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

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EXECUTIVE SUMMARY

This addendum to the Material Disposal Area (MDA) L investigation report describes the results of the supplemental drilling and sampling activities conducted to complete the investigation of MDA L, Solid Waste Management Unit 54-006, located within Technical Area 54 at Los Alamos National Laboratory (the Laboratory).

The Laboratory submitted the investigation report for MDA L to the New Mexico Environment Department (NMED) in September 2005 and the revised investigation report in March 2006. The Laboratory subsequently received a notice of disapproval (NOD) from NMED. The NOD required that three new boreholes be installed and constructed to monitor soil vapor to define the lateral and vertical extent of subsurface contamination at MDA L. The NOD also required that the Laboratory collect additional pore-gas samples from existing MDA L boreholes to analyze for volatile organic compounds (VOCs).

The results of tuff and pore-gas sample analysis from newly installed and existing boreholes confirm the results from the Phase I Resource Conservation and Recovery Act facility investigation, the 2004–2005 Compliance Order on Consent investigation, and quarterly pore-gas monitoring. Concentrations of inorganic chemicals are not present in a pattern that is indicative of release and are near background values or detection limits. VOCs are detected sporadically in tuff samples, are not present in a pattern that is indicative of a release, and are near detection limits. Concentrations of VOCs are detected in all subsurface pore-gas samples collected and indicate two VOC source areas associated with the eastern and western disposal shaft fields. VOC vapor concentrations are bound at depth by the Cerros del Rio basalt. Maximum concentrations of tritium are below the U.S. Environmental Protection Agency drinking water standard of 20,000 pCi/L. Pore-gas sampling results indicate that the vertical distribution of VOC and tritium concentrations present no current threat of groundwater contamination from these constituents. The results of this addendum are consistent with the conclusions of the investigation report and revised investigation report.

In NMED’s letter approving the supplemental drilling and sampling activities, the Laboratory was requested to characterize the waste in Impoundments B, C, and D. The results of the characterization activities are included in Appendix H of this addendum.

This addendum completes the investigation of MDA L. The site is recommended to be further evaluated under the corrective measures evaluation process.

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1.0 INTRODUCTION

In September 2005, Los Alamos National Laboratory (the Laboratory) submitted the "Investigation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54" (LANL 2005, 092591) to the New Mexico Environment Department (NMED). In March 2006, the Laboratory submitted the "Investigation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54, Revision 1" (LANL 2006, 091888) to NMED, which included quarterly pore-gas monitoring data for Material Disposal Area (MDA) L from the September 2006 periodic monitoring report (LANL 2006, 093910). On August 25, 2006, the Laboratory received a notice of disapproval (NOD) from NMED (NMED 2006, 093542) that contained requirements for additional investigation activities to further define the lateral and vertical extent of subsurface contamination from inorganic chemicals and volatile organic compounds (VOCs) beneath MDA L, located at Technical Area (TA) 54 (Figure 1.0-1). Specifically, the NOD required that the Laboratory install three new boreholes at MDA L that are advanced, at a minimum, into the Otowi Member at depths estimated to be approximately 350 ft below ground surface (bgs) and construct each borehole for pore-gas monitoring. The NOD and corresponding November 13, 2006, notice of approval also specified the sampling intervals and analytical suites for both tuff and pore-gas samples collected.

This addendum to the investigation report summarizes the results of the additional activities conducted from February to April 2007 to determine the lateral and vertical extent of inorganic chemical, VOC, and tritium contamination at MDA L. These activities included the installation of new boreholes BH-H (location 54-27641), BH-I (location 54-27642), and BH-J (location 54-27643) (Figure 1.0-2) and the construction of each borehole for pore-gas monitoring. In addition to field screening and laboratory analytical results for tuff and pore-gas samples collected from the new boreholes, analytical results for pore-gas samples collected from existing boreholes BH-A (location 54-24242), BH-B (location 54-24239), BH-C (location 54-24240), BH-D2 (location 54-24399), BH-E (location 54-24238), BH-F (location 54-24243), BH-G (location 54-24244), and periodic monitoring borehole locations 54-01015 and 54-01016 are provided and discussed.

In NMED's letter approving the supplemental drilling and sampling activities, the Laboratory was requested to characterize the waste in Impoundments B, C, and D. The results of the characterization activities are included in Appendix H of this addendum.

This addendum addresses potential hazardous and radioactive contamination at MDA L, and information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with U.S. Department of Energy policy.

1.1 Purpose

Inorganic chemicals were detected above background values (BVs) in tuff samples collected from core at the total depth (TD) of BH-A (location 54-24242), BH-B (location 54-24239), BH-C (location 54-24240), BH-E (location 54-24238), BH-F (location 54-24243), and BH-G (location 54-24244) during 2005 investigation activities. VOCs (primarily chlorinated VOCs [CVOCs]) were also detected in tuff samples collected from core in these boreholes. Analytical results of pore-gas samples collected from boreholes during quarterly pore-gas monitoring and from 2004–2005 investigation activities confirmed the presence of vapor-phase chemicals consisting primarily of CVOCs originating from two source areas at MDA L (LANL 2006, 093910). The presence of tritium was also confirmed in pore-gas samples collected during these previous activities.

An evaluation of vertical concentration trends for inorganic chemicals in tuff samples did not indicate that a release had occurred and that the vertical extent had been defined (LANL 2006, 091888, Appendix M). In addition, an evaluation of the vertical concentration trends for VOCs in tuff samples also indicated a decreasing trend with depth. Additional data were collected to define the overall vertical distribution of inorganic chemicals and VOCs beneath MDA L from the greater depths of the Cerro Toledo interval and the Otowi Member.

The installation of three new boreholes on the eastern and western boundaries of Area L and the construction of each borehole for pore-gas monitoring, were deemed necessary to define the lateral and vertical extent of subsurface contamination associated with MDA L.

1.2 Site Description

MDA L, Solid Waste Management Unit (SWMU) 54-006, is located in the east central portion of the Laboratory at TA 54, Area L, on Mesita del Buey (Figure 1.2-1). TA-54 has been the main waste storage and disposal facility for the Laboratory since the 1950s. Area L is a 2.5-acre fenced area containing both surface and subsurface waste management units.

MDA L 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 1.2-1). Shafts 36 and 37 are the former lead-stringer shafts that are undergoing Resource Conservation and Recovery Act (RCRA) closure according to the 40 CFR 265, Subpart G, regulations and are not part of SWMU 54-006. Historically, MDA L was used for the disposal 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.

Most of the surface of Area L is paved with asphalt and consists of aboveground structures that house ongoing waste-management activities including the storage of chemical, hazardous, and mixed low-level wastes managed within container storage units. The topography of Area L is relatively flat with surface water runoff from the area controlled and diverted to an outfall into Cañada del Buey at the northeast corner of the site.

The regional aquifer is estimated to be at an average depth of approximately 930 ft bgs at Area L, based on data from boreholes at the Laboratory and the predictions of the hydrogeologic conceptual model for the Pajarito Plateau (LANL 1998, 059599).

2.0 SCOPE OF ACTIVITIES

This addendum describes the results of supplemental investigation activities that were proposed in the NMED-approved (with modifications) “Supplemental Investigation Work Plan for Sampling at Material Disposal Area L, Solid Waste Management Unit 54-006” (LANL 2006, 094673). These activities were conducted in response to the August 25, 2006, NOD and the November 13, 2006, notice of approval.

Activities completed during this supplemental investigation include the following:

- installation of three new boreholes, two within the Area L site boundary (BH-H [location 54-27641] and BH-I [location 54-27642]) and one outside the site boundary near the east side of Area L (BH-J [location 54-27643]);

- field screening of subsurface air for vapor phase 1,1,1-trichloroethane (TCA), trichloroethene (TCE), tetrachloroethene (PCE), trichlorofluoromethane (Freon-11), oxygen, and carbon dioxide during borehole installation;
- collection of tuff core samples for analysis of VOCs, target analyte list (TAL) metals, and lithium during borehole installation;
- construction of each new borehole for subsurface vapor monitoring;
- collection of pore-gas samples for analysis of VOCs and tritium from new boreholes BH-H (location 54-27641), BH-I (location 54-27642), and BH-J (location 54-27643);
- collection of pore-gas samples for analysis of VOCs from existing boreholes BH-A (location 54-24242), BH-B (location 54-24239), BH-C (location 54-24240), BH-E (location 54-24238), BH-F (location 54-24243), and BH-G (location 54-24244); and
- management of investigation-derived wastes (IDW).

The results of field screening and laboratory analytical samples were used to evaluate the vertical extent of VOCs and inorganic chemical concentrations in the boreholes sampled at MDA L, discussed further in sections 4.0 and 5.0 of this addendum.

Supplemental field investigation activities began on February 5, 2007, and were completed on April 25, 2007. All activities were conducted in accordance with the applicable Environmental Programs Directorate (EP) standard operating procedures (SOPs), quality procedures (QPs), Laboratory implementation requirements (LIRs), Laboratory implementation guidance (LIGs), and Laboratory performance requirements (LPRs) and are summarized in the approved supplemental work plan (LANL 2006, 094673).

Deviations from the Approved Supplemental Work Plan

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

- At NMED's request, the sand filter-pack intervals that contain pore-gas sample ports in new boreholes BH-H (location 54-27641), BH-I (location 54-27642), and BH-J (location 54-27643) were separated solely by layers of bentonite clay rather than a combination of bentonite and tuff/fill material as indicated in the proposed borehole construction diagram. Bentonite clay was used to ensure an adequate seal between sample ports and does not affect the quality of the pore-gas samples collected from these wells.
- The final pore-gas sample port depths for existing boreholes BH-A (location 54-24242), BH-B (location 54-24239), BH-C (location 54-24240), BH-E (location 54-24238), BH-F (location 54-24243), and BH-G (location 54-24244) (installed before supplemental investigation activities began) were adjusted from the depths proposed in the investigation report (LANL 2005, 092591) and the supplemental work plan (LANL 2006, 094673) to account for changing field conditions, including borehole sloughing and collapse. Borehole sloughing and collapse also resulted in the elimination of the three deepest sample ports in borehole BH-C (location 54-24240) and the two deepest sample ports in borehole BH-E (location 54-24238). However, with the exception of the deepest port in borehole BH-E (location 54-24238), sample ports were installed in each borehole within each specified stratigraphic unit.
- To further define the vertical extent of VOC contamination at MDA L, VOC results for pore-gas samples, collected from periodic monitoring boreholes BH-D2 (location 54-24399) and locations

54-01015 and 54-01016 at depths within the Cerros del Rio basalt (Tcb) as part of ongoing quarterly pore-gas monitoring activities, were included and evaluated in this addendum.

2.1 Health and Safety Monitoring

As part of the health and safety program, a site-specific health and safety plan (SSHASP) and integrated work document (IWD) (LANL 2004, 088415) were developed to delineate the scope of work of the project and to provide background information specific to the project, including relevant history and descriptions of the project sites, administrative and engineering controls, 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 set of discrete work steps. A detailed hazard analysis of the work steps was 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 windblown material, and radioactive and volatile organic 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, Gas, 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 task required in the approved supplemental work plan.

2.2 Drilling Activities

Borehole locations are shown in Figure 1.0-2. The new boreholes BH-H (location 54-27641), BH-I (location 54-27642), and BH-J (location 54-27643) were initially drilled using a large-diameter auger sufficient in size to provide a minimum borehole annulus of 2 in. for grout emplacement around a nominal 10-in. surface casing. The surface casing was installed to a depth of approximately 10 ft to guide drilling and facilitate installation of a surface completion for long-term monitoring. The new boreholes were then advanced into the Otowi Member of the Bandelier Tuff using a $7^5/_8$-in.-outside-diameter (O.D.) hollow-stem auger. The TDs of the new boreholes range from 350 ft to 377 ft bgs and are summarized in Table 2.2-1.

As-built construction diagrams illustrating the completed borehole configurations for the new boreholes are provided in Figures 2.2-7 through 2.2-9.

2.3 Vapor Screening

Field screening for vapor phase VOCs was conducted during drilling to determine the TD of each borehole. Field screening was conducted in 20-ft intervals below a depth of 150 ft bgs using an inflatable packer assembly. Total VOCs were measured using a photoionization detector (PID) equipped with an 11.7 eV lamp, and TCA, TCE, PCE, Freon-11, water vapor, and carbon dioxide were measured using a Brüel and Kjaer (B&K) Type 1302 photoacoustic gas analyzer (multigas monitor).

After drilling and borehole construction activities began and immediately before soil vapor samples were collected for laboratory analysis, soil vapor from each instrumented interval was field screened for VOCs using a B&K multigas monitor; carbon dioxide and oxygen using a Lantec GEM-500 landfill gas monitor; and differential pressure using a Dwyer Series 475 Mark III digital manometer.

The results of field-screening activities are presented in Appendix B.

2.4 Core Sampling

Tuff samples were collected from the core of new boreholes at approximately 50-ft intervals beginning at a depth of 150 ft. Sample intervals included the Cerro Toledo sediments, the Otowi Member, and TD of each borehole. Core was examined for intervals showing evidence of fractures and moisture; however, no intervals were identified containing significant fractures or high levels of moisture. All samples were collected according to SOP-06.26, Core Barrel Sampling for Subsurface Earth Materials, and submitted for laboratory analysis of VOCs according to U.S. Environmental Protection Agency (EPA) Method 8260B, and TAL metals and lithium according to EPA Methods 6010B and 6020A. Tuff sampling interval depths are summarized in Table 2.4-1.

Quality assurance/quality control (QA/QC) samples consisted of a field duplicate to determine sample and analytical precision and two trip blanks for detecting potential shipping and storage contamination. Field screening of core samples for radiation was conducted as required by the radiological worker permit for worker safety at the intervals and frequency determined by the facility radiation control technicians.

2.5 Pore-Gas Completions

Each new borehole was constructed to monitor pore gas once the borehole was advanced to the prescribed depth. Each newly completed borehole contains sample ports constructed with ¼-in. stainless-steel tubing installed at depths corresponding to stratigraphic units and field screening and core sampling intervals specified in the approved supplemental work plan (LANL 2006, 094637). NMED concurrence was obtained before each new borehole was constructed for pore-gas monitoring. Pore-gas sample ports were completed within a 4–5-ft zone of sand filter pack and were sealed and separated from other sample port intervals by a layer of bentonite clay pellets. All materials were tremied down the borehole to ensure the down-hole ports were adequately completed. A second tremie pipe was used to deploy the stainless-steel tubing and to prevent snagging of the tube couplings on the inside diameter (I.D.) of the augers. Boreholes BH-H (location 54-27641) and BH-I (location 54-27642) are located in high-traffic areas and were completed with flush-mounted vaults, while BH-J (location 54-27643) was completed with a nominal 2-ft casing stick-up.

Final sample port depths and corresponding stratigraphic units for the new boreholes (BH-H [location 54-27641], BH-I [location 54-27642], and BH-J [location 54-27643]); existing boreholes (BH-A [location 54-24242], BH-B [location 54-24239], BH-C [location 54-24240], BH-E [location 54-24238], BH-F [location 54-24243], and BH-G [location 54-24244]); and periodic monitoring boreholes BH-D2 (location 54-24399), and locations 54-01015 and 54-01016 are summarized in Table 2.5-1. As-built diagrams for the existing boreholes are provided in Figures 2.2-1 through 2.2-6. As-built diagrams for the new boreholes are provided in Figures 2.2-7 through 2.2-9. As-built diagrams for the periodic monitoring boreholes are provided in Figures 2.2-10 through 2.2-14.

The pore-gas sample ports for existing boreholes BH-A (location 54-24242), BH-B (location 54-24239), BH-C (location 54-24240), BH-E (location 54-24238), BH-F (location 54-24243), and BH-G (location 54-24244) were previously constructed with the FLUTe membrane liner system, as described in the MDA L investigation report (LANL 2005, 092591). The final sample port depths for the existing boreholes were adjusted from the depths proposed in the supplemental work plan (LANL 2006, 094637) to account for changing field conditions such as borehole sloughing and collapse. However, sample ports were installed at regular intervals within each stratigraphic unit (Table 2.5-1 and Figures 2.2-1 through 2.2-6).

Periodic monitoring borehole BH-D2 (location 54-24399) contains steel casing from the ground surface to a depth of 570 ft bgs, below which it is open to a TD of 660 ft bgs (Table 2.5-1 and Figure 2.2-10). Pore-gas samples are collected from the open interval of borehole BH-D2 (location 54-24399) using an inflatable packer assembly placed at the base of the steel casing before sampling.

Periodic monitoring borehole locations 54-01015 and 54-01016 are angled boreholes located to the north of Area L in Cañada del Buey (Figure 1.0-2). Each borehole is installed at an approximate angle of 60 degrees, trending towards and beneath MDA L to depths of approximately 550 ft (54-01015) and 580 ft (54-01016) below the MDA L ground surface. The pore-gas sample ports for each borehole are constructed with Solinist monitoring ports, as illustrated in Figures 2.2-12 and 2.2-14 and as described in Appendix F of the investigation work plan (LANL 2005, 087624). Sample port depths for each borehole are summarized in Table 2.5-1 and illustrated in Figures 2.2-11 through 2.2-14.

2.6 Subsurface Vapor Sampling

A total of 21 pore-gas samples were collected from the new boreholes, and a total of 20 samples were collected from existing boreholes. Pore-gas samples were collected from each of the seven vapor sampling ports installed within new boreholes BH-H (location 54-27641), BH-I (location 54-27642), and BH-J (location 54-27643). Three pore-gas samples were collected from each existing borehole BH-A (location 54-24242), BH-B (location 54-24239), BH-C (location 54-24240), and BH-E (location 54-24238). Four pore-gas samples were collected from each existing borehole BH-F (location 54-24243) and BH-G (location 54-24244). The three pore-gas samples collected from each existing borehole BH-A (location 54-24242), BH-B (location 54-24239), BH-C (location 54-24240), and BH-E (location 54-24238) included a sample from the shallowest port, the deepest port (TD), and the port installed within unit Qbt 1v(u) of the Tshirege Member having the highest VOC field-screening concentration. An additional (fourth) pore-gas sample was collected each from existing boreholes BH-F (location 54-24243) and BH-G (location 54-24244) to provide additional VOC characterization data.

Pore-gas samples were collected from the third and fourth deepest sample ports, respectively, in periodic monitoring borehole locations 54-01015 and 54-01016. One pore-gas sample was collected from the open 570- ft to 660-ft-bgs interval in deep periodic monitoring borehole BH-D2 (location 54-24399). All periodic monitoring borehole samples were collected from within unit Tcb.

Pore-gas samples collected from the new boreholes were submitted for laboratory analysis of VOCs and tritium. Pore-gas samples collected from the existing and periodic monitoring boreholes were submitted for laboratory analysis of VOCs. Sample depths are presented in Table 2.5-1.

VOC pore-gas samples were collected in SUMMA canisters according to SOP-06.31, Sampling of Subatmospheric Air, and submitted for analysis using EPA Method TO-15. Tritium samples were collected using silica gel cartridges according to SOP-06.31, Sampling of Subatmospheric Air, and submitted for laboratory analysis using EPA Method 906.0.

The QA/QC samples for VOCs in pore gas consisted of two equipment blanks and four field duplicates, for tritium in pore gas the QA/QC samples consisted of two equipment blanks and two field duplicates. The equipment blanks were collected after sampling and subsequent purge decontamination to detect potential cross-contamination. The equipment blanks for VOCs were collected once after each sampling event and following purge decontamination by pulling zero gas (99.9% ultrahigh-purity nitrogen) through the sample tubing into SUMMA canisters. The field blanks for tritium were collected once after each day of sampling by sampling atmospheric air. The field duplicate samples were collected approximately 1 per every 12 VOC samples and approximately 1 per every 10 tritium samples to determine the precision of collection and analysis.

