LA-UR-07-2582
May 2007
EP2007-0215

Addendum to the Investigation Report for Material Disposal Area G, Consolidated Unit 54-013(b)-99, at Technical Area 54

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NATIONAL LABORATORY
EST.1943

Prepared by the Environmental Programs Directorate

LA-UR-07-2582
EP2007-0215

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May 2007

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EXECUTIVE SUMMARY

This addendum to the Material Disposal Area (MDA) G investigation report describes the results of supplemental drilling and sampling activities required to complete the site investigation of MDA G, Consolidated Unit 54-013(b)-99, located within Area G of Technical Area 54 at Los Alamos National Laboratory (the Laboratory).

In September 2005, the Laboratory submitted the investigation report for MDA G to the New Mexico Environment Department (NMED). The Laboratory subsequently received two notices of disapproval (NODs) from NMED in response to the 2005 investigation activities and analytical results. These NODs assert that the 2005 investigation did not determine the vertical extent of vapor-phase volatile organic compound (VOC) contamination in four distinct zones. The NODs required that the Laboratory install four additional boreholes or extend four existing boreholes to greater depths to determine the vertical extent of VOC contamination. NMED concurred with the Laboratory's proposed approach to extend existing boreholes (BH) (BH-2 [location 54-24361], BH-10 [location 54-24370], BH-26 [location 54-24386], and BH-34 [location 54-24394]) to a total depth at which the vertical extent of VOC contamination can be defined. An existing borehole (BH-37) near existing borehole location 54-01111 was also extended to determine the vertical profile of tritium concentrations in the vapor phase at this location.

The results of pore-gas sampling analyses from boreholes extended into the basalt confirm the results of the Phase I Resource Conservation and Recovery Act facility investigation, previous quarterly monitoring, and the 2005 site investigation. The highest VOC concentrations are beneath the eastern portions of MDA G. Vertically, VOC concentrations are highest in the Tshirege Member of the Bandelier Tuff and decrease markedly in the underlying stratigraphic units. VOC concentrations are lowest in the deepest unit sampled, the Cerros del Rio basalt. The dominant subsurface VOC vapor contaminant is 1,1,1-trichloroethane in the eastern and central portions of MDA G, while in the western portions of MDA G trichloroethene is more dominant. Tritium is detected in BH-37 (location 54-24397), near borehole location 54-01111, with concentrations that peak at 50 ft below ground surface (bgs) near the base of the nearby tritium shafts at 60 ft bgs. The concentrations decrease as the sampling depth increases to 239.75 ft bgs. The vertical extent of contamination is determined for both VOCs and tritium.

Additional data are not needed to characterize the nature and extent of contaminant releases at MDA G. The vertical distribution of VOC and tritium concentrations indicates no current threat of groundwater contamination from these constituents, but future pore-gas monitoring is appropriate. The pore-gas sampling data indicate that the existing subsurface vapor-monitoring network is adequate to track contaminants in pore gas. The forthcoming corrective measures report will present a long-term monitoring plan for future pore-gas monitoring at MDA G.

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1.0 INTRODUCTION

In September 2005, Los Alamos National Laboratory (the Laboratory or LANL) submitted the "Investigation Report for Material Disposal Area G, Consolidated Unit 54-013(b)-99, at Technical Area 54" (LANL 2005, 090513) to the New Mexico Environment Department (NMED). On July 26, 2006, the Laboratory received a notice of disapproval (NOD) (NMED 2006, 093385) that directed the Laboratory to complete additional investigation activities to determine the vertical extent of vapor-phase volatile organic compound (VOC) contamination in the eastern and northern portions of Material Disposal Area (MDA) G in Technical Area (TA) 54 (Figure 1.0-1). Following a review of the July 2006 "Periodic Monitoring Report for Vapor Sampling Activities at Technical Area 54, Material Disposal Area G" (LANL 2006, 093269), NMED issued a supplement to the NOD on August 11, 2006 (NMED 2006, 093754). The supplemental NOD revised the additional investigation requirements and stipulated extending four existing boreholes (BH-2 [location 54-24361], BH-10 [location 54-24370], and BH-26 [location 54-24386] and BH-34 [location 54-24394]). One borehole (BH-37) located near existing borehole location 54-01111 was also extended to monitor vapor-phase concentrations of tritium (Figure 1.0-2).

This addendum to the investigation report summarizes the results of additional investigation activities conducted in February and March 2007 in response to the supplemental NOD to determine the vertical extent of vapor-phase VOCs and tritium at MDA G. These activities included extending existing boreholes (BH-10, BH-26, BH-34, and BH-37), installing a new borehole (BH-2b) near existing BH-2, and constructing each borehole for pore-gas monitoring. Field-screening and laboratory analytical results of VOC and tritium pore-gas samples collected during this supplemental investigation are provided and discussed in this addendum.

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

1.1 Purpose

The pore-gas results presented in the September 2005 investigation report (LANL 2005, 090513) and the July 2006 periodic monitoring report (LANL 2006, 093269) indicated an overall decrease of VOC concentrations with depth (i.e., the lowest concentrations were detected in the deepest sample collected in the Cerros del Rio basalt). However, VOC concentrations increased with depth in some shallower boreholes completed in the Tshirege Member of the Bandelier Tuff. Also, no pore-gas samples had been collected from the Cerro Toledo interval or the Otowi Member, which are between the Tshirege Member and the Cerros del Rio basalt. Therefore, additional data were needed on the overall vertical distribution of VOCs in the stratigraphic units underlying MDA G. These data are important for evaluating the potential for contamination of groundwater by VOC vapors.

Pore-gas results in the vapor-monitoring report also indicate tritium concentrations increase with depth in borehole location 54-01111; The August 11, 2006, supplement to the NOD (NMED 2006, 093754) recommended that an additional borehole be installed near borehole location 54-01111 to determine the vertical profile of vapor-phase tritium. To meet this need, a nearby existing borehole (BH-37, location 54-24397) was advanced and constructed to monitor vapor-phase tritium concentrations in support of the Area G performance assessment (Hollis et al. 1997, 063131).

1.2 Site Description

MDA G [Consolidated Unit 54-013(b)-99] is located at TA-54, Area G, on a mesa in the east-central portion of the Laboratory (Figure 1.0-1). TA-54 has been the main waste storage and disposal facility for the Laboratory since the 1950s. Area G is a 65-acre fenced area containing both surface and subsurface waste management units.

MDA G consists of inactive subsurface disposal units within Area G and includes 32 pits, 194 shafts, and 4 trenches (Figure 1.2-1), with depths ranging from 10 to 65 ft below the original ground surface. Historically, MDA G was used for the disposal of low-level radioactive waste (LLW) and transuranic (TRU) radioactive waste, certain radioactively contaminated infectious waste, asbestos-contaminated material, polychlorinated biphenyls (PCBs), and the retrievable storage of TRU waste. Disposal of LLW waste continues at Area G. The operational history of MDA G is summarized in the approved Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan for Operable Unit (OU) 1148 (LANL 1992, 007669, pp. 5-179-5-200) and in the historical investigation report of the approved investigation work plan for MDA G (LANL 2004, 087833, Appendix B).

Most of Area G consists of asphalt-paved roads and storage areas, graded roads, buildings, utilities, stormwater drainages, shaft caps, and vegetated pit and trench covers. The topography at Area G is relatively flat and narrow, with steep sides draining into Cañada del Buey to the north and Pajarito Canyon to the south. The geology underlying MDA G generally consists of Bandelier Tuff formations to a depth of approximately 200 ft, with Cerros del Rio basalts at greater depths. The regional aquifer is estimated to be at an average depth of approximately 900 ft below ground surface (bgs) at Area G, 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 proposed in the NMED-approved “Work Plan for Supplemental Sampling at Material Area G, Consolidated Unit 54-013(b)-99” (LANL 2006, 094803). These activities were conducted in response to the July 26, 2006, NOD (NMED 2006, 093385), and the August 4, 2006, supplemental NOD (NMED 2006, 093754).

Activities completed during this supplemental investigation include

- advancing four existing boreholes: BH-10, BH-26, BH-34, and BH-37;
- installing a new borehole (designated BH-2b) in the immediate vicinity of existing borehole BH-2;
- constructing and instrumenting BH-2b and extending and instrumenting BH-10, BH-26, BH-34, and BH-37 for vapor monitoring;
- measuring pore gas for VOCs, oxygen, carbon dioxide, and moisture using field instrumentation;
- collecting pore-gas samples for analyzing VOCs (BH-2b, BH-10, BH-26, and BH-34) and tritium (BH-37); and
- managing investigation-derived wastes (IDW).

The results of field screening and pore-gas sampling analyses were used to evaluate the vertical extent of VOCs and tritium in the boreholes sampled at MDA G, discussed further in sections 4.0 and 5.0 of this addendum.

Supplemental field investigation activities began on January 5, 2007, and were completed on March 1, 2007. All activities were conducted in accordance with the applicable Environmental Protection (EP) standard operating procedures (SOPs), quality procedures (QPs), Laboratory implementation requirements (LIRs), Laboratory implementation guidances (LIGs), and Laboratory performance requirements (LPRs) summarized in the supplemental work plan (LANL 2006, 094803).

Deviations from the Approved Supplemental Work Plan

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

- The supplemental work plan proposed using a photoionization detector (PID) and a Brüel and Kjaer (B&K) monitor to screen for VOC vapors as the boreholes were advanced to determine the total depth of each borehole. The boreholes were to be advanced to a depth where TCE and PCE concentrations measured in the field were below half of the lower calculated partitioning limits (2200 and 3800 $\mu g/m^3$, or 0.41 and 0.56 parts per million by volume [ppmv], respectively), or until basalt was encountered. Rather than screen for TCE and PCE concentration limits during drilling, each borehole was advanced 13 to 21.5 ft into the basalt. Consequently, field screening of VOC vapors was not conducted until after the sampling ports were emplaced.
- The supplemental work plan proposed extending BH-2 (location 54-24361). Because of operational constraints at TA-54, this borehole could not be advanced, and a new borehole (BH-2b, location 54-27436) was constructed 8.5 ft north of BH-2.
- The supplemental work plan proposed that each borehole have sample ports in the Qct, Qbo, and Tb 4 units. The sample port was placed at 163 ft bgs because BH-2b straddles both the Qct and Qbo units. At this location, units Qct and Qbo are not sufficiently thick to emplace individual ports.
- Although not discussed in the supplemental work plan, BH-37 was extended and constructed for pore-gas monitoring of tritium. Six samples were collected from BH-37 and submitted for laboratory analysis of tritium.

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, 087833) 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 discrete set of 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. Additionally, air sampling was conducted for the presence of silica and radiological samples were collected 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, 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

The locations of the five boreholes addressed in this addendum are shown in Figure 1.0-2. The four preexisting boreholes (BH-10, BH-26, BH-34, and BH-37) were installed in 2005 using a $7^5/_8$-in.-outside-diameter (O.D.) hollow-stem auger (HAS). In 2005, the boreholes were advanced vertically, ranging in depth from 186 ft to 225 ft, and were completed with 10-in.-inside-diameter (I.D.) steel surface casing to depths of approximately 10 ft to 20 ft. These boreholes were extended for this investigation 13 ft to 21.5 ft into the Cerros del Rio basalt, resulting in total depths ranging from 201 ft to 306.5 ft. A new borehole (designated BH-2b) was installed 8.5 ft north of existing BH-2, 21.5 ft into the basalt, with a final depth of 191.5 ft, and completed with nominal 10-in.-diameter steel surface casing. As-built construction diagrams for the completed borehole configurations are shown in Figures 2.2-1 through 2.2-5. The total depths and depth-to-basalt for each borehole are summarized in Table 2.2-1.

The new borehole was started with a large-diameter auger sufficient in size to provide a minimum borehole annulus of 2 in. for emplacing grout around a nominal 10-in. surface casing. The surface casing was installed to guide drilling and to facilitate installing a surface completion for long-term monitoring. The new and existing boreholes were advanced using a $7^5/_8$-in.-O.D. HSA; once basalt was encountered, a $3^7/_8$-in.-O.D. HSA was used to extend the boreholes into the basalt. Before drilling, the four existing boreholes each contained an approximate volume of slough material equal to 20% of the predrilled depth.

2.3 Vapor Screening

Because all boreholes sampled as part of this investigation were predetermined to be advanced 13 to 21.5 ft into the basalt, field screening of VOC vapor to determine total depths was not conducted during drilling. Following drilling and borehole construction activities, soil vapor from each instrumented interval was field screened for (1) VOCs using a B&K Type 1302 photoacoustic gas analyzer, (2) carbon dioxide and oxygen using a Landtec GEM-500, and (3) differential pressure using a Dwyer Series 475 Mark III Digital manometer. The results of vapor-phase field analyses are presented in Appendix B.

2.4 Pore-Gas Completions

Each borehole was constructed to monitor pore gas once it was advanced to the prescribed depth within the basalt. The final configuration of each borehole is illustrated in the as-built diagrams (Figures 2.2-1 through 2.2-5). Each completed borehole contains sample ports constructed with ¼-in. stainless-steel tubing installed at approximately 40-ft intervals, within the lithologies specified in the approved supplemental work plan (LANL 2006, 094803). Any deviations from these intervals resulting in the need to accommodate correlations between sampling depths and lithologies, are illustrated in the as-built diagrams. Final sample depths and corresponding lithologic formations are summarized in Table 2.4-1.

The downhole ports were each completed in a 5 to 11.5-ft zone of sand filter pack. Each filter-pack interval was sealed and separated by a layer of bentonite. All materials were tremied down the borehole to ensure adequate completion of the downhole ports. A second tremie pipe was used to deploy the stainless-steel tubing and prevent snagging of the tube couplings on the I.D. of the augers, retracting as necessary to emplace sand and bentonite intervals. Final sample intervals and corresponding lithologic formations are summarized in Table 2.4-2.

BH-2b, BH-10, BH-26, and BH-37 are located in high-traffic areas and were completed with flush-mounted vaults, while BH-34 was completed with a nominal 2-ft casing stick up.

2.5 Subsurface Vapor Sampling

Pore-gas samples were collected from each vapor-sampling port installed within BH-2b, BH-10, BH-26, and BH-34 and submitted for laboratory analysis of VOCs. VOC pore-gas samples were collected in SUMMA canisters, according to SOP-06.31, Sampling of Subatmospheric Air, and submitted for analysis using U.S. Environmental Protection Agency (EPA) Method TO-15. Pore-gas samples were collected from each vapor sampling port in BH-37 using silica gel cartridges and submitted for laboratory analysis of tritium using EPA Methods 114 and 906.0. Sampling-port intervals for each borehole are presented in Table 2.4-2 and shown in the borehole logs and as-built diagrams (Figures 2.2-1 through 2.2-5).

Quality assurance (QA)/quality control (QC) samples for VOCs in pore gas consisted of an equipment blank or field blank and a field duplicate. The equipment blanks for VOCs were collected after sampling and subsequent purge decontamination to detect potential cross-contamination. The field blank for tritium was collected by sampling atmospheric air during pore-gas moisture sampling. The field duplicate samples were collected during VOC and tritium sampling to indicate the precision of collection and analysis.

2.6 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 H of the approved MDA G work plan (LANL 2004, 087833). The management of IDW is described in Appendix F.

3.0 FIELD INVESTIGATION RESULTS

Supplemental field investigation activities at MDA G began on January 5, 2007, and were completed on March 1, 2007. Four existing boreholes (BH-10, BH-26, BH-34, and BH-37) were extended into the underlying basalt. A new borehole (BH-2b) was installed 8.5 ft north of BH-2 and advanced into the basalt. Each borehole was constructed for pore-gas monitoring. Pore-gas samples were collected from each borehole to determine the vertical extent of vapor-phase VOC and tritium contamination within the subsurface of MDA G.

3.1 Surface Conditions

The surface of Area G is regularly modified to accommodate ongoing waste storage and management operations. A very limited portion of the area can be considered undisturbed with respect to vegetation, erosional features, and soil formation. Most of Area G consists of asphalt-paved roads and storage areas, graded roads, buildings, utilities, stormwater drainages, shaft caps, and vegetated pit and trench covers.

BH-2b, BH-10, BH-26, and BH-37 are located in high-traffic areas covered with a mix of asphalt or road-base material, while BH-34 is located in an area with controlled access to vehicle traffic.

3.2 Subsurface Conditions

A detailed description of the stratigraphy beneath MDA G was presented in the approved investigation work plan (LANL 2004, 087833) and in the investigation report (LANL 2005, 090513). Supplemental investigation activities confirmed that the general stratigraphy beneath MDA G is consistent with what was encountered during previous drilling at MDA G and with the regional geology described by Broxton and Reneau (1995, 049726).

3.2.1 Borehole Extension and Installation

From January 5 to February 23, 2007, four existing boreholes (BH-10, BH-26, BH-34, and BH-37) were extended from 13 ft to 21.5 ft into the Cerros del Rio basalt, resulting in total depths of 249.5 ft, 201 ft, 306.5 ft, and 244.3 ft, respectively. New borehole BH-2b was extended 21.5 ft into the Cerros del Rio basalt to a total depth of 191.5 ft. Total depths and depth-to-basalt for each borehole are summarized in Table 2.2-1 and shown in the borehole logs and as-built diagrams (Figures 2.2-1 through 2.2-5).

All boreholes were advanced using a combination of $7^5/_8$-in.-O.D. HSA and once basalt was encountered, $3^7/_8$-in.-O.D. HSA. Drilling operations were conducted according to SOP-04.01, Drilling Methods and Drill Site Management. Core material was visually inspected by a trained geologist to ensure that appropriate depths were achieved.

VOC vapor-monitoring and gross-radiation screening were conducted for health and safety purposes 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 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 collected for oxygen, carbon dioxide, water vapor, 1,1,1-trichloroethane (TCA), TCE, PCE, and trichlorofluoromethane (Freon-11). These gasses were monitored using a B&K Type 1302 multigas monitor and a Landtec GEM-500. Laboratory analytical samples were collected only after measurements for both instruments had stabilized. Calibration of all instruments used during field-screening was verified daily following the manufacturer's specifications. A total of 22 subsurface pore-gas samples were collected for VOC analyses from BH-2b, BH-10, BH-26, and BH-34. The sampling depths and corresponding lithologic formations are summarized in Table 2.4-1. The samples were collected in SUMMA canisters and submitted to the Laboratory's Sample Management Office (SMO) for subsequent analysis at Air Toxics, Ltd., a commercial contract laboratory in Folsom, CA. Each sample was analyzed for VOCs according to EPA Method TO-15.

QA/QC samples for VOCs in pore gas consisted of three equipment blanks and four field duplicates for the 22 total sampling ports in the four boreholes. After sampling and purge decontamination were completed, the equipment blanks were collected by pulling zero gas (99.9% ultrahigh-purity nitrogen) through the sampling tubing into SUMMA canisters. These samples were used to evaluate the sampling equipment decontamination procedures. The field duplicate samples were collected to evaluate the reproducibility of the sampling technique. QA/QC samples were collected once during each sampling event in accordance with SOP-01.05, Field Quality Control Samples.

A total of six subsurface pore-gas samples were collected for tritium analysis from BH-37. 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 Subatomospheric 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. One tritium field duplicate and one field blank were collected during vapor sampling.

4.0 SITE CONTAMINATION

The purpose of the supplemental investigation activities was to obtain the data needed to complete the evaluation of the nature and extent of subsurface VOC and tritium pore-gas contamination related to historical waste disposal activities at MDA G. This section presents the analytical results for subsurface vapor sampling conducted in newly extended and the installed boreholes at MDA G.

Disposal records compiled in the OU 1148 data report (IT Corporation 1992, 023247) do not contain records of organic liquid disposal at MDA G. VOCs found to be present at MDA G originated from solid decontamination and decommissioning (D&D) materials, solid chemical and laboratory wastes, and contaminated soils that contained various amounts and types of VOCs. BH-26 (location 54-24386) is located between Pits 4 and 5, which were in operation between 1966 and 1974, and is also associated with Pits 1, 2 and 3, which were in operation from 1959 to 1966. Disposal records indicate that all five pits were used to dispose of D&D materials, graphite, wooden boxes, drums, and depleted uranium. BH-2b (location 54-27436) is located near Pit 6, which was in operation from 1970 to 1972 and was used to dispose of D&D materials, wood, and miscellaneous scrap. BH-37 (location 54-24397) is located near active tritium disposal shafts. BH-10 (location 54-24370) is located between Pits 29 and 30, which were in operation from 1984 to 1992 and were used to dispose of D&D materials, chemical waste, asbestos, PCBs, laboratory waste, glove boxes, wooden boxes, and contaminated soil. BH-34 (location 54-24394) is located near Pits 32 and 33, which were in operation from 1982 to 1987 and were used to dispose of D&D materials, PCBs, asphalt, transformers, contaminated soil, glove boxes, plywood boxes, capacitors, asbestos, beryllium stored in stainless steel, laboratory waste, and chemical wastes.

4.1 Subsurface Vapor-Sampling Analytical Results

Twenty-two pore-gas samples were collected for VOC analysis from BH-2b, BH-10, BH-26, and BH-34. Six pore-gas samples were collected for tritium analysis from BH-37. Laboratory analytical results for the 22 VOC samples and 6 tritium samples are reported in Tables 4.1-1 and 4.1-2, respectively. The locations and concentrations of VOCs and tritium detected in the vapor samples are also shown in Figure 4.1-1.

A total of 18 VOCs were detected at least once in each of the 22 samples submitted for VOC analysis. Table 4.1-1 lists the VOCs detected in pore gas by borehole. Six VOC compounds—TCA; 1,1-dichloroethane (DCA); 1,1-dichloroethene (DCE); TCE; PCE; and 1,1,2-trichloro-1,2,2-trifluoroethane (Freon-113)—were detected in each of the 22 samples analyzed. With one exception, PCE concentrations were lower than TCA and TCE in every sample. The lowest concentrations of PCE were detected in BH-34 (location 54-24394) at the west end of MDA G. Concentrations of PCE in BH-2b (location 54-27436) and BH-26 (location 54-24386) were similar and somewhat higher than the concentrations in BH-10 (location 54-24370).

TCA is the predominant VOC detected in the eastern and central areas of MDA G. The concentrations of TCA ranged from 880 $\mu g/m^3$ to 790,000 $\mu g/m^3$. The highest TCA concentrations were detected in BH-26 (location 54-24386) at a depth of 40 ft in the eastern portion of the site in the vicinity of Pits 1, 2, 3, 4, and 5 and the nearby shaft field. TCE is the predominant VOC detected in the western areas of MDA G. The concentrations of TCE across MDA G ranged from 290 $\mu g/m^3$ to 190,000 $\mu g/m^3$. The highest TCE concentrations were detected in BH-34 (location 54-24394) at a depth of 45 ft in the vicinity of Pits 32 and 33.

