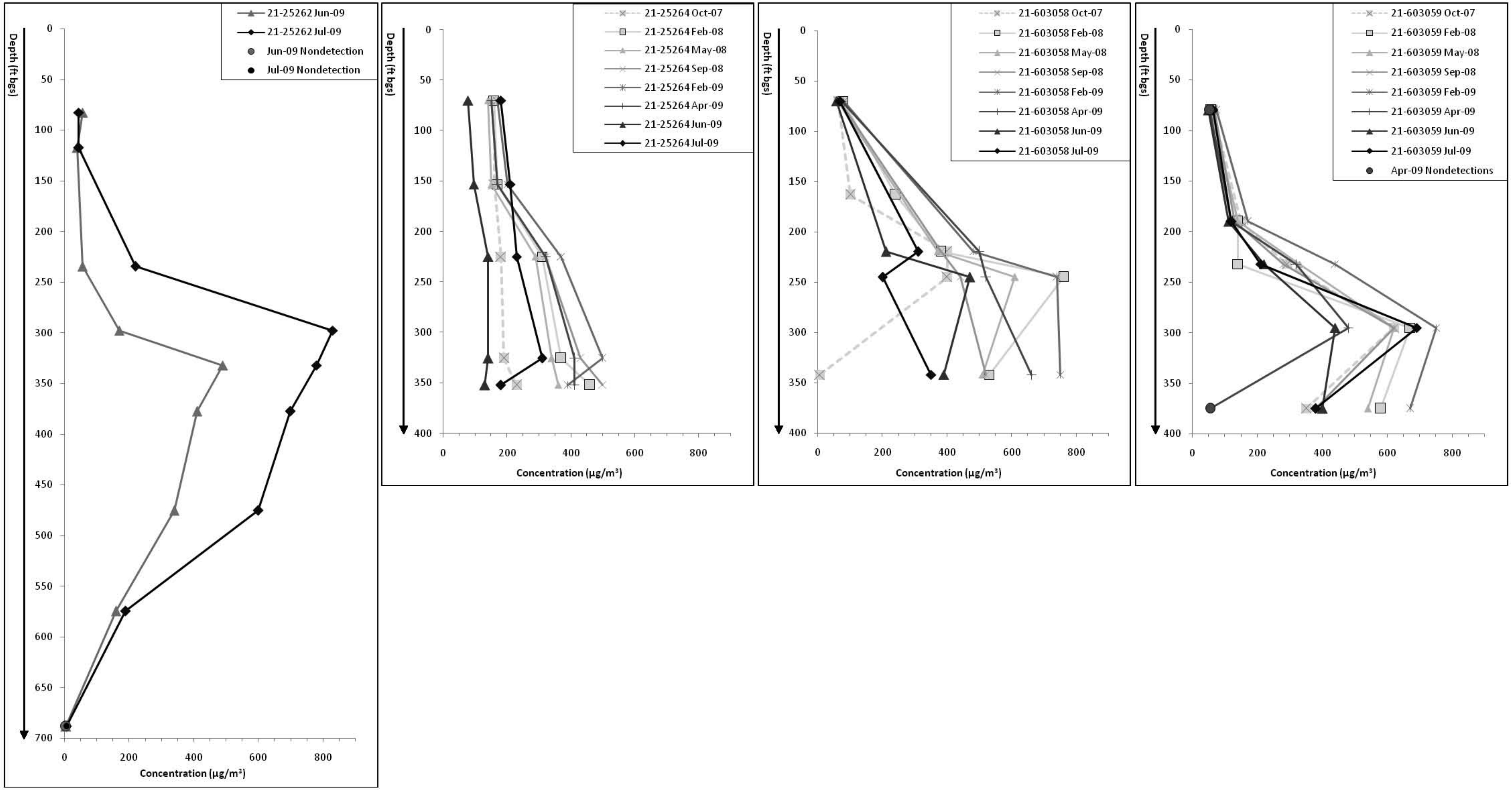


Figure 6.2-2 Vertical profile of carbon tetrachloride in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059, October 2007–July 2009

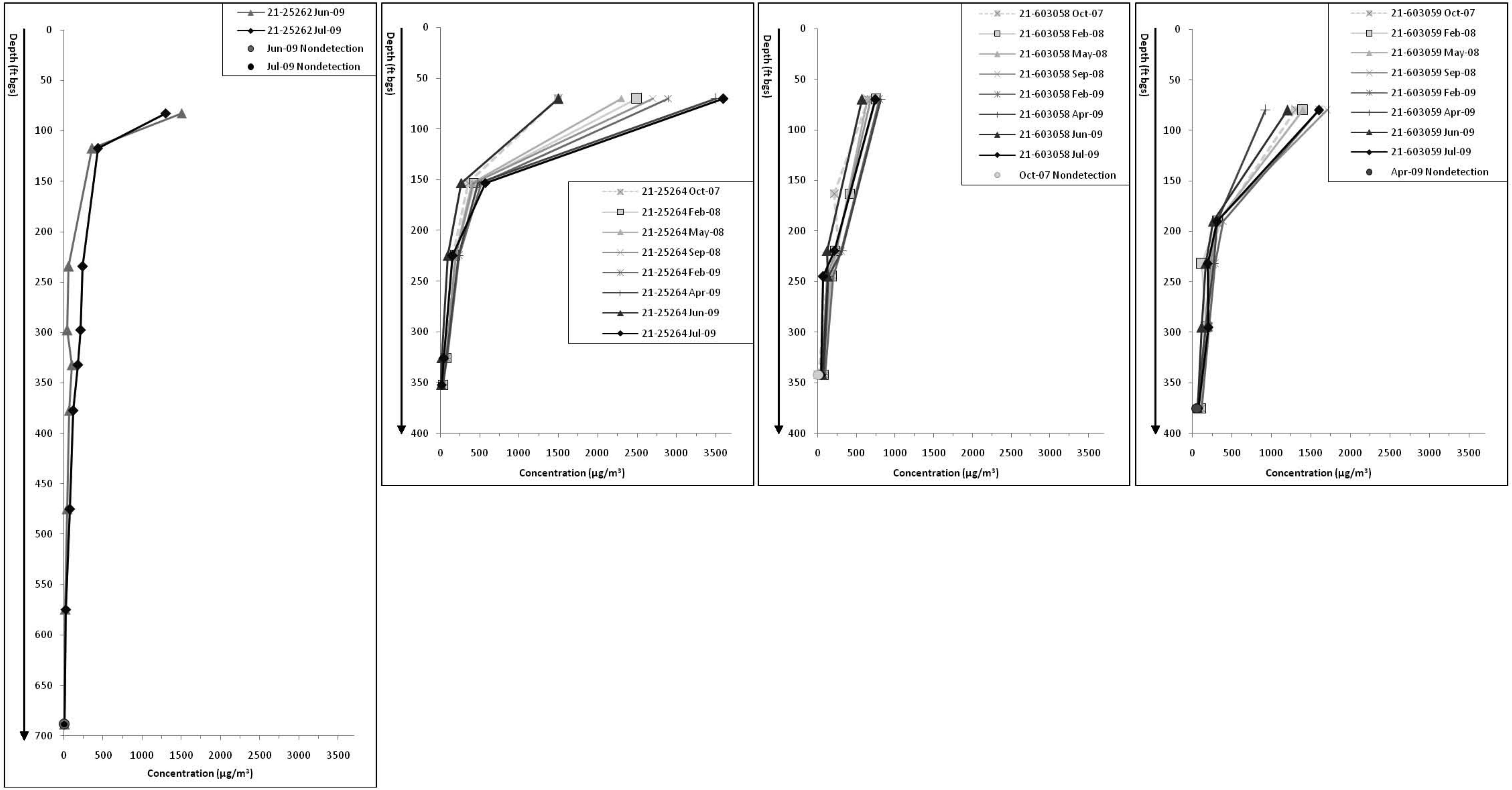


Figure 6.2-3 Vertical profile of PCE in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059, October 2007–July 2009

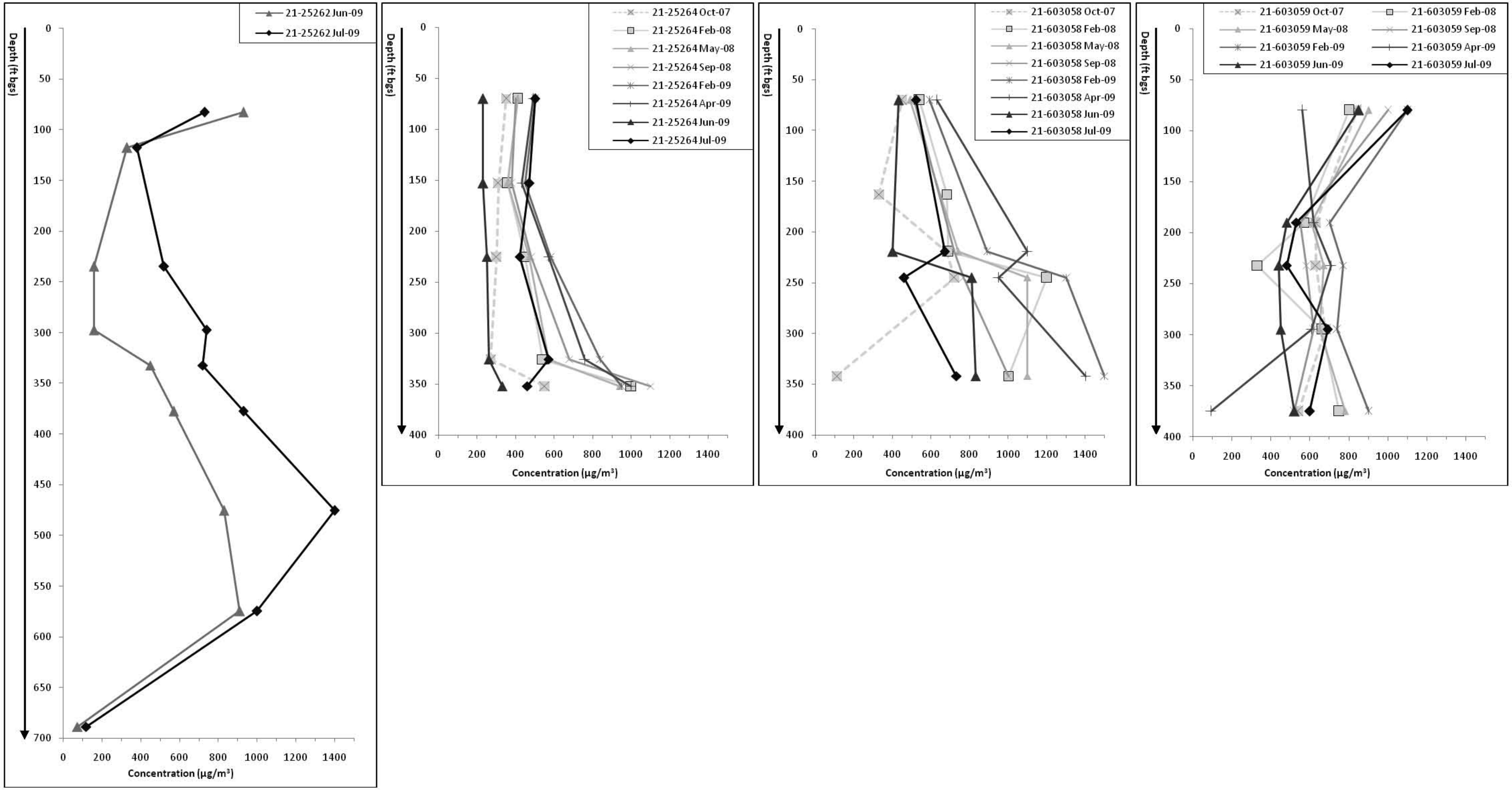


Figure 6.2-4 Vertical profile of chloroform in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059, October 2007–July 2009

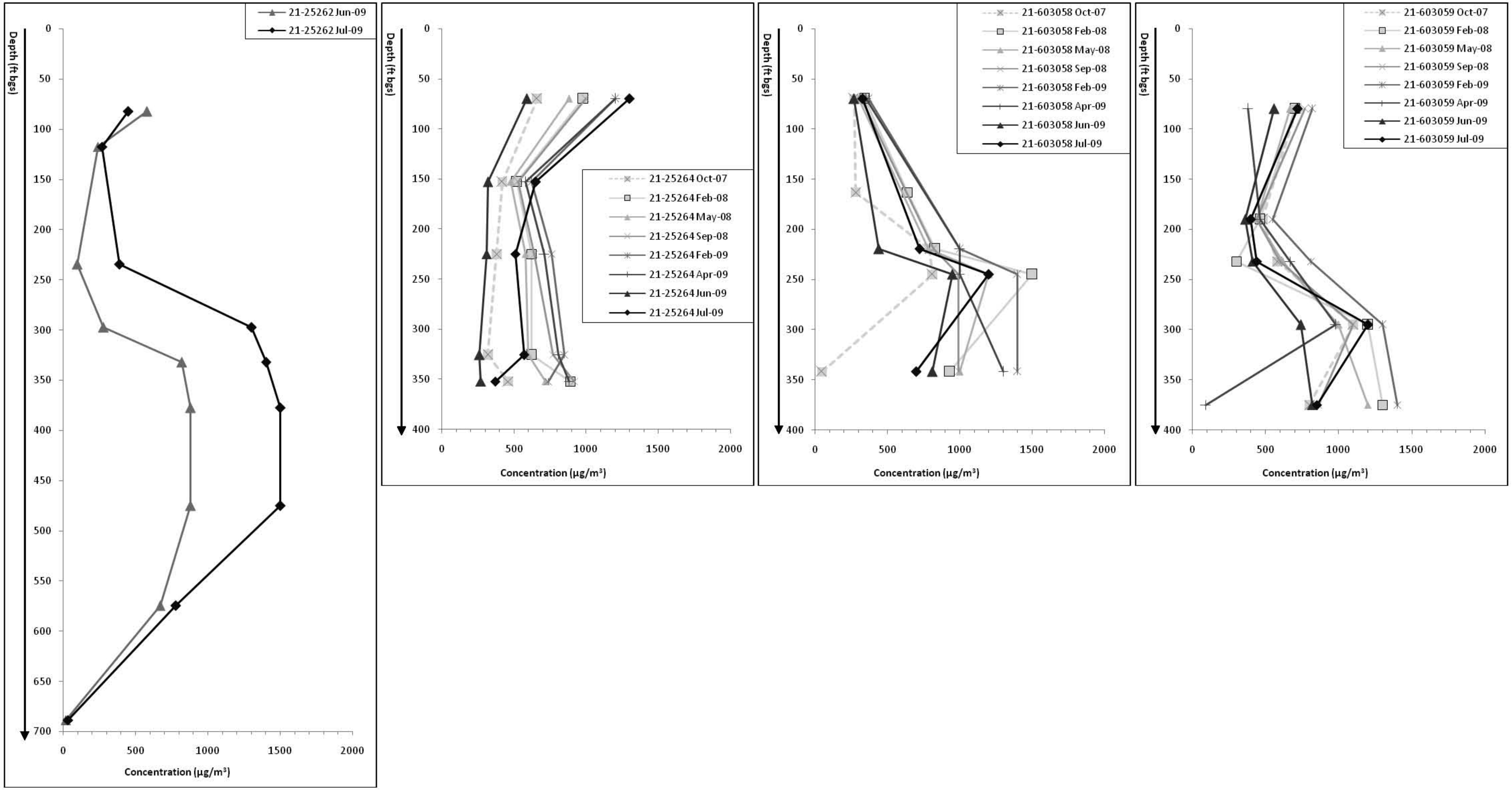


Figure 6.2-5 Vertical profile of TCE in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059, October 2007–July 2009

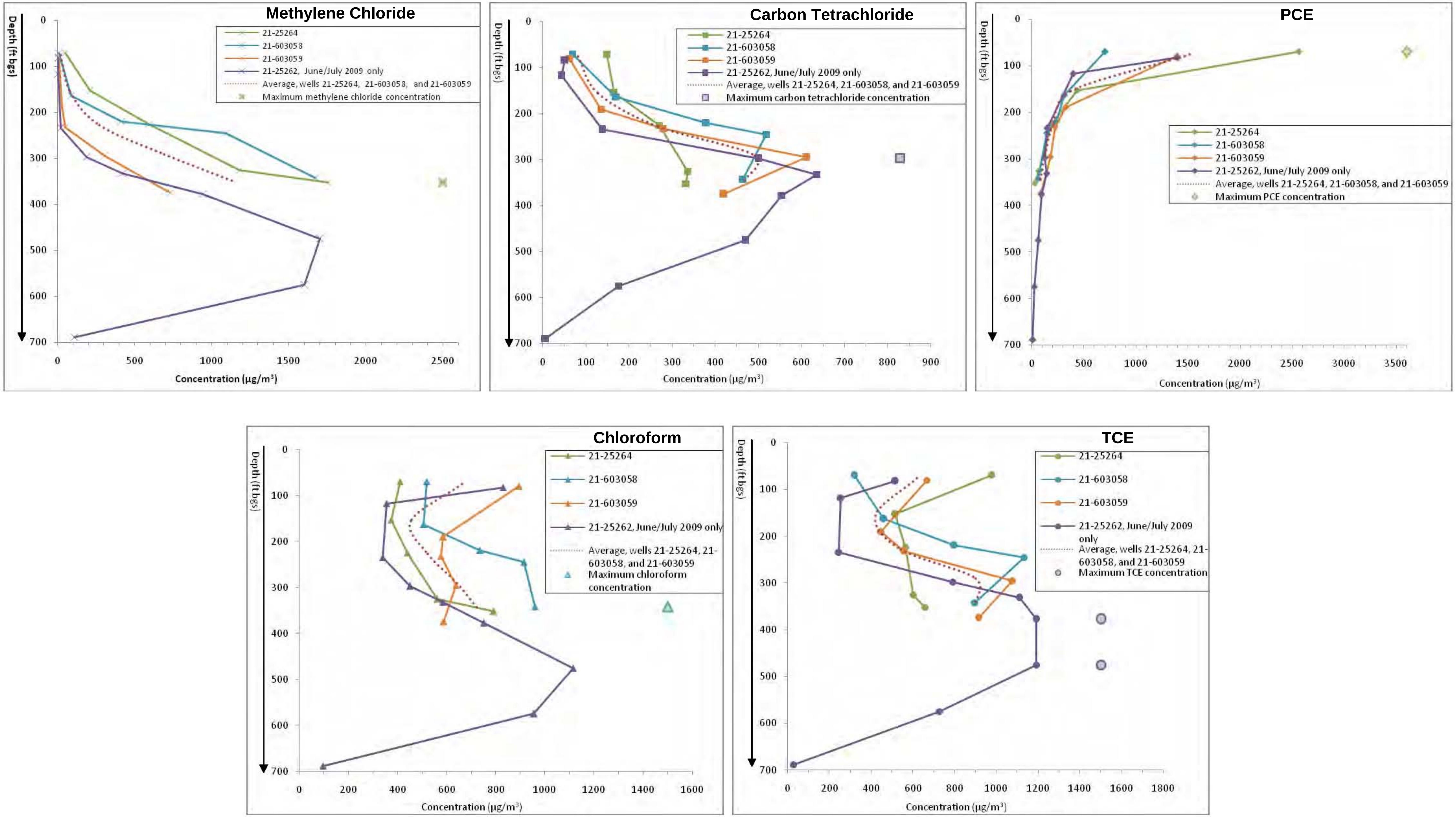


Figure 6.2-6 **Vertical time-averaged profile of methylene chloride, carbon tetrachloride, PCE, chloroform, and TCE concentration in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059**

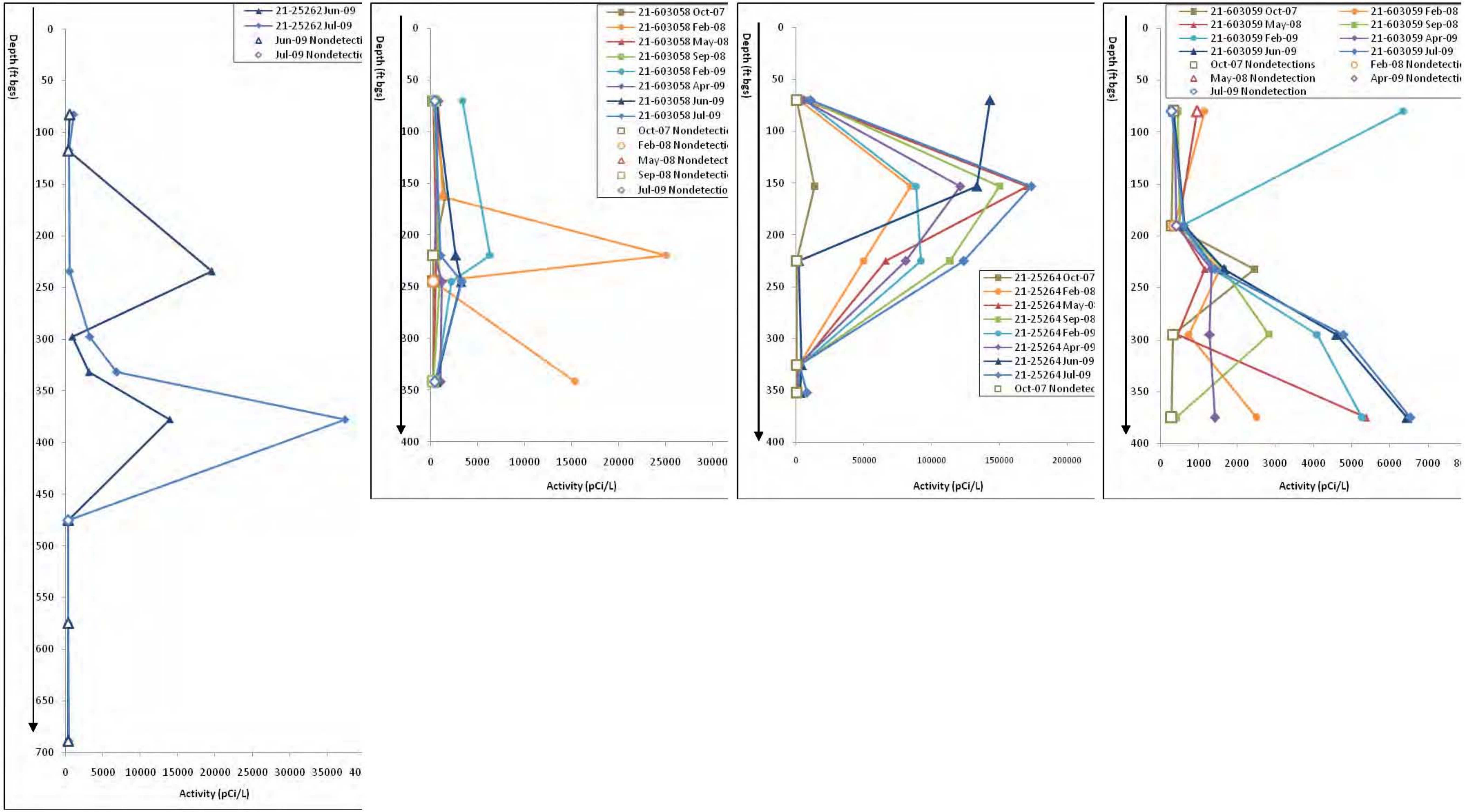


Figure 6.2-7 Vertical profile of tritium activity in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059

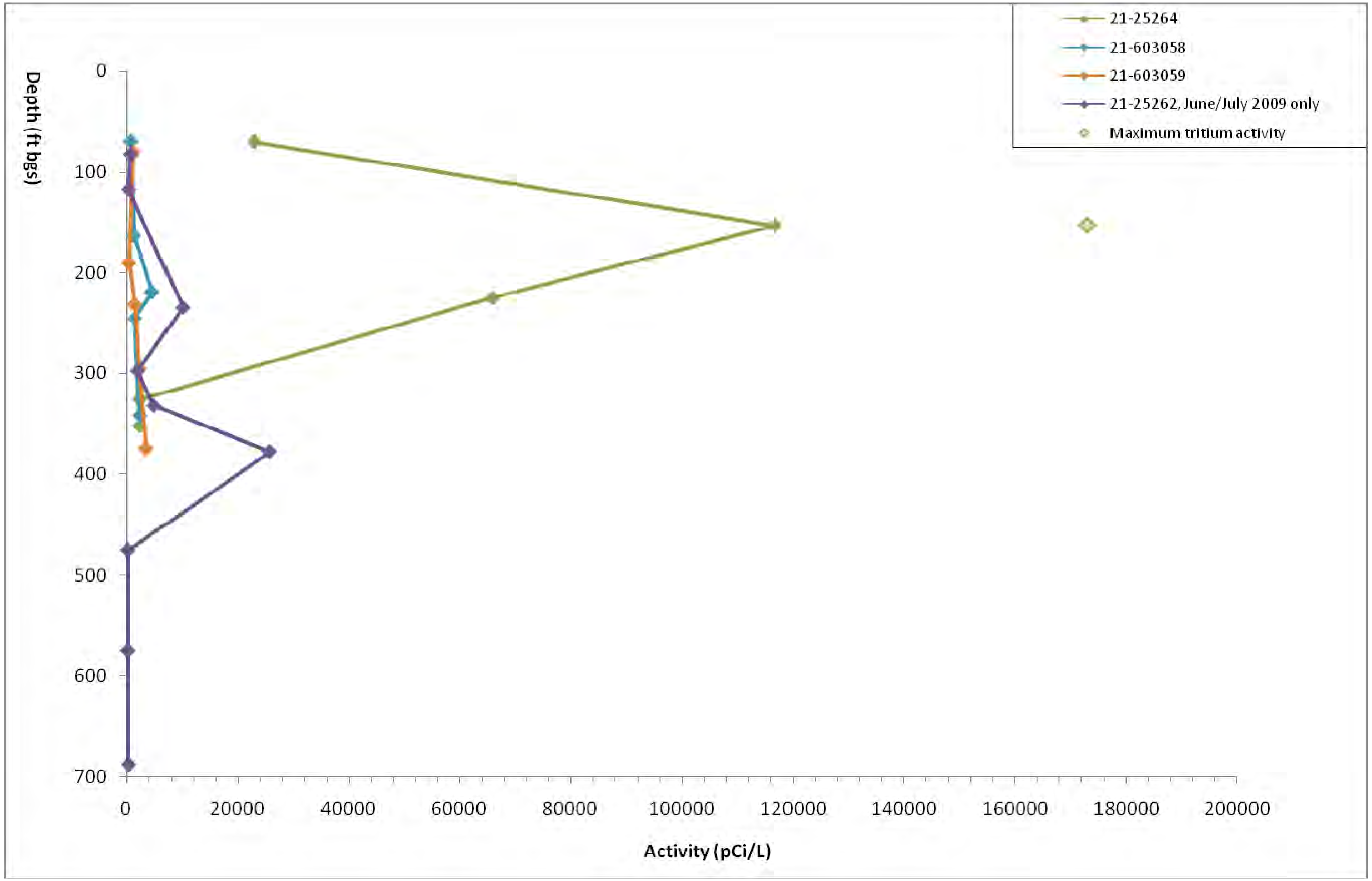


Figure 6.2-8 Vertical time-averaged profile of tritium activity in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059

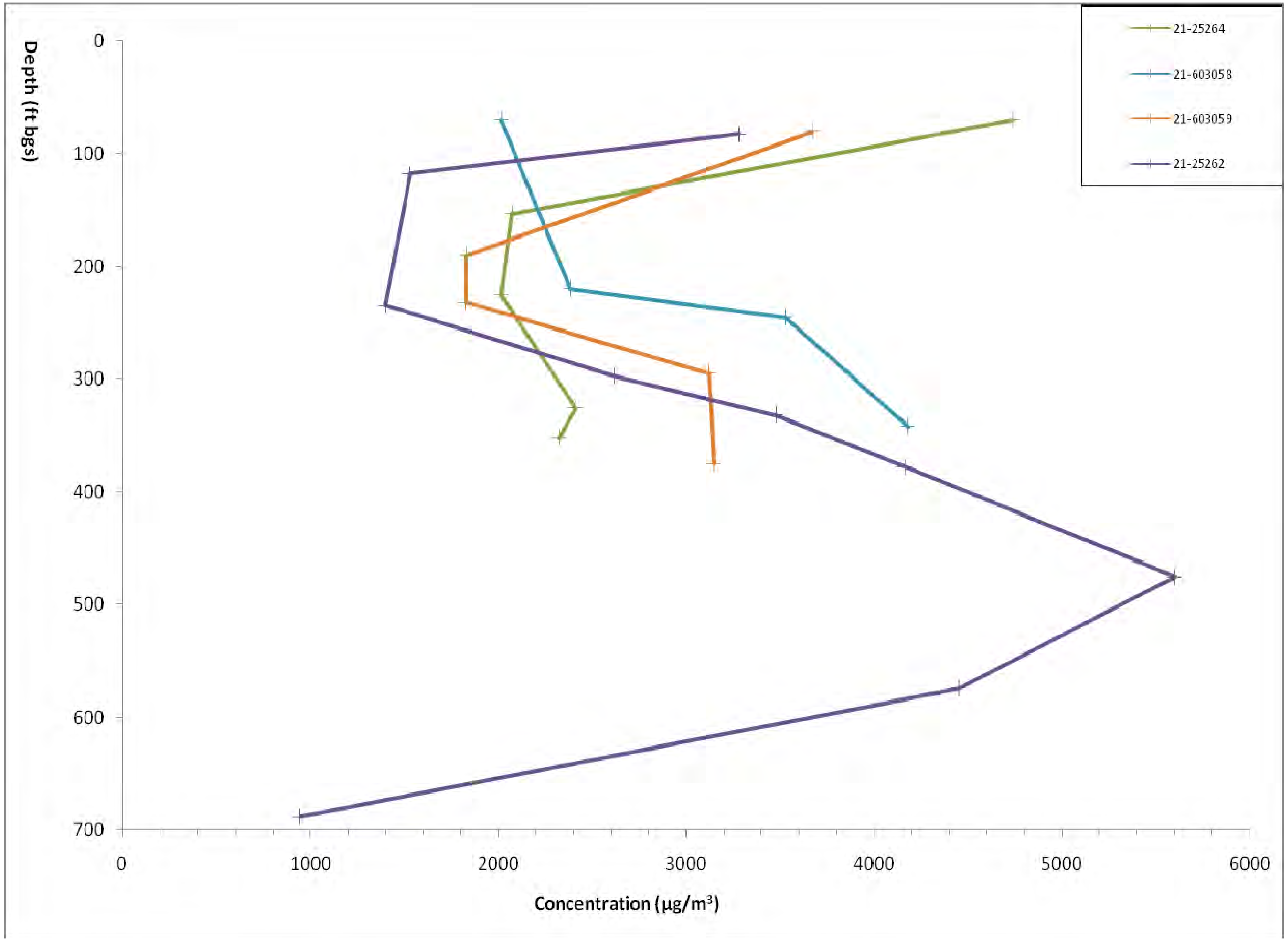


Figure 6.3-1 Vertical time-averaged profile (June/July only) of total VOC concentration in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059

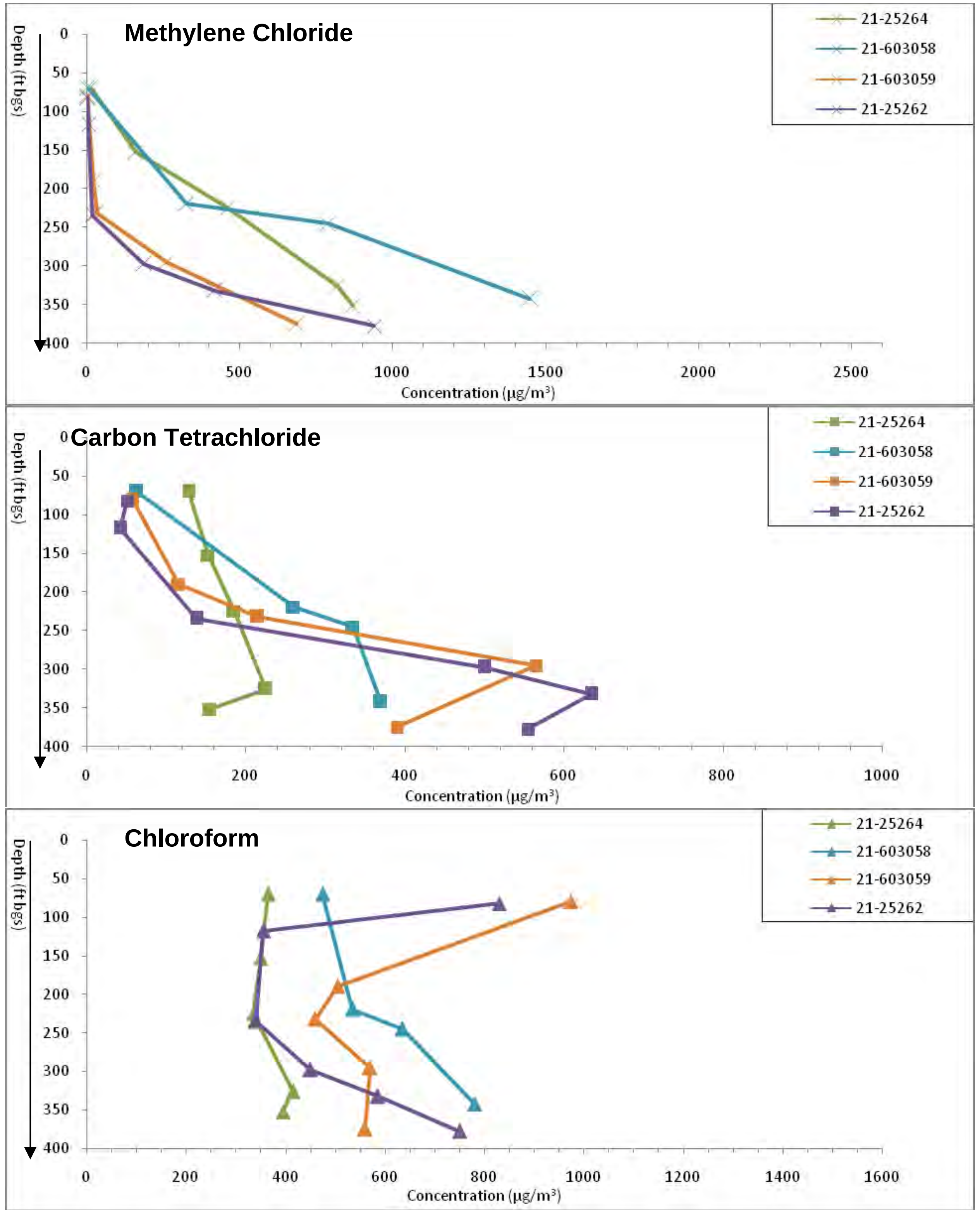


Figure 6.3-2 **Vertical time-averaged profile (June/July only) for methylene chloride, carbon tetrachloride, and chloroform concentration in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059**