2.7 Investigation-Derived Waste Management

IDW generated and managed during supplemental investigation activities included drill cuttings, PPE, and plastics. All wastes were managed as specified in Appendix J of the MDA L work plan (LANL 2004, 087624). The management of IDW generated during supplemental investigation activities is described in Appendix F of this addendum.

3.0 FIELD INVESTIGATION RESULTS

Supplemental field investigation activities at MDA L began on February 5, 2007, and concluded on April 25, 2007. Three new boreholes (BH-H [location 54-27641], BH-I [location 54-27642], and BH-J [location 54-27643]) were advanced into the Otowi Member and constructed for pore-gas monitoring. Core and pore-gas samples were collected from each borehole to define the lateral and vertical extent of inorganic chemicals, VOC, and tritium contamination within the subsurface of MDA L. Pore-gas samples were also collected from existing boreholes BH-A (location 54-24242), BH-B (location 54-24239), BH-C (location 54-24240), BH-E (location 54-24238), BH-F (location 54-24243), BH-G (location 54-24244), from periodic monitoring boreholes BH-D2 (location 54-24399), and from locations 54-01015 and 54-01016 and analyzed for VOCs.

3.1 Surface Conditions

The majority of the surface of Area L is paved with asphalt and consists of aboveground structures that house ongoing waste-management activities including the storage of chemical, hazardous, and mixed low-level wastes managed within container storage units.

Boreholes BH-A (location 54-24242), BH-B (location 54-24239), BH-C (location 54-24240), BH-D2 (location 54-24399), BH-E (location 54-24238), BH-H (location 54-27641), and BH-I (location 54-27642) are located within Area L in high-traffic areas covered with asphalt, while boreholes BH-F (location

54-24243), BH-G (location 54-24244), and BH-J (location 54-27643) are located immediately outside the eastern boundary of Area L in vegetated areas with limited access by vehicular traffic (Figure 1.0-2). Periodic monitoring borehole locations 54-01015 and 54-01016 are sited to the north of Area L in Cañada del Buey and also have limited access by vehicular traffic.

3.2 Subsurface Conditions

A detailed description of the stratigraphy beneath MDA L was presented in the approved investigation work plan (LANL 2004, 087624) and in the investigation report (LANL 2005, 092591). Supplemental investigation activities confirmed that the general stratigraphy beneath MDA L is consistent with that encountered during previous drilling at MDA L and with the regional geology described by Broxton and Reneau (1995, 049726).

3.2.1 Borehole Installation

From February 5 to March 9, 2007, new boreholes BH-H (location 54-27641), BH-I (location 54-27642), and BH-J (location 54-27643) were installed into the Otowi Member of the Bandelier Tuff to TDs of 350 ft, 377 ft, and 370 ft bgs, respectively. The TDs for each new borehole are summarized in Table 2.2-1 and illustrated in the borehole logs and as-built diagrams (Figures 2.2-7 through 2.2-9).

All boreholes were advanced using a $7^5/_8$-in.-O.D. hollow-stem auger. Drilling operations were conducted according to SOP-04.01, Drilling Methods and Drill Site Management. Core material was visually inspected by a geologist to ensure that appropriate depths were achieved and that core samples were collected from the appropriate stratigraphic units.

As the boreholes were advanced, field screening was performed using a B&K multigas monitor for vapor phase analysis of TCA, TCE, PCE, Freon-113, water vapor, and carbon dioxide and using a PID with an 11.7 eV lamp for vapor-phase monitoring of total VOCs. Field screening was conducted at approximately 20-ft intervals below a depth of 150 ft using an inflatable packer assembly. The field-screening results are presented in Appendix B.

Although nondetect concentrations of vapor phase VOCs were not achieved during field screening at TD, the lowest field-screening value for each borehole was achieved at TD (Appendix B). Because the total depth of each borehole was limited by auger-depth restrictions and borehole sloughing and collapse, it was not technically feasible to sample depths greater than those achieved at which VOCs were not detected. NMED concurrence was received for borehole TD and pore-gas completion specifications for each new borehole.

For health and safety purposes, workspace VOC vapor monitoring and gross radiation screening were conducted during drilling activities. All drilling equipment was decontaminated between and after drilling at each borehole according SOP-01.08, Field Decontamination of Drilling and Sampling Equipment.

3.2.2 Tuff Conditions

A total of 16 tuff samples were collected from the core of the new boreholes and submitted for laboratory analysis of VOCs according to EPA Method 8260B and TAL metals and lithium according to EPA Methods 7471A, 6010B, and 6020A. The samples were collected in approximately 50-ft intervals below a depth of 150 ft according to SOP-06.26, Core Barrel Sampling for Subsurface Earth Materials. Sample intervals included the Cerro Toledo interval, the Otowi Member, depths corresponding to subsequent pore-gas sample ports, and the TD of each borehole. No evidence of fractures or moisture was indicated in any borehole core; consequently, no samples showing evidence of either were collected. Core samples were collected in 125 mL amber glass or polypropylene bottles and submitted to the Laboratory's Sample Management Office (SMO) for subsequent analyses at General Engineering Laboratories, Inc., or Severn Trent Laboratories, Inc., commercial contract laboratories located in Charleston, SC, and St. Louis, MO, respectively. Core-sample intervals are summarized in Table 2.4-1.

The QA/QC tuff samples consisted of one field duplicate for determining reproducibility and two trip blanks for detecting potential shipping and storage contamination.

3.2.3 Subsurface Vapor Conditions

Following the construction of pore-gas sampling ports, pore-gas field-screening measurements and investigation samples were collected according to SOP-06.31, Sampling of Subatmospheric Air. Field-screening measurements were made for carbon dioxide, water vapor, TCA, TCE, PCE, and Freon-11 using a B&K multigas monitor, oxygen, and carbon dioxide using a Landtec GEM-500, and differential pressure using a Dwyer Series 475 Mark III digital manometer. Laboratory analytical samples were collected only after measurements for the B&K and GEM-500 instruments had stabilized. The calibrations of all instruments used during field screening were verified daily following the manufacturer's specifications.

VOC pore-gas samples collected from existing boreholes BH-A (location 54-24242), BH-B (location 54-24239), BH-C (location 54-24240), BH-E (location 54-24238), BH-F (location 54-24243), and BH-G (location 54-24244) were collected during two sampling events. Samples collected during the initial event (February 22 to March 1, 2007) were collected from the port installed at TD within each borehole and from the port having the highest VOC field-screening value. VOC pore-gas samples collected during the second event (April 24, 2007) were taken from either the shallowest port in each borehole or from an intermediate depth corresponding to stratigraphic unit Qbt 1v(u) of the Tshirege Member. VOC pore-gas samples collected from borehole BH-G (location 54-24244) during the April 24, 2007, event included samples from both the shallowest and deepest sample ports.

Seven subsurface pore-gas samples were collected for tritium analysis from each new borehole BH-H (location 54-27641), BH-I (location 54-27642), and BH-J (location 54-27643) for a total of 21 samples. The samples were collected as water vapor by pulling pore gas through columns filled with absorbent silica gel in accordance with SOP-06.31, Sampling of Subatmospheric Air, and submitted to the SMO for subsequent analysis at Paragon Analytics, a commercial contract laboratory in Fort Collins, CO. The samples were analyzed for tritium according to EPA Method 906.0.

The QA/QC samples for tritium consisted of two field duplicates and two field blanks. The field blanks for tritium were collected once after each day of sampling by sampling atmospheric air. The field duplicate samples for tritium were collected approximately 1 per every 10 tritium samples. The QA/QC samples were collected in accordance with SOP-01.05, Field Quality Control Samples.

4.0 SITE CONTAMINATION

The purpose of the supplemental investigation activities was to obtain data to complete the evaluation of the nature and extent of subsurface inorganic chemical, VOC, and tritium contamination in tuff and pore gas beneath MDA L. This section presents the analytical results for subsurface tuff and vapor sampling conducted in newly installed and existing boreholes at MDA L.

4.1 Subsurface Vapor Field-Screening Results

Field-screening values obtained during drilling activities and before pore-gas sample were collected are summarized in Appendix B.

4.2 Tuff Sample Analytical Results

A total of 16 tuff samples were collected from core for inorganic chemical and VOC analysis of BH-H (location 54-27641), BH-I (location 54-27642), and BH-J (location 54-27643). Laboratory analytical results for inorganic chemicals and VOCs are reported in Tables 4.2-1 and 4.2-2, respectively. The locations and concentrations of inorganic chemicals detected in the core samples above BVs are illustrated in Figure 4.2-1, while locations and concentrations of VOCs detected in core samples are shown in Figure 4.2-2.

Inorganic Chemicals Detected in Tuff

Nine tuff samples were collected from core below a depth of 150 ft from unit Qbt 1g. Aluminum, barium, calcium, chromium, iron, magnesium, manganese, nickel, selenium, and vanadium were detected at concentrations above their respective unit Qbt 1g BVs. The concentrations of inorganic chemicals detected above BV in Qbt 1g samples ranged from 1.1 to 2.9 times the BV. Arsenic and cadmium were not detected; however, the detection limits for both inorganic chemicals were above the unit Qbt 1g BVs. Lithium was detected in each of the 16 samples but does not have a BV associated with unit Qbt 1g.

Two samples were collected from tuff in unit Qct. Aluminum, chromium, copper, iron, nickel, selenium, vanadium, and zinc were detected at concentrations above their respective unit Qct BVs. The concentrations of inorganic chemicals detected above BV in Qct samples ranged from 1.1 to 5.0 times the BV. Arsenic and cadmium were not detected in unit Qct samples; however, the detection limits for both inorganic chemicals were above their respective unit Qct BVs. Lithium was detected in both of the samples but does not have a BV associated with unit Qct.

Three samples were collected from tuff in unit Qbo. Chromium, copper, iron, magnesium, manganese, nickel, and vanadium were detected at concentrations above their respective unit Qbo BVs. The concentrations of inorganic chemicals detected above BV in Qbo samples ranged from 1.1 to 3.4 times the BV. Arsenic, cadmium, and selenium were not detected in unit Qbo; however, the detection limits for these inorganic chemicals were above their respective unit Qbo BVs. Lithium was detected in each of the samples but does not have a BV associated with unit Qbo.

One sample was collected from tuff in unit Qbog. Aluminum, barium, beryllium, calcium, copper, iron, lead, lithium, magnesium, magnesium, nickel, potassium, sodium, vanadium, and zinc were detected but do not have unit Qbog BVs.

Concentrations of inorganic chemicals detected in unit Qct were less than 2 times the BVs (a few tenths of a mg/kg to several mg/kg above the BVs), with the exception of the sample collected from borehole BH-J (location 54-27643) in the 279-ft to 280-ft interval (sample MD54-07-76047). Concentrations of barium, calcium, iron, magnesium, nickel, and vanadium in this sample were the highest for these inorganic chemicals detected in unit Qct and were less than 3 times the BVs. Visual inspection of this sample indicated that it contained more silt than other samples collected from Qct, which may result in a sample having a higher cation exchange capacity and consequently higher concentrations of inorganic chemicals. Although lithium was detected in all samples and has no BV, its concentrations are similar to the concentrations detected in core samples collected during 2005 investigation activities (LANL 2005, 092591). The concentrations of lithium reported likely represent naturally occurring concentrations. In addition, the vertical profiles of inorganic results show sporadic detections above BVs and do not exhibit consistent detections above BVs that would indicate a contaminant release.

Organic Chemicals Detected in Tuff

Four VOCs were detected in the 16 tuff samples collected. Acetone was detected in 8 of 16 samples collected, methylene chloride was detected in 1 of 16 samples collected, toluene was detected in 4 of 16 samples collected, and TCE was detected in 2 of 16 samples collected. All VOCs were detected at concentrations near or below their respective estimated quantitation limit (EQL). Concentrations of acetone were possibly the result of field, transportation, and/or laboratory contamination because similar concentrations of acetone were detected in the trip blank samples. The infrequent detection and low concentrations of VOCs in the core samples, as well as the low correlation between VOCS in these core samples and pore-gas samples collected from similar depths, do not indicate any ongoing releases from the former waste disposal units. A comparison of VOC concentrations for core and pore-gas samples collected from similar depths is provided in Table 4.2-3.

4.3 Subsurface Vapor Sampling Analytical Results

A total of 49 subsurface pore-gas samples and 4 field duplicates were collected for VOC analysis from all boreholes sampled. Laboratory analytical results for the VOC samples are reported in Table 4.3-1. The locations and concentrations of VOCs detected in pore-gas samples are shown in Plate 1.

A total of 21 subsurface pore-gas samples and two field duplicates were collected for tritium analysis from new boreholes BH-H (location 54-27641), BH-I (location 54-27642), and BH-J (location 54-27643). Laboratory analytical results for the tritium samples are reported in Table 4.3-2. The locations and concentrations of tritium detected in pore-gas samples are shown in Figure 4.3-1.

Organic Chemicals Detected in Pore Gas

A total of 26 VOCs were detected in the 49 samples submitted for VOC analysis. Table 4.3-1 lists the VOCs detected in pore gas by borehole. Plate 1 shows the detected concentrations of VOCs. TCA, TCE, and PCE were detected in all 49 samples. The concentrations of TCA, the primary pore-gas VOC, ranged from 430 $\mu g/m^3$ to 4,900,000 $\mu g/m^3$. The highest concentration of TCA (4,900,000 $\mu g/m^3$) was collected from BH-C (location 54-24240) near the western disposal shaft field at a depth of 28 ft bgs. The next highest concentration of TCA (3,500,000 $\mu g/m^3$) was detected in BH-E (location 54-24238) near the eastern disposal shaft field at a depth of 64 ft bgs. These results are similar to the concentrations of TCA previously detected in pore gas at MDA L.

Concentrations of all VOCs detected in new and existing boreholes reach their maximum concentrations between the surface and a depth of approximately 180 ft bgs. Below 180 ft bgs, concentrations of VOCs in new boreholes BH-H, BH-I, and BH-J decrease to the TD of each borehole by 1 to 3 orders of magnitude. Concentrations of VOCs in existing boreholes have not changed appreciably over time.

The pore-gas data collected for depths of 32.5 ft bgs or more below the ground surface support the risk assessment results presented in the investigation report. As a result, there are no additional exposure data from this sampling to evaluate the potential risk and dose to an industrial worker at MDA L.

Tritium Detected in Pore Gas

Tritium was detected in 15 of 21 samples collected from the new boreholes. Tritium concentrations were variable and ranged from 370 pCi/L at a sampling interval of 272 to 277.5 ft bgs at BH-I (location 54-27642) to 18,200 pCi/L at a sampling interval of 30 to 34 ft bgs at BH-I (location 54-27641). Tritium was not detected at six sampling intervals ranging from the 27.5- to 32.5-ft interval at BH-J (location 54-27643) to TD at BH-I (location 54-27642). Although the detectable concentrations of tritium do not exhibit clear trends of decreasing or increasing with depth, they are all below the EPA drinking water standard of 20,000 pCi/L.

5.0 CONCLUSIONS

The MDA L supplemental field investigation was conducted to provide data to complete the 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 1 RCRA facility investigation, the quarterly pore-gas monitoring conducted from 1997 to present, and the data collected during the 2004–2005 Compliance Order on Consent investigation.

The results of inorganic chemical analysis of core samples indicate natural variability within the various stratigraphic layers. Comparisons of results to BV are limited by the background data set, which contains a relatively small number of samples for units Qbt 1g, Qct, and Qbo. The sample containing the highest inorganic chemical concentrations was collected from a unit Qct sample with a high proportion of silt. Higher naturally occurring concentrations of inorganic chemicals have historically correlated with samples containing higher proportions of silt. Concentrations of inorganic chemicals in this sample were below all soil and sediment BVs. Even though no BVs exist for Qbog, concentrations of inorganic chemicals in Qbog are less than Qbo BVs; thus, they represent naturally occurring levels of inorganic chemicals. Background values for inorganic chemicals in the other lower Bandelier Tuff units are exceeded by factors of approximately 2 or less. Lithium was detected in all samples but has no BV. Lithium concentrations are similar to, but less than, the concentrations detected during 2004–2005 investigation activities and likely reflect naturally occurring levels.

All detectable concentrations of tritium are low and variable and are below the EPA drinking water standard of 20,000 pCi/L. Tritium collected at BH-H (location 54-27641) near the western shaft field exhibits a decreasing concentration trend from the surface to TD. Tritium concentrations in BH-I (location 54-27642) maximize at the 113.5- to118.5-ft interval, then decrease to not detected at TD. Tritium concentrations at BH-J (location 54-27643) do not exhibit a clear trend but are near detection limits. The tritium results indicate that tritium does not pose a potential threat of groundwater contamination.

Acetone was detected in eight core samples, methylene chloride was detected in one sample, toluene was detected in four samples, and TCE was detected in two samples. No other VOCs were detected in core. Acetone concentrations in samples and trip blanks were similar, indicating contamination during handling, shipping, storage, and/or analyses. Acetone, toluene, and methylene chloride are common analytical laboratory contaminants. Concentrations of the four VOCs detected in MDA L core samples were near detection limits and are not indicative of ongoing releases from the former waste disposal unit.

An evaluation of the pore-gas data confirm the presence of vapor-phase VOCs associated with sources in the eastern and western disposal shaft fields. Six VOCs, including dichloroethane (DCA), dichloroethylene (DCE), TCA, TCE, PCE, and Freon-113, were detected in each pore-gas sample collected. Concentrations of these VOCs reach their maximum concentrations in the shallower Qbt 2, Qbt 1v, and Qbt 1g units of the Bandelier Tuff. Concentrations of each VOC decrease in the unit Qct and unit Qbo of the Bandelier Tuff. Concentrations of VOCs are lowest in the Tcb unit sampled from periodic monitoring boreholes. These analytical results confirm the conclusions of the 2004–2005 investigation, which reported that the plumes are in a near-steady state, and that vapor-phase concentrations do not indicate the presence of a free liquid source in the subsurface beneath MDA L.

All detectable concentrations of tritium are low and variable and are below the EPA drinking water standard of 20,000 pCi/L. The tritium results indicate that tritium does not pose a potential threat of groundwater contamination. Tritium collected at BH-H (location 54-27641) near the western shaft field exhibits a decreasing concentration trend from the surface to TD. Tritium concentrations in BH-I (location 54-27642) maximize at the 113.5- to118.5-ft interval, then decrease to not detected at TD. Tritium concentrations at BH-J (location 54-27643) do not exhibit a clear increasing or decreasing trend and range from 440 to 360 pCi/L.

The concentrations of VOCs in pore-gas samples collected from the deeper Qbo and Tcb units were screened to evaluate the potential for groundwater contamination. The results of this screening are presented in Appendix E and indicate that the pore-gas VOCs do not pose a potential threat of groundwater contamination.

Based on the distribution of VOC concentrations with depth, the vertical extent of contamination is affected by physical processes governing plume distribution (e.g., release depth and diffusive transport). The increase in concentration with depth in the near surface unit (Qbt) results from the proximity of sampling depths to contaminant sources and the potential for VOC losses near the surface from diffusion to the atmosphere. An evaluation of the vertical extent of vapor-phase contamination across multiple stratigraphic units, including Qbt, Qct, Qbo, and Tcb, indicates a decrease in VOC concentrations to a maximum sampled depth of 660 ft bgs.