Overall, the results of the VOC pore-gas sampling show a decrease in concentration with depth. For the six VOCs detected in every sample, the lowest concentration in each borehole was detected in the sample collected from the Cerros del Rio basalt (Tb 4). In all cases, the next highest concentration was detected in the sample collected from either the Cerro Toledo interval (Qct) or the Otowi Member (Qbo). The concentrations detected in the Tshirege Member (Qbt) generally decrease with depth, although the lowest concentration may not be detected in the deepest sample from Qbt. Concentrations detected in the samples from Qbt are much higher than the concentrations detected in samples from Tb 4. Thus, the overall trend is a decrease in concentrations vertically from Qbt to Qct and Qbo and then to Tb 4.

Tritium was detected in each of the six samples collected from BH-37 (location 54-24397) adjacent to the tritium disposal shafts. Tritium concentrations ranged from 4,480,000 pCi/L at the shallowest sample collected at 50 ft bgs, close to the depth of the disposal shafts, to 1750 pCi/L at the deepest sample collected at 239.75 ft bgs in the basalt. Tritium concentrations decrease with depth in BH-37. The distribution of tritium concentrations in samples from the various stratigraphic units is the same as for the VOCs.

Based on a review of the additional data collected in 2007, no changes to the conclusions of the present-day risk assessment are warranted.

The pore-gas data collected from depths of 45 ft or more below the ground surface support the risk assessment results presented in the original MDA G 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 G. The potential risk from the inhalation of ambient air VOCs, as presented in the TA-54 RFI report (LANL 2000, 064360), was excluded from the risk assessments conducted in the MDA G investigation report because no additional ambient-air VOC data are available. Ambient-air VOCs at MDA G have not been monitored since the 1994 sampling event. Because the risk from exposure of a worker to VOCs in ambient air was below the applicable target levels (hazard index of 1.0 and total excess cancer risk of 1×10^{-5}) (LANL 2000, 064360), the assessment results were not presented again in the MDA G investigation report.

5.0 CONCLUSIONS

Earlier investigations of VOCs in pore gas showed higher concentrations of VOCs in samples collected from the deeper of two sampling ports in BH-18 (location 54-24378), BH-19 (location 54-24379), BH-25 (location 54-24385), and BH-26 (location 54-24386) in the eastern portion of MDA G near Pits 1, 2, 3, 4, and 5 and nearby disposal shafts. Samples collected from BH-26 (location 54-24386), extended in 2007 to 201 ft bgs, complete the definition of nature and extent of VOCs in the vertical direction in the eastern portion of MDA G. Pore-gas sample results from this borehole location (Table 4.1-1) indicated that maximum concentrations of carbon disulfide (2100 $\mu g/m^3$), DCA (36,000 $\mu g/m^3$), PCE (6500 $\mu g/m^3$), Freon-113 (4700 $\mu g/m^3$), and TCA (790,000 $\mu g/m^3$) were detected at 40 ft in unit Qbt 2, while maximum concentrations of acetone (2600 $\mu g/m^3$), DCE (56,000 $\mu g/m^3$), toluene (4700 $\mu g/m^3$), and TCE (8300 $\mu g/m^3$) were detected at 117 ft bgs in unit Qct. Concentrations of each VOC detected markedly decreased in the Qbo unit of tuff and decreased further in the Tb 4 unit of basalt at 195 ft bgs, where the lowest concentration of each VOC, acetone (not detected [ND]), carbon disulfide (ND), DCA (1900 $\mu g/m^3$), DCE (3400 $\mu g/m^3$), PCE (440 $\mu g/m^3$), toluene (ND), Freon-113 (200 $\mu g/m^3$), TCA (23000 $\mu g/m^3$), and TCE (600 $\mu g/m^3$) in BH-26 was detected.

Earlier investigations of VOCs in pore gas showed four areas of higher TCE concentrations in BH-2 (location 54-24361), BH-10 (location 54-24370), BH-26 (location 54-24386), discussed above, and BH-34 (location 54-24394), surrounded by areas with lower TCE concentrations and two areas with higher PCE concentrations at BH-15-1 (location 54-24375) and BH-26 (location 54-24386), discussed above, surrounded by areas with lower PCE concentrations. Samples collected during this supplemental investigation complete the definition of nature and extent of VOCs in the vertical direction throughout MDA G. Pore-gas sampling results from BH-2b (location 54-27436) indicated that maximum concentrations of TCE (190,000 $\mu g/m^3$) and PCE (10,000 $\mu g/m^3$) were detected at 45 ft bgs in unit Qbt 2. Pore-gas sample results from BH-34 (location 54-24394) indicated that maximum concentrations of TCE (83,000 $\mu g/m^3$) and PCE (540 $\mu g/m^3$) were detected at 50 ft bgs in unit Qbt 2. Pore-gas sampling results from BH-10 (location 54-24370) indicated that maximum concentrations of TCE (26,000 $\mu g/m^3$) and PCE (2100 $\mu g/m^3$) were detected at 72.5 ft bgs in unit Qbt1v. The concentration of TCE and PCE decreased as sampling depths increased, until minimum concentrations were reached at the maximum sampling depth. Pore-gas sampling results from BH-2b (location 54-27436) indicated minimum concentrations of TCE (1800 $\mu g/m^3$) and PCE (160 $\mu g/m^3$) were detected at 185 ft bgs in unit Tb 4. Pore-gas sampling results from BH-10 (location 54-24370) indicated that minimum concentrations of TCE (560 $\mu g/m^3$) and PCE (120 $\mu g/m^3$) were detected at 243.7 ft bgs in unit Tb 4. Pore-gas sample results from BH-34 (location 54-24394) indicated that minimum concentrations of TCE (290 $\mu g/m^3$) and PCE (45 $\mu g/m^3$) were detected at 300.5 ft bgs in unit Tb 4.

The concentrations of VOCs in pore-gas samples from the Tb 4 were screened to evaluate the potential for groundwater contamination. The results of this screening are presented in Table E-3.2-1 in Appendix E and indicate that the detected concentrations do not currently pose a threat of groundwater contamination. Based on the concentrations detected, continued pore-gas monitoring in the deeper stratigraphic units is appropriate. A proposed long-term pore-gas monitoring plan for MDA G will be presented in the corrective measures evaluation report for MDA G, as specified in Comment 7 of the July 26, 2006, NOD (NMED 2006, 093385).

Based on the distribution of VOC concentrations with depth, the vertical extent of contamination appears to be affected by stratigraphy. Samples collected from the Qbt near source areas may initially increase with depth but will decrease with depth in lower stratigraphic units. As a result, evaluation of vertical extent should be based on data collected from multiple stratigraphic units, including the Qbt, Qct, Qbo, and Tb 4 and should not be based solely on data from the Qbt unit. The apparent increase in concentration with depth in the near surface unit may result from the nature of the releases (i.e., at depth), and the potential for VOC losses near the surface may be the result of diffusion to the atmosphere.

An evaluation of tritium detected collected from BH-37 (location 54-24397) near the 60-ft-deep tritium disposal shafts indicates that tritium activities are greatest at 50 ft, then decrease with increasing depths. Tritium-activity levels fall off markedly in the sample collected from unit Tb 4 at 239.75 ft bgs. Tritium concentrations are consistent with earlier investigations and decrease with depth. The nature and extent of tritium contamination is defined. The concentration of tritium detected in pore-water collected from the Tb 4 is 1750 pCi/L. This value is less than 10% of the maximum contaminant level for drinking water. Thus, tritium in pore water does not currently pose a threat of groundwater contamination. As with VOCs, however, continued monitoring of tritium is appropriate.

6.0 REFERENCES AND MAP DATA SOURCES

6.1 References

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID 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.

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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.	Fig. 1.0-2. Fig. 1.2-1. Fig. 4.1-1.
Hypsography, 20 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.	Fig. 1.0-2. Fig. 1.2-1. Fig. 4.1-1.
Hypsography, 100 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.	Fig. 1.0-2. Fig. 1.2-1. Fig. 4.1-1.
LANL Occupation and Exterior Perimeter of DOE Land; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 21 December 2006.	Fig. 1.0-1.
LANL Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 21 December 2006.	Fig. 1.0-1.
Materials Disposal Areas; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; ER2004-0221; 1:2,500 Scale Data; 23 April 2004.	Fig. 1.0-1. Fig. 1.0-2. Fig. 1.2-1. Fig. 4.1-1.
Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 27 April 2007.	Fig. 1.0-1. Fig. 1.0-2. Fig. 1.2-1. Fig. 4.1-1.

Data Source	Figures
Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, Environment and Remediation Support Services Division, EP2007-0255; 13 April 2007.	Fig. 1.0-2. Fig. 4.1-1.
Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 27 April 2007.	Fig. 1.0-2. Fig. 1.2-1. Fig. 4.1-1.
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.	Fig. 1.0-2. Fig. 1.2-1. Fig. 4.1-1.
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.	Fig. 1.0-2. Fig. 1.2-1. Fig. 4.1-1.

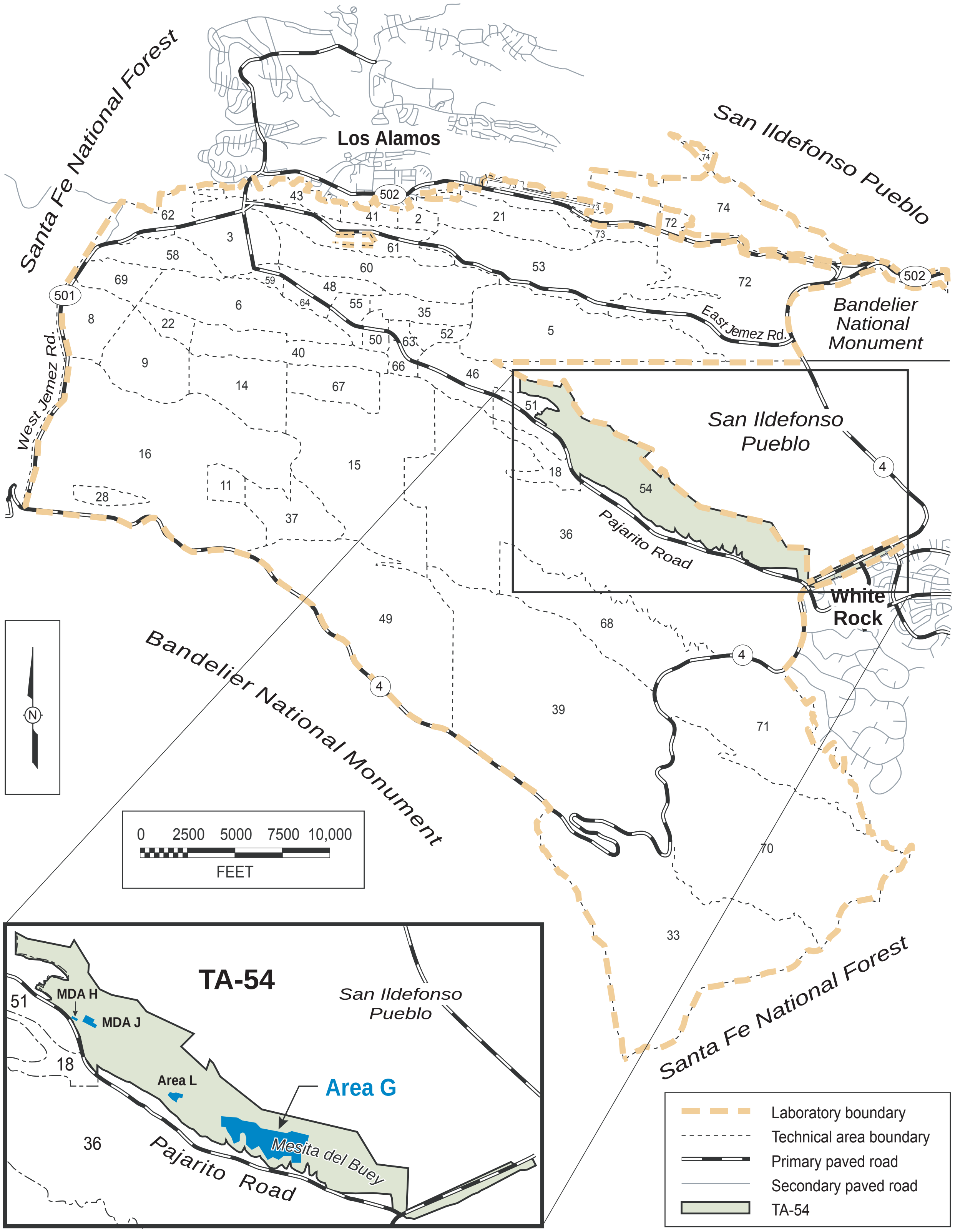


Figure 1.0-1 Area G at Technical Area 54, Los Alamos National Laboratory

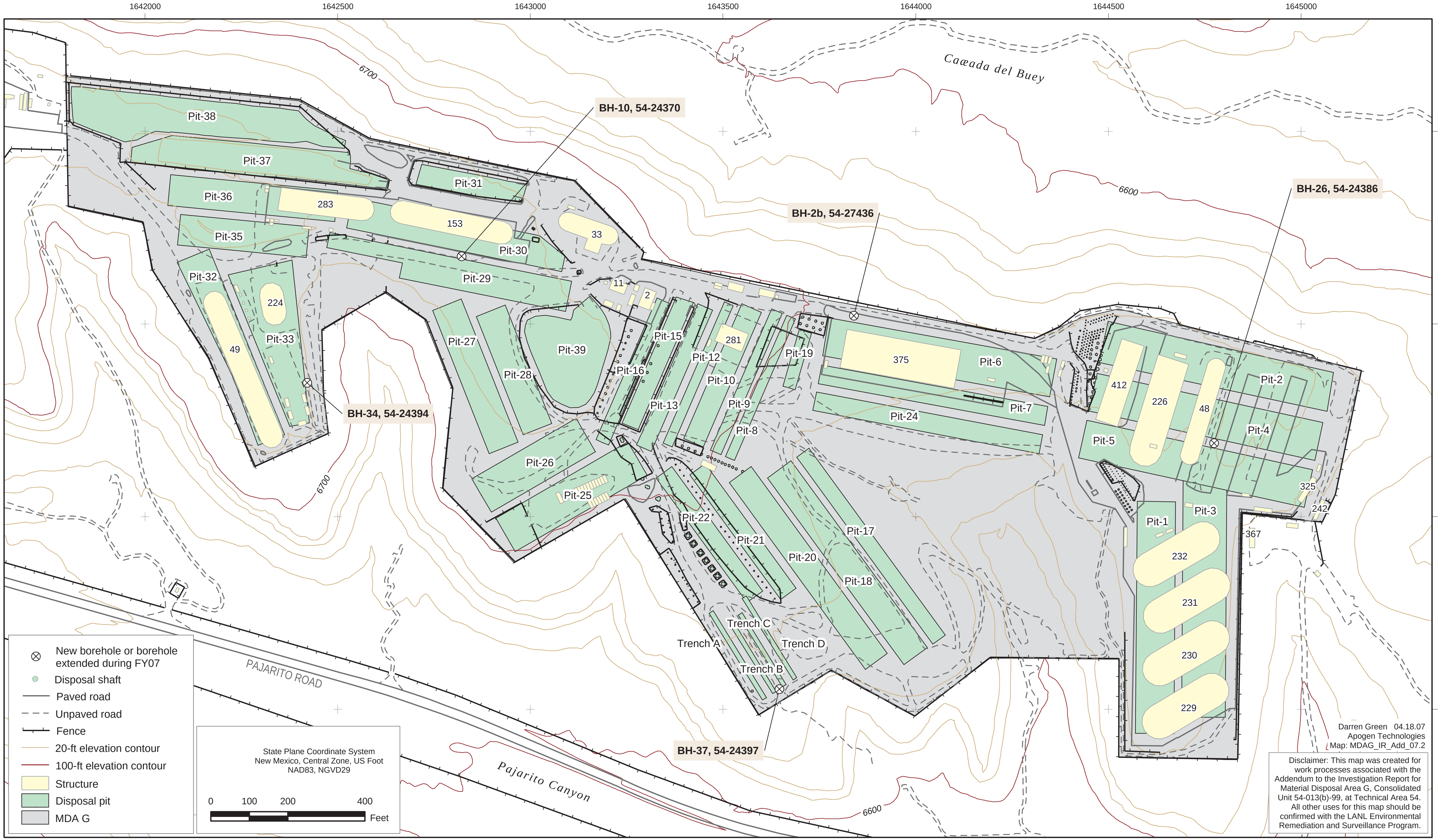
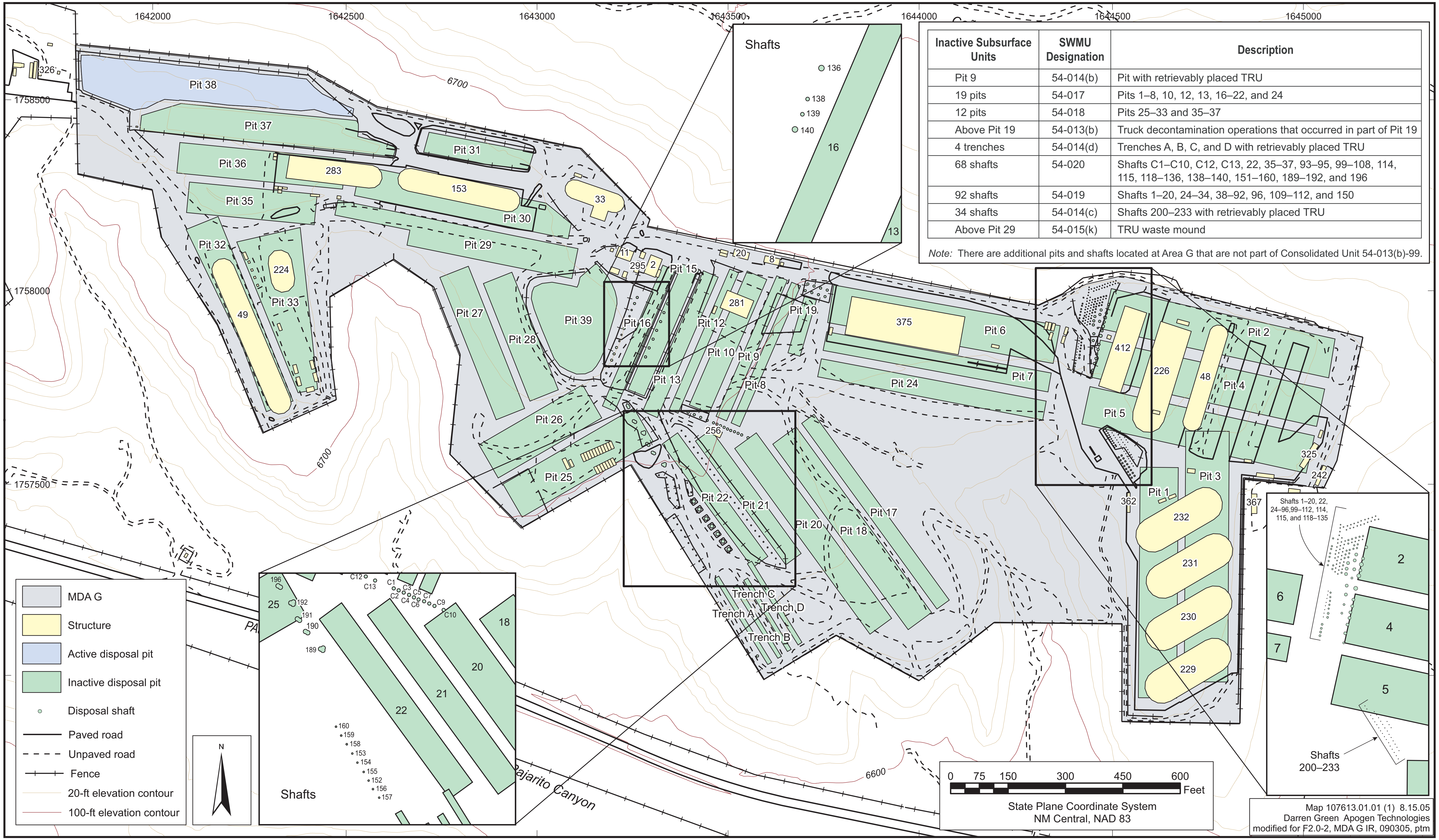


Figure 1.0-2 Locations of supplemental investigation boreholes at MDA G

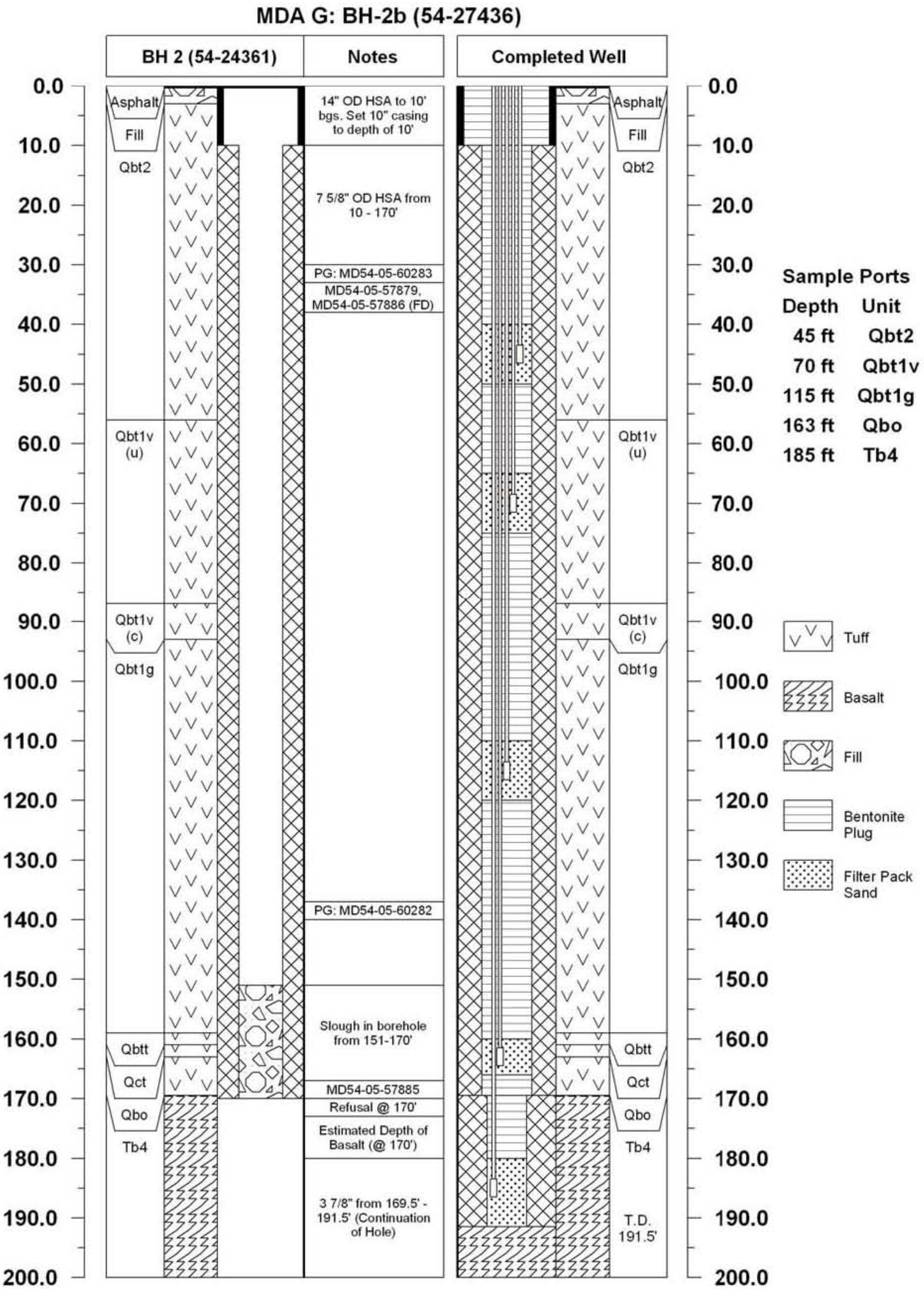


Inactive Subsurface Units	SWMU Designation	Description
Pit 9	54-014(b)	Pit with retrievably placed TRU
19 pits	54-017	Pits 1–8, 10, 12, 13, 16–22, and 24
12 pits	54-018	Pits 25–33 and 35–37
Above Pit 19	54-013(b)	Truck decontamination operations that occurred in part of Pit 19
4 trenches	54-014(d)	Trenches A, B, C, and D with retrievably placed TRU
68 shafts	54-020	Shafts C1–C10, C12, C13, 22, 35–37, 93–95, 99–108, 114, 115, 118–136, 138–140, 151–160, 189–192, and 196
92 shafts	54-019	Shafts 1–20, 24–34, 38–92, 96, 109–112, and 150
34 shafts	54-014(c)	Shafts 200–233 with retrievably placed TRU
Above Pit 29	54-015(k)	TRU waste mound

Note: There are additional pits and shafts located at Area G that are not part of Consolidated Unit 54-013(b)-99.