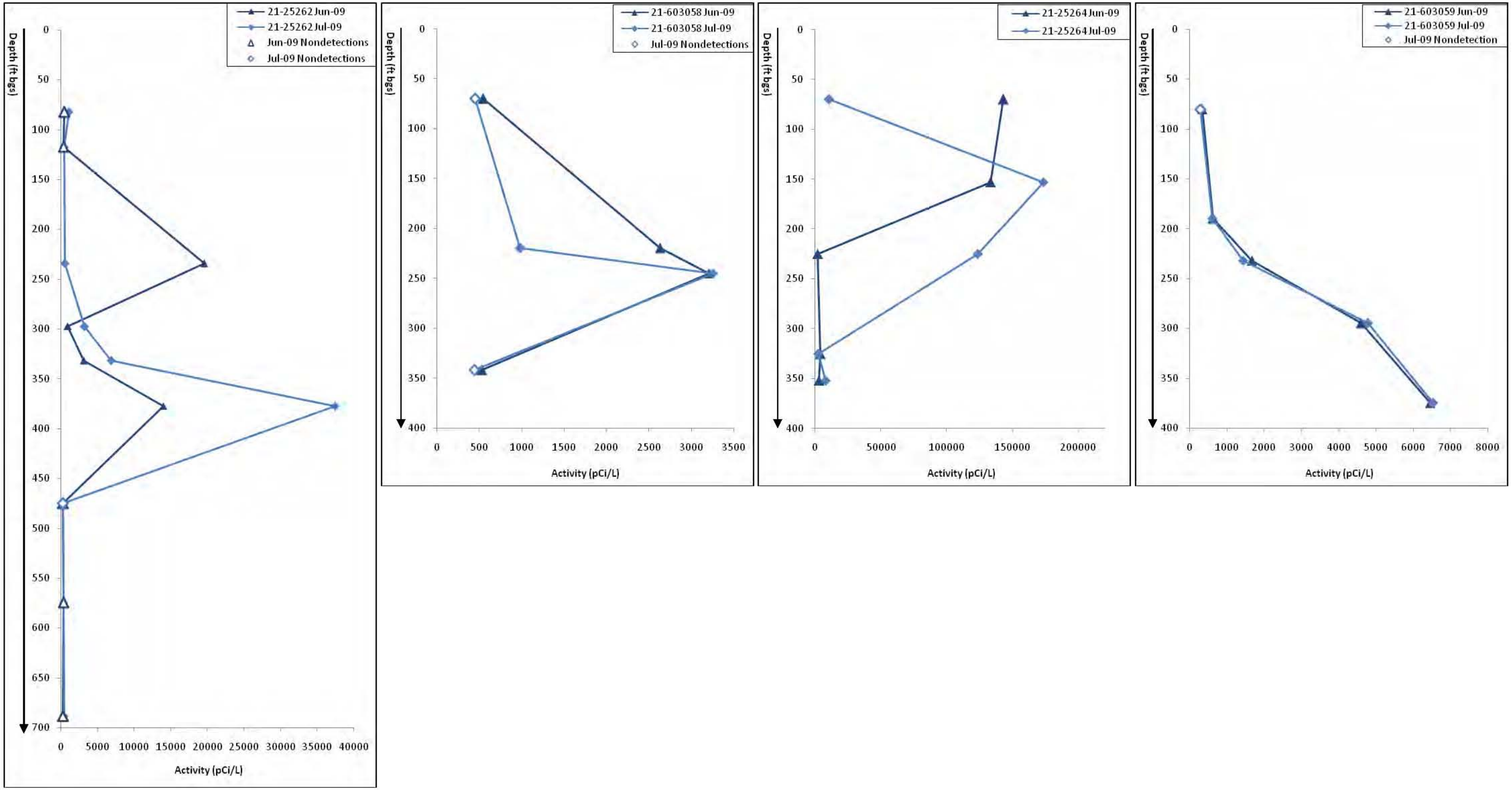


Figure 6.3-3 Vertical profile of tritium activity (June–July only) in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059

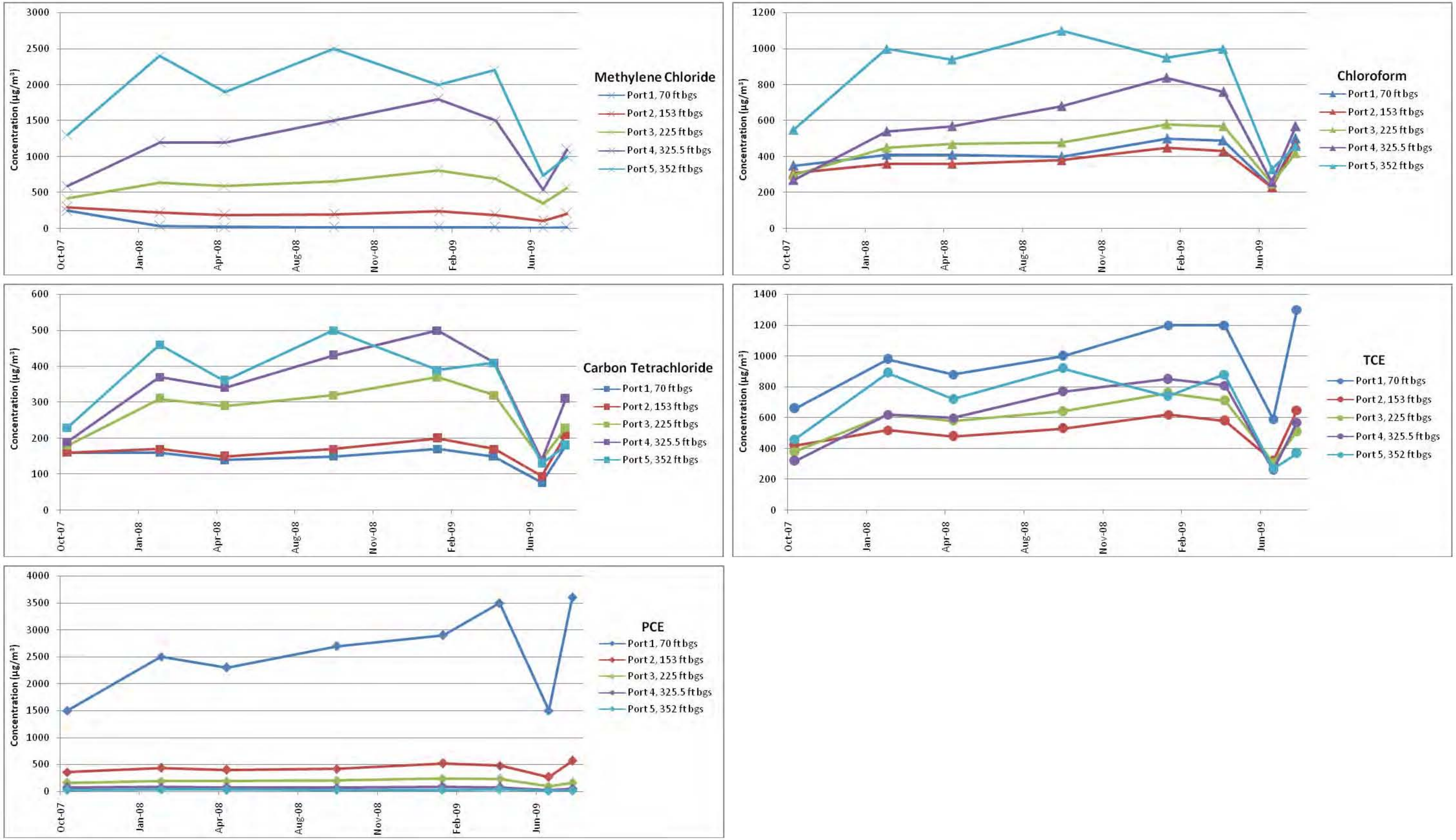


Figure 6.4-1 Time sequence of methylene chloride, carbon tetrachloride, PCE, chloroform, and TCE concentration in all ports of vapor-monitoring well 21-25264

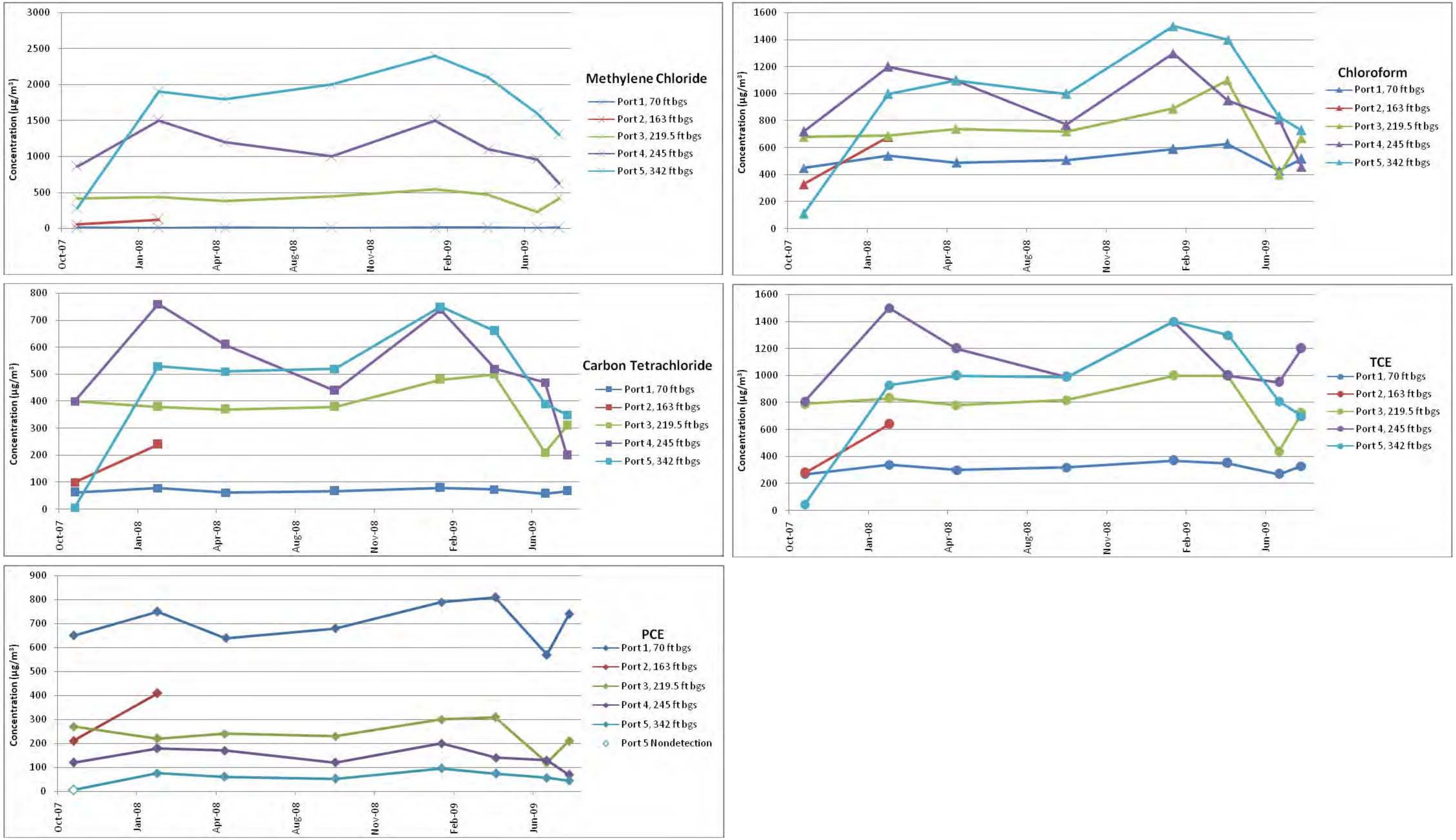


Figure 6.4-2 Time sequence of methylene chloride, carbon tetrachloride, PCE, chloroform, and TCE concentration in all ports of vapor-monitoring well 21-603058

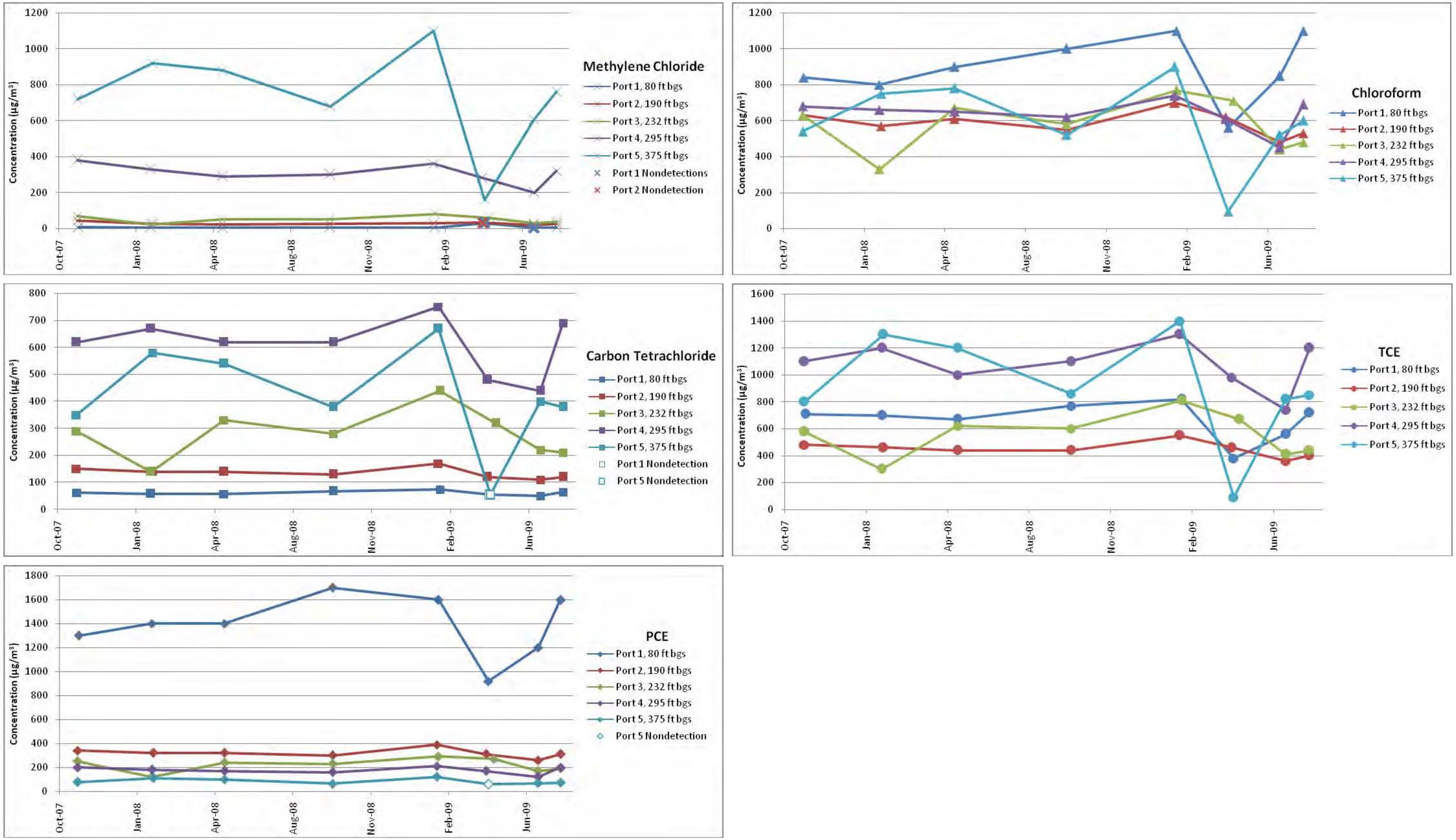


Figure 6.4-3 Time sequence of methylene chloride, carbon tetrachloride, PCE, chloroform, and TCE concentration in all ports of vapor-monitoring well 21-603059

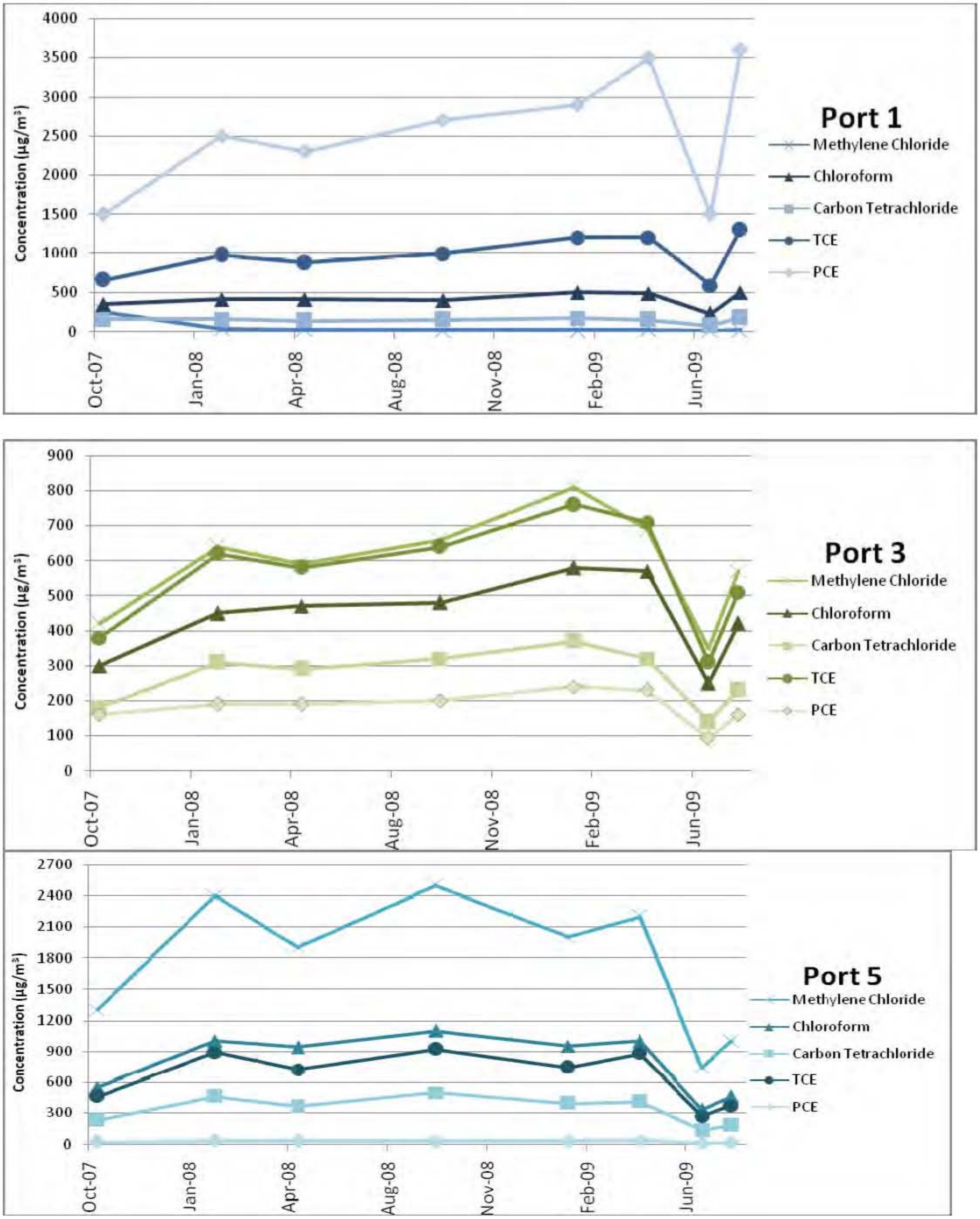


Figure 6.4-4 **Time sequence of methylene chloride, carbon tetrachloride, PCE, chloroform, and TCE concentration in a shallow (Port 1), intermediate (Port 3), and deep port (Port 5) of well 21-25264**

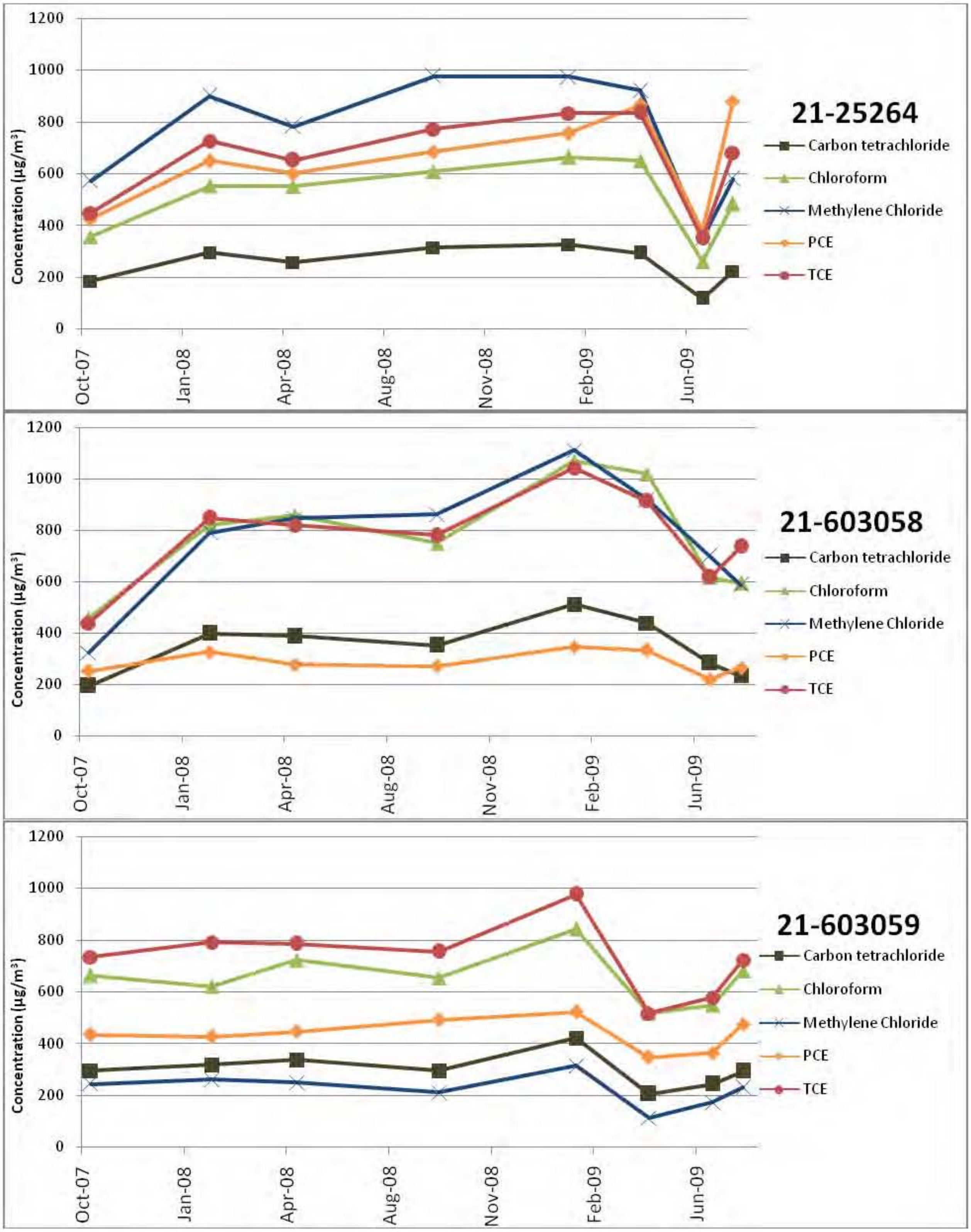


Figure 6.4-5 **Time sequence of average carbon tetrachloride, chloroform, methylene chloride, PCE, and TCE concentration in vapor-monitoring wells 21-25264, 21-603058, and 21-603059**

Figure 6.4-6 Time sequence of average VOC concentration (methylene chloride, chloroform, carbon tetrachloride, TCE, and PCE) in vapor-monitoring wells 21-25264, 21-603058, and 21-603059

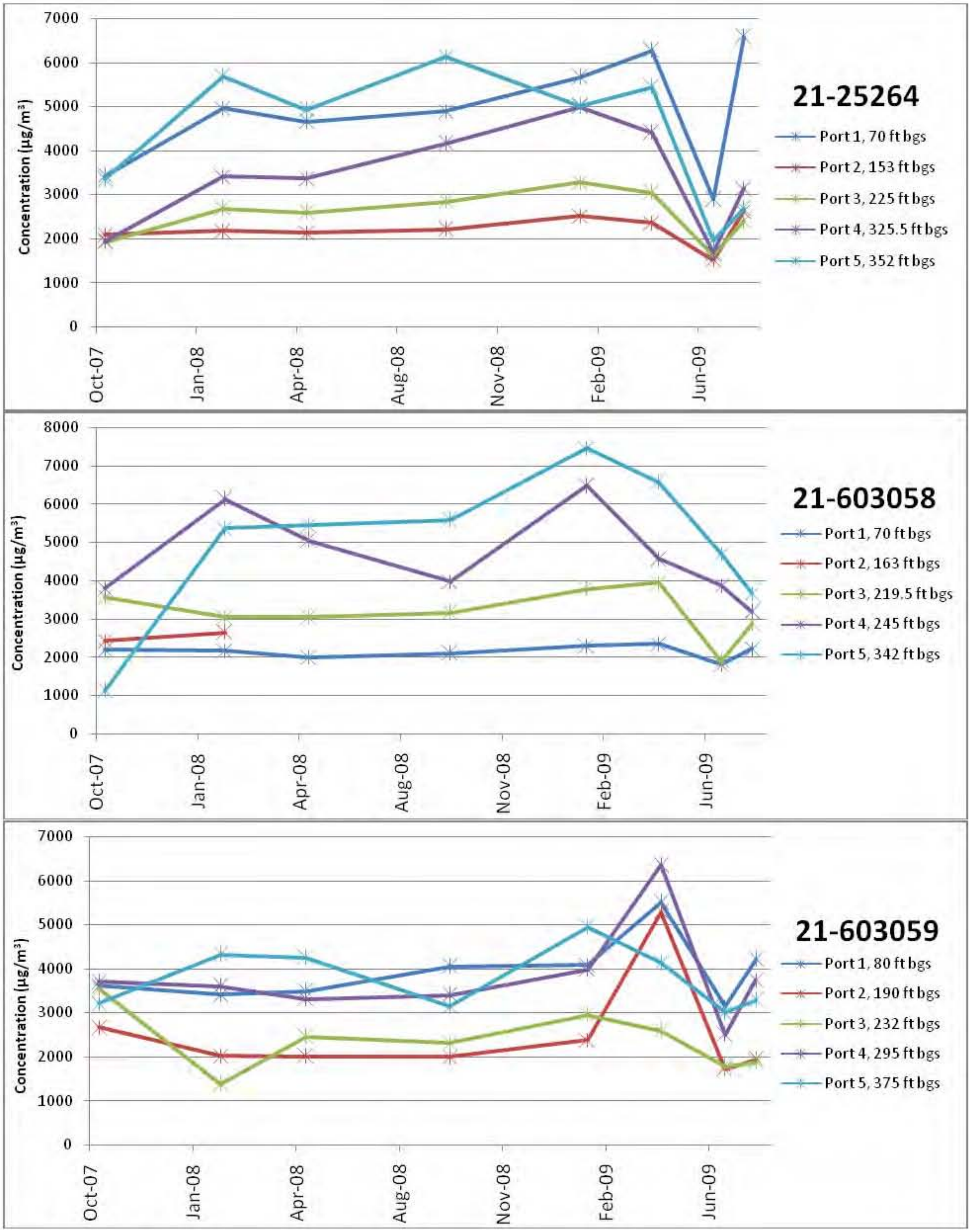


Figure 6.4-7 Time sequence of total VOC concentration in all ports of vapor-monitoring wells 21-25264, 21-603058, and 21-603059

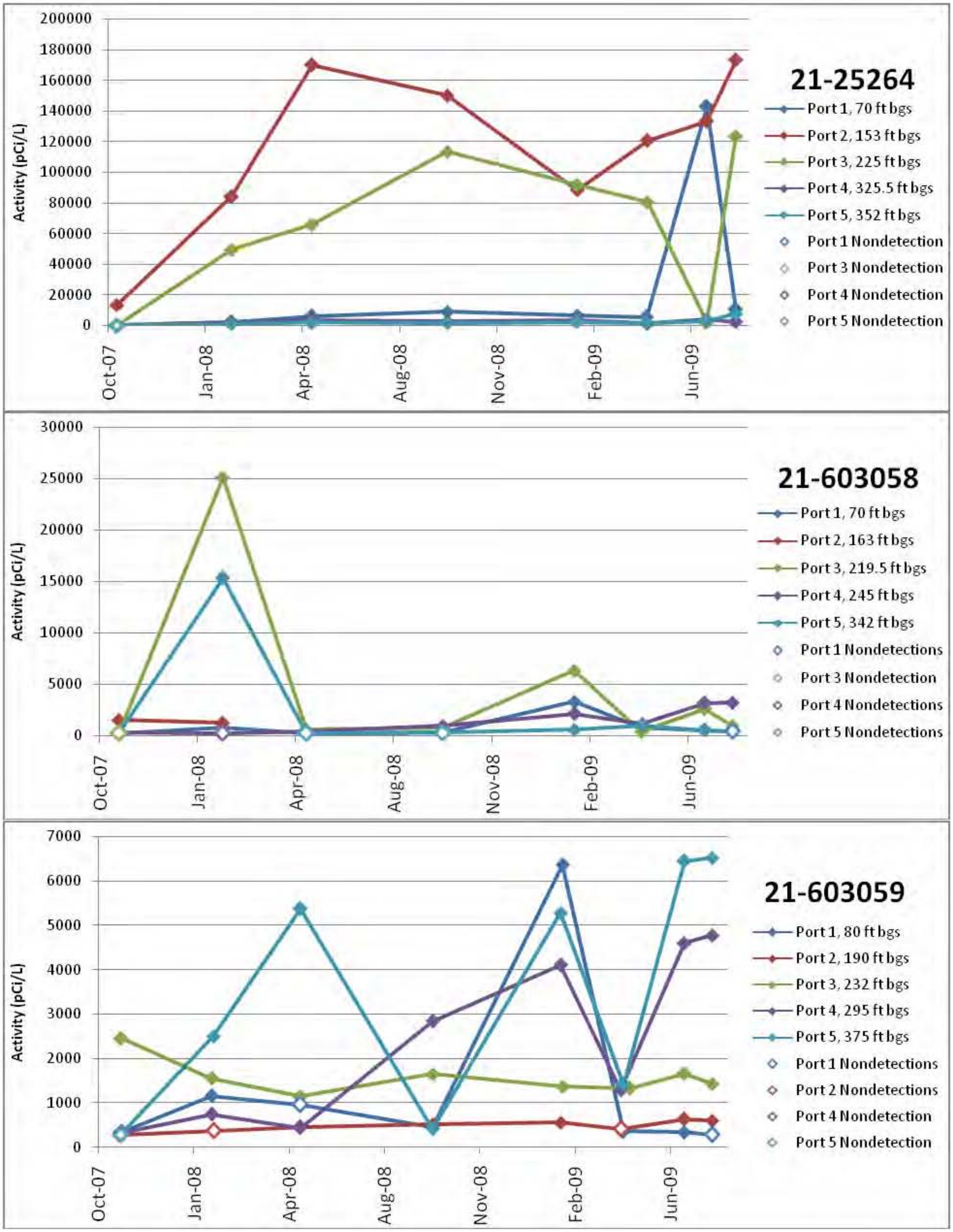


Figure 6.4-8 **Time sequence of tritium activity in all ports of vapor-monitoring wells 21-25264, 21-603058, and 21-603059**

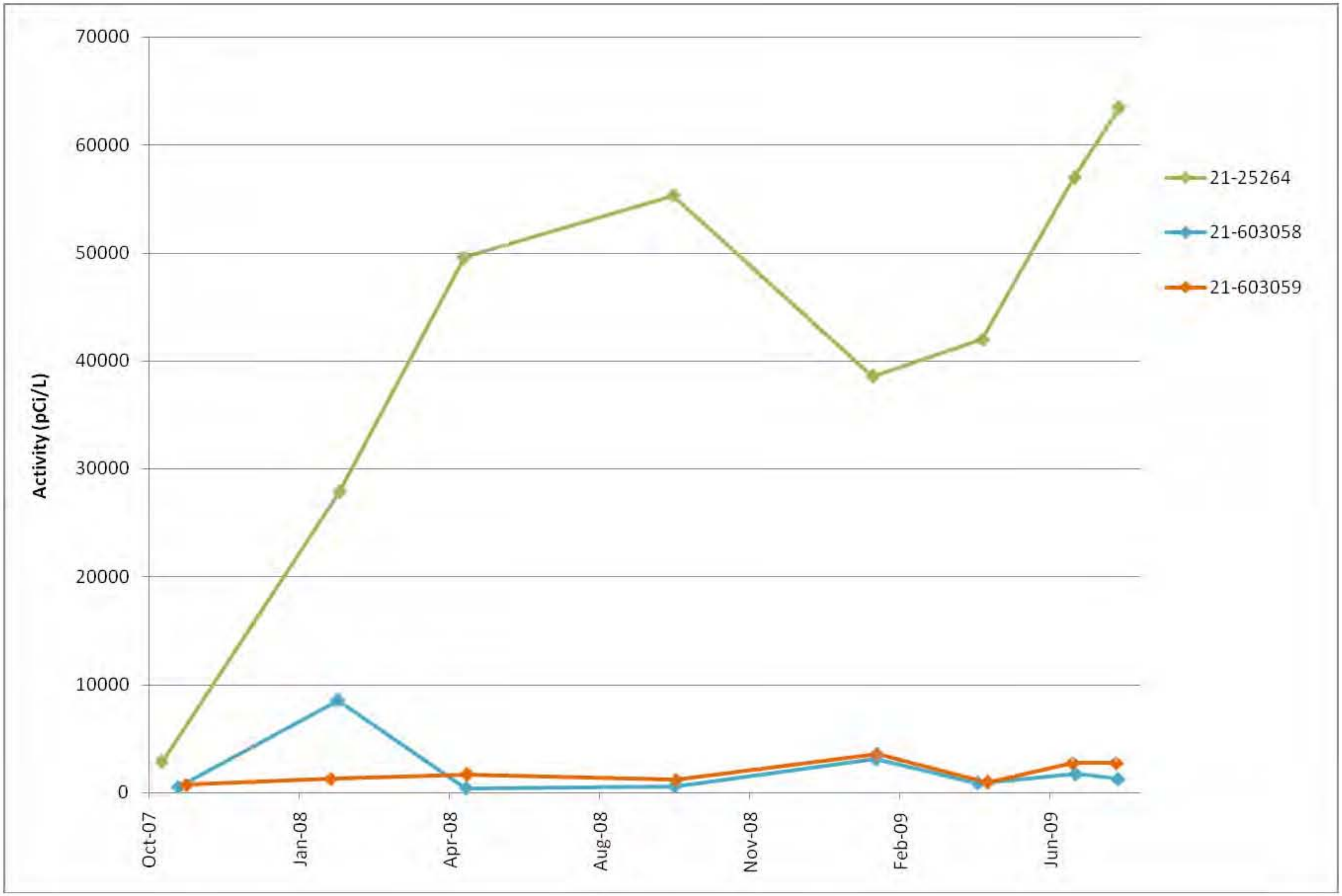


Figure 6.4-9 Time sequence of average tritium activity in vapor-monitoring wells 21-25264, 21-603058, and 21-603059

Table 4.1-1
Summary of 2009 Core Samples Collected

Sample ID	Location ID	Depth (ft bgs)	Collection Date	Media	Field QC Type	Anion	Tritium	Perchlorate	VOC	Calculated Total Porosity	Density	Moisture Content by ASTM	Saturated Hydraulic Conductivity
MD21-09-4633	21-25262	420–425	4/13/2009	Qbo	n/a[a]	09-1473	09-1473	09-1473	09-1473	09-1490	09-1490	09-1490	09-1490
MD21-09-4634	21-25262	470–473	4/16/2009	Qbo	n/a	09-1500	09-1500	09-1500	09-1500	09-1499	09-1499	09-1499	09-1499
MD21-09-4635	21-25262	520–525	4/20/2009	Qbo	n/a	09-1529	09-1529	09-1529	09-1529	09-1565	09-1565	09-1565	09-1565
MD21-09-4636	21-25262	520–525	4/20/2009	Qbo	FD	09-1529	09-1529	09-1529	09-1529	09-1565	09-1565	09-1565	09-1565
MD21-09-4637	21-25262	570–575	4/20/2009	Qbo	n/a	09-1529	09-1529	09-1529	09-1529	09-1565	09-1565	09-1565	09-1565
MD21-09-4638	21-25262	620–625	4/22/2009	Qbo	n/a	09-1588	09-1588	09-1588	09-1588	09-1605	09-1605	09-1605	09-1605
MD21-09-4639	21-25262	670–675	4/22/2009	Qbog	n/a	09-1588	09-1588	09-1588	09-1588	09-1605	09-1605	09-1605	09-1605
MD21-09-4640	21-25262	675–680	4/22/2009	Qbog	n/a	09-1588	09-1588	09-1588	09-1588	09-1605	09-1605	09-1605	09-1605
MD21-09-8973	21-25262	693.7–695.1	5/4/2009	Tp	n/a	09-1694	09-1694	09-1694	09-1694	NA[b]	NA	NA	NA

Note: Numbers in analyte columns are request numbers.

[a] n/a = Not applicable.

[b] NA = Not analyzed.