6.0 REFERENCES AND MAP DATA SOURCES

6.1 References

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

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; the U.S. Environmental Protection Agency, Region 6; and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Broxton, D.E., and S.L. Reneau, August 1995. "Stratigraphic Nomenclature of the Bandelier Tuff for the Environmental Restoration Project at Los Alamos National Laboratory," Los Alamos National Laboratory report LA-13010-MS, Los Alamos, New Mexico. (Broxton and Reneau 1995, 049726)

LANL (Los Alamos National Laboratory), May 22, 1998. "Hydrogeologic Workplan," Los Alamos National Laboratory document LA-UR-01-6511, Los Alamos, New Mexico. (LANL 1998, 059599)

LANL (Los Alamos National Laboratory), September 22, 1998. "Inorganic and Radionuclide Background Data for Soils, Canyons Sediments and Bandelier Tuff at Los Alamos National Laboratory," draft, Los Alamos National Laboratory document LA-UR-98-4847, Los Alamos, New Mexico. (LANL 1998, 059730)

LANL (Los Alamos National Laboratory), November 2004. “Investigation Work Plan for Material Disposal Area L, Solid Waste Management Unit 54-006 at Technical Area 54, Revision 2,” Los Alamos National Laboratory document LA-UR-04-8245, Los Alamos, New Mexico. (LANL 2004, 087624)

LANL (Los Alamos National Laboratory), November 16, 2004. “Integrated Work Document for the Characterization of Material Disposal Area L,” Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2004, 088415)

LANL (Los Alamos National Laboratory), September 2005. “Investigation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54,” Los Alamos National Laboratory document LA-UR-05-5777, Los Alamos, New Mexico. (LANL 2005, 092591)

LANL (Los Alamos National Laboratory), March 2006. “Investigation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54, Revision 1,” Los Alamos National Laboratory document LA-UR-06-1564, Los Alamos, New Mexico. (LANL 2006, 091888)

LANL (Los Alamos National Laboratory), August 2006. “Response to the Notice of Disapproval for the Groundwater Background Investigation Report,” (includes the "Groundwater Background Investigation Report, Rev. 1," LA-UR-06-5973), Los Alamos National Laboratory document LA-UR-06-6134, Los Alamos, New Mexico. (LANL 2006, 094637)

LANL (Los Alamos National Laboratory), September 2006. “Periodic Monitoring Report for Vapor Sampling Activities at Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54, for Fourth Quarter Fiscal Year 2005 Through Third Quarter Fiscal Year 2006,” Los Alamos National Laboratory document LA-UR-06-6239, Los Alamos, New Mexico. (LANL 2006, 093910)

LANL (Los Alamos National Laboratory), October 2006. “Supplemental Investigation Work Plan for Sampling at Material Disposal Area L, Solid Waste Management Unit 54-006,” Los Alamos National Laboratory document LA-UR-06-7348, Los Alamos, New Mexico. (LANL 2006, 094673)

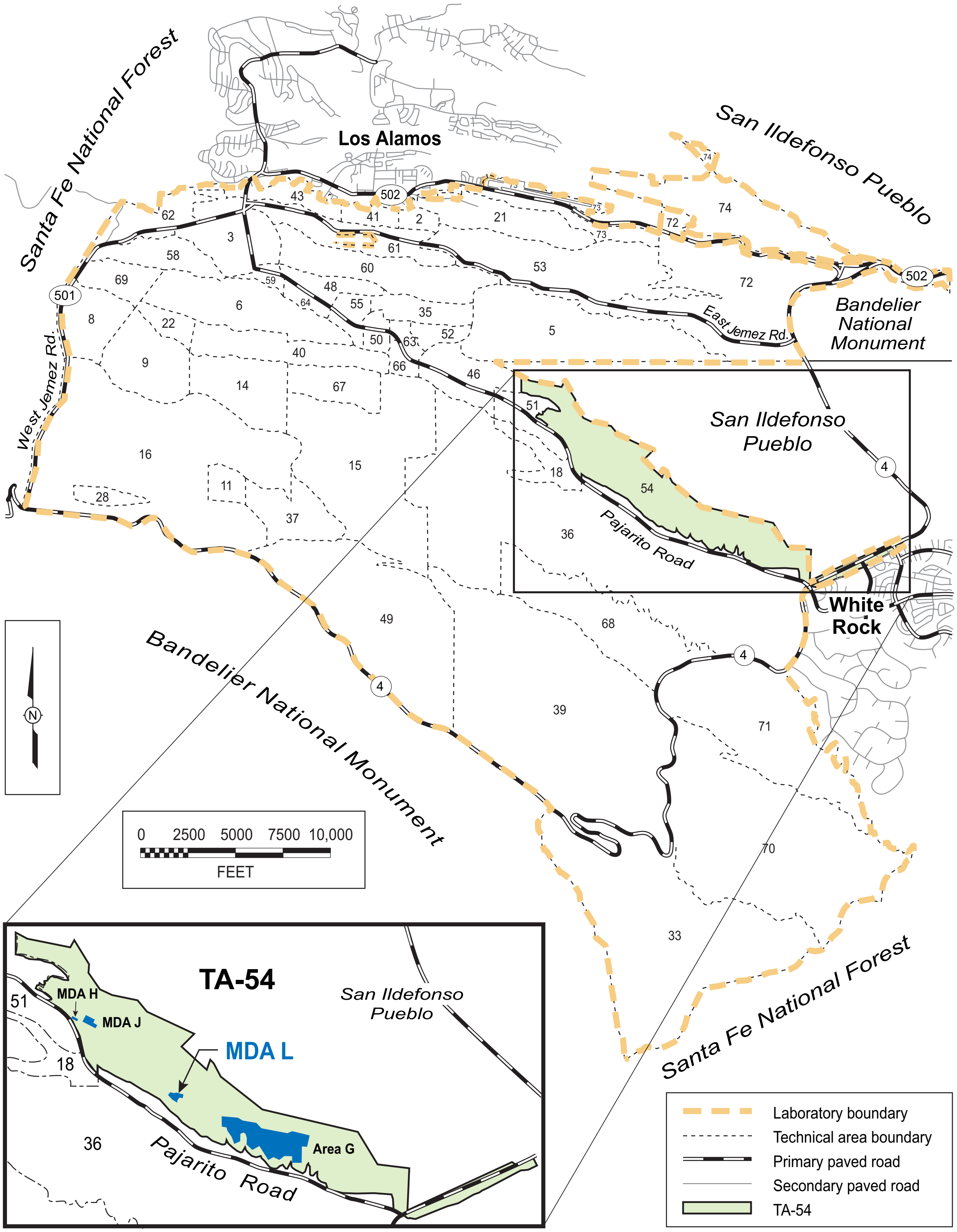
NMED (New Mexico Environment Department), August 25, 2006. “Notice of Disapproval of the Investigation Report for Material Disposal Area (MDA) L, Solid Waste Management Unit 54-006, at Technical Area 54, Revision 1,” New Mexico Environment Department letter to D. Gregory (DOE LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2006, 093542)

6.2 Map Data Sources

Data Source	Figures
Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 27 April 2007	Figure 1.0-2 Figure 1.2-1 Figure 4.2-1 Figure 4.2-2 Figure 4.3-1 Plate 1

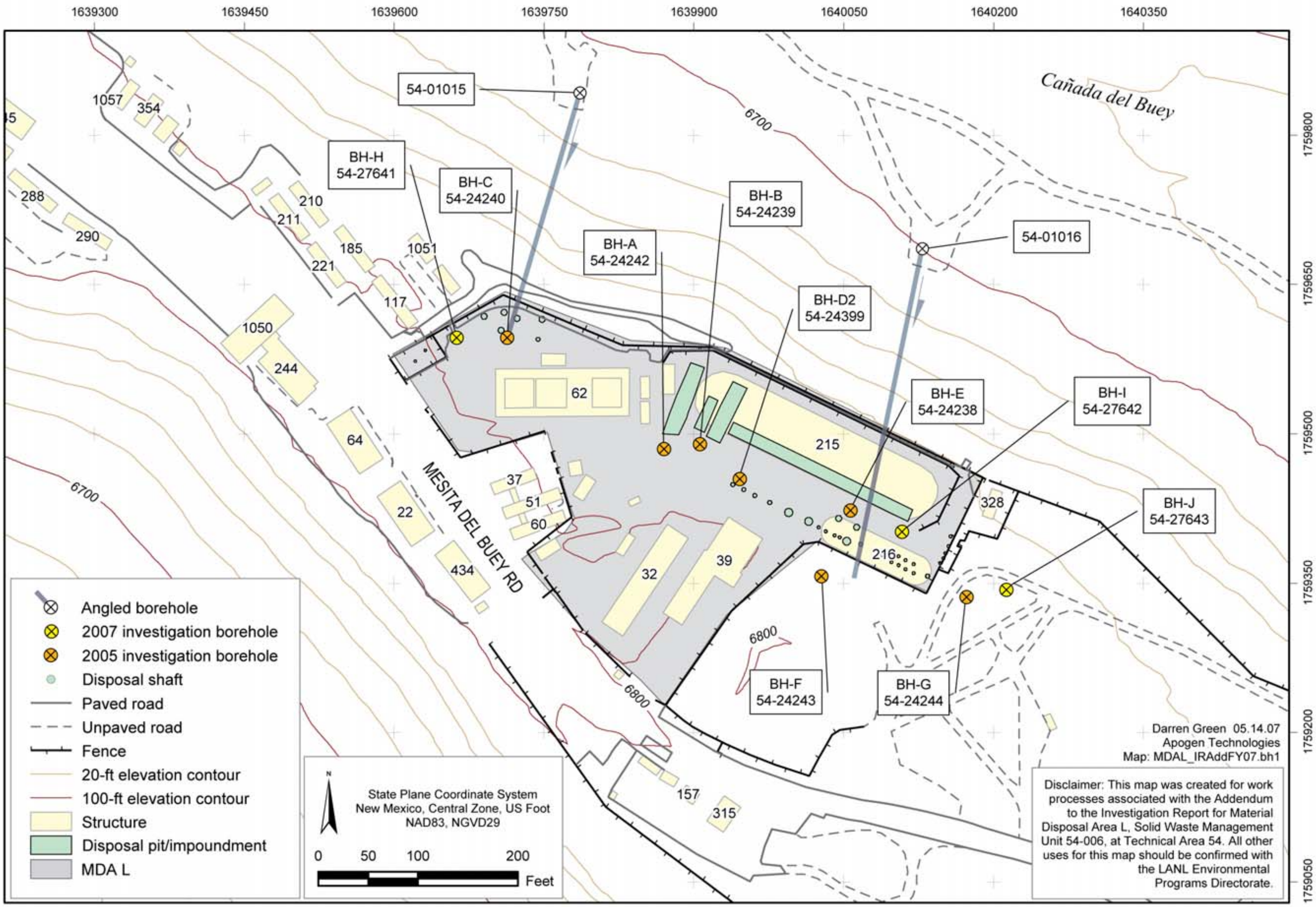
Data Source	Figures
Hypsography, 20 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991	Figure 1.0-2 Figure 1.2-1 Figure 4.2-1 Figure 4.2-2 Figure 4.3-1 Plate 1
Hypsography, 100 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991	Figure 1.0-2 Figure 1.2-1 Figure 4.2-1 Figure 4.2-2 Figure 4.3-1 Plate 1
LANL Occupation and Exterior Perimeter of DOE Land; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 21 December 2006	Figure 1.0-1
LANL Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 21 December 2006	Figure 1.0-1 Figure 4.2-1 Plate 1
Materials Disposal Areas; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; ER2004-0221; 1:2,500 Scale Data; 23 April 2004	Figure 1.0-1 Figure 1.0-2 Figure 1.2-1 Figure 4.2-1 Figure 4.2-2 Figure 4.3-1 Plate 1
Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 27 April 2007	Figure 1.0-1 Figure 1.0-2 Figure 1.2-1 Figure 4.2-1 Figure 4.2-2 Figure 4.3-1 Plate 1
Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, Environment and Remediation Support Services Division, EP2007-0255; 13 April 2007	Figure 1.0-2 Figure 4.2-1 Figure 4.2-2 Figure 4.3-1 Plate 1
Security and Industrial Fences and Gates; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 27 April 2007	Figure 1.0-2 Figure 1.2-1 Figure 4.2-1 Figure 4.2-2 Figure 4.3-1 Plate 1
Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 27 April 2007	Figure 1.0-2 Figure 1.2-1 Figure 4.2-1 Figure 4.2-2 Figure 4.3-1 Plate 1

Data Source	Figures
Waste Storage Features; Los Alamos National Laboratory, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007	Figure 1.0-2 Figure 1.2-1 Figure 4.2-1 Figure 4.2-2 Figure 4.3-1 Plate 1



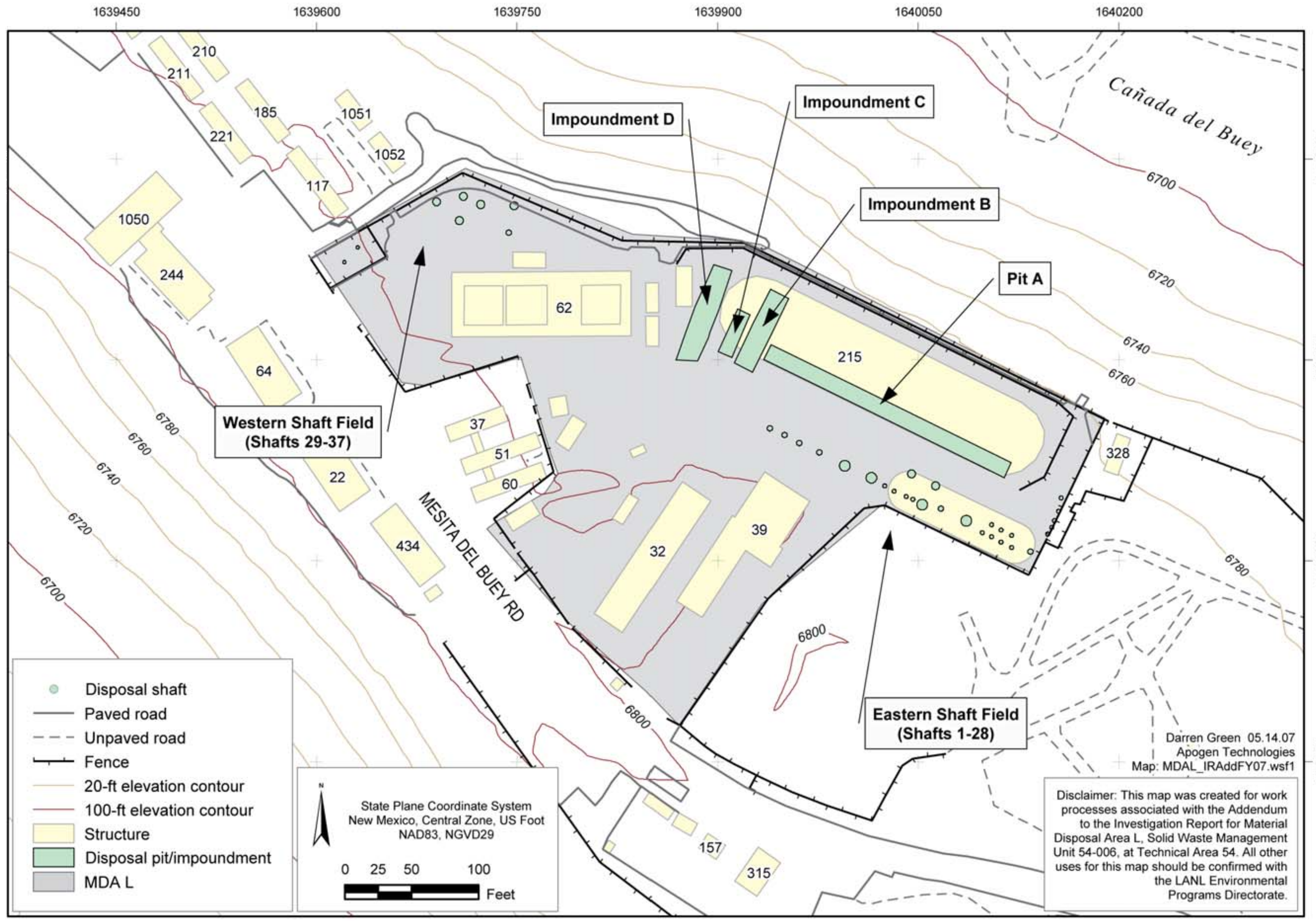
F2.0-1, MDA L IR, 082605, ptm

Figure 1.0-1 Area L at Technical Area 54



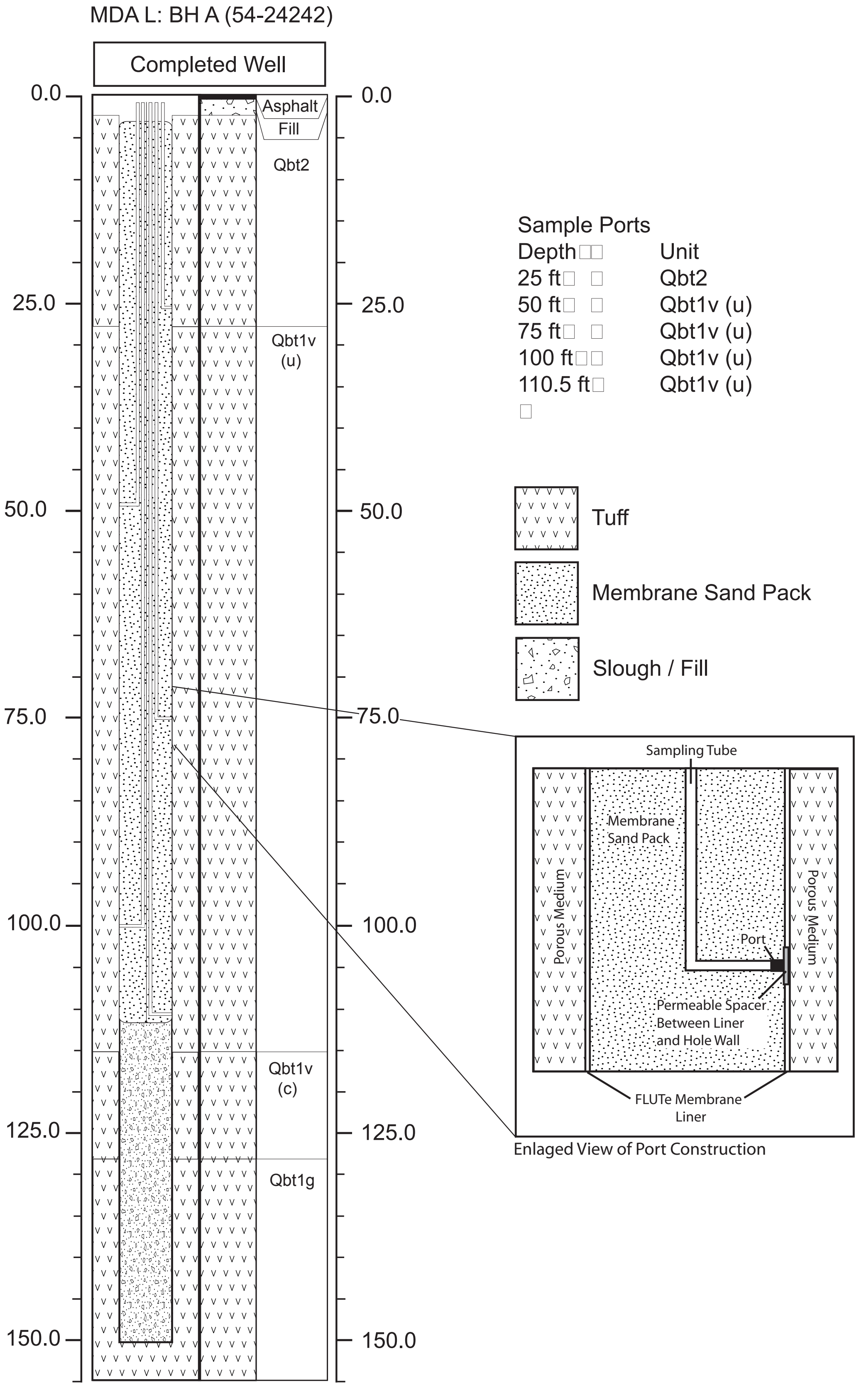
Disclaimer: This map was created for work processes associated with the Addendum to the Investigation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54. All other uses for this map should be confirmed with the LANL Environmental Programs Directorate.

Figure 1.0-2 Locations of existing and supplemental investigation boreholes at MDA L



Disclaimer: This map was created for work processes associated with the Addendum to the Investigation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54. All other uses for this map should be confirmed with the LANL Environmental Programs Directorate.

