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# Investigation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54

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Prepared by
Environmental Stewardship Division–
Environmental Remediation and Surveillance Program

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# Investigation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54

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Responsible project leader:

| Printed Name | Signature | Title | Organization | Date |
|---|---|---|---|---|
| John Hopkins |  | Project Leader | ENV-ECR | 9/12/05 |

Responsible UC representative:

| Printed Name | Signature | Title | Organization | Date |
|---|---|---|---|---|
| David McInroy |  | Deputy Program Director | ENV-ERS | 9/12/05 |

Responsible DOE representative:

| Printed Name | Signature | Title | Organization | Date |
|---|---|---|---|---|
| David Gregory |  | Federal Project Director | DOE-LASO | 9/12/05 |

## EXECUTIVE SUMMARY

This investigation report describes the results of the 2004–2005 field investigation proposed in the investigation work plan for Material Disposal Area (MDA) L and approved with modifications by the New Mexico Environment Department. This investigation report also presents an assessment of the nature and extent of contamination and the potential present-day risks to human health and the environment associated with MDA L based on the results of investigations conducted from 1993 through 2005.

The objectives of the 2004–2005 investigation were to complete the determination of the nature and extent of releases of hazardous waste constituents and/or radionuclides identified during the 1993–1995 Phase I Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) and to collect additional information on the hydrogeologic properties and other physical characteristics of the vadose zone beneath MDA L.

In total, eight boreholes were drilled alongside the pit, impoundments, and shafts at MDA L. Five boreholes were drilled to a depth of 150 ft, and one borehole was drilled with the auger rig to a depth of 300 ft at an angle of 85º from horizontal. One borehole was drilled to a depth of 660 ft with an air-rotary rig to evaluate whether perched groundwater was present. This borehole was the second attempt to reach the target depth of 700 ft and resulted in drilling eight boreholes. The initial borehole was abandoned at a depth of 568 ft when the downhole tools failed.

Continuous core was collected in the six shallow boreholes and the initial deep borehole to characterize the stratigraphy beneath the site, and samples were collected and analyzed for target analyte list metals, cyanide, lithium, nitrates, explosive compounds, dioxins, furans, polychlorinated biphenyls, perchlorate, pesticides, volatile organic compounds (VOCs), semivolatile organic compounds, and radionuclides. The sampling plan also focused on fracture characterization. Samples of fracture fill and surrounding intact tuff were collected when substantial fractures were encountered. Finally, geotechnical and geochemical samples were collected from the deep boreholes to measure chloride-ion concentration, matric potential, and moisture content. Moisture content and matric potential samples were collected every 5 ft; samples for chloride analyses were collected every 10 ft from recovered core. Pore-gas samples were collected to evaluate the nature and extent of vapor-phase VOCs and tritium in pore water beneath MDA L.

The results of rock sample analyses detected a number of organic and inorganic chemicals at trace levels beneath the former disposal units and were generally consistent with the results obtained during the Phase I RFI. The only organic chemicals detected in core samples were chlorinated VOCs and trace levels of several dioxin and furan congeners. Inorganic chemicals detected above background levels did not show any discernable patterns or trends and did not indicate a release from any of the historical waste units at MDA L. Radionuclides were detected either at levels equivalent to or less than media-specific background values.

Subsurface samples collected to evaluate moisture properties did not identify any perched groundwater zones to a depth of 660 ft beneath MDA L. Fifty-one samples, collected at approximately 5-ft intervals, were submitted to a contract laboratory for moisture content and matric potential analyses. The results of gravimetric moisture analyses showed moisture levels ranging from 1.3 to 27.9% moisture by weight in all samples except one, which showed moisture levels less than, or equal to, 11.3%. Laboratory matric potential readings confirmed all samples collected beneath MDA L contained moisture levels below saturation.

Data gathered during the Phase I RFI, quarterly pore-gas monitoring, and the approved investigation work plan activities have characterized the nature and extent of contamination in surface and subsurface

media. The results of the human health and ecological assessments indicated that MDA L poses no unacceptable present-day risk to human health and the environment. Therefore, no additional data are needed to characterize the nature and extent of contaminant releases at MDA L.

The analytical results from pore-gas samples collected from the eight boreholes during this investigation confirmed the presence of VOCs (consisting primarily of chlorinated VOCs) in the vadose zone beneath MDA L. Data collected during the Phase I RFI, quarterly monitoring from 1997 to the present, and the 2004–2005 investigation indicate that the highest concentrations of VOCs are centered around the eastern and western disposal shaft fields and are limited at depth by the Cerros del Rio basalts. The dominant subsurface vapor contaminant is 1,1,1-trichloroethane. Tritium was detected in pore-gas samples collected from all eight boreholes. The highest concentrations were detected in samples beneath the eastern portion of MDA L; however, the results showed no discernable trend indicating a potential source area.

The existing subsurface vapor-monitoring network at MDA L was expanded by the construction of seven additional vapor-monitoring wells. Therefore, this investigation report makes the following recommendations:

- complete a corrective measures evaluation to ensure that future releases from the site pose no unacceptable risks to human and ecological receptors;
- as part of the evaluation, use the results of the soil vapor extraction pilot study to evaluate this method as a potential remedial strategy; and
- monitor subsurface vapor beneath MDA L in accordance with a long-term monitoring plan approved by the New Mexico Environment Department.

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## 1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility owned by the U.S. Department of Energy (DOE) and managed by the University of California (UC). The Laboratory is located in north-central New Mexico, approximately 60 mi northeast of Albuquerque and 20 mi northwest of Santa Fe. The Laboratory site covers 40 $mi^2$ of the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep canyons containing perennial and intermittent streams running from west to east. The mesa tops range in elevation from approximately 6200 to 7800 ft above sea level (asl).

The Laboratory's Environmental Stewardship Division–Environmental Remediation and Surveillance (ENV-ERS) Program is participating in a national effort by DOE to clean up sites and facilities formerly involved in weapons research and production. The goal of ENV-ERS is to ensure that past operations at the Laboratory do not threaten human or environmental health and safety in and around Los Alamos County, New Mexico. To achieve this goal, ENV-ERS is currently investigating sites potentially contaminated by past Laboratory operations. The sites under investigation are either solid waste management units (SWMUs) or areas of concern (AOCs). This report describes the investigation undertaken at Material Disposal Area (MDA) L to fulfill the requirements of Section IV.C.1.e of the March 1, 2005, Compliance Order on Consent (hereafter, the Consent Order), signed by the New Mexico Environment Department (NMED), DOE, and UC.

Historically, MDA L at Technical Area (TA) 54 was used for disposition of nonradiological liquid chemical wastes. These types of wastes are no longer disposed of at this site. On September 28, 2004, NMED approved the investigation work plan (hereafter, the approved work plan) for MDA L with modifications (NMED 2004, 89306) to finalize the environmental characterization of the site. The Laboratory incorporated NMED's comments and issued a second revision to the MDA L work plan on January 5, 2005 (LANL 2005, 87624). The locations of the subsurface disposal units were determined by confirming engineering drawings (LANL 1993, 76052) using a nonintrusive geophysical survey. The survey was conducted in 2004 by Advanced Geological Services, Inc. (AGS 2005, 89655), and the results correlate well with the locations that were gleaned from historical information.

Implementation of the approved work plan meets the requirements for investigating MDA L contained in Section IV.C.1.e of the Consent Order. Eight boreholes were drilled alongside the subsurface pit, impoundments, and shafts, and numerous subsurface samples and one sediment sample were collected. The samples were analyzed for organic chemicals, inorganic chemicals, and radionuclides.

This investigation report (IR) was written according to the requirements described in the Consent Order, Appendix XI, Reporting Requirements. This IR assesses the nature and extent of contamination based upon a review of analytical laboratory results of the samples collected at the site. It also assesses the potential present-day risks/doses to human health and the environment associated with MDA L, based on the results of field investigations from 1986 through May 2005.

Appendix A includes a list of acronyms and defines the terms used in this report. Appendix B describes the field methods used during the site investigations. Appendix C presents borehole logs and geophysical survey results. Appendix D includes the quality assurance (QA)/quality control (QC) review of the data. Appendix E, on three CDs, provides the analytical data, data validation reports, analytical reports, and the chain-of-custody forms. Appendix F presents a review of the analytical data. Appendix G includes the present-day risk assessments. Appendix H includes the ecological scoping checklist and surface-water assessment. Appendix I includes the long-term subsurface vapor monitoring plan for MDA L. Appendix J describes the disposition of investigation-derived waste (IDW). Appendix K presents the results of indoor air monitoring conducted at MDA L. Appendix L provides an evaluation of on-site x-ray fluorescence (XRF) screening data.

## 2.0 BACKGROUND

MDA L (SWMU 54-006) is located in the east-central portion of the Laboratory on Mesita del Buey (Figure 2.0-1), within an 1100 ft by 3000 ft (2.5-acre) fenced area known as Area L. It consists of one inactive subsurface disposal pit (Pit A); three inactive subsurface treatment and disposal impoundments (Impoundments B, C, and D); and 34 inactive disposal shafts (Shafts 1 through 34) (Figure 2.0-2). Shafts 36 and 37 are the former lead-stringer shafts that are undergoing closure and are not part of SWMU 54-006. The subsurface disposal units range in depth from 10 ft to 65 ft below the original ground surface. An asphalt cover was placed over the site between 1989 and 1996, thus increasing the ground surface by 3 in. or more. The pit, impoundments, and shafts are constructed in the Tshirege Member of the Bandelier Tuff, a consolidated tuff unit. The regional aquifer is estimated to be at a depth of approximately 930 ft below ground surface (bgs), based on data from other wells at the Laboratory and the predictions of the hydrogeologic conceptual model for the Pajarito Plateau (LANL 1998, 59599). The topography of Area L is relatively flat, and most of the surface overlying MDA L is paved with asphalt to house ongoing waste management activities, including the storage of chemical, hazardous, and mixed low-level wastes managed within container storage units. Surface water runoff from this area is controlled and diverted to an outfall to Cañada del Buey at the northeast corner of the site (Figure 2.0-3). The inactive subsurface disposal units and the existing surface structures used for current waste management activities are shown in Figure 2.0-4.

MDA L is located in an industrial area within TA-54. The Laboratory does not anticipate that land use at TA-54 will change from industrial in the reasonably foreseeable future. Public access to the site is restricted by fencing and locked gates, and entry onto Pajarito Road is restricted to Laboratory employees. Under present-day conditions, only Laboratory employees or contractors may enter the site for site-management activities (i.e., installing best management practices, conducting waste-management operations, or performing environmental sampling).

### 2.1 Site History

During the late 1950s, the Laboratory, with the approval of the U.S. Atomic Energy Commission and upon recommendation of the U.S. Geological Survey, selected Mesita del Buey within TA-54 for underground disposal of Laboratory-generated waste (Rogers 1977, 05707; Rogers 1977, 05708, p. G-1). Since then, the main waste storage and disposal facilities for the Laboratory have been located at TA-54. MDA L is one of four inactive disposal areas on Mesita del Buey, which is located between Pajarito Canyon (south) and Cañada del Buey (north) and within TA-54 (Figure 2.1-1).

MDA L is a decommissioned (i.e., removed from service) area established for disposing of nonradiological liquid chemical waste, including containerized and uncontainerized liquid wastes; bulk quantities of treated aqueous waste; batch-treated salt solutions; electroplating wastes, including precipitated heavy metals; and small-batch quantities of treated lithium hydride. MDA L operated from the early 1960s until it was decommissioned in 1985.

At MDA L, 1 pit, 3 impoundments, and 34 shafts were excavated into the overlying soil and unit 2 of the Tshirege Member of the Bandelier Tuff (Figure 2.0-2). The pit, impoundments, and shafts were unlined. The bottoms of the pit and impoundments were not sloped so liquid could spread over the entire surface area to facilitate evaporation. Upon decommissioning, the pit and impoundments were filled and covered with clean, crushed, consolidated tuff. The bottom of each shaft was covered with 3 ft of crushed tuff to seal cracks and joints, and a steel cap was placed over the opening. When the shafts were filled to within approximately 3 ft of the surface, they were capped with a 3-ft concrete plug (LANL 1992, 07669, p. 5-108).

## 2.2 Results of Previous Investigations

In 1994 and 1995, sediment samples and core samples from borehole drilling were collected during a Phase I Resource Conservation and Recovery Act (RCRA) facility investigation (RFI). In addition, quarterly pore-gas samples have been collected since 1985. The following sections summarize the results of these previous investigations that were reported in Appendix B, the historical investigation report (HIR) of the approved MDA L work plan (LANL 2005, 87624, pp. B-6–B-17).

### 2.2.1 Sampling and Analysis of 1994 Sediment Samples

Phase I RFI channel sediment sampling was conducted at MDA L in July 1994. Eight locations within the outfall to Cañada del Buey were selected for sampling to determine if contaminants had migrated from MDA L. The most likely depositional areas (e.g., low areas behind obstructions) for the channel were determined by an on-site geomorphic survey. These locations included areas with coarse sediment deposition on the upper slope and areas with finer sediment deposition on the lower slope. The sample depths ranged from 0 to 4 in. or 0 to 8 in. Eight sediment samples were collected and field-screened for gross alpha, beta, and gamma radiation. The sample with the highest gross alpha and gross beta, the sample with the highest gross gamma, and two other samples (for a total of four) selected at random were submitted to an off-site contract laboratory for analysis of target analyte list (TAL) metals, polychlorinated biphenyls (PCBs), pesticides, radionuclides (by alpha and gamma spectroscopy), tritium, and strontium-90 (LANL 1996, 54462, pp. 57, A2-1–A2-2).

No inorganic chemicals were detected at concentrations above the sediment background values (BVs) in any of the channel sediment samples (Table 2.2-1). Although cadmium, selenium, and silver were not detected, the detection limits (DLs) for these inorganic chemicals exceeded their respective BVs.

Detected concentrations of radionuclides were compared with the sediment BVs or the sediment fallout values (FVs), depending on whether the radionuclide is naturally occurring or a fallout radionuclide (LANL 1998, 59730) (Table 2.2-2). Plutonium-238 was the only radionuclide detected in sediment samples above its respective BV or FV. The highest detected concentration for plutonium-238 (0.011 pCi/g) exceeded the associated sediment FV of 0.006 pCi/g.

The pesticide methoxychlor[4,4'-] was detected in two samples at concentrations of 0.028 mg/kg and 0.063 mg/kg, approximately one to three times the estimated quantitation limit (EQL) (0.02 mg/kg). No other organic chemicals were detected in the sediment samples.

### 2.2.2 Sampling and Analysis of Core Samples, 1993 through 1995

From September 9, 1993, to May 8, 1995, during the Phase I RFI, seven vertical boreholes and eleven angled boreholes were advanced at MDA L. A total of 184 core samples were collected from these boreholes. Not all samples were analyzed for the same suites, but, in general, they were analyzed for TAL metals, pesticides, PCBs, semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), cyanide, pesticides, and radionuclides (americium-241, cesium-137, plutonium and uranium isotopes, and tritium).

Samples from eight boreholes in the vicinity of the disposal shafts, impoundments, and pit were submitted for inorganic chemical analyses. The data review indicated that barium, chromium, cobalt, copper, manganese, nickel, uranium, and zinc were elevated compared with Laboratory BVs (Table 2.2-3).

Core samples from seven boreholes were analyzed for tritium; five of these samples were analyzed for americium-241, cesium-137, and plutonium and uranium isotopes. Americium-241, cesium-137, and isotopic plutonium are not compared to FVs but are evaluated only on the basis of detection. Tritium was the only radionuclide identified as a chemical of potential concern (COPC) (Table 2.2-4).

All 184 core samples were analyzed for VOCs. Samples from eight boreholes drilled in the vicinity of the disposal shafts and the pit were analyzed for SVOCs, pesticides, and PCBs. Nineteen VOCs were detected in core samples, most at trace concentrations (i.e., less than or slightly above the EQLs) (Table 2.2-5). Aroclor-1260, dichlorodiphenyldichloroethane (DDD[4,4'-]), and methoxychlor[4,4'-] were each detected in one sample.

### 2.2.3 Quarterly Sampling of VOCs in Pore Gas, 1985 through 2004

Because methods and resulting data quality have changed substantially over the years, pore-gas data before 1996 were used only semiquantitatively in the MDA L HIR (LANL 2005, 87624). Data collected from 1997 to the present have been subjected to rigorous QA/QC procedures. The pore-gas monitoring data for MDA L indicate that 1,1,1-trichloroethane (TCA) is the primary VOC detected, followed by trichloroethene (TCE). VOCs are the primary COPCs in the subsurface at MDA L.

Analyses of the pore-gas monitoring data indicate that two subsurface vapor-phase VOC plumes are present. The plumes have two unique sources, identified as Shaft Fields 1 through 28 and 29 through 34 and referred to respectively as the western source area and the eastern source area. Both plumes are dominated by the presence of TCA, but the relative compositions and concentrations of lesser compounds differ (Table 2.2-6).

## 3.0 SCOPE OF ACTIVITIES

This section describes the field activities undertaken to implement the approved work plan for MDA L. The objectives of the investigation were to complete the determination of the nature and extent of hazardous waste constituents and/or radionuclide releases identified during the Phase I RFI and reported in the MDA L HIR (LANL 2005, 87624, pp. B-6–B-17).

The approved work plan required conducting a geophysical survey, drilling seven boreholes adjacent to or under the disposal units, and collecting samples to supplement the Phase I RFI data for determining the nature and extent of contamination. One borehole was also drilled to 660 ft bgs to determine whether perched groundwater is present and to collect hydrogeologic property data. This borehole was the second attempt to reach the target depth of 700 ft, resulting in the drilling of a total of eight boreholes. The initial borehole was abandoned at 568 ft bgs when the downhole tools failed. In addition, one sediment sample was collected in the outfall to Cañada del Buey to supplement the Phase I RFI data.

The field investigation was specifically designed to determine

1. The nature and extent of contamination in subsurface tuff, including
    - the vertical extent of metals in tuff beneath Pit A, Impoundments B, C, and D, and the two shaft fields;
    - the lateral extent of tritium in the vapor phase in subsurface tuff;

  - the nature and extent of the VOC plumes in subsurface tuff; and
  - the presence of perchlorate, nitrate, dioxins, furans, and explosive compounds in the tuff beneath MDA L.

2. The potential presence of perched groundwater beneath MDA L.
3. The hydrogeologic properties and fracture characteristics of the vadose zone beneath MDA L needed to perform contaminant-transport modeling.

Field activities at MDA L began on November 18, 2004, and were completed on May 10, 2005. All activities were conducted in accordance with applicable Environmental Stewardship Division–Environmental Characterization and Remediation (ENV-ECR) Group standard operating procedures (SOPs) (Appendix B), quality procedures (QPs), Laboratory Implementation Requirements (LIRs), Laboratory Implementation Guidance (LIGs), and Laboratory Performance Requirements (LPRs).

### Deviations from the Approved MDA L Work Plan

The following were deviations from the approved work plan during the field investigation.

- Because of uncertainties related to field-screening instrument readings, the boreholes were not advanced to total depth (TD) based on photoionization detector (PID) readings or XRF field-screening results. The PID is susceptible to fluctuations resulting from water vapor. Headspace measurements of core contained in sealed bags rapidly formed condensation as water in the core evaporated, causing the PID to be unreliable for detecting low concentrations or organic vapors. The XRF field results were found to generally be biased high; readings consistently showed values exceeding the background data set. Confirmation samples submitted to an off-site laboratory confirmed the high bias of the XRF analyses.
- The deep borehole, D-1 (location 54-24241), originally had a target depth of 700 ft but was advanced only to a depth of 250 ft because of downhole difficulties, including deviating from the bore path that eventually led to a broken drill string. A second borehole, D-2 (54-24399), was advanced 10 ft northwest of borehole D-1. Borehole D-2 reached a TD of 660 ft, where drilling stopped when the drill bit and drill rods binded on basalt cobbles.
- Rock samples for gravimetric moisture analysis were to be collected at 5-ft intervals in borehole D-1 (54-24241). Samples were collected at 5-ft intervals from 0 to 250 ft bgs in borehole D-1 (54-24241) and from 385 to 400 ft in borehole D-2 (54-24399). However, samples could not be collected from 250 ft to 385 ft bgs and 400 ft to 660 ft bgs in borehole D-2 (54-24399) because the core recovery was insufficient.
- A pore-gas sample was to be collected at the bottom depth of D-2 (54-24399); however, because the borehole was unstable, packers were used to isolate the bottom of the steel casing at a depth of 568 ft below grade. Therefore, the pore-gas sample was collected from the entire open borehole below the casing, an interval spanning 568 ft to 660 ft below grade. This interval was entirely in Cerros del Rio basalts.
- Materials testing samples from borehole D-1 (54-24241) for saturated and unsaturated hydraulic conductivity, porosity, and bulk-density analyses were not collected because sufficient intact core could not be recovered during drilling.
- No rinsate blanks were collected as part of the QA/QC for the characterization sampling.
- No paired fracture samples were collected, as specified in the work plan because material recovery was insufficient.

## 3.1 Health and Safety Monitoring

As part of the health and safety program, a site-specific health and safety plan (SSHASP) and an Integrated Work Document (IWD) were developed to provide the project scope of work and background information specific to the project, including relevant history and descriptions of the project sites, administrative and engineering controls, and personal protective equipment (PPE) and task-specific exposure-monitoring requirements. The SSHASP and IWD were prepared using a multidisciplinary team of drillers, geologists, waste management personnel, and subject matter experts in industrial and radiological safety. During the preparation of these documents, the team identified the primary work activities and divided them into a discrete set of work steps. A detailed hazard analysis of the work steps was then conducted, and a set of hazard controls was established and incorporated into the SSHASP and IWD to which all personnel were required to be briefed as part of the project-specific training process.

As a result of the hazard assessment, real-time field health and safety monitoring was conducted for the following hazards: noise from drilling operations, dust and potential airborne inorganic chemical contaminants resulting from drilling operations and wind-blown material, and potential radionuclides and VOCs. Additionally, air sampling was conducted to detect the presence of silica and radiological samples were taken and analyzed for various potential contaminants.

Health and safety monitoring was conducted in accordance with applicable Occupational Safety and Health Administration (OSHA), Laboratory, American Conference of Governmental Industrial Hygienists (ACGIH), and National Institute for Occupational Safety and Health (NIOSH) protocols. The relevant regulations and documents are as follows:

- OSHA 29 Code of Federal Regulations 1926.52, Occupational Noise Exposure
- OSHA 29 Code of Federal Regulations 1926.65, Hazardous Waste Operations and Emergency Response
- OSHA 29 Code of Federal Regulations 1926.55, Gases, Vapors, Fumes, Dusts, and Mists
- Los Alamos National Laboratory Implementation Procedure (IMP) 300.2, Integrated Work Management for Work Activities
- LIR 402-700-01.2, Occupational Radiation Protection Requirements
- NIOSH, Manual of Analytical Methods
- ACGIH, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices

Health and safety monitoring did not affect or limit completion of any tasks required in the approved MDA L work plan.

## 3.2 Geophysical Survey

A geophysical survey was conducted within the MDA L fenceline to define subsurface waste disposal unit locations using electromagnetic (EM) geophysical methods and ground-penetrating radar (GPR). Additional geophysical surveys were used to avoid known interferences from utility lines, buildings, and the MDA L fence.

## 3.3 Drilling Activities

Eight boreholes were drilled alongside the pit, impoundments, and shafts in 2004 and 2005 at locations shown in Figure 3.3-1. The locations and sampling criteria for the boreholes were detailed in the approved work plan for MDA L (LANL 2005, 87624, p. 29). Three different drill rigs were used to complete characterization drilling at MDA L. The drilling methods included both auger drilling and air-rotary drilling. Auger drilling was completed with a Central Mine Equipment 75, and air-rotary drilling was completed with a Failing F-10 and a George E. Failing Company SpeedStar 30k DH. Five boreholes were drilled to 150 ft bgs and another was drilled at an angle of 85º from horizontal to a vertical depth of 300 ft bgs. One borehole was drilled to 660 ft bgs with an air-rotary rig to evaluate whether perched groundwater was present. This borehole was the second attempt to reach the target depth of 700 ft and resulted in drilling eight boreholes. The initial borehole was abandoned at 568 ft when the downhole tools failed. Table 3.3-1 summarizes the drilling activities conducted at MDA L.

All boreholes were started with a 12-in.-outside-diameter auger, advanced to a depth of 10 ft bgs. In this hole, a 10-in.-inside-diameter casing was installed to guide drilling and facilitate surface completion for long-term monitoring. In addition to the 10-in. surface casing, borehole D-2 (54-24399) was also cased with 8-in.-outside-diameter casing to 140 ft bgs, and 6 5/8-in. casing to a depth of 568 ft.

Hollow-stem auger drilling used 7 5/8-in.-outside-diameter auger flights and a continuous-core sampling system that consisted of a 3-in.-inside-diameter, split-core barrel retrieved with centering rods. The average core recovery using this system was 95%.

Air-rotary drilling employed a variety of techniques including open-hole drilling and casing advance using an underreaming hammer. Coring was completed with a 2 1/2-in. inside-diameter solid core barrel with wireline retrieval. Core recovery using this system averaged 70% to 90% in basalts, and no recovery was realized within the volcanic tuffs. In addition, air-rotary drilling methods required using a total dust suppression system (TDSS) to contain drill cuttings and filter the air stream.

All core was visually inspected and field-screened for alpha and beta/gamma radioactivity and organic vapors in headspace. Core samples were collected and delivered to an off-site laboratory for the analyses stipulated in the approved work plan. The analytical data are provided in Appendix E and discussed in Section 6. Field data collection, including visual examination, headspace-vapor screening for VOCs, continuous screening for radiological contamination, selective screening for explosive compounds, pH, and metals screening using XRF, health and safety monitoring, and general daily activities, were recorded in field logbooks, as required by the approved MDA L work plan. The boreholes were surveyed using a differential global positioning system (DGPS) unit. Logs were prepared for each borehole and are included in Appendix C of this report.

Seven boreholes were completed for vapor monitoring using a FLUTe soil-gas sampling positive-pressure membrane, and the boreholes were incorporated into the pore-gas monitoring network. Figure 3.3-2 is a schematic of the FLUTe membrane showing ports and related instrumentation. Although a FLUTe membrane was not installed in the deep borehole, D-2 (54-24399), it was left open to make subsequent pore-gas measurements with inflatable packers.

The status of all MDA L boreholes is summarized in Table 3.3-1.

## 3.4 Subsurface Vapor Sampling

Vapor samples for tritium and VOCs were collected to evaluate the nature and extent of the VOC vapor plumes and tritium in water vapor beneath MDA L. Samples were collected from the lowest base elevation of the adjacent disposal unit and at TD of borehole. For the deep borehole, D-2 (54-24399), a sample was taken from the bottom of the casing for VOCs and tritium.

To supplement the current pore-gas monitoring program, boreholes A through C, D-1, and E through G were completed as vapor-monitoring boreholes by installing a FLUTe soil-gas sampling sand-filled membrane. In addition, the pore-gas monitoring instruments may be used to continue monitoring tritium in the MDA L subsurface.

### 3.5 Canyon Sediment Sampling

One sediment sample was collected in the historic MDA L drainage channel (Figure 2.0-3) according to ECR-SOP-6.09, Rev. 1, Spade and Scoop Method for Collection of Soil Samples. This sample was sent to an off-site contract laboratory for analysis of TAL metals, cyanide, pesticides/PCBs, nitrates, perchlorate, americium-241, isotopic plutonium, isotopic uranium, strontium-90, and tritium.

### 3.6 Exploratory Boring Geophysical Logging

Geophysical surveys were completed for each new borehole. All boreholes drilled were caliper-logged, neutron-logged, and gamma-logged. In addition, borehole D-2 (54-24399) was camera-logged from a depth of 550 to 660 ft. The results of neutron and gamma surveys and camera logging are presented in the borehole logs in Appendix C.

### 3.7 Management of IDW

The waste streams generated and managed during the MDA L investigation included drill cuttings, PPE, and plastic. Pending analysis, the IDW was stored on-site in drums and other approved containers. All wastes were managed in accordance with applicable federal, state, DOE, and Laboratory requirements. The disposition of IDW from the MDA L investigation is described in Appendix J.

### 3.8 Aquifer Testing

No site-specific aquifer testing was conducted. However, as required by the approved work plan, an analysis of the groundwater samples collected from the regional wells surrounding TA-54 and the municipal wells in the vicinity of TA-54 are presented in a recent groundwater monitoring report submitted to NMED in July 2005 (LANL 2005, 89383).

### 3.9 Pilot Tests

A work plan and schedule for an in situ soil vacuum extraction pilot were submitted to NMED on May 31, 2005 (LANL 2005, 89305). The proposed pilot study entails installing an active soil vapor extraction system to evaluate the rate at which contaminant concentrations immediately around the source areas are reduced. The two extraction boreholes proposed in the pilot study are scheduled to be installed in September 2005; a pilot test will be conducted from January 2006 through May 2006.

## 4.0 FIELD INVESTIGATION RESULTS

Field investigations began on November 19, 2004, and concluded on May 10, 2005. Borehole core samples and pore-gas samples were collected to determine the nature and extent of potential releases from the subsurface disposal units. One sediment sample was collected to determine the nature and extent of potential surface releases from the site. Field-screening for radionuclides, and organic chemicals, and inorganic chemicals was conducted to determine when drilling was completed according to the approved work plan for MDA L (LANL 2005, 87624, p. 31). The procedures and methods used to complete the investigation activities at the site are summarized in Appendix B.

## 4.1 Surface Conditions

Between 1989 and 1996, an asphalt cover was placed over the area that comprises Area L. The topography of this area is relatively flat, and most of the surface overlying MDA L is paved with asphalt to house ongoing waste management activities; surface water runoff from this area is controlled and diverted to an outfall at the northeast corner of the site (Figure 2.0-3). Given the site conditions, the investigation focused primarily on subsurface contamination associated with the disposal pit, impoundments, and shafts. A sediment sample was collected in the historic site drainage per the requirements of the approved work plan to confirm that no changes in concentrations of COPCs in sediments occurred between the time of the Phase I RFI sampling event and the present-day.