Map 107613.01.01 (1) 8.15.05
Darren Green Apogen Technologies
modified for F2.0-2, MDA G IR, 090305, ptm

Figure 1.2-1 MDA G waste disposal units



Sample Ports

Depth	Unit
45 ft	Qbt2
70 ft	Qbt1v
115 ft	Qbt1g
163 ft	Qbo
185 ft	Tb4

Figure 2.2-1 Detail of Borehole BH-2b

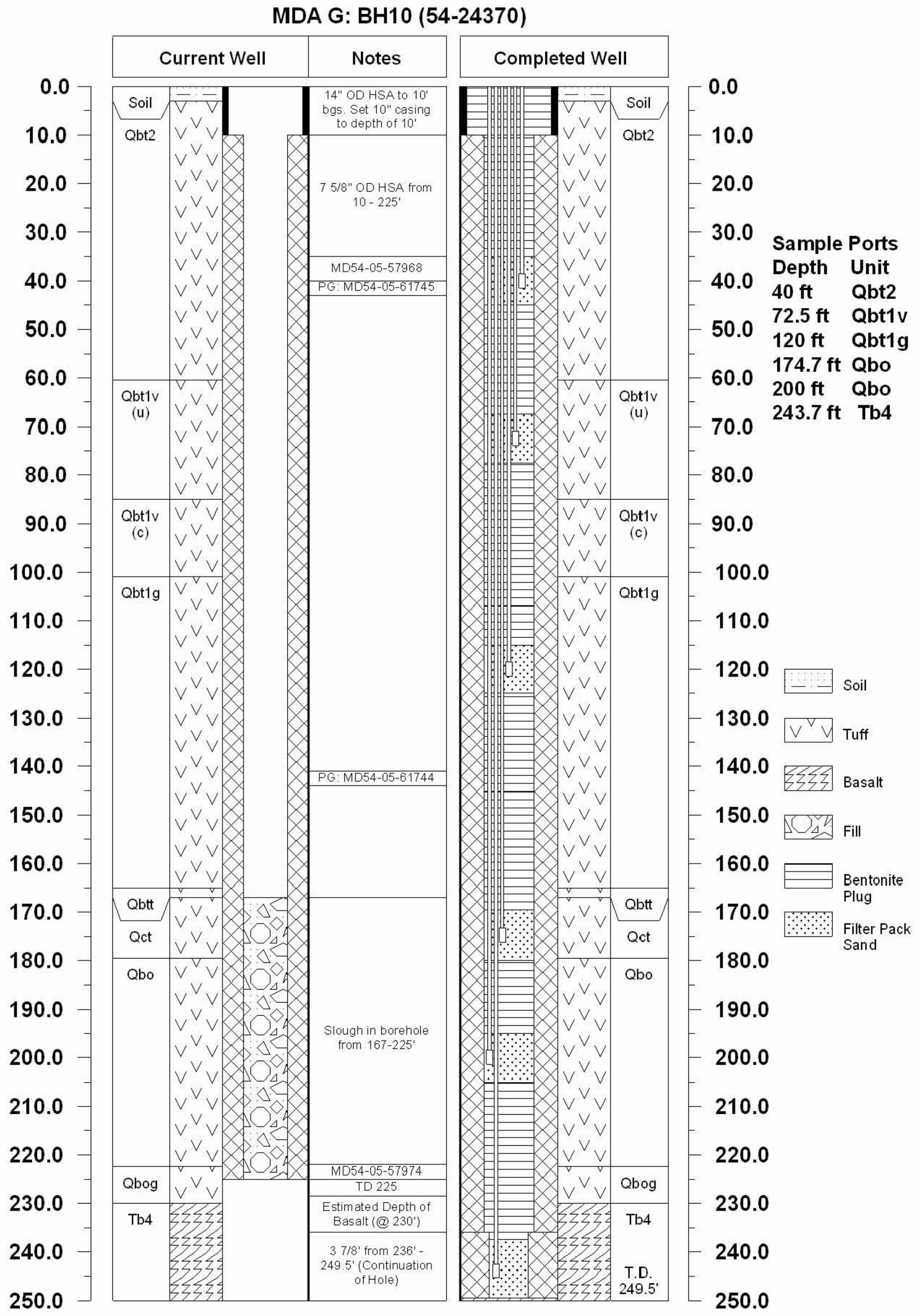


Figure 2.2-2 Detail of Borehole BH-10

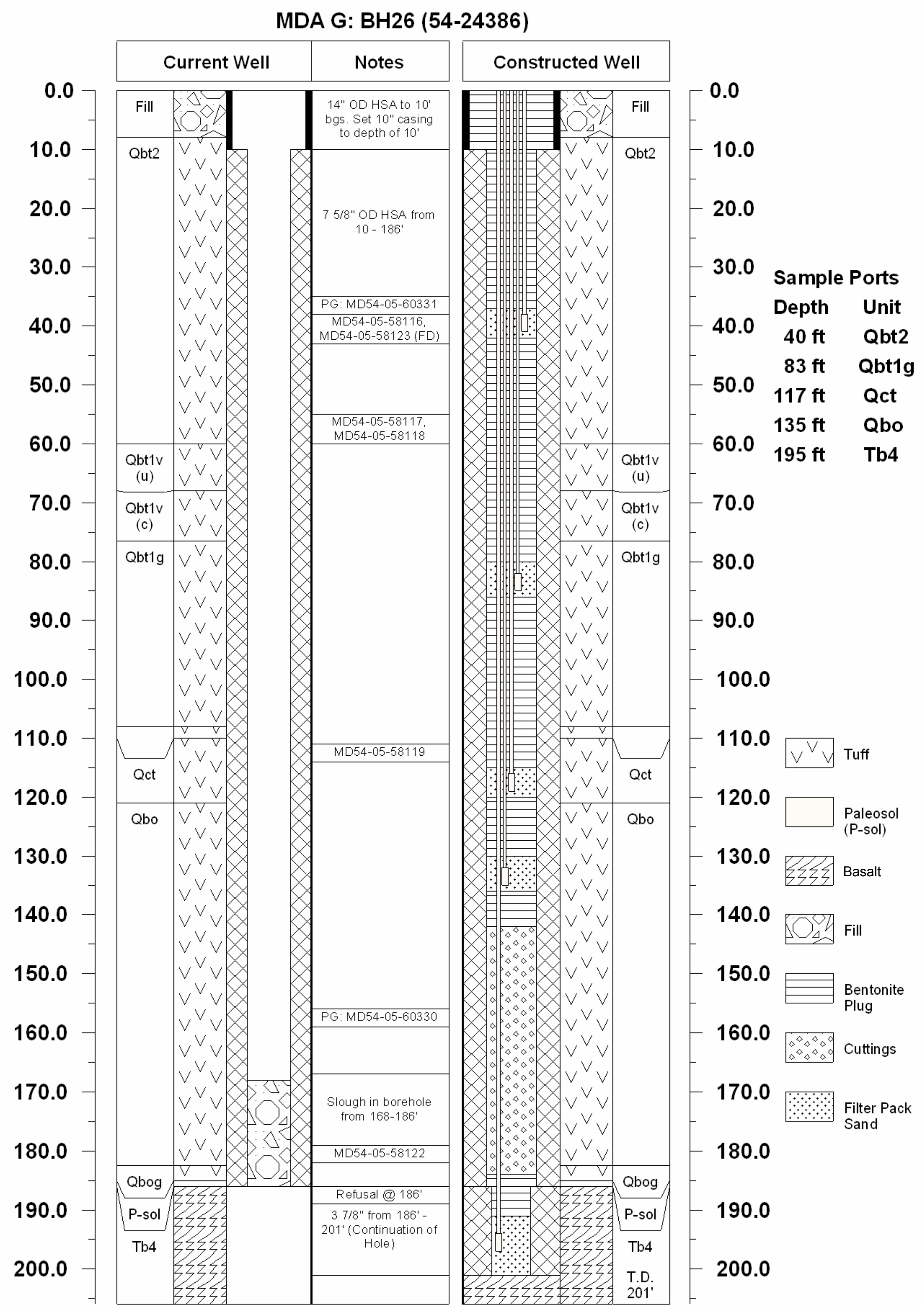


Figure 2.2-3 Detail of Borehole BH-26

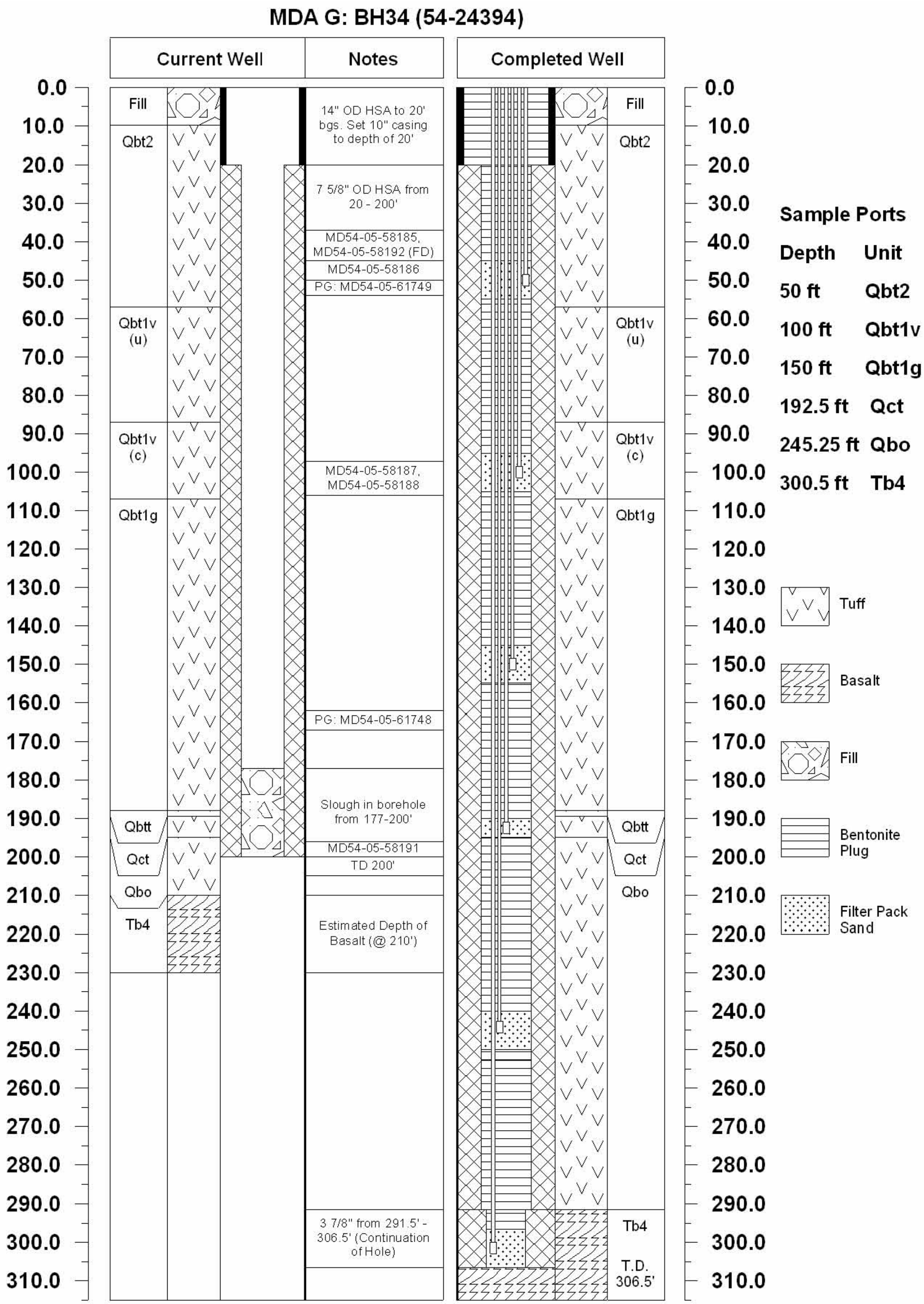


Figure 2.2-4 Detail of Borehole BH-34

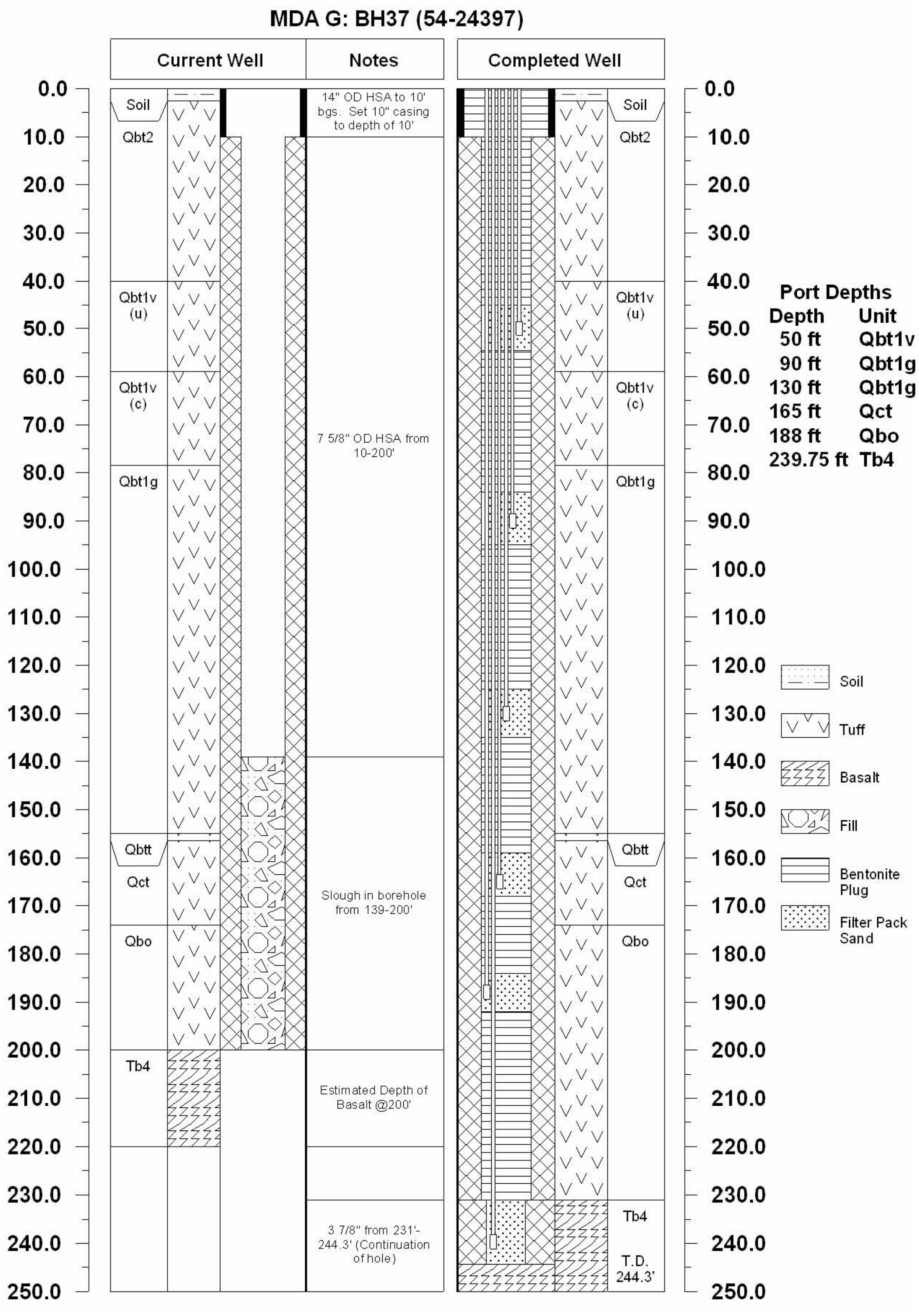
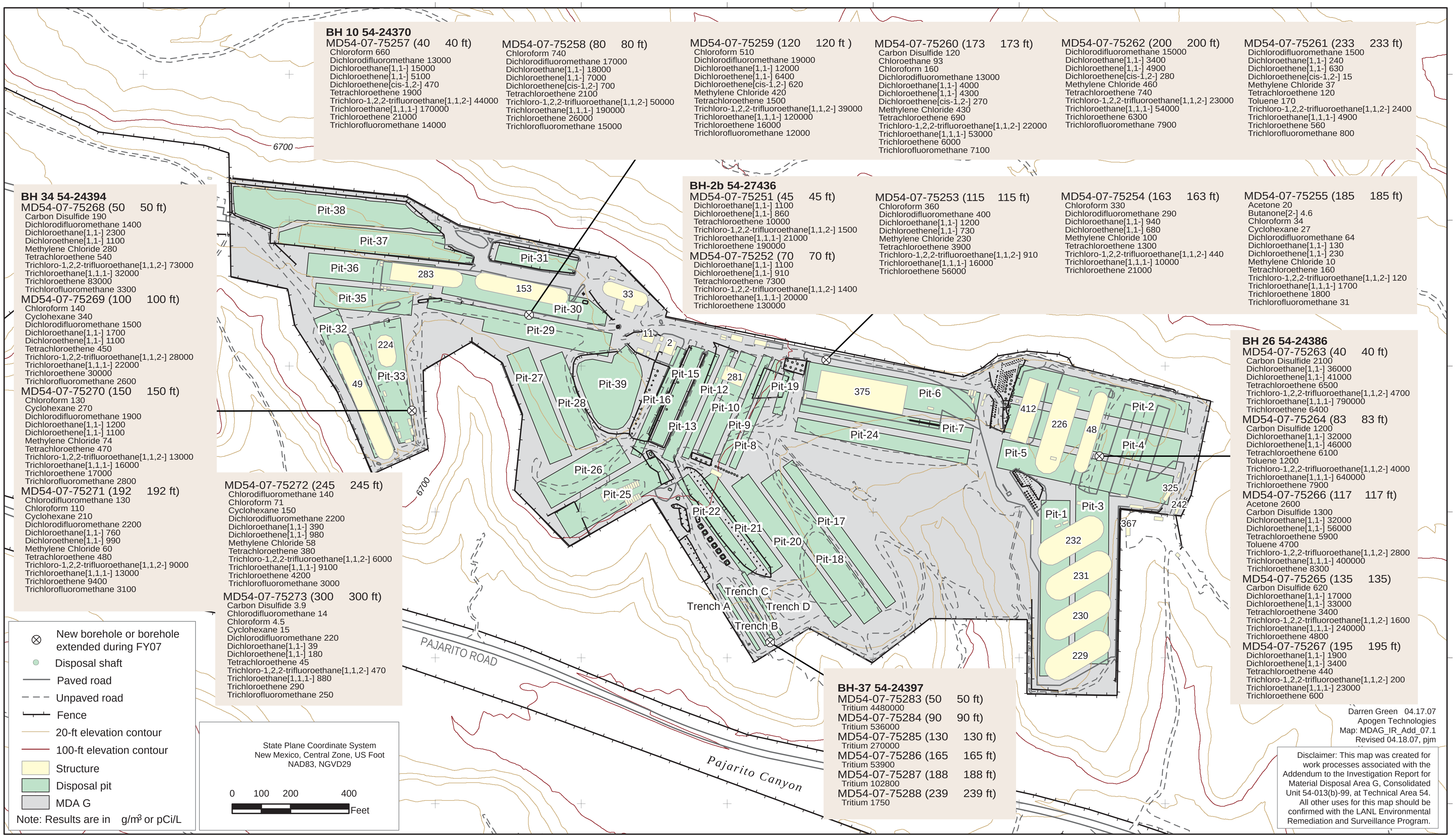


Figure 2.2-5 Detail of Borehole BH-37



BH 10 54-24370

MD54-07-75257 (40 40 ft)
Chloroform 660
Dichlorodifluoromethane 13000
Dichloroethane[1,1-] 15000
Dichloroethene[1,1-] 5100
Dichloroethene[cis-1,2-] 470
Tetrachloroethene 1900
Trichloro-1,2,2-trifluoroethane[1,1,2-] 44000
Trichloroethane[1,1,1-] 170000
Trichloroethene 21000
Trichlorofluoromethane 14000

MD54-07-75258 (80 80 ft)
Chloroform 740
Dichlorodifluoromethane 17000
Dichloroethane[1,1-] 18000
Dichloroethene[1,1-] 7000
Dichloroethene[cis-1,2-] 700
Tetrachloroethene 2100
Trichloro-1,2,2-trifluoroethane[1,1,2-] 50000
Trichloroethane[1,1,1-] 190000
Trichloroethene 26000
Trichlorofluoromethane 15000