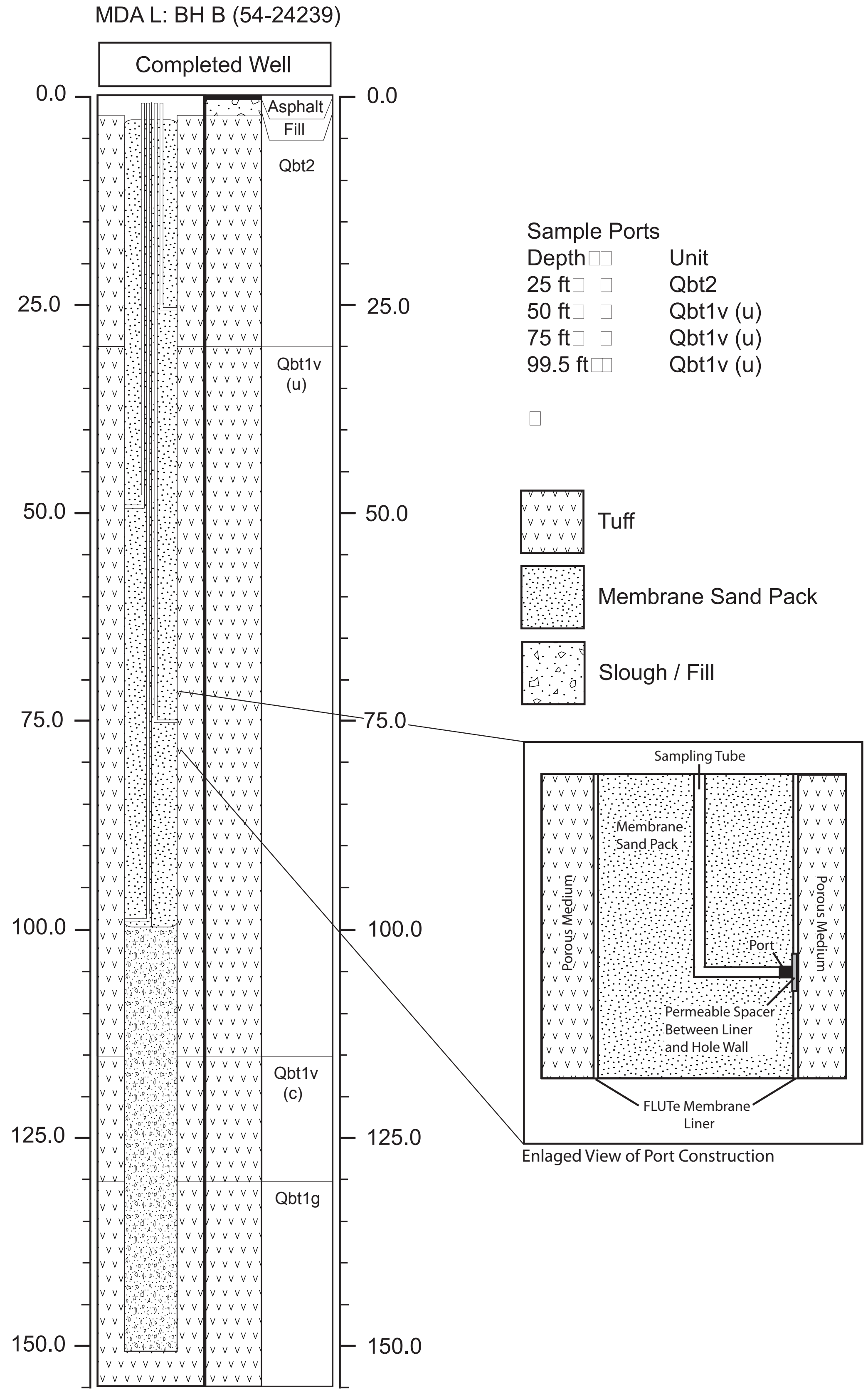
Figure 1.2-1 MDA L waste disposal units



Sample Ports

Depth	Unit
25 ft	Qbt2
50 ft	Qbt1v (u)
75 ft	Qbt1v (u)
100 ft	Qbt1v (u)
110.5 ft	Qbt1v (u)

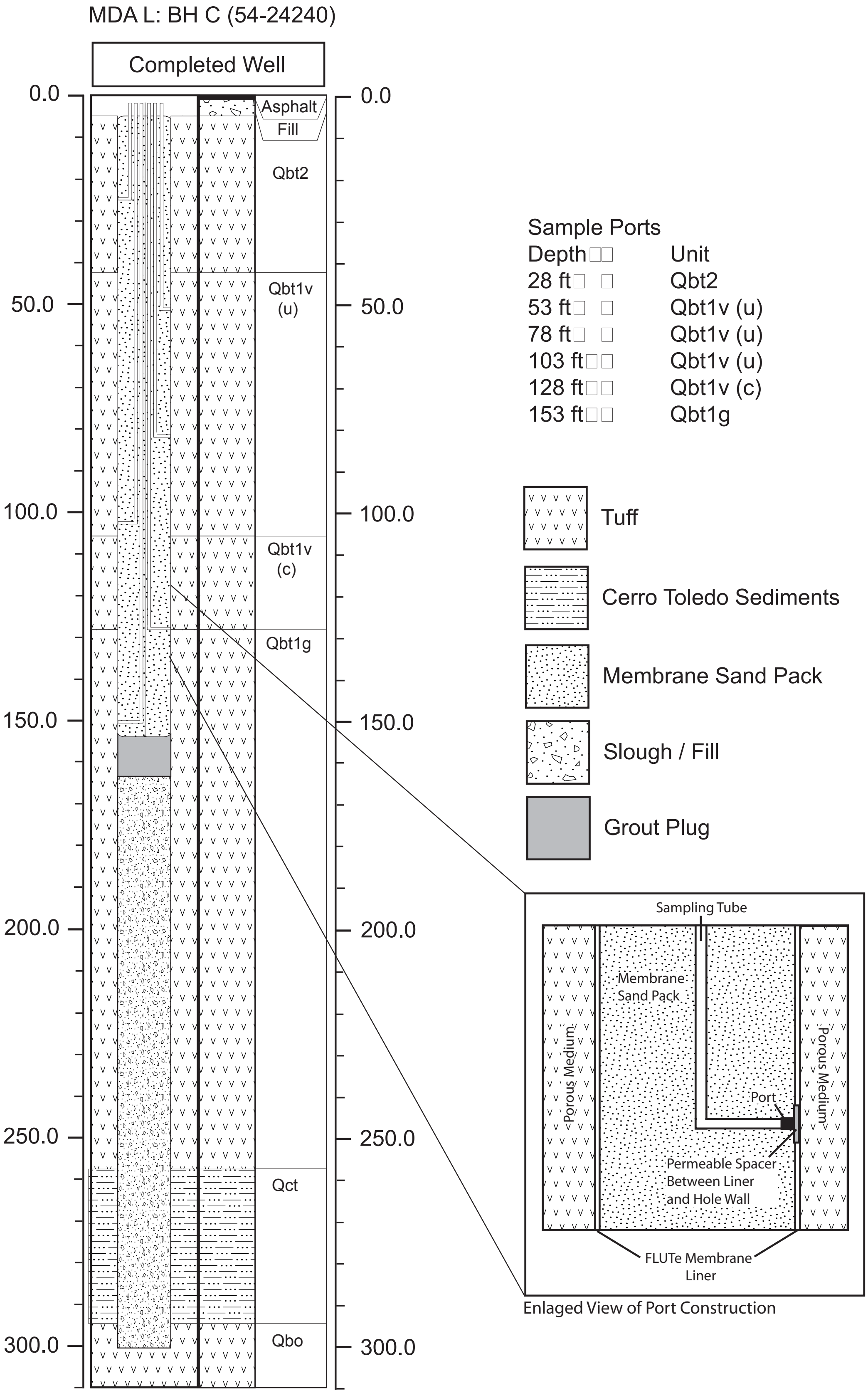
Figure 2.2-1 Detail of BH-A (location 54-24242)



Sample Ports

Depth	Unit
25 ft	Qbt2
50 ft	Qbt1v (u)
75 ft	Qbt1v (u)
99.5 ft	Qbt1v (u)

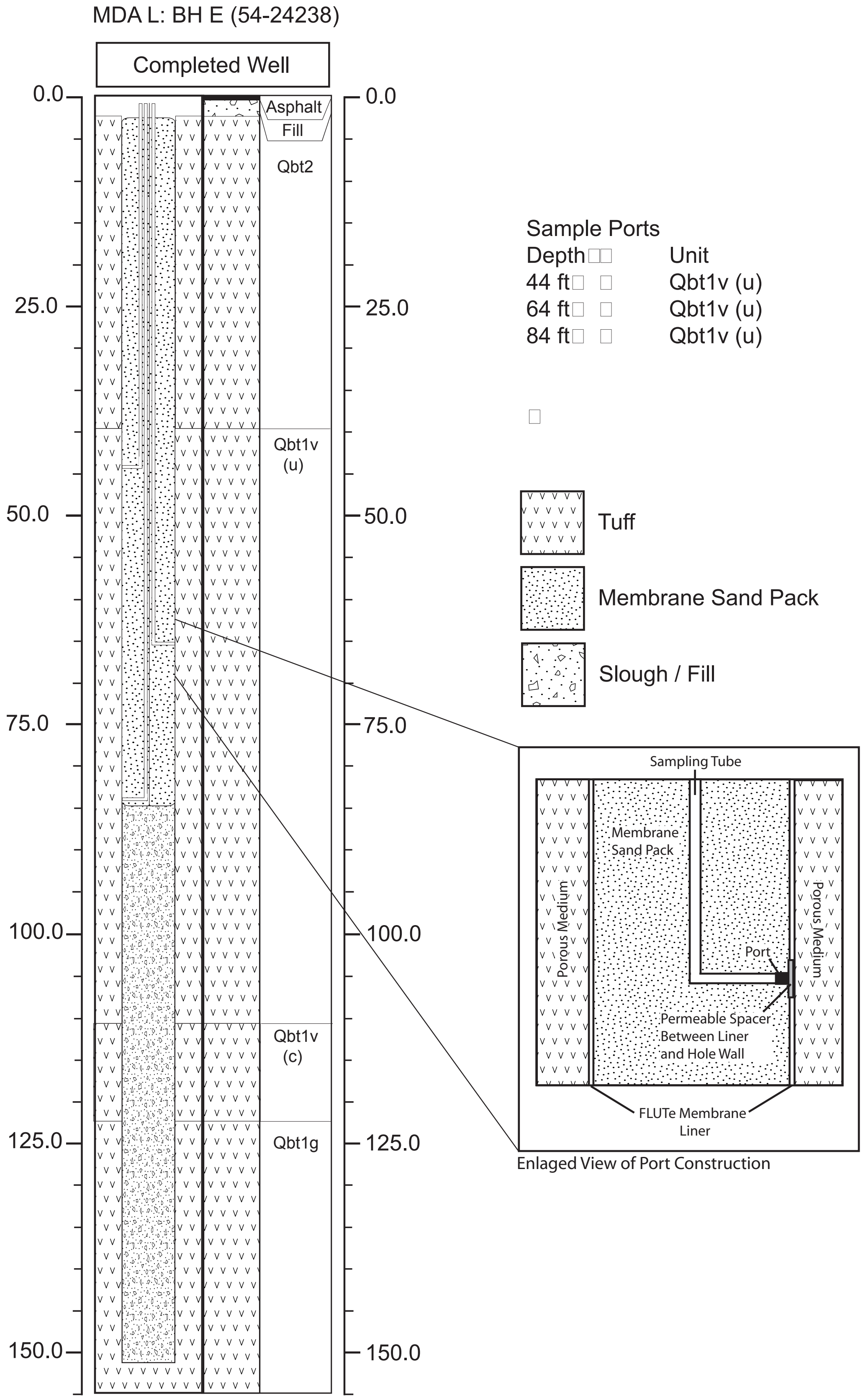
Figure 2.2-2 Detail of BH-B (location 54-24239)



Sample Ports

Depth	Unit
28 ft	Qbt2
53 ft	Qbt1v (u)
78 ft	Qbt1v (u)
103 ft	Qbt1v (u)
128 ft	Qbt1v (c)
153 ft	Qbt1g

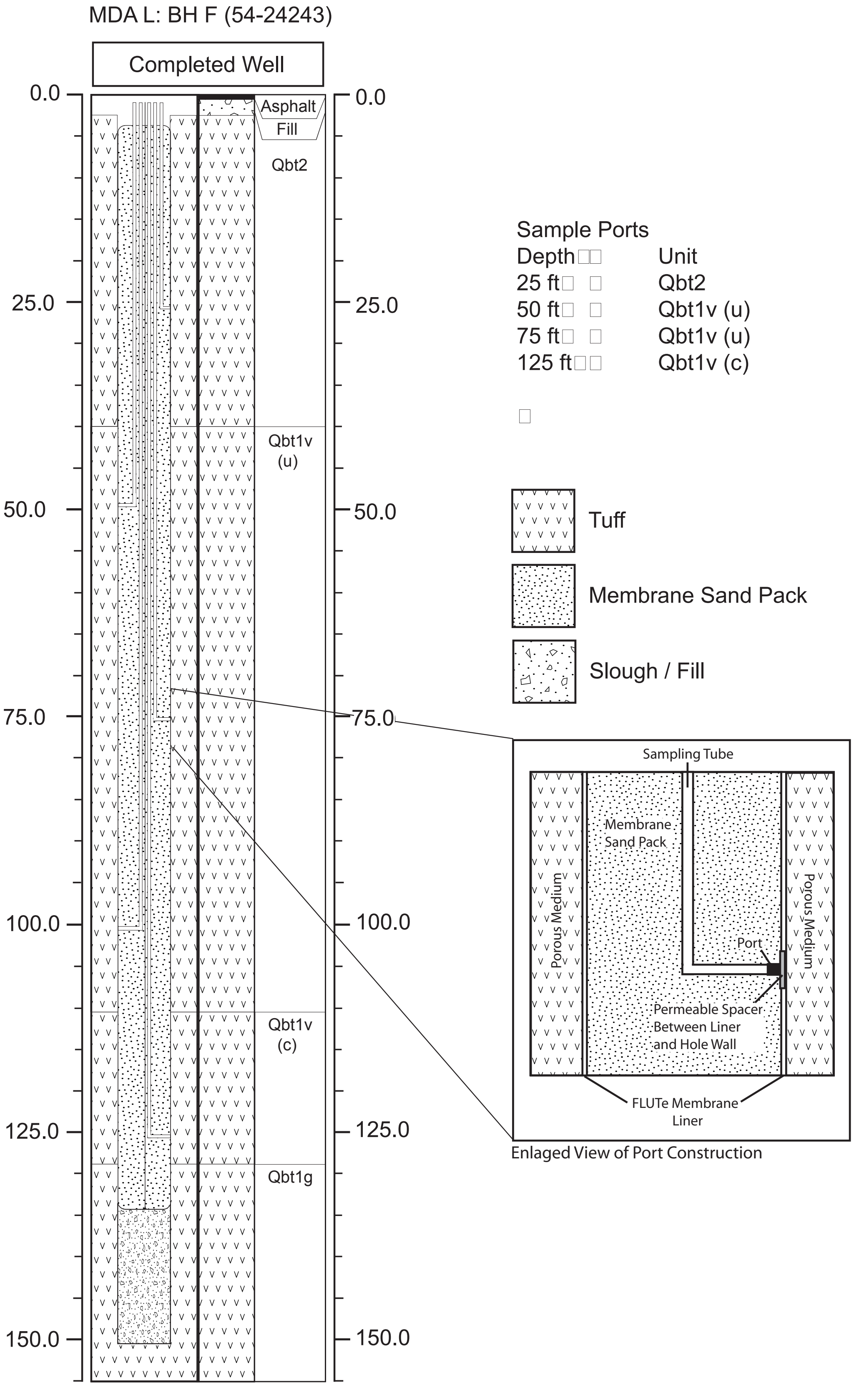
Figure 2.2-3 Detail of BH-C (location 54-24240)



Sample Ports

Depth	Unit
44 ft	Qbt1v (u)
64 ft	Qbt1v (u)
84 ft	Qbt1v (u)

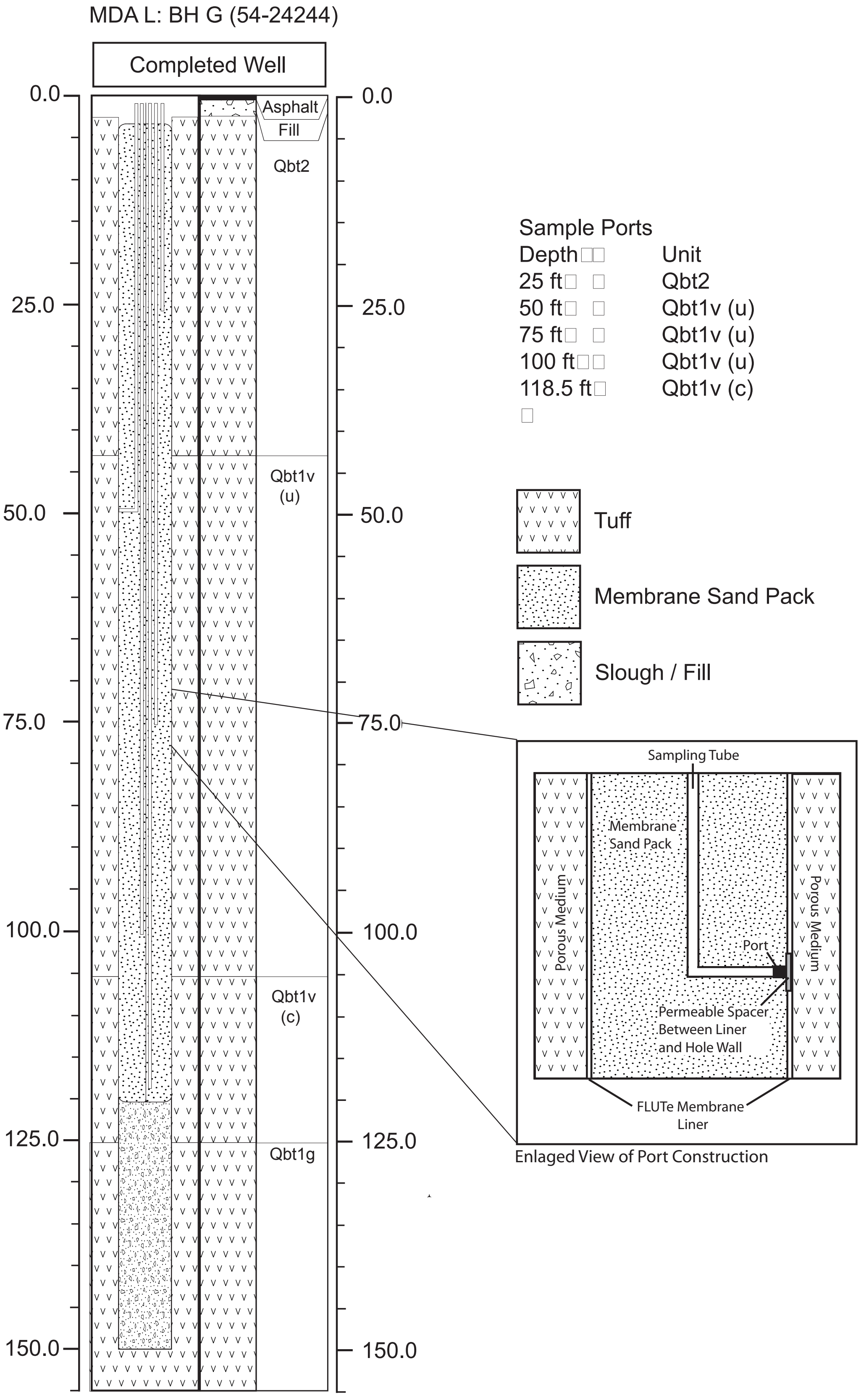
Figure 2.2-4 Detail of BH-E (location 54-24238)