## 4.2 Exploratory Drilling Investigations

From November 2004 to January 2005, seven shallow and one deep boreholes were drilled at MDA L. Core was collected continuously using a 5-ft core barrel sampler in the seven shallow boreholes. Subsurface tuff samples were collected with a core-barrel sampler following ENV-ECR SOP-6.26, Rev. 1, Core Barrel Samples for Subsurface Earth Materials, and all boreholes were logged to TD following ENV-ECR SOP-12.01, Rev. 4, Field Logging, Handling, and Documentation of Borehole Materials. Field documentation of samples collected from fractures included a detailed physical description of the fracture-fill material and rock matrix sampled, following ENV-ECR SOP-12.01, Rev. 4. The core was screened for organic vapors using a PID with an 11.7 electron volt (eV) lamp, according to ENV-ECR SOP-06.33, Rev. 0, Headspace Vapor Sampling with a Photoionization Detector. Gross alpha-beta radiation was measured using an Eberline E600 probe following manufacturer's instructions. Borehole logs containing lithological descriptions, organic vapor screening results, and radiological screening results are presented in Appendix C. Inorganic chemicals were screened only at boreholes A, B, and C using a portable XRF. Inorganic chemicals were not screened for at the other boreholes because the method was determined to be ineffective (Appendix L). Screening for explosive compounds was completed at the TD of each borehole, except borehole D-2 (54-24399) where material recovery was insufficient (Appendix C).

Samples were analyzed using methods specified by contract requirements of the Laboratory's analytical statement of work (SOW) (LANL 2000, 71233). The QA/QC samples included field duplicate samples to evaluate the reproducibility of the sampling technique and trip blanks to evaluate laboratory procedures. These samples were collected following ENV-ECR SOP-01.05, Rev. 1, Field Quality Control Samples. A field duplicate was collected for each borehole at the base elevation of the adjacent pit, impoundments, or shafts. Field trip blanks were collected for every shipment of VOC samples. This level of QA/QC sampling complies with Section IX.B.2.e of the Consent Order. The sampling equipment was decontaminated using dry decontamination methods (i.e., using window cleaner, paper towels, and wire brushes).

In accordance with the approved work plan, samples were collected in boreholes A through C, D-1, E, F and G at (1) the base elevation of the adjacent pit or shaft, (2) the TD of the borehole, and (3) approximately 20-ft intervals between the samples taken at the base elevation and at TD. In accordance with the approved work plan, the samples collected at the base elevation and at TD were analyzed for TAL metals, cyanide, lithium, explosive compounds, dioxins, furans, PCBs, pesticides, anions, pH, perchlorate, VOCs, SVOCs, and radionuclides (americium-241, strontium-90, isotopic uranium, isotopic plutonium, and those by gamma spectroscopy). The samples collected between the base elevation and TD were analyzed for an abbreviated suite of analytes that included TAL metals, cyanide, lithium, anions, pH, perchlorate, and radionuclides (americium-241, strontium-90, isotopic uranium, isotopic plutonium, and those by gamma spectroscopy). The approved work plan also focused on fracture characterization. Five fracture samples were collected from the characterization boreholes drilled at MDA L. No paired fracture samples were collected, as specified in the approved work plan (LANL 2005, 87624, pp. 32–33), because material recovery was insufficient. However, nonfracture samples were collected between 10 ft and 20 ft bgs above each fracture sample and may be used to investigate the potential of preferential transport of contaminants through fractures in the Bandelier Tuff.

In accordance with the approved work plan, samples were collected from borehole D-2 (54-24399) to measure saturated and unsaturated hydraulic conductivity, chloride-ion concentration, porosity, bulk density, matric potential, and moisture content. Moisture content and matric potential samples were collected every 5 ft; samples for chloride analysis were collected every 10 ft. Samples were collected for saturated and unsaturated hydraulic conductivity, porosity, and bulk-density analyses once in each tuff unit, twice from the Cerro Toledo interval, and at five depths in the Otowi Member. The samples collected from these units were representative of all the textural intervals encountered. Analyses for saturated and unsaturated hydraulic conductivity, porosity, and bulk density were to be performed using the methods specified by contract requirements of the Laboratory's SOW for analytical laboratories (LANL 2000, 71233). One field duplicate sample was collected and analyzed. The samples were collected, handled, packaged, and analyzed according to applicable ENV-ECR SOPs. In accordance with the approved work plan, no characterization samples were collected from the core of borehole D-2 (54-24399); the core and cuttings at borehole D-2 (54-24399) were inspected to determine whether saturated zones were present.

Auger flights and split-spoon sampling equipment were dry decontaminated using paper towels and brushes.

## 4.3 Exploratory Boring Geophysical Logging

Downhole geophysical methods were used to provide information important to evaluating subsurface physical properties. Each borehole was logged with caliper, camera, neutron, and natural gamma tools according to ENV-ECR SOP 5.07, Rev. 0, Operation of Borehole Logging Trailer. Caliper logging was used to continuously measure changes with depth in the borehole diameter. Camera logging provided a visual inspection of the condition of the borehole, and the images may be useful in confirming fractures and changes in lithology. Neutron probe readings were collected to provide information on moisture content. Gamma probe readings measured natural and potential anthropogenic sources of radionuclides. Because naturally occurring radionuclides tend to accumulate in fine-grained deposits, gamma logging may provide information on changes in the lithology of zones with higher moisture content. The results of the geophysical logging are presented in the borehole logs in Appendix C and include the rock classifications encountered.

## 4.4 Subsurface Conditions

A detailed presentation of the stratigraphy beneath MDA L was presented in the approved work plan (LANL 2005, 87624, pp. 17–20). The borehole logs confirm that the general stratigraphy beneath MDA L is consistent with what was encountered during previous drilling at MDA L and with the regional geology described by Broxton and Reneau (1995, 49726). The stratigraphy encountered is summarized. The locations of surface structures and subsurface utilities are shown in Figure 2.0-2.

### 4.4.1 Stratigraphy beneath Mesita del Buey

The boreholes drilled at MDA L as part of Phase I RFI activities and those drilled according to the approved work plan confirm the stratigraphy as described in Broxton and Reneau (1995, 49726). The locations and depths of previously drilled regional wells (R-20, R-21, R-22, and R-32) were also used to infer the stratigraphy beneath MDA L, which includes the Bandelier Tuff and the Cerros del Rio basalts. The regional aquifer is located within the Santa Fe Group, Puye Formation, and Cerros del Rio basalts.

With reference to the Bandelier Tuff, the term *welding* is used to distinguish between tuffs that are uncompacted and porous (nonwelded) and those that are more compacted and dense (welded). In the field, the degree of welding in tuff is quantified by the degree of flattening of pumice fragments (a higher degree of flattening and elongation equals a higher degree of welding). Petrographically, welded tuffs show adhesion (welding) of grains, but nonwelded tuffs do not. The term *devitrified* is applied to tuff whose volcanic glass has crystallized.

#### Tshirege Member

The Tshirege Member of the Bandelier Tuff is a compound-cooling unit that resulted from several successive ash-flow deposits separated by periods of inactivity, which allowed for partial cooling of each unit. Properties related to water flow and contaminant migration (e.g., density, porosity, degree of welding, fracture content, and mineralogy) vary both vertically and laterally as a result of localized emplacement temperature, thickness, gas content, and composition.

#### *Tshirege Member Unit 2*

Unit 2 of the Tshirege Member of the Bandelier Tuff is a competent, resistant unit that forms the surface of Mesita del Buey. Its thickness varies from 35 ft (10.7 m) to 40 ft (12.2 m) at MDA L. Where it is exposed, unit 2 forms nearly vertical cliffs on the sides of the mesa. The rock is described as a moderately welded ash-flow tuff composed of crystal-rich, devitrified pumice fragments in a matrix of ash, shards, and phenocrysts (primarily potassium feldspar [sanidine] and quartz).

Unit 2 is extensively fractured as a result of contraction during postdepositional cooling. The cooling-joint fractures are visible on mesa edges and on the walls of the pit. In general, the fractures dissipate at the bottom of unit 2. On average, fractures in unit 2 are nearly vertical. The mean spacing between fractures ranges from 1.9 ft to 2.6 ft (0.6 m and 8.8 m), and the fracture width ranges between less than 0.03 in. and 0.51 in. (1 mm and 13 mm) with a median width of 0.12 in. (3 mm). The fractures are typically filled with clays to a depth of about 9.9 ft (3 m); smectites are the dominant clay minerals present. Smectites are known for their tendency to swell when water is present and for their ability to strongly bind certain elements, both of which have implications for the transport of metals and radionuclides in fractures. Opal and calcite can be found throughout the fractured length, usually in the presence of tree and plant roots (live and decomposed); the presence of both the minerals and the roots indicates some water at depth in fractures.

At the base of unit 2 is a series of thin, less than 3.9-in.-thick (10-cm-thick), discontinuous, crystal-rich, fine- to coarse-grained surge deposits. Bedding structures are often observed in these deposits. The surge beds mark the base of unit 2.

### *Tshirege Member Unit 1v*

Tshirege Member unit 1v is a vapor-phase-altered cooling unit underlying unit 2. This unit forms sloping outcrops, which contrast with the near-vertical cliffs of unit 2. Unit 1v is further subdivided into units 1vu and 1vc.

*Unit 1vu.* The uppermost portion of unit 1v is devitrified and vapor-phase-altered ash-fall and ash-flow tuff; it has been designated unit 1vu, where u signifies upper. Its thickness varies from 60 ft (18.3 m) to 75 ft (22.9 m) at MDA L. Unit 1vu is unconsolidated at its base and becomes moderately welded nearer the overlying unit 2. Only the more prominent cooling fractures originating in unit 2 continue into the more welded upper section of unit 1vu but not in the lower, less consolidated section. More typically, fractures in unit 2 do not extend into unit 1vu.

*Unit 1vc.* Beneath unit 1vu is unit 1vc, where c stands for colonnade, named for the columnar jointing visible in cliffs formed from this unit. Unit 1vc is a poorly welded, devitrified ash-flow tuff at its base and top, and becomes more welded in its interior. Unit 1vc is approximately 25 ft (7.6 m) thick beneath MDA L.

### *Tshirege Member Unit 1g*

The basal contact of unit 1vc is marked by a rapid change (within 0.7 ft [0.2 m] vertical) from devitrified (crystallized) matrix in unit 1vc to vitric (glassy) matrix in the underlying unit 1g. Vitric pumices in unit 1g stand out in relief on weathered outcrops, but devitrified pumices above this interval are weathered out. In outcrop, this devitrification interval forms a prominent erosional recess termed the *vapor-phase notch*. No depositional break is associated with the vapor-phase notch; the abrupt transition indicates this feature is the base of the devitrification that occurred in the hot interior of the cooling ash-flow sheet after emplacement.

Unit 1g is a vitric, pumiceous, nonwelded ash-flow tuff underlying the devitrified unit 1vc. It is about 140 ft (42.7 m) thick at MDA L. Few fractures are observed in the visible outcrops of this unit, and weathered cliff faces have a distinctive Swiss-cheese appearance because of the softness of the tuff. The uppermost 5 ft to 20 ft (1.5 m to 6.1 m) of unit 1g are iron-stained and slightly welded. This portion of unit 1g is resistant to erosion, helping to preserve the vapor-phase notch in the outcrops. A distinctive pumice-poor surge deposit forms the base of unit 1g.

### Tsankawi Pumice Bed

The Tsankawi Pumice Bed (Qbtt) is the basal air-fall deposit of the Tshirege Member of the Bandelier Tuff. It is a thin bed of gravel-sized vitric pumice about 3 ft (1 m) thick beneath MDA L.

### Cerro Toledo Interval

The Cerro Toledo interval consists of thin beds of tuffaceous sandstones, paleosols, siltstones, ash, and pumice falls; the Cerro Toledo interval separates the Tshirege and Otowi Members of the Bandelier Tuff. The Cerro Toledo interval also includes localized gravel- and cobble-rich fluvial deposits predominantly derived from intermediate composition lavas eroded from the Jemez Mountains west of the Pajarito Plateau. This interval varies in thickness from 15 ft (4.6 m) to 30 ft (9.1 m) beneath MDA L.

### Otowi Member

The Otowi Member (Qbo) tuffs are about 80 ft (24.4 m) thick at MDA L. The tuffs are a massive, nonwelded, pumice-rich, and mostly vitric ash flow. The pumices are fully inflated, supporting tubular structures that have not collapsed as a result of welding. The matrix is an unsorted mix of glass shards, phenocrysts, perlite clasts, and minute, broken pumice fragments.

The Guaje Pumice Bed (Qbog) is the basal air-fall deposit of the Otowi Member of the Bandelier Tuff. The thickness of the unit has been measured at 10 ft (3.1 m) beneath MDA L. The pumice bed is nonwelded but brittle. Pumice tubes are partially filled with silica cement.

### Cerros del Rio Basalts (Tb 4)

In the vicinity of TA-54, the Cerros del Rio basalts lie directly beneath the Otowi Member of the Bandelier Tuff. In R-32, the basalts are 636 ft (193.9 m) thick; in R-22 the basalts are 983 ft (299.6 m) thick. In both wells, the regional water table occurs within these basalts. Examination of borehole cores drilled at MDA L during the Phase I RFI and during the 2004–2005 investigation showed that the basalts consist of both angular rubble and dense, fractured masses, with zones of moderately to very porous lavas. Deeper drilling at R-22 showed a wide variety of lithologies within the basalts, including massive flows, interflow rubble or scoria zones, sediments, and paleosols.

### Puye Formation (Tpf, Tpp) and Older Fanglomerate

The Puye Formation is a conglomerate deposit derived primarily from volcanic rocks to the west, with varying lithologies, including stream channel and overbank deposits, ash and pumice beds, debris flows and lahar deposits. Well tests on the plateau confirm that the unit is very heterogeneous with both high and low permeability zones present (Nylander et al. 2003, 76059). The formation is poorly lithified and as such is not likely to sustain open fractures.

The Puye Formation thins from west to east beneath TA-54. At supply well PM-2, the Puye Formation (including fanglomerate, pumiceous units and ancestral Rio Grande deposits) is approximately 800 ft (243.8 m) thick; at R-23 it is completely absent. Recent drilling across the plateau indicates that the Puye Formation is frequently underlain by alluvial fan deposits similar in lithology to the Puye but considerably older. These deposits are of considerable thickness at PM-2, were penetrated at R-22 (approximately 80 ft [24.4 m] thick), and were absent at R-23. The Puye Formation was also encountered at R-16 (351 ft [106.9 m] thick); the water table occurs at this depth within this formation.

### Totavi Lentil Deposits (Tpt)

The Totavi Lentil is an ancestral Rio Grande deposit that consists of coarse gravels and sands with abundant quartzite. The deposit has been alternatively conceptualized as a series of distinct north-south trending ribbons as well as a continuous thin sheet at the base of the Puye Formation. Like the overlying Puye Formation, it has both high and low permeability zones (Nylander et al. 2003, 76059).

### Santa Fe Group (Tsf, Tf, and Ts) and Santa Fe-Age Basalts (Tb 1 and Tb 2)

The Santa Fe Group is an alluvial-fan deposit consisting of medium to fine sands and clays. Numerous north-south trending faults are present in this unit. Santa Fe Group rocks are deep below TA-54 (1500 ft [457.2 m] bgs at PM-2) and were not penetrated by R-20, R-32, or R-22. Most water supply wells on the eastern edge of the Pajarito Plateau and elsewhere in the basin are completed in these rocks.

The Santa Fe Group units are characterized with the lowest permeability compared to the other units in the regional aquifer.

Basaltic lava flows occurred during the time the Santa Fe Group was deposited; these basalts occur both within the Santa Fe Group and within the pre-Puye sands, gravels, and conglomerates penetrated by R-20 and R-22. These old basalts appear to have fewer open fractures than the younger Cerros del Rio basalts.

### 4.4.2 Stratigraphic Units Encountered during MDA L Drilling

The subsurface conditions encountered beneath MDA L showed minor lateral variations in cooling unit thickness. The uppermost units encountered were cooling unit 2 (Qbt 2), which ranged in thickness from 26 ft to 42 ft, followed at depth by Qbt 1vu, which ranged in thickness from 62 ft to 86 ft (18.9 to 26.2 m), followed by the colonnade member Qbt 1vc, which ranged in thickness from 13 ft to 20 ft (4.0 to 6.1 m). The units Qbt 1g, Qbtt, and Qct were encountered beneath the colonnade unit in boreholes D-2 (54-24399) and C (54-24240): Qbt 1g was 123 ft to 128.5 (37.5 to 39.2 m) ft thick; Qbtt was less than 5 ft thick (1.5 m); and Qct was 36 ft to 39 ft (11.0 to 11.9 m) thick. Units Qbo and Qbog were encountered in borehole D-2 (54-24399) and were 81 ft and 12.5 ft (24.7 to 3.8 m) thick, respectively.

## 4.5 Groundwater Conditions

Borehole 54-24399 was drilled to 660 ft bgs to determine if perched groundwater is present in the vadose zone beneath Mesita del Buey at MDA L. Perched water was reported previously in basalt samples collected in RFI boreholes at locations 54-01015 and 54-01016 (Jansen and Taylor 1995, 44459; Jansen and Taylor 1995, 45978). Perched water was not encountered in this borehole. Moisture samples collected to a depth of 400 ft in boreholes D-1 (54-24241) (from 0 to 250 ft [0 to 76.3 m] bgs) and D-2 (54-24399) (from 385 to 400 ft [117.4 to 122 m] bgs), showed moisture levels below saturation in all samples collected (see Section 6.3.2). These samples included core material from the Puye Formation paleosol. Moisture samples were not collected in D-2 (54-24399) from 400 to 660 ft (122 to 201.3 m) bgs because core could not be recovered; however, cuttings from this interval did not display evidence of saturation. Camera logging conducted in uncased interval of borehole D-2 (54-24399) from approximately 560 to 660 ft (170.8 to 201.3 m) bgs showed no signs of perched zones within the Cerros del Rio basalts (Appendix C). Neutron logging results indicate the effects of alternating intervals of massive, vesicular, and cavernous rock on the measurement. The varying density of rock does not allow for these data to be correlated with moisture content data; however, repeated measurements may identify changes in moisture content through time.

## 4.6 Surface Air and Subsurface Vapor Conditions

After drilling was completed, pore-gas samples were collected for VOC analysis from boreholes A through G, following ENV-ECR SOP-06.31, Rev. 1, Sampling of Sub-Atmospheric Air, and using a straddle packer to isolate discrete depths within the borehole after allowing for equilibration of pore gas. Each interval was purged before sampling until measurements of carbon dioxide and oxygen were stable and representative of subsurface conditions. Subsurface pore-gas samples were collected in SUMMA canisters and submitted to an off-site contract laboratory for VOC analysis using Environmental Protection Agency (EPA) Method TO-15 and in silica gel samplers for tritium analysis using EPA Method 906.0.

The QA/QC samples for VOCs in pore gas consisted of an equipment blank and a field duplicate for each sampling round. After sampling and purge decontamination, the equipment blank was collected by pulling zero gas (99.9% ultrahigh-purity nitrogen) through the packer sampling apparatus. This sample was used to evaluate decontamination procedures. The field duplicate pore-gas sample was collected to evaluate the reproducibility of the sampling technique. The QA/QC samples were collected once during each sampling event in accordance with ENV-ECR SOP-01.05, Rev. 1, Field Quality Control Samples.

Pore gas samples were also collected to determine the lateral and vertical extent of the subsurface tritium at MDA L. Samples from noninstrumented boreholes were collected using an inflatable straddle-packer system. Samples were collected as water vapor by pulling pore gas through columns filled with absorbent silica gel in accordance with ENV-ECR SOP-06.31, Rev. 1, Sampling of Sub-Atmospheric Air. After allowing time for equilibration, the newly completed boreholes were sampled from the depth equal to the base depth of the adjacent disposal unit and at TD. QA/QC samples were collected according to applicable SOPs. Tritium samples were analyzed in water from the pore-gas samples using EPA Method 906.0.

Air permeability data was not collected during this investigation. However, the bulk permeability of the media may be inferred from data collected in boreholes at the site (SEA 1997, 87918). Anemometry measurements from the site provide information on the bulk flow within the media. These data indicated that in the upper 300 ft of strata, surface air flow is least restricted by the matrix within the Cerro Toledo interval. Subsequent discrete-point permeability measurements confirmed the Cerro Toledo has a higher permeability than the other stratigraphic layers (3–10 D compared to 0.2–0.9 D). Figure 4.6-1 shows both the anemometry and discrete-point permeability measurements from borehole at location 54-01018. The variability in the anemometry readings within the Qbt 1g unit resulted from measurement variability; however, the general data trend is consistent with the permeability results and the conceptual site model.

Tritium in air readings was collected during two biweekly sampling events in the breathing zone for an on-site worker at the MDA L fenceline. For the two-week period ending on April 11, 2004, the average tritium activity per unit volume was 0.92 pCi/m$^3$. For the two-week period ending on April 25, 2005, the average tritium activity per unit volume was 0.37 pCi/m$^3$.

Ambient air in eight selected structures at MDA L was sampled using SUMMA canisters. The sampling event is reported in Appendix K. A total of eight samples and one duplicate sample were collected over an 8-hr period on February 19, 2004. The SUMMA samples were analyzed by EPA Method TO-15.

## 5.0 REGULATORY CRITERIA

This section describes the regulatory criteria used for screening sample results and for evaluating potential risk to receptors. Regulatory criteria identified in Section XI.C.8 of the Consent Order include cleanup standards, risk-based screening levels, and risk-based clean-up goals, and are established by medium. These criteria are discussed in the following subsections. Applicable criteria identified in this section are included in the data tables in Section 6 and Appendixes F and G.

### 5.1 Screening Levels

Screening levels for chemicals in sediment and tuff are NMED soil screening levels (SSLs) as presented in the "Technical Background Document for Development of Soil Screening Levels" (NMED 2004, 85615). In accordance with this guidance, if an NMED SSL is not available for a chemical, the EPA Region 6 human health media-specific screening level is used as the SSL (adjusted to $10^{-5}$ risk for carcinogens) (EPA 2004, 87478). Both residential and industrial SSLs are presented in chemical data tables and in the risk assessment (Appendix G) for comparison with analytical results.

Screening levels for radionuclides in sediment and tuff are screening action levels (SALs) based on 15 mrem/yr exposure and are derived using RESRAD, Version 6.21 (LANL 2005, 88493). SALs for both residential and industrial exposure are presented in radionuclide data tables and in the risk assessment (Appendix G) for comparison with analytical results.

Screening levels for VOCs and tritium in pore vapor have not been established for MDA L. These data were collected to determine the nature and extent of subsurface vapor plumes to evaluate contaminant transport and potential corrective measures. Although no screening levels for VOCs in the pore gas are available, the NMED letter approving the MDA L work plan with modifications requires that ambient-air quality standards be used for comparison to pore-gas values (NMED 2004, 89306). EPA Region 6 screening levels for ambient air are provided in the pore-gas data table to fulfill this requirement (Table 6.6-1; Table G-4.1-15 in Appendix G). OSHA-permissible exposure limits (PELs) and ACGIH–threshold limit values (TLVs) are applicable to indoor air in work places, and these values are compared with the indoor VOC data collected at MDA L. This comparison is presented in Tables K-1.1-2 and K-1.1-4 in Appendix K. In addition, tritium in air measurements were compared with the EPA standard for inhalation of 10 mrem/yr.

### 5.2 Cleanup Goals

The cleanup goals specified in Section VIII of the Consent Order are a target risk level of $10^{-5}$ for carcinogens or a hazard index (HI) of 1 for noncarcinogens. DOE has established a cleanup goal of 15 mrem/yr incremental exposure for radioactively contaminated sites. The screening levels described in Section 5.1 are based on these cleanup goals. As specified in Section VIII.B.1 of the Consent Order, the screening levels may be used as cleanup levels unless determined to be impracticable or unless SSLs do not exist for the current and reasonably foreseeable future land use. The cleanup levels to be used at MDA L will be determined during the corrective measures evaluation (CME).

## 6.0 SITE CONTAMINATION

The approved work plan was designed to provide the data necessary to complete the evaluation of the nature and extent of subsurface contamination from historical waste disposal activities. This section presents the analytical results for sediment, rock, and vapor sampling conducted under the approved work plan field activities.

### 6.1 Tuff and Sediment Sampling

### 6.1.1 Sediment Sampling

One sediment sample was collected in 2005 adjacent to Phase I RFI sample location 54-05148 (Figure 2.0-3). The location was selected to complete the characterization of the channel that drained storm water from the surface of MDA L before the asphalt surface was emplaced. Phase I RFI sampling at this location in 1994 detected low concentrations of methoxychlor[4,4‘-] and plutonium-238. The 2005 sediment sample was collected at the interface of the alluvial sediments and bedrock and submitted to an off-site contract laboratory for analysis of TAL metals, cyanide, pesticides/PCBs, nitrates, perchlorate, americium-241, isotopic plutonium, isotopic uranium, strontium-90, and tritium.

### 6.1.2 Subsurface Sampling

Subsurface samples were collected from eight boreholes within and adjacent to MDA L. Analytical samples for determining the nature and extent of contamination were collected from the seven shallow boreholes, and geotechnical and hydrogeological samples were collected from boreholes D-1 (54-24241) and D-2 (54-24399). The samples were collected from these eight boreholes from predetermined depths according to the approved work plan and from selected depth intervals that showed unusual lithologies or fractures. The locations of these boreholes and their identification numbers are presented in Figure 3.3-1 and Table 3.3-1.

Table 6.1-1 presents the date, depth interval, lithological unit, and analyte list for each sample collected during this investigation by borehole location. In addition, field-screening results and sample lithology descriptions are presented in the borehole logs in Appendix C.

## 6.2 Tuff and Sediment Sampling Field-Screening Results

All recovered core samples were screened for radioactivity and VOCs, and the selected core samples were screened for inorganic chemicals and high explosives (HE). The core was sampled and logged after field-screening. In addition to the prescribed sampling intervals, seven samples were collected after visual examination of core for lithology with greater porosity, fractures, and staining. Five samples were collected based on the presence of fractures, and two samples were collected based on changes in lithology indicating a possible increase in porosity. No staining was present in any core sample.

Screening for gross alpha and gross beta radiation was performed using an Eberline E-600 portable radiation monitor and an SHP-38AB scintillation detector. These instruments were borrowed from and returned daily to the Heath, Safety, and Radiation Protection (HSR) 1 Group, which conducted daily performance and operational checks. Screening was conducted in accordance with ENV-ECR SOP-10.07, Field Monitoring for Surface and Volume Radioactivity Levels, and field personnel were given hands-on training with the instruments by HSR-1 personnel. Radiological screening results were recorded in the borehole logs (Appendix C). The results of radiological field-screening cannot be compared between boreholes because background radiation values varied with geographic location across the site.

Organic vapor monitoring was performed using a Rae Systems, Inc., MiniRae 2000, Model PGM-7600 PID with an 11.7-eV bulb to monitor the core immediately after the core barrels were opened. Headspace screening was conducted on core samples at 10-ft intervals. Screening was conducted in accordance with ENV-ECR SOP-06.33, Headspace Vapor Sampling with a Photoionization Detector. PID readings were recorded in the borehole logs (Appendix C). While valuable for screening for high concentrations of VOCs, the PID is susceptible to moisture and can fluctuate as the detectable concentration decreases with atmospheric moisture, which interferes with the detection instrumentation. Therefore, no biased samples were submitted for VOC analyses based on PID readings.

Field-screening for inorganic chemicals was conducted using Innov-X-Systems XRF instrument, Model XT-440. Screening methodology followed ENV-ECR SOP-10.08, Operation of the Spectrace 9000 Field Portable X-Ray Flourescence Instrument. Screening was conducted on core samples at a minimum of three depths from the following boreholes and locations: A (54-24242), B (54-24239), C (54-24240), and D-1 (54-24241). The results and a discussion of the XRF data are presented in Appendix L.

Screening for HE was conducted using D-Tech test kits for the explosive compounds trinitrotoluene (TNT) and 1,3,5-trinitro-1,3,5-triazine (RDX) at the TD of each borehole. No HE was detected during MDA L field-screening activities. The results of the HE field-screening are presented in the borehole logs (Appendix C).

## 6.3 Tuff and Sediment Sampling Analytical Results

The MDA L IR data set includes a sediment sample and rock samples from seven boreholes, two outdoor ambient-air tritium samples, and one indoor air-sampling event (described in Appendix K). Field-related QA/QC samples include field duplicates and trip blanks. In addition, the analytical laboratory used specific QA/QC procedures to ensure data quality. These procedures are described in Appendix D. The analytical results, analytical reports, chain-of-custody forms, and data validation reports are provided in Appendix E, and the data validation results are summarized in Appendix D. The results of analytical testing at MDA L are summarized below.

### 6.3.1 Sediment Sampling

Analytical results for the sediment sample are presented in Appendix E. To determine inorganic COPCs and to evaluate nature and extent of contamination, inorganic chemicals, and naturally occurring radionuclides were screened against sediment BVs. Radionuclides associated with atomic weapons testing were compared with FVs. Organic chemicals detected are retained as COPCs.

No radionuclide or inorganic chemicals were detected at levels exceeding BVs or FVs.

The only organic COPC detected in channel sediments during this round of sampling was Aroclor-1260 at a concentration of 0.0013 mg/kg (Figure 6.3-1).

### 6.3.2 Subsurface Sampling

Core samples were collected from six boreholes and submitted to an off-site analytical laboratory for analysis of VOCs, SVOCs, PCBs, pesticides, dioxins, furans, inorganic chemicals, explosive compounds, and radionuclides. The results for subsurface samples are presented in Appendix E. Subsurface sampling data is reviewed in Appendix F. To determine the COPCs and to evaluate the nature and extent of contamination, subsurface data for inorganic chemicals and naturally occurring radionuclides were screened against BVs for individual stratigraphic units. Organic chemicals and fallout radionuclides detected are retained as COPCs.

#### Organic Chemicals Detected in Rock Samples beneath MDA L

Table 6.3-1 presents inorganic chemicals detected above BVs by borehole and depth. Aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, magnesium, manganese, nickel, potassium, vanadium, and zinc (one sample) were detected above their respective BVs. Figure 6.3-2 shows the locations and the depths of inorganic chemicals detected above BVs.

#### Inorganic Chemicals Detected in Qbt 2

Barium, lithium, nitrate, and selenium were detected in unit Qbt 2. Barium was detected at a concentration above BV in one of seven samples collected within Qbt 2 in borehole E (54-24238); this value (51.6 mg/kg) was equivalent to the maximum concentration in the background data set (LANL 1998, 59730). Selenium was not detected above BV; however, the DLs for six of seven selenium analyses were greater than the BV. Lithium and nitrate do not have BVs.