MD54-07-75259 (120 120 ft)
Chloroform 510
Dichlorodifluoromethane 19000
Dichloroethane[1,1-] 12000
Dichloroethene[1,1-] 6400
Dichloroethene[cis-1,2-] 620
Methylene Chloride 420
Tetrachloroethene 1500
Trichloro-1,2,2-trifluoroethane[1,1,2-] 39000
Trichloroethane[1,1,1-] 120000
Trichloroethene 16000
Trichlorofluoromethane 12000

MD54-07-75260 (173 173 ft)
Carbon Disulfide 120
Chloroethane 93
Chloroform 160
Dichlorodifluoromethane 13000
Dichloroethane[1,1-] 4000
Dichloroethene[1,1-] 4300
Dichloroethene[cis-1,2-] 270
Methylene Chloride 430
Tetrachloroethene 690
Trichloro-1,2,2-trifluoroethane[1,1,2-] 22000
Trichloroethane[1,1,1-] 53000
Trichloroethene 6000
Trichlorofluoromethane 7100

MD54-07-75262 (200 200 ft)
Dichlorodifluoromethane 15000
Dichloroethane[1,1-] 3400
Dichloroethene[1,1-] 4900
Dichloroethene[cis-1,2-] 280
Methylene Chloride 460
Tetrachloroethene 740
Trichloro-1,2,2-trifluoroethane[1,1,2-] 23000
Trichloroethane[1,1,1-] 54000
Trichloroethene 6300
Trichlorofluoromethane 7900

MD54-07-75261 (233 233 ft)
Dichlorodifluoromethane 1500
Dichloroethane[1,1-] 240
Dichloroethene[1,1-] 630
Dichloroethene[cis-1,2-] 15
Methylene Chloride 37
Tetrachloroethene 120
Toluene 170
Trichloro-1,2,2-trifluoroethane[1,1,2-] 2400
Trichloroethane[1,1,1-] 4900
Trichloroethene 560
Trichlorofluoromethane 800

BH-2b 54-27436

MD54-07-75251 (45 45 ft)
Dichloroethane[1,1-] 1100
Dichloroethene[1,1-] 860
Tetrachloroethene 10000
Trichloro-1,2,2-trifluoroethane[1,1,2-] 1500
Trichloroethane[1,1,1-] 21000
Trichloroethene 190000

MD54-07-75252 (70 70 ft)
Dichloroethane[1,1-] 1100
Dichloroethene[1,1-] 910
Tetrachloroethene 7300
Trichloro-1,2,2-trifluoroethane[1,1,2-] 1400
Trichloroethane[1,1,1-] 20000
Trichloroethene 130000

MD54-07-75253 (115 115 ft)
Chloroform 360
Dichlorodifluoromethane 400
Dichloroethane[1,1-] 1200
Dichloroethene[1,1-] 730
Methylene Chloride 230
Tetrachloroethene 3900
Trichloro-1,2,2-trifluoroethane[1,1,2-] 910
Trichloroethane[1,1,1-] 16000
Trichloroethene 56000

MD54-07-75254 (163 163 ft)
Chloroform 330
Dichlorodifluoromethane 290
Dichloroethane[1,1-] 940
Dichloroethene[1,1-] 680
Methylene Chloride 100
Tetrachloroethene 1300
Trichloro-1,2,2-trifluoroethane[1,1,2-] 440
Trichloroethane[1,1,1-] 10000
Trichloroethene 21000

MD54-07-75255 (185 185 ft)
Acetone 20
Butanone[2-] 4.6
Chloroform 34
Cyclohexane 27
Dichlorodifluoromethane 64
Dichloroethane[1,1-] 130
Dichloroethene[1,1-] 230
Methylene Chloride 10
Tetrachloroethene 160
Trichloro-1,2,2-trifluoroethane[1,1,2-] 120
Trichloroethane[1,1,1-] 1700
Trichloroethene 1800
Trichlorofluoromethane 31

BH 34 54-24394

MD54-07-75268 (50 50 ft)
Carbon Disulfide 190
Dichlorodifluoromethane 1400
Dichloroethane[1,1-] 2300
Dichloroethene[1,1-] 1100
Methylene Chloride 280
Tetrachloroethene 540
Trichloro-1,2,2-trifluoroethane[1,1,2-] 73000
Trichloroethane[1,1,1-] 32000
Trichloroethene 83000
Trichlorofluoromethane 3300

MD54-07-75269 (100 100 ft)
Chloroform 140
Cyclohexane 340
Dichlorodifluoromethane 1500
Dichloroethane[1,1-] 1700
Dichloroethene[1,1-] 1100
Tetrachloroethene 450
Trichloro-1,2,2-trifluoroethane[1,1,2-] 28000
Trichloroethane[1,1,1-] 22000
Trichloroethene 30000
Trichlorofluoromethane 2600

MD54-07-75270 (150 150 ft)
Chloroform 130
Cyclohexane 270
Dichlorodifluoromethane 1900
Dichloroethane[1,1-] 1200
Dichloroethene[1,1-] 1100
Methylene Chloride 74
Tetrachloroethene 470
Trichloro-1,2,2-trifluoroethane[1,1,2-] 13000
Trichloroethane[1,1,1-] 16000
Trichloroethene 17000
Trichlorofluoromethane 2800

MD54-07-75271 (192 192 ft)
Chlorodifluoromethane 130
Chloroform 110
Cyclohexane 210
Dichlorodifluoromethane 2200
Dichloroethane[1,1-] 760
Dichloroethene[1,1-] 990
Methylene Chloride 60
Tetrachloroethene 480
Trichloro-1,2,2-trifluoroethane[1,1,2-] 9000
Trichloroethane[1,1,1-] 13000
Trichloroethene 9400
Trichlorofluoromethane 3100

MD54-07-75272 (245 245 ft)
Chlorodifluoromethane 140
Chloroform 71
Cyclohexane 150
Dichlorodifluoromethane 2200
Dichloroethane[1,1-] 390
Dichloroethene[1,1-] 980
Methylene Chloride 58
Tetrachloroethene 380
Trichloro-1,2,2-trifluoroethane[1,1,2-] 6000
Trichloroethane[1,1,1-] 9100
Trichloroethene 4200
Trichlorofluoromethane 3000

MD54-07-75273 (300 300 ft)
Carbon Disulfide 3.9
Chlorodifluoromethane 14
Chloroform 4.5
Cyclohexane 15
Dichlorodifluoromethane 220
Dichloroethane[1,1-] 39
Dichloroethene[1,1-] 180
Tetrachloroethene 45
Trichloro-1,2,2-trifluoroethane[1,1,2-] 470
Trichloroethane[1,1,1-] 880
Trichloroethene 290
Trichlorofluoromethane 250

BH 26 54-24386

MD54-07-75263 (40 40 ft)
Carbon Disulfide 2100
Dichloroethane[1,1-] 36000
Dichloroethene[1,1-] 41000
Tetrachloroethene 6500
Trichloro-1,2,2-trifluoroethane[1,1,2-] 4700
Trichloroethane[1,1,1-] 790000
Trichloroethene 6400

MD54-07-75264 (83 83 ft)
Carbon Disulfide 1200
Dichloroethane[1,1-] 32000
Dichloroethene[1,1-] 46000
Tetrachloroethene 6100
Toluene 1200
Trichloro-1,2,2-trifluoroethane[1,1,2-] 4000
Trichloroethane[1,1,1-] 640000
Trichloroethene 7900

MD54-07-75266 (117 117 ft)
Acetone 2600
Carbon Disulfide 1300
Dichloroethane[1,1-] 32000
Dichloroethene[1,1-] 56000
Tetrachloroethene 5900
Toluene 4700
Trichloro-1,2,2-trifluoroethane[1,1,2-] 2800
Trichloroethane[1,1,1-] 400000
Trichloroethene 8300

MD54-07-75265 (135 135)
Carbon Disulfide 620
Dichloroethane[1,1-] 17000
Dichloroethene[1,1-] 33000
Tetrachloroethene 3400
Trichloro-1,2,2-trifluoroethane[1,1,2-] 1600
Trichloroethane[1,1,1-] 240000
Trichloroethene 4800

MD54-07-75267 (195 195 ft)
Dichloroethane[1,1-] 1900
Dichloroethene[1,1-] 3400
Tetrachloroethene 440
Trichloro-1,2,2-trifluoroethane[1,1,2-] 200
Trichloroethane[1,1,1-] 23000
Trichloroethene 600

BH-37 54-24397

MD54-07-75283 (50 50 ft)
Tritium 4480000
MD54-07-75284 (90 90 ft)
Tritium 536000
MD54-07-75285 (130 130 ft)
Tritium 270000
MD54-07-75286 (165 165 ft)
Tritium 53900
MD54-07-75287 (188 188 ft)
Tritium 102800
MD54-07-75288 (239 239 ft)
Tritium 1750

Darren Green 04.17.07
Apogen Technologies
Map: MDAG_IR_Add_07.1
Revised 04.18.07, pjm

Disclaimer: This map was created for work processes associated with the Addendum to the Investigation Report for Material Disposal Area G, Consolidated Unit 54-013(b)-99, at Technical Area 54. All other uses for this map should be confirmed with the LANL Environmental Remediation and Surveillance Program.

Figure 4.1-1 Organic chemicals (µg/m^3) and tritium (pCi/L) detected in subsurface pore-gas monitoring boreholes at MDA G

Table 2.2-1
MDA G Supplemental Investigation Drilling Summary

Borehole ID	Borehole Location	Depth to Basalt (ft)	Total Depth (ft)
BH-2b	54-27436	170	191.5
BH-10	54-24370	230	249.5
BH-26	54-24386	186	201
BH-34	54-24394	291.5	306.5
BH-37	54-24397	231	244.3

Table 2.4-1
MDA G Supplemental Investigation Pore-Gas Sampling Port Construction Summary

Borehole ID	Sample Port Depths in ft (Unit Sampled)					
BH-2b (54-27436)	45 (Qbt 2)	70 (Qbt 1v)	115 (Qbt 1g)	163 (Qbo)	185 (Tb 4)	—*
BH-10 (54-24370)	40 (Qbt 2)	72.5 (Qbt 1v)	120 (Qbt 1g)	174.7 (Qct)	200 (Qbo)	243.7 (Tb 4)
BH-26 (54-24386)	40 (Qbt 2)	83 (Qbt 1g)	117 (Qct)	135 (Qbo)	195 (Tb 4)	—
BH-34 (54-24394)	50 (Qbt 2)	100 (Qbt 1v)	150 (Qbt 1g)	192.5 (Qct)	245.25 (Qbo)	300.5 (Tb 4)
BH-37 (54-24397)	50 (Qbt 1v)	90 (Qbt 1g)	130 (Qbt 1g)	165 (Qct)	188 (Qbo)	239.75 (Tb 4)

* — = Sixth sampling port not necessary.

Table 2.4-2
MDA G Supplemental Investigation Pore-Gas Sampling Interval Construction Summary

Borehole ID	Sample Interval Depths in ft (Unit Sampled)					
BH-2b (54-27436)	40–50 (Qbt 2)	65–75 (Qbt 1v)	110–120 (Qbt 1g)	160 (Qct)–166 (Qbo)	180–191.5 (Tb 4)	—*
BH-10 (54-24370)	35–45 (Qbt 2)	67.5–77.5 (Qbt 1v)	115–125 (Qbt 1g)	169.5–180 (Qct)	195–205 (Qbo)	237.5–249.5 (Tb 4)
BH-26 (54-24386)	37.5–42.5 (Qbt 2)	80.5–86 (Qbt 1g)	115–120 (Qct)	130–136 (Qbo)	191–201 (Tb 4)	—
BH-34 (54-24394)	45–55 (Qbt 2)	95–105 (Qbt 1v)	145–154.8 (Qbt 1g)	190–195 (Qct)	240–250 (Qbo)	296.5–306.5 (Tb 4)
BH-37 (54-24397)	45–55 (Qbt 1v)	84–95 (Qbt 1g)	125–135 (Qbt 1g)	160–168 (Qct)	184–192 (Qbo)	232.5–244.3 (Tb 4)

* — Sixth sampling port not necessary.

Table 4.1-1
MDA G Supplemental Investigation VOC Pore-Gas Results

Sample ID	Location ID	Depth Interval (ft)	Acetone	Butanone[2-]	Carbon Disulfide	Chlorodifluoromethane	Chloroethane	Chloroform	Cyclohexane	Dichlorodifluoromethane	Dichloroethane[1,1-]
MD54-07-75257	54-24370	35–45	—*	—	—	—	—	660	—	13000	15000
MD54-07-75258	54-24370	67.5–77.5	—	—	—	—	—	740	—	17000	18000
MD54-07-75259	54-24370	115 –125	—	—	—	—	—	510	—	19000	12000
MD54-07-75260	54-24370	169.5 - 180	—	—	120	—	93	160	—	13000	4000
MD54-07-75262	54-24370	195–205	—	—	—	—	—	—	—	15000	3400
MD54-07-75261	54-24370	237.5–249.5	—	—	—	—	—	—	—	1500	240
MD54-07-75263	54-24386	37.5–42.5	—	—	2100	—	—	—	—	—	36000
MD54-07-75264	54-24386	80.5–86	—	—	1200	—	—	—	—	—	32000
MD54-07-75266	54-24386	115 –120	2600	—	1300	—	—	—	—	—	32000
MD54-07-75265	54-24386	130–136	—	—	620	—	—	—	—	—	17000
MD54-07-75267	54-24386	191–201	—	—	—	—	—	—	—	—	1900
MD54-07-75268	54-24394	45–55	—	—	190	—	—	—	—	1400	2300
MD54-07-75269	54-24394	95–105	—	—	—	—	—	140	340	1500	1700
MD54-07-75270	54-24394	145–154.8	—	—	—	—	—	130	270	1900	1200
MD54-07-75271	54-24394	190–195	—	—	—	130	—	110	210	2200	760
MD54-07-75272	54-24394	240 –250	—	—	—	140	—	71	150	2200	390
MD54-07-75273	54-24394	296.5–306.5	—	—	3.9	14	—	4.5	15	220	39
MD54-07-75251	54-27436	40–50	—	—	—	—	—	—	—	—	1100
MD54-07-75252	54-27436	65–75	—	—	—	—	—	—	—	—	1100
MD54-07-75253	54-27436	110–120	—	—	—	—	—	360	—	400	1200
MD54-07-75254	54-27436	160–166	—	—	—	—	—	330	—	290	940
MD54-07-75255	54-27436	180–191.5	20	4.6	—	—	—	34	27	64	130

Table 4.1-1 (continued)

Sample ID	Location ID	Depth Interval (ft)	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Methylene Chloride	Tetrachloroethene	Toluene	Trichloro-1,2,2-trifluoroethane[1,1,2-]	Trichloroethane[1,1,1-]	Trichloroethene	Trichlorofluoromethane
MD54-07-75257	54-24370	35–45	5100	470	—	1900	—	44000	170000	21000	14000
MD54-07-75258	54-24370	67.5–77.5	7000	700	—	2100	—	50000	190000	26000	15000
MD54-07-75259	54-24370	115 - 125	6400	620	420	1500	—	39000	120000	16000	12000
MD54-07-75260	54-24370	169.5 –180	4300	270	430	690	—	22000	53000	6000	7100
MD54-07-75262	54-24370	195–205	4900	280	460	740	—	23000	54000	6300	7900
MD54-07-75261	54-24370	237.5–249.5	630	15	37	120	170	2400	4900	560	800
MD54-07-75263	54-24386	37.5–42.5	41000	—	—	6500	—	4700	790000	6400	—
MD54-07-75264	54-24386	80.5–86	46000	—	—	6100	1200 (J)	4000	640000	7900	—
MD54-07-75266	54-24386	115–120	56000	—	—	5900	4700	2800	400000	8300	—
MD54-07-75265	54-24386	130–136	33000	—	—	3400	—	1600	240000	4800	—
MD54-07-75267	54-24386	191–201	3400	—	—	440	—	200	23000	600	—
MD54-07-75268	54-24394	45–55	1100	—	280	540	—	73000	32000	83000	3300
MD54-07-75269	54-24394	95–105	1100	—	—	450	—	28000	22000	30000	2600
MD54-07-75270	54-24394	145–154.8	1100	—	74	470	—	13000	16000	17000	2800
MD54-07-75271	54-24394	190–195	990	—	60	480	—	9000	13000	9400	3100
MD54-07-75272	54-24394	240–250	980	—	58	380	—	6000	9100	4200	3000
MD54-07-75273	54-24394	296.5–306.5	180	—	—	45	—	470	880	290	250
MD54-07-75251	54-27436	40–50	860	—	—	10000	—	1500	21000	190000	—
MD54-07-75252	54-27436	65–75	910	—	—	7300	—	1400	20000	130000	—
MD54-07-75253	54-27436	110–120	730	—	230	3900	—	910	16000	56000	—
MD54-07-75254	54-27436	160–166	680	—	100	1300	—	440	10000	21000	—
MD54-07-75255	54-27436	180–191.5	230	—	10	160	—	120	1700	1800	31

Note: All values are reported in µg/m^3.

*— = Analytical result was not detected.

Table 4.1-2
MDA G Supplemental Investigation Tritium Pore-Gas Results

Borehole ID	Sample Depth Interval (ft)	Sample ID	Result (pCi/L)
BH-37 (54-24397)	45–55	MD54-07-75283	4,480,000
	84–95	MD54-07-75284	536,000
	125–135	MD54-07-75285	270,000
	160–168	MD54-07-75286	53,900
	194–192	MD54-07-75287	102,800
	232.5–244	MD54-07-75288	1750

Appendix A

Acronyms, Glossary, and Metric Conversion and Data Qualifier Definition Tables

A-1.0 ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AK	acceptable knowledge
asl	above sea level
B&K	Brüel and Krajer
bgs	below ground surface
BH	borehole
D&D	decontamination and decommissioning
DCA	dichloroethane[1,1-]
Dce	dichloroethene[1,1-]
DOE	Department of Energy (U.S.)
EP	Environmental Programs Directorate
EPA	Environmental Protection Agency (U.S.)
EPC	exposure point concentration
EQL	estimated quantitation limit
ERSS	Environment and Remediation Support Services (Laboratory program)
HI	hazard index
HSA	hollow-stem auger
I.D.	inside diameter
IDW	investigation-derived waste
IMP	implementation procedure
IWD	integrated work document
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory (designation of the Laboratory before January 1, 1981)
LCS	laboratory control sample
LIG	Laboratory implementing guidance
LIR	Laboratory implementation requirements
LLW	low-level waste
LPR	Laboratory performance requirements
MDA	material disposal area
NIOSH	National Institute of Occupational Safety and Health
NMED	New Mexico Environmental Department
O.D.	outside diameter

OSHA	Occupational Safety and Health Administration
OU	operable unit
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PID	photoionization detector
PPE	personal protective equipment
ppmv	parts per million by volume
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
SL	screening level
SMO	Sample Management Office
SOP	standard operating procedure
SOW	statement of work
SSHASP	site-specific health and safety plan
SV	screening value
TA	technical area
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TD	total depth
TRU	transuranic
TRV	toxicity reference value
UC	University of California
VOC	volatile organic compound
WCSF	Waste Characterization Strategy Form

A-2.0 GLOSSARY

accuracy—A measure of the closeness of measurements to the true value of the parameter being measured.

administrative authority—For Los Alamos National Laboratory, one or more regulatory agencies, such as the New Mexico Environment Department, the U.S. Environmental Protection Agency, or the U.S. Department of Energy, as appropriate.

alpha radiation—A form of particle radiation that is highly ionizing and has low penetration. Alpha radiation consists of two protons and two neutrons bound together into a particle that is identical to a helium nucleus and can be written as He2+.

analysis—A critical evaluation, usually made by breaking a subject (either material or intellectual) down into its constituent parts, then describing the parts and their relationship to the whole. Analyses may include physical analysis, chemical analysis, toxicological analysis, and knowledge-of-process determinations.

analyte—The element, nuclide, or ion a chemical analysis seeks to identify and/or quantify; the chemical constituent of interest.

analytical method—A procedure or technique for systematically performing an activity.

annular space (annulus)—The space between a borehole wall and a well casing, or the space between a casing pipe and a liner pipe.

aquifer—An underground geological formation (or group of formations) containing water that is the source of groundwater for wells and springs.

area count—An integrated area under a chromatographic peak. The area count is proportional to the amount of compound present in the aliquot that is injected into the chromatograph.

assessment—(1) The act of reviewing, inspecting, testing, checking, conducting surveillance, auditing, or otherwise determining and documenting whether items, processes, or services meet specified requirements. (2) An evaluation process used to measure the performance or effectiveness of a system and its elements. In this glossary, assessment is an all-inclusive term used to denote any one of the following: audit, performance evaluation, management system review, peer review, inspection, or surveillance.

background concentration—Naturally occurring concentrations of an inorganic chemical or radionuclide in soil, sediment, or tuff.

background data—Data that represent naturally occurring concentrations of inorganic and radionuclide constituents in a geologic medium. Los Alamos National Laboratory's (the Laboratory's) background data are derived from samples collected at locations that are either within, or adjacent to, the Laboratory. These locations (1) are representative of geological media found within Laboratory boundaries, and (2) have not been affected by Laboratory operations.

background level—(1) The concentration of a substance in an environmental medium (air, water, or soil) that occurs naturally or is not the result of human activities. (2) In exposure assessment, the concentration of a substance in a defined control area over a fixed period of time before, during, or after a data-gathering operation.

background radiation—The amount of radioactivity naturally present in the environment, including cosmic rays from space and natural radiation from soils and rock.