MDA L: BH F (54-24243)

Sample Ports

Depth	Unit
25 ft	Qbt2
50 ft	Qbt1v (u)
75 ft	Qbt1v (u)
125 ft	Qbt1v (c)

Figure 2.2-5 Detail of BH-F (location 54-24243)

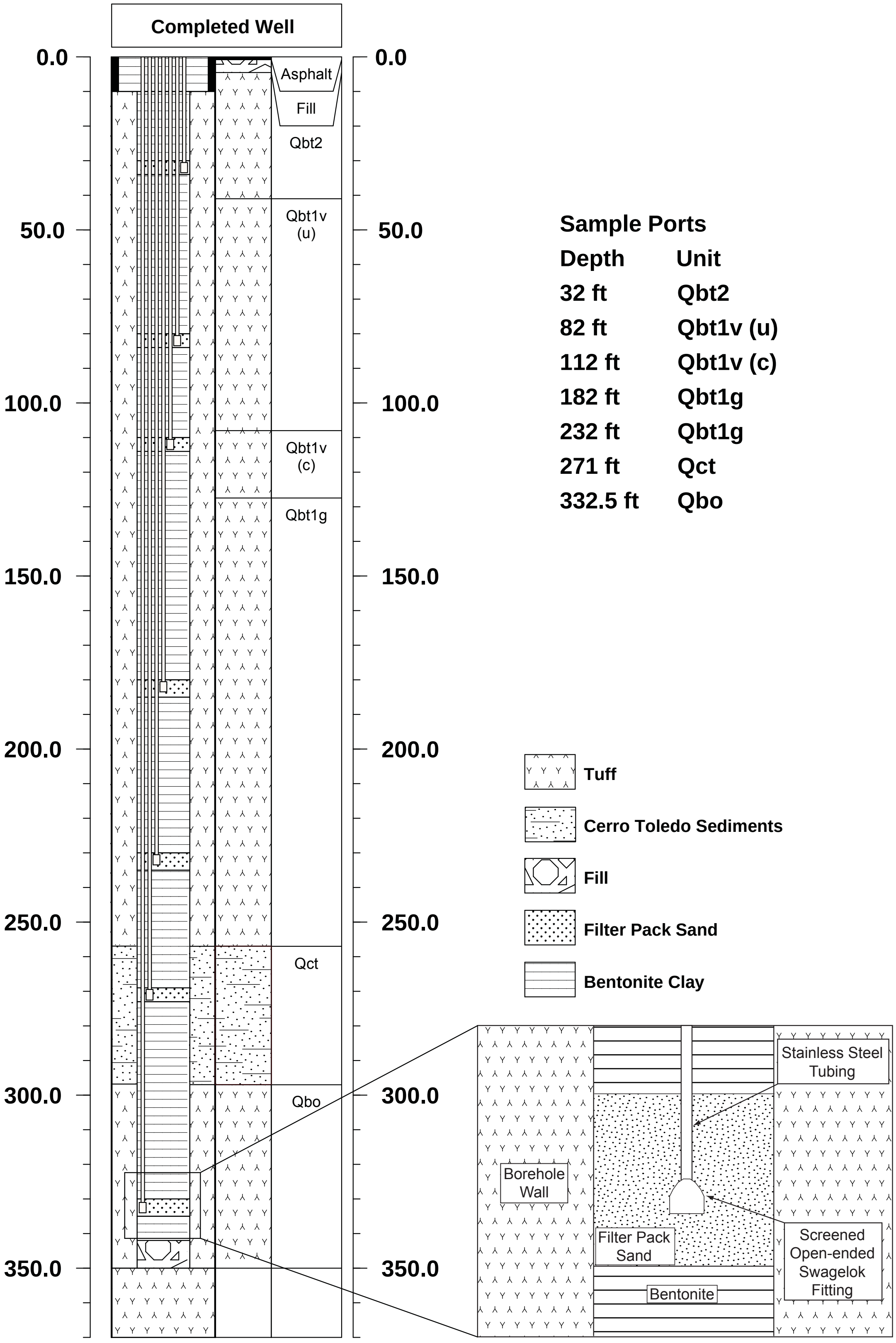


Sample Ports

Depth	Unit
25 ft	Qbt2
50 ft	Qbt1v (u)
75 ft	Qbt1v (u)
100 ft	Qbt1v (u)
118.5 ft	Qbt1v (c)

Figure 2.2-6 Detail of BH-G (location 54-24244)

MDA L: BH H (54-27641)



Sample Ports

Depth	Unit
32 ft	Qbt2
82 ft	Qbt1v (u)
112 ft	Qbt1v (c)
182 ft	Qbt1g
232 ft	Qbt1g
271 ft	Qct
332.5 ft	Qbo

Figure 2.2-7 Detail of BH-H (location 54-27641)

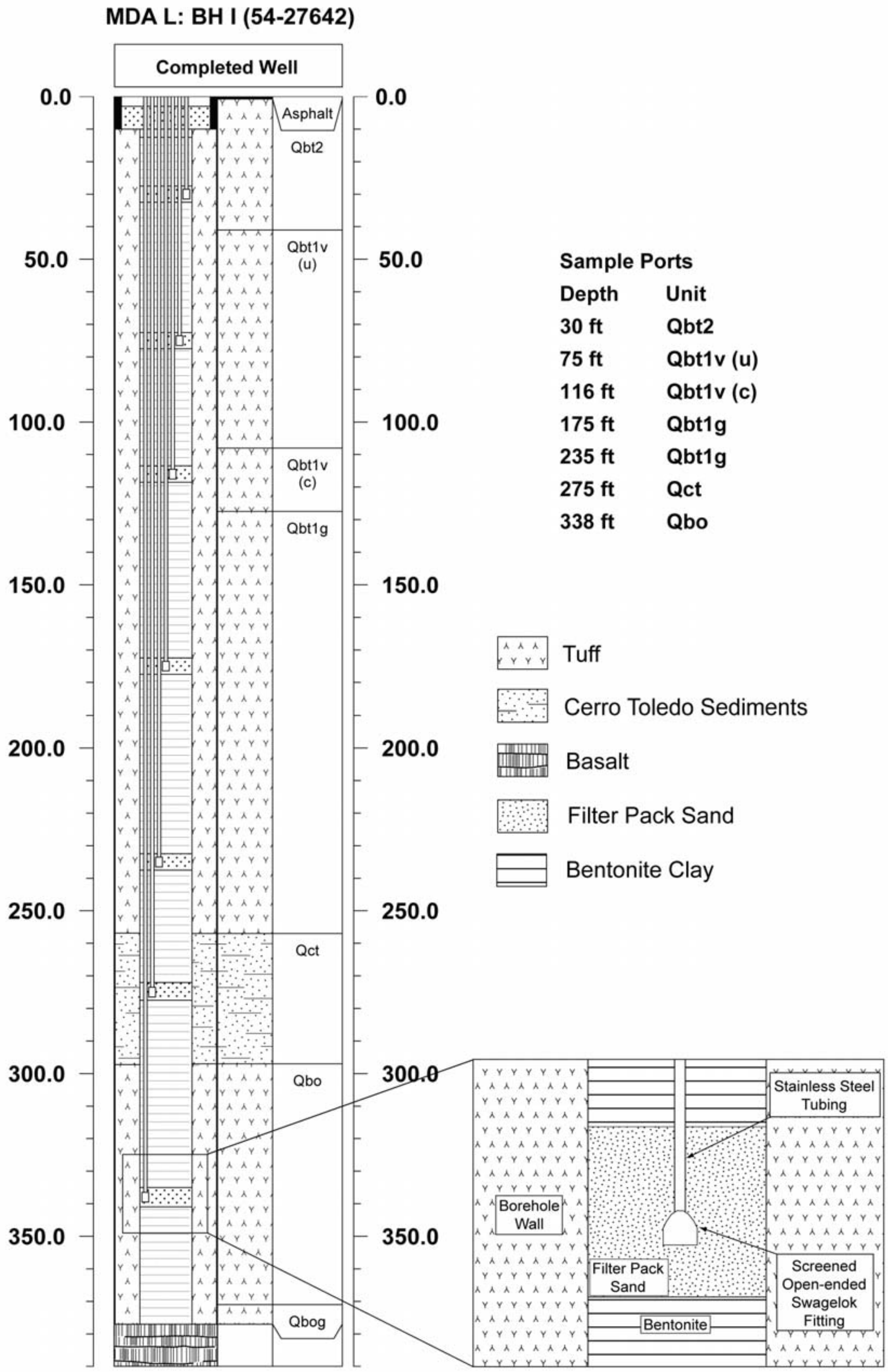
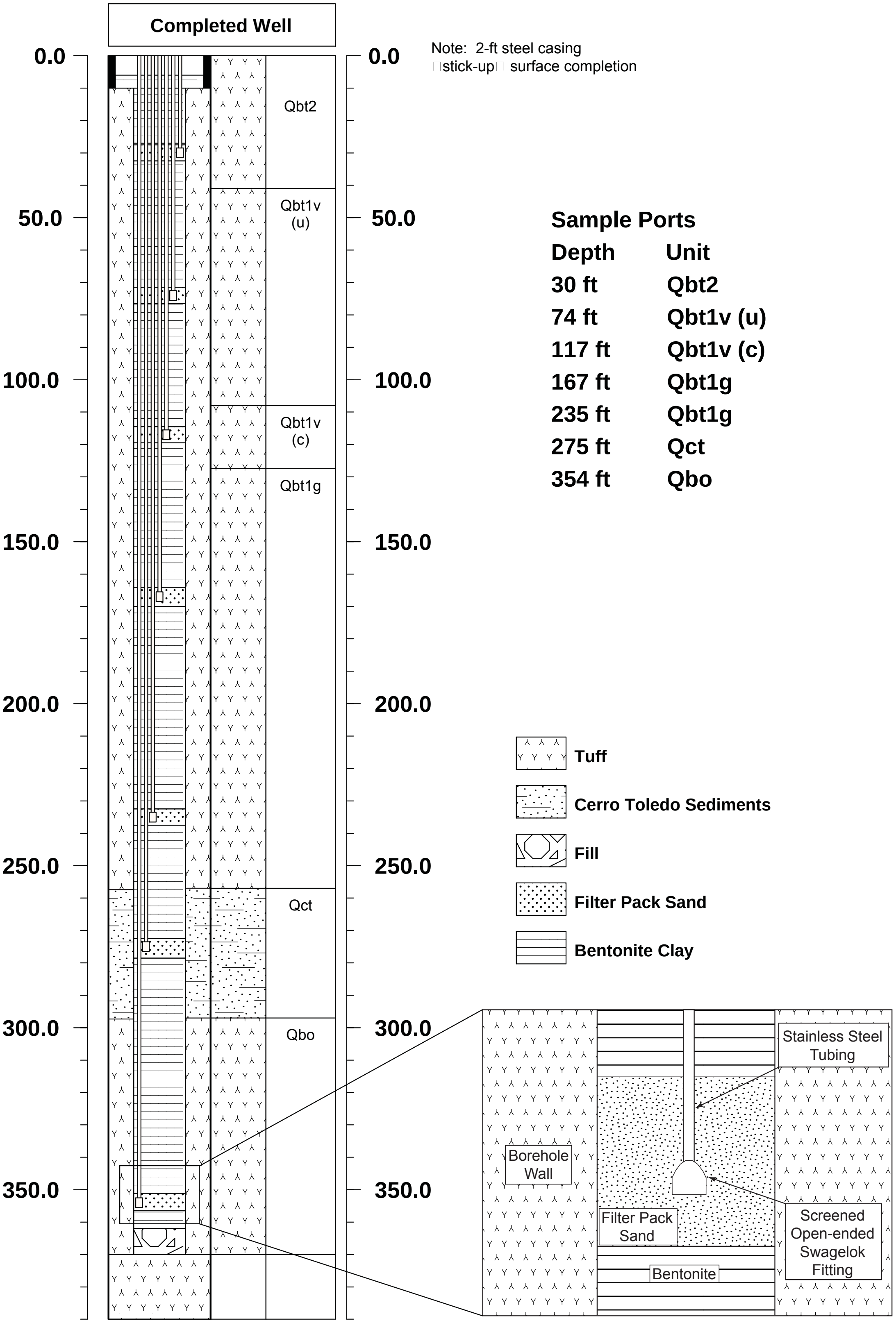


Figure 2.2-8 Detail of BH-I (location 54-27642)

MDA L: BH J (54-27643)



Sample Ports

Depth	Unit
30 ft	Qbt2
74 ft	Qbt1v (u)
117 ft	Qbt1v (c)
167 ft	Qbt1g
235 ft	Qbt1g
275 ft	Qct
354 ft	Qbo

Figure 2.2-9 Detail of BH-J (location 54-27643)

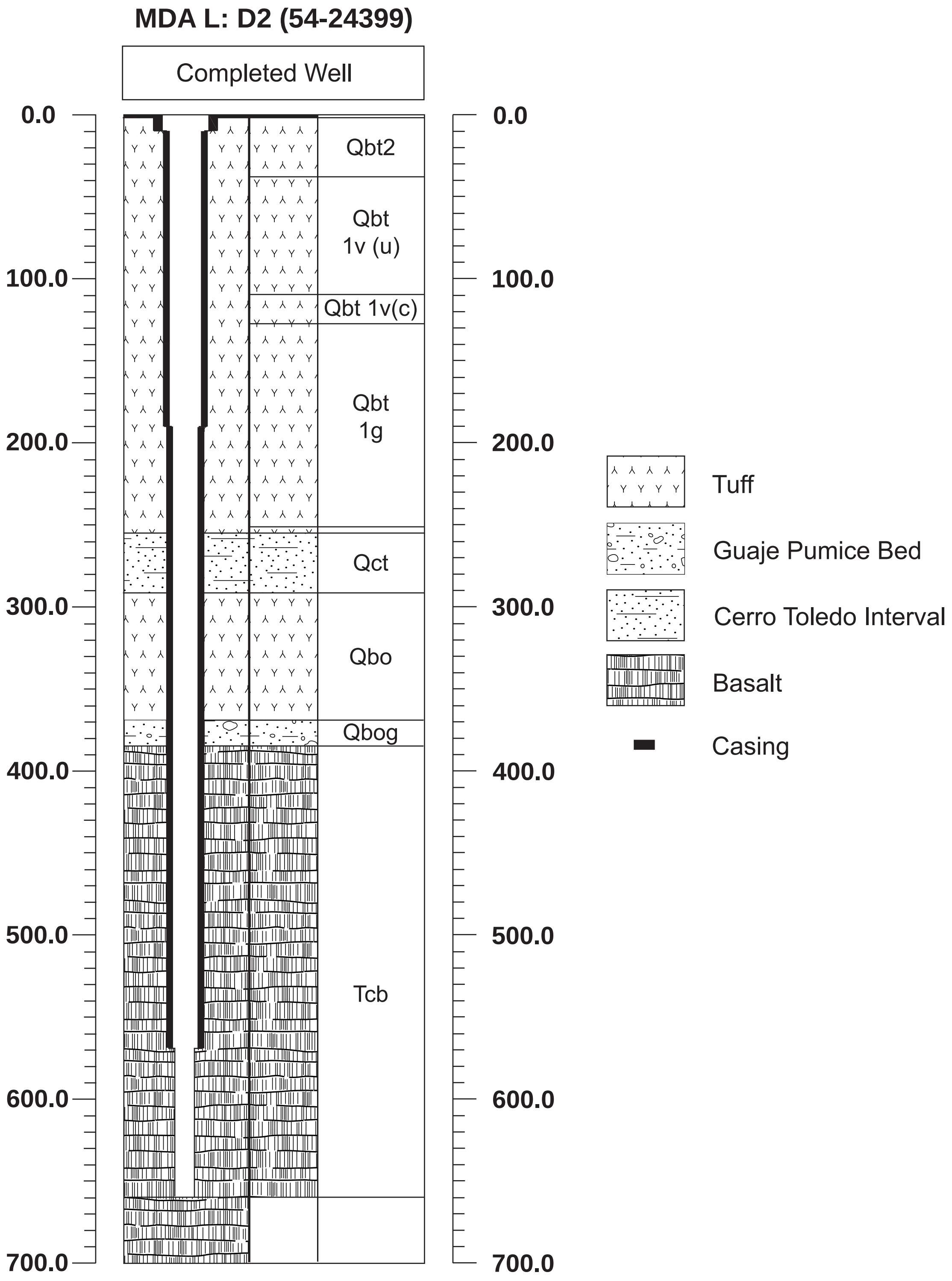
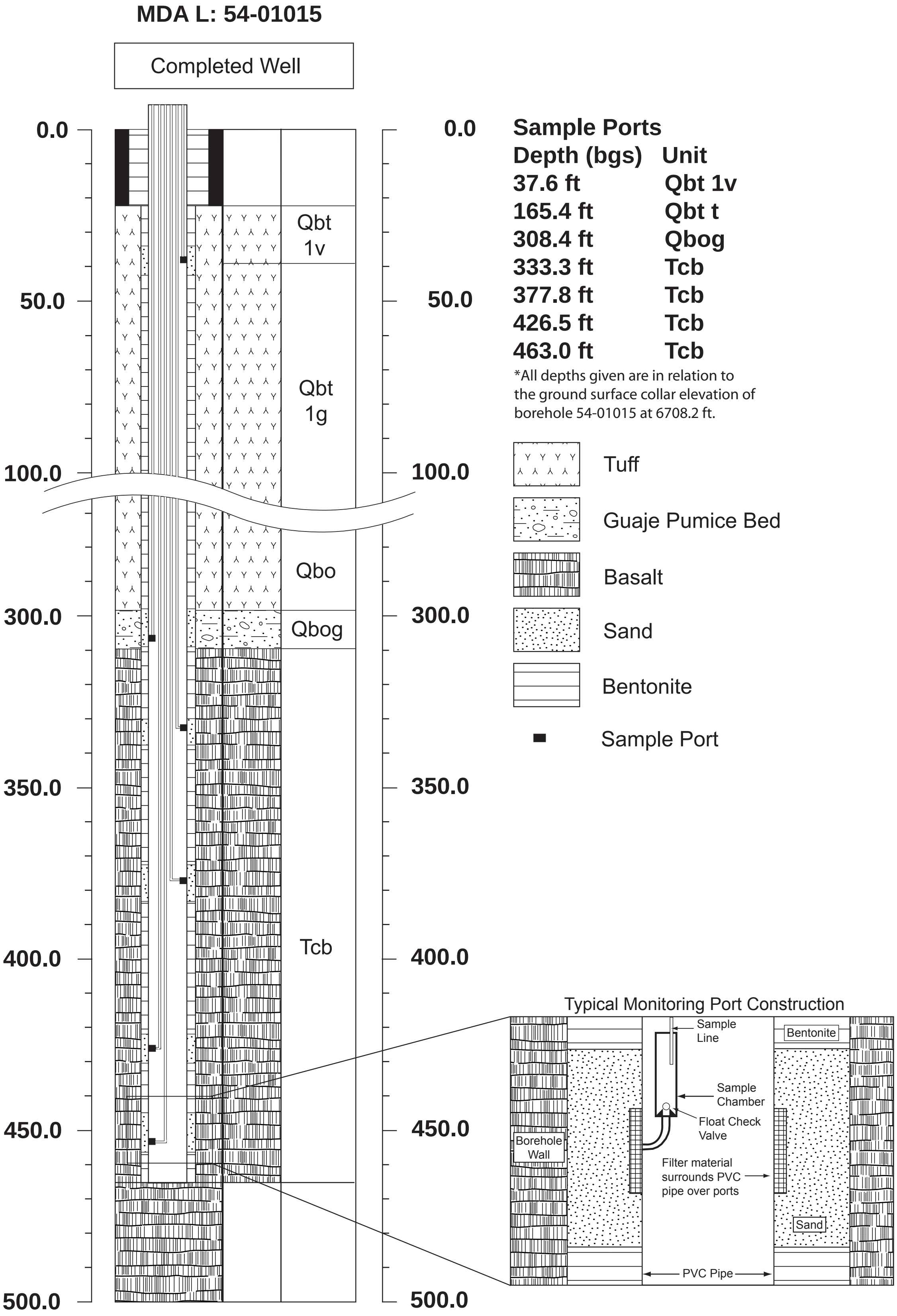


Figure 2.2-10 Detail of BH-D2 (location 54-24399)



Sample Ports

Depth (bgs)	Unit
37.6 ft	Qbt 1v
165.4 ft	Qbt t
308.4 ft	Qbog
333.3 ft	Tcb
377.8 ft	Tcb
426.5 ft	Tcb
463.0 ft	Tcb

*All depths given are in relation to the ground surface collar elevation of borehole 54-01015 at 6708.2 ft.