### Inorganic Chemicals Detected in Qbt 1v

Arsenic, barium, beryllium, copper, cyanide (total), fluoride, lithium, nickel, nitrate, perchlorate, and selenium were detected in samples from unit Qbt 1v. Cyanide was not detected above BV. Arsenic was detected at concentrations above BV in 7 of 31 samples. Barium, beryllium, copper, nickel and selenium were detected above BV in 1 or 2 of 31 samples. Perchlorate was detected in one sample from borehole E (54-24238) and in two samples from borehole B (54-24239). Fluoride, lithium, nitrate, and perchlorate do not have established BVs.

### Inorganic Chemicals Detected in Qbt 1g

Inorganic chemicals detected above BV in Qbt 1g included aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, vanadium, and zinc. Arsenic, barium, iron, and manganese were detected at concentrations above BVs in 11 to 14 of the 21 samples collected; the remaining inorganic chemicals were detected above BVs in 1 to 3 samples. Eleven nondetected selenium results and 17 nondetected cadmium results had DLs greater than the respective BVs. Fluoride, lithium, nitrate, and sulfate were detected in Qbt 1g samples; however, no BVs exist.

### Inorganic Chemicals Detected In Qbo

One sample was collected from Qbo beneath MDA L at a depth of approximately 300 ft in borehole C (54-24240). Aluminum, barium, iron, and magnesium were detected at levels slightly above their respective BVs. Lithium and nitrate also were detected; however, no BVs exists for these chemicals. Cadmium was not detected; however, the DL was greater than the BV.

### Organic Chemicals Detected in Rock Samples beneath MDA L

Two samples were collected from each of the six shallow boreholes for analysis of organic chemicals: one at the depth that corresponds with the base of the closest waste disposal unit, and one at the TD of the borehole. In borehole D-1 (54-24241), samples were collected from the depth corresponding to the base of the closest waste disposal unit and from the 245- to 250-ft depth interval.

Analytes detected include VOCs (including chlorinated VOCs [CVOCs], SVOCs, dioxin/furans, explosive compounds, and PCBs. Table 6.3-2 presents organic chemicals detected by borehole and depth. Figure 6.3-3 shows the organic chemicals detected in each of the six shallow boreholes.

The CVOCs, primarily TCA, 1,1-dichloroethane, 1,2-dichloroethane, and TCE, were detected in µg/kg concentrations in rock samples in four boreholes (Figure 6.3-3). Dioxin and furan congeners were detected at concentrations ranging from 0.0000001 mg/kg to 0.000599 mg/kg in samples from six of the boreholes at MDA L; they were not detected in samples from borehole F (54-24243). Aroclor-1254 and Aroclor-1260 were detected in one sample from the 62.3- to 67.2-ft interval in borehole C (54-24240). Butylbenzylphthalate and bis(2-ethylhexyl)phthalate were detected in one and two samples, respectively, at concentrations near the EQL; each of the three detected concentrations was in a different borehole. Explosive compounds and pesticides were not detected in rock samples collected beneath MDA L.

**Radionuclides Detected in Rock Samples beneath MDA L**

Uranium-235 was detected in Qbt 1v at a concentration of 0.144 pCi/g versus the background of 0.14 pCi/g (Table 6.3-3). No other radionuclides were detected or detected above BVs in core samples beneath MDA L.

**Results of Moisture Analyses from Boreholes D-1 (54-24241) and D-2 (54-24399)**

Fifty-one samples for analytical laboratory analyses of moisture content and matric potential were collected at approximately 5-ft intervals to a depth of 250 ft from borehole D-1 (54-24241). Three moisture and matric potential samples were collected at 5-ft intervals from 385 ft to 400 ft in borehole D-2 (54-24399). The results of these analyses are presented in Table 6.3-4. Gravimetric moisture content results ranged from 1.3% to 27.9%. The moisture content in Qbt 2 ranged from 6.2% to 9.2%, with a mean of 7.3%. The moisture content in Qbt 1v ranged from 2.1% to 9.1%, with a mean of 5.3%. The moisture content in Qbt 1g ranged from 5.5% to 11.3%, with a mean of 7.9%. The median values for all units were within 0.5% of the mean values. One moisture content sample, collected from borehole D-2 (54-24399) from the paleosol layer overlying the basalt showed a moisture content of 27.9%. One sample collected at a depth of 385 ft to 390 ft from the basalt, in borehole D-2 (54-24399) showed a moisture content of 1.3%. Matric potential measurements ranged from –2.1 bars to –8.2 bars, indicating that none of the samples submitted for moisture analysis were saturated (negative matric potential readings indicate unsaturated conditions). The paleosol sample showing the moisture content of 27.9% had a matric potential reading of –6.2 bars.

**Results of Materials Testing from Boreholes D-1 (54-24241) and D-2 (54-24399)**

The approved work plan called for collecting samples to analyze for saturated and unsaturated hydraulic conductivity, porosity, and bulk-density analyses. These samples were not collected because sufficient intact core could not be recovered.

## 6.4 Subsurface Vapor Sampling

In each shallow borehole, vapor samples for VOCs and tritium were collected at the base depth of the nearest adjacent disposal unit and at total depth of the borehole. In borehole D-2 (54-24399), vapor samples for VOCs and tritium were collected from the open borehole interval from (550 ft to 608 ft) below the casing. In addition to SUMMA canisters for VOC analyses and silica gel samples for tritium analysis, screening data collected in the field during sampling included TCA, TCE, trichloro-1,2,2-trifluoroethane[1,1,2-] (Freon-113), tetrachloroethene (PCE), carbon dioxide, water vapor using a Bruel & Krajer (B&K) multigas analyzer Model 1302, and percent carbon dioxide using a Landtec landfill gas indicator.

## 6.5 Subsurface Vapor Field-Screening Results

Following borehole completion, pore-gas samples were collected and analyzed in the field using a downhole straddle-packer system to isolate the sampling interval, and a B&K analyzer was used to analyze VOC concentrations. Each sampling interval was purged before sampling until measurements of carbon dioxide and oxygen measurements were stable and represented subsurface conditions. The field-screening results along with sampling depths are presented in Table 6.5-1.

## 6.6 Subsurface Vapor Sampling Analytical Results

Pore-gas samples were sent to an off-site laboratory for analysis of VOCs and tritium.

Samples from the boreholes installed during the 2005 investigation reported detected concentrations of multiple VOCs. Table 6.6-1 presents the VOCs detected in pore gas by depth in boreholes drilled under the approved work plan. Figure 6.6-1 shows the VOCs detected in pore-gas samples collected at MDA L. TCA was the primary VOC detected, followed consistently across the site by TCE, PCE, and Freon-113. Concentrations of TCA ranged from 200 μg/m$^3$ to 2,200,000 μg/m$^3$. Figure 6.6-2 is a schematic that shows TCA concentrations in pore gas beneath MDA L. The highest concentrations were detected in the boreholes closest to the eastern and western disposal shaft fields. The TCA was detected at a concentration of 2,000,000 μg/m$^3$ in two boreholes adjacent to the eastern shaft field: borehole E (54-24238) at a depth of 65 ft, and borehole F (54-24243) at a depth of 130 ft. The highest TCA concentration (2,200,000 μg/m$^3$) was reported at a depth of 65 ft in borehole C (54-24240) in the vicinity of the western shaft field. TCA was detected in the deepest sample interval (550 ft to 608 ft) from borehole D-2 (54-24399) within the Cerros del Rio basalts at a concentration of 200 μg/m$^3$.

In addition to the CVOCs, fluorinated organic compounds were also detected beneath MDA L. Freon-113 was detected in all eight boreholes at concentrations ranging from 100 μg/m$^3$ to 480,000 μg/m$^3$. The highest concentrations were found in boreholes in the central portion of MDA L and near the eastern shaft field.

Tritium samples collected from all eight boreholes detected tritium concentrations ranging from 1270 pCi/L (borehole E [54-24238] at 108 ft) to 153,000 pCi/L (borehole F [54-24243] at 65 ft) (Table 6.2-2). The highest tritium readings were beneath the eastern portion of the facility (Figure 6.6-3). In addition, tritium was detected at 20,400 pCi/L in the Cerros del Rio basalts at a depth interval of 550 to 608 ft in borehole D-2 (54-24399), which is higher than the 19,500 pCi/L result from the deepest sample (154 ft to 156 ft bgs) in the nearest borehole, D-1 (54-24241).

Ambient air in eight selected structures at MDA L was sampled using SUMMA canisters. The sampling event is reported in Appendix K. Analytical results are summarized in Table K-1.1-2. TCA was the dominant VOC detected. The two highest TCA measurements were 817.95 μg/m$^3$ [0.1500 ppmv] and 1145.13 μg/m$^3$ [0.2100 ppmv]) detected in samples collected from Structure 54-215 within the Area L fenceline. Multiple other VOCs were measured at very low concentrations. Concentrations of the individual analytes and analyte mixtures were compared with the ACGIH threshold limit values (TLVs) or OSHA PELs, and they were found to be below the published exposure limits (Tables K-1.1-2 and K-1.1-4, Appendix K).

## 7.0 CONCLUSIONS

The MDA L field investigation was designed to provide data to complete an assessment of the nature and extent of contamination resulting from the historical waste disposal activities at MDA L. These data complement the data collected between 1994 and 1995 as part of the Phase I RFI and the quarterly pore-gas monitoring conducted from 1997 to present.

### 7.1 Summary of Phase I RFI Data

In sediment samples, plutonium-238 was the only radionuclide detected above its FV at a concentration of 0.011 pCi/g. No inorganic chemicals were detected above sediment BVs in the drainage channel at MDA L. However, the analytical DLs for cadmium, selenium, and silver exceeded the sediment BVs. These inorganic chemicals were retained as COPCs. The pesticide methoxychlor[4,4'-] was the only organic chemical detected in two samples at concentrations of 0.028 mg/kg (borehole location 54-05143) and 0.063 mg/kg (borehole location 54-05145).

The core data collected during the Phase I RFI indicated several inorganic chemicals, organic chemicals, and tritium in subsurface tuff beneath Pit A, Impoundments B, C, and D, and the two shaft fields. Concentrations of barium, chromium, cobalt, copper, manganese, nickel, uranium, and zinc were detected above BVs in core samples beneath MDA L. Nineteen VOCs were detected in core samples, most at trace concentrations (i.e., less than or slightly above the EQLs) in five shallow boreholes angled beneath Pit A and Impoundments B, C, and D and in two deep-angled boreholes drilled beneath Shafts 1 through 34 and Pit A. Two pesticides, DDD[4,4'-] and methoxychlor[4,4'-], were each detected in one sample (borehole location 54-01011). Aroclor-1260 was also detected in one sample (borehole location 54-01010). Tritium was the only radionuclide detected in core samples during the Phase I RFI that was retained as a COPC.

## 7.2 Summary of Quarterly Pore-Gas Results

Ongoing quarterly pore-gas monitoring conducted since 1997 indicates that the highest concentrations of vapor-phase VOCs are located in close proximity to two source areas: the western and eastern disposal shaft fields. The primary vapor-phase contaminant detected beneath MDA L was TCA; other compounds detected included TCE, PCE, and Freon-113. Concentrations of vapor-phase VOCs decreased in all directions from the two source areas. The most prevalent VOC detected was determined to be TCA and thus is the best indicator of the extent of the VOC plumes. The highest vapor-phase concentrations of TCA were found in borehole locations 54-02002, located immediately south of the eastern shaft field, and 54-02022, located northwest of the western shaft field.

Pore-gas monitoring also confirmed the following:

- Vertically, the plumes extend from ground surface to the top of the basalt (approximately 320 ft bgs).
- Laterally, the plumes extend north-south about 1000 ft in diameter and east-west approximately 450 ft (the width of the mesa).
- The plumes are changing very little in area or contaminant concentrations over time (1999 to the present).
- The concentrations of the 11 most frequently detected VOCs have remained relatively constant over time or have decreased slightly over time.

## 7.3 Results of the MDA L Work Plan Investigation

During the 2004–2005 field investigation, seven shallow boreholes and one deep borehole were drilled at MDA L to collect rock and pore-gas samples to determine the nature and extent of contamination at the site.

One sediment sample was collected to confirm the presence of COPCs from the Phase I RFI. During 2005 sampling, no radionuclide or inorganic chemicals were detected at levels that exceeded BVs or FVs in channel sediments. The only organic chemical detected in channel sediments during this round of sampling was Aroclor-1260 at a concentration of 0.0013 mg/kg.

Rock samples confirmed the presence of a number of organic chemicals at trace levels beneath the former disposal units and were consistent with the results obtained during the Phase I RFI. The primary organic chemicals detected included CVOCs and trace levels of several dioxin and furan congeners. The CVOCs are present at low concentrations (µg/kg) and appear to be the result of multiphase partitioning from the vapor plumes. Other VOCs detected beneath MDA L appear to be isolated occurrences and not the result of an on-going release from the former waste disposal units

Concentrations of inorganic chemicals detected beneath MDA L were indicative of natural variability within the various stratigraphic layers. In unit Qbt 2, the unit adjacent to the base of the disposal pit and impoundments, the only inorganic chemical detected above BV was barium at 33 ft to 35 ft bgs in borehole E (54-24238). This value was only 12% above the Qbt 2 BV for barium and within the range of background concentrations. In Qbt 1v, the unit underlying the disposal shafts, arsenic, barium, beryllium, copper, nickel, and selenium were detected above BVs in one to seven samples. All detected concentrations were less than two times the Qbt 1v BVs (a few tenths of a mg/kg to several mg/kg above the BVs). Although lithium, fluoride, nitrate, and perchlorate were detected and have no BVs, their concentrations probably reflect naturally occurring levels.

Inorganic chemicals identified as COPCs in the Phase I RFI were detected in subsurface rock samples collected during the 2005 investigation; in addition, other inorganic chemicals were detected above BVs. Inorganic chemicals detected above BVs generally were preceded or followed at depth by concentrations lower than their respective BVs. Inorganic chemicals detected above BVs did not show any discernable trends to indicate a release from any of the historical waste units at MDA L.

Only one radionuclide result was above its BV. Uranium-235 was detected at a concentration of 0.144 pCi/g in a Qbt 1v sample compared to its uranium-235 Qbt 1v BV of 0.14 pCi/g.

Analytical results from pore-gas samples collected from the eight boreholes drilled in 2004–2005 confirmed the presence of vapor-phase plumes consisting primarily of chlorinated VOCs. The nature and extent of the VOC plumes have been defined. The most prevalent vapor-phase contaminants were TCA, TCE, PCE and Freon-113. Data collected during implementation of the Phase I RFI work plan and ongoing quarterly vapor-plume monitoring indicated that the plumes were centered on the eastern and western disposal shaft fields. Both plumes are limited at depth by the Cerros del Rio basalt layer. Analytical results from the boreholes drilled under the approved work plan and recent quarterly monitoring data confirmed the shaft fields to be the sources of the plumes. Recent data also confirm that the VOC plumes are in a near steady state, and the vapor-phase concentrations do not indicate the presence of a free liquid source in the subsurface beneath MDA L. The TCA was detected at 200 $\mu g/m^3$ in a pore-gas sample collected in the basalt layer at a depth of 550 ft to 608 ft, indicating the VOC plumes extend into the basalt.

Tritium was detected in pore-gas samples collected from all eight boreholes. The highest concentration (153,000 pCi/L) was detected beneath the eastern portion of MDA L. Increasing concentrations with depth in several boreholes, along with the detection of tritium in the deepest sample within the Cerros del Rio basalts, indicates that tritium concentrations to nondetect have not been bound at depth.

Subsurface samples were collected from boreholes D-1 (54-24241) and D-2 (54-24399) to evaluate moisture properties and to determine if perched water zones are present beneath MDA L. Detailed lithological logging of core did not identify visibly saturated zones to a depth of 400 ft. Fifty-one samples, collected at approximately 5-ft intervals, were submitted to a contract laboratory to analyze for moisture content and matric potential analyses. The results of gravimetric moisture analyses showed moisture levels ranging from 1.3% to 27.9% moisture by weight, with all samples except one showing moisture levels less than, or equal to, 11.3%. Laboratory matric potential readings confirmed all samples collected beneath MDA L contained moisture levels below saturation.

Perched groundwater was not encountered during drilling beneath MDA L. Moisture samples collected to a depth of 400 ft in boreholes D-1 ([54-24241] from 0 to 250 ft bgs) and D-2 ([54-24399] from 385 to

400 ft bgs) identified no saturated intervals. Because sample recovery was low, moisture samples were not collected in borehole D-2 (54-24399) from 400 to 660 ft bgs. Camera logging conducted in this borehole from approximately 560 ft to 660 ft showed no signs of a perched zone within the Cerros del Rio basalts.

### 7.4 Summary of Risk Assessment Results

The present-day risk assessment for MDA L concluded that surface and subsurface contamination at the site does not pose a potential unacceptable risk to human health from exposure to ambient air or from inorganic, organic, or radionuclide COPCs in the sediment.

The results of the human health risk assessment indicated that present-day noncarcinogenic and carcinogenic risks (HI of 0.001 and cancer risk of $2 \times 10^{-9}$) for an industrial-site worker were less than NMED's target levels of an HI of 1.0 and cancer risk of $10^{-5}$ (NMED 2004, 85615). Potential dose for an industrial-site worker from plutonium-238 at MDA L is approximately 0.0007 mrem/yr, which is below the DOE's target dose of 15 mrem/yr (DOE 2000, 67489). The equivalent risk for the dose is $7 \times 10^{-10}$ based on a comparison to EPA radiation preliminary remediation goals (PRGs) for an industrial scenario (http://epa-prgs.ornl.gov/cgi-bin/epa-prgs). In addition, the measurement and assessment of VOCs and tritium in buildings and ambient air, respectively, do not indicate any potential unacceptable present-day risks/doses to site workers.

Contamination in channel sediment and tuff does not pose a potential risk to ecological receptors. Methoxychlor[4,4'-] and Aroclor-1260 were detected in 2 and 1 sediment samples, respectively, and had hazard quotients (HQs) less than 0.3. Plutonium-238 was detected in 4 samples but had HQs less than 0.3. Inorganic chemicals of potential ecological concern (COPECs) were either not detected in channel sediment or had detected concentrations below BVs. Potential exposure to the inorganic COPECs is similar to background. Pore-gas VOCs may potentially impact burrowing animals based on the inhalation HI. However, no burrows are present within the fence at MDA L because the surface is paved with asphalt. The presence of active burrows outside of the fenced source area to the west of MDA L indicates that pore-gas VOCs may not be a factor limiting or preventing gopher burrows.

## 8.0 RECOMMENDATIONS

The objectives of the approved work plan were to

- complete the characterization of the nature and extent of contaminant releases at MDA L,
- evaluate the potential ecological and human health risks posed by exposure to COPCs under present-day conditions, and
- recommend a path forward to reduce uncertainties associated with contaminant behavior and to ensure that existing COPCs do not pose an unacceptable risk/dose to human and ecological receptors.

Data gathered during the Phase I RFI, from ongoing quarterly monitoring, and from the 2004–2005 investigation have characterized the nature and extent of contamination in the drainage and subsurface media. In addition, the results from human health and ecological impact assessments presented in Appendix G indicate that MDA L poses no unacceptable present-day risk to human health and the environment.

Therefore, based on the results of the field investigations, the recommended actions are as follows:

- Complete a CME to ensure potential future releases from the site pose no unacceptable risks to human and ecological receptors; activities to be conducted as part of the CME process include
    - ♦ evaluating the results of the in situ soil vapor extraction pilot study and recommending a treatment and management strategy for the subsurface vapor-phase VOC plumes to ensure that human health and the environment are protected,
    - ♦ evaluating containment and excavation alternatives for Pit A and Impoundments B, C, and D to ensure human health and the environment are protected, and
    - ♦ evaluating containment alternatives for the shafts to ensure human health and the environment are protected.
- Monitor the subsurface vapor plumes in accordance a long-term monitoring plan (Appendix I) approved by NMED.

## 9.0 REFERENCES AND MAP DATA SOURCES

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*Copies of the reference library are maintained at the NMED Hazardous Waste Bureau; the DOE Los Alamos Site Office; and EPA, Region 6. This library is a living collection of documents that was developed to ensure that the administrative authority has all the necessary material to review the decisions and actions proposed in this document. However, documents previously submitted to the administrative authority are not included.*

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Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Development Edition of 06 January 2005.

Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, ENV-Environmental Remediation and Surveillance Program, ER2005-0401; 16 June 2005.

Primary Electric Grid; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 05 January 2005.

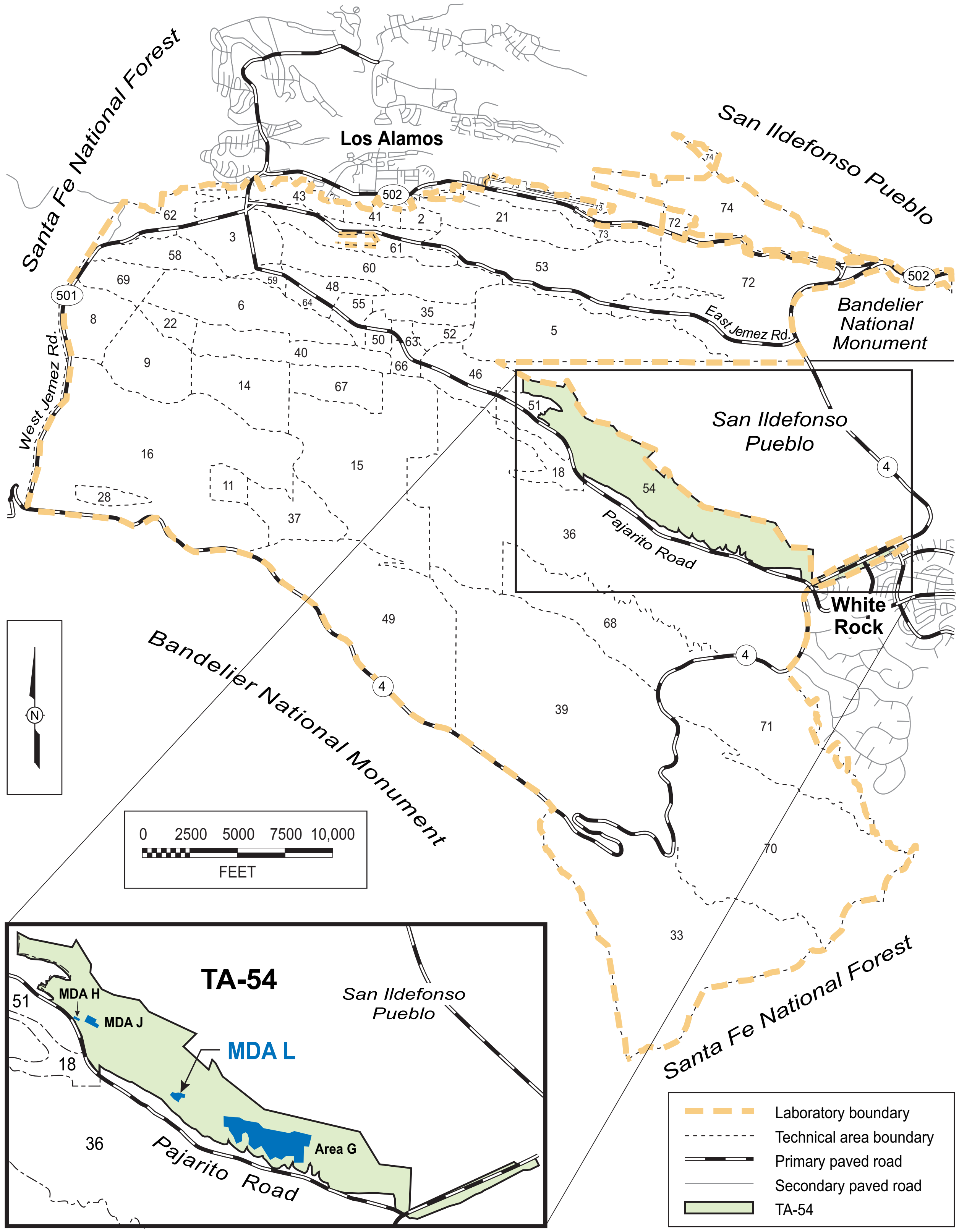
Security and Industrial Fences and Gates; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; 06 January 2004; Development Edition of 06 January 2005.

Sewer Line System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Development Edition of 05 January 2005.

Structures, line feature data; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Development Edition of 22 June 2005.

Waste Storage Features; Los Alamos National Laboratory, ENV-Environmental Remediation and Surveillance Program, ER2005-0322; 1:2,500 Scale Data; 10 August 2005.

Water Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Development Edition of 05 January 2005.



F2.0-1, MDA L IR, 082605, ptm

**Figure 2.0-1. Location of MDA L in TA-54 with respect to Laboratory technical areas and surrounding land holdings**

Figure 2.0-2. Locations of subsurface disposal units and utilities at MDA L in TA-54