Background value (BV). The background concentration of a chemical used to represent the background of statistically derived BV in the upper tolerance limit (UTL) of the distribution. If a UTL cannot be derived, either the detection limit or maximum reported value in the background data set is used.

basalt—A fine-grained, dark volcanic rock comprised chiefly of plagioclase, augite, olivine, and magnetite.

bentonite—An absorbent aluminum silicate clay formed from volcanic ash and used in various adhesives, cements, and ceramic fillers. Because bentonite can absorb large quantities of water and expand to several times its normal volume, it is a common drilling mud additive.

beta radiation—High-energy electrons emitted by certain types of radioactive nuclei, such as potassium-40. The beta particles emitted are a form of ionizing *radiation* also known as beta rays.

blank—A s*ample* that is expected to have a negligible or unmeasurable amount of an *analyte*. Results of blank sample analyses indicate whether *field samples* might have been contaminated during the sample collection, *transport*, storage, preparation, or *analysis* processes.

borehole—(1) A hole drilled or bored into the ground, usually for exploratory or economic purposes. (2) A hole into which *casing*, screen, and other materials may be installed to construct a well.

borehole logging—The process of making remote measurements of physical, chemical, or other parameters at multiple depths in a *borehole*.

calibration—A process used to identify the relationship between the true *analyte* concentration or other variable and the response of a measurement instrument, *chemical analysis method*, or other measurement system.

calibration blank—A *calibration standard* prepared to contain negligible or unmeasurable amounts of *analytes*. A calibration blank is used to establish the zero concentration point for analytical measurement *calibrations*.

calibration standard—A *sample* prepared to contain known amounts of *analytes* of interest and other constituents required for an *analysis*.

canyon—A stream-cut chasm or gorge, the sides of which are composed of cliffs or a series of cliffs rising from the canyon's bed. Canyons are characteristic of arid or semiarid regions where downcutting by streams greatly exceeds weathering.

cap—A modern engineered landfill cover that is designed and constructed to minimize or eliminate the release of constituents into the environment.

casing—A solid piece of pipe, typically steel, stainless steel, or polyvinyl chloride (PVC) plastic, used to keep a well open in either unconsolidated material or unstable rock and as a means to contain zone-isolation materials, such as cement *grout* or *bentonite*.

chain of custody—An unbroken, documented trail of accountability that is designed to ensure the uncompromised physical integrity of *samples*, data, and *records*.

chemical—Any naturally occurring or human-made substance characterized by a definite molecular composition, including molecules that contain *radionuclides*.

chemical analysis—A process used to measure one or more attributes of a *sample* in a clearly defined, controlled, and systematic manner. Chemical analysis often requires treating a sample chemically or physically before measurement.

chemical interference—A *chemical* or physical entity whose influence results in a decrease or increase in the response of an *analytical method* or other measurement system relative to the response obtained in the absence of the entity.

cold vapor atomic absorption—An analytical technique used for measuring mercury which is described in *U.S. Environmental Protection Agency* Methods 7470A ("Mercury in Liquid Waste") and 7471A ("Mercury in Solid or Semisolid Waste"). The technique is based on the *absorption* of nonionizing *radiation* at 253.7 nanometers (nm) by mercury vapor. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance (peak height) is measured as a function of mercury concentration.

Compliance Order on Consent (Consent Order)—For the *Environmental Restoration Project*, an enforcement *document* signed by the New Mexico Environment Department, the *U.S. Department of Energy*, and the University of California on March 1, 2005, which prescribes the requirements for *corrective action* at Los Alamos National Laboratory. The purposes of the Consent Order are (1) to define the nature and extent of *releases* of *contaminants* at, or from, the *facility*; (2) to identify and evaluate, where needed, alternatives for *corrective measures* to clean up contaminants in the environment and prevent or mitigate the *migration* of contaminants at, or from, the facility; and (3) to implement such corrective measures. The Consent Order supersedes the corrective action requirements previously specified in Module VIII of the *Hazardous Waste Facility Permit*.

conceptual hydrogeologic model—An approximation of the occurrence, movement, and quality of *groundwater* in a given area and the relationship of that groundwater to the surface water, *soil water*, and geologic framework in that area.

conceptual model—See *site conceptual model*.

Consent Order—See *Compliance Order on Consent*.

construction worker scenario—A scenario that evaluates exposures to a human *receptor* throughout a construction project. The activities typically involve substantial short-term on-site exposures.

contaminant—(1) Any *chemical* (including *radionuclides*) present in environmental media or on structural debris above *background levels*. (2) According to the *Compliance Order on Consent*, any *hazardous waste* listed or identified as characteristic in 40 Code of Federal Regulations (CFR) 261 (incorporated by 20.4.1.200 New Mexico Administrative Code [NMAC]); any *hazardous constituent* listed in 40 CFR 261 Appendix VIII (incorporated by 20.4.1.200 NMAC) or 40 CFR 264 Appendix IX (incorporated by 20.4.1.500 NMAC); any *groundwater* contaminant listed in the Water Quality Control Commission (WQCC) Regulations at 20.6.3.3103 NMAC; any *toxic pollutant* listed in the WQCC Regulations at 20.6.2.7 NMAC; explosive compounds; nitrate; and perchlorate. (Note: Under the *Compliance Order on Consent*, the term “contaminant” does not include radionuclides or the radioactive portion of *mixed waste*.)

continuing calibration—A combination of *calibration blank* and check standards used to determine if an instrument’s response to an analyte concentration is within acceptable bounds relative to its *initial calibration*. A continuing calibration is performed every 12 hr of operation or every 10 injections, depending on the analytical test method, thus verifying the satisfactory performance of an instrument on a day-to-day basis. The continuing-calibration 12-hr period assumes that the instrument has not been shut down since the initial calibration.

contract analytical laboratory—An analytical laboratory under contract to the University of California to analyze samples from work performed at Los Alamos National Laboratory.

corrective action—(1) In the *Resource Conservation and Recovery Act*, an action taken to rectify conditions potentially adverse to human health or the environment. (2) In the *quality assurance* field, the process of rectifying and preventing *nonconformances*. (Also see *accelerated corrective action*.)

corrective measure—An action taken at a *solid waste management unit* or *area of concern* to protect human health or the environment in the event of a *release* of *contaminants* into the environment. (Also see *accelerated corrective measure*.)

corrective measure evaluation—An evaluation of potential remedial alternatives undertaken to identify a preferred remedy that will be protective of human health and the environment and that will attain appropriate *cleanup* goals.

Curie—A unit of *radioactivity* defined as the quantity of any radioactive nuclide that has an activity of $3.7 \times 10_{10}$ disintegrations per second (dps).

daily calibration—The combination of a *calibration blank* and *calibration standard* used to determine if the instrument response to an *analyte* concentration is within acceptable bounds relative to the *initial* *calibration*. A daily *calibration* establishes the instrument response factors on which quantitations are based, thus verifying the satisfactory performance of an instrument on a day-to-day basis.

data package—The hard copy deliverable for each sample delivery group produced by a *contract analytical laboratory* in accordance with the statement of work for analytical services.

data quality assessment—The statistical and/or scientific evaluation of a data set that establishes whether the data set is adequate for its intended use.

data validation—A systematic process that applies a defined set of performance-based criteria to a body of data and that may result in the *qualification* of the data. The data-validation process is performed independently of the analytical laboratory that generates the data set and occurs before conclusions are drawn from the data. The process may comprise a standardized data review (*routine data validation*) and/or a problem-specific data review (*focused data validation*).

data verification—The process of evaluating the completeness, correctness, consistency, and compliance of a laboratory *data package* against a specified standard or contract.

- Completeness: All required information is present—in both hard copy and electronic forms.
- Correctness: The reported results are based on properly documented and correctly applied algorithms.
- Consistency: The values are the same when they appear in different reports or are transcribed from one report to another.
- Compliance: The data pass numerical *quality control* tests based on parameters or limits specified in a contract or in an auxiliary *document*.

decontamination—The removal of unwanted material from the surface of, or from within, another material.

detect (detection)—An analytical result, as reported by an analytical laboratory, that denotes a *chemical* or *radionuclide* to be present in a *sample* at a given concentration.

detection limit—The minimum concentration that can be determined by a single measurement of an instrument. A detection limit implies a specified statistical confidence that the analytical concentration is greater than zero.

disposal—The *discharge*, deposit, injection, dumping, spilling, leaking, or placing of any *solid waste* or *hazardous waste* into, or on, any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including *groundwaters*. (40 Code of Federal Regulations [CFR] 260.10)

document—A written or pictorial compilation of information that describes, defines, specifies, reports, or certifies activities, requirements, procedures, or results (e.g., plan, report, proposal, regulatory response, *permit modification* request, document addendum or update, or procedure) and that must be submitted to the *administrative authority* or that has significance to the operations of the *Environmental Restoration Project*. Document types are shown in Quality Procedure 4.9, Document Development and Approval Process.

duplicate analysis—An *analysis* performed on one member of a pair of identically prepared *subsamples* taken from the same *sample*.

duplicate measurement—An additional measurement performed on a *prepared sample* under identical conditions to evaluate any variance in measurement.

Environmental Restoration (ER) Project—A Los Alamos National Laboratory project established in 1989 as part of a *U.S. Department of Energy* nationwide program. The ER Project's specific purposes are (1) to investigate hazardous and/or *radioactive materials* that may be present in the environment as a result of past Laboratory operations, (2) to determine if the materials currently pose an unacceptable *risk* to human health or the environment, and (3) to remediate (clean up, stabilize, or restore) those *sites* where contamination is still present.

environmental samples—Air, *soil*, water, or other media *samples* that have been collected from streams, wells, and soils, or other locations, and that are not expected to exhibit properties classified as hazardous by the U.S. Department of Transportation.

equipment blank (rinsate blank)—A *sample* used to rinse sample-collection equipment and expected to have negligible or unmeasurable amounts of *analytes*. The equipment blank is collected after the equipment *decontamination* is completed but before the collection of another *field sample*.

ER data—Data derived from *samples* that have been collected and paid for through *Environmental Restoration Project* funding.

ER database (ERDB)—A database housing analytical and other programmatic information for the *Environmental Restoration Project*. The ERDB currently contains about 3 million analyses in 300 tables.

ER identification (ER ID) number—A unique identifier assigned by the *Environmental Restoration (ER) Project*'s Records Processing Facility to each *document* when it is submitted as a final *record*. The ER ID number signals the end of the document process.

error—The quantifiable difference between an observed value and the true value of a parameter being measured.

estimated detection limit—A *reporting limit* required by a Los Alamos National Laboratory statement of work for analytical services.

estimated quantitation limit (EQL)—The lowest concentration that can be reliably achieved within specified limits of *precision* and *accuracy* during routine analytical-laboratory operating conditions. The low point on a *calibration* curve should reflect this quantitation limit. The EQL is not used to establish detection status. Sample EQLs are highly matrix-dependent and the specified EQLs might not always be achievable.

external standard calibration—A comparison of instrument responses from a *sample* to the responses from target compounds in the *calibration standards*. The sample's peak areas (or peak heights) are compared to the standards' peak areas (or peak heights).

facility—All contiguous land (and structures, other appurtenances, and improvements on the land) used for treating, storing, or disposing of *hazardous waste*. A facility may consist of several *treatment*, storage, or *disposal* operational units. For the purpose of implementing a *corrective action*, a facility is all the contiguous property that is under the control of the owner or operator seeking a *permit* under Subtitle C of the Resource Conservation and Recovery Act (40 Code of Federal Regulations 260.10).

fallout radionuclides—*Radionuclides* that are present at globally elevated levels in the environment as a result of fallout from atomic weapons tests. The Los Alamos National Laboratory (the Laboratory) *background data* sets consist of *environmental surveillance samples* taken from marginal and regional locations for the following radionuclides associated with fallout: tritium, cesium-137, americium-241, plutonium-238, plutonium-239/240, and strontium-90. Samples were collected from regional and marginal locations in the Laboratory's vicinity that were (1) representative of geological media found within Laboratory boundaries, and (2) were not impacted by Laboratory operations.

field blank (field reagent blank)—A *blank sample* prepared in the field or carried to the sampling *site*, exposed to sampling conditions (e.g., by removing bottle caps), and returned to a laboratory to be analyzed in the same manner in which *environmental samples* are being analyzed. Field blanks are used to identify the presence of any contamination that may have been added during the sampling and *analysis* process.

field duplicate (replicate) samples—Two separate, independent *samples* taken from the same source, which are collected as *collocated samples* (i.e., equally representative of a sample matrix at a given location and time).

field notebook—A *record* of activities performed in the field or a compilation of field data.

field reagent blank—See *field blank*.

field sample—See *sample*.

focused data validation—A technically based *analyte*-, *sample*-, and data-use-specific process that extends the *qualification* of data beyond method or contractual compliance and provides a higher level of confidence that an analyte is present or absent. If an analyte is present, the quality of the quantitation may be obtained through focused validation. (Also see *data validation*.)

gamma radiation—A form of electromagnetic, high-energy ionizing *radiation* emitted from a nucleus. Gamma rays are essentially the same as x-rays (though at higher energy) and require heavy shielding, such as concrete or steel, to be blocked.

geohydrology—The science that applies hydrologic methods to the understanding of geologic phenomena.

groundwater—Interstitial water that occurs in saturated earth material and is capable of entering a well in sufficient amounts to be used as a water supply.

hazardous constituent (hazardous waste constituent)—According to the *Compliance Order on Consent*, any constituent identified in Appendix VIII to 40 Code of Federal Regulations (CFR) 261 (incorporated by 20.4.1.200 New Mexico Administrative Code [NMAC]) or any constituent identified in 40 CFR 264, Appendix IX (incorporated by 20.4.1.500 NMAC).

hazardous waste—(1) *Solid waste* (as defined in 40 Code of Federal Regulations [CFR] 261.2) that is a listed *hazardous waste* (as provided in 40 CFR Subpart D), or a waste that exhibits any of the characteristics of hazardous waste (i.e., ignitability, corrosivity, reactivity, or toxicity, as provided in 40 CFR Subpart C). (2) According to *Compliance Order on Consent*, any solid waste or combination of solid wastes which, because of its quantity, concentration, or physical, chemical, or infectious characteristics, meets the description set forth in New Mexico Statutes Annotated 1978, § 74-4-3(K) and is listed as a hazardous waste or exhibits a hazardous waste characteristic under 40 CFR 261 (incorporated by 20.4.1.200 New Mexico Administrative Code).

Hazardous Waste Facility Permit[0]—The *permit* issued to Los Alamos National Laboratory (the Laboratory) by the New Mexico Environment Department that allows the Laboratory to operate as a *hazardous waste treatment*, storage, and *disposal facility*.

Hazardous Waste Bureau—The New Mexico Environment Department bureau charged with providing regulatory oversight and technical guidance to New Mexico *hazardous waste* generators and to *treatment, storage, and disposal facilities*, as required by the New Mexico Hazardous Waste Act and by regulations promulgated under the Act.

holding time—The maximum elapsed time a *sample* can be stored without unacceptable changes in *analyte* concentrations. Holding times apply under prescribed conditions, and deviations from these conditions may affect the holding times. Extraction holding time refers to the time lapsed between sample collection and sample preparation. Analytical holding time refers to the time lapsed between sample preparation and *analysis*.

HSWA module—Module VIII of the Los Alamos National Laboratory (the Laboratory) *Hazardous Waste Facility Permit*. This *permit* allows the Laboratory to operate as a *hazardous waste treatment, storage, and disposal facility*. Module VIII incorporates requirements from the *Hazardous and Solid Waste Amendments*, including the requirement of *corrective actions* for *releases* from *solid waste management units*.

initial calibration—The process used to establish the relationship between instrument response and *analyte* concentration at several analyte concentration values in order to demonstrate that an instrument is capable of acceptable analytical performance.

institutional controls—Controls that prohibit or limit access to contaminated media. Institutional controls may include use restrictions, permitting requirements, *standard operating procedures*, laboratory implementation requirements, laboratory implementation guidance, and laboratory performance requirements. (Also see *administrative controls*.)

instrument detection limit (IDL)—A measure of instrument *sensitivity* without any consideration for contributions to the signal from reagents. The IDL is calculated as follows: Three times the average of the standard deviations obtained on three nonconsecutive days from the *analysis* of a standard solution, with seven consecutive measurements of that solution per day. The standard solution must be prepared at a concentration of three to five times the instrument manufacturer’s estimated IDL.

instrument performance check—The a*nalysis* of a *chemical* of known relative mass abundances to indicate how well a mass spectrometer is performing over a specified mass range.

internal standards—Compounds added to a *sample* after the sample has been prepared for qualitative and quantitative instrument *analysis*. The compounds serve as a standard of retention time and response which is invariant from run to run.

Investigation-derived waste—*Solid waste* or *hazardous waste* that was generated as a result of *corrective action* investigation or *remediation* field activities. Investigation-derived waste may include drilling muds, cuttings, and purge water from the installation of test pits or wells; purge water, *soil*, and other materials from the collection of *samples*; residues from the testing of *treatment* technologies and pump-and-treat systems; contaminated personal protective equipment; and solutions (aqueous or otherwise) used to decontaminate nondisposable protective clothing and equipment. (U.S. Environmental Protection Agency, January 1992. Publication 9345.3-03FS)

laboratory control sample (LCS)—A known matrix that has been spiked with compound(s) representative of *target analytes*. LCSs are used to document laboratory performance, and the acceptance criteria for LCSs are method-specific.

laboratory qualifier (laboratory flag)—Codes applied to data by a *contract analytical laboratory* to indicate, on a gross scale, a verifiable or potential data deficiency. These flags are applied according to the *U.S. Environmental Protection Agency* contract-laboratory program guidelines.

LANL (Los Alamos National Laboratory) data validation qualifiers—The Los Alamos National Laboratory data qualifiers which are defined by, and used, in the *Environmental Restoration (ER) Project* validation process. The qualifiers describe the general usability (or quality) of data. For a complete list of data qualifiers applicable to any particular analytical suite, consult the appropriate ER Project *standard operating procedure*.

LANL (Los Alamos National Laboratory) data validation reason codes—The Los Alamos National Laboratory designations applied to sample data by data validators who are independent of the contract laboratory that performed a given sample *analysis*. Reason codes provide an analysis-specific explanation for applying a qualifier, with some description of the qualifier's potential impact on data use. For a complete list of data qualifiers applicable to any particular analytical suite, consult the appropriate *Environmental Restoration Project standard operating procedure*.

log book—A notebook used to record tabulated data (e.g., the history of *calibrations*, *sample* tracking, numerical data, or other technical data).

Los Alamos unlimited release (LA-UR) number—A unique identification number required for all *documents* or presentations prepared for distribution outside Los Alamos National Laboratory (the Laboratory). LA-UR numbers are obtained by filling out a technical information release form (http://enterprise.lanl.gov/alpha.htm) and submitting the form together with 2 copies of the document to the Laboratory's Classification Group (S-7) for review.

lower acceptance limit (LAL)—The lowest limit that is acceptable according to *quality control* (QC) criteria for a specific QC *sample* and for a specific method. Any results lower than the LAL are qualified following the routine validation procedure.

material disposal area (MDA)—A subset of all the *solid waste management units* and *areas of concern* at Los Alamos National Laboratory (the Laboratory), including trenches, pits, and shafts, that were historically designated by the Laboratory as MDAs.

matrix—Relatively fine material in which coarser fragments or crystals are embedded; also called "ground mass" in the case of igneous rocks. (Also see *sample matrix*.)

matrix spike—An *aliquot* of a *sample* spiked with a known concentration of *target analyte(s)*. Matrix spike samples are used to measure the ability to recover prescribed analytes from a native *sample matrix*. The spiking typically occurs before sample preparation and *analysis*. (Also see *matrix spike duplicate*.)

matrix spike duplicate—An intralaboratory duplicate *sample* spiked with a known amount of *target analyte(s)*. Spiking typically occurs before sample preparation and *analysis*. (Also see *matrix spike*.)

measuring and test equipment—Devices or systems used to calibrate, measure, gauge, test, or inspect entities to control or acquire data and verify conformance to specified requirements.

medium (environmental)—Any medium capable of absorbing or transporting constituents. Examples of media include *tuffs*, *soils* and *sediments* derived from these tuffs, surface water, *soil water*, *groundwater*, air, structural surfaces, and debris.

method blank—An *analyte*-free matrix to which all reagents are added in the same volumes or proportions as those used in the *environmental sample* processing, and which is prepared and analyzed in the same manner as the corresponding environmental samples. The method blank is used to assess the potential for *sample* contamination during preparation and *analysis*.

method detection limit (MDL)—The minimum concentration of a substance that can be measured and reported with a known statistical confidence that the *analyte* concentration is greater than zero. After subjecting *samples* to the usual preparation, the MDL is determined by analyzing those samples of a given matrix type that contain the analyte. The MDL is used to establish detection status.

migration—The movement of inorganic and organic chemical species through unsaturated or saturated materials.

minimum detectable activity (MDA)—For the *analysis* of *radionuclides*, the lowest detectable *radioactivity* for a given analytical technique. The following equation is used to calculate the MDA unless otherwise noted or approved by Los Alamos National Laboratory. (Note: "MDA" here should not to be confused with *material disposal area)*:

$$\text{MDA} = \frac{4.65(\text{BKG})^{0.5} + 2.71}{2.22 \times \text{EFF} \times \text{V} \times \text{T}_s \times \text{Y}}$$

where BKG = the total background counts,

EFF = the fraction detector efficiency,

V = the volume or unit weight,

T_s = the sample count duration, and

Y = the fractional chemical recovery obtained from the *tracer* recovery.

Depending on the type of analysis, other terms may also be required in the denominator (e.g., gamma abundance).

mixed waste—Waste containing both hazardous and source, special nuclear, or byproduct materials subject to the Atomic Energy Act of 1954. (Laboratory Implementation Requirement 404-00-03.1)

model—A schematic description of a physical, biological, or social system, theory, or phenomenon that accounts for its known or inferred properties and may be used for the further study of its characteristics.

monitoring well—(1) A well used to obtain water-quality *samples* or to measure *groundwater* levels. (2) A well drilled at a *hazardous waste* management facility or *Superfund site* to collect groundwater samples for the purpose of physical, chemical, or biological analysis and to determine the amounts, types, and distribution of *contaminants* in the groundwater beneath the site.

notices of approval, of approval with modification, or of disapproval—Notices issued by the New Mexico Environment Department (NMED). Upon receipt of a *work plan*, schedule, report, or other deliverable *document*, NMED reviews the document and approves the document as submitted, modifies the document and approves it as modified, or disapproves the document. A notice of approval means that the document is approved as submitted. A notice of approval with modifications means that the document is approved but with modifications specified by NMED. A notice of disapproval means that the document is disapproved and it states the deficiencies and other reasons for disapproval. If NMED issues a notice of disapproval for a document, it may include written instructions for modifying and resubmitting the document. (Note: Notices of disapproval have grown out of the *Compliance Order on Consent*. *Notices of deficiency* are used more broadly by NMED and have been in use for a longer time. Generally, the acronym NOD is used for a notice of deficiency.)

operable units (OUs)—At Los Alamos National Laboratory, 24 areas originally established for administering the *Environmental Restoration Project*. Set up as groups of *potential release sites*, the OUs were aggregated according to geographic proximity for the purposes of planning and conducting *Resource Conservation and Recovery Act (RCRA) facility assessments* and *RCRA facility investigations*. As the project matured, it became apparent that there were too many areas to allow efficient communication and to ensure consistency in approach. In 1994, the 24 OUs were reduced to 6 administrative field units.

peer review—See *decision peer review* and *document peer review*.

percent recovery (%R)—The amount of material detected in a *sample* (less any amount already in the sample) divided by the amount added to the sample, expressed as a percentage.

polychlorinated biphenyls (PCBs)—Any chemical substance that is limited to the biphenyl molecule which has been chlorinated to varying degrees, or any combination that contains such substances. PCBs are colorless, odorless compounds that are chemically, electrically, and thermally stable and have proven to be toxic to both humans and other animals.

precision—The degree of mutual agreement among a series of individual measurements, values, or results.