Figure 2.2-11 Vertical profile of BH location 54-01015

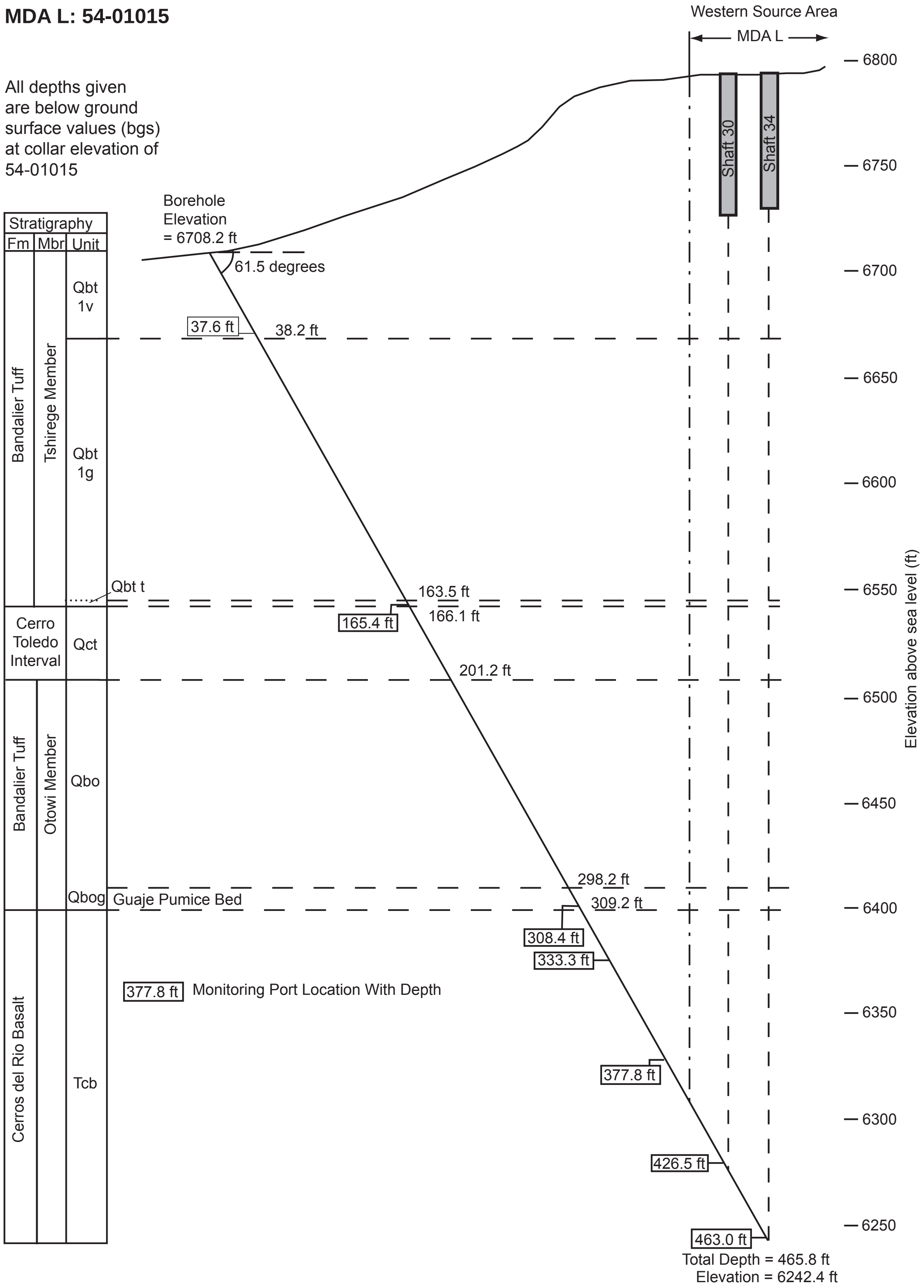
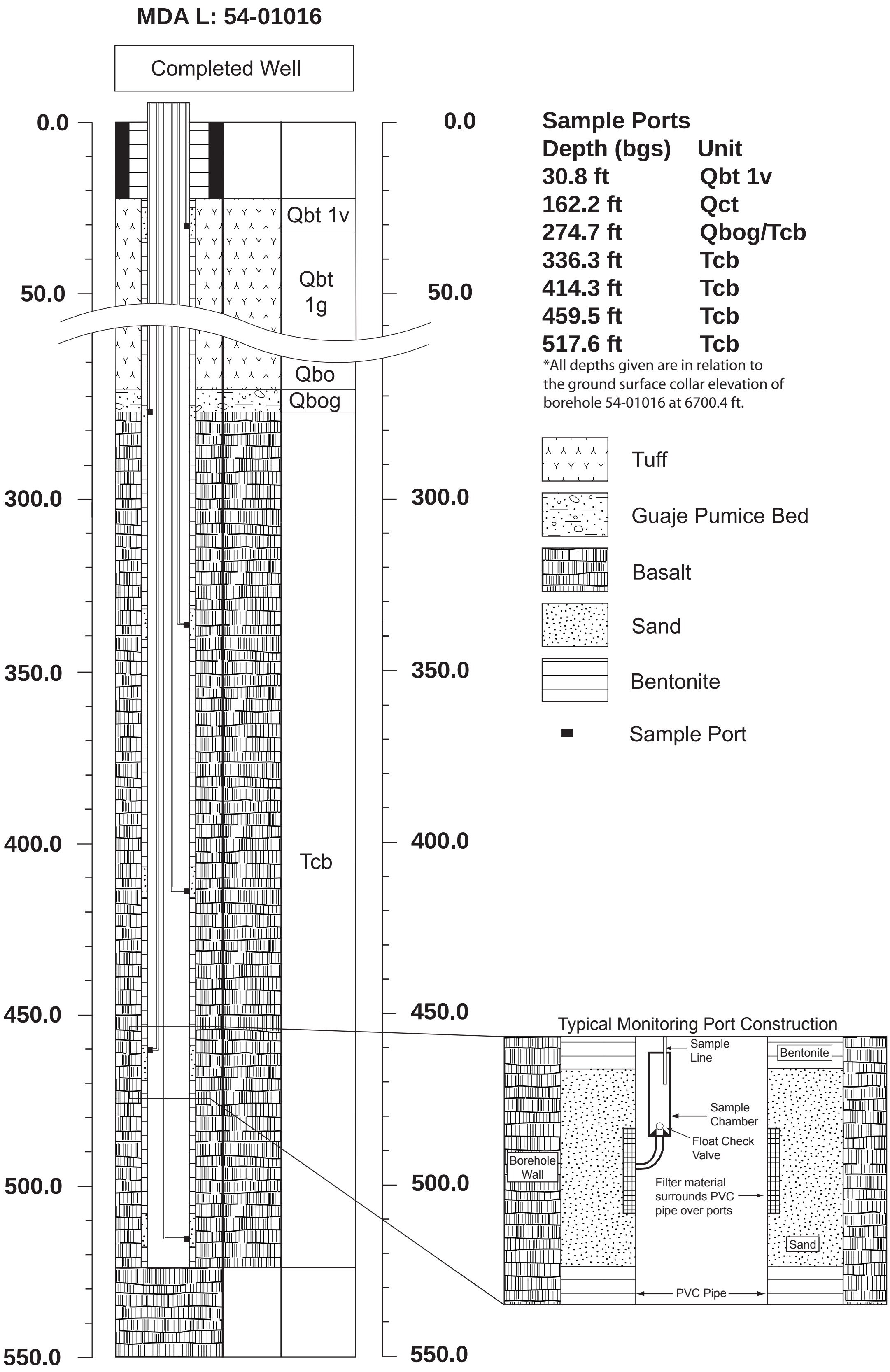


Figure 2.2-12 Detail of BH location 54-01015



Sample Ports

Depth (bgs)	Unit
30.8 ft	Qbt 1v
162.2 ft	Qct
274.7 ft	Qbog/Tcb
336.3 ft	Tcb
414.3 ft	Tcb
459.5 ft	Tcb
517.6 ft	Tcb

*All depths given are in relation to the ground surface collar elevation of borehole 54-01016 at 6700.4 ft.

Figure 2.2-13 Vertical profile of BH location 54-01016

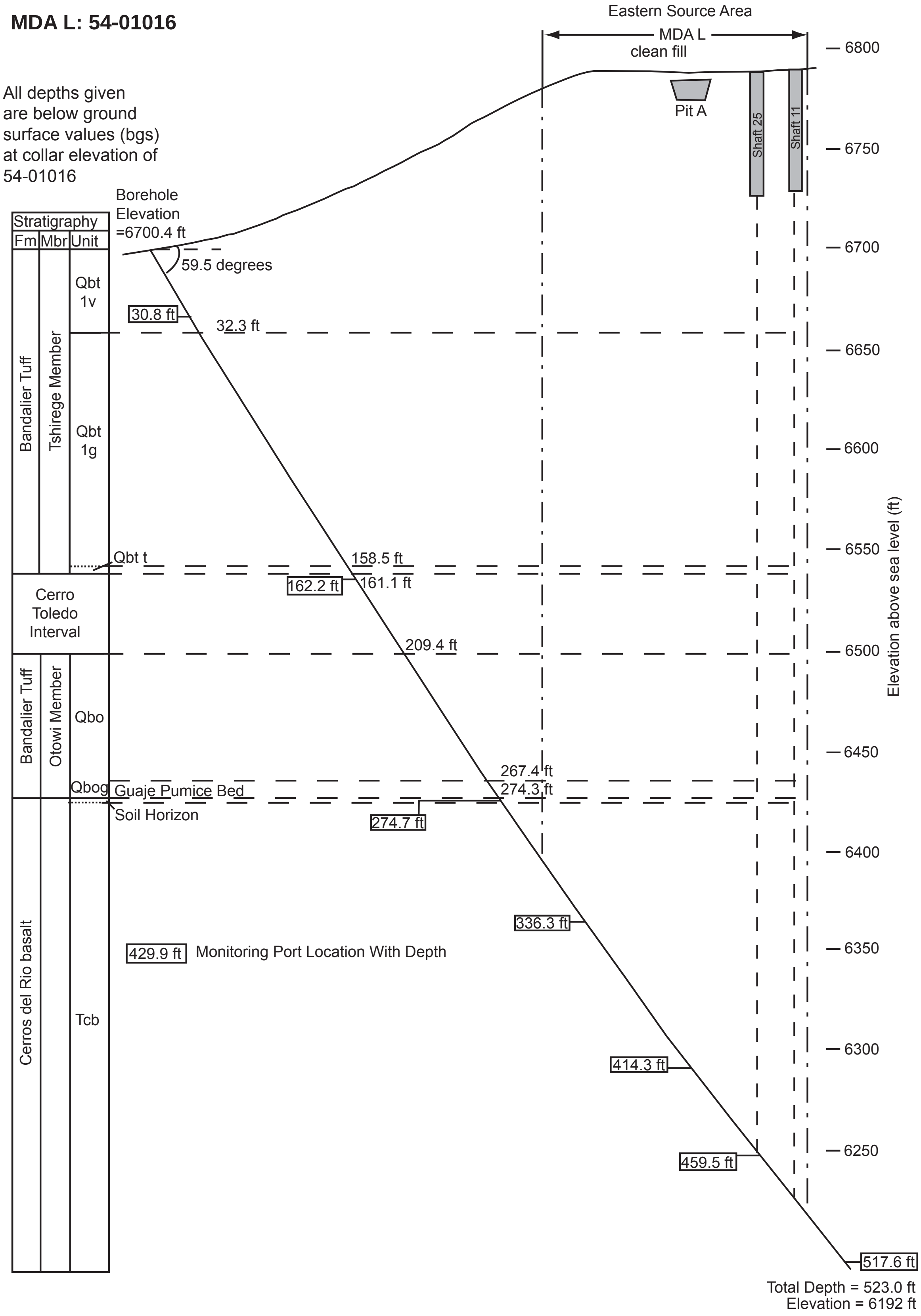
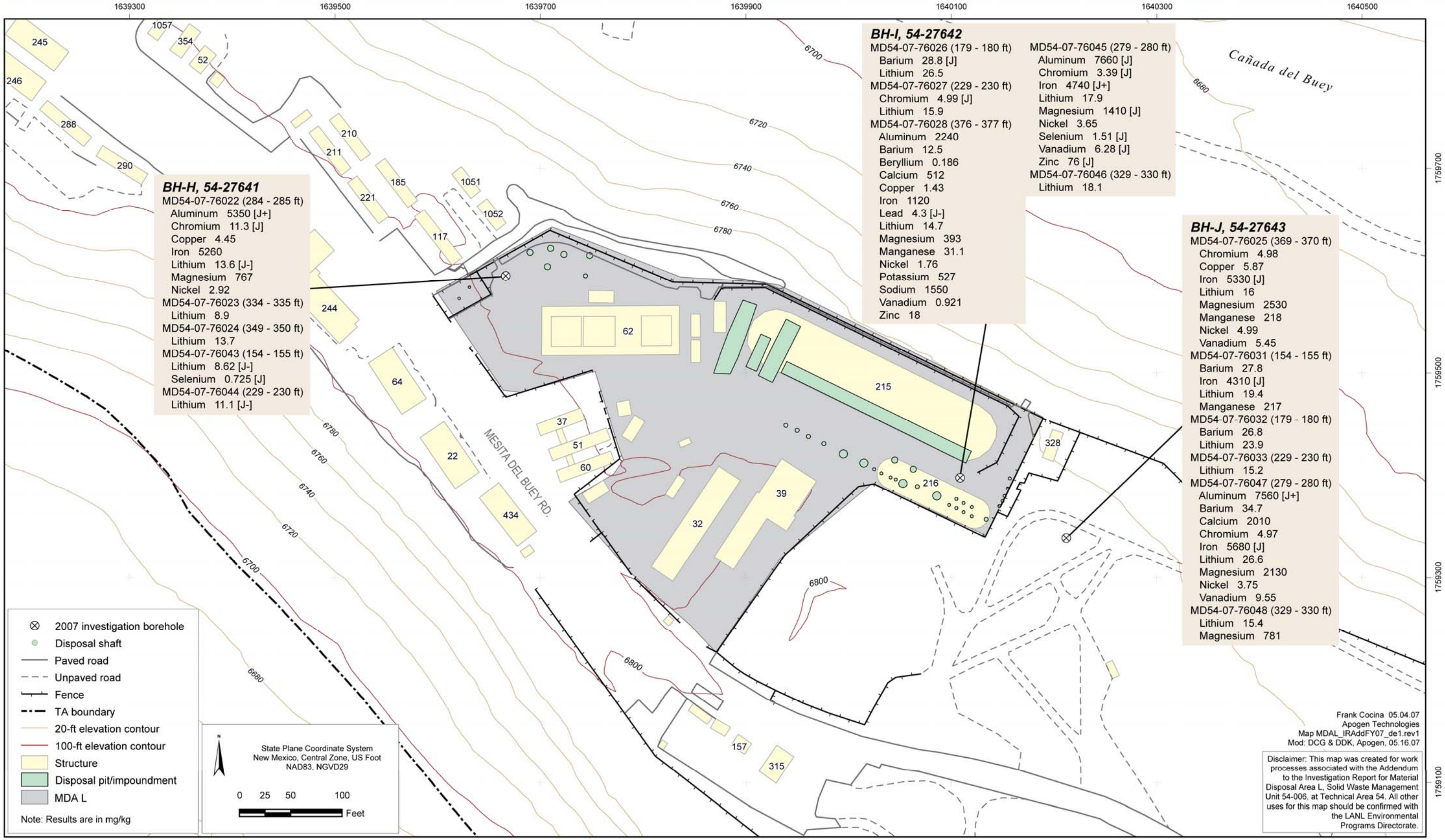


Figure 2.2-14 Detail of BH location 54-01016



BH-H, 54-27641
MD54-07-76022 (284 - 285 ft)
Aluminum 5350 [J+]
Chromium 11.3 [J]
Copper 4.45
Iron 5260
Lithium 13.6 [J-]
Magnesium 767
Nickel 2.92
MD54-07-76023 (334 - 335 ft)
Lithium 8.9
MD54-07-76024 (349 - 350 ft)
Lithium 13.7
MD54-07-76043 (154 - 155 ft)
Lithium 8.62 [J-]
Selenium 0.725 [J]
MD54-07-76044 (229 - 230 ft)
Lithium 11.1 [J-]

BH-I, 54-27642
MD54-07-76026 (179 - 180 ft)
Barium 28.8 [J]
Lithium 26.5
MD54-07-76027 (229 - 230 ft)
Chromium 4.99 [J]
Lithium 15.9
MD54-07-76028 (376 - 377 ft)
Aluminum 2240
Barium 12.5
Beryllium 0.186
Calcium 512
Copper 1.43
Iron 1120
Lead 4.3 [J-]
Lithium 14.7
Magnesium 393
Manganese 31.1
Nickel 1.76
Potassium 527
Sodium 1550
Vanadium 0.921
Zinc 18
MD54-07-76045 (279 - 280 ft)
Aluminum 7660 [J]
Chromium 3.39 [J]
Iron 4740 [J+]
Lithium 17.9
Magnesium 1410 [J]
Nickel 3.65
Selenium 1.51 [J]
Vanadium 6.28 [J]
Zinc 76 [J]
MD54-07-76046 (329 - 330 ft)
Lithium 18.1

BH-J, 54-27643
MD54-07-76025 (369 - 370 ft)
Chromium 4.98
Copper 5.87
Iron 5330 [J]
Lithium 16
Magnesium 2530
Manganese 218
Nickel 4.99
Vanadium 5.45
MD54-07-76031 (154 - 155 ft)
Barium 27.8
Iron 4310 [J]
Lithium 19.4
Manganese 217
MD54-07-76032 (179 - 180 ft)
Barium 26.8
Lithium 23.9
MD54-07-76033 (229 - 230 ft)
Lithium 15.2
MD54-07-76047 (279 - 280 ft)
Aluminum 7560 [J+]
Barium 34.7
Calcium 2010
Chromium 4.97
Iron 5680 [J]
Lithium 26.6
Magnesium 2130
Nickel 3.75
Vanadium 9.55
MD54-07-76048 (329 - 330 ft)
Lithium 15.4
Magnesium 781

Disclaimer: This map was created for work processes associated with the Addendum to the Investigation Report for Material Disposal Area L, Solid Waste Management Unit 54-006, at Technical Area 54. All other uses for this map should be confirmed with the LANL Environmental Programs Directorate.