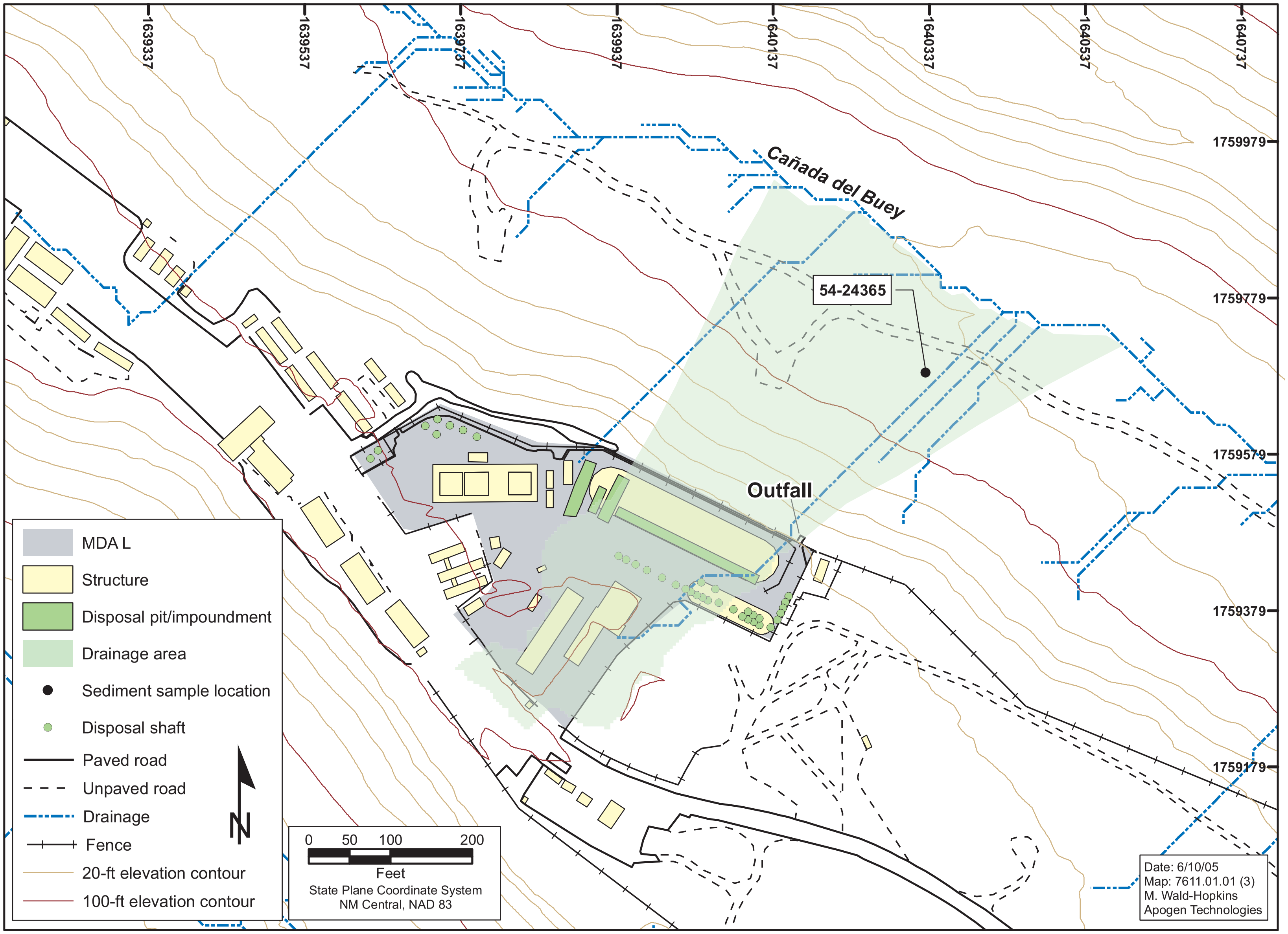


**Figure 2.0-3.** MDA L drainage area and channel sediment sampling location

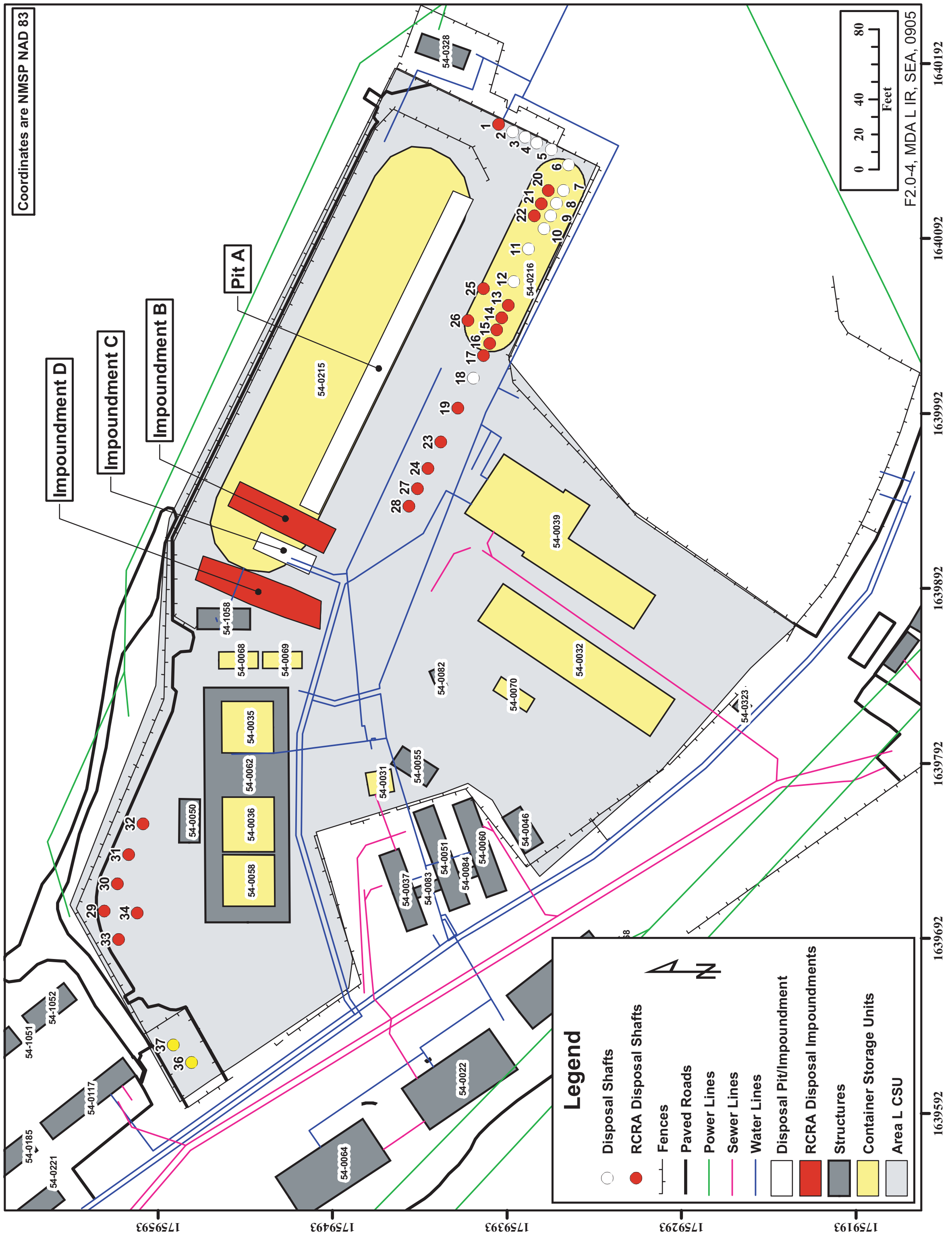
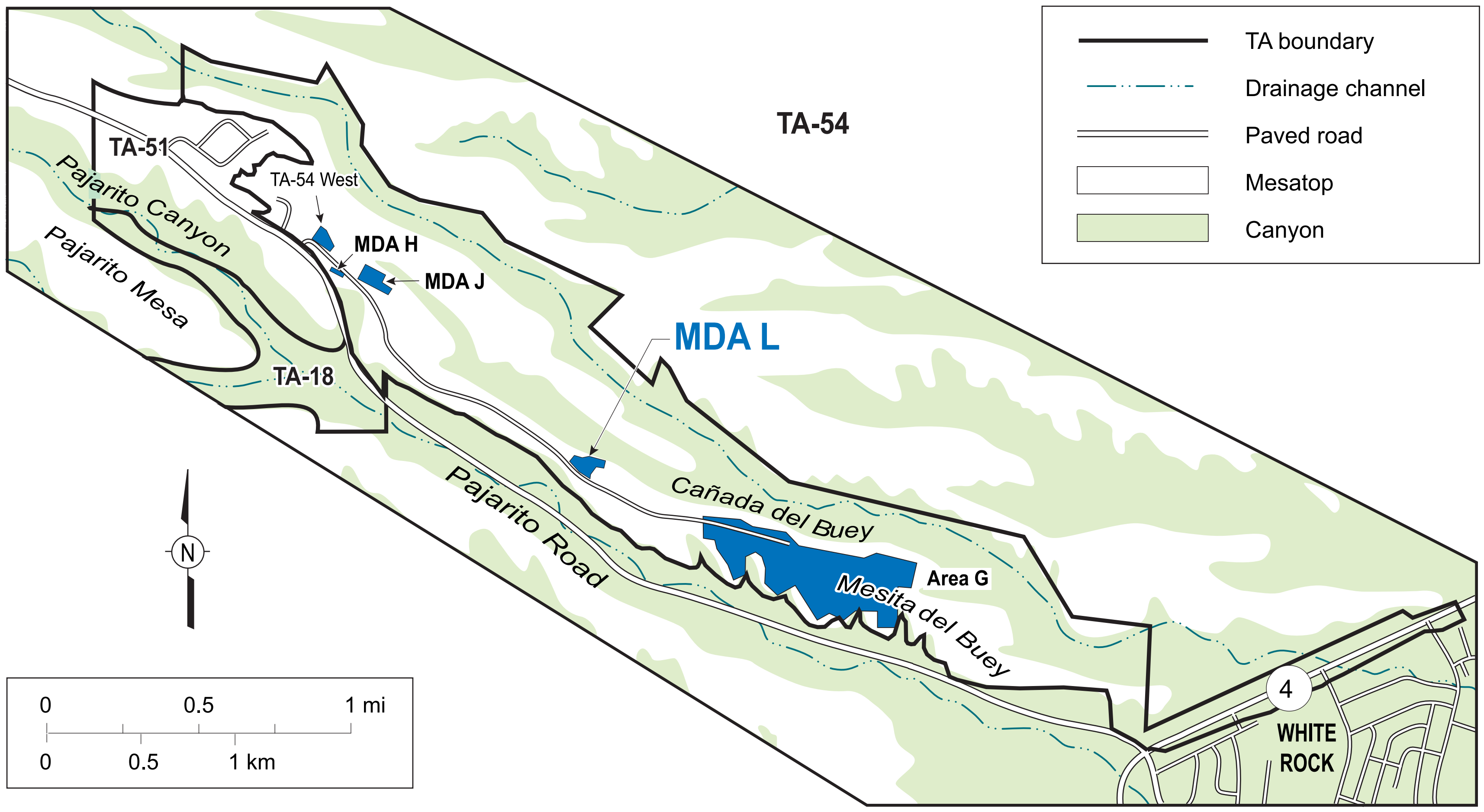


Figure 2.0-4. Inactive subsurface disposal units and existing surface structures at MDA L



Source: A. Kron_MDA L RFI Rpt., 120302, modified for F21-1, MDA L IR, 082605, ptm

Figure 2.1-1. Location of MDA L in TA-54

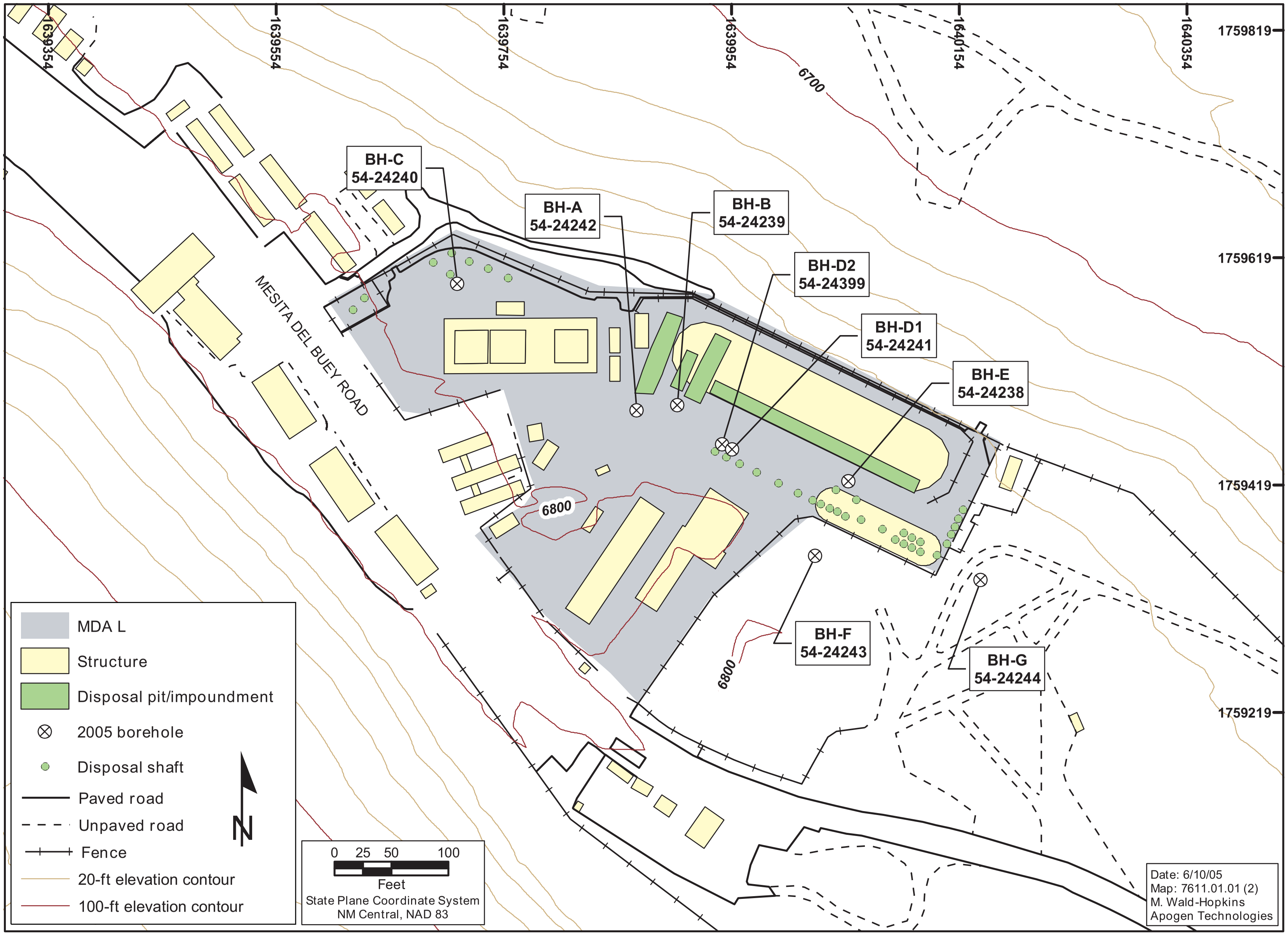


Figure 3.3-1. Locations of boreholes drilled during the MDA L investigation in 2004 and 2005

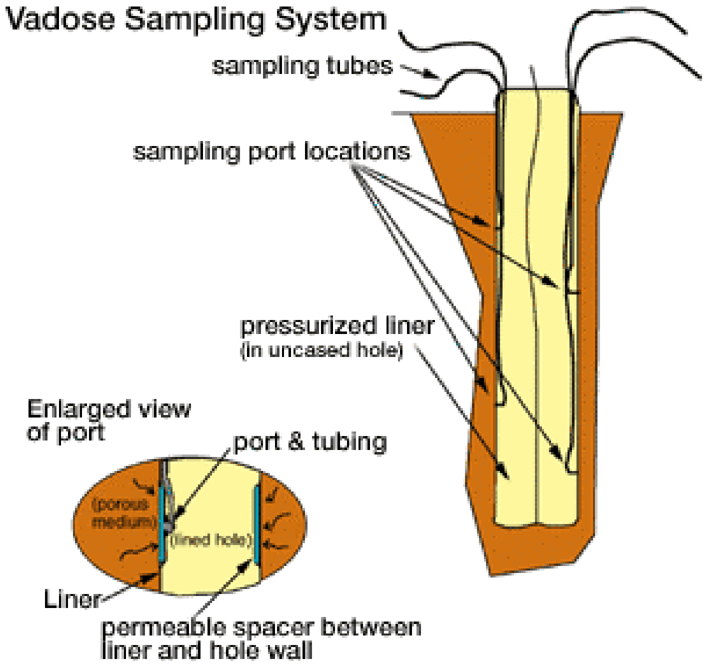


**Figure 3.3-2. FLUTe membrane liner system for vadose zone pore-gas-sampling**

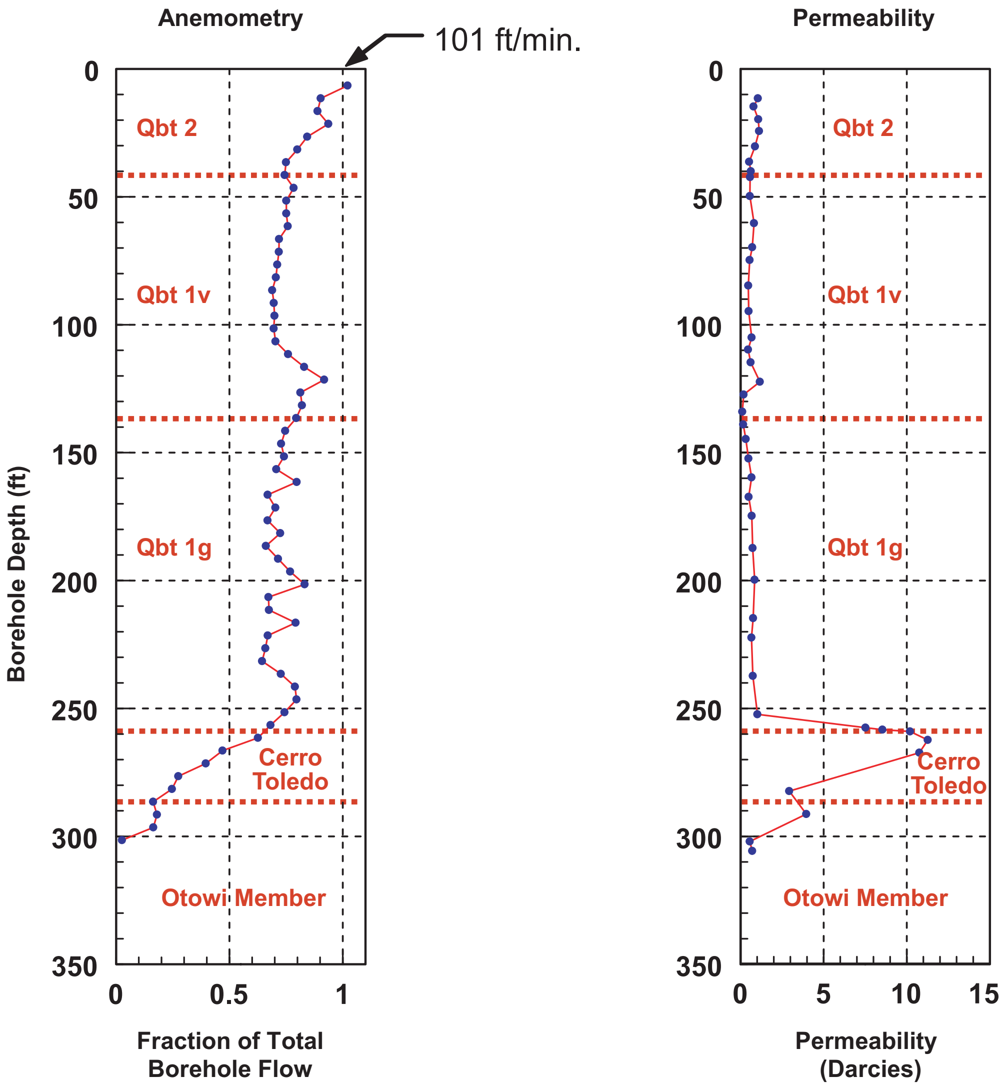
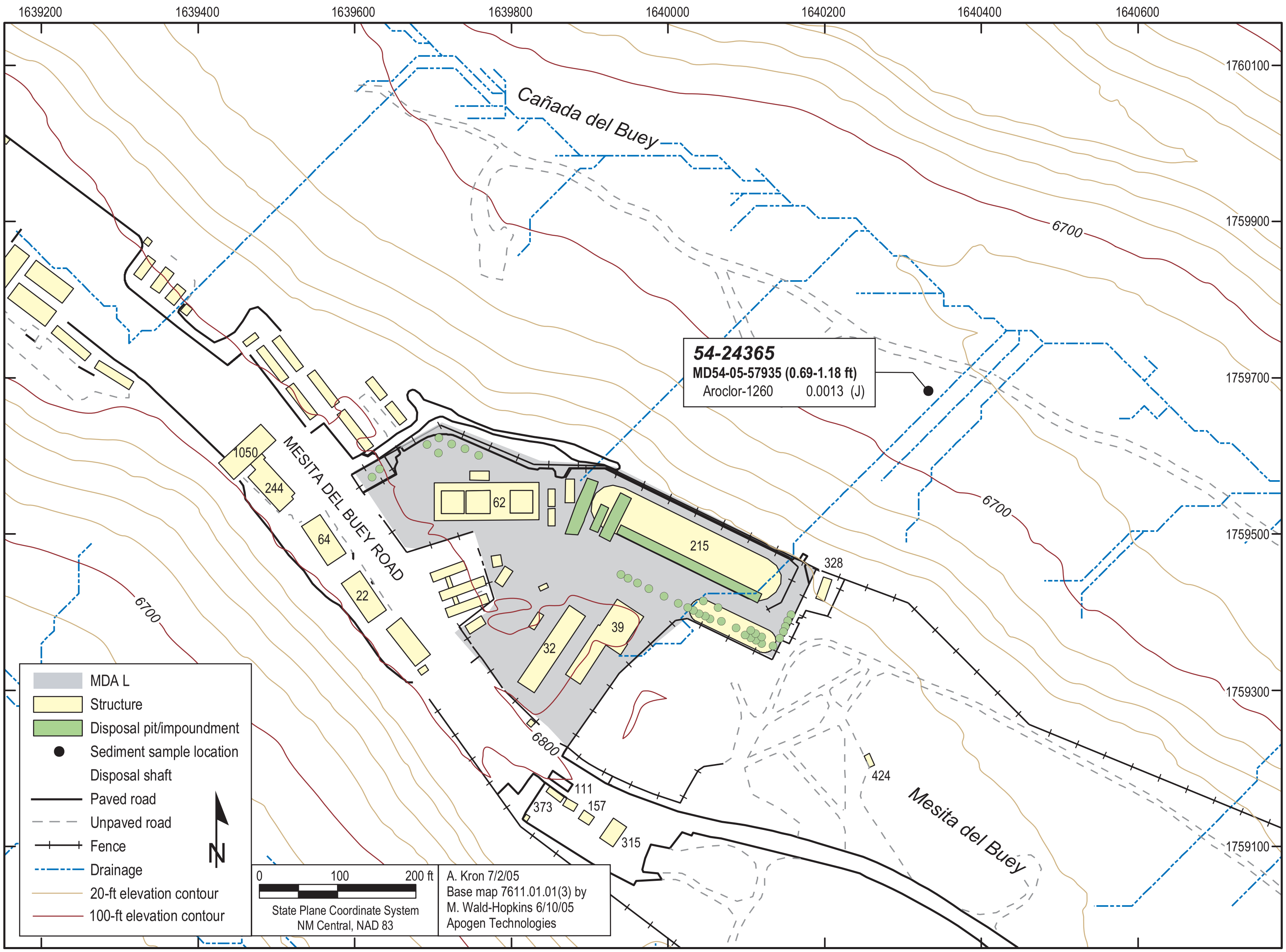


**Figure 4.6-1. Borehole 54-01018 anemometry and permeability results**



**54-24365**
**MD54-05-57935 (0.69-1.18 ft)**
Aroclor-1260 0.0013 (J)

Figure 6.3-1. Organic chemicals (mg/kg) detected in channel sediments at MDA L

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11 x 17

**Figure 6.3-2.** **Inorganic chemicals (mg/kg) detected above background values in subsurface tuff at MDA L**

back of 11 x 17

**Figure 6.3-3. Organic chemicals (mg/kg) detected in subsurface tuff at MDA L**

11 x 17

**Figure 6.6-1. Organic chemicals (µg/m$^3$) detected in subsurface pore gas at MDA L**

back of 11 x 17

**Figure 6.6-2. Trichloroethane[1,1,1-] (μg/m$^3$) detected in subsurface pore gas at MDA L**

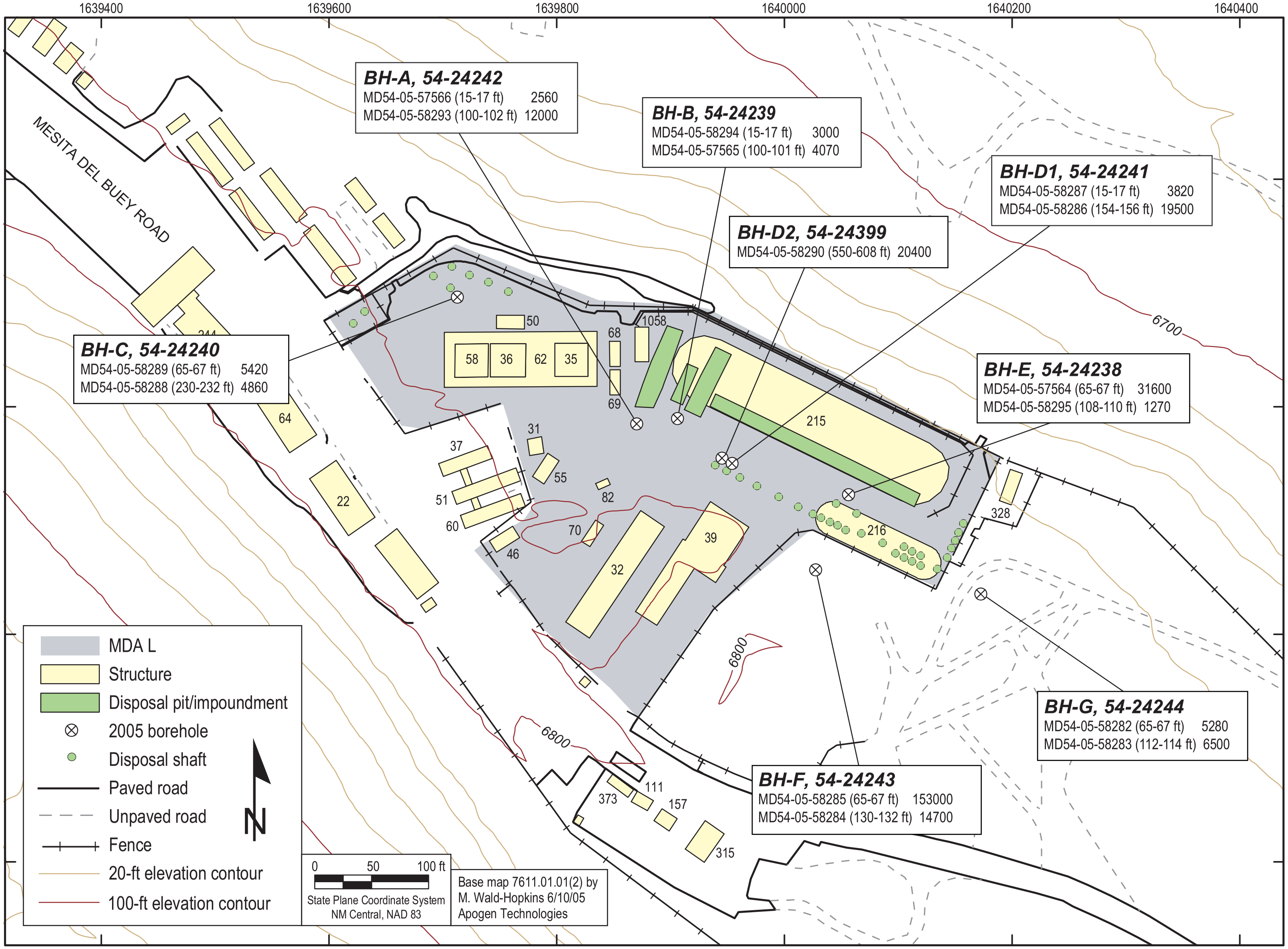

Figure 6.6-3. Tritium (pCi/L) detected in subsurface pore gas at MDA L

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## Table 2.2-1
## Frequency of Inorganic Chemicals above BVs in Channel Sediment Samples at MDA L

| Analyte | Number of Analyses | Number of Detects | Concentration Range[a] (mg/kg) | Background Value[b] (mg/kg) | Frequency of Detects above Background Value | Frequency of Nondetects above Background Value |
|---|---|---|---|---|---|---|
| Aluminum | 4 | 4 | 2270 to 3940 | 15400 | 0/4 | 0/4 |
| Antimony | 4 | 0 | [0.2 to 0.21] | 0.83 | 0/4 | 0/4 |
| Arsenic | 4 | 0 | [0.78 to 1.5] | 3.98 | 0/4 | 0/4 |
| Barium | 4 | 3 | [37] to 65.7 | 127 | 0/4 | 0/4 |
| Beryllium | 4 | 0 | [0.25 to 0.51] | 1.31 | 0/4 | 0/4 |
| Cadmium | 4 | 0 | [0.4 to 0.67] | 0.4 | 0/4 | 3/4 |
| Calcium | 4 | 4 | 1130 to 1830 | 4420 | 0/4 | 0/4 |
| Chromium | 4 | 4 | 2 to 4.2 | 10.5 | 0/4 | 0/4 |
| Cobalt | 4 | 0 | [1.4 to 2.6] | 4.73 | 0/4 | 0/4 |
| Copper | 4 | 0 | [3.6 to 4.7] | 11.2 | 0/4 | 0/4 |
| Iron | 4 | 4 | 3540 to 4870 | 13800 | 0/4 | 0/4 |
| Lead | 4 | 4 | 7.3 to 15.3 | 19.7 | 0/4 | 0/4 |
| Magnesium | 4 | 0 | [506 to 872] | 2370 | 0/4 | 0/4 |
| Manganese | 4 | 4 | 138 to 224 | 543 | 0/4 | 0/4 |
| Mercury | 4 | 0 | [0.02 to 0.02] | 0.1 | 0/4 | 0/4 |
| Nickel | 4 | 0 | [2.7 to 3.8] | 9.38 | 0/4 | 0/4 |
| Potassium | 4 | 0 | [545 to 805] | 2690 | 0/4 | 0/4 |
| Selenium | 4 | 0 | [0.6 to 0.64] | 0.3 | 0/4 | 4/4 |
| Silver | 4 | 0 | [2 to 2.1] | 1 | 0/4 | 4/4 |
| Sodium | 4 | 0 | [35.6 to 74] | 1470 | 0/4 | 0/4 |
| Thallium | 4 | 0 | [0.2 to 0.21] | 0.73 | 0/4 | 0/4 |
| Vanadium | 4 | 0 | [4.7 to 7.7] | 19.7 | 0/4 | 0/4 |
| Zinc | 4 | 4 | 20.7 to 30.3 | 60.2 | 0/4 | 0/4 |

[a] Values in square brackets indicate detection limits for nondetects.

[b] Sediment BVs obtained from LANL 1998, 59730.

## Table 2.2-2
## Frequency of Detected Radionuclides above BVs in Channel Sediment Samples at MDA L

| Analyte | Number of Analyses | Number of Detects | Concentration Range[a] (pCi/g) | Background Value[b] (pCi/g) | Frequency of Detects above Background Value |
|---|---|---|---|---|---|
| Americium-241 | 4 | 4 | 0.004 to 0.009 | 0.04 | 0/4 |
| Cesium-137 | 4 | 2 | [0.09] to 0.38 | 0.9 | 0/4 |
| Cobalt-60 | 4 | 0 | [0.02 to 0.09] | na[c] | 0/4 |
| Plutonium-238 | 4 | 4 | 0.003 to 0.011 | 0.006 | 1/4 |
| Plutonium-239 | 4 | 4 | 0.01 to 0.017 | 0.068 | 0/4 |
| Strontium-90 | 4 | 4 | -0.04 to 0.12 | 1.04 | 0/4 |
| Technitium-99 | 4 | 0 | [0.2] to [0.2] | na | 0/4 |
| Thorium-228 | 4 | 4 | 1.26 to 1.92 | 2.28 | 0/4 |
| Thorium-230 | 4 | 4 | 1.12 to 1.69 | 2.29 | 0/4 |
| Thorium-232 | 4 | 4 | 1.28 to 1.84 | 2.33 | 0/4 |
| Tritium | 4 | 4 | 6.84E-03 to 3.30E-02 | 0.093 | 0/4 |
| Uranium-234 | 4 | 4 | 1.12 to 1.81 | 2.59 | 0/4 |
| Uranium-235 | 4 | 4 | 0.07 to 0.1 | 0.2 | 0/4 |
| Uranium-238 | 4 | 4 | 1.37 to 2.03 | 2.29 | 0/4 |

[a] Values in square brackets indicate detection limits for nondetects.

[b] Sediment background and fallout values obtained from LANL 1998, 59730.

[c] na = Not available.