Table 4.1-2
Summary of Geotechnical Sample Results

Sample ID	Location ID	Depth (ft bgs)	Media	Collection Date	Calculated Total Porosity (%)	Density (g/cm^3)	Moisture Content (Gravimetric and Volumetric) by ASTM (%)	Saturated Hydraulic Conductivity (cm/sec)
MD21-09-4633	21-25262	420-425	Qbo	4/13/2009	58.1	1.11	20.8	0.000092
MD21-09-4634	21-25262	470-473	Qbo	4/16/2009	57.5	1.13	14.6	0.0019
MD21-09-4635	21-25262	520-525	Qbo	4/20/2009	59.5	1.07	14.2	0.0017
MD21-09-4637	21-25262	570-575	Qbo	4/20/2009	57.9	1.12	19.3	0.000029
MD21-09-4638	21-25262	620-625	Qbo	4/22/2009	57.2	1.13	17.5	0.00019
MD21-09-4639	21-25262	670-675	Qbog	4/22/2009	65.6	0.91	18	0.000076
MD21-09-4640	21-25262	675-680	Qbog	4/22/2009	70.4	0.79	25.7	0.00016

Table 4.2-1
Summary of Solid Media Core Field-Screening Results

Top Depth (ft bgs)	PID (ppm)	Daily MDA[a] Alpha (dpm)	Daily MDA Beta (dpm)	Sample Gross Alpha/Beta
391	0.2	NR[b]	NR	<MDA
396	0.0	NR	NR	<MDA
400	0.6	38.5	2520	<MDA
405	0.2	38.5	2520	<MDA
412	0-0.2	38.5	2520	<MDA
415	0.0	38.5	2520	<MDA
420	0.0	38.5	2520	<MDA
470	0.0	88.9	1687	<MDA
520	0.0	37.7	1862	<MDA
570	0.0	37.7	1862	<MDA
620	0.0	36.9	1570	<MDA
650	0.0	0.0	1285	<MDA
655	0.0	0.0	1285	<MDA
660	0.0	0.0	1285	<MDA
665	0.0	0.0	1285	<MDA
670	0.0	0.0	1285	<MDA
675	0.0	0.0	1285	<MDA
686	0.0	47.8	2000	<MDA
691	0.0	47.8	2000	<MDA
693.7	NA[b]	47.8	2000	<MDA

[a] MDA = Minimum detectable activity.

[b] NR = Not recorded.

Table 4.3-1
MDA T Pore-Gas Sampling Depths and Collection Dates, October 2007–July 2009

Vapor-Monitoring Well ID	Sample Port	Begin Depth (ft bgs)	End Depth (ft bgs)	Round 1 Collection Date (Event ID 236)	Round 2 Collection Date (Event ID 340)	Round 3 Collection Date (Event ID 407)	Round 4 Collection Date (Event ID 487)	Round 5 Collection Date (Event ID 649)	Round 6 Collection Date (Event IDs 677 & 751)	Round 7 Collection Date (Event ID 877)	Round 8 Collection Date (Event ID 912)
21-25262	1	80	85	n/a[a]	n/a	n/a	n/a	n/a	n/a	6/12/2009	7/14/2009
21-25262	2	115	120	n/a	n/a	n/a	n/a	n/a	n/a	6/12/2009	7/14/2009
21-25262	3	232	237	n/a	n/a	n/a	n/a	n/a	n/a	6/12/2009	7/14/2009
21-25262	4	295	300	n/a	n/a	n/a	n/a	n/a	n/a	6/12/2009	7/14/2009
21-25262	5	329.5	334.5	n/a	n/a	n/a	n/a	n/a	n/a	6/12/2009	7/14/2009
21-25262	6	375	380	n/a	n/a	n/a	n/a	n/a	n/a	6/12/2009	7/14/2009
21-25262	7	472.25	478	n/a	n/a	n/a	n/a	n/a	n/a	6/12/2009	7/14/2009
21-25262	8	572	577	n/a	n/a	n/a	n/a	n/a	n/a	6/12/2009	7/14/2009
21-25262	Single packer[b]	229.5	234.5	n/a	n/a	n/a	n/a	n/a	4/20/2009	n/a	n/a
21-25262	9	686	691	n/a	n/a	n/a	n/a	n/a	n/a	6/15/2009	7/14/2009
21-25264	1	67.5	72.5	10/19/2007	2/14/2008	5/7/2008	9/23/2008	2/4/2009	4/16/2009	6/17/2009	7/17/2009
21-25264	2	150.5	155.5	10/19/2007	2/14/2008	5/7/2008	9/23/2008	2/4/2009	4/17/2009	6/17/2009	7/17/2009
21-25264	3	222.5	227.5	10/19/2007	2/14/2008	5/7/2008	9/23/2008	2/3/2009	4/17/2009	6/17/2009	7/17/2009
21-25264	4	323	328	10/19/2007	2/14/2008	5/7/2008	9/23/2008	2/3/2009	4/17/2009	6/17/2009	7/17/2009
21-25264	5	349.5	354.5	10/19/2007	2/14/2008	5/7/2008	9/23/2008	2/3/2009	4/16/2009	6/17/2009	7/17/2009
21-603058	1	67.5	72.5	10/30/2007	2/13/2008	5/9/2008	9/24/2008	2/5/2009	4/14/2009	6/18/2009	7/16/2009
21-603058	2	160.5	165.5	10/30/2007	2/13/2008	—[c]	—	—	—	—	—
21-603058	3	217	222	10/30/2007	2/13/2008	5/8/2008	9/24/2008	2/5/2009	4/14/2009	6/18/2009	7/16/2009
21-603058	4	242.5	247.5	10/30/2007	2/13/2008	5/8/2008	9/24/2008	2/5/2009	4/15/2009	6/18/2009	7/16/2009
21-603058	5	339.5	344.5	10/30/2007	2/13/2008	5/8/2008	9/24/2008	2/5/2009	4/15/2009	6/18/2009	7/16/2009
21-603059	1	77.5	82.5	11/4/2007	2/6/2008	5/9/2008	9/25/2008	2/8/2009	4/13/2009	6/16/2009	7/15/2009
21-603059	2	112.5	117.5	—	—	—	—	—	—	—	—
21-603059	3	187.5	192.5	11/3/2007	2/8/2008	5/9/2008	9/25/2008	2/6/2009	4/10/2009	6/16/2009	7/15/2009

Table 4.3-1 (continued)

Vapor-Monitoring Well ID	Sample Port	Begin Depth (ft bgs)	End Depth (ft bgs)	Round 1 Collection Date (Event ID 236)	Round 2 Collection Date (Event ID 340)	Round 3 Collection Date (Event ID 407)	Round 4 Collection Date (Event ID 487)	Round 5 Collection Date (Event ID 649)	Round 6 Collection Date (Event IDs 677 & 751)	Round 7 Collection Date (Event ID 877)	Round 8 Collection Date (Event ID 912)
21-603059	4	229.5	234.5	11/3/2007	2/6/2008	5/9/2008	9/25/2008	2/8/2009	4/20/2009[b]	6/16/2009	7/15/2009
21-603059	5	292.5	297.5	11/3/2007	2/6/2008	5/9/2008	9/25/2008	2/6/2009	4/10/2009	6/16/2009	7/15/2009
21-603059	6	372.5	377.5	11/3/2007	2/8/2008	5/9/2008	9/25/2008	2/6/2009	4/13/2009	6/16/2009	7/15/2009

Note: Event IDs refer to the sample collection log and chain of custody packages provided in Appendix D.

[a] n/a = Not applicable.

[b] Single packer sample collected during drilling.

[c] — = Sample not collected. See section 2.2 for further explanation.

Table 4.3-2
Summary of Pore-Gas Samples Collected at MDA T, Vapor-Monitoring Well 21-25262, June and July 2009

Sample ID	Depth (ft bgs)	Collection Date	Field QC Type	Request Number	
				Tritium	VOCs
April 2009					
MD21-09-4676	n/a[a]	4/24/2009	FB	—[b]	09-1607
MD21-09-4674	679.25–680.75	4/23/2009	n/a	—	09-1587
MD21-09-4675	679.25–680.75	4/23/2009	FD	—	09-1587
MD21-09-8569	679.25–680.75	4/23/2009	n/a	09-1606	—
MD21-09-8570	679.25–680.75	4/23/2009	FD	09-1606	—
June 2009					
MD21-09-10355	80–85	6/12/2009	n/a	09-2321	09-2320
MD21-09-10356	115–120	6/12/2009	n/a	09-2321	09-2320
MD21-09-10357	232–237	6/12/2009	n/a	09-2321	09-2320
MD21-09-10358	295–300	6/12/2009	n/a	09-2321	09-2320
MD21-09-10359	329.5–334.5	6/12/2009	n/a	09-2334	09-2333
MD21-09-10360	375–380	6/12/2009	n/a	09-2334	09-2333
MD21-09-10361	472.25–478	6/12/2009	n/a	09-2334	09-2333
MD21-09-10362	572–577	6/12/2009	n/a	09-2334	09-2333
MD21-09-10363	686–691	6/15/2009	n/a	09-2334	09-2333
MD21-09-10364	686–691	6/15/2009	FD	09-2334	09-2333
July 2009					
MD21-09-11294	80–85	7/14/2009	n/a	09-2636	09-2635
MD21-09-11295	115–120	7/14/2009	n/a	09-2636	09-2635
MD21-09-11296	232–237	7/14/2009	n/a	09-2636	09-2635
MD21-09-11297	295–300	7/14/2009	n/a	09-2636	09-2635
MD21-09-11298	329.5–334.5	7/14/2009	n/a	09-2636	09-2635
MD21-09-11299	375–380	7/14/2009	n/a	09-2636	09-2635
MD21-09-11300	472.25–478	7/14/2009	n/a	09-2636	09-2635
MD21-09-11301	572–577	7/14/2009	n/a	09-2636	09-2635
MD21-09-11302	686–691	7/14/2009	n/a	09-2636	09-2635
MD21-09-11303	686–691	7/14/2009	FB	—	09-2635
MD21-09-11304	686–691	7/14/2009	FD	09-2636	09-2635

[a] n/a = Not applicable.

[b] — = Sample not collected.

Table 4.3-3
Summary of Pore-Gas Samples Collected at MDA T, Vapor-Monitoring Well 21-25264, October 2007–July 2009

Sample ID	Depth (ft bgs)	Collection Date	Field QC Type	Request Number	
				Tritium	VOCs
October 2007					
MD21-07-6813	67.5–72.5	10/19/2007	n/a[a]	08-80	08-79
MD21-07-6814	150.5–155.5	10/19/2007	n/a	08-80	08-79
MD21-07-6815	222.5–227.5	10/19/2007	n/a	08-80	08-79
MD21-07-6816	323–328	10/19/2007	n/a	08-80	08-79
MD21-07-6817	349.5–354.5	10/19/2007	n/a	08-80	08-79
February 2008					
MD21-08-10517	n/a	2/19/2008	FB	—[b]	08-646
MD21-08-10511	67.5–72.5	2/14/2008	n/a	08-631	08-630
MD21-08-10512	150.5–155.5	2/14/2008	n/a	08-631	08-630
MD21-08-10513	222.5–227.5	2/14/2008	n/a	08-631	08-630
MD21-08-10514	323–328	2/14/2008	n/a	08-631	08-630
MD21-08-10515	349.5–354.5	2/14/2008	n/a	08-631	08-630
MD21-08-10516	349.5–354.5	2/14/2008	FD	08-631	08-630
May 2008					
MD21-08-12247	67.5–72.5	5/7/2008	n/a	08-1108	08-1107
MD21-08-12257	67.5–72.5	5/7/2008	FD	08-1108	—
MD21-08-12248	150.5–155.5	5/7/2008	n/a	08-1108	08-1107
MD21-08-12249	222.5–227.5	5/7/2008	n/a	08-1108	08-1107
MD21-08-12250	323–328	5/7/2008	n/a	08-1108	08-1107
MD21-08-12251	349.5–354.5	5/7/2008	n/a	08-1108	08-1107
September 2008					
MD21-08-14828	67.5–72.5	9/23/2008	n/a	08-2021	08-2020
MD21-08-14829	150.5–155.5	9/23/2008	n/a	08-2021	08-2020
MD21-08-14830	222.5–227.5	9/23/2008	n/a	08-2021	08-2020
MD21-08-14831	323–328	9/23/2008	n/a	08-2021	08-2020
MD21-08-14832	349.5–354.5	9/23/2008	n/a	08-2021	08-2020
MD21-08-14833	349.5–354.5	9/23/2008	FD	08-2021	08-2020
February 2009					
MD21-09-3564	67.5–72.5	2/4/2009	n/a	09-812	09-811
MD21-09-3563	150.5–155.5	2/4/2009	n/a	09-812	09-811
MD21-09-3565	150.5–155.5	2/4/2009	FD	09-812	09-811
MD21-09-3560	222.5–227.5	2/3/2009	n/a	09-812	09-811
MD21-09-3561	323–328	2/3/2009	n/a	09-812	09-811
MD21-09-3562	349.5–354.5	2/3/2009	n/a	09-812	09-811

Table 4.3-3 (continued)

Sample ID	Depth (ft bgs)	Collection Date	Field QC Type	Request Number	
				Tritium	VOCs
April 2009					
MD21-09-7164	67.5–72.5	4/16/2009	n/a	09-1505	09-1504
MD21-09-7166	150.5–155.5	4/17/2009	n/a	09-1510	09-1509
MD21-09-7168	222.5–227.5	4/17/2009	n/a	09-1510	09-1509
MD21-09-7167	323–328	4/17/2009	n/a	09-1510	09-1509
MD21-09-7165	349.5–354.5	4/16/2009	n/a	09-1505	09-1504
MD21-09-7174	349.5–354.5	4/16/2009	FD	09-1505	09-1504
June 2009					
MD21-09-10354	n/a	6/18/2009	FB	—	09-2406
MD21-09-10344	67.5–72.5	6/17/2009	n/a	09-2363	09-2362
MD21-09-10345	150.5–155.5	6/17/2009	n/a	09-2363	09-2362
MD21-09-10353	150.5–155.5	6/17/2009	FD	09-2363	09-2362
MD21-09-10346	222.5–227.5	6/17/2009	n/a	09-2363	09-2362
MD21-09-10347	323–328	6/17/2009	n/a	09-2363	09-2362
MD21-09-10348	349.5–354.5	6/17/2009	n/a	09-2363	09-2362
July 2009					
MD21-09-11292	n/a	7/17/2009	FB	—	09-2683
MD21-09-11283	67.5–72.5	7/17/2009	n/a	09-2684	09-2683
MD21-09-11284	150.5–155.5	7/17/2009	n/a	09-2684	09-2683
MD21-09-11293	150.5–155.5	7/17/2009	FD	09-2684	09-2683
MD21-09-11285	222.5–227.5	7/17/2009	n/a	09-2684	09-2683
MD21-09-11286	323–328	7/17/2009	n/a	09-2684	09-2683
MD21-09-11287	349.5–354.5	7/17/2009	n/a	09-2684	09-2683

[a] n/a = Not applicable.

[b] — = Sample not collected.

Table 4.3-4
Summary of Pore-Gas Samples Collected at MDA T, Vapor-Monitoring Well 21-603058, October 2007–July 2009

Sample ID	Depth (ft bgs)	Collection Date	Field QC Type	Request Number	
				Tritium	VOCs
October 2007					
MD21-07-6818	n/a[a]	10/30/2007	FB	08-125	08-124
MD21-07-6807	67.5–72.5	10/30/2007	n/a	08-99	08-98
MD21-07-6808	160.5–165.5	10/30/2007	n/a	08-99	08-98
MD21-07-6809	217–222	10/30/2007	n/a	08-99	08-98
MD21-07-6810	242.5–247.5	10/30/2007	n/a	08-99	08-98
MD21-07-6811	339.5–344.5	10/30/2007	n/a	08-99	08-98
MD21-07-6812	339.5–344.5	10/30/2007	FD	08-99	08-98
February 2008					
MD21-08-10504	67.5–72.5	2/13/2008	n/a	08-624	08-623
MD21-08-10505	160.5–165.5	2/13/2008	n/a	08-624	08-623
MD21-08-10506	217–222	2/13/2008	n/a	08-624	08-623
MD21-08-10507	242.5–247.5	2/13/2008	n/a	08-624	08-623
MD21-08-10508	339.5–344.5	2/13/2008	n/a	08-624	08-623
May 2008					
MD21-08-12255	n/a	5/8/2008	FB	—[b]	08-1147
MD21-08-12242	67.5–72.5	5/9/2008	n/a	08-1114	08-1113
MD21-08-12244	217–222	5/8/2008	n/a	08-1114	08-1113
MD21-08-12245	242.5–247.5	5/8/2008	n/a	08-1114	08-1113
MD21-08-12246	339.5–344.5	5/8/2008	n/a	08-1114	08-1113
MD21-08-12256	339.5–344.5	5/8/2008	FD	—	08-1113
September 2008					
MD21-08-14826	n/a	9/24/2008	FB	—	08-2020
MD21-08-14813	67.5–72.5	9/24/2008	n/a	08-2021	08-2020
MD21-08-14814	217–222	9/24/2008	n/a	08-2021	08-2020
MD21-08-14815	242.5–247.5	9/24/2008	n/a	08-2021	08-2020
MD21-08-14816	339.5–344.5	9/24/2008	n/a	08-2021	08-2020
February 2009					
MD21-09-3559	n/a	2/8/2009	FB	—	09-842
MD21-09-3553	67.5–72.5	2/5/2009	n/a	09-836	09-835
MD21-09-3554	217–222	2/5/2009	n/a	09-836	09-835
MD21-09-3558	217–222	2/5/2009	FD	09-836	09-835
MD21-09-3555	242.5–247.5	2/5/2009	n/a	09-836	09-835
MD21-09-3556	339.5–344.5	2/5/2009	n/a	09-836	09-835

Table 4.3-4 (continued)

Sample ID	Depth (ft bgs)	Collection Date	Field QC Type	Request Number	
				Tritium	VOCs
April 2009					
MD21-09-7169	n/a	4/15/2009	FB	—	09-1494
MD21-09-7159	67.5–72.5	4/14/2009	n/a	09-1491	09-1476
MD21-09-7160	217–222	4/14/2009	n/a	09-1491	09-1476
MD21-09-7162	242.5–247.5	4/15/2009	n/a	09-1495	09-1494
MD21-09-7161	339.5–344.5	4/15/2009	n/a	09-1495	09-1494
MD21-09-7172	339.5–344.5	4/15/2009	FD	09-1495	09-1494
June 2009					
MD21-09-10352	n/a	6/18/2009	FB	—	09-2406
MD21-09-10339	67.5–72.5	6/18/2009	n/a	09-2407	09-2406
MD21-09-10341	217–222	6/18/2009	n/a	09-2407	09-2406
MD21-09-10351	217–222	6/18/2009	FD	09-2407	09-2406
MD21-09-10342	242.5–247.5	6/18/2009	n/a	09-2407	09-2406
MD21-09-10343	339.5–344.5	6/18/2009	n/a	09-2407	09-2406
July 2009					
MD21-09-11290	n/a	7/16/2009	FB	—	09-2669
MD21-09-11278	67.5–72.5	7/16/2009	n/a	09-2670	09-2669
MD21-09-11280	217–222	7/16/2009	n/a	09-2670	09-2669
MD21-09-11291	217–222	7/16/2009	FD	09-2670	09-2669
MD21-09-11281	242.5–247.5	7/16/2009	n/a	09-2670	09-2669
MD21-09-11282	339.5–344.5	7/16/2009	n/a	09-2670	09-2669

[a] n/a = Not applicable.

[b] — = Sample not collected.

Table 4.3-5
Summary of Pore-Gas Samples Collected at MDA T, Vapor-Monitoring Well 21-603059, October 2007–July 2009

Sample ID	Depth (ft bgs)	Collection Date	Field QC Type	Request Number	
				Tritium	VOCs
November 2007					
MD21-08-8445	n/a[a]	11/3/2007	FB	08-125	08-124
MD21-07-6804	77.5–82.5	11/4/2007	n/a	08-125	08-124
MD21-07-6803	187.5–192.5	11/3/2007	n/a	08-125	08-124
MD21-07-6801	229.5–234.5	11/3/2007	n/a	08-125	08-124
MD21-07-6802	292.5–297.5	11/3/2007	n/a	08-125	08-124
MD21-07-6800	372.5–377.5	11/3/2007	n/a	08-125	08-124
MD21-07-6806	372.5–377.5	11/3/2007	FD	08-125	08-124
February 2008					
MD21-08-10525	n/a	2/19/2008	FB	—[b]	08-646
MD21-08-10518	77.5–82.5	2/6/2008	n/a	08-605	08-604
MD21-08-10524	77.5–82.5	2/6/2008	FD	08-605	08-604
MD21-08-10519	187.5–192.5	2/8/2008	n/a	08-605	08-604
MD21-08-10520	229.5–234.5	2/6/2008	n/a	08-605	08-604
MD21-08-10521	292.5–297.5	2/6/2008	n/a	08-605	08-604
MD21-08-10522	372.5–377.5	2/8/2008	n/a	08-605	08-604
May 2008					
MD21-08-12252	n/a	5/9/2008	FB	—	08-1147
MD21-08-12236	77.5–82.5	5/9/2008	n/a	08-1114	08-1113
MD21-08-12237	187.5–192.5	5/9/2008	n/a	08-1114	08-1113
MD21-08-12238	229.5–234.5	5/9/2008	n/a	08-1114	08-1113
MD21-08-12239	292.5–297.5	5/9/2008	n/a	08-1114	08-1113
MD21-08-12240	372.5–377.5	5/9/2008	n/a	08-1114	08-1113
MD21-08-12253	372.5–377.5	5/9/2008	FD	08-1114	08-1113
September 2008					
MD21-08-14824	n/a	9/25/2008	FB	—	08-2020
MD21-08-14818	77.5–82.5	9/25/2008	n/a	08-2021	08-2020
MD21-08-14819	187.5–192.5	9/25/2008	n/a	08-2021	08-2020
MD21-08-14820	229.5–234.5	9/25/2008	n/a	08-2021	08-2020
MD21-08-14821	292.5–297.5	9/25/2008	n/a	08-2021	08-2020
MD21-08-14822	372.5–377.5	9/25/2008	n/a	08-2021	08-2020
MD21-08-14825	372.5–377.5	9/25/2008	FD	08-2021	08-2020

Table 4.3-5 (continued)

Sample ID	Depth (ft bgs)	Collection Date	Field QC Type	Request Number	
				Tritium	VOCs
February 2009					
MD21-09-3552	n/a	2/6/2009	FB	—	09-842
MD21-09-3546	77.5–82.5	2/8/2009	n/a	09-843	09-842
MD21-09-3545	187.5–192.5	2/6/2009	n/a	09-843	09-842
MD21-09-3547	229.5–234.5	2/8/2009	n/a	09-843	09-842
MD21-09-3549	292.5–297.5	2/6/2009	n/a	09-836	09-835
MD21-09-3550	372.5–377.5	2/6/2009	n/a	09-836	09-835
April 2009					
MD21-09-7170	n/a	4/20/2009	FB	—	09-1513
MD21-09-7155	77.5–82.5	4/13/2009	n/a	09-1455	09-1454
MD21-09-7154	187.5–192.5	4/10/2009	n/a	09-1453	09-1452
MD21-09-7157	229.5–234.5	4/13/2009	n/a	09-1455	09-1454
MD21-09-7163	229.5–234.5	4/20/2009	n/a	09-1514	09-1513
MD21-09-7153	292.5–297.5	4/10/2009	n/a	09-1453	09-1452
MD21-09-7156	372.5–377.5	4/13/2009	n/a	09-1455	09-1454
June 2009					
MD21-09-10350	n/a	6/18/2009	FB	—	09-2406
MD21-09-10333	77.5–82.5	6/16/2009	n/a	09-2343	09-2342
MD21-09-10334	187.5–192.5	6/16/2009	n/a	09-2343	09-2342
MD21-09-10335	229.5–234.5	6/16/2009	n/a	09-2343	09-2342
MD21-09-10336	292.5–297.5	6/16/2009	n/a	09-2343	09-2342
MD21-09-10349	292.5–297.5	6/16/2009	FD	09-2343	09-2342
MD21-09-10337	372.5–377.5	6/16/2009	n/a	09-2343	09-2342
July 2009					
MD21-09-11272	77.5–82.5	7/15/2009	n/a	09-2655	09-2654
MD21-09-11273	187.5–192.5	7/15/2009	n/a	09-2655	09-2654
MD21-09-11274	229.5–234.5	7/15/2009	n/a	09-2655	09-2654
MD21-09-11275	292.5–297.5	7/15/2009	n/a	09-2655	09-2654
MD21-09-11276	372.5–377.5	7/15/2009	n/a	09-2655	09-2654
MD21-09-11289	372.5–377.5	7/15/2009	FD	09-2655	09-2654

[a] n/a = Not applicable.

[b] — = Sample not collected.

Table 4.4-1
Summary of Pore-Gas Field-Screening Results, February 2009–July 2009

Event ID	Collection Date	FY2009* Sampling Round	Location ID	Sample Port Number	Top Depth (ft bgs)	Bottom Depth (ft bgs)	% CO_2	% O_2
877	6/12/2009	7	21-25262	1	80	85	0.7	19.8
912	7/14/2009	8	21-25262	1	80	85	0.6	19.8
877	6/12/2009	7	21-25262	2	115	120	0.5	20.1
912	7/14/2009	8	21-25262	2	115	120	0.4	20.2
877	6/12/2009	7	21-25262	3	232	237	0.0	20.6
912	7/14/2009	8	21-25262	3	232	237	0.6	20.0
877	6/12/2009	7	21-25262	4	295	300	0.0	20.6
912	7/14/2009	8	21-25262	4	295	300	0.8	19.9
877	6/12/2009	7	21-25262	5	329.5	334.5	0.5	19.5
912	7/14/2009	8	21-25262	5	329.5	334.5	0.7	19.9
877	6/12/2009	7	21-25262	6	375	380.16	0.4	19.9
912	7/14/2009	8	21-25262	6	375	380.16	0.4	20.2
877	6/12/2009	7	21-25262	7	472.25	478	0.2	19.9
912	7/14/2009	8	21-25262	7	472.25	478	0.2	20.2
877	6/12/2009	7	21-25262	8	572	577	0.1	19.2
912	7/14/2009	8	21-25262	8	572	577	0.0	20.7
877	6/12/2009	7	21-25262	9	686	691	0.0	19.5
912	7/14/2009	8	21-25262	9	686	691	0.0	20.7
649	2/4/2009	5	21-25264	1	67.5	72.5	1.3	19.9
751	4/16/2009	6	21-25264	1	67.5	72.5	1	19.3
877	6/17/2009	7	21-25264	1	67.5	72.5	0.7	19.9
912	7/17/2009	8	21-25264	1	67.5	72.5	0.7	19.4
649	2/4/2009	5	21-25264	2	150.5	155.5	1.4	20.1
751	4/17/2009	6	21-25264	2	150.5	155.5	1	19.9
877	6/17/2009	7	21-25264	2	150.5	155.5	0.6	20.3
912	7/17/2009	8	21-25264	2	150.5	155.5	0.8	19.5
649	2/3/2009	5	21-25264	3	222.5	227.5	1	20.2
751	4/17/2009	6	21-25264	3	222.5	227.5	1.2	19.7
877	6/17/2009	7	21-25264	3	222.5	227.5	0.4	20.7
912	7/17/2009	8	21-25264	3	222.5	227.5	0.4	19.9
649	2/3/2009	5	21-25264	4	323	328	0.8	20.1
751	4/17/2009	6	21-25264	4	323	328	0.8	20.1
877	6/17/2009	7	21-25264	4	323	328	0.0	20.8
912	7/17/2009	8	21-25264	4	323	328	0.3	20.0
649	2/3/2009	5	21-25264	5	349.5	354.5	0.2	20.5
751	4/16/2009	6	21-25264	5	349.5	354.5	0.6	19.9
877	6/17/2009	7	21-25264	5	349.5	354.5	0.0	20.7
912	7/17/2009	8	21-25264	5	349.5	354.5	0.1	20.0

Table 4.4-1 (continued)

Event ID	Collection Date	FY2009* Sampling Round	Location ID	Sample Port Number	Top Depth (ft bgs)	Bottom Depth (ft bgs)	% CO_2	% O_2
649	2/5/2009	5	21-603058	1	67.5	72.5	1.1	19.8
751	4/14/2009	6	21-603058	1	67.5	72.5	1	19.6
877	6/18/2009	7	21-603058	1	67.5	72.5	0.0	20.6
912	7/16/2009	8	21-603058	1	67.5	72.5	0.7	19.4
649	2/5/2009	5	21-603058	3	217	222	0.9	19.9
751	4/14/2009	6	21-603058	3	217	222	0.7	19.7
877	6/18/2009	7	21-603058	3	217	222	0.5	20.4
912	7/16/2009	8	21-603058	3	217	222	0.5	20.0
649	2/5/2009	5	21-603058	4	242.5	247.5	1	20.1
751	4/15/2009	6	21-603058	4	242.5	247.5	0.7	19.7
877	6/18/2009	7	21-603058	4	242.5	247.5	0.7	20.1
912	7/16/2009	8	21-603058	4	242.5	247.5	0.2	20.1
649	2/5/2009	5	21-603058	5	339.5	344.5	1.2	19.8
751	4/15/2009	6	21-603058	5	339.5	344.5	0.7	19.7
877	6/18/2009	7	21-603058	5	339.5	344.5	0.6	20.0
912	7/16/2009	8	21-603058	5	339.5	344.5	0.4	19.9
649	2/8/2009	5	21-603059	1	77.5	82.5	0.8	20.1
751	4/13/2009	6	21-603059	1	77.5	82.5	0.7	19.7
877	6/16/2009	7	21-603059	1	77.5	82.5	0.7	19.6
912	7/15/2009	8	21-603059	1	77.5	82.5	0.6	19.7
649	2/6/2009	5	21-603059	3	187.5	192.5	0.8	20.3
751	4/10/2009	6	21-603059	3	187.5	192.5	0.7	20.2
877	6/16/2009	7	21-603059	3	187.5	192.5	0.5	19.9
912	7/15/2009	8	21-603059	3	187.5	192.5	0.5	19.8
649	2/8/2009	5	21-603059	4	229.5	234.5	1.1	20.1
751	4/13/2009	6	21-603059	4	229.5	234.5	0.6	19.9
751	4/20/2009	6	21-603059	4	229.5	234.5	0.9	19.8
877	6/16/2009	7	21-603059	4	229.5	234.5	0.6	20.1
912	7/15/2009	8	21-603059	4	229.5	234.5	0.4	20.1
649	2/6/2009	5	21-603059	5	292.5	297.5	0.8	20.6
751	4/10/2009	6	21-603059	5	292.5	297.5	0.8	18.9
877	6/16/2009	7	21-603059	5	292.5	297.5	0.4	20.5
912	7/15/2009	8	21-603059	5	292.5	297.5	0.5	19.6
649	2/6/2009	5	21-603059	6	372.5	377.5	0.6	20
751	4/13/2009	6	21-603059	6	372.5	377.5	0.2	20
877	6/16/2009	7	21-603059	6	372.5	377.5	0.3	20.0
912	7/15/2009	8	21-603059	6	372.5	377.5	0.1	19.7

* FY = Fiscal year.

Table 5.1-1
Henry's Law Constant, Groundwater Screening Levels, and Calculated Concentrations Corresponding to Groundwater Screening Levels for Detected VOCs in Pore Gas

VOC	Henry's Law Constant[a] (dimensionless)	Groundwater Screening Level (µg/L)	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard[b] ($\mu g/m^3$)
Acetone	0.0016	22,000[c]	35,200
Benzene	0.228	5[d]	1140
Bromodichloromethane	0.087	1.2[c]	104
Bromoform	0.022	85[c]	1870
1,3-Butadiene	3	0.018[c]	54
1-Butanol	0.00036[c]	3700[c]	1332
2-Butanone	0.0023	7100[c]	16,330
Carbon Disulfide	0.59	1000[c]	590,000
Carbon Tetrachloride	1.1	5[d]	5500
Chlorodibromomethane	0.032	1.5[c]	48
Chloroform	0.15	100[e]	15,000
Cyclohexane	6.1b	13,000[c]	79,300,000
1,2-Dichlorobenzene	0.0779	600[d]	46,740
1,4-Dichlorobenzene	0.0996	75[d]	7470
Dichlorodifluoromethane	14	390[c]	5,460,000
1,2-Dichloroethane	0.048	5[d]	240
1,1-Dichloroethene	1.1	5[e]	5500
cis-1,2-Dichloroethane	0.17	70[d]	11,900
Ethanol	na[f]	na	na
Ethylbenzene	0.323	750[e]	242,250
4-Ethyltoluene	na	na	na
n-Heptane	88[g]	880[h]	77,440,000
Hexane	74	880[c]	65,120,000
2-Hexanone	na	na	na
4-Methyl-2-pentanone	0.0056	2000[c]	11,200
Methylene chloride	0.13	5[d]	650
2-Propanol	na	na	na
Propylene	na	na	na
Tetrachloroethene	0.72	5[d]	3600
Tetrahydrofuran	0.0099[i]	16[g]	158
Toluene	0.272	750[e]	204,000
1,1,2-Trichloro-1,2,2-trifluoroethane	22	59,000[c]	1,298,000,000
1,1,1-Trichloroethane	0.705	60[e]	42,300
1,1,2-Trichloroethane	0.034	5[d]	170
Trichloroethene	0.4	5[d]	2000

Table 5.1-1(continued)

VOC	Henry's Law Constant[a] (dimensionless)	Groundwater SL (µg/L)	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard[b] ($\mu g/m^3$)
1,3,5-Trimethylbenzene	0.32	12[c]	3840
1,2-Xylene	0.213	620[e]	132,060
1,3-Xylene+1,4-Xylene	0.27	620[e]	167,400

[a] NMED (2009, 106420, Appendix B) unless otherwise noted.

[b] Derived from denominator of Equation 5.1-3.

[c] Henry's law constant and tap water screening levels from EPA regional screening tables (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm).

[d] EPA MCL (40 Code of Federal Regulations 141.61).

[e] NMWQCC groundwater standard (20.6.2.3103 New Mexico Administrative Code).

[f] na = Not available.

[g] EPA regional SL not available. EPA Region 6 tap water SL used (EPA 2007, 099314).

[h] Hexane used as a surrogate, based on structural similarity.

[i] EPA Superfund chemical data matrix value for 25°C (http://www.dep.state.pa.us/physicalproperties/Default.htm).

Table 6.1-1
Summary of Inorganic Chemicals Detected in 2009 Core Samples

Sample ID	Location ID	Depth (ft bgs)	Collection Date	Media	Chloride	Fluoride	Nitrate	Perchlorate	Sulfate
Qbo Background Value					**474[a]**	**na[b]**	**na**	**na**	**1120**
Qbog Background Value					**474**	**na**	**na**	**na**	**1120**
Tp Background Value					**na**	**na**	**na**	**na**	**na**
Residential SSL[c]					**na**	**4690**	**125000**	**54.8**	**na**
IndustrialSSL[c]					**na**	**68100**	**1820000**	**795**	**na**
Construction Worker SSL[c]					**na**	**18600**	**496000**	**217**	**na**
MD21-09-4633	21-25262	420–425	4/13/2009	Qbo	4.08	NA[d]	3.97	0.0114	NA
MD21-09-4634	21-25262	470–473	4/16/2009	Qbo	3.46	NA	1.8	—[e]	NA
MD21-09-4635	21-25262	520–525	4/20/2009	Qbo	3.69(J-)	NA	1.67	—	NA
MD21-09-4637	21-25262	520–525	4/20/2009	Qbo	3.48(J-)	NA	1.67	—	NA
MD21-09-4638	21-25262	620–625	4/22/2009	Qbo	3.75	NA	1.06(J)	—	NA
MD21-09-4639	21-25262	670–675	4/22/2009	Qbog	5.66	NA	1.7	0.000702(J+)	NA
MD21-09-4640	21-25262	675–680	4/22/2009	Qbog	7.3	NA	1.95	0.00101(J+)	NA
MD21-09-8973	21-25262	693.7–695.1	5/4/2009	Tp	—	3.48(J)	—	—	5.36

Note: Units are in mg/kg.