Figure 4.2-1 Supplemental investigation inorganic chemicals detected above BV in tuff at MDA L (mg/kg)

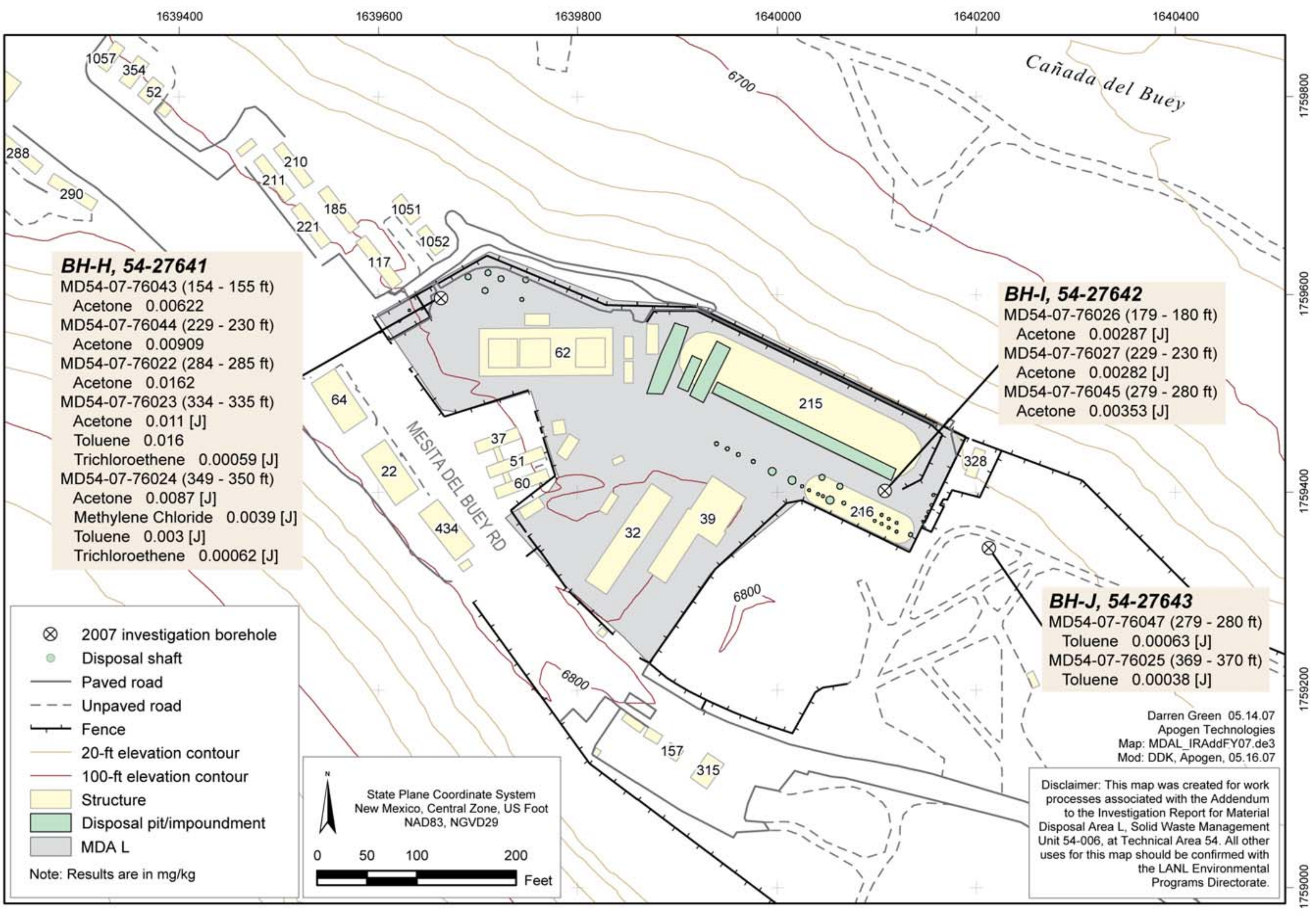


Figure 4.2-2 Supplemental investigation VOCs detected in tuff at MDA L (mg/kg)

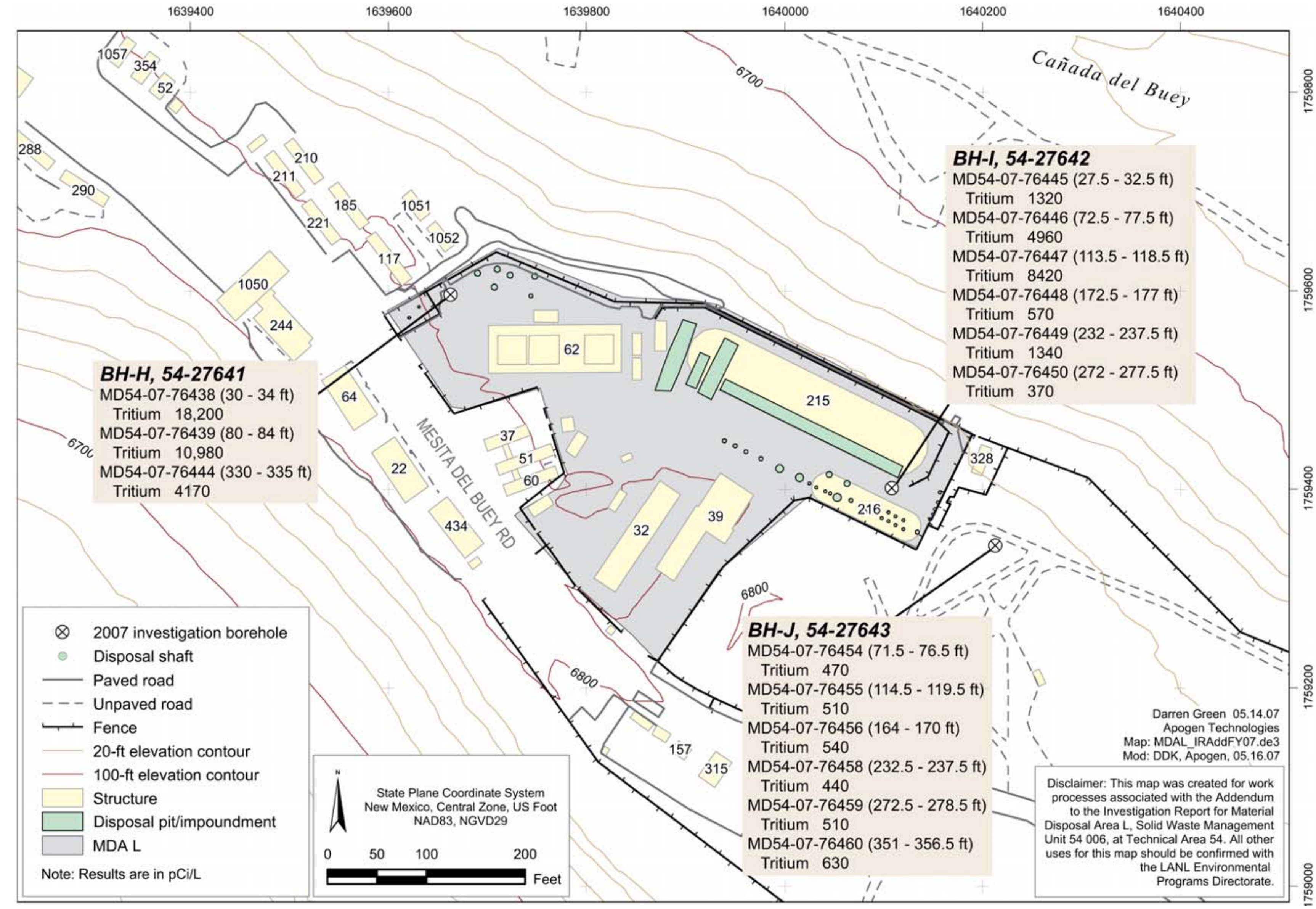


Figure 4.3-1 Supplemental investigation tritium detected in subsurface pore gas at MDA L (pCi/L)

Table 2.2-1
MDA L Supplemental Investigation Drilling Summary

Borehole ID	Depth to Otowi Member (ft)	Total Depth (ft)
BH-H (54-27641)	298	350
BH-I (54-27642)	298	377
BH-J (54-27643)	298	370

Table 2.4-1
MDA L Supplemental Investigation Core Sample Depths

Borehole ID	Sample Depth Interval (ft) and Stratigraphic Unit					
BH-H (54-27641)	154–155 (Qbt 1g)	229–230 (Qbt 1g)	284–285 (Qct)	334–335 (Qbo)	349–350 (Qbo)	
BH-I (54-27642)	179–180 (Qbt 1g)	229–230 (Qbt 1g)	279–280 (Qct)	329–330 (Qbo)	376–377 (Qbog)	
BH-J (54-27643)	154–155 (Qbt 1g)	179–180 (Qbt 1g)	229–230 (Qbt 1g)	279–280 (Qct)	329–330 (Qbo)	369–370 (Qbo)

Table 2.5-1
MDA L Supplemental Investigation Pore-Gas Sample Port Construction and Sampling Summary

Borehole ID	Sample Port Depths/Intervals (ft) and Stratigraphic Units						
BH-A (54-24242)	**24–26 (Qbt2)**	**49–51 (Qbt1v-u)**	74–76 (Qbt1v-u)	99–101 (Qbt1v-u)	**109.5–111.5 (Qbt1v-c)**	—[a]	—
BH-B (54-24239)	**24–26 (Qbt2)**	49–51 (Qbt1v-u)	**74–76 (Qbt1v-u)**	**98.5–100.5 (Qbt1v-u)**	—	—	—
BH-C (54-24240)	**27–29 (Qbt2)**	52–54 (Qbt1v-u)	**77–79 (Qbt1v-u)**	102–105 (Qbt1v-u)	127–129 (Qbt1v-c)	**152–154 (Qbt1g)**	
BH-E (54-24238)	**43–45 (Qbt1v-u)**	**63-65 (Qbt1v-u)**	**83-85 (Qbt1v-u)**	—	—	—	—
BH-F (54-24243)	**24–26 (Qbt2)**	**49–51 (Qbt1v-u)**	**74–76 (Qbt1v-u)**	**99–101 (Qbt1v-u)**	**124–126 (Qbt1v-c)**	—	—
BH-G (54-24244)	**24–26 (Qbt2)**	**49–51 (Qbt2)**	**74–76 (Qbt1v-u)**	**99–101 (Qbt1v-u)**	**117.5–119.5 (Qbt1v-c)**	—	—
BH-H (54-27641)	**32 (Qbt2)**	**82 (Qbt1v-u)**	**112 (Qbt1v-c)**	**182 (Qbt1g)**	**232 (Qbt1g)**	**271 (Qct)**	**332.5 (Qbo)**
BH-I (54-27642)	**30 (Qbt2)**	**75 (Qbt1v-u)**	**116 (Qbt1v-c)**	**175 (Qbt1g)**	**235 (Qbt1g)**	**275 (Qct)**	**338 (Qbo)**
BH-J (54-27643)	**30 (Qbt2)**	**74 (Qbt1v-u)**	**117 (Qbt1v-c)**	**167 (Qbt1g)**	**235 (Qbt1g)**	**275 (Qct)**	**354 (Qbo)**
BH-D2 (54-24399)	**570–660 (Tcb)**[b]	—	—	—	—	—	—
54-01015	37.6 (Qbt 1v)	165.4 (Qbt t)	308.4 (Qtp)	333.3 (Tcb)	**377.8 (Tcb)**	**426.5 (Tcb)**	**463 (Tcb)**
54-01016	30.8 (Qbt 1v)	162.2 (Qct)	274.7 (Qbo/Tcb)	**336.3 (Tcb)**	**414.3 (Tcb)**	**459.5 (Tcb)**	**517.6 (Tcb)**

Note: Sampling port depths/intervals in bold were sampled during investigation or monitoring activities.

[a] — = No sample collected.

[b] Open borehole interval; no sample port construction.

Table 4.2-1
Summary of Inorganic Chemicals above BV in Core Samples (mg/kg)

Sample ID	Location ID	Depth (ft)	Media	Aluminum	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Copper	Iron	Lead
Qbt 1g, Qct, Qbo Background Values				**3560**	**0.56**	**25.7**	**1.44**	**0.4**	**1900**	**2.6**	**3.96**	**3700**	**13.5**
Qbog Background Values				**na**[a]	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**
MD54-07-76043	54-27641	154.0–155.0	Qbt 1g	—[b]	1.55 (U)	—	—	0.517 (U)	—	—	—	—	—
MD54-07-76044	54-27641	229.0 230.0	Qbt 1g	—	1.55 (U)	—	—	0.516 (U)	—	—	—	—	—
MD54-07-76022	54-27641	284.0–285.0	Qct	5350 (J+)	1.69 (U)	—	—	0.563 (U)	—	11.3 (J)	4.45	5260	—
MD54-07-76023	54-27641	334.0–335.0	Qbo	—	—	—	—	—	—	—	—	—	—
MD54-07-76024	54-27641	349.0–350.0	Qbo	—	—	—	—	—	—	—	—	—	—
MD54-07-76026	54-27642	179.0–180.0	Qbt 1g	—	1.56 (U)	28.8 (J)	—	0.521 (U)	—	—	—	—	—
MD54-07-76027	54-27642	229.0–230.0	Qbt 1g	—	1.52 (U)	—	—	0.508 (U)	—	4.99 (J)	—	—	—
MD54-07-76045	54-27642	279.0–280.0	Qct	7660 (J)	1.62 (U)	—	—	0.542 (U)	—	3.39 (J)	—	4740 (J+)	—
MD54-07-76046	54-27642	329.0–330.0	Qbo	—	1.57 (U)	—	—	0.524 (U)	—	—	—	—	—
MD54-07-76028	54-27642	376.0–377.0	Qbog	2240	—	12.5	0.186	—	512	—	1.43	1120	4.3 (J-)
MD54-07-76031	54-27643	154.0–155.0	Qbt 1g	—	0.941 (U)	27.8	—	0.523 (U)	—	—	—	4310 (J)	—
MD54-07-76032	54-27643	179.0–180.0	Qbt 1g	—	1.58 (U)	26.8	—	0.526 (U)	—	—	—	—	—
MD54-07-76033	54-27643	229.0–230.0	Qbt 1g	—	1.6 (U)	—	—	0.532 (U)	—	—	—	—	—
MD54-07-76047	54-27643	279.0–280.0	Qbt 1g	7560 (J+)	1.44 (U)	34.7	—	0.539 (U)	2010	4.97	—	5680 (J)	—
MD54-07-76048	54-27643	329.0–330.0	Qbt 1g	—	1.58 (U)	—	—	0.527 (U)	—	—	—	—	—
MD54-07-76025	54-27643	369.0–370.0	Qbo	—	1.28 (U)	—	—	0.555 (U)	—	4.98	5.87	5330 (J)	—

Table 4.2-1 (continued)

Sample ID	Location ID	Depth (ft)	Media	Lithium	Magnesium	Manganese	Nickel	Potassium	Selenium	Sodium	Vanadium	Zinc
Qbt 1g, Qct, Qbo Background Values				**na**	**739**	**189**	**2**	**2390**	**0.3**	**4350**	**4.59**	**40**
Qbog Background Values				**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**
MD54-07-76043	54-27641	154.0–155.0	Qbt 1g	8.62 (J-)	—	—	—	—	0.725 (J)	—	—	—
MD54-07-76044	54-27641	229.0–230.0	Qbt 1g	11.1 (J-)	—	—	—	—	1.55 (U)	—	—	—
MD54-07-76022	54-27641	284.0–285.0	Qct	13.6 (J-)	767	—	2.92	—	1.69 (U)	—	—	—
MD54-07-76023	54-27641	334.0–335.0	Qbo	8.9	—	—	—	—	—	—	—	—
MD54-07-76024	54-27641	349.0–350.0	Qbo	13.7	—	—	—	—	—	—	—	—
MD54-07-76026	54-27642	179.0–180.0	Qbt 1g	26.5	—	—	—	—	1.56 (U)	—	—	—
MD54-07-76027	54-27642	229.0–230.0	Qbt 1g	15.9	—	—	—	—	1.52 (U)	—	—	—
MD54-07-76045	54-27642	279.0–280.0	Qct	17.9	1410 (J)	—	3.65	—	1.51 (J)	—	6.28 (J)	76 (J)
MD54-07-76046	54-27642	329.0–330.0	Qbo	18.1	—	—	—	—	1.57 (U)	—	—	—
MD54-07-76028	54-27642	376.0–377.0	Qbog	14.7	393	31.1	1.76	527	—	1550	0.921	18
MD54-07-76031	54-27643	154.0–155.0	Qbt 1g	19.4	—	217	—	—	1.57 (U)	—	—	—
MD54-07-76032	54-27643	179.0–180.0	Qbt 1g	23.9	—	—	—	—	1.58 (U)	—	—	—
MD54-07-76033	54-27643	229.0–230.0	Qbt 1g	15.2	—	—	—	—	1.6 (U)	—	—	—
MD54-07-76047	54-27643	279.0–280.0	Qbt 1g	26.6	2130	—	3.75	—	1.62 (U)	—	9.55	—
MD54-07-76048	54-27643	329.0–330.0	Qbt 1g	15.4	781	—	—	—	1.58 (U)	—	—	—
MD54-07-76025	54-27643	369.0–370.0	Qbo	16	2530	218	4.99	—	1.67 (U)	—	5.45	—

Notes: BVs from LANL (1998, 059730); data qualifiers are defined in Appendix A.

[a] BV not available for the unit.

[b] — = Analyte concentration is below the unit BV, or is not detected if a BV is not available for the unit.

Table 4.2-2
VOCs Detected in Core Samples at MDA L (mg/kg)

Sample ID	Location ID	Depth (ft)	Media	Acetone	Methylene Chloride	Toluene	Trichloroethene
MD54-07-76043	54-27641	150.00–150.00	Qbt 1g	0.00622	—*	—	—
MD54-07-76044	54-27641	225.00–230.00	Qbt 1g	0.00909	—	—	—
MD54-07-76022	54-27641	280.00–285.00	Qct	0.0162	—	—	—
MD54-07-76023	54-27641	330.00–335.00	Qbo	0.011 (J)	—	0.016	0.00059 (J)
MD54-07-76024	54-27641	345.00–350.00	Qbo	0.0087 (J)	0.0039 (J)	0.003 (J)	0.00062 (J)
MD54-07-76026	54-27642	180.00–180.00	Qbt 1g	0.00287 (J)	—	—	—
MD54-07-76027	54-27642	230.00–230.00	Qbt 1g	0.00282 (J)	—	—	—
MD54-07-76045	54-27642	280.00–280.00	Qct	0.00353 (J)	—	—	—
MD54-07-76047	54-27643	179.00–180.00	Qbt 1g	—	—	0.00063 (J)	—
MD54-07-76025	54-27643	369.00–370.00	Qbo	—	—	0.00038 (J)	—

*— = Analyte was not detected.