## Table 2.2-3
## Inorganic Chemicals Detected or Detected above BVs in Phase I RFI Subsurface Core Samples at MDA L

| Location ID | Sample ID | Depth (ft) | Media | Aluminum | Barium | Beryllium | Boron | Cadmium | Calcium | Chromium | Cobalt | Copper | Cyanide (Total) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Qbt 2 Background Value**[a] | | | | **7340** | **46** | **1.21** | **na**[b] | **1.63** | **2200** | **7.14** | **3.14** | **4.66** | **0.5** |
| **Qbt 1v Background Value**[a] | | | | **8170** | **26.5** | **1.70** | **na** | **0.40** | **3700** | **2.24** | **1.78** | **3.26** | **0.5** |
| **Qbt 1g Background Value**[a] | | | | **3560** | **25.7** | **1.44** | **na** | **0.40** | **1900** | **2.60** | **8.89** | **3.96** | **0.5** |
| 54-01007 | AAA6034 | 5.5–6.5 | Qbt 2 | —[c] | 83 | — | — | — | 79000 | — | — | 7.7 | — |
| 54-01007 | AAA6035 | 15–16.5 | Qbt 2 | 10000 | — | — | 4.0 | — | — | — | — | 370 | — |
| 54-01007 | AAA6036 | 35–36 | Qbt 2 | — | 55 | — | — | — | — | — | — | 15 | — |
| 54-01007 | AAA7415 | 31–32 | Qbt 2 | — | — | — | — | — | — | — | — | 52 | — |
| 54-01007 | AAA7409 | 49–50 | Qbt 1v | — | 43 | — | — | — | — | — | — | 11 | — |
| 54-01007 | AAA7408 | 60–62.5 | Qbt 1v | — | — | — | — | — | — | 3.4 | — | — | — |
| 54-01007 | AAA7420 | 68–69.8 | Qbt 1v | — | — | — | — | — | — | — | — | 64 | — |
| 54-01007 | AAA7421 | 75.5–77 | Qbt 1v | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA7446 | 87.8–89 | Qbt 1v | — | — | — | — | — | — | 3.9 | — | 46 | — |
| 54-01007 | AAA7450 | 98.5–99.6 | Qbt 1v | — | — | — | — | — | — | 4.1 | — | — | — |
| 54-01007 | AAA7451 | 106.4–107.5 | Qbt 1v | — | — | — | — | — | — | 4.3 | — | 81.4 | — |
| 54-01007 | AAA7447 | 130.8–132 | Qbt 1g | — | — | — | — | — | — | — | — | 17.3 | — |
| 54-01007 | AAA7449 | 145.5–146.7 | Qbt 1g | — | — | — | — | — | — | 4.3 | — | 34.9 | — |
| 54-01008 | AAA7413 | 5.5–6.3 | Qbt 2 | — | — | — | — | — | — | — | — | 8.3 | — |
| 54-01008 | AAA7400 | 20.5–22 | Qbt 2 | — | — | — | — | — | — | — | — | 21 | — |
| 54-01008 | AAA7405 | 38–39 | Qbt 1v | — | — | — | — | — | — | — | 1.8 | 40 | — |
| 54-01008 | AAA7423 | 45–46.2 | Qbt 1v | — | — | — | — | — | — | — | 6.1 | 37 | — |
| 54-01008 | AAA7422 | 55.5–57 | Qbt 1v | — | — | — | — | — | — | 2.4 | — | 4.5 | — |
| 54-01008 | AAA7448 | 66–67 | Qbt 1v | — | — | — | — | — | — | 3.8 | — | 33 | — |

### Table 2.2-3 (continued)

| Location ID | Sample ID | Depth (ft) | Media | Aluminum | Barium | Beryllium | Boron | Cadmium | Calcium | Chromium | Cobalt | Copper | Cyanide (Total) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Qbt 2 Background Value[a]** | | | | **7340** | **46** | **1.21** | **na[b]** | **1.63** | **2200** | **7.14** | **3.14** | **4.66** | **0.5** |
| **Qbt 1v Background Value[a]** | | | | **8170** | **26.5** | **1.70** | **na** | **0.40** | **3700** | **2.24** | **1.78** | **3.26** | **0.5** |
| **Qbt 1g Background Value[a]** | | | | **3560** | **25.7** | **1.44** | **na** | **0.40** | **1900** | **2.60** | **8.89** | **3.96** | **0.5** |
| 54-01008 | AAA7414 | 76.5–77.5 | Qbt 1v | — | — | — | — | — | — | 2.6 | — | 110 | — |
| 54-01008 | AAA7398 | 85.5–89 | Qbt 1v | — | — | — | — | — | — | 2.3 | — | 110 | — |
| 54-01008 | AAA7445 | 107–108 | Qbt 1v | — | — | — | — | — | — | 3.8 | 1.8 | 190 | — |
| 54-01008 | AAA7419 | 125–126.5 | Qbt 1v | — | 34 | 3.3 | — | — | — | — | 1.8 | 12 | — |
| 54-01008 | AAA7411 | 146–147 | Qbt 1g | — | — | — | — | — | — | — | — | 100 | — |
| 54-01009 | AAA7406 | 6–7.5 | Qbt 2 | — | — | — | — | — | — | — | — | 21 | — |
| 54-01009 | AAA7417 | 15.7–17 | Qbt 2 | — | — | — | — | — | — | — | — | 14 | — |
| 54-01009 | AAA7410 | 26–27.5 | Qbt 2 | — | — | — | — | — | — | — | — | 66 | — |
| 54-01009 | AAA7401 | 38–40 | Qbt 1v | — | 27 | — | — | — | — | — | — | 11 | — |
| 54-01009 | AAA7397 | 45.5–46.8 | Qbt 1v | — | — | — | — | — | — | 3.5 | — | 12 | — |
| 54-01009 | AAA7412 | 59–60 | Qbt 1v | — | 33 | — | — | — | — | — | — | 13 | — |
| 54-01009 | AAA7404 | 65–66 | Qbt 1v | — | 44 | — | — | — | — | — | — | 6.3 | — |
| 54-01009 | AAA7407 | 83.3–84.5 | Qbt 1v | — | 32 | — | — | — | — | — | — | 21 | — |
| 54-01009 | AAA7402 | 95–100 | Qbt 1v | — | 31 | — | — | — | — | — | — | 54 | — |
| 54-01009 | AAA7403 | 115.5–117 | Qbt 1v | — | — | — | — | — | — | — | — | 100 | — |
| 54-01009 | AAA7399 | 135–137 | Qbt 1g | — | 44 | 1.6 | — | — | — | — | — | 180 | — |
| 54-01010 | AAB6797 | 13.2–14.1 | Qbt 2 | — | — | — | — | — | — | 7.8 | — | — | — |
| 54-01010 | AAB6798 | 20.4–21.2 | Qbt 2 | — | — | — | — | — | — | — | — | — | — |
| 54-01010 | AAB6787 | 34.5–35 | Qbt 2 | — | — | — | — | — | — | — | — | — | — |
| 54-01010 | AAB6800 | 41.6–42.1 | Qbt 1v | — | — | — | — | — | — | 4.8 (J) | — | — | — |
| 54-01011 | AAB6796 | 23.6–24.1 | Qbt 2 | — | 138 | — | — | — | — | — | — | — | — |

## Table 2.2-3 (continued)

| Location ID | Sample ID | Depth (ft) | Media | Aluminum | Barium | Beryllium | Boron | Cadmium | Calcium | Chromium | Cobalt | Copper | Cyanide (Total) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Qbt 2 Background Value**[a] | | | | **7340** | **46** | **1.21** | **na**[b] | **1.63** | **2200** | **7.14** | **3.14** | **4.66** | **0.5** |
| **Qbt 1v Background Value**[a] | | | | **8170** | **26.5** | **1.70** | **na** | **0.40** | **3700** | **2.24** | **1.78** | **3.26** | **0.5** |
| **Qbt 1g Background Value**[a] | | | | **3560** | **25.7** | **1.44** | **na** | **0.40** | **1900** | **2.60** | **8.89** | **3.96** | **0.5** |
| 54-01012 | AAB6807 | 7.5–8.2 | Qbt 2 | — | — | 1.5 | — | — | — | 57.8 | — | 105 (J) | — |
| 54-01012 | AAB6791 | 15.8–16.4 | Qbt 2 | — | — | — | — | — | — | 47.9 | — | 36.5 (J) | — |
| 54-01012 | AAB6780 | 23.6–24.1 | Qbt 2 | — | — | — | — | — | — | 13.5 | — | 38.2 (J) | 0.96 (J) |
| 54-01012 | AAB6782 | 40–40.7 | Qbt 1v | — | — | — | — | 1.7 | — | 4.2 | — | — | — |
| 54-01013 | AAB6811 | 5.7–6.1 | Qbt 2 | — | — | — | — | — | — | — | — | — | — |
| 54-01013 | AAB6809 | 14.3–14.7 | Qbt 2 | — | — | — | — | — | — | — | — | — | — |
| 54-01013 | AAB6799 | 22.5–23.3 | Qbt 2 | — | — | — | — | — | — | — | — | 49.6 (J) | — |
| 54-01013 | AAB6810 | 29.5–30.0 | Qbt 2 | — | — | — | — | — | — | — | — | 48.9 | — |
| 54-01013 | AAB6792 | 39.3–41 | Qbt 1v | — | — | — | — | — | — | 4.6 | — | 55.7 | — |
| 54-01014 | AAB6801 | 5.2–5.3 | Qbt 2 | — | — | — | — | — | — | — | — | — | — |
| 54-01014 | AAB6786 | 15.4–16 | Qbt 2 | — | — | — | — | — | — | — | — | — | — |
| 54-01014 | AAB6784 | 23.4–24.1 | Qbt 2 | — | — | — | — | — | — | — | — | — | — |
| 54-01014 | AAB6793 | 33.7–34.5 | Qbt 2 | — | — | — | — | — | — | — | — | 5.7 | — |
| 54-01014 | AAB6781 | 40.1–41 | Qbt 1v | — | — | — | — | — | — | 3.0 | — | — | — |

## Table 2.2-3 (continued)

| Location ID | Sample ID | Depth (ft) | Media | Iron | Lead | Manganese | Mercury | Molybdenum | Nickel | Selenium | Uranium | Vanadium | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Qbt 2 Background Value**[a] | | | | **14,500** | **11.2** | **482** | **0.1** | **na** | **6.58** | **0.3** | **2.4** | **17** | **63.5** |
| **Qbt 1v Background Value**[a] | | | | **9900** | **18.4** | **408** | **0.1** | **na** | **2.0** | **0.3** | **6.22** | **4.48** | **84.6** |
| **Qbt 1g Background Value**[a] | | | | **3700** | **13.5** | **189** | **0.1** | **na** | **2.0** | **0.3** | **0.72** | **4.59** | **40** |
| 54-01007 | AAA6034 | 5.5–6.5 | Qbt 2 | — | — | — | — | — | — | 1.0 | — | — | — |
| 54-01007 | AAA6035 | 15–16.5 | Qbt 2 | — | — | — | — | — | — | — | — | — | 240 |
| 54-01007 | AAA6036 | 35–36 | Qbt 2 | — | 13 | 770 | — | — | — | — | — | — | 64 |
| 54-01007 | AAA7415 | 31–32 | Qbt 2 | — | — | — | — | — | — | — | — | — | 82 |
| 54-01007 | AAA7409 | 49–50 | Qbt 1v | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA7408 | 60–62.5 | Qbt 1v | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA7420 | 68–69.8 | Qbt 1v | — | — | — | — | — | — | — | — | — | 94 |
| 54-01007 | AAA7421 | 75.5–77 | Qbt 1v | — | — | 430 | — | — | — | — | — | — | — |
| 54-01007 | AAA7446 | 87.8–89 | Qbt 1v | — | — | — | — | — | — | — | — | — | 99 |
| 54-01007 | AAA7450 | 98.5–99.6 | Qbt 1v | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA7451 | 106.4–107.5 | Qbt 1v | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA7447 | 130.8–132 | Qbt 1g | — | — | — | — | — | — | — | — | — | 52.3 |
| 54-01007 | AAA7449 | 145.5–146.7 | Qbt 1g | — | — | — | — | — | — | — | — | — | — |
| 54-01008 | AAA7413 | 5.5–6.3 | Qbt 2 | — | — | — | — | — | — | — | — | — | — |
| 54-01008 | AAA7400 | 20.5–22 | Qbt 2 | — | — | — | — | — | — | — | — | — | — |
| 54-01008 | AAA7405 | 38–39 | Qbt 1v | — | — | — | — | — | — | — | — | — | — |
| 54-01008 | AAA7423 | 45–46.2 | Qbt 1v | — | — | — | — | 3.4 | — | — | — | — | — |
| 54-01008 | AAA7422 | 55.5–57 | Qbt 1v | — | — | 410 | — | — | — | — | — | — | — |
| 54-01008 | AAA7448 | 66–67 | Qbt 1v | — | — | — | — | — | — | — | — | — | — |
| 54-01008 | AAA7414 | 76.5–77.5 | Qbt 1v | — | — | — | — | — | — | — | — | — | 110 |
| 54-01008 | AAA7398 | 85.5–89 | Qbt 1v | — | — | — | — | — | — | — | — | — | 130 |

## Table 2.2-3 (continued)

| Location ID | Sample ID | Depth (ft) | Media | Iron | Lead | Manganese | Mercury | Molybdenum | Nickel | Selenium | Uranium | Vanadium | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Qbt 2 Background Value**[a] | | | | **14,500** | **11.2** | **482** | **0.1** | **na** | **6.58** | **0.3** | **2.4** | **17** | **63.5** |
| **Qbt 1v Background Value**[a] | | | | **9900** | **18.4** | **408** | **0.1** | **na** | **2.0** | **0.3** | **6.22** | **4.48** | **84.6** |
| **Qbt 1g Background Value**[a] | | | | **3700** | **13.5** | **189** | **0.1** | **na** | **2.0** | **0.3** | **0.72** | **4.59** | **40** |
| 54-01008 | AAA7445 | 107–108 | Qbt 1v | — | — | — | — | — | — | — | — | — | 160 |
| 54-01008 | AAA7419 | 125–126.5 | Qbt 1v | — | 20 | — | — | — | — | — | — | 4.5 | — |
| 54-01008 | AAA7411 | 146–147 | Qbt 1g | 5000 | — | — | — | — | — | — | — | — | 78 |
| 54-01009 | AAA7406 | 6–7.5 | Qbt 2 | — | — | — | — | 0.3 | — | — | — | — | — |
| 54-01009 | AAA7417 | 15.7–17 | Qbt 2 | — | — | — | — | 0.5 | 6.6 | — | — | — | — |
| 54-01009 | AAA7410 | 26–27.5 | Qbt 2 | — | — | — | — | 0.4 | — | — | — | — | 79 |
| 54-01009 | AAA7401 | 38–40 | Qbt 1v | — | — | — | — | 0.4 | 3.9 | — | — | — | — |
| 54-01009 | AAA7397 | 45.5–46.8 | Qbt 1v | — | — | — | — | 0.4 | 3.8 | — | — | — | — |
| 54-01009 | AAA7412 | 59–60 | Qbt 1v | — | — | — | — | 0.5 | 3.9 | — | — | — | — |
| 54-01009 | AAA7404 | 65–66 | Qbt 1v | — | — | — | — | 0.4 | 2.5 | — | — | — | — |
| 54-01009 | AAA7407 | 83.3–84.5 | Qbt 1v | — | — | — | — | 0.3 | — | — | — | — | — |
| 54-01009 | AAA7402 | 95–100 | Qbt 1v | — | — | — | — | 0.4 | 2.5 | — | — | — | 91 |
| 54-01009 | AAA7403 | 115.5–117 | Qbt 1v | — | — | — | — | 0.8 | — | — | — | — | 110 |
| 54-01009 | AAA7399 | 135–137 | Qbt 1g | — | — | 210 | — | 0.7 | 2.6 | — | — | — | 140 |
| 54-01010 | AAB6797 | 13.2–14.1 | Qbt 2 | — | — | — | — | — | — | — | — | — | — |
| 54-01010 | AAB6798 | 20.4–21.2 | Qbt 2 | — | — | — | 0.16 | — | — | — | — | — | — |
| 54-01010 | AAB6787 | 34.5–35 | Qbt 2 | — | — | — | — | — | — | — | 3.71 (J) | — | — |
| 54-01010 | AAB6800 | 41.6–42.1 | Qbt 1v | — | — | — | — | — | — | — | — | — | — |
| 54-01011 | AAB6796 | 23.6–24.1 | Qbt 2 | — | — | — | — | — | — | — | — | — | — |
| 54-01012 | AAB6807 | 7.5–8.2 | Qbt 2 | — | — | — | 0.15 | — | — | — | — | — | — |
| 54-01012 | AAB6791 | 15.8–16.4 | Qbt 2 | — | — | — | — | — | — | — | 9.54 | — | — |

## Table 2.2-3 (continued)

| Location ID | Sample ID | Depth (ft) | Media | Iron | Lead | Manganese | Mercury | Molybdenum | Nickel | Selenium | Uranium | Vanadium | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Qbt 2 Background Value[a]** | | | | **14,500** | **11.2** | **482** | **0.1** | **na** | **6.58** | **0.3** | **2.4** | **17** | **63.5** |
| **Qbt 1v Background Value[a]** | | | | **9900** | **18.4** | **408** | **0.1** | **na** | **2.0** | **0.3** | **6.22** | **4.48** | **84.6** |
| **Qbt 1g Background Value[a]** | | | | **3700** | **13.5** | **189** | **0.1** | **na** | **2.0** | **0.3** | **0.72** | **4.59** | **40** |
| 54-01012 | AAB6780 | 23.6–24.1 | Qbt 2 | — | — | — | — | — | — | — | 2.41 | — | — |
| 54-01012 | AAB6782 | 40–40.7 | Qbt 1v | — | — | — | — | — | — | — | — | — | — |
| 54-01013 | AAB6811 | 5.7–6.1 | Qbt 2 | — | — | — | — | — | — | — | 3.58 | — | — |
| 54-01013 | AAB6809 | 14.3–14.7 | Qbt 2 | — | — | — | — | — | — | — | 2.93 | — | — |
| 54-01013 | AAB6799 | 22.5–23.3 | Qbt 2 | — | — | — | — | — | 17.3 | — | 3.14 | — | — |
| 54-01013 | AAB6810 | 29.5–30.0 | Qbt 2 | — | — | — | — | — | — | — | 4.90 | — | — |
| 54-01013 | AAB6792 | 39.3–41 | Qbt 1v | — | — | — | — | — | 22.4 | — | — | — | — |
| 54-01014 | AAB6801 | 5.2–5.3 | Qbt 2 | — | — | — | — | — | 16.2 | — | 2.62 (J) | — | — |
| 54-01014 | AAB6786 | 15.4–16 | Qbt 2 | — | — | — | — | — | — | — | 2.56 (J) | — | — |
| 54-01014 | AAB6784 | 23.4–24.1 | Qbt 2 | — | — | — | — | — | — | — | 3.10 | — | — |
| 54-01014 | AAB6793 | 33.7–34.5 | Qbt 2 | — | — | — | — | — | — | — | 3.01 (J) | — | — |
| 54-01014 | AAB6781 | 40.1–41 | Qbt 1v | — | — | — | — | — | — | — | — | — | — |

*Note:* All values are in mg/kg. See Appendix A for data qualifier definitions.

[a] Tuff BVs obtained from LANL 1998, 59730.

[b] na = Not available.

[c] Dash indicates that the concentration was not detected or not detected above the BV.

## Table 2.2-4
## Frequency of Detected Radionuclides above BV or Detects in Subsurface Core Samples at MDA L

| Analyte | Geologic Unit | Number of Analyses | Number of Detects | Concentration Range (pCi/g)[a] | Background Value (pCi/g) | Frequency of Detects above Background Value |
|---|---|---|---|---|---|---|
| Plutonium-238 | Qbt 2 | 1 | 0 | [0.003 to 0.003] | n/a[b] | 0/1 |
| Plutonium-238 | Qbt 1v | 4 | 0 | [0 to 0.004] | n/a | 0/4 |
| Plutonium-239 | Qbt 2 | 1 | 0 | [0.001 to 0.001] | n/a | 0/1 |
| Plutonium-239 | Qbt 1v | 4 | 0 | [-0.001 to 0.005] | n/a | 0/4 |
| Tritium | Qbt 2 | 24 | 16 | [-1.95E-02] to 11.63 | n/a | 16/24 |
| Tritium | Qbo | 5 | 0 | [-5.50E-02 to 3.91E-02] | n/a | 0/5 |
| Tritium | Qbt 1v | 5 | 4 | 5.30E-02 to 0.34 | n/a | 4/5 |
| Tritium | TCB[c] | 14 | 2 | [-9.9E-04] to 0.13 | n/a | 2/14 |
| Uranium-234 | Qbt 2 | 1 | 1 | 1.617 to 1.617 | 1.98 | 0/1 |
| Uranium-234 | Qbt 1v | 4 | 4 | 1.953 to 2.479 | 3.12 | 0/4 |
| Uranium-235 | Qbt 2 | 1 | 0 | [0.084 to 0.084] | 0.09 | 0/1 |
| Uranium-235 | Qbt 1v | 4 | 0 | [0.075 to 0.144] | 0.14 | 0/4 |
| Uranium-238 | Qbt 2 | 1 | 1 | 1.733 to 1.733 | 1.93 | 0/1 |
| Uranium-238 | Qbt 1v | 4 | 4 | 2.24 to 2.777 | 3.05 | 0/4 |

[a] Values in brackets indicate detection limits for nondetects.

[b] n/a = Not applicable.

[c] TCB = Tertiary Cerros del Rio basalts.

## Table 2.2-5
## Organic Chemicals Detected in Phase I RFI Subsurface Core Samples at MDA L

| Location ID | Sample ID | Depth (ft) | Media | Acetone | Aroclor-1260 | Bis(2-ethylhexyl)phthalate | Bromobenzene | 2-Butanone | n-Butylbenzene | 4,4'-DDD | Dibromomethane | 1,2-Dichlorobenzene | 1,3-Dichlorobenzene | 1,2-Dichloroethane | 1,2-Dichloropropane |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54-01001 | AAA5537 | 89.8–91.1 | Qbt 1v | 0.022 | —* | — | — | — | — | — | — | — | — | — | — |
| 54-01001 | AAA4324 | 268.6–269.3 | Qct | 0.023 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA4321 | 37.4–38.1 | Qbt 2 | 0.033 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA5373 | 58–58.8 | Qbt 1v | 0.025 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA5378 | 75–76.6 | Qbt 1v | 0.021 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA5374 | 93.5–96 | Qbt 1v | 0.027 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA4320 | 96–96.9 | Qbt 1v | 0.036 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA4322 | 113–114.4 | Qbt 1v | 0.098 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA5377 | 131–132.6 | Qbt 1v | 0.040 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA5540 | 149.8–150.8 | Qbt 1g | 0.046 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA5541 | 187–187.6 | Qbt 1g | 0.034 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01003 | AAA5422 | 66.5–67.7 | Qbt 1v | — | — | — | 0.0075 | — | — | — | 0.0073 | 0.013 | — | — | — |
| 54-01005 | AAA7958 | 22.7–23.3 | Qbt 2 | 0.20 (J) | — | — | — | — | — | — | — | — | — | — | — |
| 54-01006 | AAA5480 | 18.3–19.6 | Qbt 2 | 0.022 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA6034 | 5.5–6.5 | Qbt 2 | 1.3 (J) | — | — | — | 0.050 (J) | — | — | — | — | — | — | — |
| 54-01007 | AAA6035 | 15–16.5 | Qbt 2 | 0.45 (J) | — | — | — | 0.026 (J) | — | — | — | — | — | — | — |
| 54-01007 | AAA7415 | 31–32 | Qbt 2 | 1.9 (J) | — | — | — | 4.8 (J) | — | — | — | — | — | — | — |
| 54-01007 | AAA6036 | 35–36 | Qbt 2 | 2.1 (J) | — | — | — | 0.43 (J) | — | — | — | — | — | — | — |
| 54-01007 | AAA7409 | 49–50 | Qbt 1v | 0.32 (J) | — | — | — | 0.88 (J) | — | — | — | — | — | — | — |
| 54-01007 | AAA7408 | 60–62.5 | Qbt 1v | 0.055 (J) | — | — | — | 0.12 (J) | — | — | — | — | — | — | — |
| 54-01007 | AAA7420 | 68–69.8 | Qbt 1v | — | — | — | — | 0.035 (J) | — | — | — | — | — | — | — |
| 54-01007 | AAA7421 | 75.5–77 | Qbt 1v | 0.053 (J) | — | — | — | 0.014 (J) | — | — | — | — | — | — | — |
| 54-01008 | AAA7423 | 45–46.2 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |

## Table 2.2-5 (continued)

| Location ID | Sample ID | Depth (ft) | Media | Acetone | Aroclor-1260 | Bis(2-ethylhexyl)phthalate | Bromobenzene | 2-Butanone | n-Butylbenzene | 4,4'-DDD | Dibromomethane | 1,2-Dichlorobenzene | 1,3-Dichlorobenzene | 1,2-Dichloroethane | 1,2-Dichloropropane |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54-01009 | AAA7406 | 6–7.5 | Qbt 2 | 0.023 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7417 | 15.7–17 | Qbt 2 | 0.035 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7410 | 26–27.5 | Qbt 2 | 0.030 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7401 | 38–40 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7397 | 45.5–46.8 | Qbt 1v | 0.071 | — | — | — | — | 0.012 | — | — | — | 0.011 | — | — |
| 54-01009 | AAA7412 | 59–60 | Qbt 1v | 0.062 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7404 | 65–66 | Qbt 1v | 0.046 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7407 | 83.3–84.5 | Qbt 1v | 0.022 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7402 | 95–100 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7403 | 115.5–117 | Qbt 1v | 0.10 | — | — | — | — | — | — | — | — | — | 0.0093 | — |
| 54-01010 | AAB6794 | 6.1–7.1 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | 0.018 | 0.010 |
| 54-01010 | AAB6797 | 13.2–14.1 | Qbt 2 | 0.056 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01010 | AAB6798 | 20.4–21.2 | Qbt 2 | — | 0.313 | 0.80 | — | — | — | — | — | — | — | 0.006 | — |
| 54-01010 | AAB6802 | 26.5–28.3 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | 0.020 | — |
| 54-01010 | AAB6800 | 41.6–42.1 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01011 | AAB6785 | 15.2–16.2 | Qbt 2 | — | — | — | — | — | — | 0.00588 | — | — | — | — | — |
| 54-01012 | AAB6807 | 7.5–8.2 | Qbt 2 | 0.057 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01012 | AAB6791 | 15.8–16.4 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01013 | AAB6810 | 29.5–30.3 | Qbt 2 | 0.12 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01013 | AAB6792 | 39.3–41 | Qbt 1v | 0.70 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01014 | AAB6781 | 40.1–41 | Qbt 1v | 0.044 | — | — | — | — | — | — | — | — | — | — | — |
| 54-01016 | AAC0734 | 260.6–261.5 | Qbo | 0.043 | — | — | — | — | — | — | — | — | — | — | — |

## Table 2.2-5 (continued)

| Location ID | Sample ID | Depth (ft) | Media | 1,3-Dichloropropane | Di-n-butylphthalate | 2-Hexanone | 4-Isopropyltoluene | 4,4'-Methoxychlor | 4-Methy-2-pentanone | Methylene chloride | Pentachlorophenol | Tetrachloroethene | 1,1,1-Trichloroethane | Trichloroethene | 1,2,3-Trichloropropane |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54-01001 | AAA5537 | 89.8–91.1 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01001 | AAA4324 | 268.6–269.3 | Qct | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA4321 | 37.4–38.1 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA5373 | 58–58.8 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA5378 | 75–76.6 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA5374 | 93.5–96 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA4320 | 96–96.9 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA4322 | 113–114.4 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA5377 | 131–132.6 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA5540 | 149.8–150.8 | Qbt 1g | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01002 | AAA5541 | 187–187.6 | Qbt 1g | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01003 | AAA5422 | 66.5–67.7 | Qbt 1v | 0.0068 | — | — | 0.0052 | — | — | — | — | — | — | — | 0.014 |
| 54-01005 | AAA7958 | 22.7–23.3 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01006 | AAA5480 | 18.3–19.6 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA6034 | 5.5–6.5 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA6035 | 15–16.5 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA7415 | 31–32 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA6036 | 35–36 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA7409 | 49–50 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA7408 | 60–62.5 | Qbt 1v | — | — | — | — | — | 0.012 | — | — | — | — | — | — |
| 54-01007 | AAA7420 | 68–69.8 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01007 | AAA7421 | 75.5–77 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01008 | AAA7423 | 45–46.2 | Qbt 1v | — | — | — | — | — | 0.015 | — | — | — | — | — | — |
| 54-01009 | AAA7406 | 6–7.5 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7417 | 15.7–17 | Qbt 2 | — | — | 0.021 | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7410 | 26–27.5 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |

## Table 2.2-5 (continued)

| Location ID | Sample ID | Depth (ft) | Media | 1,3-Dichloropropane | Di-n-butylphthalate | 2-Hexanone | 4-Isopropyltoluene | 4,4'-Methoxychlor | 4-Methy-2-pentanone | Methylene chloride | Pentachlorophenol | Tetrachloroethene | 1,1,1-Trichloroethane | Trichloroethene | 1,2,3-Trichloropropane |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54-01009 | AAA7401 | 38–40 | Qbt 1v | — | 1.0 | 0.020 | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7397 | 45.5–46.8 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7412 | 59–60 | Qbt 1v | — | — | — | — | — | 0.034 | — | — | — | — | — | — |
| 54-01009 | AAA7404 | 65–66 | Qbt 1v | — | 0.45 | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7407 | 83.3–84.5 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7402 | 95–100 | Qbt 1v | — | 0.44 | — | — | — | — | — | — | — | — | — | — |
| 54-01009 | AAA7403 | 115.5–117 | Qbt 1v | — | 0.75 | — | 0.0060 | — | 0.078 | — | — | — | — | — | — |
| 54-01010 | AAB6794 | 6.1–7.1 | Qbt 2 | — | — | — | — | — | — | 0.010 | — | — | 0.015 | 0.008 | — |
| 54-01010 | AAB6797 | 13.2–14.1 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01010 | AAB6798 | 20.4–21.2 | Qbt 2 | — | — | — | — | — | — | 0.006 | — | — | — | 0.008 | — |
| 54-01010 | AAB6802 | 26.5–28.3 | Qbt 2 | — | — | — | — | — | — | 0.014 | — | — | 0.008 | 0.008 | — |
| 54-01010 | AAB6800 | 41.6–42.1 | Qbt 1v | — | — | — | — | 0.0756 | — | — | — | — | — | — | — |
| 54-01011 | AAB6785 | 15.2–16.2 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01012 | AAB6807 | 7.5–8.2 | Qbt 2 | — | — | — | — | — | — | — | 13 (J) | 0.009 | — | — | — |
| 54-01012 | AAB6791 | 15.8–16.4 | Qbt 2 | — | — | — | — | — | — | — | 3.3 (J) | — | — | — | — |
| 54-01013 | AAB6810 | 29.5–30.3 | Qbt 2 | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01013 | AAB6792 | 39.3–41 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01014 | AAB6781 | 40.1–41 | Qbt 1v | — | — | — | — | — | — | — | — | — | — | — | — |
| 54-01016 | AAC0734 | 260.6–261.5 | Qbo | — | — | — | — | — | — | — | — | — | — | — | — |

*Note:* All values are in mg/kg. See Appendix A for data qualifier definitions.

*Dash indicates that the concentration was not detected.