[a] BVs from LANL (1998, 059730).

[b] na = Not available.

[c] SSLs from NMED (2009, 106420, Appendix A).

[d] NA = Not analyzed.

[e] — = Not detected.

Table 6.1-2
Summary of Organic Chemicals Detected in 2009 Core Samples

Sample ID	Location ID	Depth (ft bgs)	Collection Date	Media	Acetone
Residential SSL*					**67,500**
Industrial SSL*					**851,000**
Construction Worker SSL*					**263,000**
MD21-09-4640	21-25262	675–680	4/22/2009	Qbog	0.00227(J)

Note: Units are in mg/kg.

*NMED (2009, 106420, Appendix A).

Table 6.1-3
Summary of Tritium Detected in 2009 Core Samples

Sample ID	Location ID	Depth (ft bgs)	Collection Date	Media	Tritium
Qbo Background Value					**na**[a]
Residential SAL[b]					**750**
Industrial SAL[b]					**440,000**
Construction Worker SAL[b]					**320,000**
MD21-09-4633	21-25262	420–425	4/13/2009	Qbo	0.594186
MD21-09-4637	21-25262	570–575	4/20/2009	Qbo	0.0736364

Note: Units are in pCi/g.

[a] na = Not available.

[b] SALs from LANL (2005, 088493).

Table 6.1-4
Summary of VOCs Detected in Pore-Gas Samples at MDA T Vapor-Monitoring Well 21-25262, June and July 2009

Sample ID	Depth (ft bgs)	Collection Date	Acetone	Benzene	Bromodichloromethane	1,3-Butadiene	1-Butanol	2-Butanone	Carbon Disulfide	Carbon Tetrachloride	Chloroform	1,4-Dichlorobenzene	Dichlorodifluoromethane	1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Hexane	Methylene Chloride	Propylene	Tetrachloroethene	Tetrahydrofuran	Toluene	1,1,2-Trichloro-1,2,2-trifluoroethane	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene
April 2009																										
MD21-09-4674	679.25–680.75	4/23/2009	**51**[a]	—[b]	—	—	82(J)	**6**	—	11	270	—	—	—	9.9	—	—	340	8.9	—	—	**5.6**	—	—	35	85
June 2009																										
MD21-09-10355	80–85	6/12/2009	—	—	—	—	—	—	3.2	57	930	—	4.7	—	—	—	—	3.8	—	**1500**	—	—	—	17	—	580
MD21-09-10356	115–120	6/12/2009	—	—	—	—	—	—	—	41	330	—	4.5	—	—	—	—	5.1	—	360	—	—	—	11	—	240
MD21-09-10357	232–237	6/12/2009	37	—	—	—	—	4.4	—	56	160	—	—	—	—	—	—	8.1	—	57	—	—	—	5.8	—	100
MD21-09-10358	295–300	6/12/2009	26	—	—	—	—	2.8	—	170	160	—	—	—	5.7	—	—	67	—	39	—	—	10	6.3	—	280
MD21-09-10359	329.5–334.5	6/12/2009	12	—	7.8	—	—	—	6.2	490	450	—	6	6	20	3.6	—	320	—	97	—	—	27	16	24	820
MD21-09-10360	375–380	6/12/2009	24	—	7.9	—	—	4.1	—	410	570	—	—	9.4	36	—	—	680	—	63	—	3.9	14	8.3	55	880
MD21-09-10361	472.25–478	6/12/2009	14	—	—	—	—	—	4.9	340	830	—	—	16	61	—	—	1300	—	41	—	4.5	9.3	—	110	880
MD21-09-10362	572–577	6/12/2009	—	—	—	—	—	—	5.2	160	910	—	—	15	63	—	—	1500	—	17	—	—	—	—	66	670
MD21-09-10363	686–691	6/15/2009	22	—	—	—	—	**6**	3.5	—	74	—	—	—	—	—	—	77	9.2	—	—	—	—	—	14	19
July 2009																										
MD21-09-11294	80–85	7/14/2009	—	—	—	—	—	—	3.6	45	730	—	4.9	—	—	—	—	—	—	1300	—	—	—	12	—	450
MD21-09-11295	115–120	7/14/2009	—	—	—	—	—	—	—	44	380	—	4.9	—	—	—	—	5.8	—	430	—	—	—	12	—	270
MD21-09-11296	232–237	7/14/2009	—	—	6.3	—	—	—	3.2	220	520	—	7.4	—	6	—	—	30	—	240	—	—	21	21	—	390
MD21-09-11297	295–300	7/14/2009	—	—	11	—	—	—	8.2	**830**	740	—	**11**	5.1	29	4.5	—	310	—	210	—	—	**56**	**31**	16	1300
MD21-09-11298	329.5–334.5	7/14/2009	—	—	14	—	—	—	4.6	780	720	—	8.4	9.4	35	4.8	—	520	—	180	—	—	50	25	44	1400
MD21-09-11299	375–380	7/14/2009	—	3.9	**15**	—	—	—	5.1	700	930	**7.4**	5.1	17	62	**5.5**	—	1200	—	120	**3.7**	—	26	14	100	**1500**
MD21-09-11300	472.25–478	7/14/2009	—	—	—	—	**36**	—	**19**	600	**1400**	—	—	**27**	**100**	—	—	**2100**	—	74	—	—	18	—	**200**	**1500**
MD21-09-11301	572–577	7/14/2009	—	—	—	—	—	—	—	190	1000	—	—	17	71	—	—	1700	13	23	—	—	—	—	85	780
MD21-09-11302	686–691	7/14/2009	—	**13**	—	**7.4**	—	—	4.8	—	120	—	—	—	7.1	—	**5.6**	140	**120**	—	—	—	—	—	21	34

Note: Organic chemical detections per sample; standard unit of measure = μg/m^3.

[a] Bold values represent the maximum concentrations.

[b] — = Not detected.

Table 6.1-5
Summary of VOCs Detected in Pore-Gas Samples at MDA T Vapor-Monitoring Well 21-25264, October 2007–July 2009

Sample ID	Depth (ft bgs)	Collection Date	Acetone	Benzene	Bromodichloromethane	Bromoform	2-Butanone	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Cyclohexane	1,4-Dichlorobenzene	Dichlorodifluoromethane	1,2-Dichloroethane	1,1-Dichloroethene	Ethanol	Methylene Chloride	Propylene	Tetrachloroethene	Tetrahydrofuran	Toluene	1,1,2-Trichloro-1,2,2-trifluoroethane	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	1,3-Xylene+1,4-Xylene
October 2007																										
MD21-07-6813	67.5–72.5	10/19/2007	17	—[a]	—	**12**[b]	—	3	160	350	3.2	—	10	3.8	—	—	250	—	1500	—	5.1	—	18	—	660	—
MD21-07-6814	150.5–155.5	10/19/2007	68	**2.9**	—	—	12	—	160	310	4.5	—	8.6	4	—	—	300	—	360	—	6.8	—	19	—	420	—
MD21-07-6815	222.5–227.5	10/19/2007	18	—	—	—	3.4	3.8	180	300	3.6	—	6.6	6.3	—	—	420	—	160	—	—	6.7 (J)	16	—	380	—
MD21-07-6816	323–328	10/19/2007	19	—	—	—	—	—	190	270	—	—	4.9	5.9	4	—	590	—	79	—	5.8	—	5.4	—	320	5.7
MD21-07-6817	349.5–354.5	10/19/2007	44	—	—	—	5.6	—	230	550	—	—	—	15	6.8	—	1300	—	26	—	9.4	—	—	—	460	**8.4**
February 2008																										
MD21-08-10511	67.5–72.5	2/14/2008	—	—	—	—	—	—	160	410	—	—	13	—	—	—	36	—	2500	—	—	—	29	—	980	—
MD21-08-10512	150.5–155.5	2/14/2008	12	—	—	—	—	5.7	170	360	5.4	—	10	—	—	—	220	—	440	—	—	7	24	—	520	—
MD21-08-10513	222.5–227.5	2/14/2008	—	—	6	—	—	**6**	310	450	5.6	—	9.9	9.3	5	—	640	—	190	—	—	9	21	4.6 (J)	620	—
MD21-08-10514	323–328	2/14/2008	—	—	—	—	—	—	370	540	—	—	7	12	8.3	—	1200	—	81	—	—	10	9.3	—	620	—
MD21-08-10515	349.5–354.5	2/14/2008	—	—	—	—	—	—	460	1000	—	—	—	30	**15**	—	2400	—	34	—	—	—	—	—	890	—
May 2008																										
MD21-08-12247	67.5–72.5	5/7/2008	—	—	—	—	—	—	140	410	—	—	13	—	—	—	24	—	2300	**5.2**	—	—	26	—	880	—
MD21-08-12248	150.5–155.5	5/7/2008	73	—	—	—	**15**	—	150	360	5.4	—	9.7	—	—	**10**	190	—	400	—	—	—	23	—	480	—
MD21-08-12249	222.5–227.5	5/7/2008	—	—	—	—	—	3.2	290	470	6.2	—	8.6	9.3	6.6	—	590	—	190	—	3.4	11	21	—	580	—
MD21-08-12250	323–328	5/7/2008	**110**	—	—	—	11	—	340	570	—	6	—	13	7.6	—	1200	—	77	—	—	11	8.6	—	600	—
MD21-08-12251	349.5–354.5	5/7/2008	—	—	—	—	—	—	360	940	—	—	—	24	12	—	1900	—	32	—	**16**	—	—	—	720	—
September 2008																										
MD21-08-14828	67.5–72.5	9/23/2008	—	—	—	—	—	—	150	400	—	—	13	—	—	—	19	—	2700	—	—	—	27	—	1000	—
MD21-08-14829	150.5–155.5	9/23/2008	—	—	—	—	—	—	170	380	—	—	9.8	3.8	—	—	200	6.9	420	—	—	7.7	26	—	530	—
MD21-08-14830	222.5–227.5	9/23/2008	—	—	—	—	—	—	320	480	—	—	9.8	11	5.2	—	660	13	200	—	—	10	24	—	640	—
MD21-08-14831	323–328	9/23/2008	—	—	—	—	—	—	430	680	—	—	8.1	20	8	—	1500	19	70	—	—	11	11	—	770	—
MD21-08-14832	349.5–354.5	9/23/2008	—	—	—	—	—	—	**500**	**1100**	—	—	—	**36**	13	—	**2500**	21	31	—	—	—	—	—	920	—
February 2009																										
MD21-09-3564	67.5–72.5	2/4/2009	—	—	—	—	—	—	170	500	—	—	15	—	—	—	20	—	2900	—	—	—	31	—	1200	—
MD21-09-3563	150.5–155.5	2/4/2009	14	2.8	—	—	4.3	—	200	450	5.8	—	13	3.8	—	—	240	9.4	520	—	—	8	29	—	620	—
MD21-09-3560	222.5–227.5	2/3/2009	23	—	**7.7**	—	3.5	—	370	580	**7.6**	—	11	12	6.7	—	810	16	240	—	—	12	28	**5**	760	—
MD21-09-3561	323–328	2/3/2009	—	—	—	—	—	—	**500**	840	—	—	9.2	22	11	—	1800	**22**	90	—	—	**16**	12	—	850	—
MD21-09-3562	349.5–354.5	2/3/2009	—	—	—	—	—	—	390	950	—	—	—	25	13	—	2000	19	30	—	—	—	—	—	740	—

Table 6.1-5 (continued)

Sample ID	Depth (ft bgs)	Collection Date	Acetone	Benzene	Bromodichloromethane	Bromoform	2-Butanone	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Cyclohexane	1,4-Dichlorobenzene	Dichlorodifluoromethane	1,2-Dichloroethane	1,1-Dichloroethene	Ethanol	Methylene Chloride	Propylene	Tetrachloroethene	Tetrahydrofuran	Toluene	1,1,2-Trichloro-1,2,2-trifluoroethane	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	1,3-Xylene+1,4-Xylene
April 2009																										
MD21-09-7164	67.5–72.5	4/16/2009	—	—	—	—	—	—	150	490	—	—	19	—	—	—	21	—	3500	—	—	—	24	—	1200	—
MD21-09-7166	150.5–155.5	4/17/2009	—	—	—	—	—	—	170	430	6.1	—	11	—	8.5	—	190	—	480	—	—	7.8	19	—	580	—
MD21-09-7168	222.5–227.5	4/17/2009	—	—	6.8	—	—	—	320	570	7.3	—	9	10	11	—	690	—	230	—	—	13	18	—	710	—
MD21-09-7167	323–328	4/17/2009	—	—	—	—	—	—	410	760	—	—	—	18	12	—	1500	—	78	—	—	14	—	—	810	—
MD21-09-7165	349.5–354.5	4/16/2009	22	—	—	—	6.4	—	410	1000	—	**11**	—	28	14	—	2200	—	39	—	—	—	—	—	880	—
June 2009																										
MD21-09-10344	67.5–72.5	6/17/2009	11	—	—	—	—	—	77	230	—	—	8.4	—	—	—	9.5	—	1500	—	—	—	15	—	590	—
MD21-09-10345	150.5–155.5	6/17/2009	10	—	—	—	—	—	95	230	—	—	7.1	—	—	—	110	—	270	—	7.3	—	15	—	320	—
MD21-09-10346	222.5–227.5	6/17/2009	10	—	—	—	—	—	140	250	—	—	5.9	5.4	—	—	350	—	94	—	8	—	11	—	310	—
MD21-09-10347	323–328	6/17/2009	12	—	—	—	—	—	140	260	—	—	4.4	6.6	—	—	540	—	23	—	6.8	—	—	—	260	—
MD21-09-10348	349.5–354.5	6/17/2009	34	—	—	—	5	—	130	330	—	—	—	9.6	4.4	—	740	—	10	—	5.9	—	—	—	270	—
July 2009																										
MD21-09-11283	67.5–72.5	7/17/2009	—	—	—	—	—	—	180	500	—	—	**17**	—	—	—	18	—	**3600**	—	—	—	**32**	—	**1300**	—
MD21-09-11284	150.5–155.5	7/17/2009	—	—	—	—	—	—	210	470	—	—	14	3.9	—	—	210	—	570	—	—	8.3	30	—	650	—
MD21-09-11285	222.5–227.5	7/17/2009	—	—	—	—	—	—	230	420	—	—	8.6	9.1	3.8	—	570	—	160	—	—	—	17	—	510	—
MD21-09-11286	323–328	7/17/2009	—	—	—	—	9.6	—	310	570	—	5.2 (J)	7.1	16	7.8	—	1100	—	50	—	—	8.3	7.1	—	570	—
MD21-09-11287	349.5–354.5	7/17/2009	—	—	—	—	—	—	180	460	—	—	—	17	6.1	—	1000	—	18	—	—	—	—	—	370	—

Note: Organic chemical detections per sample, standard unit of measure = µg/m^3.

[a] — = Not detected.

[b] Bold values represent the maximum concentrations.

Table 6.1-6
Summary of VOCs Detected in Pore Gas Samples at MDA T Vapor-Monitoring Well 21-603058, October 2007–July 2009

Sample ID	Depth (ft bgs)	Collection Date	Acetone	Benzene	Bromodichloromethane	Bromoform	1-Butanol	2-Butanone	Carbon Disulfide	Carbon Tetrachloride	Chlorodibromomethane	Chloroform	1,2-Dichlorobenzene	1,4-Dichlorobenzene	Dichlorodifluoromethane	1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Ethanol	Ethylbenzene	Hexane	2-Hexanone	4-Methyl-2-pentanone	Methylene Chloride	n-Heptane	Propylene	Tetrachloroethene	Tetrahydrofuran	Toluene	1,1,2-Trichloro-1,2,2-trifluoroethane	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	1,2-Xylene	1,3-Xylene+1,4-Xylene
October 2007																																			
MD21-07-6807	67.5–72.5	10/30/2007	120	3.9	—[a]	10	—	40	3.8	63	—	450	—	—	5.1	—	—	—	—	—	4.3	29	8.7	7.2	3.9	85	650	—	5.7	—	23	—	270	—	4.9
MD21-07-6808	160.5–165.5	10/30/2007	35	**8.4**[b]	—	—	42	17	12	100	**9.7**	330	—	—	6.9	—	—	—	—	**7.5**	**36**	—	5.5	52	**24**	**690**	210	**4.9**	**14**	8.5	17	—	280	**9.9**	**21**
MD21-07-6809	217–222	10/30/2007	**200**	4.9	**6.4**	—	—	**69**	5.7	400	—	680	—	6	6.8	5	9.7	—	—	—	8.3	**37**	**8.9**	420	6.4	150	270	—	5.8	26	36	13	790	—	4.8
MD21-07-6810	242.5–247.5	10/30/2007	170	6.4	—	**16**	—	20	6.2	400	7.3	720	—	10	5.5	9.8	11	4.1	—	—	9.4	—	4.5	860	6.3	160	120	—	9.6	19	22	19	810	—	5
MD21-07-6811	339.5–344.5	10/30/2007	160	—	—	—	—	21	—	6.4	—	110	—	—	—	3.9	—	—	—	—	—	—	—	280	—	12	—	—	—	—	—	6.3	47	—	—
February 2008																																			
MD21-08-10504	67.5–72.5	2/13/2008	—	—	—	—	—	—	2.7	78	—	540	—	—	5.5	—	—	—	—	—	—	—	—	5.1	—	—	750	—	—	7.2	26	—	340	—	—
MD21-08-10505	160.5–165.5	2/13/2008	21	—	—	—	—	13	9.7	240	—	680	—	—	7.8	—	4.1	—	—	—	—	—	—	120	—	49	410	—	—	16	38	—	640	—	—
MD21-08-10506	217–222	2/13/2008	—	—	—	—	—	—	4.1	380	—	690	—	—	7.2	6	9.5	—	—	—	—	—	—	430	—	—	220	—	**14**	24	33	—	830	—	—
MD21-08-10507	242.5–247.5	2/13/2008	—	—	—	—	—	—	7.1	**760**	—	1200	—	12	9.4	—	19	—	—	—	—	—	—	1500	—	—	180	—	—	**43**	40	**45**	**1500**	—	—
MD21-08-10508	339.5–344.5	2/13/2008	—	—	—	—	—	—	—	530	—	1000	—	14	—	24	15	—	—	—	—	—	—	1900	—	—	76	—	—	26	12	26	930	—	—
May 2008																																			
MD21-08-12242	67.5–72.5	5/9/2008	—	—	—	—	52	—	6.3	61	—	490	—	—	—	—	—	—	12	—	—	—	—	6.8	—	—	640	2.7	—	—	21	—	300	—	—
MD21-08-12244	217–222	5/8/2008	—	—	—	—	—	—	—	370	—	740	—	5.5	6.5	5.4	9.9	—	15	—	—	—	—	380	—	—	240	—	—	27	35	13	780	—	—
MD21-08-12245	242.5–247.5	5/8/2008	—	4.1	—	—	—	—	5.6	610	—	1100	—	14	8	17	17	**6**	**55**	—	—	—	—	1200	—	—	170	3.8	—	37	32	42	1200	—	—
MD21-08-12246	339.5–344.5	5/8/2008	—	—	—	—	—	—	—	510	—	1100	—	18	—	24	15	—	42	—	—	—	—	1800	—	—	61	—	—	28	11	31	1000	—	—
September 2008																																			
MD21-08-14813	67.5–72.5	9/24/2008	—	—	—	—	—	5	—	68	—	510	—	—	5	—	—	—	—	—	—	—	—	5.3	—	—	680	—	—	—	22	—	320	—	—
MD21-08-14814	217–222	9/24/2008	—	—	—	—	—	—	—	380	—	720	—	—	7.3	6.3	9.1	—	—	—	—	—	—	440	—	11	230	—	—	23	35	14	820	—	—
MD21-08-14815	242.5–247.5	9/24/2008	—	—	—	—	**70**	7	9.2	440	—	770	—	9.1(J)	6.2	15	11	5.7	7.3	—	—	—	—	1000	—	10	120	—	—	24	23	33	990	—	—
MD21-08-14816	339.5–344.5	9/24/2008	—	—	—	—	—	—	—	520	—	1000	—	13(J)	—	24	17	—	—	—	—	—	—	2000	—	16	52	—	—	23	11	25	990	—	—
February 2009																																			
MD21-09-3553	67.5–72.5	2/5/2009	—	—	—	—	—	—	—	80	—	590	—	—	6	—	—	—	—	—	—	—	—	6.6	—	—	790	—	—	7.9	24	—	370	—	—
MD21-09-3554	217–222	2/5/2009	—	—	6.2	—	—	—	—	480	—	890	—	6.1	8.5	7.7	13	—	14	—	—	—	—	540	—	—	300	—	—	29	**42**	17	1000	—	—
MD21-09-3555	242.5–247.5	2/5/2009	—	—	—	—	—	—	—	740	—	1300	—	14	—	22	19	—	46	—	—	—	—	1500	—	—	200	—	—	37	41	**45**	1400	—	—
MD21-09-3556	339.5–344.5	2/5/2009	—	—	—	—	—	—	—	750	—	**1500**	—	**25**	—	**33**	**22**	—	43	—	—	—	—	**2400**	—	—	96	—	—	33	17	42	1400	—	—

Table 6.1-6 (continued)

Sample ID	Depth (ft bgs)	Collection Date	Acetone	Benzene	Bromodichloromethane	Bromoform	1-Butanol	2-Butanone	Carbon Disulfide	Carbon Tetrachloride	Chlorodibromomethane	Chloroform	1,2-Dichlorobenzene	1,4-Dichlorobenzene	Dichlorodifluoromethane	1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Ethanol	Ethylbenzene	Hexane	2-Hexanone	4-Methyl-2-pentanone	Methylene Chloride	n-Heptane	Propylene	Tetrachloroethene	Tetrahydrofuran	Toluene	1,1,2-Trichloro-1,2,2-trifluoroethane	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	1,2-Xylene	1,3-Xylene+1,4-Xylene
April 2009																																		
MD21-09-7159	67.5–72.5	4/14/2009	—	—	—	—	—	—	—	74	—	630	—	—	7	—	5.6	—	—	—	—	—	—	5.6	—	—	**810**	—	—	7.5	17	—	350	—	—
MD21-09-7160	217–222	4/14/2009	—	—	—	—	—	—	—	500	—	1100	—	5.8	**11**	6.9	21	—	—	—	—	—	—	470	—	—	310	—	—	32	32	17	1000	—	—
MD21-09-7162	242.5–247.5	4/15/2009	—	—	—	—	—	—	—	520	—	950	—	12	—	15	18	—	—	—	—	—	—	1100	—	—	140	—	—	31	25	35	1000	—	—
MD21-09-7161	339.5–344.5	4/15/2009	—	—	—	—	—	—	—	660	—	1400	—	20	—	23	21	—	—	—	—	—	—	2100	—	—	74	—	—	36	13	23	1300	—	—
June 2009																																		
MD21-09-10339	67.5–72.5	6/18/2009	—	—	—	—	—	—	—	58	—	430	—	—	5	—	—	—	—	—	—	—	—	4.2	—	—	570	—	—	—	17	—	270	—	—
MD21-09-10341	217–222	6/18/2009	—	—	—	—	—	—	—	210	—	400	—	—	5.3	—	5.2	—	—	—	–	–	–	230	—	—	120	—	—	12	19	6.8	440	—	—
MD21-09-10342	242.5–247.5	6/18/2009	—	—	—	—	—	—	—	470	—	810	—	8.6	6.7	14	12	3.6	—	—	—	—	—	960	—	—	130	—	—	22	26	29	950	—	—
MD21-09-10343	339.5–344.5	6/18/2009	—	—	—	—	—	5.8	—	390	—	830	—	14	—	18	14	—	—	—	—	—	—	1600	—	—	57	—	—	23	—	23	810	—	—
July 2009																																		
MD21-09-11278	67.5–72.5	7/16/2009	29	—	—	—	—	4.8	—	68	—	520	—	—	5.8	—	—	—	—	—	—	—	—	5.6	—	—	740	—	**14**	—	20	—	330	—	—
MD21-09-11280	217–222	7/16/2009	—	3.1	—	—	—	—	—	310	—	670	—	—	6.7	7.8	8	—	—	—	—	—	—	420	—	—	210	—	3.7	17	27	14	720	—	—
MD21-09-11281	242.5–247.5	7/16/2009	15	—	—	—	—	5.4	**29**	200	—	460	**83**	16	5.2	8.9	6.2	—	—	—	—	—	—	620	—	—	68	—	4.8	9.5	12	17	1200	—	—
MD21-09-11282	339.5–344.5	7/16/2009	22	—	—	—	—	—	—	350	—	730	—	8.9	5	17	11	—	—	—	—	—	—	1300	—	—	44	—	—	16	7.7	18	700	—	—

Note: Organic chemical detections per sample, standard unit of measure = μg/m^3.

[a] — = Not detected.

[b] Bold values represent the maximum concentrations.

Table 6.1-7
Summary of VOCs Detected in Pore Gas Samples at MDA T Vapor-Monitoring Well 21-603059, October 2007–July 2009

Sample ID	Depth (ft bgs)	Collection Date	Acetone	Benzene	Bromodichloromethane	Bromoform	1-Butanol	2-Butanone	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Cyclohexane	1,4-Dichlorobenzene	Dichlorodifluoromethane	1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Ethanol	Ethylbenzene	4-Ethyltoluene	Hexane	2-Hexanone	4-Methyl-2-pentanone	Methylene Chloride	n-Heptane	2-Propanol	Propylene	Tetrachloroethene	Tetrahydrofuran	Toluene	1,1,2-Trichloro-1,2,2-trifluoroethane	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	1,3,5-Trimethylbenzene	1,2-Xylene	1,3-Xylene+1,4-Xylene
November 2007																																					
MD21-07-6804	77.5–82.5	11/4/2007	49	4.8	—[a]	**10**[b]	—	4.3	12	62	840	—	—	6	—	—	—	—	—	—	**8.5**	—	—	6.4	6.2	—	140	1300	—	6.6	7.2	20	—	710	—	—	5.6
MD21-07-6803	187.5–192.5	11/3/2007	290	5.5	6.4	—	—	55	5.1	150	630	**3.4**	—	7.4	—	7.4	—	—	—	—	6.8	—	3.6(J)	43	4.7	**11**	160	340	—	6.6	19	29	—	480	—	—	—
MD21-07-6801	229.5–234.5	11/3/2007	**560**	**8.2**	7.8	—	**21**	**170**	15	290	630	**3.4**	—	7.4	—	12	3.6	—	**11**	**24**	7.7	**86**	**21**	68	**12**	9	**210**	250	**3.7**	25	30	31	—	580	**11**	**16**	**35**
MD21-07-6802	292.5–297.5	11/3/2007	150	3.2	9.2	—	—	8.4	5.1	620	680	—	—	9.2	5.2	27	5	—	—	—	—	—	—	380	—	—	—	200	2.7	6	55	26	27	1100	—	—	—
MD21-07-6800	372.5–377.5	11/3/2007	130	3.3	7.3	—	—	3.7	2.8	350	540	—	—	—	11	33	—	—	—	—	—	—	—	720	—	—	40	78	—	5.1	16	8.2	81	800	—	—	—
February 2008																																					
MD21-08-10518	77.5–82.5	2/6/2008	—	—	—	—	—	—	2.8	58	800	—	—	5.1	—	—	—	—	—	—	—	—	—	4.2	—	—	—	1400	—	—	6.9	19	—	700	—	—	—
MD21-08-10519	187.5–192.5	2/8/2008	—	—	7	—	—	—	3.5	140	570	—	—	7.1	—	6.2	—	—	—	—	—	—	—	24	—	—	—	320	—	—	15	28	—	460	—	—	—
MD21-08-10520	229.5–234.5	2/6/2008	11	2.9	—	—	—	—	2.7	140	330	—	—	4.8	—	5.7	—	—	—	—	—	—	—	23	—	—	—	120	—	13	12	14	—	300	—	—	—
MD21-08-10521	292.5–297.5	2/6/2008	—	—	9.6	—	—	—	3.7	670	660	—	—	9.8	5.4	26	3.9	—	—	—	—	—	—	330	—	—	—	180	—	4.6	51	27	24	1200	—	—	—
MD21-08-10522	372.5–377.5	2/8/2008	9.4	3.4	12	—	—	—	3.4	580	750	—	7	—	16	52	5.9	—	—	—	—	—	—	920	—	—	—	110	—	7.9	24	14	**120**	1300	—	—	—
May 2008																																					
MD21-08-12236	77.5–82.5	5/9/2008	11	—	—	—	—	2.8	2.9	57	900	—	—	—	—	—	—	—	—	—	—	—	—	3.1	—	—	—	1400	—	—	6.6	19	—	670	—	—	—
MD21-08-12237	187.5–192.5	5/9/2008	—	—	6.7	—	—	—	—	140	610	—	—	—	—	7.1	—	—	—	—	—	—	—	22	—	—	—	320	—	—	18	24	—	440	—	—	—
MD21-08-12238	229.5–234.5	5/9/2008	31	—	6.8	—	—	4	4	330	670	—	—	8.4	—	14	—	—	—	—	—	—	—	50	—	—	—	240	—	—	35	29	—	620	—	—	—
MD21-08-12239	292.5–297.5	5/9/2008	—	2.8	8.4	—	—	—	—	620	650	—	—	9	5.3	24	13	21	—	—	—	—	—	290	—	—	—	170	—	3.8	54	25	22	1000	—	—	—
MD21-08-12240	372.5–377.5	5/9/2008	58	3.2	10	—	—	6.6	—	540	780	—	7.6	—	14	51	4.4	**65**	—	—	—	—	—	880	—	—	—	100	—	6.2	28	12	110	1200	—	—	—
September 2008																																					
MD21-08-14818	77.5–82.5	9/25/2008	—	—	—	—	—	—	—	67	1000	—	—	6.2	—	—	—	—	—	—	—	—	—	4.3	—	—	—	**1700**	—	—	—	21	—	770	—	—	—
MD21-08-14819	187.5–192.5	9/25/2008	—	—	7	—	—	8	—	130	550	—	—	6.5	—	5.5	—	—	—	—	—	—	—	24	—	—	8.4	300	—	—	15	26	—	440	—	—	—
MD21-08-14820	229.5–234.5	9/25/2008	—	—	—	—	—	—	—	280	580	—	—	7.1	—	11	—	—	—	—	—	—	—	49	—	—	13	230	—	—	29	28	—	600	—	—	—
MD21-08-14821	292.5–297.5	9/25/2008	—	—	9.7	—	—	—	—	620	620	—	—	8.6	5.3	23	3.8	—	—	—	—	—	—	300	—	—	20	160	—	3.9	49	25	20	1100	—	—	—
MD21-08-14822	372.5–377.5	9/25/2008	—	—	8.4	—	—	—	**18**	380	520	—	—	—	12	32	—	—	—	—	—	—	—	680	—	—	11	63	—	5.4	17	9	81	860	—	—	—
February 2009																																					
MD21-09-3546	77.5–82.5	2/8/2009	—	—	6.4	—	—	—	—	73	**1100**	—	—	6.4	—	—	—	—	—	—	—	—	—	4	—	—	—	1600	—	—	—	22	—	820	—	—	—
MD21-09-3545	187.5–192.5	2/6/2009	—	—	8.7	—	—	4.1	6.8	170	700	—	—	7.8	—	7.2	—	—	—	—	—	—	—	29	—	—	—	390	—	—	18	30	—	550	—	—	—
MD21-09-3547	229.5–234.5	2/8/2009	9	—	8.6	—	—	—	—	440	770	3.1(J)	—	10	—	19	—	—	—	—	—	—	—	80	—	—	—	290	—	—	39	**33**	—	810	—	—	—
MD21-09-3549	292.5–297.5	2/6/2009	—	—	11	—	—	—	—	**750**	740	—	—	**11**	6.1	30	—	13	—	—	—	—	—	360	—	—	—	210	—	4.8	**57**	31	25	1300	—	—	—
MD21-09-3550	372.5–377.5	2/6/2009	—	4.1	**14**	—	—	—	—	670	900	—	**7.8**	5.3	**19**	**65**	4.1	54	—	—	—	—	—	**1100**	—	—	—	120	—	7.5	28	15	**120**	**1400**	—	—	—

Table 6.1-7 (continued)

Sample ID	Depth (ft bgs)	Collection Date	Acetone	Benzene	Bromodichloromethane	Bromoform	1-Butanol	2-Butanone	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Cyclohexane	1,4-Dichlorobenzene	Dichlorodifluoromethane	1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Ethanol	Ethylbenzene	4-Ethyltoluene	Hexane	2-Hexanone	4-Methyl-2-pentanone	Methylene Chloride	n-Heptane	2-Propanol	Propylene	Tetrachloroethene	Tetrahydrofuran	Toluene	1,1,2-Trichloro-1,2,2-trifluoroethane	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	1,3,5-Trimethylbenzene	1,2-Xylene	1,3-Xylene+1,4-Xylene
April 2009																																					
MD21-09-7155	77.5–82.5	4/13/2009	—	—	—	—	—	—	—	—	560	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	920	—	—	—	—	—	380	—	—	—
MD21-09-7154	187.5–192.5	4/10/2009	—	—	—	—	—	—	—	120	620	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	310	—	—	—	—	—	460	—	—	—
MD21-09-7157	229.5–234.5	4/13/2009	—	—	—	—	—	—	—	130	400	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	130	—	—	—	—	—	320	—	—	—
MD21-09-7163	229.5–234.5	4/20/2009	37	—	7.6	—	—	10	—	320	710	—	—	8.3	—	19	—	—	—	—	—	—	—	58	—	—	—	270	—	—	34	22	—	670	—	—	—
MD21-09-7153	292.5–297.5	4/10/2009	—	—	—	—	—	—	—	480	610	—	—	—	—	—	—	—	—	—	—	—	—	280	—	—	—	170	—	—	—	—	—	980	—	—	—
MD21-09-7156	372.5–377.5	4/13/2009	—	—	—	—	—	—	—	—	94	—	—	—	—	—	—	—	—	—	—	—	—	160	—	—	—	—	—	—	—	—	—	91	—	—	—
June 2009																																					
MD21-09-10333	77.5–82.5	6/16/2009	—	—	—	—	—	—	—	50	850	—	—	5.1	—	—	—	—	—	—	—	—	—	—	—	—	—	1200	—	—	—	16	—	560	—	—	—
MD21-09-10334	187.5–192.5	6/16/2009	—	—	—	—	—	—	3.3	110	480	—	—	6.1	—	4.3	—	—	—	—	—	—	—	19	—	—	—	260	—	—	9.7	20	—	360	—	—	—
MD21-09-10335	229.5–234.5	6/16/2009	—	—	—	—	—	2.7	—	220	440	—	—	6.2	—	8.8	—	—	—	—	—	—	—	29	—	—	—	170	—	—	20	19	—	410	—	—	—
MD21-09-10336	292.5–297.5	6/16/2009	—	—	—	—	—	—	—	440	450	—	—	7.1	-	17	—	—	—	—	—	—	—	200	—	—	—	120	—	—	32	18	13	740	—	—	—
MD21-09-10337	372.5–377.5	6/16/2009	—	—	7.6	—	—	2.6	—	400	520	—	—	—	11	35	—	—	—	—	—	—	—	610	—	—	—	67	—	4.6	15	8.8	67	820	—	—	—
July 2009																																					
MD21-09-11272	77.5–82.5	7/15/2009	44	—	6.2	—	12	5.4	—	64	**1100**	—	—	5.9	—	—	—	—	—	—	—	—	—	4	—	—	—	1600	—	**200**	—	18	—	720	—	—	—
MD21-09-11273	187.5–192.5	7/15/2009	43	—	6.2	—	—	5.4	—	120	530	—	—	7	—	5.5	—	—	—	—	5.5	—	—	24	—	—	—	310	—	21	14	22	—	400	—	—	—
MD21-09-11274	229.5–234.5	7/15/2009	13	—	—	—	—	—	—	210	480	—	—	6.8	—	8.4	—	—	—	—	—	—	—	37	—	—	—	190	—	—	18	18	—	440	—	—	—
MD21-09-11275	292.5–297.5	7/15/2009	15	—	11	—	—	—	4.2	690	690	—	—	**11**	5.3	26	**7**	—	—	—	—	—	—	320	—	—	—	200	—	6.1	51	28	23	1200	—	—	—
MD21-09-11276	372.5–377.5	7/15/2009	12	—	10	—	—	—	4.6	380	600	—	6	—	13	35	—	—	—	—	—	—	—	760	—	—	—	72	—	9.5	14	8.2	85	850	—	—	4.6

Note: Organic chemical detections per sample, standard unit of measure = μg/m^3.