Quality Assurance Project Plan—A formal *document* that describes, in comprehensive detail, the necessary *quality assurance*, *quality control*, and other technical activities that must be implemented to ensure that results of work performed will satisfy stated *performance criteria*.

quality assurance/quality control—A system of procedures, checks, *audits*, and *corrective actions* set up to ensure that all *U.S. Environmental Protection Agency* research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

quality control—See *quality assurance/quality control*.

radiation—A stream of particles or electromagnetic waves emitted by atoms and molecules of a radioactive substance as a result of nuclear decay. The particles or waves emitted can consist of neutrons, positrons, alpha particles, beta particles, or *gamma radiation*.

radioactive material—For purposes of complying with U.S. Department of Transportation regulations, any material having a specific activity (activity per unit mass of the material) greater than 2 nanocuries per gram (nCi/g) and in which the *radioactivity* is evenly distributed.

radioactive tracer—A *radionuclide* added to, or induced in, a *sample* for the purpose of monitoring chemical or physical losses of *target analytes*. The *tracer* is assumed to behave in the same manner as the target analytes.

radioactive waste—Waste that, by either monitoring and *analysis*, or acceptable knowledge, or both, has been determined to contain added (or concentrated and naturally occurring) *radioactive material* or activation products, or that does not meet radiological *release* criteria.

radioactivity (radioactive decay; radioactive disintegration)—The spontaneous change in an atom by the emission of charged particles and/or gamma rays.

radionuclide—Radioactive particle (human-made or natural) with a distinct atomic weight number; can have as long a life as *soil* or water pollutants.

RCRA facility investigation (RFI)—A *Resource Conservation and Recovery Act (RCRA)* investigation that determines if a *release* has occurred and characterizes the nature and extent of contamination at a *hazardous waste facility*. The RFI is generally equivalent to the remedial investigation portion of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

receptor—A person, other animal, plant, or geographical location that is exposed to a chemical or physical agent released to the environment by human activities**.**

record—Any book, paper, map, photograph, machine-readable material, or other documentary material, regardless of physical form or characteristics.

regional aquifer—Geologic material(s) or unit(s) of regional extent whose saturated portion yields significant quantities of water to wells, contains the regional zone of saturation, and is characterized by the regional *water table* or *potentiometric surface*. (Also see *aquifer*.)

regulatory standard—Media-specific *contaminant* concentration levels of potential concern which are mandated by federal or state legislation or regulation (e.g., the Safe Drinking Water Act, New Mexico Water Quality Control Commission regulations).

relative percent difference (RPD)—The measure used to assess the *precision* between parent results and their associated duplicate results. The RPD is calculated as follows: ,

$$\left|RPD\right| = \frac{S - R}{\left(\frac{S + R}{2}\right)100}$$

where RPD = relative percent difference,

S = parent sample result, and

R = duplicate sample result.

The *Environmental Restoration Project* criteria for the RPD are less than 20% for aqueous samples and less than 35% for *soil* samples when the sample concentrations are greater than, or equal to, five times the *method detection limit (MDL)*. For samples with concentrations less than five times the MDL, but greater than the MDL, the control is +/-MDL. No precision criterion applies to samples with concentrations less than the MDL.

release—Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, *leaching*, dumping, or disposing of *hazardous waste* or *hazardous constituents* into the environment.

remediation—(1) The process of reducing the concentration of a *contaminant* (or contaminants) in air, water, or *soil* media to a level that poses an acceptable *risk* to human health and the environment. (2) The act of restoring a contaminated area to a usable condition based on specified standards.

reporting limit (RL)—The numerical value that an analytical laboratory (in conjunction with its client) selects for determining if a *target analyte* has been detected. Results below the RL are considered to be undetected, whereas results above the RL are considered to be detected. The RLs are not necessarily based on instrument *sensitivity*. RLs can be established at the *instrument detection limit*, *method detection limit*, *estimated quantitation limit*, or *contract-required detection limit*.

representativeness—The degree to which data accurately and precisely represent a characteristic of a *population* or an environmental condition.

request number—An identifying number assigned by the *Environmental Restoration Project* to a group of *samples* submitted for *analysis*.

Resource Conservation and Recovery Act—The Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976. (Public Law [PL] 94-580, as amended by PL 95-609 and PL 96-482, United States Code 6901 *et seq.*)

rinsate blank—See *equipment blank*.

risk—A measure of the probability that damage to life, health, property, and/or the environment will occur as a result of a given hazard.

risk assessment—See *baseline risk assessment.*

routine analysis—The *analysis* categories of inorganic compounds, organic compounds, metals, radiochemistry, and high explosives, as defined in a contract laboratory's statement of work.

routine data—Data generated using *analytical methods* that are identified as routine methods in the current *Environmental Restoration Project* statement of work for analytical services.

routine data validation—The process of reviewing analytical data relative to quantitative routine acceptance criteria. The objective of routine *data validation* is two-fold: • to estimate the technical quality of the data relative to minimum national standards adopted by the *Environmental Restoration Project*, and • to indicate to data users the technical data quality at a gross level by assigning *laboratory qualifiers* to environmental data whose *quality indicators* do not meet acceptance criteria.

sample—A portion of a material (e.g., rock, *soil*, water, or air), which, alone or in combination with other portions, is expected to be representative of the material or area from which it is taken. Samples are typically either sent to a laboratory for *analysis* or *inspection* or are analyzed in the field. When referring to samples of environmental media, the term *field sample* may be used.

sample matrix—In *chemical analysis*, that portion of a *sample* which is exclusive of the *analytes* of interest. Together, the matrix and the analytes of interest form the sample.

sediment—(1) A mass of fragmented inorganic solid that comes from the weathering of rock and is carried or dropped by air, water, gravity, or ice. (2) A mass that is accumulated by any other natural agent and that forms in layers on the Earth's surface (e.g., sand, gravel, silt, mud, fill, or loess). (3) A solid material that is not in solution and is either distributed through the liquid or has settled out of the liquid.

sensitivity—An indication of the lowest *analyte* concentration that can be measured with a specified degree of confidence.

serial dilution sample—A requirement of the *U.S. Environmental Protection Agency (EPA)* Method 6010B (Inductively Coupled Plasma-Atomic Emission Spectroscopy). Serial dilutions are made by performing a series of dilutions on an *aliquot* taken from a stock solution for a *target analyte*. The first dilution of the original stock solution serves as the stock solution for the second dilution, and the second dilution serves as the stock solution for the third dilution, and so on. To meet the requirement of EPA Method 6010B, one serial dilution *analysis* must be performed for each matrix in every sample batch, with a minimum of 1 serial dilution sample per 20 samples. The serial dilution analysis is accomplished by diluting the sample(s) by a factor of five and comparing the dilution-corrected results to those of the undiluted parent sample(s). The serial dilution results are required to agree within ±10% of the undiluted parent sample results, where the undiluted results are greater than, or equal to, the *method detection limit*.

site—An area or place that falls under the jurisdiction of the *U.S. Environmental Protection Agency* and/or a state for *corrective action*.

site characterization—Defining the pathways and methods of *migration* of *hazardous waste* or *constituents*, including the media affected; the extent, direction and speed of the *contaminants*; complicating factors influencing movement; or concentration profiles. (U.S. Environmental Protection Agency, May 1994. Publication EPA-520/R-94/004)

site conceptual model—A qualitative or quantitative description of sources of contamination, environmental *transport* pathways for contamination, and *receptors* that may be impacted by contamination and whose relationships describe qualitatively or quantitatively the *release* of contamination from the sources, the movement of contamination along the pathways to the exposure points, and the uptake of *contaminants* by the receptors.

Site-Specific Health and Safety Plan (SSHASP)—A health and safety plan that has been tailored to a *site* or to an *Environmental Restoration (ER) Project* field activity and that has been approved by an ER health and safety representative. A SSHASP contains information specific to the project, including the scope of work, relevant history, descriptions of hazards from activity associated with the project site(s), and techniques for exposure *mitigation* (e.g., personal protective equipment and hazard mitigation).

soil—A sample media group that includes soil and can include artificial fill materials. “Soil” refers to a material that overlies bedrock and has been subject to soil-forming processes. The sample media group of soil includes soils from all soil horizons.

soil gas—Gaseous elements and compounds in the small spaces between particles of the earth and *soil*. Such gases can be moved or driven out under pressure.

soil moisture—The water contained in the pore space of the *unsaturated zone*.

soil screening level (SSL)—The concentration of a *chemical* (inorganic or organic) below which no potential for unacceptable *risk* to human health exists. The derivation of an SSL is based on conservative exposure and land-use assumptions, and on target levels of either a *hazard quotient* of 1.0 for a noncarcinogenic chemical or a cancer risk of 10^{-5} for a carcinogenic chemical.

solid waste—Any garbage, refuse, or sludge from a waste *treatment* plant, water-supply treatment plant, or air-pollution control facility, and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from *community* activities. Solid waste does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial *discharges* which are point sources subject to *permits* under section 402 of the Federal Water Pollution Control Act, as amended; or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended.

solid waste management unit (SWMU)—(1) Any discernible site at which *solid wastes* have been placed at any time, whether or not the site use was intended to be the management of solid or hazardous waste. SWMUs include any site at a *facility* at which solid wastes have been routinely and systematically released. This definition includes regulated sites (i.e., landfills, surface impoundments, waste piles, and land *treatment* sites), but does not include passive leakage or onetime spills from production areas and sites in which wastes have not been managed (e.g., product storage areas). (2) According to the *Compliance Order on Consent*, any discernible site at which solid waste has been placed at any time, and from which NMED determines there may be a *risk* of a release of *hazardous waste* or hazardous waste constituents (*hazardous constituents*), whether or not the site use was intended to be the management of solid or hazardous waste. Such sites include any area in Los Alamos National Laboratory at which solid wastes have been routinely and systematically released; they do not include one-time spills.

standard operating procedure—A *document* that details the officially approved method(s) for an operation, *analysis*, or action, with thoroughly prescribed techniques and steps.

stratigraphy—The study of the formation, composition, and sequence of *sediments*, whether consolidated or not.

subsample—See *aliquot*.

surface sample—A *sample* taken at a collection depth that is (or was) representative of the *medium*’s surface during the period of investigative interest. A typical depth interval for a surface sample is 0 to 6 in. for mesa-top locations, but may be up to several feet in *sediment*-deposition areas within *canyons*.

surrogate (surrogate compound)—An organic compound used in the analyses of organic *target analytes* which is similar in composition and behavior to the target analytes but is not normally found in *field samples*. Surrogates are added to every *blank* and spike *sample* to evaluate the efficiency with which *analytes* are being recovered during extraction and *analysis*.

target analyte—A *chemical* or parameter, the concentration, mass, or magnitude of which is designed to be quantified by a particular test method.

technical area (TA)—At Los Alamos National Laboratory, an administrative unit of operational organization (e.g., TA-21).

technical notebook—A *record* of the methodology, observations, and results of technical activity investigations.

topography—The physical or natural features of an object or entity and their structural relationships.

total propagated uncertainty (TPU)—The range of concentrations (expressed as ± the measured concentration) that includes the theoretical or true concentration of an *analyte* with a specific degree of confidence. Radiochemical results are required to be accompanied by *sample*-specific uncertainty bounds that reflect the 67% confidence level (1-sigma TPU). The TPU includes not only the measurement or counting *error* but the technique-specific error term that includes uncertainty values for each contributing measurement process and a sample-specific contribution reflecting the specific chemical recoveries or detectors used. All radiochemical result uncertainties incorporate terms for technique-related and sample-specific measurement errors.

treatment—Any method, technique, or process, including elementary neutralization, designed to change the physical, chemical, or biological character or composition of any *hazardous waste* so as to *neutralize* such waste, recover energy or material resources from the waste, or so as to render such waste nonhazardous or less hazardous; safer to transport, store, or dispose of; or amenable for recovery or storage; or reduced in volume. (40 Code of Federal Regulations 260.10)

tremie pipe—A small-diameter pipe used to carry sand pack, *bentonite*, or grouting materials to a borehole's bottom. Materials are pumped under pressure or poured to the hole bottom through the pipe. The pipe is retracted as the *annular space* is filled.

trip blank—A *sample* of *analyte*-free medium taken from a sampling *site* and returned to an analytical laboratory unopened, along with samples taken in the field; used to monitor cross contamination of samples during handling and storage both in the field and in the analytical laboratory.

tuff—Consolidated volcanic ash, composed largely of fragments produced by volcanic eruptions.

upper acceptance limit (UAL)—The highest limit that is acceptable, based on the *quality control* (QC) criteria for a specific QC *sample* for a specific method. Any results greater than the UAL are qualified.

upper confidence limit—The statistic that represents the upper bound of the arithmetic mean (usually 95%) of the measured data and that is used in a *risk assessment* as the reasonable maximum exposure point concentration.

upper tolerance limit—A statistical measure of the upper end of a distribution. The 95th percentile upper tolerance limit, which is the 95% upper percentile of the 95th percentile of the data distribution, is the *background value* used to represent the *background data* distribution for an inorganic *chemical* or naturally occurring *radionuclide*.

U.S. Department of Energy—The federal agency that sponsors energy research and regulates nuclear materials for weapons production.

U.S. Environmental Protection Agency (EPA)—The federal agency responsible for enforcing environmental laws. Although state regulatory agencies may be authorized to administer some of this responsibility, EPA retains oversight authority to ensure the protection of human health and the environment.

verification—A test or tests, generally performed before and after logging in lieu of a *calibration*, to ascertain whether the logging system is operating properly. Verification differs from calibration in that it does not provide updated system-calibration values.

water content—The amount of water in an unsaturated *medium*, expressed as the ratio of the weight of water in a *sample* to the weight of the oven-dried sample (often expressed as a percentage). (Also see *gravimetric moisture content*.)

welded tuff—A volcanic deposit hardened by the action of heat, pressures from overlying material, and hot gases.

well casing—A solid piece of pipe, typically steel or polyvinyl chloride (PVC) plastic, used to keep a well open in either unconsolidated materials or unstable rock and as a means to contain zone-isolation materials such as cement *grout* or *bentonite*.

work plan—A *document* that specifies the activities to be performed when implementing an investigation or remedy. At a minimum, the work plan should identify the scope of the work to be performed, specify the procedures to be used to perform the work, and present a schedule for performing the work. The work plan may also present the technical basis for performing the work.

A-3.0 METRIC CONVERSION TABLE

Multiply SI (Metric) Unit	by	To Obtain US Customary Unit
kilometers (km)	0.622	miles (mi)
kilometers (km)	3281	feet (ft)
meters (m)	3.281	feet (ft)
meters (m)	39.37	inches (in.)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.394	inches (in.)
millimeters (mm)	0.0394	inches (in.)
micrometers or microns (µm)	0.0000394	inches (in.)
square kilometers (km^2)	0.3861	square miles (mi^2)
hectares (ha)	2.5	acres
square meters (m^2)	10.764	square feet (ft^2)
cubic meters (m^3)	35.31	cubic feet (ft^3)
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter (g/cm^3)	62.422	pounds per cubic foot (lb/ft^3)
milligrams per kilogram (mg/kg)	1	parts per million (ppm)
micrograms per gram (µg/g)	1	parts per million (ppm)
liters (L)	0.26	gallons (gal.)
milligrams per liter (mg/L)	1	parts per million (ppm)
degrees Celsius (°C)	9/5 + 32	degrees Fahrenheit (°F)

A-4.0 DATA QUALIFIER DEFINITIONS

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

Appendix B

Supplemental Field Investigation Results

B-1.0 INTRODUCTION

This appendix discusses field analyses and the acceptability of field data. Los Alamos National Laboratory (the Laboratory) collected subsurface pore-gas samples from discrete instrumented zones within each borehole at Material Disposal Area (MDA) G. at Technical Area (TA) 54. The samples were selected after review of core and with the agreement of the New Mexico Environment Department (NMED).

During field measurements, vapor samples were monitored for percent oxygen; carbon dioxide; water vapor; 1,1,1-trichloroethane (TCA); trichloroethene (TCE); tetrachloroethene (PCE); and trichlorofluoromethane (Freon-11). These gasses were monitored during purging with a Brüel and Kjaer (B&K) multigas monitor (Type 1302) (Table B-1.0-1) and a Landtec GEM 500 (Table B-1.0-2). Pressure differential measurements between the sample-collection port and the surface were recorded using a Dwyer Series 475 Mark III Digital Manometer (Table B-1.0-3). Analytical measurements were collected only after all readings had stabilized. Each field instrument’s calibration was verified daily following the manufacturer’s specifications.

The B&K multigas monitor produces results that are sensitive and stable over long periods of time and that are useful for monitoring trends in volatile organic compound (VOC) concentrations in soil vapor over depth intervals and over time. However, readings from the B&K multigas monitor are subject to uncorrectable interferences from complex organic gas matrices. Subsurface vapor down to 200 ft below ground surface (bgs) in borehole (BH) 10 (location 54-24370) and at 50 ft bgs in BH-34 (location 54-24394) contained an interferent that severely depressed TCA concentrations, making them unusable. The results affected by this interferent are shaded in Table B-1.0-1. A comparison of concentrations resulting from B&K and U.S. Environmental Protection Agency (EPA) Method TO-15 analyses of TCA, TCE, PCE, and Freon-11 is presented in Figure B-1.0-1. This comparison shows the results of interferences on B&K analyses at each borehole. TCE is least susceptible to interferences. Biases created by interferences on PCE concentrations are most substantial. Despite the interferences, the B&K results are useful for monitoring trends in contaminants spatially and over time because the concentration biases created by interferences on the B&K analyses of PCE, TCA, and Freon-11 are consistent at each borehole. B&K measurements consistently show VOC concentrations decreasing with increasing depth in subsurface pore gas. Depth profiles from B&K analyses match the depth profiles of VOC concentrations of pore gas collected for analyses by EPA Method TO-15 (Figure B-1.0-1). Before sampling was performed, a calibration gas containing known concentrations of TCA, TCE, and Freon-11 was analyzed to confirm the instrument was producing readings within ±20% of the known concentrations. The analyses are not conducted if the instrument is not capable of reading within ±20% specifications.

The Landtec GEM-500 measures percent levels of carbon dioxide and oxygen. Landtec readings determine if a borehole is blocked or open and if a sampling port in a borehole and sample lines has purged completely. Before sampling is performed each day, ambient air containing known concentrations of 20.9% oxygen and 0.04% carbon dioxide is analyzed to confirm the instrument produces readings within ±20% of the known concentrations. Analyses are not conducted if the instrument is not capable of reading within ±20% specifications.

Field investigation results for differential pressure are measured using a Dwyer Series 475 Mark III digital manometer. The manometer readings determine if a borehole’s ports are blocked. Before each use, the positive and negative ports of the manometer are open to the same atmospheric conditions, and the digital reading is confirmed to be set to 0.00 kiloPascals (kPa). Analyses are not conducted if the instrument is not capable of reading zero when no pressure differential between the positive and negative terminals occurs.

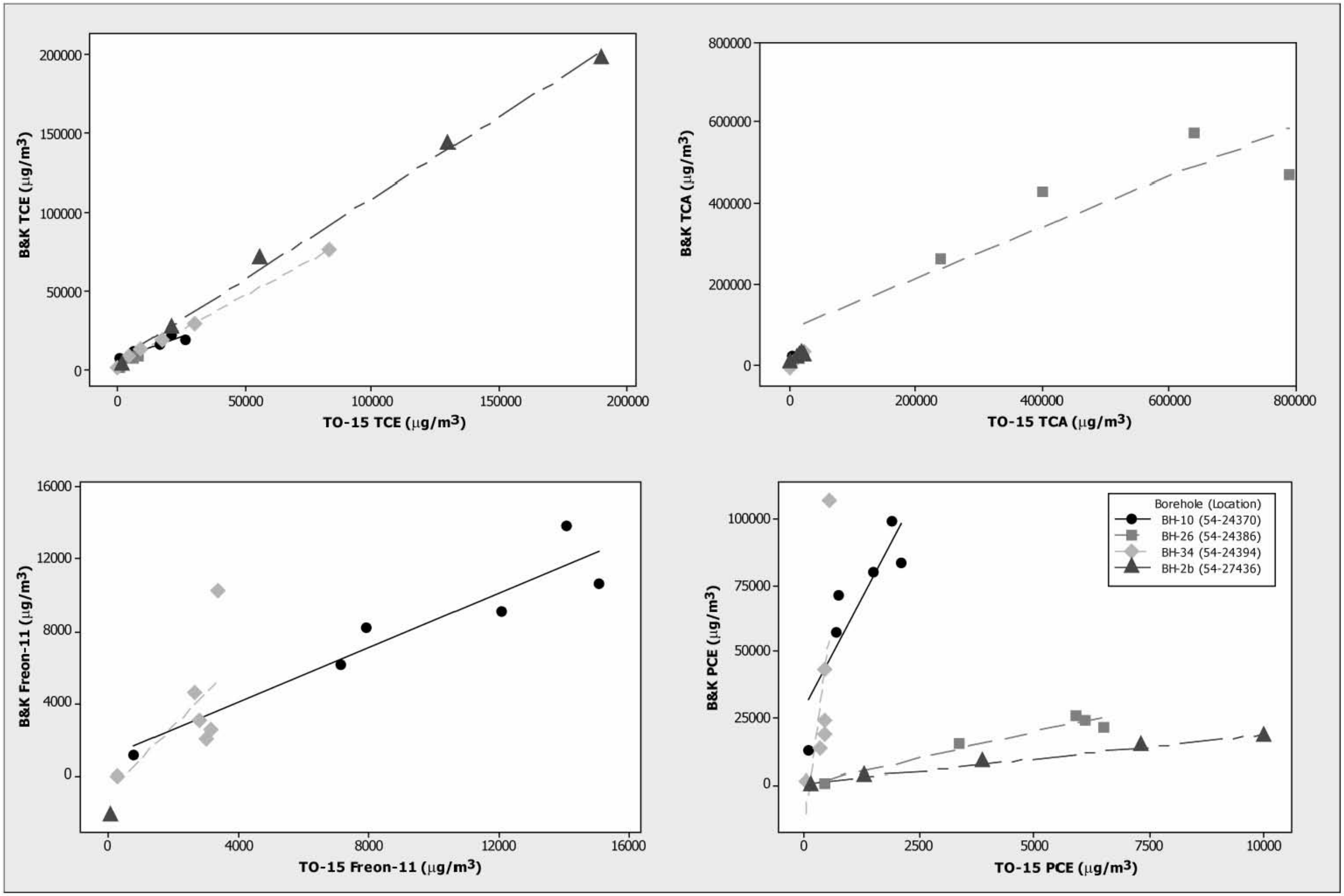


Figure B-1.0-1 Comparison of VOCs detected in colocated subsurface pore-gas samples by B&K and EPA Method TO-15 at MDA G

Table B-1.0-1
Field Investigation Results for VOCs Using a B&K Type 1302 Photoacoustic Gas Analyzer

Borehole ID	Borehole Location	Depth (ft)	Date	Time	TCA	TCE	Freon-11	PCE	CO2	H2O
BH-10	54-24370	40	2/26/2007	12:55	-116*	4.15	2.48	14.7	123000	12200
BH-10	54-24370	72.5	2/26/2007	13:10	-75.0*	3.70	1.89	12.3	85700	9080
BH-10	54-24370	120	3/8/2007	16:10	-35.0*	3.08	1.63	11.8	64600	9030
BH-10	54-24370	174.7	3/8/2007	16:04	-5.00*	2.21	1.09	8.44	41300	8610
BH-10	54-24370	200	3/8/2007	15:58	-6.20*	2.21	1.46	10.6	43500	8360
BH-10	54-24370	243.7	2/26/2007	13:20	4.68	1.34	0.215	1.97	8980	12400
BH-26	54-24386	40	2/15/2007	15:07	86.2	1.56	0.679	3.23	73500	10200
BH-26	54-24386	83	2/15/2007	15:20	106	1.70	0.786	3.56	45200	10600
BH-26	54-24386	117	2/15/2007	15:47	78.8	1.86	1.05	3.89	29700	10700
BH-26	54-24386	135	2/15/2007	15:35	49.0	1.32	0.624	2.34	24700	11000
BH-26	54-24386	195	2/15/2007	16:04	4.90	0.481	0.0436	0.0904	3850	10500
BH-34	54-24394	50	2/27/2007	13:26	-3.90*	14.1	1.83	15.8	22100	12000
BH-34	54-24394	100	2/27/2007	14:36	5.91	5.60	0.813	6.46	19100	12000
BH-34	54-24394	150	2/27/2007	14:26	4.47	3.51	0.537	3.60	18500	11800
BH-34	54-24394	192.5	2/27/2007	14:10	3.35	2.64	0.462	2.78	17000	11900
BH-34	54-24394	245.24	2/27/2007	13:58	2.16	1.83	0.373	2.07	15200	12000
BH-34	54-24394	300.5	2/27/2007	13:44	-0.593	0.384	0.00504	0.244	2480	11700
BH-2b	54-27436	45	2/28/2007	10:10	4.62	36.6	-0.00100	2.68	11900	11600
BH-2b	54-27436	70	2/28/2007	10:23	5.32	26.5	0.0170	2.14	11700	11200
BH-2b	54-27436	115	2/28/2007	10:33	4.29	13.1	0.0113	1.24	11400	7560
BH-2b	54-27436	163	3/1/2007	10:17	3.32	5.06	-0.0200	0.513	8320	8810
BH-2b	54-27436	185	3/1/2007	10:33	0.741	0.690	-0.38	0.0465	2610	8400

*Shading indicates that interference was observed.