### Table 2.2-6
### Frequency of VOCs Detected in Pore Gas at MDA L, Second Quarter FY 1997 through Fourth Quarter 2003

| Analyte | Number of Analyses | Number of Detects | Concentration[a] (ppbv) | EQL (ppbv) | Frequency of Detects |
|---|---|---|---|---|---|
| Acetone | 260 | 38 | 0.5 to [1100000] | 5 | 38/260 |
| Acetonitrile | 148 | 3 | 1.8 to [210000] | 1 | 3/148 |
| Acetophenone | 69 | 1 | [5 to 10000] | 0.2 | 1/69 |
| Acrylonitrile | 151 | 2 | [1.2 to 110000] | 0.5 | 2/151 |
| Benzene | 269 | 71 | 0.13 to [42000] | 0.2 | 71/269 |
| Benzonitrile | 69 | 5 | 1.2 to [10000] | 0.5 | 5/69 |
| Bromodichloromethane | 259 | 1 | [0.47 to 42000] | 0.2 | 1/259 |
| Bromoform | 260 | 6 | [0.47 to 42000] | 0.2 | 6/260 |
| Bromomethane | 269 | 9 | [0.47 to 42000] | 0.5 | 9/269 |
| Butadiene[1,3-] | 259 | 2 | [0.47 to 42000] | 0.2 | 2/259 |
| Butane[n-] | 152 | 64 | [0.48 to 42000] | 0.2 | 64/152 |
| Butanol[1-] | 256 | 3 | [1.2 to 110000] | 0.5 | 3/256 |
| Butanone[2-] | 260 | 2 | [1.2 to 110000] | 0.5 | 2/260 |
| Butene[1-] | 69 | 41 | [1.6] to 2950 | 0.2 | 41/69 |
| Butene[cis-2-] | 69 | 33 | [0.19] to 8550 | 0.2 | 33/69 |
| Butene[trans-2-] | 69 | 23 | [0.15 to 1000] | 0.2 | 23/69 |
| Carbon disulfide | 260 | 7 | [0.12 to 42000] | 0.2 | 7/260 |
| Carbon Tetrachloride | 269 | 136 | 0.47 to [42000] | 0.2 | 136/269 |
| Chloro-1,3-butadiene[2-] | 68 | 2 | [0.5 to 1000] | 0.2 | 2/68 |
| Chlorobenzene | 270 | 45 | 0.04 to [42000] | 0.2 | 45/270 |
| Chlorodibromomethane | 259 | 2 | 0.4 to [42000] | 0.2 | 2/259 |
| Chlorodifluoromethane | 191 | 25 | [0.47 to 42000] | 0.2 | 25/191 |
| Chloroethane | 269 | 31 | [0.47 to 42000] | 0.5 | 31/269 |
| Chloroform | 269 | 193 | 0.26 to 46700 | 0.2 | 193/269 |
| Chloromethane | 269 | 23 | [0.79 to 110000] | 0.5 | 23/269 |
| Cyclohexane | 260 | 61 | 0.44 to [73000] | 0.5 | 61/260 |
| Cyclohexanone | 69 | 1 | [5 to 10000] | 0.2 | 1/69 |
| Cyclopentane | 69 | 41 | 0.12 to 1340 | 0.2 | 41/69 |
| Cyclopentene | 69 | 12 | 0.2 to [1000] | 0.2 | 12/69 |
| Dibromoethane[1,2-] | 232 | 8 | [0.47 to 42000] | 0.2 | 8/232 |
| Dichloro-1,1,2,2-tetrafluoroethane[1,2-] | 232 | 4 | [0.47 to 42000] | 0.2 | 4/232 |
| Dichlorobenzene[1,2-] | 270 | 2 | 0.2 to [42000] | 0.2 | 2/270 |
| Dichlorobenzene[1,4-] | 270 | 22 | [0.2 to 42000] | 0.2 | 22/270 |
| Dichlorodifluoromethane | 232 | 153 | [2.4 to 42000] | 0.2 | 153/232 |
| Dichloroethane[1,1-] | 268 | 225 | 0.29 to 287000 | 0.2 | 225/268 |

## Table 2.2-6 (continued)

| Analyte | Number of Analyses | Number of Detects | Concentration[a] (ppbv) | EQL (ppbv) | Frequency of Detects |
|---|---|---|---|---|---|
| Dichloroethane[1,2-] | 269 | 138 | 0.22 to 240000 | 0.2 | 138/269 |
| Dichloroethene[1,1-] | 269 | 247 | 3.4 to 49000 | 0.2 | 247/269 |
| Dichloroethene[cis-1,2-] | 269 | 21 | [0.47 to 42000] | 0.2 | 21/269 |
| Dichloroethene[trans-1,2-] | 258 | 21 | [0.47 to 42000] | 0.2 | 21/258 |
| Dichloropropane[1,2-] | 269 | 108 | [0.47] to 144000 | 0.2 | 108/269 |
| Dichloropropene[cis-1,3-] | 269 | 3 | [0.47 to 42000] | 0.2 | 3/269 |
| Dichloropropene[trans-1,3-] | 268 | 2 | [0.47 to 42000] | 0.2 | 2/268 |
| Diethyl Ether | 152 | 23 | [1.2 to 110000] | 0.5 | 23/152 |
| Dimethylbutane[2,2-] | 69 | 37 | [0.12 to 1000] | 0.2 | 37/69 |
| Dimethylbutane[2,3-] | 69 | 29 | [0.5] to 2370 | 0.2 | 29/69 |
| Dimethylpentane[2,3-] | 64 | 29 | [0.14] to 1888 | 0.2 | 29/64 |
| Dioxane[1,4-] | 177 | 2 | [3.2 to 35000] | 1 | 2/177 |
| Ethanol | 177 | 11 | 1.8 to 58000 | 0.5 | 11/177 |
| Ethyl acrylate | 69 | 1 | 4 to [10000] | 0.2 | 1/69 |
| Ethyl tert-butyl ether | 69 | 3 | 0.8 to [10000] | 0.2 | 3/69 |
| Ethylbenzene | 270 | 25 | 0.22 to [42000] | 0.2 | 25/270 |
| Hexachlorobutadiene | 270 | 5 | [0.05 to 42000] | 0.2 | 5/270 |
| Hexane | 259 | 55 | 0.1 to [42000] | 0.2 | 55/259 |
| Hexanone[2-] | 259 | 1 | [1.2 to 110000] | 0.5 | 1/259 |
| Hexene[cis-3-] | 69 | 7 | [0.5 to 1000] | 0.2 | 7/69 |
| Hexene[trans-2-] | 69 | 6 | [0.5 to 1000] | 0.2 | 6/69 |
| Isobutane | 69 | 57 | 1.13 to 3290 | 0.2 | 57/69 |
| Isooctane | 69 | 45 | 0.02 to 2230 | 0.2 | 45/69 |
| Isopentane | 68 | 53 | 0.4 to 1010 | 0.2 | 53/68 |
| Isoprene | 69 | 12 | [0.5 to 1000] | 0.2 | 12/69 |
| Isopropylbenzene | 152 | 8 | [0.47 to 42000] | 0.2 | 8/152 |
| Methanol | 251 | 19 | [2.4 to 2100000] | 10 | 19/251 |
| Methyl methacrylate | 69 | 3 | 0.05 to [10000] | 0.2 | 3/69 |
| Methyl tert-butyl ether | 260 | 4 | [1.2 to 110000] | 0.2 | 4/260 |
| Methyl-1-butene[3-] | 69 | 20 | 0.2 to [1000] | 0.2 | 20/69 |
| Methyl-1-pentene[2-] | 69 | 13 | [0.5 to 1000] | 0.2 | 13/69 |
| Methyl-1-pentene[4-] | 69 | 13 | [0.5 to 1000] | 0.2 | 13/69 |
| Methyl-2-butene[2-] | 69 | 24 | 0.05 to [1000] | 0.2 | 24/69 |
| Methyl-2-pentanone[4-] | 260 | 7 | [1.2 to 110000] | 0.5 | 7/260 |
| Methylcyclohexane | 69 | 53 | 0.2 to 3530 | 0.2 | 53/69 |
| Methylcyclopentane | 69 | 60 | [0.22] to 3180 | 0.2 | 60/69 |
| Methylene chloride | 269 | 210 | [0.28] to 660000 | 0.2 | 210/269 |
| Methylheptane[2-] | 69 | 18 | [0.02 to 1000] | 0.2 | 18/69 |

## Table 2.2-6 (continued)

| Analyte | Number of Analyses | Number of Detects | Concentration[a] (ppbv) | EQL (ppbv) | Frequency of Detects |
|---|---|---|---|---|---|
| Methylheptane[3-] | 69 | 17 | [0.01 to 1000] | 0.2 | 17/69 |
| Methylhexane[2-] | 67 | 15 | [0.01 to 1000] | 0.2 | 15/67 |
| Methylhexane[3-] | 69 | 39 | [0.13] to 3980 | 0.2 | 39/69 |
| Methylpentane[2-] | 69 | 50 | [0.17] to 2330 | 0.2 | 50/69 |
| Methylpentane[3-] | 68 | 52 | 0.2 to 2360 | 0.2 | 52/68 |
| Methylstyrene[alpha-] | 152 | 1 | 0.3 to [42000] | 0.2 | 1/152 |
| Naphthalene | 83 | 1 | [0.47 to 42000] | na[b] | 1/83 |
| n-Heptane | 258 | 23 | [0.47 to 42000] | na | 23/258 |
| Nitrobenzene | 69 | 1 | [5 to 10000] | 0.2 | 1/69 |
| Nitropropane[2-] | 69 | 2 | 0.8 to [10000] | 0.2 | 2/69 |
| Nonane[1-] | 152 | 14 | [0.3 to 42000] | 0.2 | 14/152 |
| Octane[n-] | 152 | 14 | [0.47 to 42000] | 0.2 | 14/152 |
| Pentane | 151 | 62 | 0.68 to [110000] | 0.5 | 62/151 |
| Pentene[1-] | 69 | 17 | [0.08 to 1000] | 0.2 | 17/69 |
| Pentene[cis-2-] | 69 | 15 | 0.2 to [1000] | 0.2 | 15/69 |
| Pentene[trans-2-] | 69 | 12 | 0.3 to [1000] | 0.2 | 12/69 |
| Pinene[alpha-] | 69 | 7 | [0.5 to 1000] | 0.2 | 7/69 |
| Pinene[beta-] | 69 | 7 | [0.5 to 1000] | 0.2 | 7/69 |
| Propanol[2-] | 177 | 13 | 0.6 to 120000 | 0.5 | 13/177 |
| Propylbenzene[1-] | 152 | 7 | 0.4 to [42000] | 0.2 | 7/152 |
| Propylene | 176 | 48 | [1.51 to 35000] | 0.2 | 48/176 |
| Styrene | 270 | 6 | [0.47 to 42000] | 0.2 | 6/270 |
| Tetrachloroethane[1,1,2,2-] | 270 | 9 | [0.47 to 42000] | 0.2 | 9/270 |
| Tetrachloroethene | 270 | 255 | [0.48] to 1130000 | 0.2 | 255/270 |
| Tetrahydrofuran | 177 | 16 | [3.2] to 36600 | 0.2 | 16/177 |
| Toluene | 269 | 81 | 0.41 to [42000] | 0.2 | 81/269 |
| Trichloro-1,2,2-trifluoroethane[1,1,2-] (Freon 113) | 269 | 261 | 1.5 to 400000 | 0.2 | 261/269 |
| Trichlorobenzene[1,2,4-] | 270 | 7 | [0.47 to 42000] | 0.2 | 7/270 |
| Trichloroethane[1,1,1-] | 269 | 267 | 3.9 to 6970000 | 0.2 | 267/269 |
| Trichloroethane[1,1,2-] | 269 | 24 | [0.47 to 42000] | 0.2 | 24/269 |
| Trichloroethene | 269 | 267 | [0.48] to 2600000 | 0.2 | 267/269 |
| Trichlorofluoromethane | 232 | 196 | 2 to 81000 | 0.2 | 196/232 |
| Trimethylbenzene[1,2,4-] | 270 | 17 | [0.04 to 42000] | 0.2 | 17/270 |
| Trimethylbenzene[1,3,5-] | 270 | 6 | [0.47 to 42000] | 0.2 | 6/270 |
| Trimethylpentane[2,3,4-] | 69 | 16 | 0.4 to [1000] | 0.2 | 16/69 |
| Undecane[n-] | 83 | 1 | [0.47 to 42000] | na | 1/83 |
| Vinyl acetate | 260 | 3 | [1.2 to 110000] | 0.5 | 3/260 |

## Table 2.2-6 (continued)

| Analyte | Number of Analyses | Number of Detects | Concentration[a] (ppbv) | EQL (ppbv) | Frequency of Detects |
|---|---|---|---|---|---|
| Vinyl chloride | 268 | 33 | 0.08 to [42000] | 0.2 | 33/268 |
| Xylene (total) | 88 | 6 | [0.49 to 42000] | na | 6/88 |
| Xylene[1,2-] | 270 | 39 | 0.3 to [42000] | 0.2 | 39/270 |
| Xylene[1,3-] | 81 | 24 | 0.4 to [8400] | 0.2 | 24/81 |
| Xylene[1,3-]+xylene[1,4-] | 101 | 9 | [0.47 to 27000] | na | 9/101 |

[a] Values in square brackets indicate detection limits for nondetects.

[b] na = Not available.

## Table 3.3-1
## Borehole Information

| Borehole ID | Year Installed | Depth (ft from mesa-top surface) | Declination (degrees from horizontal) | Adjacent Waste Disposal Unit | Current Status |
|---|---|---|---|---|---|
| **Phase I RFI** | | | | | |
| 54-01001 | 1993 | 315 | 63.5 | None | Backfilled |
| 54-01002 | 1993 | 310 | 69 | None | Backfilled |
| 54-01003 | 1993 | 299 | Vertical | None | Backfilled |
| 54-01004 | 1993 | 340 | Vertical | None | Backfilled |
| 54-01005 | 1993 | 291 | 69 | None | Backfilled |
| 54-01006 | 1993 | 320 | 65 | None | Backfilled |
| 54-01007 | 1993 | 150 | Vertical | Shafts 1–6 | Backfilled |
| 54-01008 | 1993 | 150 | Vertical | Shafts 30–34 | Backfilled |
| 54-01009 | 1993 | 150 | Vertical | Shaft 27; Pit A | Backfilled |
| 54-01010 | 1994 | 60 | 45 | Pit A | Backfilled |
| 54-01011 | 1994 | 50 | 55 | Pit A | Backfilled |
| 54-01012 | 1994 | 50 | 55 | Impoundment B | Backfilled |
| 54-01013 | 1994 | 50 | 55 | Impoundment C | Backfilled |
| 54-01014 | 1994 | 50 | 55 | Impoundments D and C | Backfilled |
| 54-01015 | 1995 | 530 | 61.5 | None | Pore-gas monitoring borehole |
| 54-01016 | 1995 | 607 | 59.5 | None | Pore-gas monitoring borehole |
| 54-01017 | 1995 | 159 | Vertical | None | Backfilled |
| 54-01018 | 1995 | 328 | Vertical | None | Backfilled |
| **Pre-RFI** | | | | | |
| 54-02001 | 1986 | 200 | Vertical | Lead stringer shafts; Shaft 33 | Buried |
| 54-02002 | 1986 | 200 | Vertical | Shafts 7–11 | Pore-gas monitoring borehole |
| 54-02012 | 1985 | 42 | Vertical | Shafts 30–34 | Pore-gas monitoring borehole |
| 54-02013 | 1985 | 63 | Vertical | None | Pore-gas monitoring borehole |

## Table 3.3-1 (continued)

| Borehole ID | Year Installed | Depth (ft from mesa-top surface) | Declination (degrees from horizontal) | Adjacent Waste Disposal Unit | Current Status |
|---|---|---|---|---|---|
| 54-02014 | 1985 | 86 | Vertical | Shafts 17–18 | Pore-gas monitoring borehole |
| 54-02015 | 1985 | 82 | Vertical | Shafts 3–5 | Pore-gas monitoring borehole |
| 54-02016 | 1985 | 82 | Vertical | Pit A | Pore-gas monitoring borehole |
| 54-02020 | 1986 | 200 | Vertical | None | Pore-gas monitoring borehole |
| 54-02021 | 1986 | 200 | Vertical | None | Pore-gas monitoring borehole |
| 54-02022 | 1986 | 197 | Vertical | None | Pore-gas monitoring borehole |
| 54-02023 | 1986 | 200 | Vertical | None | Pore-gas monitoring borehole |
| 54-02024 | 1986 | 200 | Vertical | None | Pore-gas monitoring borehole |
| 54-02025 | 1988 | 190 | Vertical | None | Pore-gas monitoring borehole |
| 54-02026 | 1988 | 215 | Vertical | None | Pore-gas monitoring borehole |
| 54-02027 | 1988 | 250 | Vertical | None | Pore-gas monitoring borehole |
| 54-02028 | 1988 | 250 | Vertical | None | Pore-gas monitoring borehole |
| 54-02029 | 1988 | 288 | Vertical | None | Pore-gas monitoring borehole |
| 54-02030 | 1989 | 243 | Vertical | None | Pore-gas monitoring borehole |
| 54-02031 | 1989 | 260 | Vertical | None | Pore-gas monitoring borehole |
| 54-02034 | 1988 | 300 | Vertical | None | Pore-gas monitoring borehole |
| 54-02087 | 1985? | 86 | Vertical | None | Pore-gas monitoring borehole |
| 54-02088 | 1985? | 86 | Vertical | None | Pore-gas monitoring borehole |
| 54-02089 | 1985? | 86 | Vertical | None | Pore-gas monitoring borehole |
| **Approved Work Plan** | | | | | |
| 54-24242 | 2004 | 150 | Vertical | Impoundment D | Pore-gas monitoring borehole |
| 54-24239 | 2004 | 150 | Vertical | Impoundments B, C | Pore-gas monitoring borehole |
| 54-24240 | 2004 | 300 | 85 | Shafts 29, 30, 34 | Pore-gas monitoring borehole |
| 54-24241 | 2004 | 250 | Vertical | Pit A, eastern shaft field | Pore-gas monitoring borehole |
| 54-24399 | 2005 | 660 | Vertical | Pit A, eastern shaft field | Open borehole |
| 54-24238 | 2004 | 150 | Vertical | Pit A, eastern shaft field | Pore-gas monitoring borehole |
| 54-24243 | 2004 | 150 | Vertical | Eastern shaft field | Pore-gas monitoring borehole |
| 54-24244 | 2004 | 150 | Vertical | Eastern shaft field | Pore-gas monitoring borehole |

*Note:* The -01000 series boreholes are Phase I RFI characterization boreholes. The -02000 series boreholes are pre-RFI boreholes drilled for pore-gas monitoring. The -24000 series boreholes were drilled as part of the approved MDA L work plan (LANL 2005, 87624).

## Table 6.1-1
## Summary of Sediment and Rock Samples Collected at MDA L

| Borehole | Borehole Location | Actual Analytical Sample Depth (ft) | Sample ID | Matrix | Sample Type |
|---|---|---|---|---|---|
| A | 54-24242 | 15–20 | MD54-05-57249 | Qbt2 | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
|  | 54-24242 | 15–20 | MD54-05-57255 | Qbt2 | Field Dup TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
|  | 54-24242 | n/a* | MD54-05-57257 | n/a | Trip Blank |
|  | 54-24242 | 33–35 | MD54-05-57480 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
|  | 54-24242 | 48–50 | MD54-05-57481 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
|  | 54-24242 | 68–70 | MD54-05-57482 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
|  | 54-24242 | 88–90 | MD54-05-57483 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
|  | 54-24242 | 108–110 | MD54-05-57484 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
|  | 54-24242 | 128–130 | MD54-05-57485 | Qbt1g | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
|  | 54-24242 | 147–150 | MD54-05-57254 | Qbt1g | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| B | 54-24239 | 15–20 | MD54-05-56966 | Qbt2 | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
|  | 54-24239 | 15–20 | MD54-05-56972 | Qbt2 | Field Dup TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
|  | 54-24239 | 31.5–33.5 | MD54-05-56967 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
|  | 54-24239 | 48–50 | MD54-05-57528 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
|  | 54-24239 | 68–70 | MD54-05-57529 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
|  | 54-24239 | 88–90 | MD54-05-56968 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |

## Table 6.1-1 (continued)

| Borehole | Borehole Location | Actual Analytical Sample Depth (ft) | Sample ID | Matrix | Sample Type |
|---|---|---|---|---|---|
| B (cont.) | 54-24239 | 108–110 | MD54-05-56969 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24239 | 128–130 | MD54-05-56970 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24239 | 147–150 | MD54-05-56971 | Qbt1g | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| | 54-24239 | n/a | MD54-05-56984 | n/a | Trip Blank |
| C | 54-24240 | n/a | MD54-05-57474 | n/a | Trip blank |
| | 54-24240 | 62.3–67.2 | MD54-05-56979 | Qbt1v | Field Dup TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| | 54-24240 | 62.3–67.2 | MD54-05-56973 | Qbt1v | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| | 54-24240 | 80.7–82.2 | MD54-05-57536 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24240 | 105.6–107.1 | MD54-05-57537 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24240 | 115.6–117.1 | MD54-05-57538 | Qbt1vc | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24240 | 135.5–137.5 | MD54-05-57539 | Qbt1vc | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24240 | 150.4–151.9 | MD54-05-57540 | Qbt1vg | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24240 | 170.4–171.8 | MD54-05-57541 | Qbt1vg | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24240 | 190.3–191.8 | MD54-05-57542 | Qbt1vg | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24240 | 202.2–206.7 | MD54-05-57543 | Qbt1vg | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24240 | 210.2–211.7 | MD54-05-57544 | Qbt1vg | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24240 | 230.1–231.6 | MD54-05-57545 | Qbt1vg | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24240 | 251.5–254 | MD54-05-57548 | Qbt1vg | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24240 | 255–265.5 | MD54-05-57547 | Cerro Toledo | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |

## Table 6.1-1 (continued)

| Borehole | Borehole Location | Actual Analytical Sample Depth (ft) | Sample ID | Matrix | Sample Type |
|---|---|---|---|---|---|
| C (cont.) | 54-24240 | 275–276.4 | MD54-05-57549 | Cerro Toledo | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24240 | 299.9–301.3 | MD54-05-56978 | Otowi | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| D-1 | 54-24241 | 65–70 | MD54-05-57505 | Qbt1v | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| | 54-24241 | 65–70 | MD54-05-57511 | Qbt1v | Field Dup TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| | 54-24241 | n/a | MD54-05-56985 | n/a | Trip Blank |
| | 54-24241 | 82–83.5 | MD54-05-57506 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24241 | 132–134 | MD54-05-57507 | Qbt1g | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24241 | 147.5–149 | MD54-05-57508 | Qbt1g | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24241 | 197–199 | MD54-05-57509 | Qbt1g | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24241 | 245–250 | MD54-05-57510 | Qbt1g | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| | 54-24241 | 14–15 | MD54-05-57020 | Qbt2 | Anions-Chloride |
| | 54-24241 | 19–20 | MD54-05-57021 | Qbt2 | Anions-Chloride |
| | 54-24241 | 29–30 | MD54-05-57022 | Qbt2 | Anions-Chloride |
| | 54-24241 | 39–40 | MD54-05-57023 | Qbt1v | Anions-Chloride |
| | 54-24241 | 49–50 | MD54-05-57024 | Qbt1v | Anions-Chloride |
| | 54-24241 | 59–60 | MD54-05-57025 | Qbt1v | Anions-Chloride |
| | 54-24241 | 69–70 | MD54-05-57026 | Qbt1v | Anions-Chloride |
| | 54-24241 | 79–80 | MD54-05-57027 | Qbt1v | Anions-Chloride |
| | 54-24241 | 89–90 | MD54-05-57028 | Qbt1v | Anions-Chloride |
| | 54-24241 | 99–100 | MD54-05-57029 | Qbt1v | Anions-Chloride |
| | 54-24241 | 109–110 | MD54-05-57030 | Qbt1v | Anions-Chloride |
| | 54-24241 | 119–120 | MD54-05-57031 | Qbt1v | Anions-Chloride |
| | 54-24241 | 129–130 | MD54-05-57032 | Qbt1g | Anions-Chloride |
| | 54-24241 | 139–140 | MD54-05-57033 | Qbt1g | Anions-Chloride |

## Table 6.1-1 (continued)

| Borehole | Borehole Location | Actual Analytical Sample Depth (ft) | Sample ID | Matrix | Sample Type |
|---|---|---|---|---|---|
| D-1 (cont.) | 54-24241 | 149–150 | MD54-05-57034 | Qbt1g | Anions-Chloride |
| | 54-24241 | 159–160 | MD54-05-57035 | Qbt1g | Anions-Chloride |
| | 54-24241 | 169–170 | MD54-05-57036 | Qbt1g | Anions-Chloride |
| | 54-24241 | 179–180 | MD54-05-57037 | Qbt1g | Anions-Chloride |
| | 54-24241 | 189–190 | MD54-05-57038 | Qbt1g | Anions-Chloride |
| | 54-24241 | 199–200 | MD54-05-57039 | Qbt1g | Anions-Chloride |
| | 54-24241 | 209–210 | MD54-05-57040 | Qbt1g | Anions-Chloride |
| | 54-24241 | 219–220 | MD54-05-57041 | Qbt1g | Anions-Chloride |
| | 54-24241 | 229–230 | MD54-05-57042 | Qbt1g | Anions-Chloride |
| | 54-24241 | 239–240 | MD54-05-57043 | Qbt1g | Anions-Chloride |
| | 54-24241 | 249–250 | MD54-05-57044 | Qbt1g | Anions-Chloride |
| | 54-24241 | 88–90 | MD54-05-57574 | Qbt1v | Geotechnical Parameters |
| | 54-24241 | 162–164 | MD54-05-57575 | Qbt1g | Geotechnical Parameters |
| | 54-24241 | 14–15 | MD54-05-57099 | Qbt2 | Moisture Content |
| | 54-24241 | 19–20 | MD54-05-57100 | Qbt2 | Moisture Content |
| | 54-24241 | 24–25 | MD54-05-57101 | Qbt2 | Moisture Content |
| | 54-24241 | 29–30 | MD54-05-57102 | Qbt2 | Moisture Content |
| | 54-24241 | 34–35 | MD54-05-57103 | Qbt2 | Moisture Content |
| | 54-24241 | 39–40 | MD54-05-57104 | Qbt1v | Moisture Content |
| | 54-24241 | 44–45 | MD54-05-57105 | Qbt1v | Moisture Content |
| | 54-24241 | 49–50 | MD54-05-57106 | Qbt1v | Moisture Content |
| | 54-24241 | 54–55 | MD54-05-57107 | Qbt1v | Moisture Content |
| | 54-24241 | 59–60 | MD54-05-57108 | Qbt1v | Moisture Content |
| | 54-24241 | 64–65 | MD54-05-57109 | Qbt1v | Moisture Content |
| | 54-24241 | 70–71 | MD54-05-57110 | Qbt1v | Moisture Content |
| | 54-24241 | 75–76 | MD54-05-57111 | Qbt1v | Moisture Content |
| | 54-24241 | 79–80 | MD54-05-57112 | Qbt1v | Moisture Content |
| | 54-24241 | 84–85 | MD54-05-57113 | Qbt1v | Moisture Content |
| | 54-24241 | 94–95 | MD54-05-57115 | Qbt1v | Moisture Content |
| | 54-24241 | 99–100 | MD54-05-57116 | Qbt1v | Moisture Content |
| | 54-24241 | 104–105 | MD54-05-57117 | Qbt1v | Moisture Content |
| | 54-24241 | 109–110 | MD54-05-57118 | Qbt1v | Moisture Content |
| | 54-24241 | 114–115 | MD54-05-57119 | Qbt1v | Moisture Content |
| | 54-24241 | 119–120 | MD54-05-57120 | Qbt1v | Moisture Content |
| | 54-24241 | 124–125 | MD54-05-57121 | Qbt1v | Moisture Content |
| | 54-24241 | 129–130 | MD54-05-57122 | Qbt1g | Moisture Content |

## Table 6.1-1 (continued)

| Borehole | Borehole Location | Actual Analytical Sample Depth (ft) | Sample ID | Matrix | Sample Type |
|---|---|---|---|---|---|
| D-1 (cont.) | 54-24241 | 134–135 | MD54-05-57123 | Qbt1g | Moisture Content |
| | 54-24241 | 139–140 | MD54-05-57124 | Qbt1g | Moisture Content |
| | 54-24241 | 144–145 | MD54-05-57125 | Qbt1g | Moisture Content |
| | 54-24241 | 149–150 | MD54-05-57126 | Qbt1g | Moisture Content |
| | 54-24241 | 154–155 | MD54-05-57127 | Qbt1g | Moisture Content |
| | 54-24241 | 159–160 | MD54-05-57128 | Qbt1g | Moisture Content |
| | 54-24241 | 169–170 | MD54-05-57130 | Qbt1g | Moisture Content |
| | 54-24241 | 174–175 | MD54-05-57131 | Qbt1g | Moisture Content |
| | 54-24241 | 179–180 | MD54-05-57132 | Qbt1g | Moisture Content |
| | 54-24241 | 184–185 | MD54-05-57133 | Qbt1g | Moisture Content |
| | 54-24241 | 189–190 | MD54-05-57134 | Qbt1g | Moisture Content |
| | 54-24241 | 194–195 | MD54-05-57135 | Qbt1g | Moisture Content |
| | 54-24241 | 199–200 | MD54-05-57136 | Qbt1g | Moisture Content |
| | 54-24241 | 204–205 | MD54-05-57137 | Qbt1g | Moisture Content |
| | 54-24241 | 209–210 | MD54-05-57138 | Qbt1g | Moisture Content |
| | 54-24241 | 214–215 | MD54-05-57139 | Qbt1g | Moisture Content |
| | 54-24241 | 219–220 | MD54-05-57140 | Qbt1g | Moisture Content |
| | 54-24241 | 224–225 | MD54-05-57141 | Qbt1g | Moisture Content |
| | 54-24241 | 229–230 | MD54-05-57142 | Qbt1g | Moisture Content |
| | 54-24241 | 234–235 | MD54-05-57143 | Qbt1g | Moisture Content |
| | 54-24241 | 239–240 | MD54-05-57144 | Qbt1g | Moisture Content |
| | 54-24241 | 244–245 | MD54-05-57145 | Qbt1g | Moisture Content |
| | 54-24241 | 249–250 | MD54-05-57146 | Qbt1g | Moisture Content |
| D-2 | 54-24399 | 385–390 | MD54-05-57174 | Paleosol | Moisture Content |
| | 54-24399 | 390–395 | MD54-05-57175 | Paleosol | Moisture Content |
| | 54-24399 | 395–400 | MD54-05-57176 | Qtb | Moisture Content |
| | 54-24399 | 380–390 | MD54-05-57058 | Paleosol | Anions-Chloride |
| | 54-24399 | 390–400 | MD54-05-57059 | Paleosol | Anions-Chloride |
| | 54-24399 | 400–410 | MD54-05-57060 | Qtb | Anions-Chloride |
| E | 54-24238 | 15–20 | MD54-05-56959 | Qbt2 | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| | 54-24238 | 15–20 | MD54-05-56965 | Qbt2 | Field Dup TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |

## Table 6.1-1 (continued)

| Borehole | Borehole Location | Actual Analytical Sample Depth (ft) | Sample ID | Matrix | Sample Type |
|---|---|---|---|---|---|
| E (cont.) | 54-24238 | 33–35 | MD54-05-56960 | Qbt2 | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24238 | 48–50 | MD54-05-56961 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24238 | 68–70 | MD54-05-56962 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24238 | 78–80 | MD54-05-56963 | Qbt1vc | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24238 | 108–110 | MD54-05-57520 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24238 | 128–130 | MD54-05-57521 | Qbt1g | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24238 | 128–130 | MD54-05-56983 | Qbt1v | Trip Blank |
| | 54-24238 | 147–150 | MD54-05-56964 | Qbt1g | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| F | 54-24243 | 65–70 | MD54-05-57258 | Qbt1v | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| | 54-24243 | 65–70 | MD54-05-57475 | Qbt1v | Field Dup TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| | 54-24243 | 88–90 | MD54-05-57486 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24243 | 115–117 | MD54-05-57487 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24243 | 128–130 | MD54-05-57259 | Qbt1g | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24243 | 148–150 | MD54-05-57263 | Qbt1g | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| | 54-24243 | n/a | MD54-05-57473 | n/a | Trip Blank |

## Table 6.1-1 (continued)

| Borehole | Borehole Location | Actual Analytical Sample Depth (ft) | Sample ID | Matrix | Sample Type |
|---|---|---|---|---|---|
| G | 54-24244 | 65–70 | MD54-05-57266 | Qbt1v | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| | 54-24244 | 65–70 | MD54-05-57269 | Qbt1v | Field Dup TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| | 54-24244 | n/a | MD54-05-57270 | n/a | Trip blank |
| | 54-24244 | 88–90 | MD54-05-57494 | n/a | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24244 | 108–110 | MD54-05-57495 | Qbt1v | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24244 | 128–130 | MD54-05-57496 | Qbt1g | radionuclides, TAL metals+Cn+Li, anions+perchlorate+pH |
| | 54-24244 | 148–150 | MD54-05-57268 | Qbt1g | TAL Metals+Cn+Li, Radionuclides, VOCs, SVOCs, Anions(perchlorate+pH+nitrate), explosive compounds, pesticides/PCBs, dioxins, and furans |
| Channel Sediment | 54-24365 | 21–26 cm | MD54-05-57935 | Drainage Sediment | TAL Metals +Cn, Tritium, Radionuclides, pesticides/PCBs, nitrates, perchlorate |

*n/a = Not applicable.