[a] — = Not detected.

[b] Bold values represent the maximum concentrations.

Table 6.1-8
Summary of Tritium Results in Pore-Gas Samples at MDA T Vapor-Monitoring Well 21-25262, June and July 2009

Sample ID	Depth (ft bgs)	Collection Date	Tritium
June 2009			
MD21-09-10357	232–237	6/12/2009	19,570.9
MD21-09-10358	295–300	6/12/2009	901.051
MD21-09-10359	329.5–334.5	6/12/2009	3062.27
MD21-09-10360	375–380	6/12/2009	13,958.3
June 2009			
MD21-09-11294	80–85	7/14/2009	1041.73
MD21-09-11295	115–120	7/14/2009	441.102
MD21-09-11296	232–237	7/14/2009	556.992
MD21-09-11297	295–300	7/14/2009	3199.46
MD21-09-11298	329.5–334.5	7/14/2009	6803.85
MD21-09-11299	375–380	7/14/2009	**37413.2***
MD21-09-11301	572–577	7/14/2009	321.425
MD21-09-11302	686–691	7/14/2009	420.838

Note: Units are in pCi/g.

* Bold value represents the maximum concentration.

Table 6.1-9
Summary of Tritium Results in Pore-Gas Samples at MDA T Vapor-Monitoring Well 21-25264, October 2007–July 2009

Sample ID	Depth (ft bgs)	Collection Date	Tritium
October 2007			
MD21-07-6814	150.5–155.5	10/19/2007	13373.2
February 2008			
MD21-08-10511	67.5–72.5	2/14/2008	2251.85
MD21-08-10512	150.5–155.5	2/14/2008	84172.8
MD21-08-10513	222.5–227.5	2/14/2008	49611.9
MD21-08-10514	323–328	2/14/2008	1975.59
MD21-08-10515	349.5–354.5	2/14/2008	1132.8
May 2008			
MD21-08-12247	67.5–72.5	5/7/2008	6251.64
MD21-08-12248	150.5–155.5	5/7/2008	170123
MD21-08-12249	222.5–227.5	5/7/2008	66092.6
MD21-08-12250	323–328	5/7/2008	3493.47
MD21-08-12251	349.5–354.5	5/7/2008	1872.38
September 2008			
MD21-08-14828	67.5–72.5	9/23/2008	8939.89
MD21-08-14829	150.5–155.5	9/23/2008	150,117
MD21-08-14830	222.5–227.5	9/23/2008	113,362
MD21-08-14831	323–328	9/23/2008	2605.36
MD21-08-14832	349.5–354.5	9/23/2008	1586
February 2009			
MD21-09-3564	67.5–72.5	2/4/2009	6608.33
MD21-09-3563	150.5–155.5	2/4/2009	88,523.8
MD21-09-3560	222.5–227.5	2/3/2009	91,886.9
MD21-09-3561	323–328	2/3/2009	3613.93
MD21-09-3562	349.5–354.5	2/3/2009	2228.43
April 2009			
MD21-09-7164	67.5–72.5	4/16/2009	5647
MD21-09-7166	150.5–155.5	4/17/2009	120,741
MD21-09-7168	222.5–227.5	4/17/2009	80587.5
MD21-09-7167	323–328	4/17/2009	1421.08
MD21-09-7165	349.5–354.5	4/16/2009	1557.89
June 2009			
MD21-09-10344	67.5–72.5	6/17/2009	142,818
MD21-09-10345	150.5–155.5	6/17/2009	133,254
MD21-09-10346	222.5–227.5	6/17/2009	2093.28
MD21-09-10347	323–328	6/17/2009	3952.86

Table 6.1-9 (continued)

Sample ID	Depth (ft bgs)	Collection Date	Tritium
July 2009			
MD21-09-11283	67.5–72.5	7/17/2009	10560.3
MD21-09-11284	150.5–155.5	7/17/2009	**173,113***
MD21-09-11285	222.5–227.5	7/17/2009	123530
MD21-09-11286	323–328	7/17/2009	2323.85
MD21-09-11287	349.5–354.5	7/17/2009	7802.76

Note: Units are in pCi/g.

* Bold value represents the maximum concentration.

Table 6.1-10
Summary of Tritium Results in Pore-Gas Samples at MDA T Vapor-Monitoring Well 21-603058, October 2007–July 2009

Sample ID	Depth (ft bgs)	Collection Date	Tritium
October 2007			
MD21-07-6808	160.5–165.5	10/30/2007	1549.88
February 2008			
MD21-08-10504	67.5–72.5	2/13/2008	796.201
MD21-08-10505	160.5–165.5	2/13/2008	1231.56
MD21-08-10506	217–222	2/13/2008	**25,118.3***
MD21-08-10508	339.5–344.5	2/13/2008	15,351.3
May 2008			
MD21-08-12244	217–222	5/8/2008	583.107
MD21-08-12245	242.5–247.5	5/8/2008	461.252
September 2008			
MD21-08-14814	217–222	9/24/2008	799.333
MD21-08-14815	242.5–247.5	9/24/2008	963.595
February 2009			
MD21-09-3553	67.5–72.5	2/5/2009	3346.86
MD21-09-3554	217–222	2/5/2009	6339.59
MD21-09-3555	242.5–247.5	2/5/2009	2155.65
MD21-09-3556	339.5–344.5	2/5/2009	581.996
April 2009			
MD21-09-7159	67.5–72.5	4/14/2009	812.322
MD21-09-7160	217–222	4/14/2009	390.326

Note: Units are in pCi/g.

*Bold value represents the maximum concentration.

Table 6.1-11
Summary of Tritium Results in Pore-Gas Samples at MDA T Vapor-Monitoring Well 21-603059, October 2007–July 2009

Sample ID	Depth (ft bgs)	Collection Date	Tritium
November 2007			
MD21-07-6801	229.5–234.5	11/3/2007	2453.32
February 2008			
MD21-08-10518	77.5–82.5	2/6/2008	1160.83
MD21-08-10520	229.5–234.5	2/6/2008	1553.92
MD21-08-10521	292.5–297.5	2/6/2008	743.398
MD21-08-10522	372.5–377.5	2/8/2008	2505.89
May 2008			
MD21-08-12237	187.5–192.5	5/9/2008	457.765
MD21-08-12238	229.5–234.5	5/9/2008	1143.8
MD21-08-12239	292.5–297.5	5/9/2008	438.762
MD21-08-12240	372.5–377.5	5/9/2008	5380.01
September 2008			
MD21-08-14818	77.5–82.5	9/25/2008	452.696
MD21-08-14819	187.5–192.5	9/25/2008	505.469
MD21-08-14820	229.5–234.5	9/25/2008	1646.42
MD21-08-14821	292.5–297.5	9/25/2008	2835.43
MD21-08-14822	372.5–377.5	9/25/2008	417.64
February 2009			
MD21-09-3546	77.5–82.5	2/8/2009	6357.79
MD21-09-3545	187.5–192.5	2/6/2009	556.668
MD21-09-3547	229.5–234.5	2/8/2009	1368.89
MD21-09-3549	292.5–297.5	2/6/2009	4105.41
MD21-09-3550	372.5–377.5	2/6/2009	5277.58
April 2009			
MD21-09-7155	77.5–82.5	4/13/2009	353.451
MD21-09-7157	229.5–234.5	4/13/2009	756.393
MD21-09-7153	292.5–297.5	4/10/2009	1284.11
MD21-09-7156	372.5–377.5	4/13/2009	1420.85
MD21-09-7163	229.5–234.5	4/20/2009	1332.55
June 2009			
MD21-09-10333	77.5–82.5	6/16/2009	334.831
MD21-09-10334	187.5–192.5	6/16/2009	628.593
MD21-09-10335	229.5–234.5	6/16/2009	1660.84
MD21-09-10336	292.5–297.5	6/16/2009	4605.51
MD21-09-10337	372.5–377.5	6/16/2009	6449.81

Table 6.1-11 (continued)

Sample ID	Depth (ft bgs)	Collection Date	Tritium
July 2009			
MD21-09-11273	187.5–192.5	7/15/2009	601.61
MD21-09-11274	229.5–234.5	7/15/2009	1428.52
MD21-09-11275	292.5–297.5	7/15/2009	4776.39
MD21-09-11276	372.5–377.5	7/15/2009	**6527.3***

Note: Units are in pCi/g.

*Bold value represents the maximum concentration.

Table 6.5-1
Screening of VOCs Detected in Pore Gas at MDA T, October 2007–July 2009

VOC	Maximum Pore Gas Concentration (μg/m^3)	Groundwater SL (μg/L)	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard (μg/m^3)	SV (unitless)
Acetone	560	22,000[a]	35,200	1.59E-02
Benzene	13	5[b]	1140	1.14E-02
Bromodichloromethane	15	1.2[a]	104.4	1.44E-01
Bromoform	16	85[a]	1870	8.56E-03
1,3-Butadiene	7.4	0.018[a]	54	1.37E-01
1-Butanol	82	3700[a]	1332	6.16E-02
2-Butanone	170	7100[a]	16,330	1.04E-02
Carbon Disulfide	29	1000[a]	590,000	4.92E-05
Carbon Tetrachloride	830	5[b]	5500	1.51E-01
Chlorodibromomethane	9.7	1.5[a]	48	2.02E-01
Chloroform	1500	100[c]	15,000	1.00E-01
Cyclohexane	7.6	13,000[a]	79,300,000	9.58E-08
1,2-Dichlorobenzene	83	600[b]	46,740	1.78E-03
1,4-Dichlorobenzene	25	75[b]	7470	3.35E-03
Dichlorodifluoromethane	19	390[a]	5,460,000	3.48E-06
1,2-Dichloroethane	36	5[b]	240	1.50E-01
1,1-Dichloroethene	100	5[c]	5500	1.82E-02
cis-1,2-Dichloroethane	13	70[b]	11,900	1.09E-03
Ethylbenzene	11	750[c]	242,250	4.54E-05
Hexane	36	880[a]	65,120,000	5.53E-07
n-Heptane	24	880[d]	77,440,000	3.10E-07
4-Methyl-2-pentanone	21	2000[a]	11,200	1.88E-03
Methylene chloride	2500	5[b]	650	3.85
Tetrachloroethene	3600	5[b]	3600	1
Tetrahydrofuran	5.2	16[e]	158.4	3.28E-02

Table 6.5-1 (continued)

VOC	Maximum Pore Gas Concentration (µg/m³)	Groundwater SL (µg/L)	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard (µg/m³)	SV (unitless)
Toluene	200	750[c]	204,000	9.80E-04
1,1,2-Trichloro-1,2,2-trifluoroethane	57	59,000[a]	1,298,000,000	4.39E-08
1,1,1-Trichloroethane	42	60[c]	42,300	9.93E-04
1,1,2-Trichloroethane	200	5[b]	170	1.18
Trichloroethene	1500	5[b]	2000	7.50E-01
1,3,5-Trimethylbenzene	11	12[a]	3840	2.86E-03
1,2-Xylene	16	620[c]	132,060	1.21E-04
1,3-Xylene+1,4-Xylene	35	620[c]	167,400	2.09E-04

Note: Calculated concentrations in pore gas corresponding to groundwater standard derived from denominator of Equation 3.0-3.

[a] EPA regional tap water screening levels (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm).

[b] EPA MCL (40 Code of Federal Regulations 141.61).

[c] NMWQCC groundwater standard (20.6.2.3103 New Mexico Administrative Code).

[d] Hexane used as a surrogate, based on structural similarity.

[e] EPA regional screening level not available. EPA Region 6 tap water SL used (EPA 2007, 099314).

Table 6.5-2
Screening of Methylene Chloride, Tetrachloroethene, and 1,1,2-Trichloroethane at Port 9, Vapor-Monitoring Well 21-25262

VOC	Maximum Pore Gas Concentration (µg/m³)	Groundwater SL (µg/L)	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard (µg/m³)	SV (unitless)
Methylene chloride	140	5*	650	0.22
Tetrachloroethene	7.2	5*	3,600	0.002
1,1,2-Trichloroethane	21	5*	170	0.12

Note: Calculated concentrations in pore gas corresponding to groundwater standard derived from denominator of Equation 3.0-3.
*EPA MCL (40 Code of Federal Regulations 141.61).

Appendix A

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

A-1.0 ACRONYMS AND ABBREVIATIONS

$\%CO_2$	percent carbon dioxide
$\%O_2$	percent oxygen
%R	percent recovery
%RSD	percent relative deviation
AOC	area of concern
bgs	below ground surface
BH	borehole
BV	background value
CCV	continuing calibration verification
COC	chain of custody
COPC	chemical of potential concern
DER	duplicate error ratio
DOE	Department of Energy (U.S.)
EPA	Environmental Protection Agency (U.S.)
EQL	estimated quantitation limit
FB	field blank
FD	field duplicate
FV	fallout value
GC/MS	gas chromatography/mass spectrometry
ICS	interference check sample
ICV	initial calibration verification
I.D.	inside diameter
IDW	investigation-derived waste
LAL	lower acceptance limit
LANL	Los Alamos National Laboratory
LCS	laboratory control sample
MCL	maximum contaminant level
MDA	material disposal area
MDC	minimum detectable concentration
MDL	method detection limit
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
NES	nuclear environmental site

MS	matrix spike
PB	preparation blank
PCE	tetrachloroethene
PID	photoionization detector
PPE	personal protective equipment
Qbt	Tshirege Member of the Bandelier Tuff
Qct	Cerro Toledo Interval
Qbo	Otowi Member of the Bandelier Tuff
Qbog	Guaje Pumice Bed
QA	quality assurance
QC	quality control
QP	quality procedures
RCT	radiological control technician
RPF	Records Processing Facility
RPD	relative percent difference
RWSA	retrievable waste storage area
SCL	sample collection log
SAL	screening action level
SL	screening level
SMO	Sample Management Office
SOP	standard operating procedures
SOW	statement of work
SQL	standard quantitation limit
SSL	soil screening level
SWMU	solid waste management unit
SSO	site safety officer
SV	screening value
TA	technical area
TCE	trichloroethene
TD	total depth
Tp	Puye Formation
UAL	upper acceptance limit
VOC	volatile organic compound
WCSF	waste characterization strategy form

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)	2.5	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 (ppm)
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 (ppm)
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 implemented during the 2009 drilling and pore-gas monitoring activities at Material Disposal Area (MDA) T, Consolidated Unit 21-016(a)-99, in Technical Area 21 (TA-21) at Los Alamos National Laboratory (LANL or the Laboratory). All activities were conducted in accordance with the most current applicable standard operating procedures (SOPs), quality procedures, Laboratory implementation requirements and Laboratory procedural requirements.

The following sections provide a description of field methods. Table B-1.0-1 provides a summary of the specific field methods followed; Table B-1.0-2 lists the general procedures followed.

B-2.0 DRILLING OF WELL 21-25262

The advancement of borehole (BH) 21-25262 was initiated on March 17, 2009, and was completed on May 4, 2009. Drilling was conducted using a Delta Base track air-core rig and casing-advance methods. Two casing sizes were employed while advancing the borehole to target depth. Slough was removed from the open borehole by hammer bit and 140-mm-inside diameter (I.D.) casing landed at 390 ft below ground surface (bgs). A 115-mm I.D. casing was then telescoped through the 140-mm-I.D. casing and advanced to 585 ft bgs. The remainder of the borehole was advanced using core tooling to total depth (TD). Core samples were collected at designated depths in the borehole using a split-core barrel sampler and HQ size-core tooling for sampling and retrieval.

B-2.1 Borehole Logging

Core was retrieved in 5-ft lengths from targeted intervals using a split-core barrel sampler. The split-core barrel sampler was lined with Lexan tubing (2.25-I.D.) to retain core integrity and moisture.

Logging was documented in accordance with SOP-12.01, Field Logging, Handling, and Documentation of Borehole Materials. Information recorded on field-boring logs included footage and percent recovery, rock-quality designation (if measurable), lithology, depth of samples collected, field-screening results for radioactivity and organic vapors, core description, and other relevant observations.

The lithologic description for each core interval included

- color (using a Munsell Soil Color Chart);
- ash matrix size;
- degree of welding of matrix;
- presence and size of phenocrysts;
- presence of pumice clasts (in tuff) with color, size, alteration, and color, size, and nature of phenocrysts;
- staining and/or presence of clay-filled fracture zones;
- qualitative description of moisture presence; and
- any other information pertinent to the geology of the core recovered.

B-3.0 FIELD-SCREENING METHODS

This section summarizes the field-screening methods used during the 2009 drilling and sampling activities at MDA T. The field-screening results are presented in section 4.0.

Field screening for volatile organic compounds (VOCs) and radioactivity was performed on core samples during the drilling of borehole 21-25262; field screening for percent oxygen (%O2) and percent carbon dioxide (%CO_2) was performed during pore-gas sampling from all vapor-monitoring wells.

B-3.1 Field Screening for VOCs

Organic vapor screening was conducted using a MiniRAE 2000 portable VOC monitor model PGM-7600 photoionization detector (PID). A site safety officer (SSO) conducted field screening for VOCs on each core according to SOP-06.33, Headspace Vapor Screening with a Photoionization Detector. The PID was equipped with an 11.7-electronvolt (eV) lamp with sensitivity to 1 ppm. Screening was performed by removing sample material from the core barrel and placing a portion of the sample in a glass container with a foil-sealed cover. The jar was gently shaken and allowed to equilibrate for 5 min, and then the PID probe was inserted into the glass jar to measure the VOCs. All readings were recorded in parts per million.

B-3.2 Field Screening for Radioactivity

As soon as the core barrel sampler was separated, each 5-ft section of core was screened for radioactivity, targeting alpha and beta/gamma emitters. A laboratory radiological control technician (RCT) conducted radiological screening using an Eberline E-600 radiation meter with an SHP-380AB alpha/beta scintillation detector held within 1 in. of the exposed core. The Eberline E-600 with attachment SHP-380AB consists of a dual phosphor plate covered by two Mylar windows housed in a light-excluding metal body. The phosphor plate is a plastic scintillator used to detect beta emissions, and it is thinly coated with zinc sulfide used to detect alpha emissions. The operational range varies from trace emissions to 1,000,000 dpm.

Local background levels for radioactivity were measured in ambient air and were calculated daily using the following procedure. To determine the minimum detectable activity (the instrument’s lower detection limit) in the field with the SHP-380AB attachment, a background reading was obtained. This reading was typically taken from the sampling table at MDA T before drilling began for the day. The minimum detectable activity was calculated as follows: minimum detectable activity = $2.71 + 4.65/(Rb \times 0.2)\ 0.2$, where Rb is the background rate in counts per minute. The minimum detectable activity was then converted from counts per minute to disintegrations per minute, where efficiency was assumed to be 20% for the SHP-380AB attachment based on the manufacturer’s specifications. All field results for radioactivity were recorded in disintegrations per minute.

B-3.3 Field Screening for %O2 and %CO_2

Before each pore-gas sampling event, each sample port was purged and monitored with a Landtec GEM2000 instrument (or equivalent), until the %CO_2 and %CO_2 levels stabilized at values representative of subsurface pore-gas conditions. Field-screening results were recorded on the appropriate sample collection log (SCL) and/or in the field logbook. Field chains of custody (COCs) and SCLs are provided in Appendix D.

B-4.0 FIELD INSTRUMENT CALIBRATION

Instrument calibration and/or function check was completed daily. Several environmental factors affected the field instrument's integrity, including air temperature, atmospheric pressure, wind speed, and humidity. The SSO calibrated the PID. The RCT calibrated the Eberline E-600. All calibrations were performed according to the manufacturers' specifications and requirements.

B-4.1 PID Calibration

The PID was calibrated both to ambient air and a standard reference gas (100 ppm isobutylene). The ambient air calibration determined the zero point of the instrument sensor calibration curve in ambient air. Calibration with the standard reference gas determined a second point of the sensor calibration curve. Each calibration was within 3% of 100 ppm isobutylene, qualifying the instrument for use.

The following calibration information was recorded daily in the health and safety site logbook:

- instrument ID number
- initial and final span settings
- date and time
- concentration and type of calibration gas used (isobutylene at 100 ppm)
- name of the SSO performing the calibration

All daily calibration procedures for the MiniRae 2000 model PGM-7600 PID met the manufacturer's specifications for standard reference gas calibration and the requirements of SOP-5006, Control of Measuring and Test Equipment.

B-4.2 Eberline E-600 Instrument Calibration

The Eberline E-600 was calibrated daily before local background levels for radioactivity were measured. The instrument was calibrated by means of plutonium-239 and chloride-36 sources for alpha and beta emissions, respectively. The following five checks were performed as part of the calibration procedures: calibration date, physical damage, battery, response to a source of radioactivity, and background. All calibrations performed for the Eberline E-600 met the manufacturer's specifications, the requirements of the most current version of SOP-5006, and the applicable radiation detection instrument manual.

B-5.0 SUBSURFACE SAMPLING

All work was conducted per a site-specific health and safety plan and an integrated work document. Field activities conducted according to SOPs are discussed below.

B-5.1 Rock Sampling Methods

All samples collected from borehole 21-25262 at MDA T were submitted for fixed laboratory analysis. These samples were collected in accordance with SOP-06.26, Core Barrel Sampling for Subsurface Earth Materials. Borehole samples were collected in a lined, stainless-steel, core-barrel sampler that retrieved core in 5-ft lengths from targeted intervals.

Immediately upon retrieval, core was screened for gross-alpha and beta/gamma radiation for health and safety purposes. After radiological field-screening measurements established that core material was within background concentrations, the core was visually inspected and field-screening and laboratory samples were collected. Each sample was labeled with the borehole number, date, time, depth interval, and type of material and preserved (as required) for transport to the Laboratory's Sample Management Office (SMO).

In addition to characterization samples, field duplicates (FDs) were submitted for the same suite of analyses as the investigation samples for quality assurance (QA)/quality control (QC) at a frequency of 1:10.

All core and drill cuttings that remained after the completion of sampling and logging were placed in 1 yd^3 waste containers and staged on-site in an appropriate waste storage area until final disposition.

B-5.2 Pore-Gas Sample Collection

To help ascertain the final completion depth for BH 21-25262, a pore-gas sample was collected on April 23, 2009, in the open borehole at TD using a single inflatable packer. All other 2009 pore-gas samples were collected from stainless-steel ports permanently installed in the MDA T vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059. All pore-gas samples were collected in accordance with SOP-5074, Sampling for Sub-Atmospheric Air.

Before each sampling event, each isolated interval/sample port was purged and monitored with a Landtec GEM2000 instrument (or equivalent), until the %CO_2 and %O levels stabilized at values representative of subsurface pore-gas conditions. In addition, the vapor-sample tubing was purged of stagnant air by drawing air from the sampling interval through the line. To ensure that the sample collected was representative of the subsurface air at depth, every sampling activity included a purge cycle.

B-5.2.1 VOCs

Once purging and field screening are complete, vapor samples intended for VOC analysis are collected using SUMMA canisters and the sample information is recorded on the appropriate SCL. Field-screening results are also recorded on the appropriate SCL and/or in the field logbook. Field COCs and SCLs are provided in Appendix D.

In addition to the characterization samples, two types of QA/QC samples are collected and analyzed for VOCs using SUMMA canisters: an FD sample and an equipment blank (FB) of ultrapure nitrogen. FD and FB samples are collected at a frequency greater than or equal to 10% per sampling event in accordance with SOP-5059, Field Quality Control Samples.

All samples are submitted to the SMO for processing and transport to off-site contract analytical laboratories.

B-5.2.2 Tritium

Once purging and field screening were complete, water vapor intended for tritium analysis was collected from pore gas by pulling a pore-gas sample through a canister of silica gel, and the sample information is recorded on the appropriate SCL (Appendix D). Silica–gel column FD samples were also collected at a frequency greater than or equal to 10% per sampling event in accordance with the current version of SOP-5059.

Following delivery of the canister and silica–gel sample to the analytical laboratory, silica gel was heated and the moisture driven off is collected for liquid scintillation counting. Dry silica gel contains bound water that dilutes the tritium in the pore-gas moisture sample. A correction factor for this dilution was developed on a sample-by-sample basis, based on field measurements of silica gel (Marczak 2009, 106500; Whicker et al. 2009, 106429).

Silica gel was prepared for sampling by drying at a temperature above 100oC; however, this drying process does not completely remove bound water. Before sample collection, the amount of silica gel used in each sample was weighed (typically about 135 g) as well as the sample canister with silica gel. SOP-5074 requires that at least 5 g of moisture be collected. Following sampling, sample canister with silica gel was weighed again.

The canister sample was shipped to the analytical laboratory and the canister sample was weighed again. The silica gel was emptied into a distillation apparatus and heated to 110oC, driving moisture off the silica gel. This moisture was collected and analyzed for tritium by liquid scintillation. The laboratory also weighed the empty canister. The laboratory 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 concentration and the calculated percent moisture were reported to the Laboratory in the analytical data package and the electronic data deliverable.

The correction factor for the impacts of bound water was determined on a sample-by-sample basis. The correction factor for the tritium concentration data presented in this report was determined from the percent moisture value determined in the analytical laboratory (Marczak 2009, 106500).

B-5.3 Decontamination of Sampling Equipment

The core-barrel sampler and all other sampling equipment that came in contact with sample material were decontaminated after each sampling run. Decontamination included spraying the equipment with a household-strength cleaner and wiping it with sterile paper towels. Decontamination activities were performed in accordance with SOP-5061, Field Decontamination of Drilling and Sampling Equipment.

B-6.0 REFERENCES

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the New Mexico Environment Department Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Marczak, S., July 2009. “Technical Implementation of the Correction Factor Calculation for Tritium in Pore-Gas Data,” Los Alamos National Laboratory document LA-UR-09-4629, Los Alamos, New Mexico. (Marczak 2009, 106500)

Whicker, J.J., J.M. Dewart, S.P. Allen, W.F. Eisele, M.C. McNaughton, and A.A. Green, June 17, 2009. “Corrections for Measurement of Tritium in Subterranean Vapor Using Silica Gel,” Los Alamos National Laboratory document LA-UR-09-03837, Los Alamos, New Mexico. (Whicker et al. 2009, 106429)

Table B-1.0-1
Summary of Field Methods

Method	Summary
General Instructions for Field Investigations	This general procedure provides an overview of instructions regarding activities to be performed before, during, and after field investigations. It is assumed that field investigations involve standard sampling equipment, personal protective equipment, waste management, and site-control equipment/materials. The procedure covers premobilization activities, mobilization to the site, documentation and sample collection activities, sample media evaluation, surveillance, and completion of lessons learned.
Core-Barrel Sampling	The core barrel is a cylindrical barrel split lengthwise so that the two halves can be separated to expose the core sample. The stainless-steel core barrel (3-in. internal standard, 5 ft long) was pushed directly into the subsurface media by means of an air-core drilling rig. Core was extracted with the core barrel in 5-ft sections. Once extracted, each section of core was screened for radioactivity and organic vapors, photographed, and described in a geologic log. If located within a targeted sample interval, a portion of the core was then collected for fixed laboratory analysis.
Field Logging, Handling, and Documenting Borehole Materials	Upon reaching the surface, core barrels were immediately opened for field screening, logging, and sampling. Logging borehole materials included run number, core recovery percentage, depth interval (in 5-ft increments), field-screening results, lithological and structural description, and a photograph. Once the core material was logged, selected samples were taken from discrete intervals of the core. All borehole materials not sampled were then disposed of as waste. No material from the boreholes at MDA T was archived.
Headspace Vapor Screening	In accordance with SOP-06.33, every 5-ft interval of an individual soil, rock, or sediment sample was field screened for VOCs by placing a portion of the sample in a glass container with a foil-sealed cover. The container was sealed and gently shaken and allowed to equilibrate for 5 min. The sample was then screened through the insertion of PID probe that was equipped with an 11.7-eV lamp into the container, measuring, and recording any detected vapors.
Sample Containers and Preservation	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on the U.S. Environmental Protection Agency (EPA) guidance for environmental sampling, preservation, and QA. Specific requirements are met for each sample and are printed in the SCLs provided by the SMO (size and type of container, preservatives, etc.). All samples are preserved by placing them in insulated containers with ice to maintain a temperature of 4°C.
Handling, Packaging, and Transporting Field Samples	Field team members sealed and labeled samples before packing to ensure that the sample containers and the containers used for transport are free of external contamination. All environmental samples were collected, preserved, packaged, and transported to the SMO under COC. 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 included SCLs, COC forms, sample container labels, and custody seals. SCLs 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 are placed around container lids or openings. COC forms were completed and signed to verify that the samples were not left unattended.

Table B-1.0-1 (continued)

Method	Summary
Field QC	Field QC samples were collected as follows: FDs were collected at a frequency of 10% at the same time as a regular sample and submitted for the same analyses. 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 of Subatmospheric Air	Vapor sampling was performed on four monitoring wells in accordance with the current version of SOP-5074 and analyzed for VOCs and tritium. This SOP described the process of sampling subatmospheric air from vapor ports in monitoring wells and boreholes. The procedure covers presampling 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, and 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 drill casing, to obtain a sample from a discrete section), and postsampling activities
Management, Characterization, and Storage of Investigation-Derived Waste	Investigation-derived waste (IDW) was managed, characterized, and stored in accordance with an approved waste characterization strategy form that documents site history, field activities, and the characterization approach for each waste stream managed. Waste characterization complied with on-site or off-site waste acceptance criteria, as appropriate. All stored IDW was marked with appropriate signage and labels, as appropriate. Drummed IDW was stored on pallets to prevent deterioration of containers. Means to store, control, and transport each potential waste type and classification was determined before the start of field operations. A waste storage area was established before generation of waste. Each container of waste generated was individually labeled as to waste classification, item identification number, and radioactivity (if applicable), immediately following containerization. All waste was segregated by classification and compatibility to prevent cross-contamination.
Field Decontamination of Drilling and Sampling Equipment	Dry decontamination was the preferred method of decontamination used at MDA T to minimize the generation of liquid waste. Dry decontamination included the use of a wire brush or other tool for removal of soil or other material adhering to the sampling equipment, followed by use of a commercial cleaning agent (nonacid, waxless cleaners) and paper wipes.

Table B-1.0-2
List of Applicable General Procedures for MDA T Field Activities

Doc. Number	LANL Procedure Title
P101-6 R0	Personal Protective Equipment
SOP-5181 R0	Notebook Documentation for Environmental Restoration Technical Activities
SOP-5228 R0	ADEP Reporting Requirements for Abnormal Events

Appendix C

Lithologic Log and 2009 Field Photos

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 1
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/09/2005:1255	FINISH DATE/TIME: 1/05/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0' GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Lithologic Symbol	ADDITIONAL COMMENTS
0.0	2.9/5 NR		PID= 0.0 α/β=<MDA	CLAY, SILT, AND GRAVEL FILL: *(0.0-0.6 ft)* Brown (7.5YR, 4/2) mixed fill with roughly equal parts of silt clay and gravel with little fine to medium-grained sand and trace organics (roots and grasses). Slightly damp. CLAY and REWORKED TUFF FILL: *(0.6-2.9 ft)* Variable in color: grey, pink, brown. Dominantly clay and reworked tuff material with trace amounts of fine to medium-grained sand and silt. Slightly damp.		
5.0	5/5		PID= 0.1 α/β=<MDA	SILT AND CLAY FILL: *(5.0-7.8 ft)* Red brown (5YR, 4/4) fill composed primarily of fines (silts and clays), with little fine to medium-grained sand and trace reworked tuff. Slightly damp and soft. REWORKED TUFF: *(7.8-10.9 ft)* (5YR, 6/2) weathered tuff with 15-20% qtz and plagioclase phenocrysts and ~10% pumice clasts (2-4 mm in diameter).	FILL	
10.0	5/5		PID= 0.6 α/β=<MDA	UNIT 3 TSHIERGE MEMBER, BANDELIER TUFF: *Poorly-welded crystalline ash flow tuff.* *(10.9-20.0 ft)* Light grey (5YR 6/1) with ~15% of qtz and ~10% plagioclase in a grey ash matrix. Pumice clasts also present (10-15%) and range in size from 6-10 mm, dry.		Fill/tuff contact at 10.9' bgs. Set 12" diameter surface casing 0-12"
15.0	5/5	**MD21-06-64011** *(15.0 to 16.0' bgs)* ***Moisture***	PID= 0.3 α/β=<MDA		Qbt3	
20.0						

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 2
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/12/2005:1235	FINISH DATE/TIME: 1/05/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0' GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
20.0	5/5	**MD21-06-64012** (20.0 to 21.0' bgs) Moisture	PID= 0.4 α/β=<MDA	UNIT 3 TSHIERGE MEMBER, BANDELIER TUFF: *Same As Above (SAA)* *(20.0-40.0 ft)* *Poorly-welded crystalline ash flow tuff.* Minor variations noted below.			
		MD21-06-63897 (22.0 to 23.5' bgs) Fracture		*Downsection:* *22.7' bgs*: Clay-filled fracture (aperture 6-8 mm) 35-40 degrees relative to ground surface.			
25.0	5/5	**MD21-06-64013** (25.0 to 26.0' bgs) Moisture **MD21-06-64143** (26.0 to 27.0' bgs) Geotechnical	PID= 0.3 α/β=<MDA				
30.0	5/5	**MD21-06-64014** (30.0 to 31.0' bgs) Moisture	PID= na α/β=<MDA			Qbt3	
35.0	5/5	**MD21-06-64015** (35.0 to 36.0' bgs) Moisture	PID= 1.6 α/β=<MDA	35.0-40.0*' bgs*: Degree of welding is increasingly variable, poorly welded to nonwelded.			Degree of welding decreasing.
40.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 3
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/12/2005:1545	FINISH DATE/TIME: 1/5/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7'	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0'
DRILLER: Steven Tanuz		GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
40.0	4.5/5	**MD21-06-64016** *(40.0 to 41.0' bgs)* ***Moisture***	PID= 2.6 α/β=<MDA	UNIT 3 TSHIERGE MEMBER, BANDELIER TUFF: *Poorly welded to non-welded ash flow tuff.* *(40.0-60.0 ft)* Slightly less welded and more crystalline than above. Tuff is grey (5YR, 6/1) and contains primarily qtz (10-15%) and plagioclase (10-15%) phenocrysts in a grey ash matrix. Pumice clasts also present and range in size 2-6 mm.		Qbt3	
45.0	NR 4.5/5	**MD21-06-64017** *(45.0 to 46.0' bgs)* ***Moisture***	PID= 0.3 α/β=<MDA				
50.0	NR 5/5	**MD21-06-64018** *(50.0 to 51.0' bgs)* ***Moisture***	PID= 0.3 α/β=<MDA				
55.0	5/5	**MD21-06-64019** *(55.0 to 56.0' bgs)* ***Moisture***	PID= 0.3 α/β=<MDA	*55.0-60.0' bgs*: Slight variability in tuff color. At 57.3-57.6' bgs, tuff is a light brown (7.5YR, 6/2) but color is not pervasive and does not continue through the core diameter.			
60.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 4
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/13/2005:1100	FINISH DATE/TIME: 1/05/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0' GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
60.0	5/5	**MD21-06-64020** *(60.0 to 61.0' bgs)* ***Moisture***	PID= 0.3 α/β=<MDA	UNIT 3 TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *(60.0-75.0 ft)* *Poorly welded to non-welded crystalline ash flow tuff.*			
65.0	5/5	**MD21-06-64021** *(65.0 to 66.0' bgs)* ***Moisture***	PID= 0.1 α/β=<MDA				
70.0	5/5	**MD21-06-64022** *(70.0 to 71.0' bgs)* ***Moisture***	PID= 0.2 α/β=<MDA			Qbt3	
75.0	2/5	**MD21-06-64023** *(75.0 to 76.0' bgs)* ***Moisture*** ***AND*** **MD21-06-63898** *(75.0 to 77.0' bgs)* ***Gen. Investigation***	PID= 0.2 α/β=<MDA	*Non-welded crystalline ash flow tuff.* *(75.0-80.0 ft)* Tuff is non-welded throughout this section. Qtz phenocrysts slightly larger and more abundant (~20%) in unwelded portions.			Sample collected at the inferred base of disposal shaft(s) (75-77' bgs).
	NR	**MD21-06-64204** *(79.0 to 81.0' bgs)* ***Pore Gas***					
80.0							