Table B-1.0-2
Field Investigation Results for Carbon Dioxide and Oxygen Using a Landtec GEM-500

Borehole ID	Borehole No.	Depth (ft)	Date	Time	CO_2 Landtec	O_2 Landtec
BH-10	54-24370	40	2/26/2007	12:55	11.8	7.5
BH-10	54-24370	72.5	2/26/2007	13:10	11.6	7.5
BH-10	54-24370	120	3/8/2007	16:10	8.10	11.4
BH-10	54-24370	174.7	3/8/2007	16:04	4.5	14.8
BH-10	54-24370	200	3/8/2007	15:58	3.80	8.4
BH-10	54-24370	243.7	2/26/2007	13:10	0.3	20.4
BH-26	54-24386	40	2/15/2007	15:07	6.9	10.4
BH-26	54-24386	83	2/15/2007	15:20	4.3	14.4
BH-26	54-24386	117	2/15/2007	15:47	2.9	16.8
BH-26	54-24386	135	2/15/2007	15:35	2.4	16.8
BH-26	54-24386	195	2/15/2007	16:04	0.2	20.2
BH-34	54-24394	50	2/27/2007	13:26	—*	—
BH-34	54-24394	100	2/27/2007	14:36	—	—
BH-34	54-24394	150	2/27/2007	14:26	—	—
BH-34	54-24394	192.5	2/27/2007	14:10	—	—
BH-34	54-24394	245.25	2/27/2007	13:58	—	—
BH-34	54-24394	300.5	2/27/2007	13:44	—	—
BH-2b	54-27436	45	2/28/2007	10:10	—	—
BH-2b	54-27436	70	2/28/2007	10:23	—	—
BH-2b	54-27436	115	2/28/2007	10:33	—	—
BH-2b	54-27436	163	3/1/2007	10:17	—	—
BH-2b	54-27436	185	3/1/2007	10:33	—	—

*— = Measurement not collected because of instrument malfunction.

Table B-1.0-3
Field Investigation Results for Differential Pressure Using a Dwyer Series 475 Mark III Digital Manometer

Borehole No	Depth (ft)	Date	Time	Pressure Differential
54-24370	40	2/26/2007	12:55	0.03
54-24370	72.5	2/26/2007	13:10	0.15
54-24370	120	3/8/2007	16:10	0.34
54-24370	174.7	3/8/2007	16:04	0.42
54-24370	200	3/8/2007	15:58	0.39
54-24370	243.7	2/26/2007	13:10	0.21
54-24386	40	2/15/2007	15:07	-0.03
54-24386	83	2/15/2007	15:20	-0.05
54-24386	117	2/15/2007	15:47	-0.18
54-24386	135	2/15/2007	15:35	-0.18
54-24386	195	2/15/2007	16:04	0.00
54-24394	50	2/27/2007	13:26	0.04
54-24394	100	2/27/2007	14:36	0.22
54-24394	150	2/27/2007	14:26	0.24
54-24394	192.5	2/27/2007	14:10	0.23
54-24394	245.25	2/27/2007	13:58	0.24
54-24394	300.5	2/27/2007	13:44	0.23
54-27436	45	2/28/2007	10:10	0.06
54-27436	70	2/28/2007	10:23	0.20
54-27436	115	2/28/2007	10:33	0.34
54-27436	163	3/1/2007	10:17	-0.23
54-27436	185	3/1/2007	10:33	-0.13

Appendix C

Quality Assurance/Quality Control Program

C-1.0 INTRODUCTION

This appendix discusses analytical methods, data quality objectives, and data quality review. Quality assurance (QA), quality control (QC), and data validation procedures were implemented in accordance with the "Quality Assurance Project Plan Requirements for Sampling and Analysis" (LANL 1996, 054609), and the Los Alamos National Laboratory's (the Laboratory's or LANL's) statement of work (SOW) for analytical laboratories (LANL 2000, 071233). The results of the QA/QC procedures were used to estimate the accuracy, bias, and precision of the analytical measurements. Samples for QC include method blanks, blank spikes, matrix spikes, laboratory control samples (LCSs), internal standards, initial and continuing calibrations, surrogates, and tracers.

The type and frequency of QC analyses are described in the analytical laboratories SOW (LANL 2000, 071233). Other QC factors, such as sample preservation and holding times, were also assessed in accordance with the requirements outlined in the Standard Operating Procedure (SOP) 01.02, Sample Containers and Preservation. A focused data validation was also performed for each data package (also referred to as request numbers). The SOPs used for data validation are provided in Table C-1.0-1. The focused validation included a more detailed review of the data generated by the analytical laboratory. The analytical data and instrument printouts used during focused validation are provided in Appendix E.

Analytical data were reviewed and evaluated based on U.S. Environmental Protection Agency (EPA) National Functional Guidelines for organic chemical data review where applicable (EPA 1999, 066649). Data have also been assessed using guidelines established in SW-846 (EPA 1997, 057589). As a result of the data validation and assessment efforts, qualifiers are assigned to the analytical records.

C-2.0 ANALYSIS SUMMARY

From February 15 to March 1, 2007, 22 pore-gas samples and four field duplicate samples were collected at Material Disposal Area (MDA) G at Technical Area (TA) 54 for analysis of volatile organic compounds (VOCs) using EPA Method TO-15. All QC procedures were followed as required by the analytical laboratories SOW (LANL 2000, 071233). Table C-2.0-1 lists the analytical methods used for organic chemical analysis

From February 21 to 23, 2007, six pore-gas samples and one field duplicate sample were collected for tritium analysis using EPA Method 906.0 (NESHAP Part 61, Appendix B). All QC procedures were followed as required by the analytical laboratories SOW (LANL 2000, 071233). Table C-2.0-2 lists the analytical methods used for radionuclide analyses.

C-3.0 ORGANIC CHEMICAL ANALYSES

The requirements of the analytical methods for VOCs were followed and are summarized in this section. The required estimated quantitation limit (EQL) was met for each analyte and all QC procedures were followed as required by the analytical laboratories SOW (LANL 2000, 071233).

C-3.1 Maintenance of Chain of Custody

Chain of custody was properly maintained for all samples.

C-3.2 Sample Documentation and Dilutions

The samples were properly documented in the field.

C-3.3 Sample Preservation

The preservation criteria were met for all samples.

C-3.4 Holding Times

The holding times were met for all samples.

C-3.5 Initial and Continuing Calibrations

Initial calibration criteria were met for all samples. Continuing calibration criteria were met for all but three VOCs, propylene (eight affected records), chloromethane (eight affected records), and 1-butanol (22 affected records), in 22 pore-gas samples analyzed by EPA Method TO-15. Continuing calibration percent differences (%D) were occasionally greater than 25% for these VOCs. The reported values for the 38 affected pore-gas records are usable for all risk and characterization purposes but have been qualified with UJ and are an estimate of the sample-specific quantitation limits or detection limits.

C-3.6 Analyte Identification

Analyte identification criteria were met for all the VOC pore gas samples. Four VOC samples did not meet the mass spectral criteria and are qualified as not detected (U).

C-3.7 Analyte Quantitation

Analyte quantitation criteria were met for all VOC analytical results.

C-3.8 Method Blanks

The method blank results for all VOC analysis were within acceptable limits.

C-3.9 Matrix Spike Recoveries

Matrix spike recoveries for all VOC analysis were within acceptable limits.

C-3.10 Surrogate Recoveries and Internal Standard Responses

Surrogate recoveries for VOC analysis were within acceptable limits. Internal standard responses for VOC analysis were within acceptable limits.

C-3.11 LCS Recoveries

The LCS recoveries were within acceptance limits.

C-3.12 Laboratory and Field Duplicates

Laboratory duplicate precision is not evaluated for organic chemicals.

Field duplicate precision criteria were met for all but one field duplicate sample. The field duplicate and corresponding sample results of 1100 µg/m^3 and 730 µg/m^3, respectively, for 1,1-dichloroethene in borehole (BH) 2b (location 54-27436) at 115 ft below ground surface (bgs) yield a duplicate relative percent difference (RPD) of 40.4%. No qualification of sample results is necessary based field duplicate precision.

C-3.13 Field Blanks

Field blank sample results were within acceptable limits for all but one of the pore gas sample analyses. A single sample was analyzed to contain 2-butanone at 4.6 µg/kg; however, this result is within 5 times the field blank result of 3 µg/kg, indicating that the result of this sample may be from contamination. However, no qualification is performed based on field blank contamination.

C-4.0 RADIONUCLIDE ANALYSES

The requirements of the analytical methods for radionuclide were followed and are summarized in this section. The required minimum detectable activity was met for each analyte and all QC procedures were followed as required by the analytical laboratories SOW (LANL 2000, 071233).

C-4.1 Maintenance of Chain of Custody

Chain of custody was properly maintained for all samples.

C-4.2 Sample Documentation and Dilutions

Samples were properly documented in the field.

C-4.3 Sample Preservation

Preservation criteria were met for all samples.

C-4.4 Holding Times

Holding times were met for all samples.

C-4.5 Initial and Continuing Calibrations

Initial and continuing calibrations are acceptable for all.

C-4.6 Analyte Identification

Analyte identification criteria were met for all.

C-4.7 Analyte Quantitation

Analyte quantitation criteria were met for all.

C-4.8 Method Blanks

The method blank results for radionuclide analysis were within acceptable limits.

C-4.9 Matrix Spike Recoveries

The matrix spike recoveries for radionuclide analyses were within acceptable limits.

C-4.10 Carrier and Tracer Recoveries

The tracer and carrier recoveries for radionuclide analyses were within acceptable limits.

C-4.11 LCS Recoveries

Recoveries of LCSs for radionuclide analyses were within acceptable limits.

C-4.12 Laboratory and Field Duplicates

The field duplicate collected for radionuclide analysis indicate poor precision. The field duplicate and corresponding sample results of 4470 pCi/L and 1750 pCi/L respectively for tritium in BH-37 (location 54-24397) at 239 ft bgs yield a duplicate RPD of 87%. No qualification is performed based on field duplicate precision.

C-4.13 Field Blanks

Tritium was detected in the field blank at a concentration of 1270 pCi/L. The concentration of tritium in BH-37 (location 5-24397) at 239 ft bgs is 1750 pCi/L. This sample result is within 5 times the field blank result, indicating that the result in this sample could be the result of contamination. Qualification is performed based on field blank contamination.

C-5.0 REFERENCES

The following list includes all documents cited in this appendix. 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 New Mexico Environment Department Hazardous Waste Bureau; the U.S. Department of Energy–Los Alamos Site Office; EPA, 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.

EPA (U.S. Environmental Protection Agency), 1997. "Test Methods for Evaluating Solid Waste, Laboratory Manual, Physical/Chemical Methods," SW-846, 3rd ed., Update III, Office of Solid Waste and Emergency Response, Washington, D.C. (EPA 1997, 057589)

EPA (U.S. Environmental Protection Agency), October 1, 1999. “USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review,” EPA540/R-99/008, Office of Solid Waste and Emergency Response, Washington, D.C. (EPA 1999, 066649)

LANL (Los Alamos National Laboratory), March 1996. “Quality Assurance Project Plan Requirements for Sampling and Analysis,” Los Alamos National Laboratory document LA-UR-96-441, Los Alamos, New Mexico. (LANL 1996, 054609)

LANL (Los Alamos National Laboratory), December 2000. “University of California, Los Alamos National Laboratory (LANL), I8980SOW0-8S, Statement of Work for Analytical Laboratories,” Rev. 1, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2000, 071233)

Table C-1.0-1
Data Analysis and Assessment Procedures

Procedure Identifier	Title	Effective Date
SOP-15.01, Rev. 1	Routine Validation of Volatile Organic Data	04/20/2004
SOP-15.07, R1, ICN1	Routine Validation of Chemical Separation Alpha Spectrometry, Gas Proportional Counting, and Liquid Scintillation Data	04/20/2004

Table C-2.0-1
Analytical Methods Used for Organic Chemical Analyses

Analytical Method	Analytical Description	Target Compound List
EPA Method TO-15 – Sampling and Analysis	VOCs in air	Analytical services SOW (LANL 2000, 071233)

Table C-2.0-2
Analytical Methods Used for Radionuclide Analyses

Analytical Method	Analytical Technique	Radionuclides
EPA Method 114 – Sampling EPA Method 114 – Extraction EPA Method 906.0 – Analysis	Liquid scintillation in air	Tritium

Appendix D

Analytical Data, Analytical Reports,
Data Validation Reports, and Chain-of-Custody Forms
(on CD included with this document)

Appendix E

Review of Analytical Data

E-1.0 INTRODUCTION

This appendix describes the data for the addendum to the Material Disposal Area (MDA) G investigation report at Los Alamos National Laboratory (the Laboratory or LANL). The data are used to evaluate the nature and extent of volatile organic compound (VOC) contamination at Material Disposal Area (MDA) G, as measured by pore-gas analysis. The pore-gas data are discussed in separate sections of this appendix. Also included in this appendix are the ambient-air data collected in 1994 and analyses of these data, originally presented in the Technical Area (TA) 54 Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) report (LANL 2000, 064360). These data and the analyses were not included in the MDA G investigation report (LANL 2005, 090513) because the potential risks/dose from exposure to VOCs and tritium in ambient air, as presented in the TA-54 RFI report (LANL 2000, 064360), were below the applicable target levels (dose of 15 mrem/yr, hazard index [HI] of 1.0, and total excess cancer risk of 1×10^{-5}). The results of the previous investigation are presented in response to a comment from the New Mexico Environment Department (NMED) in the July 26, 2006, notice of disapproval for the MDA G investigation report (NMED 2006, 092513).

E-2.0 SUMMARY OF SAMPLES COLLECTED

Subsurface Vapor Sampling Summary

After drilling was completed, boreholes (BHs) were instrumented. Pore-gas samples were collected for VOC analysis from all boreholes following Standard Operating Procedure (SOP) 06.31, Sampling of Subatmospheric Air, from instrumented ports within the borehole after allowing for equilibration of pore gas in the filter pack sand. Each interval was purged before sampling, until the 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 a contract analytical laboratory for VOC analysis using U.S. Environmental Protection Agency (EPA) Method TO-15.

Moisture in pore gas was also collected to determine the lateral and vertical extent of the subsurface tritium release at BH-37 (location 54-24397). Samples for tritium analysis were collected in silica gel samplers for analysis using EPA Method 906.0. The samples were collected as water vapor by pulling pore gas through columns filled with absorbent silica gel in accordance with SOP-06.31. After allowing for equilibration, the newly completed borehole was sampled from approximately the 40-ft-depth interval corresponding to each geologic unit. Quality assurance (QA)/quality control (QC) samples, including a field duplicate and a field blank sample, were collected according to applicable SOPs.

QA/QC samples for VOCs and tritium in pore gas consisted of an equipment blank or a field blank and field duplicate. A field duplicate sample was collected to evaluate the reproducibility of the sampling technique. After sampling and purge decontamination, an equipment blank for VOCs was collected by pulling zero gas (99.9% ultrahigh-purity nitrogen) through the packer-sampling apparatus. A field blank was collected during tritium sampling by pulling ambient air through a sample column during sample collection. The VOC equipment blank sample was used to evaluate decontamination procedures. The tritium field blank sample was used to evaluate tritium contamination in the field. QA/QC samples were collected in accordance with SOP-01.05, Field Quality Control Samples.

E-3.0 MDA G DATA REVIEW

E-3.1 Subsurface Vapor Sample Data

In each borehole, pore-gas samples were collected at the instrumented depths. Pore-gas samples were sent to an off-site laboratory for analysis of VOCs or tritium. Table E-3.1-1 shows the frequency of detected VOCs. Table E-3.1-2 shows the frequency of detected tritium.

Samples from the boreholes installed during this supplemental investigation reported detected concentrations of multiple VOCs. Table E-3.1-3 presents the VOCs detected in pore gas by depth in each borehole. Figure 4.1-1 of the investigation report (LANL 2005, 090513) shows the VOCs detected in pore-gas samples at MDA G. The primary VOC detected in pore gas across most of MDA G was 1,1,1-trichloroethane (TCA), followed by trichloroethene (TCE), tetrachloroethene (PCE), and 1,1,2-trichloro-1,2,2-trifluoroethane (Freon-113). The concentrations of TCA ranged from 880 $\mu g/m^3$ to 790,000 $\mu g/m^3$. The highest concentrations of TCA were detected in BH-26 (location 54-24386) at 40 ft below ground surface (bgs). Concentrations of all VOCs decrease with depth at each borehole sampled.

Dichloroethane[1,1-] (DCA), dichloroethene[1,1-] (DCE), PCE, Freon-113, TCA, and TCE were detected in the deepest sample interval within the Cerros del Rio basalts from each borehole collected. The concentrations of each VOC detected in basalt were less than the concentrations detected at shallower depths.

In addition to the chlorinated VOCs, fluorinated VOCs were detected beneath MDA G. Freon-113 was detected in all four boreholes at concentrations ranging from 120 $\mu g/m^3$ to 73,000 $\mu g/m^3$. The highest concentration was found in BH-34 (location 54-24394) at 50 ft bgs in the western portion of MDA G. The concentrations of Freon-113 in basalt were less than the concentrations detected at shallower depths. The ratios of chlorinated VOCs to fluorinated VOCs vary across MDA G. Freon-113 to TCA ratios (2.28 at 50 ft bgs to 0.53 at 300 ft bgs) are greatest at BH-34 (location 54-24394) and are lowest (0.01 at all depths) at BH-26 (location 54-24386).

Samples collected from BH-37 (location 54-24397) contained tritium concentrations ranging from 1750 pCi/L at 239 ft in the Cerros del Rio basalts to 4,480,000 pCi/L at 50 ft (Table E-3.1-4). The tritium concentrations decreased with depth in BH-37.

Subsurface Vapor Contamination Summary for MDA G

Analytical results from pore-gas samples collected confirm 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 DCA, DCE, 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. The plumes were found to be diffusion-driven from historical VOC sources in the eastern and western shaft fields, limited laterally by the mesa edges, and limited at depth by the Cerros del Rio basalt layer. No evidence of a free liquid release was found. Ratios of concentrations of VOCs confirm multiple heterogeneous sources across MDA G. The recent data also confirm that the VOC plumes are in a near-steady state, and vapor-phase concentrations do not indicate the presence of a free liquid source in the subsurface beneath MDA G.

Tritium was detected in each pore-gas sample collected from BH-37 (location 54-24397); previous sampling at this location showed tritium concentrations increasing from the 15–17-ft interval to the 125–127-ft interval (LANL 2006, 093269). This borehole was extended from 200 ft bgs to 244 ft bgs, and four permanent sampling ports were emplaced below 127 ft bgs. The tritium results from samples collected at the newly emplaced ports show that tritium concentrations below 50 ft bgs decrease by more than 3 orders of magnitude to the basalt.

E-3.2 Screening of Pore-Gas Data Based on Potential Groundwater Contamination

VOC results from pore-gas sampling were screened to evaluate whether concentrations of VOCs in the subsurface pore gas would be of concern as a potential source of groundwater contamination. Because no screening levels for pore gas address potential for groundwater contamination, the screening evaluation was based on groundwater cleanup levels contained in the March 1, 2005, Compliance Order on Consent (the Consent Order) and Henry's Law constants that describe the equilibrium relationship between vapor and water concentrations. The source of the Henry's Law constants was the NMED soil screening level technical background document (NMED 2006, 092513). If Henry's Law constants were not available from this source, they were obtained from the Pennsylvania Department of Environmental Protection chemical- and physical-properties database at the following URL: http://www.dep.state.pa.us/physicalproperties/Default.htm. The following dimensionless form of Henry's Law constant was used:

$$H' = \frac{C_{air}}{C_{water}} \qquad \textbf{Equation E-1}$$

where C_{air} is the volumetric concentration of contaminant in air and C_{water} is the volumetric concentration of contaminant in water. Equation E-1 can be used to calculate the following screening value:

$$SV = \frac{C_{air}}{1{,}000 \times H' \times SL} \qquad \textbf{Equation E-2}$$

where C_{air} is the concentration of VOC in the pore-gas sample ($\mu g/m^3$), H' is the dimensionless Henry's Law constant, SL is the screening level (µg/L) and 1000 is a conversion factor from L to m^3. The SLs are groundwater cleanup levels specified in the Consent Order. These are the EPA maximum contaminant level (MCL) or New Mexico Water Quality Control Commission (WQCC) groundwater standard, whichever is lower. As specified in the Consent Order, if no MCL or WQCC standard is available, the EPA Region 6 human health medium-specific screening level (HHMSSL) for tap water is used (adjusted to 10^{-5} risk for carcinogens). The numerator in Equation E-2 is the actual concentration of VOC in pore gas, and the denominator represents the concentration in pore gas that is needed to exceed the SL. Therefore, if the screening value (SV) is less than 1, the concentration of VOC in pore gas is not sufficiently high to cause the water SL to be exceeded, even if the VOC plume were in contact with groundwater.