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## Table 6.3-1
## Inorganic Chemicals above BVs in Sediment and Subsurface Rock Samples at MDA L

11 x 17

4 pp.

## Table 6.3-2
## Organic Chemicals Detected in Sediment and Subsurface Rock Samples at MDA L

11 x 17

2 pp.

### Table 6.3-3
### Radionuclides Detected above BVs in Subsurface Rock Samples at MDA L

| Sample ID | Location ID | Depth (ft) | Media | Uranium-235 |
|---|---|---|---|---|
| **Qbt 1v Background Value** | | | | **0.14** |
| **Industrial Screening Action Level** | | | | **87** |
| **Residential Screening Action Level** | | | | **17** |
| MD54-05-57520 | 54-24238 | 108.00–110.00 | Qbt 1v | 0.144 |

*Note:* All values are in pCi/g.

### Table 6.3-4
### Matric Potential and Gravimetric Moisture Content Summary

| Borehole Location | Sample ID | Depth (ft) | Matrix (unit) | Matric Potential | | Gravimetric Moisture Content (%, g/g) |
|---|---|---|---|---|---|---|
| | | | | (-bars) | (-cm) | |
| 54-24241 | MD54-05-57099 | 14–15 | Qbt2 | 2.1 | 2142 | 6.4 |
| | MD54-05-57100 | 19–20 | Qbt2 | 3 | 3059 | 6.2 |
| | MD54-05-57101 | 24–25 | Qbt2 | 5.1 | 5201 | 7.7 |
| | MD54-05-57102 | 29–30 | Qbt2 | 2.7 | 2753 | 7.0 |
| | MD54-05-57103 | 34–35 | Qbt2 | 4.2 | 4283 | 9.2 |
| | MD54-05-57104 | 39–40 | Qbt1v | 4.2 | 4283 | 5.8 |
| | MD54-05-57105 | 44–45 | Qbt1v | 4.6 | 4691 | 7.4 |
| | MD54-05-57106 | 49–50 | Qbt1v | 3.5 | 3569 | 6.6 |
| | MD54-05-57107 | 54–55 | Qbt1v | 4.9 | 4997 | 9.1 |
| | MD54-05-57108 | 59–60 | Qbt1v | 3.4 | 3467 | 7.4 |
| | MD54-05-57109 | 64–65 | Qbt1v | 5.2 | 5303 | 7.9 |
| | MD54-05-57110 | 70–71 | Qbt1v | 4.2 | 4283 | 6.4 |
| | MD54-05-57111 | 75–76 | Qbt1v | 5.1 | 5201 | 4.9 |
| | MD54-05-57112 | 79–80 | Qbt1v | 6.3 | 6425 | 3.5 |
| | MD54-05-57574 | 88–90 | Qbt1v | 7.0 | 7139 | 2.1 |
| | MD54-05-57113 | 84–85 | Qbt1v | 6.9 | 7037 | 2.6 |
| | MD54-05-57115 | 94–95 | Qbt1v | 8.2 | 8362 | 2.5 |
| | MD54-05-57116 | 99–100 | Qbt1v | 7.2 | 7343 | 3.0 |
| | MD54-05-57117 | 104–105 | Qbt1v | 6.8 | 6935 | 3.3 |
| | MD54-05-57118 | 109–110 | Qbt1v | 5.9 | 6017 | 4.0 |
| | MD54-05-57119 | 114–115 | Qbt1v | 5.2 | 5303 | 5.7 |

## Table 6.3-4 (continued)

| Borehole Location | Sample ID | Depth (ft) | Matrix (unit) | Matric Potential |  | Gravimetric Moisture Content (%, g/g) |
|---|---|---|---|---|---|---|
|  |  |  |  | (-bars) | (-cm) |  |
| 54-24241 (continued) | MD54-05-57120 | 119–120 | Qbt1v | 3.8 | 3875 | 6.5 |
|  | MD54-05-57121 | 124–125 | Qbt1v | 4.5 | 4589 | 6.5 |
|  | MD54-05-57122 | 129–130 | Qbt1g | 5.4 | 5507 | 11.3 |
|  | MD54-05-57123 | 134–135 | Qbt1g | 3.9 | 3977 | 9.7 |
|  | MD54-05-57124 | 139–140 | Qbt1g | 6.0 | 6119 | 5.5 |
|  | MD54-05-57125 | 144–145 | Qbt1g | 2.6 | 2651 | 5.9 |
|  | MD54-05-57126 | 149–150 | Qbt1g | 4.2 | 4283 | 6.7 |
|  | MD54-05-57127 | 154–155 | Qbt1g | 2.8 | 2855 | 6.6 |
|  | MD54-05-57128 | 159–160 | Qbt1g | 4.9 | 4997 | 7.0 |
|  | MD54-05-57575 | 162–164 | Qbt1g | 3.4 | 3467 | 6.5 |
|  | MD54-05-57130 | 169–170 | Qbt1g | 4.5 | 4589 | 6.1 |
|  | MD54-05-57131 | 174–175 | Qbt1g | 4.6 | 4691 | 6.4 |
|  | MD54-05-57132 | 179–180 | Qbt1g | 4.8 | 4895 | 6.7 |
|  | MD54-05-57133 | 184–185 | Qbt1g | 2.8 | 2855 | 6.8 |
|  | MD54-05-57134 | 189–190 | Qbt1g | 5.4 | 5507 | 7.5 |
|  | MD54-05-57135 | 194–195 | Qbt1g | 4.9 | 4997 | 7.9 |
|  | MD54-05-57136 | 199–200 | Qbt1g | 4.5 | 4589 | 8.9 |
|  | MD54-05-57137 | 204–205 | Qbt1g | 4.8 | 4895 | 7.8 |
|  | MD54-05-57138 | 209–210 | Qbt1g | 5.0 | 5099 | 7.4 |
|  | MD54-05-57139 | 214–215 | Qbt1g | 4.4 | 4487 | 7.6 |
|  | MD54-05-57140 | 219–220 | Qbt1g | 3.8 | 3875 | 8.1 |
|  | MD54-05-57141 | 224–225 | Qbt1g | 4.7 | 4793 | 8.2 |
|  | MD54-05-57142 | 229–230 | Qbt1g | 4.2 | 4283 | 8.9 |
|  | MD54-05-57143 | 234–235 | Qbt1g | 4.3 | 4385 | 9.6 |
|  | MD54-05-57144 | 239–240 | Qbt1g | 4.5 | 4589 | 10.3 |
|  | MD54-05-57145 | 244–245 | Qbt1g | 6.2 | 6323 | 9.9 |
|  | MD54-05-57146 | 249–250 | Qbt1g | 5.0 | 5099 | 10.3 |
| 54-24399* | MD54-05-57174 | 385–390 | ALLH | 6.2 | 6323 | 27.9 |
|  | MD54-05-57175 | 390–395 | ALLH | <648 | <660,830 | 3.1 |
|  | MD54-05-57176 | 395–400 | TCB | 7.1 | 7241 | 1.3 |

*54-24399 was advanced 10 ft northwest of 54-24241.

## Table 6.5-1
## MDA L Pore Gas Field Screening Data

| Depth (ft) | TCA (ppm) | TCE (ppm) | Freon-11 (ppm) | PCE (ppm) | CO2 B&K (ppm) | Water Vapor (ppm) | $CO_2$ Landtec (percent) |
|---|---|---|---|---|---|---|---|
| **Borehole A (54-24242)** | | | | | | | |
| 15 | 41.5 | 7.55 | 0.664 | 10.1 | 3720 | 13200 | 0.3 |
| 100 | 31 | 7.5 | 0.576 | 9.55 | 3000 | 15800 | 0.6 |
| **Borehole B (54-24239)** | | | | | | | |
| 15 | 93.5 | 17.2 | 2.75 | 75.9 | 6610 | 1960 | 0.5 |
| 100 | 72.7 | 14 | 1.74 | 22.5 | 6810 | 18000 | 0.9 |
| **Borehole C (54-24240)** | | | | | | | |
| 60 | 340 | 52.8 | 2.02 | 16.4 | 7230 | 16700 | 0.9 |
| 230 | 31.2 | 5.64 | 0.16 | 1.7 | 1670 | 14800 | 0.6 |
| **Borehole D-1 (54-24241)** | | | | | | | |
| Data not collected due to calibration errors | | | | | | | |
| **Borehole D-2 (54-24399)** | | | | | | | |
| 550–608 | 2.58 | 0.05 | 0.0 | 0.0 | 1200 | 1760 | 0.0 |
| **Borehole E (54-24238)** | | | | | | | |
| Data not collected due to calibration errors | | | | | | | |
| **Borehole F (54-24243)** | | | | | | | |
| 65 | 278 | 49.2 | 11 | 58.9 | 12800 | 9220 | 1.6 |
| 130 | 222 | 29.4 | 10.6 | 48.7 | 9870 | 10100 | 1.4 |
| **Borehole G (54-24244)** | | | | | | | |
| 65 | 108 | 20.1 | 3.48 | 19.7 | 7180 | 1330 | 0.8 |
| 130 | 71.3 | 14.2 | 3.02 | 14.7 | 5020 | 13600 | 0.8 |

## Table 6.6-1
## VOCs Detected in Pore-Gas Samples at MDA L

| Borehole ID/ Location | Depth (ft) | Sample ID | Analyte | Screening Value[a] (µg/m$^3$) | Result (µg/m$^3$) |
|---|---|---|---|---|---|
| BH E<br>54-24238 | 65–67 | MD54-05-57564 | Chloroform | 0.84 | 22000 |
| | | | Dichloroethane[1,1-] | 520 | 29000 |
| | | | Dichloroethane[1,2-] | 0.74 | 40000 |
| | | | Dichloroethene[1,1-] | 210 | 44000 |
| | | | Dichloropropane[1,2-] | 0.99 | 310000 |
| | | | Methylene Chloride | 41 | 520000 |
| | | | Tetrachloroethene | 3.3 | 28000 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 280000 |
| | | | Trichloroethane[1,1,1-] | 2300 | 2000000 |
| | | | Trichloroethene | 0.17 | 330000 |
| | | | Trichlorofluoromethane | 730 | 29000 |
| | 108–110 | MD54-05-58295 | Chloroform | 0.84 | 19000 |
| | | | Dichloroethane[1,1-] | 520 | 21000 |
| | | | Dichloroethane[1,2-] | 0.74 | 34000 |
| | | | Dichloroethene[1,1-] | 210 | 35000 |
| | | | Dichloropropane[1,2-] | 0.99 | 180000 |
| | | | Methylene Chloride | 41 | 320000 |
| | | | Tetrachloroethene | 3.3 | 23000 |
| | | | Toluene | 400 | 3700 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 180000 |
| | | | Trichloroethane[1,1,1-] | 2300 | 1400000 |
| | | | Trichloroethene | 0.17 | 260000 |
| | | | Trichlorofluoromethane | 730 | 22000 |
| BH B<br>54-24239 | 15–17 | MD54-05-58294 | Chloroform | 0.84 | 8300 |
| | | | Dichloroethane[1,1-] | 520 | 7300 |
| | | | Dichloroethane[1,2-] | 0.74 | 3600 |
| | | | Dichloroethene[1,1-] | 210 | 17000 |
| | | | Dichloropropane[1,2-] | 0.99 | 4300 |
| | | | Methylene Chloride | 41 | 1300 |
| | | | Tetrachloroethene | 3.3 | 270000 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 43000(J+) |
| | | | Trichloroethane[1,1,1-] | 2300 | 390000 |
| | | | Trichloroethene | 0.17 | 97000 |
| | | | Trichlorofluoromethane | 730 | 3300 |

## Table 6.6-1 (continued)

| Borehole Location | Depth (ft) | Sample ID | Analyte | Screening Value[a] (µg/m³) | Result (µg/m³) |
|---|---|---|---|---|---|
| BH B 54-24239 (continued) | 100–101 | MD54-05-57565 | Carbon Tetrachloride | 1.3 | 3200 |
| | | | Chloroform | 0.84 | 13000 |
| | | | Dichloroethane[1,1-] | 520 | 11000 |
| | | | Dichloroethane[1,2-] | 0.74 | 13000 |
| | | | Dichloroethene[1,1-] | 210 | 22000 |
| | | | Dichloropropane[1,2-] | 0.99 | 6900 |
| | | | Methylene Chloride | 41 | 14000 |
| | | | Tetrachloroethene | 3.3 | 120000 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 77000(J+) |
| | | | Trichloroethane[1,1,1-] | 2300 | 600000 |
| | | | Trichloroethene | 0.17 | 120000 |
| | | | Trichlorofluoromethane | 730 | 6200 |
| BH C 54-24240 | 65–67 | MD54-05-58289 | Chloroform | 0.84 | 9800 |
| | | | Dichloroethane[1,1-] | 520 | 53000 |
| | | | Dichloroethane[1,2-] | 0.74 | 93000 |
| | | | Dichloroethene[1,1-] | 210 | 55000 |
| | | | Methylene Chloride | 41 | 150000 |
| | | | Tetrachloroethene | 3.3 | 40000 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 52000(J+) |
| | | | Trichloroethane[1,1,1-] | 2300 | 2200000 |
| | | | Trichloroethene | 0.17 | 310000 |
| | | | Trichlorofluoromethane | 730 | 11000 |
| | 230–232 | MD54-05-58288 | Chloroform | 0.84 | 880 |
| | | | Dichloroethane[1,1-] | 520 | 4400 |
| | | | Dichloroethane[1,2-] | 0.74 | 11000 |
| | | | Dichloroethene[1,1-] | 210 | 3600 |
| | | | Dichloropropane[1,2-] | 0.99 | 450 |
| | | | Methylene Chloride | 41 | 18000 |
| | | | Tetrachloroethene | 3.3 | 2600 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 2100(J+) |
| | | | Trichloroethane[1,1,1-] | 2300 | 110000 |
| | | | Trichloroethene | 0.17 | 23000 |
| BH D-1 54-24241 | 15–17 | MD54-05-58287 | Chloroform | 0.84 | 4200 |
| | | | Dichloroethane[1,1-] | 520 | 4400 |
| | | | Dichloroethane[1,2-] | 0.74 | 930 |
| | | | Dichloroethene[1,1-] | 210 | 3100 |
| | | | Dichloropropane[1,2-] | 0.99 | 2500 |

## Table 6.6-1 (continued)

| Borehole Location | Depth (ft) | Sample ID | Analyte | Screening Value[a] (µg/m³) | Result (µg/m³) |
|---|---|---|---|---|---|
| BH D-1 54-24241 (continued) | | | Tetrachloroethene | 3.3 | 15000 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 34000 |
| | | | Trichloroethane[1,1,1-] | 2300 | 190000 |
| | | | Trichloroethene | 0.17 | 59000 |
| | | | Trichlorofluoromethane | 730 | 1700 |
| | 154–156 | MD54-05-58286 | Carbon Tetrachloride | 1.3 | 6900 |
| | | | Chloroform | 0.84 | 16000 |
| | | | Dichloroethane[1,1-] | 520 | 13000 |
| | | | Dichloroethane[1,2-] | 0.74 | 16000 |
| | | | Dichloroethene[1,1-] | 210 | 24000 |
| | | | Dichloropropane[1,2-] | 0.99 | 17000 |
| | | | Methylene Chloride | 41 | 35000 |
| | | | Tetrachloroethene | 3.3 | 52000 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 110000 |
| | | | Trichloroethane[1,1,1-] | 2300 | 760000 |
| | | | Trichloroethene | 0.17 | 170000 |
| | | | Trichlorofluoromethane | 730 | 11000 |
| BH A 54-24242 | 15–17 | MD54-05-57566 | Carbon Tetrachloride | 1.3 | 1700 |
| | | | Chloroform | 0.84 | 5900 |
| | | | Dichloroethane[1,1-] | 520 | 5700 |
| | | | Dichloroethane[1,2-] | 0.74 | 2800 |
| | | | Dichloroethene[1,1-] | 210 | 11000 |
| | | | Dichloropropane[1,2-] | 0.99 | 2400 |
| | | | Methylene Chloride | 41 | 870 |
| | | | Tetrachloroethene | 3.3 | 60000 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 38000(J+) |
| | | | Trichloroethane[1,1,1-] | 2300 | 330000 |
| | | | Trichloroethene | 0.17 | 64000 |
| | | | Trichlorofluoromethane | 730 | 2800 |
| | 100–102 | MD54-05-58293 | Carbon Tetrachloride | 1.3 | 690 |
| | | | Chloroform | 0.84 | 3700 |
| | | | Dichloroethane[1,1-] | 520 | 3100 |
| | | | Dichloroethane[1,2-] | 0.74 | 4000 |
| | | | Dichloroethene[1,1-] | 210 | 9900 |
| | | | Dichloropropane[1,2-] | 0.99 | 1800 |
| | | | Methylene Chloride | 41 | 2300 |
| | | | Tetrachloroethene | 3.3 | 33000 |

## Table 6.6-1 (continued)

| Borehole Location | Depth (ft) | Sample ID | Analyte | Screening Value[a] (µg/m³) | Result (µg/m³) |
|---|---|---|---|---|---|
| BH A 54-24242 (continued) | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 14000(J+) |
| | | | Trichloroethane[1,1,1-] | 2300 | 160000 |
| | | | Trichloroethene | 0.17 | 38000 |
| | | | Trichlorofluoromethane | 730 | 1300 |
| BH F 54-24243 | 65–67 | MD54-05-58285 | Carbon Tetrachloride | 1.3 | 5000 |
| | | | Chloroform | 0.84 | 24000 |
| | | | Dichloroethane[1,1-] | 520 | 23000 |
| | | | Dichloroethane[1,2-] | 0.74 | 19000 |
| | | | Dichloroethene[1,1-] | 210 | 63000 |
| | | | Dichloropropane[1,2-] | 0.99 | 65000 |
| | | | Methylene Chloride | 41 | 45000 |
| | | | Tetrachloroethene | 3.3 | 20000 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 320000(J+) |
| | | | Trichloroethane[1,1,1-] | 2300 | 1500000 |
| | | | Trichloroethene | 0.17 | 280000 |
| | | | Trichlorofluoromethane | 730 | 31000 |
| | 130–132 | MD54-05-58284 | Chloroform | 0.84 | 37000 |
| | | | Dichloroethane[1,1-] | 520 | 25000 |
| | | | Dichloroethane[1,2-] | 0.74 | 38000 |
| | | | Dichloroethene[1,1-] | 210 | 99000 |
| | | | Dichloropropane[1,2-] | 0.99 | 60000 |
| | | | Methylene Chloride | 41 | 83000 |
| | | | Tetrachloroethene | 3.3 | 31000 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 480000(J+) |
| | | | Trichloroethane[1,1,1-] | 2300 | 2000000 |
| | | | Trichloroethene | 0.17 | 350000 |
| | | | Trichlorofluoromethane | 730 | 62000 |
| BH G 54-24244 | 65–67 | MD54-05-58282 | Carbon Tetrachloride | 1.3 | 2700 |
| | | | Chloroform | 0.84 | 13000 |
| | | | Dichloroethane[1,1-] | 520 | 6900 |
| | | | Dichloroethane[1,2-] | 0.74 | 11000 |
| | | | Dichloroethene[1,1-] | 210 | 22000 |
| | | | Dichloropropane[1,2-] | 0.99 | 30000 |
| | | | Methylene Chloride | 41 | 22000 |
| | | | Tetrachloroethene | 3.3 | 20000 |
| | | | Tetrahydrofuran | 9.9 | 62000 |
| | | | Toluene | 400 | 4100 |

## Table 6.6-1 (continued)

| Borehole Location | Depth (ft) | Sample ID | Analyte | Screening Value[a] (µg/m³) | Result (µg/m³) |
|---|---|---|---|---|---|
| BH G<br>54-24244<br>(continued) | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 77000(J+) |
| | | | Trichloroethane[1,1,1-] | 2300 | 500000 |
| | | | Trichloroethene | 0.17 | 91000 |
| | | | Trichlorofluoromethane | 730 | 18000 |
| | | | Xylene[1,2-] | 100 | 2400 |
| | 112–114 | MD54-05-58283 | Carbon Tetrachloride | 1.3 | 1800 |
| | | | Chloroform | 0.84 | 11000 |
| | | | Dichloroethane[1,1-] | 520 | 5300 |
| | | | Dichloroethane[1,2-] | 0.74 | 11000 |
| | | | Dichloroethene[1,1-] | 210 | 18000 |
| | | | Dichloropropane[1,2-] | 0.99 | 23000 |
| | | | Methylene Chloride | 41 | 25000 |
| | | | Tetrachloroethene | 3.3 | 12000 |
| | | | Tetrahydrofuran | 9.9 | 28000 |
| | | | Toluene | 400 | 3300 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 55000(J+) |
| | | | Trichloroethane[1,1,1-] | 2300 | 340000 |
| | | | Trichloroethene | 0.17 | 70000 |
| | | | Trichlorofluoromethane | 730 | 13000 |
| | | | Xylene[1,2-] | 100 | 1600 |
| BH D-2<br>54-24399 | 550–608 | MD54-05-58290 | Acetone | na[b] | 33 |
| | | | Butanone[2-] | 5200 | 4.7 |
| | | | Dichloroethane[1,1-] | 520 | 8.1 |
| | | | Dichloroethene[1,1-] | 210 | 71 |
| | | | Tetrachloroethene | 3.3 | 12 |
| | | | Toluene | 400 | 4.9 |
| | | | Trichloro-1,2,2-trifluoroethane[1,1,2-] | 31000 | 100 |
| | | | Trichloroethane[1,1,1-] | 2300 | 200 |
| | | | Trichloroethene | 0.17 | 23 |
| | | | Trichlorofluoromethane | 730 | 19 |

[a] Ambient air screening levels obtained from EPA Region 6 (EPA 2004, 87478) with carcinogenic values adjusted to $10^{-5}$ cancer risk.

[b] na = Not available.

## Table 6.6-2
## Tritium Detected in Pore Gas beneath MDA L

| Borehole Location | Sample ID | Concentration* (pCi/L) | Depth (ft) |
|---|---|---|---|
| 54-24238 | MD54-05-57564 | 31600 | 65.00–67.00 |
| | MD54-05-58295 | 1270 | 108.00–110.00 |
| 54-24239 | MD54-05-58294 | 3000 | 15.00–17.00 |
| | MD54-05-57565 | 4070 | 100.00–101.00 |
| 54-24240 | MD54-05-58289 | 5420 | 65.00–67.00 |
| | MD54-05-58288 | 4860 | 230.00–232.00 |
| 54-24241 | MD54-05-58287 | 3820 | 15.00–17.00 |
| | MD54-05-58286 | 19500 | 154.00–156.00 |
| 54-24242 | MD54-05-57566 | 2560 | 15.00–17.00 |
| | MD54-05-58293 | 12000 | 100.00–102.00 |
| 54-24243 | MD54-05-58285 | 153000 | 65.00–67.00 |
| | MD54-05-58284 | 14700 | 130.00–132.00 |
| 54-24244 | MD54-05-58282 | 5280 | 65.00–67.00 |
| | MD54-05-58283 | 6500 | 112.00–114.00 |
| 54-24399 | MD54-05-58290 | 20400 | 550.00–608.00 |

*Concentration of tritium in moisture extracted from pore gas.

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***BH-C, 54-24240***

**MD54-05-56973 (62.3-67.2 ft)**
Lithium 21.6 (J+)
**MD54-05-57536 (80.7-82.2 ft)**
Fluoride 2.56
Lithium 24.9 (J+)
**MD54-05-57537 (105.6-107.1 ft)**
Fluoride 4.63
Lithium 19.6 (J+)
**MD54-05-57538 (115.6-117.1 ft)**
Fluoride 3.55
Arsenic 2.03
Lithium 21.1 (J+)
**MD54-05-57539 (135.5-137 ft)**
Fluoride 4.95
Arsenic 1.81
Iron 4600
Lithium 11.3 (J+)
Manganese 213
Zinc 40.2
**MD54-05-57540 (150.4-151.9 ft)**
Fluoride 4.36
Nitrate 1.19
Iron 4040
Lithium 11.3 (J+)
Manganese 191
**MD54-05-57541 (170.4-171.8 ft)**
Fluoride 4.85
Nitrate 0.873 (J)
Arsenic 0.786
Barium 38.6
Iron 3920
Lithium 10.4 (J+)
Selenium 0.482 (J)
**MD54-05-57542 (190.3-191.8 ft)**
Fluoride 5.17
Nitrate 1.23
Barium 30.2
Lithium 15.3
**MD54-05-57543 (202.2-206.7 ft)**
Fluoride 10.4
Nitrate 2.45
Aluminum 60100
Arsenic 6.97
Barium 234
Beryllium 3.46
Cadmium 0.636 (J)
Calcium 4900
Chromium 26.1
Copper 15.1
Iron 31000
Lead 19.6
Lithium 44.8
Magnesium 6230
Manganese 281
Nickel 16.4
Potassium 5480
Vanadium 41.2
Zinc 87.8
**MD54-05-57544 (210.2-211.7 ft)**
Fluoride 2.15
Nitrate 1.33
Aluminum 4360
Arsenic 0.674
Barium 32.1
Lithium 13.2
**MD54-05-57545 (230.1-231.6 ft)**
Fluoride 1.17
Nitrate 1.44
Lithium 8.93
**MD54-05-57548 (251.5-254 ft)**
Fluoride 1.43
Nitrate 1.38
Lithium 7.18
**MD54-05-57547 (255-256.5 ft)**
Fluoride 2.39
Nitrate 1.6
Aluminum 8750
Arsenic 0.759
Barium 47
Lithium 8
**MD54-05-57549 (275-276.4 ft)**
Fluoride 1.68
Nitrate 2.05
Aluminum 7510
Arsenic 1.11
Barium 46.3
Chromium 3.07
Iron 4720
Lithium 14.3
Magnesium 932
Manganese 231
Nickel 2.46
Vanadium 5.76
Zinc 44.3
**MD54-05-56978 (299.9-301.3 ft)**
Nitrate 1.43
Aluminum 4140
Barium 28.3
Iron 4210
Lithium 17.5
Magnesium 898

***BH-A, 54-24242***

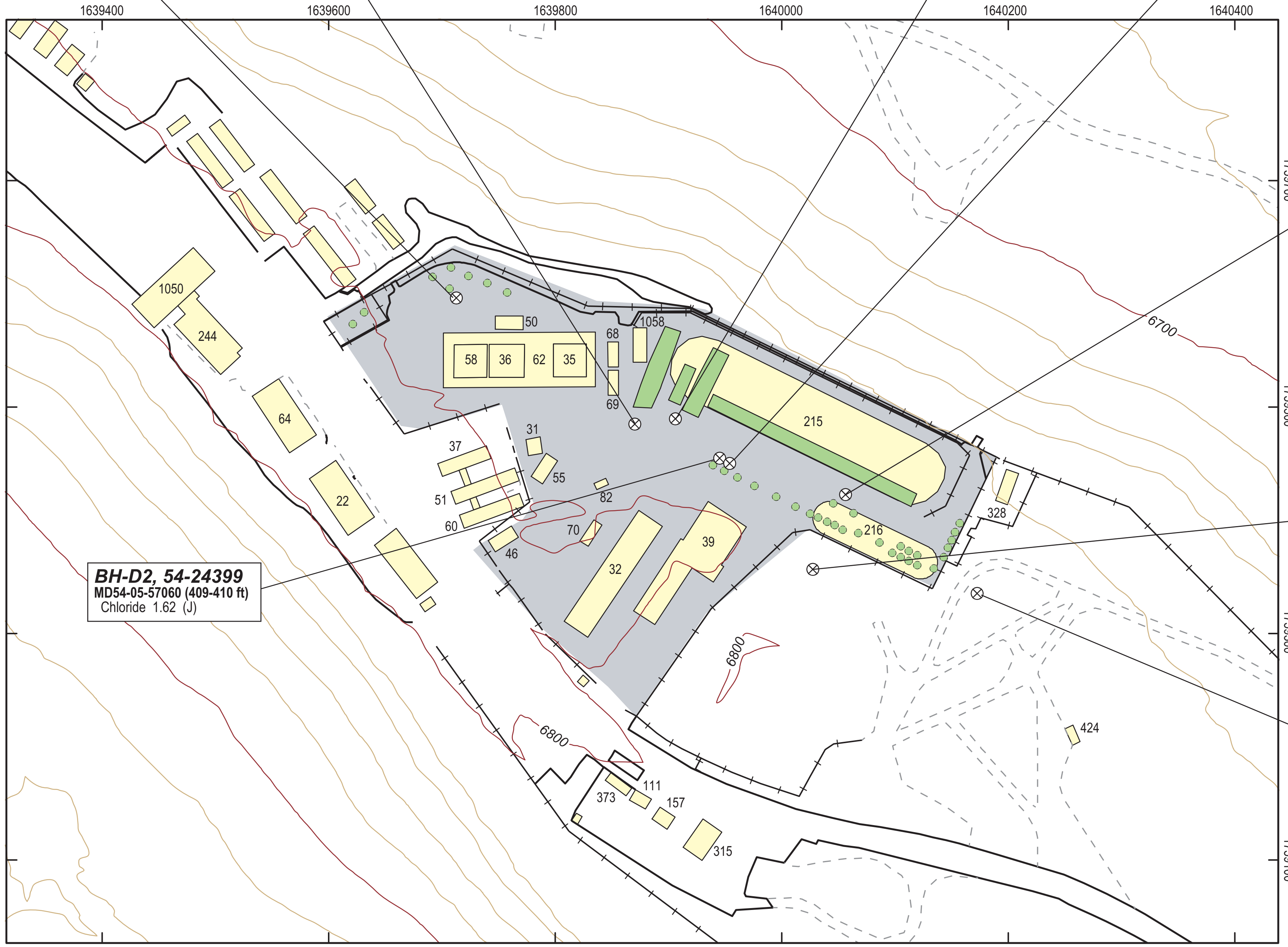
**MD54-05-57249 (15-20 ft)**
Nitrate 1.3
Lithium 4.98
**MD54-05-57480 (33-35 ft)**
Nitrate 1.55
Arsenic 1.89
Lithium 5.8
**MD54-05-57481 (48-50 ft)**
Nitrate 4.46
Lithium 13.4
**MD54-05-57482 (68-70 ft)**
Lithium 27.4
**MD54-05-57483 (88-90 ft)**
Nitrate 0.77 (J)
Lithium 23.1
**MD54-05-57484 (108-110 ft)**
Nitrate 0.902 (J)
Arsenic 1.94
Lithium 17.3
**MD54-05-57485 (128-130 ft)**
Nitrate 1.95
Arsenic 1.38
Iron 5660
Lithium 19.2
Manganese 233
Zinc 46.7
**MD54-05-57254 (147-150 ft)**
Nitrate 1.52
Barium 25.9
Iron 4080
Lithium 11.8