BOREHOLE ID: 21-25262 Technical Area (TA): 21-016(a)-99 (MDA-T) Page 5

DRILLING COMPANY: Spectrum Exploration START DATE/TIME: 12/13/2005:1350 FINISH DATE/TIME: 1/5/2006:1010

DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25” ID, 9” Diameter Bit

SAMPLING EQUIPMENT/METHOD: 3” Split-Barrel Sampler (5.0’ length)

GROUND ELEVATION: 7142.7’

α/β DAILY BACKGROUND READINGS: see log

TOTAL DEPTH: 380.0’

DRILLER: Steven Tanuz

GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
80.0	5/5	**MD21-06-64204** *(79.0 to 81.0' bgs)* ***Pore Gas*** ***AND*** **MD21-06-64024** *(80.0 to 81.0' bgs)* ***Moisture***	PID= 0.2 α/β=<MDA	UNIT 3 TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *(80.0-100.0 ft)* *Non-welded crystalline ash flow tuff.* Minor variations noted below.			
85.0	5/5	**MD21-06-64025** *(85.0 to 86.0' bgs)* ***Moisture***	PID= 0.1 α/β=<MDA				
90.0	5/5	**MD21-06-64026** *(90.0 to 91.0' bgs)* ***Moisture***	PID= 0.1 α/β=<MDA	*Downsection:* *90.0-99.5' bgs*: Grain size of matrix coarser than sections above and below. Overall non-welded tuff texture granular and sugary. Texture of sections above and below powdery and fine.		Qbt3	
95.0	5/5	**MD21-06-64027** *(95.0 to 96.0' bgs)* ***Moisture***	PID= 0.2 α/β=<MDA				
100.0							

BOREHOLE ID: 21-25262 Technical Area (TA): 21-016(a)-99 (MDA-T) Page 6

DRILLING COMPANY: Spectrum Exploration START DATE/TIME: 12/13/2005:1525 FINISH DATE/TIME: 1/5/2006:1010

DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit

SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)

GROUND ELEVATION: 7142.7'
α/β DAILY BACKGROUND READINGS: see log
TOTAL DEPTH: 380.0'
DRILLER: Steven Tanuz
GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
100.0	5/5		PID= 0.2 α/β=<MDA	UNIT 3 TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *(100.0-105.0 ft)* *Non-welded crystalline ash flow tuff.* Poorly-welded section occurs at 103.3-104.1' bgs.		Qbt3	
105.0	5/5		PID= 0.2 α/β=<MDA	*Poorly-welded crystalline ash flow tuff.* *(105.0-109.0 ft)* Tuff grades from a grey (5YR, 6/1) to (5YR, 6/2). Qtz and plagioclase phenocrysts and pumice less abundant than above (10-15% and <10%, respectively). Pumice clasts range from 2 to 5 mm in diameter. Several small (20-40 mm) white ash pockets.			
109.0				UNIT 2 TSHIERGE MEMBER, BANDELIER TUFF: *(109.0-117.2 ft)* *Poorly to moderately-welded crystalline ash flow tuff.* (5YR, 5/2) with qtz and plagioclase phenocrysts (15-20%) and pumice clasts (<10%) in a reddish grey ash matrix. Pumice clasts range from 2 to 5 mm in diameter. Tuff is dry and several sections are moderately welded.		Qbt2	Qbt3 / Qbt2 tuff contact at 109.0' bgs. Degree of welding: increasing
110.0	5/5	**MD21-06-63899** *(110.0 to 113.0' bgs)* ***Gen. Investigation*** ***AND*** **MD21-06-63915** *(110.0 to 113.0' bgs)* ***Field Duplicate***	PID= 0.2 α/β=<MDA				
114.0		**MD21-06-64206** *(114.0 to 116.0' bgs)* ***Pore Gas*** ***AND*** **MD21-06-64028** *(115.0 to 116.0' bgs)* ***Moisture***					
115.0	5/5		PID= 0.5 α/β=<MDA				
116.0		**MD21-06-63900** *(116.0 to 118.0' bgs)* ***Gen. Investigation***					
117.2				*Densly-welded crystalline ash flow tuff.* *(117.2-120.0 ft)* All other attributes SAA.			Drilling very slow, 2+ hours per 5 ft.
120.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 7
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/14/2005:1620	FINISH DATE/TIME: 1/05/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0' GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
120.0	5/5	**MD21-06-64144** *(124.6 to 125.0' bgs)* *Geotechnical*	PID= 0.4 α/β=<MDA	UNIT 2 TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *Densly-welded crystalline ash flow tuff.*			
125.0	5/5		PID= 0.1 α/β=<MDA	*Moderately-welded crystalline ash flow tuff.* *(125.0-140.0 ft)* Reddish grey (5YR 5/2) with qtz (15-20%), plagioclase (10-15%), and trace sanidine phenocrysts in a red grey ash matrix. Small (2-4 mm) pumice clasts also present but rare. Tuff is dry and hard. Phenocrysts size decreases with depth.			
130.0	5/5		PID= 0.1 α/β=<MDA			Qbt2	
135.0	5/5		PID= 0.2 α/β=<MDA				
140.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 8
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/15/2005:1135	FINISH DATE/TIME: 1/5/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0' GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
140.0	5/5	**MD21-06-64029** *(140.0 to 141.0' bgs)* ***Moisture*** **MD21-06-63901** *(141.9 to 143.4' bgs)* ***Fracture***	PID= 0.2 α/β=<MDA	UNIT 2 TSHIERGE MEMBER, BANDELIER TUFF: *(140.0-155.0 ft)* *Moderately-welded crystalline ash flow tuff, SAA.* *141.9-143.4' bgs*: Clay-filled fracture (aperture 8-10 mm) 70-75 degrees relative to the horizontal plane of reference (ground surface).			
145.0	5/5		PID= 0.1 α/β=<MDA	*148.1-148.2' bgs*: Thin (0.1' thick) grey (5YR 6/1) ash layer present.			
150.0	5/5		PID= 0.5 α/β=<MDA	Tuff becomes progressively less welded towards the base of this section (~150' bgs).		Qbt2	
155.0	5/5		PID= 0.1 α/β=<MDA	*Poorly-welded crystalline ash flow tuff.* *(155.0-160.0 ft)* Otherwise SAA.			
160.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 9
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/15/2005:1630	FINISH DATE/TIME: 1/05/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0' GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Lithologic Symbol	ADDITIONAL COMMENTS
160.0	5/5	**MD21-06-64030** *(160.0 to 161.0' bgs)* ***Moisture***	PID= 0.1 α/β=<MDA	UNIT 2 TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *(160.0-166.0 ft)* *Poorly-welded crystalline ash flow tuff.* Degree of welding continues to decrease with depth. In addition, tuff matrix grades more reddish in color towards the base of the section.	Qbt2	Degree of welding: decreasing
165.0	5/5		PID= 0.1 α/β=<MDA	UNIT Qbt 1v/Qbt2 TSHIERGE MEMBER BANDELIER TUFF: *(164.0-168.0 ft)* UNIT 1v TSHIERGE MEMBER, BANDELIER TUFF: *Poorly-welded crystalline ash flow tuff.* *(168.0- 170.0 ft)*	Qbt 1v/Qbt2	Qbt1v / Qbt2 Contact gradational.
170.0	5/5	**MD21-06-63902** *(170.0 to 172.0' bgs)* ***Gen. Investigation*** **MD21-06-64145** *(172.0 to 172.8' bgs)* ***Geotechnical***	PID= 0.1 α/β=<MDA	Reddish brown (2.5YR, 5/3) tuff with ~15% of qtz and plagioclase phenocrysts, small (6-10 mm) trace vitrified pumice clasts (<10%) in a reddish brown ash matrix. Tuff is dry, soft, and contains a few pockets of grey ash and several unwelded sections. *Non-welded crystalline ash flow tuff.* *(170.0-180.0 ft)* SAA except tuff is non-welded. Pumice up to 20 mm.	Qbt1v	
175.0	5/5		PID= 0.1 α/β=<MDA			
180.0						

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 10
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/16/2005:1225	FINISH DATE/TIME: 1/5/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0' GEOLOGIST: S. White

Depth (ft)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
180.0	5/5	**MD21-06-64031** *(180.0 to 181.0' bgs)* ***Moisture***	PID= 0.1 α/β=<MDA	UNIT 1V TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *(180.0- 200.0 ft)* *Non-welded crystalline ash flow tuff.* Tuff matrix color continues to lighten with depth; grading to light red/grey (5YR 6/3) @ 185-190' bgs to pink/grey (5YR, 6/2) @ 195-200' bgs. Phenocrysts also coarsen with depth. Pumice fragments variable in size throughout section, ranging from 2 to 25 mm in size.			Phenocrysts: coarsening
185.0	5/5		PID= 0.1 α/β=<MDA				
190.0	5/5	**MD21-06-64202** *(189.0 to 191.0' bgs)* ***Pore Gas***	PID= 0.3 α/β=<MDA			Qbt 1v	
195.0	5/5		PID= 0.1 α/β=<MDA				
200.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 11
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/16/2005:1505	FINISH DATE/TIME: 1/5/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25” ID, 9” Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3” Split-Barrel Sampler (5.0’ length)		
GROUND ELEVATION: 7142.7’ DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0’ GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
200.0	5/5	**MD21-06-64032** *(200.0 to 201.0’ bgs)* ***Moisture***	PID= 0.2 α/β=<MDA	UNIT 1V TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *(200.0-220.0 ft)* *Non-welded crystalline ash flow tuff.* Pink/grey (5YR, 6/2). Amount of pumice clasts increase with depth to 205’ bgs (20%) and become variable below this depth (5-25%). Pumice size is variable, ranging from 5 to 40 mm.			Pumice content increases with depth:
205.0	5/5		PID= 0.2 α/β=<MDA				
210.0	5/5		PID= 0.0 α/β=<MDA			Qbt1v	
215.0	5/5		PID= 0.0 α/β=<MDA				
220.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 12
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/19/2005:1210	FINISH DATE/TIME: 1/05/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0' GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
220.0	5/5		PID= 0.1 α/β=<MDA	UNIT 1V TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *(220.0-235.0 ft)* *Non-welded crystalline ash flow tuff.* Color grades to reddish brown (5YR, 6/4). Pumice content is variable (5-25%). Phenocrysts slightly coarser in lower sections. Other minor variations detailed below.		Qbt 1v	
225.0	5/5		PID= 0.0 α/β=<MDA				
230.0	4.6/5	**MD21-06-64033** *(230.0 to 231.0' bgs)* ***Moisture*** **MD21-06-64205** *(234.0 to 236.0' bgs)* ***Pore Gas*** *AND*	PID= 0.0 α/β=<MDA	*232-234.6' bgs*: Degree of welding increasing slightly with depth. Tuff is damp in shoe extracted from the 230-235' run.			Insufficient material for sampling
235.0	NR 5/5	**MD21-06-64034** *(235.0 to 236.0' bgs)* ***Moisture*** *AND* **MD21-06-63903** *(235.0 to 238.0' bgs)* ***Gen. Investigation*** *AND* **MD21-06-63916** *(235.0 to 238.0' bgs)* ***Field Duplicate*** **MD21-06-64146** *(238.0 to 238.9' bgs)* ***Geotechnical***	PID= 0.3 α/β=<MDA	*Poorly-welded crystalline ash flow tuff.* *(235.0-240.0 ft)* Red yellow (5YR, 6/6). Qtz and plagioclase phenocrysts coarse and 10-15% in a soft damp to dry matrix. Pumice (4-30 mm) remain soft and vary from 5-25%. Trace dacite/rhyolite clasts also present.			Base of Qbt1v / Top of Qbt1g
240.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 13
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/20/2005:0955	FINISH DATE/TIME: 1/05/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0' GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
240.0	3/5 NR		PID= 0.3 α/β=<MDA	UNIT 1V/1G TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *(240.0-243 ft)* *Poorly-welded crystalline ash flow tuff.*		Qbt 1v	
245.0	5/5	**MD21-06-64035** *(245.0 to 246.0' bgs)* ***Moisture***	PID= 0.4 α/β=<MDA	UNIT 1G TSHIERGE MEMBER, BANDELIER TUFF: *Non-welded pumaceous ash flow tuff.* *(245-260.0 ft)* Yellow red (5YR, 4/6) with ~10% of coarse qtz and plagioclase phenocrysts and pumice in an ash matrix. Pumice (5-25 mm, 15-20%) are hard and glassy. Black glass shards and dacite pebbles (5-15 mm) present in trace amounts.		Qbt 1g	
250.0	3.3/5 NR	**MD21-06-63904** *(251.0 to 253.0' bgs)* ***Gen. Investigation*** *AND* **MD21-06-63917** *(251.0 to 253.0' bgs)* ***Field Duplicate***	PID= 0.4 α/β=<MDA				
255.0	5/5		PID= 0.0 α/β=<MDA				
260.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 14
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/20/2005:1215	FINISH DATE/TIME: 1/5/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7'	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0'
DRILLER: Steven Tanuz		GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
260.0	5/5	**MD21-06-64036** *(265.0 to 266.0' bgs)* ***Moisture*** *AND* **MD21-06-64051** *(265.0 to 266.0' bgs)* ***Moisture FD***	PID= 0.2 α/β=<MDA	UNIT 1G TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *(260.0-280.0 ft)* *Non-welded pumaceous ash flow tuff.* Pumice clast size can exceed 50 mm in this interval (greater than width of spilt-barrel sampler) and are hard and glassy. Tuff begins to transition in color to a light reddish brown (5YR, 6/4) below 265' bgs.			
265.0	5/5		PID= 0.0 α/β=<MDA				
270.0	4/5 NR		PID= 0.1 α/β=<MDA			Qbt 1g	
275.0	5/5		PID= 0.1 α/β=<MDA				
280.0							

BOREHOLE ID: 21-25262 Technical Area (TA): 21-016(a)-99 (MDA-T) Page 15

DRILLING COMPANY: Spectrum Exploration START DATE/TIME: 12/20/2005:1600 FINISH DATE/TIME: 1/05/2006:1010

DRILLING EQUIPMENT/METHOD: CME-85 HSA 4.25" ID, 9" Diameter Bit

SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)

GROUND ELEVATION: 7142.7'
α/β DAILY BACKGROUND READINGS: see log
TOTAL DEPTH: 380.0'

DRILLER: Steven Tanuz
GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
280.0	5/5		PID= 0.0 α/β=<MDA	UNIT 1g TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *(280.0-300.0 ft)* *Non-welded ash flow tuff.* Color continues to grade lighter with increasing depth. Other minor variations noted below.			
285.0	2/5 NR	**MD21-06-64037** *(285.0 to 286.0' bgs)* ***Moisture***	PID= 0.1 α/β=<MDA				
290.0	5/5		PID= 0.0 α/β=<MDA	*290.4' bgs:* Sharp color change from 5YR, 6/3 to a pink grey (5YR, 7/2). Other constituents remain the same. *292.8-293.0' bgs*: Color band of 5YR, 6/3 tuff.		Qbt 1g	
295.0	5/5	**MD21-06-64203** *(294.0 to 296.0' bgs)* ***Pore Gas***	PID= 0.0 α/β=<MDA				
300.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 16
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 12/21/2005:1115	FINISH DATE/TIME: 01/05/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0' GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
300.0	5/5		PID= 0.0 α/β=<MDA	UNIT 1g TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *(300.0-320.0 ft)* *Non-welded ash flow tuff.* Other minor variations noted below.			
305.0	5/5	**MD21-06-64038** *(305.0 to 306.0' bgs)* ***Moisture***	PID= 0.0 α/β=<MDA				
310.0	5/5		PID= 0.3 α/β=<MDA	*310.0-320.0' bgs*: Tuff slightly moist, tan beige (7.5YR, 8/2), with 15% qtz, 10% sanidine, and 5% pumice clasts.		Qbt 1g	
315.0	5/5		α/β=<MDA				
320.0							

BOREHOLE ID: 21-25262 Technical Area (TA): 21-016(a)-99 (MDA-T) Page 17

DRILLING COMPANY: Spectrum Exploration START DATE/TIME: 01/03/2006:1215 FINISH DATE/TIME: 01/05/2006:1010

DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit

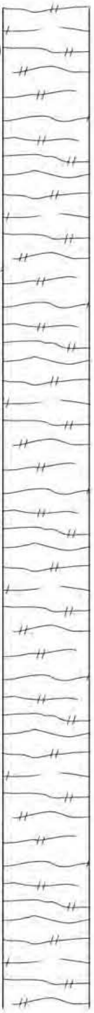
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)

GROUND ELEVATION: 7142.7'
α/β DAILY BACKGROUND READINGS: see log
TOTAL DEPTH: 380.0'

DRILLER: Steven Tanuz
GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Lithologic Symbol	ADDITIONAL COMMENTS
320.0	5/5		α/β=<MDA	UNIT 1g TSHIERGE MEMBER, BANDELIER TUFF: *SAA* *(320.0-330.3 ft)* *Non-welded ash flow tuff.* Minor variations noted below.		
325.0	5/5	**MD21-06-64039** *(325.0 to 326.0' bgs)* ***Moisture***	α/β=<MDA	*Downsection:* *325.0' bgs:* Tuff grades to a light grey (5YR, 7/1). *329.2-329.5' bgs*: A thin pumice-rich horizon present.	Qbt 1g	
330.0	5/5	**MD21-06-64040** *(331.0 to 332.0' bgs)* ***Moisture***	α/β=<MDA	TSANKAWI PUMICE BED, TSHIERGE MEMBER, BANDELIER TUFF: *Pumice deposit.* *(330.3-333.2 ft)* Grey (5YR, 6/1) granular pumice, fine to coarse-grained.	Qbtt	Qbt1g / Qbtt contact: 330.3' bgs.
		MD21-06-63905 *(333.0 to 335.0' bgs)* ***Gen. Investigation***		CERRO TOLEDO: *Sand.* *(333.2-340.0 ft)* Loose, slightly damp, multi-colored (predominantly [5YR, 5/4]) fine to coarse-grained sand with some silt and pumice gravel. Color dominantly (5YR 6/2) and (5YR 6/1) below 335.0' bgs. A 0.2' thick horizon of non-welded tuff occurs at 337.3 ft.	Qct	Qbtt / Qct contact: 333.2' bgs.
335.0	2.5/5 NR	**MD21-06-64147** *(335.0 to 336.0' bgs)* ***Geotechnical***	PID= 0.1 α/β=<MDA			
340.0						

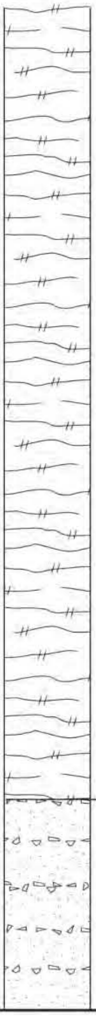
BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 18
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 01/03/2006:1615	FINISH DATE/TIME: 01/05/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0' GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
340.0	5/5		PID= 0.0 α/β=<MDA	CERRO TOLEDO: *SAA* *(340.0-360.0 ft)* *Sand.* Still slightly damp. Sub-rounded fine to medium-grained dacite gravel present in subordinate amounts. Bedding visible below 343' bgs. Sand appears finer with increasing depth but is heterogeneous.			
345.0	5/5	**MD21-06-64041** *(345.0 to 346.0' bgs)* ***Moisture***	PID= 0.3 α/β=<MDA	*Downsection:* *347.0' bgs:* Sand color grades from (7.5YR, 5/4) to (7.5YR, 6/3).			
350.0	3.2/5 NR	**MD21-06-64148** *(352.0 to 353.0' bgs)* ***Geotechnical***	PID= 0.0 α/β=<MDA			Qct	
355.0	5/5	**MD21-06-64042** *(355.0 to 356.0' bgs)* ***Moisture*** ***AND*** **MD21-06-64052** *(355.0 to 356.0' bgs)* ***Moisture FD***	PID= 0.1 α/β=<MDA				
360.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 19
DRILLING COMPANY: Spectrum Exploration	START DATE/TIME: 01/04/2006:1245	FINISH DATE/TIME: 01/05/2006:1010
DRILLING EQUIPMENT/METHOD: CME-85 HSA, 4.25" ID, 9" Diameter Bit		
SAMPLING EQUIPMENT/METHOD: 3" Split-Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: Steven Tanuz	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 380.0' GEOLOGIST: S. White

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Lithologic Symbol	ADDITIONAL COMMENTS
360.0	5/5		PID= 0.2 α/β=<MDA	CERRO TOLEDO: *SAA* *(360.0-375.8 ft)* *Sand* Slightly damp. Pumice, dacite, and volcanic gravel clasts present in trace amounts below 370.0'.	Qct	
365.0	5/5	**MD21-06-64043** *(365.0 to 366.0' bgs)* ***Moisture***	PID= 0.1 α/β=<MDA			
370.0	5/5	**MD21-06-64201** *(370.0 to 380.0' bgs)* ***Pore Gas*** ***AND*** **MD21-06-64231** *(370.0 to 380.0' bgs)* ***Pore Gas FD*** **MD21-06-63906** *(373.0 to 375.0' bgs)* ***Gen. Investigation*** ***AND*** **MD21-06-63918** *(373.0 to 375.0' bgs)* ***Field Duplicate***	PID= 0.2 α/β=<MDA			
375.0	5/5	**MD21-06-63907** *(378.0 to 380.0' bgs)* ***Gen. Investigation***	PID= 0.1 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Non-welded tuff* *(375.8-380.0 ft)* Reddish yellow (5YR 6/6) with 10% qtz and sanidine phenocrysts and trace (~5%) soft pumice clasts (2-20 mm). Tuff is slightly damp.	Qbo	Qct / Qbo contact: 375.8' bgs. *Former Borehole TD*
380.0						

Graphic Log

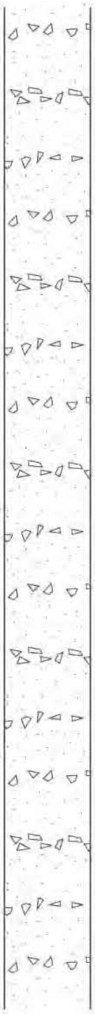


SECOND PHASE OF DRILLING, DEEPENING TO 695.1 FT BGS, DISCRETE CORED INTERVALS ONLY

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 20
DRILLING COMPANY: Precision Drilling	START DATE/TIME: 04/10/2009	FINISH DATE/TIME: 05/04/2009
DRILLING EQUIPMENT/METHOD: Delta Base Air Core		
SAMPLING EQUIPMENT/METHOD: 3" ID Core Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: D. Starnes/D. Toney	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 695.1' GEOLOGIST: L. Rought

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
390.0	NC						
	3/5		PID= 0.2 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Non-welded tuff* *(391.5-400.0 ft)* Light brown (7.5YR 6/4),10% phenocrysts (< 10mm), mostly quartz with trace sanidine; 5-8% lithics (2-5 mm); less than 5% fibrous pumice fragments (< 15 mm) with vitreous luster in ashy, glassy matrix. Lithic rounded, fine grained, dark, mostly dacitic. Pumice fragments mostly reddish yellow (7.5YR 6/4), some moderately indurated. At ~398 ft very fine grained dark crusty (planar) deposit.			
395.0	NR						
	2.8/3.5		PID= 0.0 α/β=<MDA				398 ft crusty planar deposit
	NR						
400.0	4.7/5		PID= 0.6 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Non-welded to poorly welded tuff* *(400.0-425.0 ft)* Light brown (7.5YR 6/4),10-15% phenocrysts (mostly quartz/sanidine, ratio 10:1); 5-8% mostly dacitic rounded lithics, average size is a few mm (one is 35 mm). Fibrous pumice fragments with vitreous luster on fresh surfaces (max 25 mm); reddish yellow (7.5YR 6/4). At 405 ft phenocrysts 15-20%. Samples are slightly more indurated with increasing depth. All samples slightly damp.		Qbo	
	NR						
405.0	4/5		PID= 0-0.2 α/β=<MDA				
	NR						
410.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 21
DRILLING COMPANY: Precision Drilling	START DATE/TIME: 04/10/2009	FINISH DATE/TIME: 05/04/2009
DRILLING EQUIPMENT/METHOD: Delta Base Air Core		
SAMPLING EQUIPMENT/METHOD: 3" ID Core Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7'	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 695.1'
DRILLER: D. Starnes/D. Toney		GEOLOGIST: L. Rought



Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Lithologic Symbol	ADDITIONAL COMMENTS
410.0	NC					
	4/4		PID= 0-0.2 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Non-welded to poorly welded tuff* Same as above; slightly more indurated.		
415.0	5/5		PID= 0.0 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Non-welded to poorly welded tuff* Same as above; slightly more indurated.		
420.0	4.3/5	**MD21-09-4633** *(420.0 to 425.0' bgs)* ***Gen. Investigation***	PID= 0.0 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Non-welded to poorly welded tuff* Same as above; slightly more indurated.	Qbo	
425.0	NR					425-470 ft not cored samples collected
	NC					
430.0				**NO LOG PRESENTED 430.0-465.0 FT**		

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 22
DRILLING COMPANY: Precision Drilling	START DATE/TIME: 04/10/2009	FINISH DATE/TIME: 05/04/2009
DRILLING EQUIPMENT/METHOD: Delta Base Air Core		
SAMPLING EQUIPMENT/METHOD: 3" ID Core Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: D. Starnes/D. Toney	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 695.1' GEOLOGIST: L. Rought

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Lithologic Symbol	ADDITIONAL COMMENTS
465.0	NC					425-470 ft not cored samples collected
470.0	3.2/5	**MD21-09-4634** *(470.0 to 473.0' bgs)* *Gen. Investigation*	PID= 0.0 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Non-welded to poorly welded tuff* *(470.0-475.0 ft)* Light brownish gray (10YR 6/2); matrix of glassy volcanic ash with 8-10% quartz and sanidine phenocrysts; trace pumice is fibrous with vitreous luster and quartz crystal bearing, reddish yellow (7.5YR 6/8) to gray and indurated; trace dacitic lithics. Phenocrysts and lithics mostly mm-sized, pumice to 15 mm in diameter. Sample slightly damp.	Qbo	Tuff slightly more indurated than above
	NR					
475.0						475-520 ft not cored samples collected
480.0	NC					
485.0				**NO LOG PRESENTED 485.0-515.0 FT**		

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 23
DRILLING COMPANY: Precision Drilling	START DATE/TIME: 04/10/2009	FINISH DATE/TIME: 05/04/2009
DRILLING EQUIPMENT/METHOD: Delta Base Air Core		
SAMPLING EQUIPMENT/METHOD: 3" ID Core Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: D. Starnes/D. Toney	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 695.1' GEOLOGIST: L. Rought

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
515.0	NC						475-520 ft not cored samples collected
520.0	$\frac{4.8}{5}$	**MD21-09-4635** *(520.0 to 525.0' bgs)* ***Chemical and Geotechnical*** **MD21-09-4636** *(520.0 to 525.0' bgs)* ***Field Duplicate***	PID= 0.0 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Poorly welded tuff* *(520.0-525.0 ft)* Pale brown (10YR 6/3); matrix of glassy volcanic ash; 10% quartz and minor sanidine phenocrysts; 10% mostly dacitic rounded lithics; pumice variable in size from mm to 40 mm in diameter; reddish yellow (7.5YR 6/6) to gray. Sample slightly damp.		Qbo	
525.0	NR						525-570 ft not cored samples collected
530.0	NC						
535.0							

NO LOG PRESENTED 535.0-565.0 FT

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)		Page 24
DRILLING COMPANY: Precision Drilling	START DATE/TIME: 04/10/2009	FINISH DATE/TIME: 05/04/2009	
DRILLING EQUIPMENT/METHOD: Delta Base Air Core			
SAMPLING EQUIPMENT/METHOD: 3" ID Core Barrel Sampler (5.0' length)			
GROUND ELEVATION: 7142.7' DRILLER: D. Starnes/D. Toney	α/β DAILY BACKGROUND READINGS: see log		TOTAL DEPTH: 695.1' GEOLOGIST: L. Rought

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
565.0	NC						525-570 ft not cored samples collected
570.0	4.6/5	**MD21-09-4637** *(520.0 to 525.0' bgs)* *Gen. Investigation*	PID= 0.0 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Nonwelded to poorly welded tuff* *(570.0-575.0 ft)* Pale brown (10YR 6/3); matrix of glassy volcanic ash; 10% quartz and minor sanidine phenocrysts; 10% mostly dacitic rounded lithics; pumice variable in size from mm to 30 mm in diameter; white/gray to very pale brown (10YR 6/3); quartz bearing. Sample slightly damp.		Qbo	
575.0	NR						575-620 ft not cored samples collected
580.0	NC						
585.0							

NO LOG PRESENTED 585.0-615.0 FT

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 25
DRILLING COMPANY: Precision Drilling	START DATE/TIME: 04/10/2009	FINISH DATE/TIME: 05/04/2009
DRILLING EQUIPMENT/METHOD: Delta Base Air Core		
SAMPLING EQUIPMENT/METHOD: 3" ID Core Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7'	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 695.1'
DRILLER: D. Starnes/D. Toney		GEOLOGIST: L. Rought

Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
615.0	NC						575-620 ft not cored samples collected
620.0	4.8/5	**MD21-09-4638** *(470.0 to 473.0' bgs)* ***Chemical and Geotechical***	PID= 0.0 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Nonwelded to poorly welded tuff* *(620.0-625.0 ft)* Light brown (7.5YR 6/3); composition same as above; pumice white to light gray (minor light greenish gray) and partially indurated, quartz bearing; slightly damp.		Qbo	
625.0	NR						625-650 ft not cored samples collected
630.0	NC						
635.0							

NO LOG PRESENTED 635.0-650.0 FT

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 26
DRILLING COMPANY: Precision Drilling	START DATE/TIME: 04/10/2009	FINISH DATE/TIME: 05/04/2009
DRILLING EQUIPMENT/METHOD: Delta Base Air Core		
SAMPLING EQUIPMENT/METHOD: 3" ID Core Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7'	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 695.1'
DRILLER: D. Starnes/D. Toney		GEOLOGIST: L. Rought

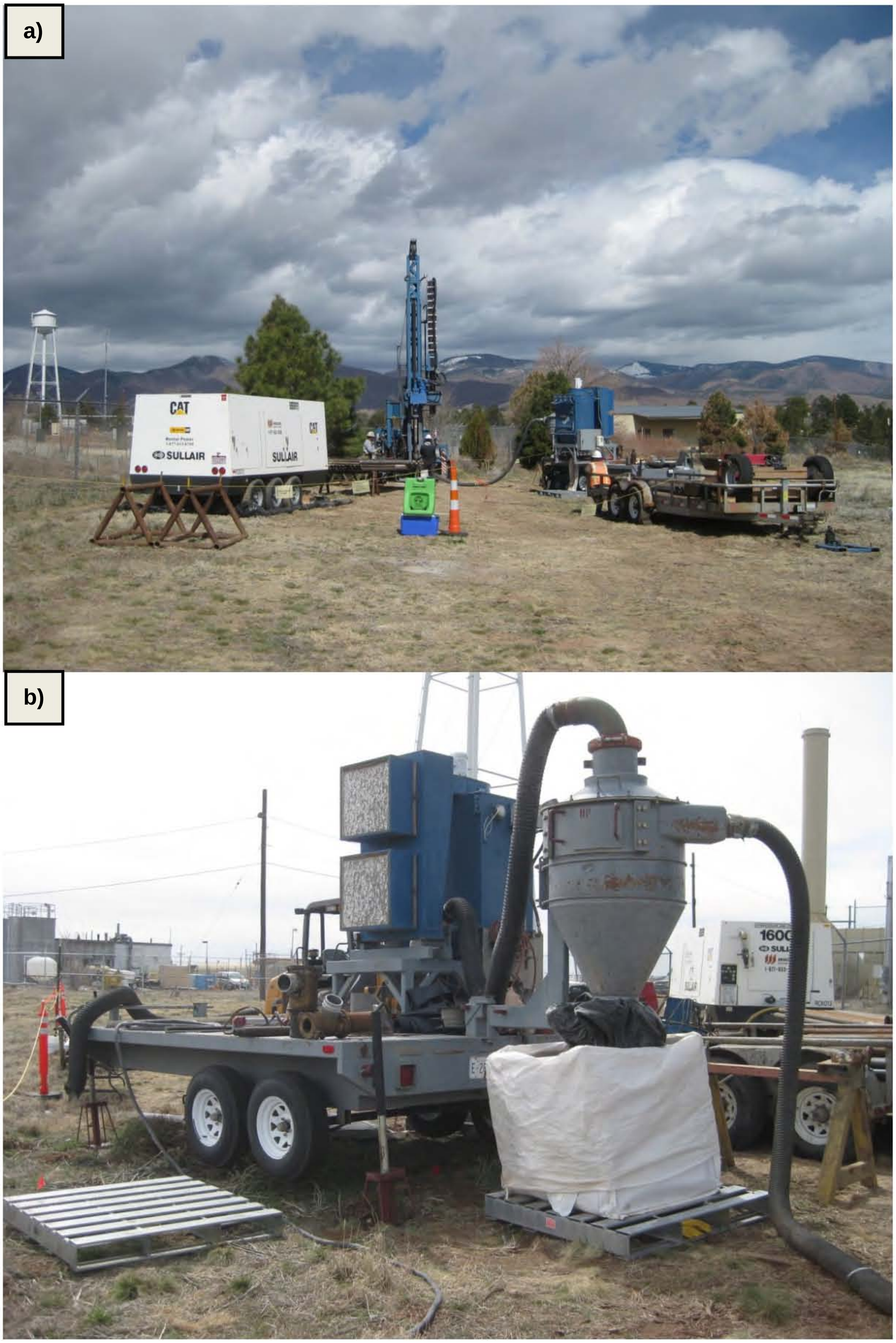
Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
650.0–655.0	4.6/5 NR		PID= 0.0 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Poorly welded tuff* *(650.0-655.0 ft)* Light brown (7.5YR 6/3); same as above; slightly damp.			
655.0–660.0	4/5 NR		PID= 0.0 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Poorly welded tuff* *(655.0-660.0 ft)* Light brown (7.5YR 6/3); 12-15% phenocrysts; pumice quartz bearing, relics of fibrous texture, maximum size 35 mm, slightly more pumice than above.			
660.0–665.0	4.5/5 NR		PID= 0.0 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Poorly welded tuff* *(660.0-665.0 ft)* Light gray (10YR 7/2); pumice white to light gray (minor yellowish to light brown), size to 40 mm; white sugary texture, 1 pumice greenish gray, soft, vesicular. Very small phenocrysts (5-8%), 5% very small rounded lithics.		Qbo	color change
665.0–670.0	4/5 NR		PID= 0.0 α/β=<MDA	OTOWI MEMBER, BANDELIER TUFF: *Poorly welded/nonwelded tuff* *(665.0-670.0 ft)* Pinkish gray (7.5YR 7/2); as above with trace pumice. At 668-670 ft very soft and slightly coarser due to increase in phenocryst content, color light brownish gray (10YR 6/2), slightly damp.			669 ft very soft, no circulation

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)	Page 27
DRILLING COMPANY: Precision Drilling	START DATE/TIME: 04/10/2009	FINISH DATE/TIME: 05/04/2009
DRILLING EQUIPMENT/METHOD: Delta Base Air Core		
SAMPLING EQUIPMENT/METHOD: 3" ID Core Barrel Sampler (5.0' length)		
GROUND ELEVATION: 7142.7' DRILLER: D. Starnes/D. Toney	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 695.1' GEOLOGIST: L. Rought