Table 4.2-3
Comparison of VOCs Detected in Pore Gas and Core Samples in New Boreholes at MDA L

Location ID	Core Depth/ Pore-Gas Depth (ft)	Media	VOCs Detected in Core	VOCs Detected in Pore Gas
54-27641	Core depth 149–150 Pore gas depth 180–185	Qbt 1g	Acetone	Acetone Carbon Disulfide Cyclohexane Dichlorodifluoromethane Dichloroethane[1,1-] Dichloroethane[1,2-] Dichloroethene[1,1-] Ethanol Hexane Methylene Chloride Tetrachloroethene Toluene Trichloro-1,2,2-trifluoroethane[1,1,2-] Trichloroethane[1,1,1-] Trichloroethene Trichlorofluoromethane
54-27641	Core depth 229–230 Pore-gas depth 230–235	Qbt 1g	Acetone	Acetone Carbon Disulfide Cyclohexane Dichlorodifluoromethane Dichloroethane[1,1-] Dichloroethane[1,2-] Dichloroethene[1,1-] Methylene Chloride Propanol[2-Propanol[2-] Tetrachloroethene Trichloro-1,2,2-trifluoroethane[1,1,2-] Trichloroethane[1,1,1-] Trichloroethene Trichlorofluoromethane
54-27641	Core depth 284–285 Pore-gas depth 269–273	Qct	Acetone	Carbon Tetrachloride Chloroform Cyclohexane Dichlorodifluoromethane Dichloroethane[1,1-] Dichloroethene[1,1-] Methylene Chloride Tetrachloroethene Trichloro-1,2,2-trifluoroethane[1,1,2-] Trichloroethane[1,1,1-] Trichloroethene Trichlorofluoromethane

Table 4.2-3 (continued)

Location ID	Core Depth/ Pore-Gas Depth (ft)	Media	VOCs Detected in Core	VOCs Detected in Pore Gas
54-27641	Core depth 334–335 Pore-gas depth 330–335	Qbo	Acetone Toluene Trichloroethene	Carbon Tetrachloride Chloroform Cyclohexane Dichlorodifluoromethane Dichloroethane[1,1-] Dichloroethane[1,2-] Dichloroethene[1,1-] Hexane Methylene Chloride Tetrachloroethene Trichloro-1,2,2-trifluoroethane[1,1,2-] Trichloroethane[1,1,1-] Trichloroethene Trichlorofluoromethane
54-27641	Core depth 349–350 Pore-gas depth 330–335	Qbo	Acentone Toluene Trichloroethene Methylene Chloride	Carbon Tetrachloride Chloroform Cyclohexane Dichlorodifluoromethane Dichloroethane[1,1-] Dichloroethane[1,2-] Dichloroethene[1,1-] Hexane Methylene Chloride Tetrachloroethene Trichloro-1,2,2-trifluoroethane[1,1,2-] Trichloroethane[1,1,1-] Trichloroethene Trichlorofluoromethane
54-27642	Core depth 179–180 Pore-gas depth 172.5–177.5	Qbt 1g	Acetone	Acetone Benzene Butanone[2-] Carbon Disulfide Carbon Tetrachloride Chloroform Dichloroethane[1,1-] Dichloroethane[1,2-] Dichloroethene[1,1-] Dichloropropane[1,2-] Hexane Methylene Chloride Tetrachloroethene Toluene Trichloro-1,2,2-trifluoroethane[1,1,2-] Trichloroethane[1,1,1-] Trichloroethene Trichlorofluoromethane Xylene[1,3-]+Xylene[1,4-]

Table 4.2-3 (continued)

Location ID	Core Depth/ Pore-Gas Depth (ft)	Media	VOCs Detected in Core	VOCs Detected in Pore Gas
54-27642	Core depth 229–230 Pore-gas depth 232–237.5	Qbt 1g	Acetone	Benzene Carbon Tetrachloride Chloroform Dichlorodifluoromethane Dichloroethane[1,1-] Dichloroethane[1,2-] Dichloroethene[1,1-] Dichloropropane[1,2-] Hexane Methylene Chloride Tetrachloroethene Toluene Trichloro-1,2,2-trifluoroethane[1,1,2-] Trichloroethane[1,1,1-] Trichloroethene Trichlorofluoromethane
54-27642	Core depth 279–280 Pore-gas depth 277–277.5	Qct	Acetone	Benzene Carbon Tetrachloride Chloroform Dichlorodifluoromethane Dichloroethane[1,1-] Dichloroethene[1,1-] Dichloropropane[1,2-] Hexane Methylene Chloride Tetrachloroethene Toluene Trichloro-1,2,2-trifluoroethane[1,1,2-] Trichloroethane[1,1,1-] Trichloroethene Trichlorofluoromethane
54-27643	Core depth 279–280 Pore-gas depth 272.5–278.5	Qbt 1g	Toluene	Benzene Carbon Tetrachloride Chloroform Cyclohexane Dichlorodifluoromethane Dichloroethane[1,1-] Dichloroethene[1,1-] Dichloropropane[1,2-] Hexane Methylene Chloride Tetrachloroethene Toluene Trichloro-1,2,2-trifluoroethane[1,1,2-] Trichloroethane[1,1,1-] Trichloroethene Trichlorofluoromethane Xylene[1,3-]+Xylene[1,4-]

Table 4.2-3 (continued)

Location ID	Core Depth/ Pore-Gas Depth (ft)	Media	VOCs Detected in Core	VOCs Detected in Pore Gas
54-27643	Core depth 369–370 Pore-gas depth 351–356.5	Qbo	Toluene	Benzene Carbon Tetrachloride Chloroform Dichlorodifluoromethane Dichloroethane[1,1-] Dichloroethene[1,1-] Hexane Methylene Chloride n-Heptane Tetrachloroethene Toluene Trichloro-1,2,2-trifluoroethane[1,1,2-] Trichloroethane[1,1,1-] Trichloroethene Trichlorofluoromethane

Table 4.3-1
VOCs Detected in Pore Gas at MDA L ($\mu g/m^3$)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Butanone[2-]	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Cyclohexane	Dichlorodifluoromethane	Dichloroethane[1,1-]
MD54-07-76465	54-24238	43.00–45.00	—*	—	—	5500	—	57000	66000	—	72000
MD54-07-76190	54-24238	63.00–65.00	—	—	—	—	—	58000	69000	—	68000
MD54-07-76191	54-24238	83.00–85.00	—	—	—	—	—	55000	60000	—	58000
MD54-07-76467	54-24239	24.00–26.00	—	—	—	—	4800	20000	12000	—	16000
MD54-07-76192	54-24239	74.00–76.00	8800	—	—	4400	5300	22000	19000	—	20000
MD54-07-76193	54-24239	98.50–100.50	10000	—	—	4300	—	23000	20000	—	22000
MD54-07-76194	54-24240	27.00–29.00	—	—	—	—	—	—	79000	65000	110000
MD54-07-76463	54-24240	52.00–54.00	18000	—	—	9900	—	11000	19000	7000	31000
MD54-07-76195	54-24240	152.00–154.00	22000	—	6000	6200	—	11000	35000	—	40000
MD54-07-76466	54-24242	24.00–26.00	—	—	—	—	3800	14000	8000	—	11000
MD54-07-76196	54-24242	49.00–51.00	—	—	—	—	—	28000	24000	—	22000
MD54-07-76197	54-24242	109.50–111.50	—	—	—	—	—	28000	24000	—	23000
MD54-07-76468	54-24243	24.00–26.00	—	—	—	—	5100	19000	14000	—	19000
MD54-07-76198	54-24243	49.00–51.00	—	—	—	—	—	33000	30000	—	32000
MD54-07-76232	54-24243	74.00–76.00	22000	—	—	21000	—	32000	32000	—	28000
MD54-07-76199	54-24243	124.00–126.00	14000	3400	—	—	—	34000	26000	—	20000
MD54-07-76469	54-24244	24.00–26.00	—	—	—	—	3800	15000	8500	—	7100
MD54-07-76200	54-24244	74.00–76.00	—	—	—	2300	—	21000	13000	—	10000
MD54-07-76201	54-24244	99.00–101.00	7400	—	—	2200	—	19000	13000	—	10000
MD54-07-76470	54-24244	117.50–119.50	—	—	—	—	—	9500	5300	—	4500

Table 4.3-1 (continued)

Sample ID	Location ID	Depth (ft)	Acetone	Benzene	Butanone[2-]	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Cyclohexane	Dichlorodifluoromethane	Dichloroethane[1,1-]
MD54-07-76202	54-27641	30.00–34.00	47000	—	7900	14000	—	—	38000	9600	81000
MD54-07-76203	54-27641	80.00–84.00	—	—	—	8500	—	—	27000	—	32000
MD54-07-76204	54-27641	110.00–114.00	—	—	—	7300	—	7000	30000	-	34000
MD54-07-76205	54-27641	180.00–185.00	17000	—	—	9100	—	—	19000	5800	17000
MD54-07-76206	54-27641	230.00–235.00	—	—	—	990	—	1900	8100	4000	6400
MD54-07-76207	54-27641	269.00–273.00	—	—	—	—	620	560	2500	1900	1600
MD54-07-76208	54-27641	330.00–335.00	—	—	—	—	170	59	330	460	120
MD54-07-76209	54-27642	27.50–32.50	—	—	—	—	—	31000	—	—	33000
MD54-07-76210	54-27642	72.50–77.50	17000	—	—	11000	—	43000	—	—	26000
MD54-07-76211	54-27642	113.50–118.50	—	—	—	16000	—	44000	—	—	36000
MD54-07-76212	54-27642	172.50–177.50	18000	4900	3800	12000	7900	35000	—	—	12000
MD54-07-76213	54-27642	232.00–237.50	—	2700	—	—	4700	17000	—	3600	5000
MD54-07-76214	54-27642	272.00–277.50	—	1800	—	—	3400	7700	—	2500	2000
MD54-07-76215	54-27642	335.00–341.00	—	540	—	—	1600	1800	—	1500	480
MD54-07-76216	54-27643	27.50–32.50	—	—	—	2000	1700	8600	5800	—	4200
MD54-07-76217	54-27643	71.50–76.50	—	—	—	1700	—	14000	—	—	6800
MD54-07-76218	54-27643	114.50–119.50	—	1500	—	1200	2700	17000	—	—	6900
MD54-07-76219	54-27643	164.00–170.00	—	1900	—	1300	2400	16000	—	2000	5000
MD54-07-76220	54-27643	232.50–237.50	—	1900	—	1300	3200	13000	—	2200	3200
MD54-07-76221	54-27643	272.50–278.50	—	1800	—	—	2700	8000	4200	1800	1800
MD54-07-76236	54-27643	351.00–356.50	—	390	—	—	1100	820	—	1000	200

Table 4.3-1 (continued)

Sample ID	Location ID	Depth (ft)	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloropropane[1,2-]	Ethanol	Hexane	Methylene Chloride	n-Heptane	Propanol[2-]	Tetrachloroethene
MD54-07-76465	54-24238	43.00–45.00	64000	160000	430000	—	—	25000	—	—	92000
MD54-07-76190	54-24238	63.00–65.00	72000	130000	510000	—	—	300000	—	—	60000
MD54-07-76191	54-24238	83.00–85.00	68000	130000	430000	—	—	120000	—	—	56000
MD54-07-76467	54-24239	24.00–26.00	7800	38000	9400	—	—	—	—	—	280000
MD54-07-76192	54-24239	74.00–76.00	14000	54000	12000	—	—	3400	—	—	220000
MD54-07-76193	54-24239	98.50–100.50	15000	58000	9800	—	—	4200	—	19000	220000
MD54-07-76194	54-24240	27.00–29.00	310000	77000	—	—	—	79000	—	—	310000
MD54-07-76463	54-24240	52.00–54.00	84000	54000	—	—	—	42000	—	—	99000
MD54-07-76195	54-24240	152.00–154.00	59000	51000	—	—	—	24000	—	—	68000
MD54-07-76466	54-24242	24.00–26.00	5000	22000	8100	—	—	—	—	—	490000
MD54-07-76196	54-24242	49.00–51.00	20000	54000	14000	—	—	14000	—	—	400000
MD54-07-76197	54-24242	109.50–111.50	23000	54000	14000	—	—	11000	—	—	390000
MD54-07-76468	54-24243	24.00–26.00	4400	29000	38000	—	—	—	—	—	30000
MD54-07-76198	54-24243	49.00–51.00	8700	67000	110000	—	—	—	—	—	31000
MD54-07-76232	54-24243	74.00–76.00	18000	55000	120000	—	12000	29000	—	19000	28000
MD54-07-76199	54-24243	124.00–126.00	34000	70000	60000	—	—	66000	—	68000	32000
MD54-07-76469	54-24244	24.00–26.00	9000	20000	29000	—	—	9000	—	—	28000
MD54-07-76200	54-24244	74.00–76.00	14000	26000	37000	—	—	24000	—	—	18000
MD54-07-76201	54-24244	99.00–101.00	14000	28000	31000	—	—	22000	—	—	16000
MD54-07-76470	54-24244	117.50–119.50	5900	13000	19000	—	—	6000	—	—	18000
MD54-07-76202	54-27641	30.00–34.00	84000	34000	—	15000	6300	120000	—	190000	66000

Table 4.3-1 (continued)

Sample ID	Location ID	Depth (ft)	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloropropane[1,2-]	Ethanol	Hexane	Methylene Chloride	n-Heptane	Propanol[2-]	Tetrachloroethene
MD54-07-76203	54-27641	80.00–84.00	65000	36000	—	—	—	94000	—	—	67000
MD54-07-76204	54-27641	110.00–114.00	65000	46000	—	—	4600	81000	—	—	42000
MD54-07-76205	54-27641	180.00–185.00	11000	40000	—	8000	4300	43000	—	—	87000
MD54-07-76206	54-27641	230.00–235.00	1100	26000	—	—	—	10000	—	3500	7100
MD54-07-76207	54-27641	269.00–273.00	—	13000	—	—	—	1700	—	—	5000
MD54-07-76208	54-27641	330.00–335.00	34	3000	—	—	56	110	—	—	800
MD54-07-76209	54-27642	27.50–32.50	12000 (J+)	81000	89000	—	—	—	—	—	46000
MD54-07-76210	54-27642	72.50–77.50	39000 (J+)	96000	78000	—	—	140000	—	—	36000
MD54-07-76211	54-27642	113.50–118.50	37000 (J+)	96000	130000	—	—	140000	—	—	39000
MD54-07-76212	54-27642	172.50–177.50	19000 (J+)	88000	33000	—	5500	120000	—	—	25000
MD54-07-76213	54-27642	232.00–237.50	2200	71000	6800	—	3400	53000	—	—	10000
MD54-07-76214	54-27642	272.00–277.50	—	48000	2100	—	2400	22000	—	—	7900
MD54-07-76215	54-27642	335.00–341.00	—	21000	—	—	1400	4000	—	—	2400
MD54-07-76216	54-27643	27.50–32.50	2900	9900	15000	—	—	1900	—	2800	11000
MD54-07-76217	54-27643	71.50–76.50	7800	21000	23000	—	—	16000	—	—	14000
MD54-07-76218	54-27643	114.50–119.50	11000	26000	22000	—	—	34000	—	—	13000
MD54-07-76219	54-27643	164.00–170.00	6800	35000	13000	—	1200	46000	—	—	8200
MD54-07-76220	54-27643	232.50–237.50	1700	41000	5000	—	1900	39000	—	—	6200
MD54-07-76221	54-27643	272.50–278.50	—	34000	2100	—	1600	19000	—	—	9400
MD54-07-76236	54-27643	351.00–356.50	—	14000	—	—	1000	1400	150	—	1400

Table 4.3-1 (continued)

Sample ID	Location ID	Depth (ft)	Tetrahydrofuran	Toluene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethene	Trichlorofluoromethane	Xylene[1,3-]+Xylene[1,4-]
MD54-07-76465	54-24238	43.00–45.00	—	—	1000000	3600000	840000	34000	—
MD54-07-76190	54-24238	63.00–65.00	14000	—	820000	3500000	760000	43000	—
MD54-07-76191	54-24238	83.00–85.00	14000	—	700000	3300000	680000	42000	—
MD54-07-76467	54-24239	24.00–26.00	—	—	94000	860000	220000	6500	—
MD54-07-76192	54-24239	74.00–76.00	—	—	110000	1100000	250000	11000	—
MD54-07-76193	54-24239	98.50–100.50	—	4500	120000	1100000	270000	12000	—
MD54-07-76194	54-24240	27.00–29.00	—	—	66000	4900000	740000	—	—
MD54-07-76463	54-24240	52.00–54.00	—	—	36000	1300000	280000	—	—
MD54-07-76195	54-24240	152.00–154.00	—	18000	44000	2000000	350000	—	—
MD54-07-76466	54-24242	24.00–26.00	—	—	61000	560000	190000	4100	—
MD54-07-76196	54-24242	49.00–51.00	—	—	140000	1400000	320000	13000	—
MD54-07-76197	54-24242	109.50–111.50	—	—	130000	1300000	340000	12000	—
MD54-07-76468	54-24243	24.00–26.00	—	—	280000	1000000	230000	10000	—
MD54-07-76198	54-24243	49.00–51.00	—	—	440000	1700000	400000	20000	—
MD54-07-76232	54-24243	74.00–76.00	—	—	360000	1700000	360000	22000	—
MD54-07-76199	54-24243	124.00–126.00	—	4800	270000	1500000	330000	32000	—
MD54-07-76469	54-24244	24.00–26.00	8200	2900	98000	620000	110000	14000	—
MD54-07-76200	54-24244	74.00–76.00	33000	3900	120000	760000	120000	22000	—
MD54-07-76201	54-24244	99.00–101.00	18000	4500	130000	730000	120000	26000	—
MD54-07-76470	54-24244	117.50–119.50	6800	2200	62000	390000	71000	8800	—
MD54-07-76202	54-27641	30.00–34.00	—	11000	35000	2100000	290000	—	—

Table 4.3-1 (continued)

Sample ID	Location ID	Depth (ft)	Tetrahydrofuran	Toluene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethene	Trichlorofluoromethane	Xylene[1,3-]+Xylene[1,4-]
MD54-07-76203	54-27641	80.00–84.00	—	5300	24000	1300000	170000	—	—
MD54-07-76204	54-27641	110.00–114.00	—	—	30000	1600000	220000	—	—
MD54-07-76205	54-27641	180.00–185.00	—	3700	28000	990000	160000	6200	—
MD54-07-76206	54-27641	230.00–235.00	—	—	23000	420000	79000	4500	—
MD54-07-76207	54-27641	269.00–273.00	—	—	14000	120000	31000	2400	—
MD54-07-76208	54-27641	330.00–335.00	—	—	5000	14000	4500	940	—
MD54-07-76209	54-27642	27.50–32.50	—	—	270000	2300000	280000	18000	—
MD54-07-76210	54-27642	72.50–77.50	15000	21000	340000	2000000	350000	52000	—
MD54-07-76211	54-27642	113.50–118.50	24000	—	440000	2600000	370000	40000	—
MD54-07-76212	54-27642	172.50–177.50	—	30000	270000	1200000	280000	49000	5600
MD54-07-76213	54-27642	232.00–237.50	—	16000	230000	580000	140000	31000	—
MD54-07-76214	54-27642	272.00–277.50	—	11000	97000	260000	95000	14000	—
MD54-07-76215	54-27642	335.00–341.00	—	2400	43000	82000	31000	5600	—
MD54-07-76216	54-27643	27.50–32.50	—	—	53000	320000	55000	8500	—
MD54-07-76217	54-27643	71.50–76.50	12000	2000	93000	500000	87000	15000	—
MD54-07-76218	54-27643	114.50–119.50	2800	6100	120000	570000	100000	21000	—
MD54-07-76219	54-27643	164.00–170.00	—	9700	140000	450000	91000	22000	—
MD54-07-76220	54-27643	232.50–237.50	—	10000	150000	340000	84000	19000	—
MD54-07-76221	54-27643	272.50–278.50	—	13000	100000	230000	81000	12000	1100
MD54-07-76236	54-27643	351.00–356.50	—	1200	35000	45000	16000	3700	—

*— = Analyte was not detected.

Table 4.3-2
Tritium Pore-Gas Results from New Boreholes at MDA L

Borehole ID	Sample Interval Depth (ft)	Sample ID	Result (pCi/L)
54-27641	30–34	MD54-07-76438	18200
54-27641	80–84	MD54-07-76439	10980
54-27641	110–114	MD54-07-76440	ND*
54-27641	180–185	MD54-07-76441	ND
54-27641	230–235	MD54-07-76442	ND
54-27641	269–273	MD54-07-76443	ND
54-27641	330–335	MD54-07-76444	4170
54-27642	27.5–32.5	MD54-07-76445	1320
54-27642	72.5–77.5	MD54-07-76446	4960
54-27642	113.5–118.5	MD54-07-76447	8420
54-27642	172.5–177	MD54-07-76448	570
54-27642	232–237.5	MD54-07-76449	1340
54-27642	272–277.5	MD54-07-76450	370
54-27642	335–341	MD54-07-76452	ND
54-27643	27.5–32.5	MD54-07-76453	ND
54-27643	71.5–76.5	MD54-07-76454	470
54-27643	114.5–119.5	MD54-07-76455	510
54-27643	164–170	MD54-07-76456	540
54-27643	232.5–237.5	MD54-07-76458	440
54-27643	272.5–278.5	MD54-07-76459	510
54-27643	351–356.5	MD54-07-76460	630

*ND = Not detected.