***BH-B, 54-24239***

**MD54-05-56966 (15-20 ft)**
Nitrate 11.3
Lithium 5.45
**MD54-05-56967 (31.5-33.5 ft)**
Nitrate 14.3
Perchlorate 0.0667
Lithium 6.09
**MD54-05-57528 (48-50 ft)**
Nitrate 19.4
Lithium 15.2
**MD54-05-57529 (68-70 ft)**
Nitrate 73.7
Perchlorate 5.46
Copper 4.07
Lithium 27.5
Nickel 4.62 (J-)
**MD54-05-56968 (88-90 ft)**
Nitrate 0.969
Lithium 26.8
**MD54-05-56969 (108-110 ft)**
Nitrate 0.858 (J)
Lithium 15.4
**MD54-05-56970 (128-130 ft)**
Nitrate 1.23
Arsenic 2.4
Lithium 22.7
**MD54-05-56971 (147-150 ft)**
Barium 43.5
Iron 4460
Lithium 10.3
Manganese 254

***BH-D1, 54-24241***

**MD54-05-57505 (65-70 ft)**
Nitrate 0.756 (J)
Lithium 24
**MD54-05-57506 (82-83.5 ft)**
Nitrate 2.2
Barium 31.8
Beryllium 1.85
Copper 6.77
Lithium 30.6
**MD54-05-57507 (132-134 ft)**
Arsenic 2.3
Barium 31.3
Iron 4830
Lithium 21.9
Manganese 236
Zinc 52.2
**MD54-05-57508 (147.5-149 ft)**
Iron 3810
Lithium 11.4
Manganese 215
**MD54-05-57509 (197-199 ft)**
Barium 31.8
Lithium 22.5
**MD54-05-57510 (245-250 ft)**
Nitrate 0.926 (J)
Chromium 7.8 (J)
Lithium 7.78
Selenium 0.309 (J)



***BH-D2, 54-24399***

**MD54-05-57060 (409-410 ft)**
Chloride 1.62 (J)

***BH-E, 54-24238***

**MD54-05-56959 (15-20 ft)**
Nitrate 1.99
Lithium 2.91
**MD54-05-56960 (33-35 ft)**
Nitrate 13.1
Barium 51.6 (J)
Lithium 14.1
**MD54-05-56961 (48-50 ft)**
Nitrate 3.09
Lithium 22.2
**MD54-05-56962 (68-70 ft)**
Nitrate 1.7
Lithium 37.1
Selenium 0.431 (J)
**MD54-05-56963 (78-80 ft)**
Nitrate 21.9
Lithium 38.6
**MD54-05-57520 (108-110 ft)**
Fluoride 4.94
Nitrate 1.11
Perchlorate 0.0656 (J)
Lithium 23.5
Selenium 0.504 (J)
**MD54-05-57521 (128-130 ft)**
Fluoride 4.26
Nitrate 2.51
Arsenic 2.48
Barium 29.7 (J)
Iron 6100
Lithium 30
Manganese 286
Selenium 0.302 (J)
Zinc 53.9
**MD54-05-56964 (147-150 ft)**
Arsenic 0.708
Barium 25.9 (J)
Iron 4170
Lithium 13.8
Manganese 207

***BH-F, 54-24243***

**MD54-05-57258 (65-70 ft)**
Nitrate 1.02
Arsenic 2.01
Lithium 24.4
**MD54-05-57486 (88-90 ft)**
Nitrate 1.25
Arsenic 1.9
Lithium 25.6
**MD54-05-57487 (115-117 ft)**
Nitrate 4.12
Arsenic 2.43
Lithium 23.8
**MD54-05-57259 (128-130 ft)**
Nitrate 2.22
Arsenic 2.54
Copper 4.38
Iron 7100
Lead 23
Lithium 25.4
Manganese 272
Zinc 53.8
**MD54-05-57263 (148-150 ft)**
Iron 3930
Lithium 12.4
Manganese 200

***BH-G, 54-24244***

**MD54-05-57266 (65-70 ft)**
Lithium 28.8
**MD54-05-57494 (88-90 ft)**
Fluoride 7.95 (J-)
Lithium 26.4
**MD54-05-57495 (108-110 ft)**
Fluoride 6.05 (J-)
Nitrate 0.978
Lithium 27.7
**MD54-05-57496 (128-130 ft)**
Fluoride 8.11 (J-)
Aluminum 5130
Arsenic 3.07
Barium 35.6
Beryllium 2.07
Copper 8.21
Iron 5260
Lead 14.9
Lithium 35.1
Manganese 232
Zinc 59.7
**MD54-05-57268 (148-150 ft)**
Lithium 17.7
Manganese 247

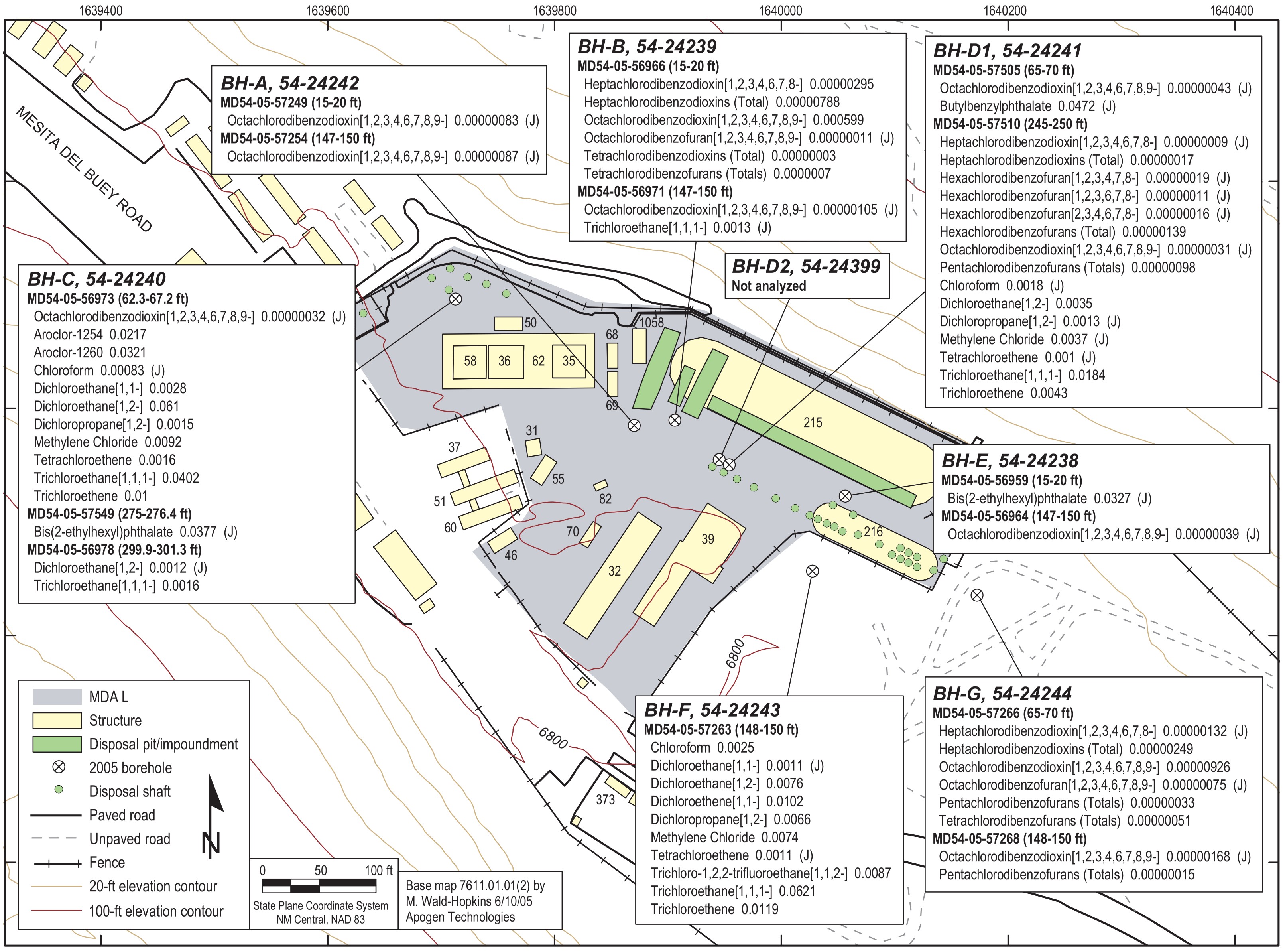
▨ MDA L
🟨 Structure
🟩 Disposal pit/impoundment
⊗ 2005 borehole
● Disposal shaft
— Paved road
- - Unpaved road
+—+ Fence
— 20-ft elevation contour
— 100-ft elevation contour

N

0 50 100 ft
State Plane Coordinate System
NM Central, NAD 83

Base map 7611.01.01(2) by
M. Wald-Hopkins 6/10/05
Apogen Technologies

**Figure 6.3-2.** **Inorganic chemicals (mg/kg) detected above background values in subsurface tuff at MDA L**



Base map 7611.01.01(2) by
M. Wald-Hopkins 6/10/05
Apogen Technologies

**BH-A, 54-24242**
**MD54-05-57249 (15-20 ft)**
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] 0.00000083 (J)
**MD54-05-57254 (147-150 ft)**
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] 0.00000087 (J)

**BH-B, 54-24239**
**MD54-05-56966 (15-20 ft)**
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-] 0.00000295
Heptachlorodibenzodioxins (Total) 0.00000788
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] 0.000599
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-] 0.00000011 (J)
Tetrachlorodibenzodioxins (Total) 0.00000003
Tetrachlorodibenzofurans (Totals) 0.0000007
**MD54-05-56971 (147-150 ft)**
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] 0.00000105 (J)
Trichloroethane[1,1,1-] 0.0013 (J)

**BH-D1, 54-24241**
**MD54-05-57505 (65-70 ft)**
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] 0.00000043 (J)
Butylbenzylphthalate 0.0472 (J)
**MD54-05-57510 (245-250 ft)**
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-] 0.00000009 (J)
Heptachlorodibenzodioxins (Total) 0.00000017
Hexachlorodibenzofuran[1,2,3,4,7,8-] 0.00000019 (J)
Hexachlorodibenzofuran[1,2,3,6,7,8-] 0.00000011 (J)
Hexachlorodibenzofuran[2,3,4,6,7,8-] 0.00000016 (J)
Hexachlorodibenzofurans (Total) 0.00000139
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] 0.00000031 (J)
Pentachlorodibenzofurans (Totals) 0.00000098
Chloroform 0.0018 (J)
Dichloroethane[1,2-] 0.0035
Dichloropropane[1,2-] 0.0013 (J)
Methylene Chloride 0.0037 (J)
Tetrachloroethene 0.001 (J)
Trichloroethane[1,1,1-] 0.0184
Trichloroethene 0.0043

**BH-C, 54-24240**
**MD54-05-56973 (62.3-67.2 ft)**
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] 0.00000032 (J)
Aroclor-1254 0.0217
Aroclor-1260 0.0321
Chloroform 0.00083 (J)
Dichloroethane[1,1-] 0.0028
Dichloroethane[1,2-] 0.061
Dichloropropane[1,2-] 0.0015
Methylene Chloride 0.0092
Tetrachloroethene 0.0016
Trichloroethane[1,1,1-] 0.0402
Trichloroethene 0.01
**MD54-05-57549 (275-276.4 ft)**
Bis(2-ethylhexyl)phthalate 0.0377 (J)
**MD54-05-56978 (299.9-301.3 ft)**
Dichloroethane[1,2-] 0.0012 (J)
Trichloroethane[1,1,1-] 0.0016

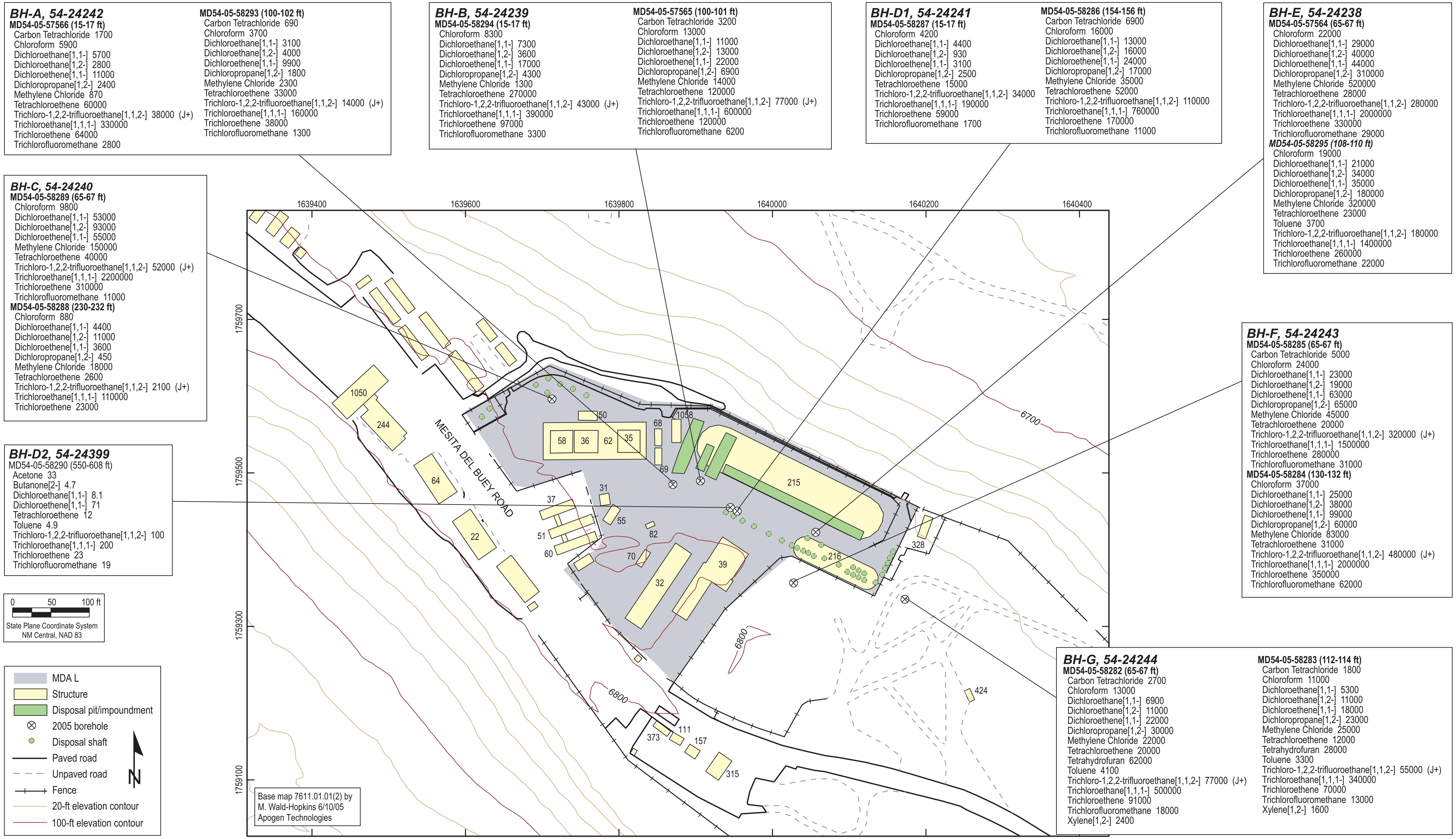
**BH-D2, 54-24399**
**Not analyzed**

**BH-E, 54-24238**
**MD54-05-56959 (15-20 ft)**
Bis(2-ethylhexyl)phthalate 0.0327 (J)
**MD54-05-56964 (147-150 ft)**
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] 0.00000039 (J)

**BH-F, 54-24243**
**MD54-05-57263 (148-150 ft)**
Chloroform 0.0025
Dichloroethane[1,1-] 0.0011 (J)
Dichloroethane[1,2-] 0.0076
Dichloroethene[1,1-] 0.0102
Dichloropropane[1,2-] 0.0066
Methylene Chloride 0.0074
Tetrachloroethene 0.0011 (J)
Trichloro-1,2,2-trifluoroethane[1,1,2-] 0.0087
Trichloroethane[1,1,1-] 0.0621
Trichloroethene 0.0119

**BH-G, 54-24244**
**MD54-05-57266 (65-70 ft)**
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-] 0.00000132 (J)
Heptachlorodibenzodioxins (Total) 0.00000249
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] 0.00000926
Octachlorodibenzofuran[1,2,3,4,6,7,8,9-] 0.00000075 (J)
Pentachlorodibenzofurans (Totals) 0.00000033
Tetrachlorodibenzofurans (Totals) 0.00000051
**MD54-05-57268 (148-150 ft)**
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-] 0.00000168 (J)
Pentachlorodibenzofurans (Totals) 0.00000015

**Figure 6.3-3. Organic chemicals (mg/kg) detected in subsurface tuff at MDA L**



Base map 7611.01.01(2) by
M. Wald-Hopkins 6/10/05
Apogen Technologies

**BH-A, 54-24242**

**MD54-05-57566 (15-17 ft)**
Carbon Tetrachloride 1700
Chloroform 5900
Dichloroethane[1,1-] 5700
Dichloroethane[1,2-] 2800
Dichloroethene[1,1-] 11000
Dichloropropane[1,2-] 2400
Methylene Chloride 870
Tetrachloroethene 60000
Trichloro-1,2,2-trifluoroethane[1,1,2-] 38000 (J+)
Trichloroethane[1,1,1-] 330000
Trichloroethene 64000
Trichlorofluoromethane 2800

**MD54-05-58293 (100-102 ft)**
Carbon Tetrachloride 690
Chloroform 3700
Dichloroethane[1,1-] 3100
Dichloroethane[1,2-] 4000
Dichloroethene[1,1-] 9900
Dichloropropane[1,2-] 1800
Methylene Chloride 2300
Tetrachloroethene 33000
Trichloro-1,2,2-trifluoroethane[1,1,2-] 14000 (J+)
Trichloroethane[1,1,1-] 160000
Trichloroethene 38000
Trichlorofluoromethane 1300

**BH-B, 54-24239**

**MD54-05-58294 (15-17 ft)**
Chloroform 8300
Dichloroethane[1,1-] 7300
Dichloroethane[1,2-] 3600
Dichloroethene[1,1-] 17000
Dichloropropane[1,2-] 4300
Methylene Chloride 1300
Tetrachloroethene 270000
Trichloro-1,2,2-trifluoroethane[1,1,2-] 43000 (J+)
Trichloroethane[1,1,1-] 390000
Trichloroethene 97000
Trichlorofluoromethane 3300

**MD54-05-57565 (100-101 ft)**
Carbon Tetrachloride 3200
Chloroform 13000
Dichloroethane[1,1-] 11000
Dichloroethane[1,2-] 13000
Dichloroethene[1,1-] 22000
Dichloropropane[1,2-] 6900
Methylene Chloride 14000
Tetrachloroethene 120000
Trichloro-1,2,2-trifluoroethane[1,1,2-] 77000 (J+)
Trichloroethane[1,1,1-] 600000
Trichloroethene 120000
Trichlorofluoromethane 6200

**BH-D1, 54-24241**

**MD54-05-58287 (15-17 ft)**
Chloroform 4200
Dichloroethane[1,1-] 4400
Dichloroethane[1,2-] 930
Dichloroethene[1,1-] 3100
Dichloropropane[1,2-] 2500
Tetrachloroethene 15000
Trichloro-1,2,2-trifluoroethane[1,1,2-] 34000
Trichloroethane[1,1,1-] 190000
Trichloroethene 59000
Trichlorofluoromethane 1700

**MD54-05-58286 (154-156 ft)**
Carbon Tetrachloride 6900
Chloroform 16000
Dichloroethane[1,1-] 13000
Dichloroethane[1,2-] 16000
Dichloroethene[1,1-] 24000
Dichloropropane[1,2-] 17000
Methylene Chloride 35000
Tetrachloroethene 52000
Trichloro-1,2,2-trifluoroethane[1,1,2-] 110000
Trichloroethane[1,1,1-] 760000
Trichloroethene 170000
Trichlorofluoromethane 11000

**BH-E, 54-24238**

**MD54-05-57564 (65-67 ft)**
Chloroform 22000
Dichloroethane[1,1-] 29000
Dichloroethane[1,2-] 40000
Dichloroethene[1,1-] 44000
Dichloropropane[1,2-] 310000
Methylene Chloride 520000
Tetrachloroethene 28000
Trichloro-1,2,2-trifluoroethane[1,1,2-] 280000
Trichloroethane[1,1,1-] 2000000
Trichloroethene 330000
Trichlorofluoromethane 29000

**MD54-05-58295 (108-110 ft)**
Chloroform 19000
Dichloroethane[1,1-] 21000
Dichloroethane[1,2-] 34000
Dichloroethene[1,1-] 35000
Dichloropropane[1,2-] 180000
Methylene Chloride 320000
Tetrachloroethene 23000
Toluene 3700
Trichloro-1,2,2-trifluoroethane[1,1,2-] 180000
Trichloroethane[1,1,1-] 1400000
Trichloroethene 260000
Trichlorofluoromethane 22000

**BH-C, 54-24240**

**MD54-05-58289 (65-67 ft)**
Chloroform 9800
Dichloroethane[1,1-] 53000
Dichloroethane[1,2-] 93000
Dichloroethene[1,1-] 55000
Methylene Chloride 150000
Tetrachloroethene 40000
Trichloro-1,2,2-trifluoroethane[1,1,2-] 52000 (J+)
Trichloroethane[1,1,1-] 2200000
Trichloroethene 310000
Trichlorofluoromethane 11000

**MD54-05-58288 (230-232 ft)**
Chloroform 880
Dichloroethane[1,1-] 4400
Dichloroethane[1,2-] 11000
Dichloroethene[1,1-] 3600
Dichloropropane[1,2-] 450
Methylene Chloride 18000
Tetrachloroethene 2600
Trichloro-1,2,2-trifluoroethane[1,1,2-] 2100 (J+)
Trichloroethane[1,1,1-] 110000
Trichloroethene 23000

**BH-F, 54-24243**

**MD54-05-58285 (65-67 ft)**
Carbon Tetrachloride 5000
Chloroform 24000
Dichloroethane[1,1-] 23000
Dichloroethane[1,2-] 19000
Dichloroethene[1,1-] 63000
Dichloropropane[1,2-] 65000
Methylene Chloride 45000
Tetrachloroethene 20000
Trichloro-1,2,2-trifluoroethane[1,1,2-] 320000 (J+)
Trichloroethane[1,1,1-] 1500000
Trichloroethene 280000
Trichlorofluoromethane 31000

**MD54-05-58284 (130-132 ft)**
Chloroform 37000
Dichloroethane[1,1-] 25000
Dichloroethane[1,2-] 38000
Dichloroethene[1,1-] 99000
Dichloropropane[1,2-] 60000
Methylene Chloride 83000
Tetrachloroethene 31000
Trichloro-1,2,2-trifluoroethane[1,1,2-] 480000 (J+)
Trichloroethane[1,1,1-] 2000000
Trichloroethene 350000
Trichlorofluoromethane 62000

**BH-D2, 54-24399**

MD54-05-58290 (550-608 ft)
Acetone 33
Butanone[2-] 4.7
Dichloroethane[1,1-] 8.1
Dichloroethene[1,1-] 71
Tetrachloroethene 12
Toluene 4.9
Trichloro-1,2,2-trifluoroethane[1,1,2-] 100
Trichloroethane[1,1,1-] 200
Trichloroethene 23
Trichlorofluoromethane 19

**BH-G, 54-24244**

**MD54-05-58282 (65-67 ft)**
Carbon Tetrachloride 2700
Chloroform 13000
Dichloroethane[1,1-] 6900
Dichloroethane[1,2-] 11000
Dichloroethene[1,1-] 22000
Dichloropropane[1,2-] 30000
Methylene Chloride 22000
Tetrachloroethene 20000
Tetrahydrofuran 62000
Toluene 4100
Trichloro-1,2,2-trifluoroethane[1,1,2-] 77000 (J+)
Trichloroethane[1,1,1-] 500000
Trichloroethene 91000
Trichlorofluoromethane 18000
Xylene[1,2-] 2400

**MD54-05-58283 (112-114 ft)**
Carbon Tetrachloride 1800
Chloroform 11000
Dichloroethane[1,1-] 5300
Dichloroethane[1,2-] 11000
Dichloroethene[1,1-] 18000
Dichloropropane[1,2-] 23000
Methylene Chloride 25000
Tetrachloroethene 12000
Tetrahydrofuran 28000
Toluene 3300
Trichloro-1,2,2-trifluoroethane[1,1,2-] 55000 (J+)
Trichloroethane[1,1,1-] 340000
Trichloroethene 70000
Trichlorofluoromethane 13000
Xylene[1,2-] 1600

**Figure 6.6-1. Organic chemicals (µg/m$^3$) detected in subsurface pore gas at MDA L**

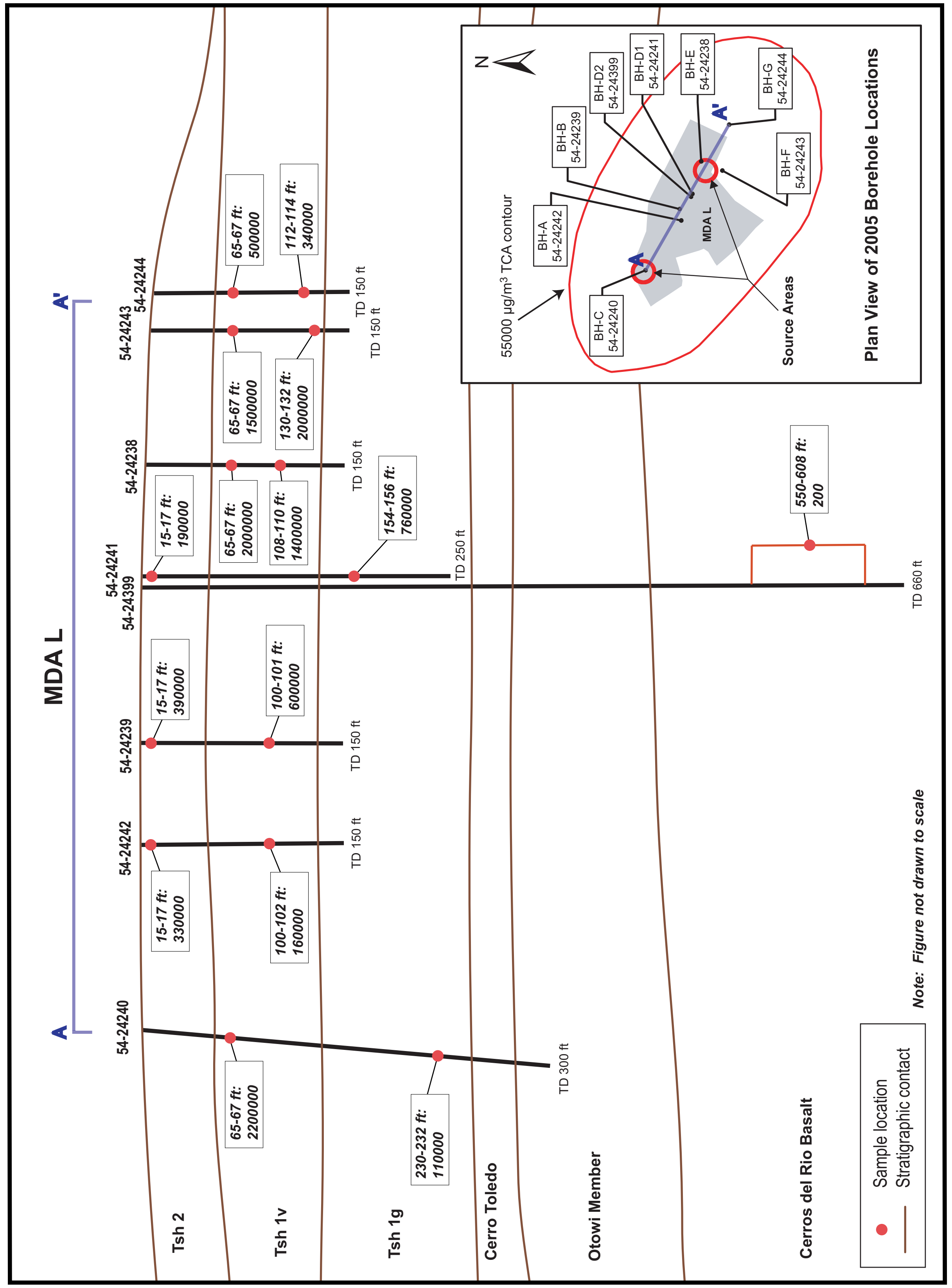


Figure 6.6-2. Trichloroethane[1,1,1-] (µg/m³) detected in subsurface pore gas at MDA L