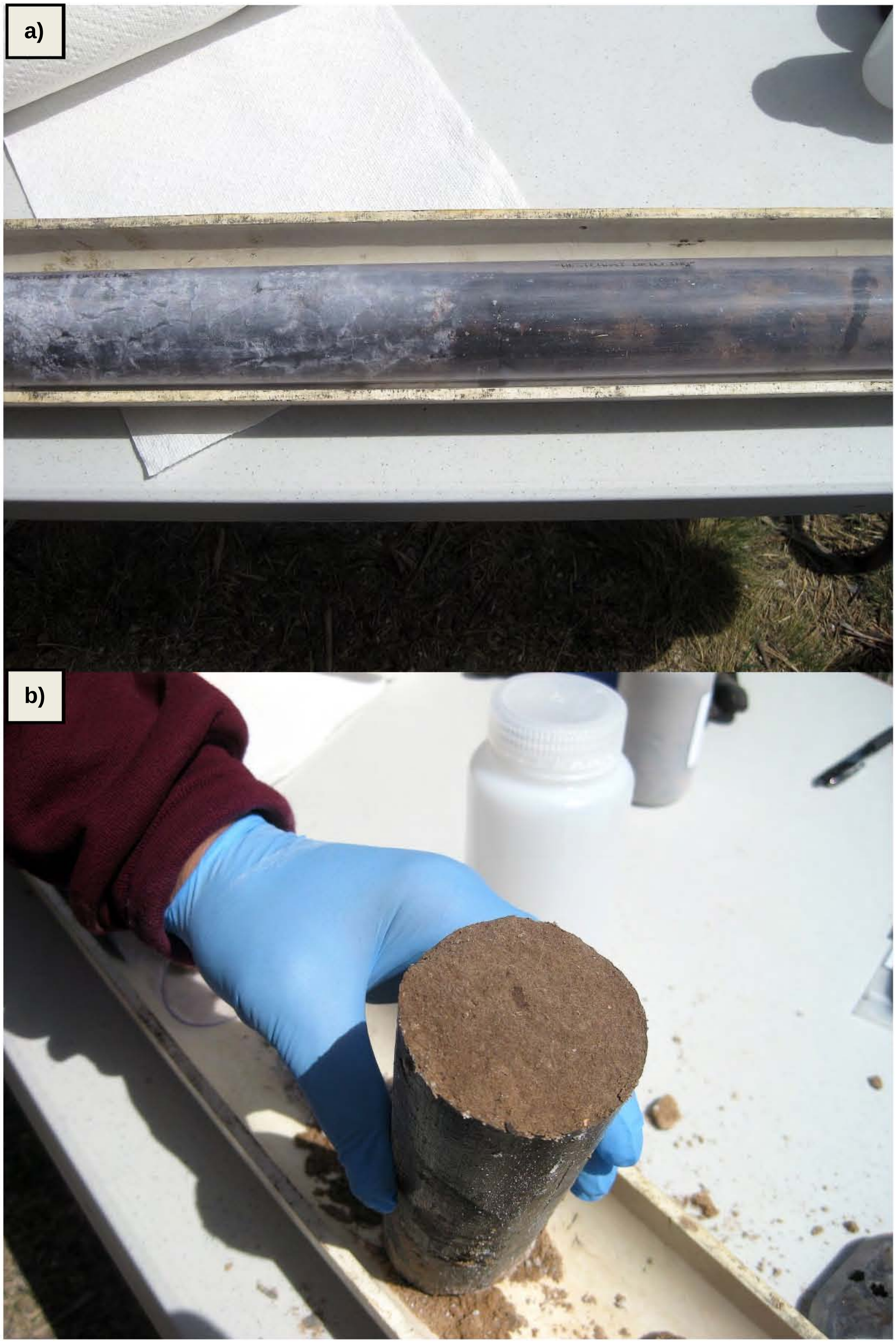
Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
670.0	4/5 NR	**MD21-09-4639** *(670.0 to 675.0' bgs)* ***Chemical and Geotechnical***	PID= 0.0 α/β=<MDA	GUAJE PUMICE BED: *Air-fall (nonwelded) tuff* *(670.0-675.0 ft)* Light gray (10YR 7/1); pumice-rich (lapilli), vitreous; 25-30% sand-sized phenocrysts (quartz, minor sanidine), 5% dark brown to black dacitic lithics (2-5 mm); slightly damp.			Qbo / Qbog contact: ~670' bgs.
675.0	3.7/5 NR	**MD21-09-4640** *(675.0 to 685.0' bgs)* ***Chemical and Geotechnical***	PID= 0.0 α/β=<MDA	GUAJE PUMICE BED: *Air-fall (nonwelded) tuff* *(675.0-680.0 ft)* White (10YR 8/1); pumice-rich; abundant (25-30%) sand-sized quartz (minor sanidine) phenocrysts in matrix; 3% dacitic lithics (< 5 mm) of dark brown to black color; slightly damp.			
680.0	NR			GUAJE PUMICE BED: *Air-fall (nonwelded) tuff* *(680.0-685.0 ft)* No core recovered		Qbog	
685.0	5/5		PID= 0.0 α/β=<MDA	GUAJE PUMICE BED: *Air-fall (nonwelded) tuff* *(685.0-690.0 ft)* Same as above.			
690.0							

BOREHOLE ID: 21-25262	Technical Area (TA): 21-016(a)-99 (MDA-T)		Page 28
DRILLING COMPANY: Precision Drilling	START DATE/TIME: 04/10/2009	FINISH DATE/TIME: 05/04/2009	
DRILLING EQUIPMENT/METHOD: Delta Base Air Core			
SAMPLING EQUIPMENT/METHOD: 3" ID Core Barrel Sampler (5.0' length)			
GROUND ELEVATION: 7142.7' DRILLER: D. Starnes/D. Toney	α/β DAILY BACKGROUND READINGS: see log	TOTAL DEPTH: 695.1' GEOLOGIST: L. Rought	

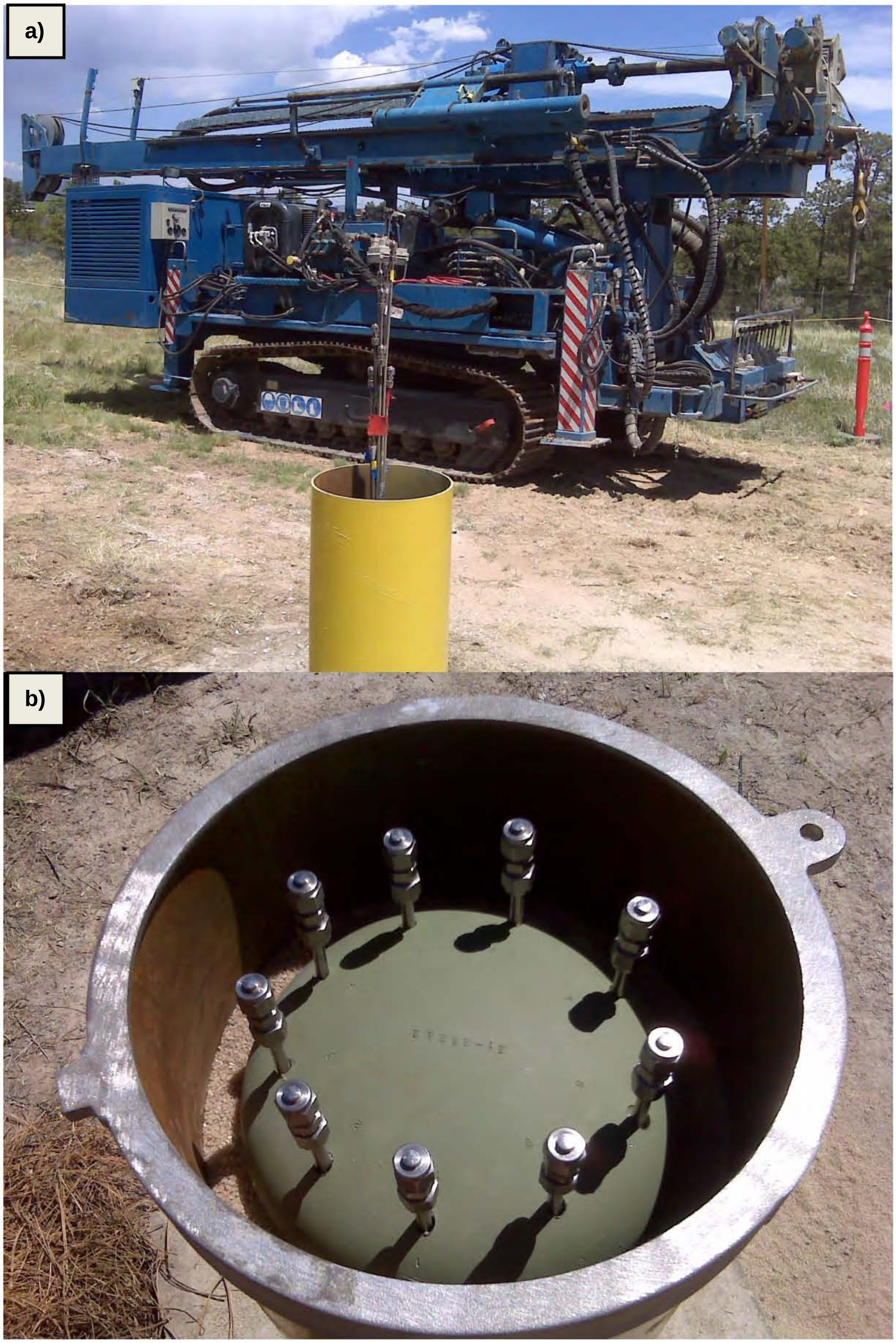
Depth (ft bgs)	Recovery (ft)	Field Analytical Sample: Sample ID/Type	Field Screening Results	LITHOLOGY - DESCRIPTION	Graphic Log	Lithologic Symbol	ADDITIONAL COMMENTS
690.0	$\frac{4.2}{4.2}$		PID= 0.0 α/β=<MDA	GUAJE PUMICE BED: *Air-fall (nonwelded) tuff* *(690.0-693.7 ft)* As above, sharp contact with Puye Formation at 693.7 ft.		Qbog	Sharp contact Qbog / Tpf contact: 693.7' bgs.
	NC	**MD21-09-8973** *(693.7 to 695.1' bgs)* ***Gen. Investigation***		PUYE FORMATION: *Silts and sandy clay* *(693.7-695.1 ft)* Reddish brown (5YR 5/3); consolidated silt with minor amounts of clay and fine sand (5-10%) and rare mm-size clasts; dry.		Tpf	TD = 695.1' bgs.
695.0							
700.0							
705.0							
710.0							



a) General site setup for drilling and sampling at BH 21-25262
b) Dust suppression system utilized during drilling of BH 21-25262



a) Sharp contact of the Guaje Pumice Bed (light gray) with Puye Formation (brown) at 693.7 ft bgs, BH 21-25262
b) Puye Formation core sample at ~695 ft bgs, BH 21-25262



a) Nine port vapor-monitoring well installed at BH 21-25262
b) Nine port vapor-monitoring well head completion for BH 21-25262

Appendix D

Analytical Reports and Results
(on CD included with this document)

Appendix E

Analytical Program

E-1.0 INTRODUCTION

This appendix discusses the analytical methods and data quality review for the 2009 solid media and pore-gas samples collected at Material Disposal Area (MDA) T, Consolidated Unit 21-016(a)-99, in Technical Area 21 (TA-21) at Los Alamos National Laboratory (LANL or the Laboratory).

Quality assurance (QA), quality control (QC), and data validation procedures were implemented in accordance with the “Quality Assurance Project Plan Requirements for Sampling and Analysis” (LANL 1996, 054609), and the Laboratory’s statement of work (SOW) for analytical laboratories (LANL 1995, 049738; LANL 2000, 071233). The results of the QA/QC procedures were used to estimate the accuracy, bias, and precision of the analytical measurements. Samples for QC include method blanks, matrix spikes (MSs), laboratory control samples (LCSs), internal standards, initial calibration verifications (ICVs) and continuing calibration verifications (CCVs), surrogates, and tracers.

The type and frequency of laboratory QC analyses are described in the SOW for analytical laboratories (LANL 1995, 049738; LANL 2000, 071233). Other QC factors, such as sample preservation and holding times, were also assessed in accordance with the requirements outlined in the current version of standard operating procedure (SOP) 5056, Sample Containers and Preservation.

The following SOPs were used for data validation:

- SOP-5161, Routine Validation of Volatile Organic Compound (VOC) Analytical Data
- SOP-5166, Routine Validation of Gamma Spectroscopy Data, Chemical Separation Alpha Spectrometry, Gas Proportional Counting, and Liquid Scintillation Analytical Data
- SOP-5167, Routine Validation of General Chemistry Analytical Data
- SOP-5191, Routine Validation of LC/MS/MS Perchlorate Analytical Data (SW-846 EPA Method 6850)

Routine data validation was performed for each data package (also referred to by request numbers), and analytical data were reviewed and evaluated, based on U.S. Environmental Protection Agency (EPA) National Functional Guidelines, where applicable (EPA 1994, 048639; EPA 1999, 066649). As a result of the data validation and assessment efforts, qualifiers are assigned to the analytical records as appropriate. The data qualifier definitions are provided in Appendix A.

Except for tritium pore-gas data, only analytical data obtained during the implementation of the Phase III investigation at MDA T are presented and reviewed in this appendix. Data quality reviews of volatile organic compound (VOC) analytical data obtained during the implementation of the 2007–2008 MDA T pore-gas monitoring activities were previously presented and discussed in the MDA T periodic monitoring report (LANL 2009, 105187). The 2007–2008 pore gas tritium data, however, are included in this appendix because a systematic low bias in previously reported tritium pore-gas measurements has been identified (Whicker et al. 2009, 106429). As a result, all tritium data have been corrected for this bias (Marczak 2009, 106500) and these corrected values are presented in this report. Details are discussed in section E-4.0.

E-2.0 ANALYTICAL DATA ORGANIZATION AND VINTAGE

The 2009 MDA T solid media analytical data were obtained from nine samples (eight characterization and one QA/QC) collected during the advancement of borehole (BH) 21-25262 to 695 ft bgs.

The 2009 MDA T VOC pore-gas analytical data were obtained from a total of 100 samples:

- 76 samples (57 characterization and 19 QA/QC) collected during four sampling events (February, April, June, and July) from vapor-monitoring well locations 21-25264, 21-603058, 21-603059
- 21 samples (18 characterization and 3 QA/QC) collected during two sampling events (June and July) from vapor-monitoring well location 21-25262
- 3 samples (1 characterization and 2 QA/QC) collected during the April 2009 advancement of BH 21-25262

The 2007–2009 MDA T tritium pore-gas analytical data are obtained from a total of 157 samples:

- 155 samples (133 characterization and 22 QA/QC) collected during eight sampling events from vapor-monitoring well locations 21-25264, 21-603058, 21-603059, and 21-25262 (two sampling events only)
- 2 samples (1 characterization and 1 QA/QC) collected during the advancement of BH 21-25262

Complete data packages and sample documentation for the 2009 solid media samples and the 2007–2009 pore-gas samples are provided in Appendix D.

E-3.0 INORGANIC CHEMICAL ANALYSIS METHODS

All nine MDA T solid media samples collected during the 2009 investigation were analyzed by one or more of the following inorganic chemical methods: anions via EPA Method 300.0 and perchlorate via EPA SW-846 Method 6850. No pore-gas samples were analyzed by inorganic chemical methods.

The analytical methods used for inorganic chemicals are listed in Table E-3.0-1. Table 4.1-1 summarizes all 2009 solid media samples collected and the analyses requested from the MDA T Phase III investigation. All inorganic chemical results are provided on CD in Appendix D.

E-3.1 Inorganic Chemical QA/QC Samples

To assess the accuracy and precision of inorganic chemical analyses, LCSs, preparation blanks (PBs), MS samples, laboratory duplicate samples, interference check samples (ICSs), and serial dilution samples were analyzed as part of the investigation. Each of these QA/QC sample types is defined in the analytical services SOW (LANL 1995, 049738; LANL 2000, 071233) and is described briefly in the sections below.

The LCS serves as a monitor of the overall performance of each step during the analysis, including sample digestion. Following Laboratory SOP guidance, analytical results were qualified according to EPA National Functional Guidelines (EPA 1994, 048639) if the individual LCS recovery indicated an unacceptable bias in the measurement of individual analytes. For inorganic chemicals in soil/tuff, LCS percent recoveries (%Rs) should fall into the control limits of 75%–125% (LANL 1995, 049738; LANL 2000, 071233).

Preparation blanks are used to measure bias and potential cross-contamination. All inorganic chemical results for the PB should be below the method detection limit (MDL).

The accuracy of inorganic chemical analyses is also assessed using MS samples. These samples are designed to provide information about the effect of the sample matrix on the sample preparation procedures and analytical technique. The MS acceptance criteria are 75%–125%, inclusive, for all spiked analytes (LANL 1995, 049738; LANL 2000, 071233).

Laboratory duplicate samples assess the precision of inorganic chemical analyses. All relative percent differences (RPDs) between the sample and laboratory duplicate should be ±35% for soil (LANL 1995, 049738; LANL 2000, 071233).

The ICSs assess the accuracy of the analytical laboratory's interelement and background correction factors used for inductively coupled plasma emission spectroscopy. The ICS %R should be within the acceptance range of 80%–120%. The QC acceptance limits are ±20%.

Serial dilution samples measure potential physical or chemical interferences and correspond to a sample dilution ratio of 1:5. The chemical concentration in the undiluted sample must be at least 50 times the MDL (100 times for inductively coupled plasma mass spectroscopy) for valid comparison. For sufficiently high concentrations, the RPD should be within 10%.

Details regarding the quality of the 2009 MDA T inorganic chemical analytical data are summarized below.

E-3.1.1 2009 MDA T Solid Media Data

A total of 30 inorganic chemical results (27 characterization and 3 field duplicate [FD]) are associated with the 2009 MDA T solid media samples.

No inorganic chemical data were rejected.

A single nitrate result was qualified as estimated (J) because the analytical laboratory qualified it as estimated, and requalification of the data via data validation did not occur because of QC requirements.

A single fluoride result was qualified as estimated (J) because it was identified in the method blank and was less than 5 times the concentration of the method blank, indicating that the reported detection is indistinguishable from contamination in the blank.

Three chloride results were qualified as estimated biased low (J-) because the associated MS %Rs were below the lower acceptance limit (LAL) but greater than 10%.

Two perchlorate results were qualified as estimated biased high (J+) because the associated MS/MS duplicate %Rs were greater than 125%.

Ten results (six perchlorate and four anion) were qualified as not detected (U or UJ) for one of the following reasons.

- The analytical laboratory qualified the result as a nondetection, and requalification of the data via data validation did not occur because of QC requirements.
- The associated MS %R was greater than the upper acceptance limit (UAL).
- The result was less than or equal to 5 times the concentration of the related analyte in the method blank, indicating that the reported detection is indistinguishable from contamination in the blank.

All inorganic chemical data collected from MDA T in 2009 were used to evaluate the nature and extent of contamination, as presented in section 6.

E-4.0 ORGANIC CHEMICAL ANALYSIS METHODS

All 9 MDA T solid media samples collected during the 2009 investigation and all 100 MDA T pore-gas samples collected in 2009 were submitted for analysis of VOCs as presented in Table E-3.0-1. Table 4.1-1 summarizes all 2009 solid media samples collected and the analyses requested from the MDA T Phase III investigation. A summary of all 2009 pore-gas samples collected at MDA T wells 21-603058, 21-603059, 21-25262, and 21-25264 and their respective analyses are presented in Tables 4.3-2–4.2-5. All VOC results are provided on CD in Appendix D.

E-4.1 Organic Chemical QA/QC Samples

The QC samples are designed to produce a qualitative measure of the reliability of a specific part of an analytical procedure. The methods for validating organic chemical results on the basis of the various QA/QC sample types are specified in the SOPs. Some of the historical analyses may have been performed before the current SOW was implemented (LANL 1995, 049738; LANL 2000, 071233). As a result, slightly different QA/QC procedures may have been followed. The validation of organic chemical data using QA/QC samples and other methods may have resulted in the rejection of the data or the assignment of various qualifiers to individual sample results.

Calibration verifications, LCSs, method blanks, surrogates, and internal standards were analyzed to assess the accuracy and precision of organic chemical analyses. Each of these QA/QC sample types is defined in the analytical services SOWs (LANL 1995, 049738; LANL 2000, 071233) and the applicable analytical methods, and summarized below.

Calibration verification is the establishment of a quantitative relationship between the response of the analytical instrument and the concentration of the target analyte. There are two aspects of calibration verification: initial and continuing. The initial calibration verifies the accuracy of the calibration curve as well as the individual calibration standards used to perform the calibration. The continuing calibration verifies that the initial calibration remains accurate and valid. The continuing calibration also serves to determine that analyte identification criteria, such as retention times and spectral matching, are being met.

The LCS is a sample of the same matrix spiked with the target analytes and serves to monitor overall performance. Following Laboratory SOP guidance, analytical results were qualified according to EPA National Functional Guidelines (EPA 1999, 066649) if the individual LCS recoveries were not within method-specific acceptance criteria.

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as those used in the environmental sample processing and is extracted and analyzed in the same manner as the corresponding environmental samples. Method blanks are used to assess the potential for sample contamination during extraction and analysis.

A surrogate compound (surrogate) is an organic chemical used in the analyses of organic target analytes. The surrogate is similar in composition and behavior to the target analytes but is not normally found in environmental samples. Surrogates are added to every blank, sample, and spike to evaluate the efficiency with which analytes are recovered during extraction and analysis. The recovery percentage of the surrogates must be within specified ranges, or the sample may be rejected or assigned a qualifier.

Internal standards are chemical compounds added to every blank, sample, and standard extract at a known concentration. Internal standards are used as the basis for quantitation of target analytes. The %R for internal standards should be within the range of 50%–200%.

Details regarding the quality of the organic chemical analytical data for MDA T are summarized, by media, in the following subsections.

E-4.1.1 2009 MDA T Solid Media VOC Data

A total of 558 VOC results (496 characterization and 62 FD) are associated with the 2009 MDA T solid media samples.

No VOC data were rejected.

A single acetone result was qualified as J because the ICV and/or CCV were recovered outside the method-specific limits.

557 VOC results were qualified as U or UJ for one of the following reasons.

- The analytical laboratory qualified the result as a nondetection, and requalification of the data via data validation did not occur because of QC requirements.
- The VOCs were analyzed with an ICV that exceeded the percent relative standard deviation (%RSD) criteria, and/or the associated multipoint calibration correlation coefficient is less than 0.995.
- The ICV and/or CCV were recovered outside the method-specific limits.

All organic chemical data collected from MDA T in 2009 were used to evaluate the nature and extent of contamination (section 6).

E-4.1.2 MDA T Pore-Gas VOC Data

A total of 5518 VOC results (4712 characterization and 806 FD) are associated with the 2009 MDA T pore-gas samples.

No VOC data were rejected.

Two VOC results (1,4-dichlorobenzene and cyclohexane) were qualified as J because the analytical laboratory qualified the result as estimated and requalification of the data via data validation did not occur because of QC requirements.

Two 1-butanol results were qualified as J either because (1) the ICV and/or continuing CCV were recovered outside the method-specific limits or (2) 1-butanol was analyzed with an ICV that exceeded the %RSD criteria and/or the associated multipoint calibration correlation coefficient is less than 0.995.

4,587 VOC results were qualified as U or UJ for one of the following reasons.

- The analytical laboratory qualified the result as a nondetection, and requalification of the data via data validation did not occur because of QC requirements.
- The LCS %R was less than the LAL but greater than 10%.
- The result was less than or equal to 5 times the concentration of the related analyte in the method blank, indicating that the reported detection is indistinguishable from contamination in the blank.
- The VOCs were analyzed with an ICV that exceeded the %RSD criteria and/or the associated multipoint calibration correlation coefficient is less than 0.995.
- The ICV and/or CCV were recovered outside the method-specific limits.

All VOC pore-gas data collected in 2009 at MDA T were used to evaluate, in conjunction with the 2007–2008 VOC pore-gas data, VOC trends over the monitoring period as well as assess whether the VOCs present in the subsurface beneath MDA T could potentially contaminate the regional aquifer (section 6).

E-5.0 RADIONUCLIDE ANALYSIS METHODS

Both the 2009 solid media and the 2007–2009 pore-gas samples collected at MDA T were analyzed for tritium. Nine solid media samples (eight characterization and one and 21 FD) collected in 2007–2009 were submitted for tritium analysis via EPA Method 906.0.

Table 4.1-1 summarizes all 2009 solid media samples collected and the analyses requested from the MDA T Phase III investigation. A summary of all 2007–2009 pore-gas samples collected at MDA T wells 21-603058, 21-603059, 21-25262, and 21-25264 and their respective analyses are presented in Table 4.3-2. All tritium results are provided on CD in Appendix D.

A systematic low bias in previously reported tritium pore-gas measurements was identified (Whicker et al. 2009, 106429) during a technical review of SOP-5074, Sampling for Sub-Atmospheric Air. The bias results from the properties of silica gel, the sample medium used to collect water vapor from pore-gas samples. Silica gel contains nontritiated water vapor bound to the silica–gel molecules that cannot be completely removed by drying before its use in sampling without degrading the silica–gel properties. Thus, when water vapor is collected from the pore gas, the tritiated sample water vapor is mixed/diluted into the clean water bound to the silica–gel molecules. The amount of dilution is proportional to the amount of silica–gel bound water in the original sample and the amount of moisture collected in the sample. Thus, a sample-by-sample process to correct for this dilution is applied to the tritium result from the analytical laboratory. In general, higher correction factors are applied to samples with lower moisture contents because the tritiated moisture in the sample is mixed into a greater volume of nontritiated bound water. The corrected tritium pore-gas concentrations are reported in Tables 6.1-8–6.1-11 and in Appendix D.

E-5.1 Radionuclide QA/QC Samples

The minimum detectable concentrations (MDCs) for tritium in PBs, method blanks, laboratory duplicates, tracer/carrier recovery, LCSs, and MS samples were analyzed as part of the MDA T pore-gas evaluation to assess the accuracy and precision of the radionuclide analysis. The qualifiers and sample types for radionuclides are defined in the analytical services SOW (LANL 1995, 049738; LANL 2000, 071233), described in the applicable validation SOPs, and discussed briefly below. The validation of radionuclide data using QA/QC samples and other methods may have resulted in the rejection of data or the assignment of various qualifiers to individual sample results.

The MDC for each radionuclide is defined as the minimum activity concentration that the analytical laboratory equipment can detect in 95% of the analyzed samples and is used to assess analytical performance.

Uncertainty and minimum detectable activity concentration results for tritium have been modified in the same manner to the analytical results, to account for the bound water found in silica gel used for sample collection.

The PBs and method blanks are used to measure bias and assess potential cross-contamination of samples during preparation and analysis. Blank results should be less than the MDC for each radionuclide.

Laboratory duplicates are used to assess or demonstrate acceptable laboratory method precision at the time of analysis as well as to assess the long-term precision of an analytical method on various matrices. Duplicate results are used to calculate a duplicate error ratio (DER). The DER is based on 1 standard deviation of the sample and the duplicate sample and should be less than 4.

The LCS serves as a monitor of the overall performance of each step during the analysis, and the acceptance criteria for LCSs are method-specific. For radionuclide methods, LCS %Rs should fall into the control limits of 80%–120%.

The accuracy of radionuclide analyses is also assessed using MS samples. These samples are designed to provide information about the effect of the sample matrix on the sample preparation procedures and analytical technique. The MS %Rs should be within the acceptance range of 75%–125%. However, if the sample result is more than 4 times the amount of the spike added, these acceptance criteria do not apply.

Details regarding the quality of the 2007–2009 MDA T tritium data are summarized by media below.

E-5.1.1 MDA T Solid Media Tritium Data

A total of nine tritium results (eight characterization and one FD) are associated with the 2009 MDA T solid media samples.

No tritium data were rejected.

Five tritium results were qualified as U because the associated sample concentration was less than or equal to the MDC.

No other data quality issues were identified.

All radionuclide data collected from MDA T in 2009 were used to evaluate the nature and extent of contamination (section 6).

E-5.1.2 MDA T Pore-Gas Tritium Data

A total of 155 tritium results (134 characterization and 21 FD) are associated with the 2007–2009 MDA T pore-gas samples.

No tritium data were rejected.

A total of 35 tritium results were qualified as U either because (1) the associated sample concentration was less than or equal to the MDC or (2) the associated sample concentration was less than 3 times 1 sigma of total propagated uncertainty.

No other data quality issues were identified.

All tritium data collected in 2007–2009 from MDA T pore gas were used to evaluate tritium trends over the monitoring period (section 6). Validated analytical results have been corrected for tritium under reporting.

E-6.0 REFERENCES

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the New Mexico Environment Department Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

EPA (U.S. Environmental Protection Agency), February 1994. "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," EPA-540/R-94/013, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1994, 048639)

EPA (U.S. Environmental Protection Agency), October 1999. "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review," EPA540/R-99/008, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1999, 066649)

LANL (Los Alamos National Laboratory), July 1995. "Statement of Work (Formerly Called "Requirements Document") - Analytical Support, (RFP number 9-XS1-Q4257), (Revision 2 - July, 1995)," Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 1995, 049738)

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LANL (Los Alamos National Laboratory), February 2009. "Periodic Monitoring Report for Vapor-Sampling Activities at Material Disposal Area T, Consolidated Unit 21-016(a)-99, Technical Area 21, Fiscal Year 2008," Los Alamos National Laboratory document LA-UR-09-0791, Los Alamos, New Mexico. (LANL 2009, 105187)

Marczak, S., July 2009. "Technical Implementation of the Correction Factor Calculation for Tritium in Pore-Gas Data," Los Alamos National Laboratory document LA-UR-09-4629, Los Alamos, New Mexico. (Marczak 2009, 106500)

Whicker, J.J., J.M. Dewart, S.P. Allen, W.F. Eisele, M.C. McNaughton, and A.A. Green, June 17, 2009. "Corrections for Measurement of Tritium in Subterranean Vapor Using Silica Gel," Los Alamos National Laboratory document LA-UR-09-03837, Los Alamos, New Mexico. (Whicker et al. 2009, 106429)

Table E-3.0-1
Analytical Methods for 2009 MDA T Samples

Analytical Method	Media	Analytical Description	Analytical Suite
EPA 300.0	Solid Media	Ion chromatography	Anions
EPA SW-846:6850	Solid Media	Liquid chromatography–mass spectrometry/mass spectrometry	Perchlorate
EPA SW-846: 8260B	Solid Media	Gas Chromatography/Mass Spectrometry (GC/MS)	VOC
EPA TO-15	Pore Gas	GC/MS	
EPA 906	Solid Media, Pore Gas	Liquid Scintillation	Tritium

Appendix F

Waste Management

F-1.0 INTRODUCTION

This appendix contains the waste management and disposal records for waste streams generated during the 2009 Phase III investigation of Material Disposal Area (MDA) T, also known as Consolidated Unit 21-016(a)-99, at Technical Area 21 (TA-21).

All wastes generated were characterized, stored, managed, and disposed of per the approved site-specific waste characterization strategy form (WCSF) and in accordance with the following standard operating procedures (SOP) and quality procedures (QP):

- SOP-5022, Characterization and Management of Environmental Restoration Project Waste
- SOP-011, Land Application of Drill Cuttings

These SOPs and QP incorporate the requirements of applicable U.S. Environmental Protection Agency and New Mexico Environment Department (NMED) regulations, U.S. Department of Energy orders, and Los Alamos National Laboratory implementation requirements.

WCSF "Continuation of Characterization of MDA T, SWMU 21-016(a)-99 and MDA A, SWMU 21-014, TA-21," was prepared and amended to address characterization approaches, on-site waste management, and final disposition options. The WCSF and its amendment are provided as Appendix F-1.

F-2.0 SUMMARY

Investigation-derived waste (IDW) generated during the 2009 investigation consisted of (1) drill cuttings; (2) contaminated personal protective equipment (PPE); and (3) other contact wastes, such as plastic sheeting, used sampling supplies, and other materials that came in contact with potential contaminants, as outlined in Table F-2.0-1. No IDW was generated during execution of vapor-monitoring activities at MDA T.

The drill cuttings were stored in 1 yd^3 bags along with the 55-gal. drum of PPE and other contact waste. Drill cuttings were directly sampled within 10 d of generation. A sample was collected from each of the waste bags, for a total of six samples (five characterization, one field duplicate) and submitted for the analysis of the following: volatile organic compounds, semivolatile organic compounds, pesticides, herbicides, polychlorinated biphenyls, metals (via total and toxicity characteristic leaching procedure), cyanide, perchlorate, nitrates, and radioactive constituents (e.g., gross alpha/beta, tritium, isotopic plutonium, isotopic uranium, strontium-90, and americium-241).

Analytical results obtained from the waste samples confirmed that the cuttings met the criteria for land application. Cuttings were land-applied per the requirements of the NMED-approved "Notice of Intent Decision Tree for Land Application of IDW Solids from Construction of Wells and Boreholes" (August 10, 2009). The drill cuttings data were used to characterize the contact waste. Based on the data, the contact waste was classified as low-level mixed waste; it is currently awaiting processing through the Green is Clean program.

Table F-2.0-1
Summary of IDW generated during the 2009 investigation Activities at MDA T

Barcode Identification Number	Waste Storage Container	Waste Type	Approximate Volumes (yd^3)	Waste Deposal Status
10094746	1 yd^3 Wrangler Bag	Drill cuttings from BH 21-25262	1	Land-applied
10094745	1 yd^3 Wrangler Bag		1	Land-applied
10094712	1 yd^3 Wrangler Bag		1	Land-applied
10094748	1 yd^3 Wrangler Bag		1	Land applied
10094713	1 yd^3 Wrangler Bag		1	Land-applied
10094649	55-gal. drum	Contact waste (plastic sheeting, PPE, and sample equipment waste)	0.0025	Pending disposal off-site
Total volume of waste produced:			**5.0025 yd^3**	

Attachment F-1

Waste Characterization Strategy Form

Waste Characterization Strategy Form

Project Title	**Continuation of Characterization of MDA T, SWMU 21-016(a)-99 and MDA A, SWMU 21-014, TA-21**
Solid Waste Management Unit or Area of Concern #	**Consolidated Unit 21-016(a)-99 (MDA T) and SWMU 21-014 (MDA A)**
Activity Type	**Drilling, sampling, installation of vapor-monitoring wells, borehole abandonment, and pore gas sampling**
Project Leader	**Bruce Wedgeworth**
Field Waste Management Coordinator	**Selene Martinez/Ron De Sotel**
Completed by	**Pattie Baucom**
Date	**January 16, 2009**

Description of Activity: This work is being conducted to finalize investigations at MDA A and MDA T located at Technical Area (TA) 21 (Figure 1). The work that remains to be completed at MDA A and MDA T includes mobilization/demobilization, additional drilling and subsurface sampling (at MDA-T only), installation of one vapor monitoring well at MDA A and up to two vapor monitoring wells at MDA T, and four quarters of pore-gas monitoring (or monthly monitoring) at each MDA. This work is being conducted for the Waste and Environmental Services (WES), Environmental Programs Directorate under the TA-21 Project Close-out Project. MDA T work will be implemented through the New Mexico Environment Department (NMED) Approval with Modifications letter dated March 28, 2008; MDA A work will be implemented through the NMED Correction to the Approval with Modification letter dated February 19, 2008, and the Statement of Work (SOW) for Continuation of Characterization for MDA-T and MDA-A dated November, 5 2008. This Waste Characterization Strategy Form (WCSF) is being written to cover project generated waste at both MDA T and MDA A.

The inventory of hazardous constituents present at MDA T and MDA A within TA-21 includes inorganic chemicals, organic chemicals, and radionuclides. MDA T and MDA A are potentially contaminated with both hazardous and radioactive components.

MDA T is a Hazard Category 2 nuclear facility that covers 3.5 acres and consists of 18 SWMUs and 13 AOCs associated with treatment and/or disposal of radioactive and potentially hazardous industrial wastewater from former TA-21 processing operations.

MDA A is a Hazard Category 2 nuclear facility comprising a 1.25-acre, fenced, and radiologically controlled area situated on the eastern end of DP Mesa.

Both MDA T and MDA A have been designated by the Laboratory as Nuclear Environmental Sites (NES) because of the potential inventory of nuclear materials. The borehole locations at MDA T are outside of the NES-designated area; however, there are locations at MDA A within the NES boundary.

The waste-generating activities addressed in this WCSF consist of drilling, sampling, borehole abandonment, and vapor monitoring well installation at MDAs T and A at TA-21. At MDA T one borehole will be drilled to 700 ft bgs and a vapor-monitoring well with multiple sampling ports will be installed in the boring. Additional vapor-monitoring wells may be installed in pre-existing open boreholes after deepening. Borings (either new or re-occupied boreholes) will be drilled using a hollow-stem auger rig (HSA) to refusal or to remove any slough that may have fallen in the open hole and will be completed to TD using an air coring drill rig, as necessary. The 700-ft boring will be continuously cored and core samples will be collected at the location where each monitoring port will be installed, every 20 ft or 50 ft, for pore gas, chemical, and geological analysis as outline in the SOW.

After all drilling and sampling is complete, the 700-ft borehole will be equipped with 9 sampling ports for collecting moisture vapor for tritium analysis. The sample tubing will consist of ¼ in-dia stainless steel tubing connected with Swagelok fittings. The 5-ft-thick sampling intervals will be filled with 10/20 silica sand and betonies chips will be tremied into the borehole and hydrated to isolate sampling intervals. If additional vapor-monitoring wells are installed they will be installed in a similar manner.

At MDA-A, up to 12 boreholes will be topped off (abandoned) with cement, bentonite chips or bentonite grout, as necessary and as specified in the SOW. And one vapor monitoring well will be installed in an existing boring. The existing boring will be re-occupied by a HSA drill rig to remove slough that may have caved into the open hole. A vapor-monitoring well will be installed as described at MDA T (above).

The following waste streams are anticipated for MDA T and MDA A:

- Waste Stream #1-Contact IDW (includes PPE)
- Waste Stream #2-Borehole Cuttings and Core Material
- Waste Stream #3-Municipal Solid Waste (MSW)
- Waste Stream #4-New Mexico Special Waste (NMSW)
- Waste Stream #5-Decontamination Fluids

Relevant Site History and Description:

MDA T has a complex process history and was one of the first disposal areas to be used at the Laboratory. The MDA T site, designated as Consolidated Unit 21-016(a)-99, is located on DP Mesa within TA 21. This area is situated along the northern boundary of the Los Alamos National Laboratory (LANL), and just east-southeast of the Los Alamos town site. MDA T comprises Solid Waste Management Units (SWMUs) 21-007; 21-010 (a-h); 21-011 (a, c, d, e, f, g, i, j); 21-016 (a, b, c); and Areas of Concern (AOCs) C-21-001; 21-011(h); C-21-028 (a); C-21-009; and C-21-012. The primary features at MDA T are four (4) inactive absorption beds; sixty-four (64) disposal shafts; the subsurface retrievable waste storage area (RWSA) which no longer contains waste; the site of former liquid waste treatment facility Building 035; and the current liquid waste treatment facility at Building 257. These features are discussed in more detail below.

Absorption Beds
Construction of the four absorption beds for disposal of DP West liquid wastes was completed in 1945. Each bed measures approximately 120 ft long by 20 ft wide by 4 ft deep. Untreated liquid radioactive waste from uranium and plutonium processing laboratories was released to the absorption beds from 1945 to 1952. When the volume of discharges began to exceed the holding capacity of the absorption beds a liquid waste treatment plant was constructed.

Building 035 Liquid Waste Treatment
Building 035 housed the first industrial liquid waste treatment facility that began operating in 1952. Building 035 was a chemical precipitation waste treatment plant designed to treat about 50 gallons per minute (gpm). The method involved adding ferric sulfate and lime to the incoming waste stream, forming a precipitate of ferric hydroxide that settled to the bottom carrying the plutonium with it (Shipman 1958, 04700). The liquid derived from de-watering the plutonium-bearing sludge was stored in tanks for several hours or days for control analysis then discharged to a nearby canyon (Abrahams 1962, 08147). This outfall was located in DP Canyon at SWMU 21-011(k).

In 1959, americium waste treatment was constructed to stabilize americium waste in cement for transport to Area G. By 1964, the condition of Building 035 had deteriorated and it was decommissioned and removed after the new treatment facility for DP Site liquid wastes was constructed at Building 257.

Building 257 Liquid Waste Treatment
Operations at Building 257 began in 1967. The basis of liquid waste treatment at Building 257 was co-precipitation of plutonium with ferric sulfate. The wastewater flowed to a flocculator then on to a settling

tank; settled effluent was pumped through a pressure filter and then sampled to verify treatment. From there, the effluent was received into two final holding tanks before being released to the DP Canyon outfall.

Building 257 also treated a variety of other wastes by "batch" process. The most demanding of these was a high solids-content, highly acidic solution that averaged approximately 1 mg/l of americium-241 and 1 mg/l of plutonium-239 (Christenson and Emility 1970, 08428). The waste was neutralized with a 50% sodium hydroxide (NaOH) solution. Post neutralization, the solids concentration was about 30%, most of which was sodium nitrate. Initially, this waste was pumped into steel drums, mixed with cement and other additives in a drum tumbler, and then shipped to TA-54. The drum tumbler was replaced by a pug mill continuous cement fixation process in 1968. The pug mill circuit was used to solidify sludge from the process wastewater treatment system as well as the neutralized americium waste and other small-volume streams. The combined sludges were staged in a sludge storage tank prior to being mixed with cement in the pug mill. From the pug mill mixer, the treated product was pumped through a buried pipeline to the disposal shafts. Later on this waste stream was put into corrugated metal pipes (CMPs) for placement in the RWSA.

Disposal Shafts
The Shaft Disposal Area at MDA T consists of approximately 64 shafts for the disposal of radioactive, cement-treated mixtures. These disposal shafts were drilled into the Bandelier Tuff located mainly between Absorption Beds 2 and 4. The shafts are approximately 8 ft in diameter and range in depth from 15 to 65 ft. The shafts were lined with heated roofing asphalt prior to filling with the cement wastes.

Retrievable Waste Storage Area (RWSA)
The RWSA was excavated in 1974 to provide a method for temporarily storing cement-treated transuranic wastes in CMPs. This area was approximately 120 ft long, 24 ft wide, and 19 ft deep. The RWSA held a total of 227 CMPs, which were subsequently removed during 1984 and 1986. The RWSA was backfilled with excavation spoils following removal of the CMPs.

COPCs Identified at MDA T:

Previous investigations identified inorganic, organic, and radionuclides as COPCs at Consolidated Unit 21-016(a)-99. The inorganic COPCs identified in soil, rock, or Qal for the Consolidated Unit 21-016(a)-99 and the DP Canyon slope include aluminum, arsenic, antimony, barium, beryllium, cadmium, chromium, cobalt, copper, fluoride, lead, lithium, magnesium, manganese, mercury, nickel, nitrate, perchlorate, selenium, silver, strontium, thallium, vanadium, and zinc.

The organic COPCs identified in soil, rock, or Qal for the Consolidated Unit 21-016(a)-99 and the DP Canyon slope include acenaphthene, acenaphthylene, acetone, anthracene, benzene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, benzoic acid, bis(2-ethylhexyl)phthalate, bromophenyl-phenylether[4-], butanone[2-], butylbenzylphthalate, carbon disulfide, chloroform, chloronaphthalene[2-], chrysene, dibromo3-chloropropane[1,2-]; dichlorobenzene[1,2-]; dichlorobenzene[1,3-]; di-n-butylphthalate, fluoranthene, fluorene, heptachlorodibenzodioxin[1,2,3,4,6,7,8-]; heptachlorodibenzofuran[1,2,3,4,6,7,8-]; hexachlorodibenzodioxin[1,2,3,4,7,8-]; hexachlorodibenzodioxin[1,2,3,6,7,8-]; hexachlorodibenzodioxin[1,2,3,7,8,9-]; hexachlorodibenzofuran[1,2,3,4,7,8-]; hexachlorodibenzofuran[1,2,3,6,7,8-]; hexachlorodibenzofuran[2,3,4,6,7,8-]; hexanone[2-], isopropyltoluene[4-], indeno(1,2,3-cd)pyrene; methyl-2-pentanone[4-], methylene chloride, methylnaphthalene[2-], naphthalene, octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]; octachlorodibenzofuran[1,2,3,4,6,7,8,9-]; pentachlorodibenzofuran[2,3,4,7,8-]; pentachlorodibenzofuran[1,2,3,7,8-]; phenanthrene, pyrene, tetrachloroethene, toluene, trichloroethene, trichlorofluoromethane, and xylene[1,3-]+xylene[1,4-].

The radionuclide COPCs identified in soil, rock, or Qal at Consolidated Unit 21-016(a)-99 include americium-241, cesium-137, cobalt-60, europium-152, plutonium-238, plutonium-239, strontium-90, tritium, uranium-234, uranium-235, and uranium-238.

MDA A (SWMU 21-014) is a 1.25-acre inactive disposal site located adjacent to MDA "T" near the center of TA-21. The site was used intermittently from 1945 to 1949 and 1969 to 1977 for disposal of radioactively contaminated solid waste, debris from decommissioning and decontamination (D&D) activities and radioactive liquids. MDA A consists of two buried tanks known as the "General's Tanks" (50,000 gallons each), two rectangular pits (18 feet wide by 12.5 feet long by 12.5 feet deep), one large central pit (approximately 172 feet long by 134 feet wide by 22 feet deep), and a drum storage area. Details regarding the tanks, pits, and drum storage area associated with MDA A is presented below.

Tanks

The "General's Tanks" are located at the western end of MDA A. They were placed 20 feet apart in pits 12 feet deep, 15 feet wide and 86 feet long on 4 concrete piers. Beginning in 1945, plutonium processing waste solutions was stored in the tanks. Between 1975 and 1983 the liquid phase was removed from the tanks and transferred to the TA-21 wastewater treatment facility. An unknown volume of sludge remains in the bottom of each tank. The area between the tanks and the remainder of the pit were filled with packed earth. A concrete slab 8 inches thick, 56 feet wide and 69 feet long was poured 1.5 feet above the tanks and approximately 5 feet of fill was placed above the tanks covering the slab. Two vertical shafts were installed to clarify rinse water generated by cleaning cement past from a transfer hose between the pug mill and the General's Tanks. The General's Tanks were never filled with cement and the shafts were never used. The vertical shafts were constructed in 1975 and filled with soil in 1977.

There have been various estimates of the radionuclide inventory contained in the General's Tanks. Based on the processes used during operation of the plutonium facility and samples obtained from 1947 Laboratory notebooks of chemical experiments conducted on the tanks contents, chemical content of the sludge indicates the presence of Pu, Am, $Ca(NO_3)_2$, $Mg(NO_3)_2$,I_2, H_2O_2, KNO_3, Al,Fe, Cr, Ni, Mg, and lanthanum for the one tank and Pu, Am, NO_3^-, NH_4^+, Mg, and Ca for the other tank. Other test results indicate the presence of Na^+, Cl^-, and K in both tanks. No samples have been collected or tests performed on the wastes using RCRA accepted analytical methods.

Pits

In 1945, the two rectangular pits were excavated in the eastern portion of MDA A and received lab equipment, building construction material, paper, rubber gloves, filters from air cleaning systems and radioactively contaminated chemicals. Contaminants of concern include plutonium, polonium, uranium, americium, curium, radium/lanthanum and actinium. The estimated quantity of waste in the pits is 4000 cubic yards.

In 1969, a large pit was excavated in the center of MDA A to receive and store debris from demolition work conducted at TA-21 from 1969 to 1974. The pit received plutonium-contaminated building debris from the demolition of building 21-012. Waste from building 21-012 included items such as doors, lumber, pipes, building materials, roofing materials, electrical boxes, wire, metals, concrete, brick, contaminated soil, and large metal items such as steel columns. Radiologically contaminated waste placed into the central disposal pit contained plutonium-239/240, plutonium-238, uranium-235, depleted uranium, and other unspecified radionuclides. The pit was decommissioned in May 1978 and a soil cover (crushed tuff) was placed over the pit.

Drum Storage

A former surface drum storage area located on the east end of MDA A was used to store several 55-gallon drums of sodium hydroxide solution and stable iodine and that reportedly is contaminated with plutonium and possible uranium. Corrosion of the drums resulted in releases to surface soils. The containers were removed in 1960 and the storage area was paved to immobilize contaminants released to surface soils. The drum storage area was used from the late 1940s to 1960, MDA A was decommissioned in May 1978 and a crushed tuff cover was placed over the entire site. In 1985, cover stabilization activities implemented at the site involved removal of surface contamination, and placement of additional cover material, followed by re-contouring and reseeding.

COPCs Identified at MDA A:

Based on chemicals encountered in the investigation of the site (LANL 2006, 095046), it has been concluded that chemicals of potential concern (COPCs) in the soil at MDA A include aluminum, iodine, arsenic, barium, beryllium, cyanide, iodide, nitrate, perchlorate, selenium cadmium, chromium, copper, iron, manganese, nickel and vanadium, acenaphthene, acetone, anthracene, Aroclor-1254, Aroclor-1260, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, benzoic acid, bis(2-ethylexyl)phthalate, chrysene, dichlorobenzene[1.4-], fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, isopropyltoluene[4-], methylene chloride, phenanthrene, pyrene, toluene, numerous dioxins and furans, americium-241, cesium-137, plutonium-238, plutonium-239, strontium-92, uranium-235, and tritium.

CHARACTERIZATION STRATEGY

All wastes will be managed in accordance with EP-ERSS-SOP-5022, Characterization and Management of Environmental Restoration Project Waste, and every effort shall be made to recycle/reuse any appropriate waste stream. Returned samples and associated PPE may be included with a waste stream at the time of disposal if appropriate. An amendment to this strategy form shall be prepared and submitted for review and approval if any of the waste streams change in description or characterization approach. Also, unanticipated waste streams generated as a result of this activity shall be subject to inclusion in an amendment to this strategy upon discovery or generation of the waste. The generation of no path forward wastes must be approved by DOE prior to generation of the waste.

If analyses indicate the presence of listed constituents that are not identified from historical processes, a due diligence may be performed to support the position that the constituents are not from a known process, spill or disposal event and therefore the waste will not carry the waste code. If a listed constituent is identified and is from a known process but the levels are below screening levels and LDRs, a No-Longer-Contained-In request may be made to NMED in order to drop the listed code from the waste stream. A copy of either the ENV-RCRA approved due diligence or the NMED no-longer-contained-in approval must accompany all waste profiles prepared for the subject waste(s).

Waste #1: Contact IDW - This waste stream is comprised of PPE and other solid waste generated during the course of investigation activities which comes into contact with contaminated media. This includes but is not limited too; plastic sheeting (e.g., tarps and liners), gloves, coveralls, booties, paper towels, plastic and glass sample bottles, and disposable sampling supplies (filters, tubing, plastic bags). It is estimated that approximately 3 cubic yards of contact IDW will be generated during this investigation.

Anticipated Regulatory Status: The possible classifications of this solid waste stream and the anticipated regulatory status include: non-hazardous, non-radioactive waste, low-level radioactive waste, hazardous waste, and mixed low-level waste (MLLW).

Characterization Approach: Contact IDW will be characterized using Acceptable Knowledge (AK) based on the characterization of Waste #(s) 2 and #4 (if generated). Characterization of this waste stream will be performed through acceptable knowledge of the waste materials, the methods of generation, and the analytical results from the sampling of the environmental media with which the materials were in contact.

Storage and Disposal Method: This solid waste will be stored in drums or waste wrangler bags, as appropriate. This waste will be managed as hazardous waste pending analysis and stored in a <90 Day Hazardous Waste Accumulation Area until a hazardous waste determination can be made. If this waste is characterized other than hazardous, it will be relabeled, managed and disposed of in the appropriate manner for its classification. If this waste stream is characterized as hazardous or mixed low-level radioactive, it will be managed as such and disposed of at an authorized off site facility.

Waste # 2: Borehole Cuttings (IDW) - Soil and rock cuttings from boreholes. Cuttings may or may not contain residue of drilling additives (drilling mud or foam) used to promote borehole integrity. It is estimated that approximately 10 to 20 cubic yards of borehole cuttings will be generated during this investigation depending on depth of borings.

Anticipated Regulatory Status: The possible classifications of this solid waste stream and the anticipated regulatory status include: non-hazardous, non-radioactive waste, low-level radioactive waste, hazardous waste, and mixed low-level waste (MLLW).

Characterization Approach: Waste characterization will be based upon the analytical results obtained from the direct sampling of containerized waste. The maximum detected concentrations of radionuclides will be compared with background values. If maximum concentrations exceed background/fallout values, the waste cuttings will be designated as low-level radioactive waste (LLW). Total concentrations of toxicity characteristic leaching procedure (TCLP) constituents will be compared with 20 times the TCLP regulatory level. If total concentrations are less than 20 times the TCLP regulatory level, the waste cuttings will be designated nonhazardous by characteristic. If total concentrations exceed 20 times the TCLP regulatory level, the waste cuttings will be sampled and analyzed using the TCLP to determine if it is hazardous by characteristic. If potential EPA-listed hazardous waste constituents are detected, the Laboratory will conduct a review of historical records and data to determine whether the source of each constituent was a listed hazardous waste at its point of generation. Samples analyses are provided in the characterization table (Table 1) presented below.

Storage and Disposal Method: This solid waste will be containerized in drums, waste wrangler bags, or roll-off containers, as appropriate, at or near the point of generation as appropriate and to minimize surface disturbance. Cuttings will be managed as hazardous waste pending analysis and stored <90 Day Hazardous Waste Accumulation Area until a hazardous waste determination can be made unless previous analyses of this waste support management in a manner other than hazardous. If this waste is characterized other than hazardous, it will be relabeled, managed as such and disposed of in the manner appropriate with its classification. If this waste stream is characterized as hazardous or mixed low-level radioactive, it will be managed as such and disposed of at an authorized off site facility.

Waste #3: Municipal Solid Waste (MSW) – This waste stream primarily consists of non contact trash including but not limited to paper, cardboard, wood, plastic, food and beverage containers, empty solution containers, but may also include commercial solid waste, and industrial solid waste or petroleum contaminated soils that are not a special waste, which are derived from project activities . It is estimated that approximately 3 cubic yards of MSW will be generated.

Anticipated Regulatory Status: Non-hazardous, non-radioactive, municipal solid waste

Characterization Approach: MSW will be characterized based on acceptable knowledge or if necessary direct sampling of containerized waste.

Management and Disposal Method: MSW will be segregated from all other waste streams. It is anticipated that the waste will be stored in plastic trash bags or other appropriate containers and disposed of at the County of Los Alamos Landfill or other authorized facility.

Waste #4: New Mexico Special Waste (NMSW): Petroleum Contaminated Soils (PCS), Spilled Chemical Substance or Commercial Product, or Regulated Asbestos Waste (potential) - NMSW may be generated from the accidental release of commercial products such as hydraulic fluid, motor oil, unleaded gasoline, or diesel fuel (e.g. from the rupture of hydraulic or fuel hoses, or spills during maintenance etc.), spills of chemicals or products used during project operations (e.g. drilling fluid additives), onto the ground, or regulated asbestos wastes generated during project activities. This may also include absorbent padding, paper towels, spill pillows or other absorbent material used to contain the released material. It is estimated that <55 gallons, if any, of this waste stream will be generated from this project.

Anticipated Regulatory Status: New Mexico Special Waste

Characterization Approach: NMSW will be characterized based on AK using the MSDS and/or direct sampling. PCS will be sampled and analyzed for total petroleum hydrocarbons (TPH), diesel range and gasoline range (DRO/GRO); benzene; ethyl benzene; toluene; xylene; and total lead. Suspect asbestos will be sampled by authorized personnel and analyzed at an approved asbestos laboratory.

Management and Disposal Method: NMSW will be managed in approved containers, staged in a designated NMSW storage area, and disposed of at an authorized NMSW facility. If PCS have contaminant levels below the NMSW standards, they will be handled as an industrial waste.

Waste #5: Decontamination fluids - This waste stream consists of liquid wastes generated from the decontamination of sampling and drilling equipment in the event that dry decontamination methods (the preferred decon-method) are unsuccessful. This waste stream will be generated only if dry decontamination methods are not effective. Dry decontamination wastes are contact waste, Waste #1. It is estimated that <55 gallons, if any, of decontamination fluids will be generated from this activity.

Anticipated Regulatory Status: The possible classifications of this liquid waste stream and the anticipated regulatory status include: non-hazardous, non-radioactive waste, low-level radioactive waste, hazardous waste, and mixed low-level waste (MLLW).

Characterization Approach: Waste characterization will be based upon the analytical results obtained from the direct sampling of containerized waste or AK based on the results of analyses of Waste # 2.

Storage and Disposal Method: Decontamination fluids will be stored in 55-gallon drums or poly tanks as appropriate. Decontamination fluids will be managed as hazardous waste pending analysis and stored in either a Satellite Accumulation Area (SAA) or a <90 Day Hazardous Waste Accumulation Area depending on waste volume until a hazardous waste determination can be made. If this waste is characterized other than hazardous, it will be relabeled, managed as such and disposed of in the manner appropriate with its classification. If this waste stream is characterized as hazardous or mixed low-level radioactive, it will be managed as such and disposed of at an authorized off site facility.

TABLE 1: CHARACTERIZATION TABLE

Waste Description	Waste # 1 Contact IDW	Waste #2 Borehole cuttings	Waste #3 Municipal Solid Waste	Waste #4 NMSW (PCS) pB 1/21/09
Volume	**3 cy**	**10 -20 cy**	**3 cy**	<55?cy gallons
Packaging	**Drums, waste bags, or roll-offs**	**Drums, waste bags, or roll-offs**	**Lined trash cans**	**Drums**
Regulatory classification:				
Radioactive	X	X	—	—
Solid	X	X	X	X
Hazardous	X	X	—	—
Mixed (hazardous and radioactive)	X	X	—	—
Toxic Substances Control Act (TSCA)	—	—	—	—
New Mexico Special Waste	—	—	—	X
Industrial	X	X	X	—
Characterization Method				
Acceptable knowledge (AK): Existing Data/Documentation	X	X	X	X
AK: Site Characterization	—	—	—	—
Direct Sampling of Containerized Waste	—	X	—	X
Analytical Testing				
Volatile Organic Compounds (EPA 8260-B)	—	X	—	X
Semivolatile Organic Compounds (EPA 8270-C)	—	X	—	X
Organic Pesticides (EPA 8081-A)	—	X	—	—
Organic Herbicides (EPA 8151-A)	—	X	—	—
PCBs (EPA 8082)	—	—	—	—
Total Metals (EPA 6010-B/7471-A)	—	X	—	X
Total Cyanide (EPA 9012-A)	—	—	—	—
High Explosives Constituents (EPA 8330/8321-A)	—	—	—	—
Asbestos	—	—	—	**IF NEEDED**
Total petroleum hydrocarbon (TPH)-GRO (EPA 8015-M)	—	—	—	X
TPH-DRO (EPA 8015-M)	—	—	—	X
Toxicity characteristic leaching procedure (TCLP) Metals (EPA 1311/6010-B)	—	X[1]	—	X[1]
TCLP Organics (EPA 1311/8260-B & 1311/8270-C)	—	—	—	—
TCLP Pest. & Herb. (EPA 1311/8081-A/1311/8151-A)	—	—	—	—
Gross Alpha (alpha counting) (EPA 900)	—	X	—	—
Gross Beta (beta counting) (EPA 900)	—	X	—	—
Tritium (liquid scintillation) (EPA 906.0)	—	X	—	—
Gamma spectroscopy (EPA 901.1)	—	X	—	—
Isotopic plutonium (chem. separation/alpha spec.) (HASL-300)	—	X	—	—
Isotopic uranium (chem. separation/alpha spec.) (HASL-300)	—	X	—	—
Total uranium (6020 inductively coupled plasma mass spectroscopy [ICPMS])	—	—	—	—
Strontium-90 (EPA 905)	—	X	—	—
Americium-241 (chem. separation/alpha spec.) (HASL-300)	—	X	—	—
Waste Profile Form #	**TBD**	**TBD**	**TBD**	**TBD**

CHARACTERIZATION TABLE CONT.

Waste Description	**Waste #6 Decon fluid**			
Volume	**<55 gal**			
Packaging	Drums or poly tanks			
Regulatory classification:				
Radioactive	**X**			
Solid	—			
Hazardous	**X**			
Mixed (hazardous and radioactive)	**X**			
Toxic Substances Control Act (TSCA)	—			
New Mexico Special Waste	—			
Industrial	—			
Characterization Method				
Acceptable knowledge (AK): Existing Data/Documentation	—			
AK: Site Characterization	**X**			
Direct Sampling of Containerized Waste	**X**			
Analytical Testing				
Volatile Organic Compounds (EPA 8260-B)	**X**			
Semivolatile Organic Compounds (EPA 8270-C)	**X**			
Organic Pesticides (EPA 8081-A)	**X**			
Organic Herbicides (EPA 8151-A)	**X**			
PCBs (EPA 8082)	—			
Total Metals (EPA 6010-B/7471-A)	**X**			
Total Cyanide (EPA 9012-A)	**X**			
High Explosives Constituents (EPA 8330/8321-A)	—			
Asbestos	—			
Total petroleum hydrocarbon (TPH)-GRO (EPA 8015-M)	—			
TPH-DRO (EPA 8015-M)	—			
Toxicity characteristic leaching procedure (TCLP) Metals (EPA 1311/6010-B)	—			
TCLP Organics (EPA 1311/8260-B & 1311/8270-C)	—			
TCLP Pest. & Herb. (EPA 1311/8081-A/1311/8151-A)	—			
Gross Alpha (alpha counting) (EPA 900)	**X**			
Gross Beta (beta counting) (EPA 900)	**X**			
Tritium (liquid scintillation) (EPA 906.0)	**X**			
Gamma spectroscopy (EPA 901.1)	**X**			
Isotopic plutonium (chem.. Separation/alpha spec.) (HASL-300)	**X**			
Isotopic uranium (chem.. Separation/alpha spec.) (HASL-300)	**X**			
Total uranium (6020 inductively coupled plasma mass spectroscopy [ICPMS])	—			
Strontium-90 (EPA 905)	**X**			
Americium-241 (chem.. Separation/alpha spec.) (HASL-300)	**X**			
Waste Profile Form #	**TBD**			

[1] Note: Section 1.2 of the TCLP method 1311 states "If a total analysis of the waste demonstrates that individual analytes are not present in the waste, or that they are present but at such low concentrations that the appropriate regulatory levels could not possibly be exceeded, the TCLP need not be run." The methodology for using total waste analyses determination for the 40 TC constituents is as follows;

Liquids – Wastes containing less than 0.5% filterable solids do not require extraction and therefore by filtering the waste and measuring the total constituent levels of the filtrate and comparing those levels to regulatory levels is appropriate.

Solids – Constituent concentrations from the extraction fluid of wastes that are 100% physical solids are divided by 20 (reflecting the 20 to 1 ratio of TCLP extraction) and then compared to the regulatory levels. If the theoretical levels do not equal or exceed the regulatory levels, the TCLP need not be run. If the levels do equal or exceed the regulatory levels, the generator may either declare the waste hazardous or run TCLP analyses.

References

ER-ERSS-SOP-5022, *Management of Environmental Restoration Project Waste.*

Waste Characterization Strategy Form (continued)

Signatures	**Date**
WES-RS Project Leader (Print name and then sign below.) Bruce Wedgeworth Bruce. Wedgeworth	1/21/09
ERSS Waste Management Coordinator (Print name and then sign below.) Gordon Jio Gordon Jio	1/21/2009
ENV-RCRA Representative (Print name and then sign below.) John M. Tymkowych John M. Tymkowych	1-21-09
WES-WA Representative (Print name and then sign below.) Andy Elicio	1/21/09

	Los Alamos National Laboratory
	ENV-ERSS

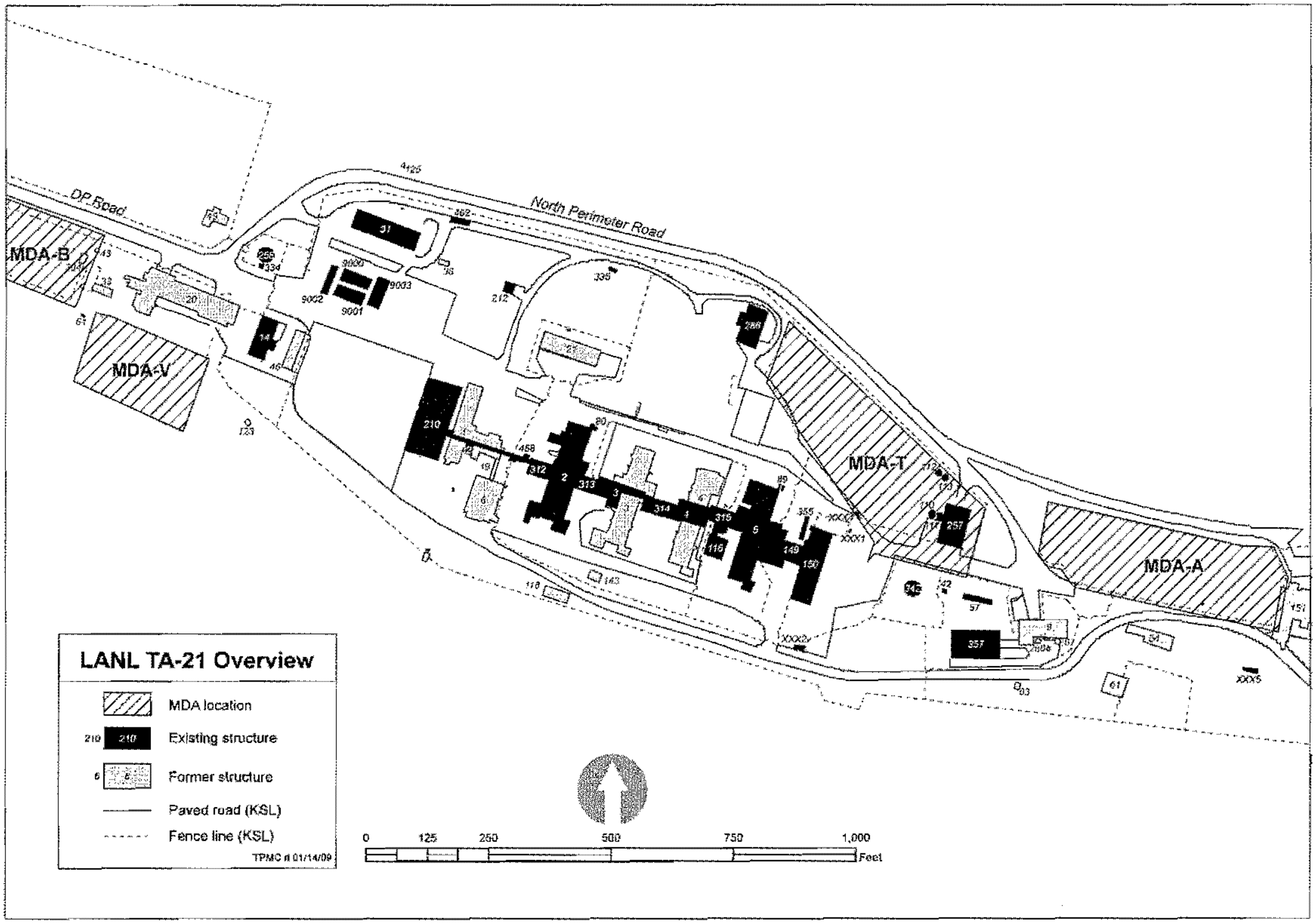

Figure 1: Location of MDA T and MDA A.

Amendment # 1 to the
Waste Characterization Strategy Form (WCSF) for MDA T, SWMU 21-016(a)-99 and MDA A, SWMU 21-014, EP2009-0021

dated 1/16/2009

Date: March 5, 2009

INTRODUCTION – This amendment to WCSF MDA T, SWMU 21-016(a)-99 and MDA A, SWMU 21-014, EP2009-0021 is to incorporate the NMED-approved Notice of Intent (NOI) Decision Tree for Land Application of Investigation Derived Waste Solids from Construction of Wells and Boreholes for Waste Stream #2

BACKGROUND– The initial characterization for Waste Stream #2 was that the maximum detected concentrations of radionuclides, would be compared with background values. If maximum concentrations exceed background/fallout values, the waste cuttings would be designated as low-level radioactive waste and dispose of at an approved off-site disposal facility.

WASTE DESCRIPTION (CHANGES): Cuttings may be land applied if they meet the criteria in the NMED-approved Notice of Intent (NOI) Decision Tree for Land Application of Investigation Derived Waste Solids from Construction of Wells and Boreholes. If they cannot be land applied, they will be transported for treatment/disposal at an authorized facility. Based on existing data, the Laboratory expects drill cuttings that cannot be land applied to be designated as industrial waste or LLW.

REGULATORY STATUS, CHARACTERIZATION, MANAGEMENT, AND DISPOSAL

Waste # 2: Borehole Cuttings (IDW) – The borehole cuttings waste stream will consist of cuttings from boreholes. Cuttings may or may not contain residue of drilling additives (drilling mud or foam) used to promote borehole integrity. The volume of waste generated is estimated to be less than 10 to 20 yd^3.

Anticipated Regulatory Status: Radioactive, Solid, Hazardous, Mixed (hazardous and radioactive), TSCA, New Mexico Special Waste, Industrial.

Characterization Approach: The borehole cuttings waste stream will be characterized using analytical results by direct sampling of the cuttings, and from MSDS's for any drilling additives.

Storage and Disposal Method: Borehole cuttings will be collected in drums, waste wrangler bags, roll-off bins or other appropriate containers at the point of generation. The cuttings will be managed as non-hazardous waste and stored in an authorized storage area pending analyses for land application. If cuttings do meet the criteria of the NMED approved NOI decision tree for land application, it will be relabeled, managed as such and disposed of in the manner appropriate with its classification.

CHARACTERIZATION TABLE

Waste Description	Waste #2 Drill Cuttings
Volume (estimated)	10-20 cy
Packaging	Approved Containers
Regulatory classification:	
Radioactive	X
Municipal	
Hazardous	X
Mixed (hazardous and radioactive)	X
Toxic Substances Control Act (TSCA)	
New Mexico Special Waste	X
Industrial	X
Liquid	
Characterization Method	
Acceptable knowledge (AK): Existing Data/Documentation	X
AK: Site Characterization	
Direct Sampling of Containerized Waste	X
Analytical Testing	
Volatile Organic Compounds (EPA 8260-B)	X
Semivolatile Organic Compounds (EPA 8270-C)	X
Organic Pesticides (EPA 8081-A)	X
Organic Herbicides (EPA 8151-A)	X
PCBs (EPA 8082)	X
Total Metals (EPA 6010-B/7471-A)	X
Total Cyanide (EPA 9012-A)	X
High Explosives Constituents (EPA 8330/8321-A)	
Asbestos	
Total petroleum hydrocarbon (TPH)-GRO (EPA 8015-M)	
TPH-DRO (EPA 8015-M)	
Toxicity characteristic leaching procedure (TCLP) Metals (EPA 1311/6010-B)	X
TCLP Organics (EPA 1311/8260-B & 1311/8270-C)	
TCLP Pest. & Herb. (EPA 1311/8081-A/1311/8151-A)	
Gross Alpha (alpha counting) (EPA 900)	X
Gross Beta (beta counting) (EPA 900)	X
Tritium (liquid scintillation) (EPA 906.0)	X
Gamma spectroscopy (EPA 901.1)	
Isotopic plutonium (chem. separation/alpha spec.) (HASL-300)	X
Isotopic uranium (chem. separation/alpha spec.) (HASL-300)	X
Total uranium (6020 inductively coupled plasma mass spectroscopy [ICPMS])	
Strontium-90 (EPA 905)	X
Americium-241 (chem. separation/alpha spec.) (HASL-300)	X
Perchlorates	X
Nitrates	X
WPF	TBD

Signatures	**Date**
Project Leader (Print name and then sign below.) Bruce Wedgeworth	3/5/09
ERSS Waste Management Coordinator (Print name and then sign below.) Ron DeSotel ~~Gordon Jio~~	3/5/09
ENV-RCRA Representative (Print name and then sign below.) John Tymkowych	3/5/09
WES-WA Representative (Print name and then sign below.) José D. Ortega ~~Andy Elicio~~	3/5/09

	Los Alamos National Laboratory **ENV-ERSS**