Equation E-2 was used to screen the VOC pore-gas data for the supplemental investigation at MDA G. The screening was performed using the maximum detected value from the deepest stratigraphic unit sampled, which is the Cerros del Rio basalt. Data from the deepest unit were used in the screening because this unit is closest to the regional aquifer. As shown in Table E-3.2-1, 16 VOCs having MCLs, WQCC standards, and/or HHMSSLs were detected in samples collected from the Cerros del Rio basalt at MDA G. These results show that the SV is below 1 in every case. Based on these screening results, the VOCs detected in subsurface pore gas at MDA G do not presently appear to be a potential source of groundwater contamination.

E-4.0 REFERENCES

The following list includes all documents cited in this appendix. 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.

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NMED (New Mexico Environment Department), June 2006. “Technical Background Document for Development of Soil Screening Levels, Revision 4.0, Volume 1, Tier 1: Soil Screening Guidance Technical Background Document,” New Mexico Environment Department, Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, Santa Fe, New Mexico. (NMED 2006, 092513)

Table E-3.1-1
Frequency of VOCs Detected in Pore-Gas Samples at MDA G

Analyte	Number of Analyses	Number of Detects	Number of Detected Locations	Concentration Range (µg/m^3)	Location (Depth) of Min Detected	Location (Depth) of Max Detected
Tetrachloroethene	22	22	4	45–10000	54-24394 (300 ft)	54-27436 (45 ft)
Trichloroethane[1,1,1-]	22	22	4	880–790000	54-24394 (300 ft)	54-24386 (40 ft)
Dichloroethane[1,1-]	22	22	4	39–36000	54-24394 (300 ft)	54-24386 (40 ft)
Dichloroethene[1,1-]	22	22	4	180–56000	54-24394 (300 ft)	54-24386 (135 ft)
Trichloro-1,2,2-trifluoroethane[1,1,2-]	22	22	4	120–73000	54-27436 (185 ft)	54-24394 (50 ft)
Trichloroethene	22	22	4	290–190000	54-24394 (300 ft)	54-27436 (45 ft)
Dichlorodifluoromethane	22	15	3	[62]*–19000	54-24386 (195 ft)	54-24370 (120 ft)
Trichlorofluoromethane	22	13	3	31–15000	54-27436 (185 ft)	54-24370 (80 ft)
Chloroform	22	12	3	4.5–[2100]	54-24394 (300 ft)	54-24386 (40 ft)
Methylene Chloride	22	11	3	[3.1]–[1500]	54-24394 (300 ft)	54-24386 (40 ft)
Carbon Disulfide	22	7	3	[3.6]–2100	54-27436 (185 ft)	54-24386 (40 ft)
Cyclohexane	22	6	2	[12]–[1500]	54-24370 (233 ft)	54-24386 (40 ft)
Dichloroethene[cis-1,2-]	22	6	1	[3.5]–[1700]	54-24394 (300 ft)	54-24386 (40 ft)
Toluene	22	3	2	[3.4]–4700	54-24394 (300 ft)	54-24386 (135 ft)
Chlorodifluoromethane	22	3	1	14 – [6200]	54-24394 (300 ft)	54-24386 (40 ft)
Acetone	22	2	2	[8.5]–[4200]	54-24394 (300 ft)	54-24386 (40 ft)
Chloroethane	22	1	1	[2.4]–[1200]	54-24394 (300 ft)	54-24386 (40 ft)
Butanone[2-]	22	1	1	[2.6]–[1500]	54-24394 (300 ft)	54-24386 (135 ft)

*The concentration in brackets was not detected.

Table E-3.1-2
Frequency of Tritium Detected in Pore-Gas Samples at MDA G

Analyte	Number of Analyses	Number of Detects	Number of Detected Locations	Concentration Range (µg/m^3)	Location (Depth) of Min Detected	Location (Depth) of Max Detected
Tritium	6	6	1	1750–4480000	54-24397 (239 ft)	54-24397 (50 ft)

Table E-3.1-3
VOCs Detected in Pore-Gas Samples at MDA G

Borehole ID/ Location	Depth (ft)	Sample ID	Analyte	Result (µg/m³)
BH-10 54-24370	35–45	MD54-07-75257	Chloroform	660
			Dichlorodifluoromethane	13,000
			Dichloroethane[1,1-]	15,000
			Dichloroethene[1,1-]	5100
			Dichloroethene[cis-1,2-]	470
			Tetrachloroethene	1900
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	44,000
			Trichloroethane[1,1,1-]	170,000
			Trichloroethene	21,000
			Trichlorofluoromethane	14,000
	67.5–77.5	MD54-07-75258	Chloroform	740
			Dichlorodifluoromethane	17,000
			Dichloroethane[1,1-]	18,000
			Dichloroethene[1,1-]	7000
			Dichloroethene[cis-1,2-]	700
			Tetrachloroethene	2100
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	50,000
			Trichloroethane[1,1,1-]	190,000
			Trichloroethene	26,000
			Trichlorofluoromethane	15,000
	115–125	MD54-07-75259	Chloroform	510
			Dichlorodifluoromethane	19,000
			Dichloroethane[1,1-]	12,000
			Dichloroethene[1,1-]	6400
			Dichloroethene[cis-1,2-]	620
			Methylene Chloride	420
			Tetrachloroethene	1500
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	39,000
			Trichloroethane[1,1,1-]	120,000
			Trichloroethene	16,000
			Trichlorofluoromethane	12,000
	169.5–180	MD54-07-75260	Carbon Disulfide	120
			Chloroethane	93
			Chloroform	160
			Dichlorodifluoromethane	13,000
			Dichloroethane[1,1-]	4000
			Dichloroethene[1,1-]	4300

Table E-3.1-3 (continued)

Borehole ID/ Location	Depth (ft)	Sample ID	Analyte	Result (µg/m³)
			Dichloroethene[cis-1,2-]	270
			Methylene Chloride	430
			Tetrachloroethene	690
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	22,000
			Trichloroethane[1,1,1-]	53,000
			Trichloroethene	6000
			Trichlorofluoromethane	7100
	195–205	MD54-07-75262	Dichlorodifluoromethane	15,000
			Dichloroethane[1,1-]	3400
			Dichloroethene[1,1-]	4900
			Dichloroethene[cis-1,2-]	280
			Methylene Chloride	460
			Tetrachloroethene	740
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	23,000
			Trichloroethane[1,1,1-]	54,000
			Trichloroethene	6300
			Trichlorofluoromethane	7900
	237.5–249.5	MD54-07-75261	Dichlorodifluoromethane	1500
			Dichloroethane[1,1-]	240
			Dichloroethene[1,1-]	630
			Dichloroethene[cis-1,2-]	15
			Methylene Chloride	37
			Tetrachloroethene	120
			Toluene	170
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	2400
			Trichloroethane[1,1,1-]	4900
			Trichloroethene	560
			Trichlorofluoromethane	800
BH-26 54-24386	37.5–42.5	MD54-07-75263	Carbon Disulfide	2100
			Dichloroethane[1,1-]	36,000
			Dichloroethene[1,1-]	41,000
			Tetrachloroethene	6500
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	4700
			Trichloroethane[1,1,1-]	790,000
			Trichloroethene	6400
	80.5–86	MD54-07-75264	Carbon Disulfide	1200
			Dichloroethane[1,1-]	32,000
			Dichloroethene[1,1-]	46,000

Table E-3.1-3 (continued)

Borehole ID/ Location	Depth (ft)	Sample ID	Analyte	Result ($\mu g/m^3$)
			Tetrachloroethene	6100
			Toluene	1200
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	4000
			Trichloroethane[1,1,1-]	640,000
			Trichloroethene	7900
	115–120	MD54-07-75266	Acetone	2600
			Carbon Disulfide	1300
			Dichloroethane[1,1-]	32,000
			Dichloroethene[1,1-]	56,000
			Tetrachloroethene	5900
			Toluene	4700
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	2800
			Trichloroethane[1,1,1-]	400,000
			Trichloroethene	8300
	130–136	MD54-07-75265	Carbon Disulfide	620
			Dichloroethane[1,1-]	17,000
			Dichloroethene[1,1-]	33,000
			Tetrachloroethene	3400
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	1600
			Trichloroethane[1,1,1-]	240,000
			Trichloroethene	4800
	191–201	MD54-07-75267	Dichloroethane[1,1-]	1900
			Dichloroethene[1,1-]	3400
			Tetrachloroethene	440
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	200
			Trichloroethane[1,1,1-]	23,000
			Trichloroethene	600
BH-34 54-24394	45–55	MD54-07-75268	Carbon Disulfide	190
			Dichlorodifluoromethane	1400
			Dichloroethane[1,1-]	2300
			Dichloroethene[1,1-]	1100
			Methylene Chloride	280
			Tetrachloroethene	540
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	73,000
			Trichloroethane[1,1,1-]	32,000
			Trichloroethene	83,000
			Trichlorofluoromethane	3300

Table E-3.1-3 (continued)

Borehole ID/ Location	Depth (ft)	Sample ID	Analyte	Result (µg/m³)
	95–105	MD54-07-75269	Chloroform	140
			Cyclohexane	340
			Dichlorodifluoromethane	1500
			Dichloroethane[1,1-]	1700
			Dichloroethene[1,1-]	1100
			Tetrachloroethene	450
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	28,000
			Trichloroethane[1,1,1-]	22,000
			Trichloroethene	30,000
			Trichlorofluoromethane	2600
	145–154.8	MD54-07-75270	Chloroform	130
			Cyclohexane	270
			Dichlorodifluoromethane	1900
			Dichloroethane[1,1-]	1200
			Dichloroethene[1,1-]	1100
			Methylene Chloride	74
			Tetrachloroethene	470
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	13,000
			Trichloroethane[1,1,1-]	16,000
			Trichloroethene	17,000
			Trichlorofluoromethane	2800
	190–195	MD54-07-75271	Chlorodifluoromethane	130
			Chloroform	110
			Cyclohexane	210
			Dichlorodifluoromethane	2200
			Dichloroethane[1,1-]	760
			Dichloroethene[1,1-]	990
			Methylene Chloride	60
			Tetrachloroethene	480
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	9000
			Trichloroethane[1,1,1-]	13,000
			Trichloroethene	9400
			Trichlorofluoromethane	3100
	240–250	MD54-07-75272	Chlorodifluoromethane	140
			Chloroform	71
			Cyclohexane	150
			Dichlorodifluoromethane	2200
			Dichloroethane[1,1-]	390

Table E-3.1-3 (continued)

Borehole ID/ Location	Depth (ft)	Sample ID	Analyte	Result (µg/m³)
			Dichloroethene[1,1-]	980
			Methylene Chloride	58
			Tetrachloroethene	380
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	6000
			Trichloroethane[1,1,1-]	9100
			Trichloroethene	4200
			Trichlorofluoromethane	3000
	296.5–306.5	MD54-07-75273	Carbon Disulfide	3.9
			Chlorodifluoromethane	14
			Chloroform	4.5
			Cyclohexane	15
			Dichlorodifluoromethane	220
			Dichloroethane[1,1-]	39
			Dichloroethene[1,1-]	180
			Tetrachloroethene	45
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	470
			Trichloroethane[1,1,1-]	880
			Trichloroethene	290
			Trichlorofluoromethane	250
BH-2b 54-27436	40–50	MD54-07-75251	Dichloroethane[1,1-]	1100
			Dichloroethene[1,1-]	860
			Tetrachloroethene	10,000
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	1500
			Trichloroethane[1,1,1-]	21,000
			Trichloroethene	190,000
	65–75	MD54-07-75252	Dichloroethane[1,1-]	1100
			Dichloroethene[1,1-]	910
			Tetrachloroethene	7300
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	1400
			Trichloroethane[1,1,1-]	20,000
			Trichloroethene	130,000
	110–120	MD54-07-75253	Chloroform	360
			Dichlorodifluoromethane	400
			Dichloroethane[1,1-]	1200
			Dichloroethene[1,1-]	730
			Methylene Chloride	230
			Tetrachloroethene	3900
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	910

Table E-3.1-3 (continued)

Borehole ID/ Location	Depth (ft)	Sample ID	Analyte	Result (µg/m^3)
			Trichloroethane[1,1,1-]	16,000
			Trichloroethene	56,000
	160–166	MD54-07-75254	Chloroform	330
			Dichlorodifluoromethane	290
			Dichloroethane[1,1-]	940
			Dichloroethene[1,1-]	680
			Methylene Chloride	100
			Tetrachloroethene	1300
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	440
			Trichloroethane[1,1,1-]	10,000
			Trichloroethene	21,000
	180–191.5	MD54-07-75255	Acetone	20
			Butanone[2-]	4.6
			Chloroform	34
			Cyclohexane	27
			Dichlorodifluoromethane	64
			Dichloroethane[1,1-]	130
			Dichloroethene[1,1-]	230
			Methylene Chloride	10
			Tetrachloroethene	160
			Trichloro-1,2,2-trifluoroethane[1,1,2-]	120
			Trichloroethane[1,1,1-]	1700
			Trichloroethene	1800
			Trichlorofluoromethane	31

Table E-3.1-4
Tritium Detected in Pore Gas beneath MDA G

Borehole Location	Depth (ft)	Sample ID	Concentration* (pCi/L)
54-24397	45–55	MD54-07-75283	4,480,000
54-24397	84–95	MD54-07-75284	536,000
54-24397	125–135	MD54-07-75285	270,000
54-24397	160–168	MD54-07-75286	53,900
54-24397	184–192	MD54-07-75287	102,800
54-24397	232.5–244.3	MD54-07-75288	1750

*Concentration of tritium in moisture extracted from pore gas.

Table E-3.2-1
Results of Pore-Gas Screening for MDA G Based on Maximum Detected Concentration in Basalt

Chemical	Maximum Detected Concentration, µg/m³	H'	Groundwater SL (µg/L)	Screening Value
Trichloroethene	1800	0.422	5[a]	8.5E-01
Dichloroethene[1,1-]	3400	1.1	5[b]	6.2E-01
Trichloroethane[1,1,1-]	23000	0.705	60[b]	5.4E-01
Dichloroethane[1,1-]	1900	0.23	25[b]	3.3E-01
Tetrachloroethene	440	0.754	5[a]	1.2E-01
Methylene Chloride	37	0.09	5[a]	8.2E-02
Acetone	20	0.0016	5500[c]	2.3E-03
Chloroform	34	0.15	100[b]	2.3E-03
Dichloroethene[cis-1,2-]	15	0.167	70[c]	1.3E-03
Dichlorodifluoromethane	1500	4.1	390[c]	9.4E-04
Butanone[2-]	4.6	0.0011	7100[c]	5.9E-04
Trichlorofluoromethane	800	4.0	1300[c]	1.5E-04
Carbon disulfide	3.9	1.2	1000[c]	3.3E-06
Trichloro-1,2,2-trifluoroethane[1,1,2-]	2400	21.4	59,000[c]	1.9E-06
Cyclohexane	27	7.24	13,000[c]	2.9E-07
Chlorodifluoromomethane	14	4.1	84,000[c]	4.1E-08

[a] EPA MCL.

[b] WQCC groundwater standard.

[c] Region 6 HHMSSL for tap water.

Appendix F

Investigation-Derived Waste Management

F-1.0 INVESTIGATION-DERIVED WASTE MANAGEMENT

This appendix describes the management of waste generated during the investigation of Material Disposal Area (MDA) G at Technical Area (TA) 54, Los Alamos National Laboratory (the Laboratory). Investigation-derived waste (IDW) is solid waste generated during field investigations and may include, but is not limited to, drill cuttings, contaminated personal protective equipment (PPE), sampling supplies and plastic and all other wastes that may potentially come in contact with contaminants.

All IDW generated during the 2007 MDA G field investigation was managed in accordance with applicable Environmental Programs (EP) standard operating procedures (SOPs). These SOPs incorporate the requirements of all applicable U.S. Environmental Protection Agency (EPA) and New Mexico Environment Department (NMED) regulations, U.S. Department of Energy (DOE) orders, and Laboratory implementation requirements (LIRs).

SOPs applicable to the characterization and management of IDW are

- SOP-1.06, Management of Environmental Restoration Project Waste and
- SOP-1.10, Revision 1, Waste Characterization.

These SOPs may be found at the following URL: http://int.lanl.gov/environment/all/qa.shtml. The 2005 Laboratory waste minimization report (LANL 2005, 091291) was implemented during field investigations at MDA G to minimize waste generation. This plan is updated annually as a requirement of Module VIII of the Laboratory's Hazardous Waste Facility Permit.

The IDW waste stream associated with the investigation of MDA G is identified in Table F-1.0-1 and is briefly described below. Table F-1.0-1 also summarizes the waste type, volume, characterization method, method of on-site management, and disposition path for the drill cuttings waste stream.

Drill cuttings: This waste stream consists of cuttings from boreholes drilled at MDA G. Drill cuttings were collected and containerized at the point of generation (i.e., at the drill rig). The drill cutting waste stream is being characterized with analytical results from direct sampling of the containerized waste. Contaminants of concern are metals and radionuclides. The maximum detected concentrations of radionuclides are compared with background/fallout values. If the maximum concentrations are above background/fallout values, the waste cuttings will be designated low-level radioactive waste (LLW). If maximum concentrations are below background/fallout values, it is anticipated that the waste cuttings will be designated as nonradioactive, nonhazardous, municipal solid waste. The waste was sampled and analyzed using the toxicity characteristic leaching procedure to confirm that it is characteristically nonhazardous, as was anticipated based on acceptable knowledge (AK) from existing data/documentation and site characterization. The waste analysis data are currently in review. At present, this waste is being managed on-site at TA-54, Area G, pending profiling.

Decontamination fluids: Decontamination fluids were not generated during this investigation because dry decontamination methods were used successfully.

Contaminated PPE: Contaminated PPE was not generated during this investigation because PPE was not used during drilling activities.

Before the start of field investigation activities, a waste characterization strategy form (WCSF) Amendment #1 was prepared and approved per the requirements of SOP-01.10. The WCSF provided information on IDW characterization, management, containerization, and estimated volumes. The IDW characterization was completed by reviewing existing data and documentation and analytical data from samples collected from the media being investigated (subsurface soil/tuff). The approved WCSF Amendment #1 is provided as Attachment F-1 to this appendix.

The selection of waste containers was based on appropriate U.S. Department of Transportation requirements, waste types, and estimated volumes of IDW to be generated. Immediately following containerization, each waste container was individually labeled with a unique identification number and with information regarding waste classification, item(s), radioactivity (if applicable), and date generated. The wastes were staged in clearly marked and appropriately constructed waste accumulation areas. Waste accumulation area postings, regulated storage duration, and inspection requirements were based on the type of IDW and its classification. Container and storage requirements were detailed in the WCSF and approved before the waste was generated.

F-2.0 REFERENCE

The following list includes all documents cited in this appendix. 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 DOE–Los Alamos Site Office; EPA, 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.

LANL (Los Alamos National Laboratory), November 2005. "Los Alamos National Laboratory Hazardous Waste Minimization Report," Los Alamos National Laboratory document LA-UR-05-8650, Los Alamos, New Mexico. (LANL 2005, 091291)

Table F-1.0-1
Summary of IDW Generation and Management

Waste Stream	Expected Waste Type	Volume	Characterization Method	On-Site Management	Expected Disposition
Drill Cuttings	Nonhazardous, LLW	12.0 yd^3	Analytical results from waste samples	55-gal. drums, 12 yd^3 rolloff	Disposal at TA-54, Area G

Attachment F-1

Approved WCSF Amendment #1

Environmental Programs (EP)
Document Signature Form

Document Catalog Number: EP2006-1010
(Please prefix the name of all electronic versions of this document with this number.)

Document Title /Subject: Amendment 1 WCSF Drilling and sampling Activities at TA-54 MDA G

PRSs: None **OUO Information: Y / N**

Associated Document Catalog Number(s): None

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Document Type: Waste Characterization Strategy Form (WCSF) or WCSF Amendment **Former OU:** N/A

Date Due: Unknown **Date Final Complete:** Unknown

Date Sent to DOE: Unknown **Date Sent to NMED:** Unknown

Date Sent to RPF: Unknown **Received Per RPF:** Unknown

LA-UR Number: **RPF ER ID Number:** **Performance Measure:** No

AA Deliverable: No **Certification Required:** No **Force Peer Review:** No

Distribution TO: **Distribution FROM:**

Distribution COPY: **Distribution THRU:**

Attachment Notes:

Status/Comments:

Reviewer Signatures: (By signing below, the reviewer indicates that he/she **reviewed** and **approves** the document. Conditional approval may be indicated by checking the COMMENTS ATTACHED box.)

Reviewer (Print reviewer's name under title)	**Signature**	**Date**	**Comments Attached**
Author			
Technical Reviewer			
Technical Reviewer (#2)			
Solid Waste Regulatory Compliance (SWRC)			
Project Leader			

Document Catalog Number EP2006-1010

Amendment # 2 to the Waste Characterization Strategy Form (WCSF) for

Drilling and sampling Activities at TA-54 MDA G (Dated 01/20/05)

Date: November 21, 2006

INTRODUCTION – This amendment addresses extending the depth of four existing boreholes, adding one new borehole in the immediate vicinity of an existing borehole and increasing the volumes of waste that is identified in WCSF Titled, "Drilling and Sampling Activities at TA-54 MDA G" and Dated, January 20, 2005. There will be no changes to the drilling methods used, however no spot test for explosives will be conducted nor will core samples be collected.

Approximately six (6) cubic yards of borehole cuttings will be added to Waste Stream # 3 (Borehole Cuttings), approximately 0.25 cubic yards will be added to Waste Stream # 2 (Municipal Solid Waste) and approximately 0.25 cubic yards to Waste Stream # 1 (Investigation Derived Waste). Based on the previous analyticals, it is anticipated that waste streams #1 and #3 will be low level waste only. No additional waste will be added to Waste Streams #'s 4 & 5 and no waste is anticipated to be added to Waste Streams #'s 6, 7 & 8.

BACKGROUND– In September 2005, the Laboratory submitted the "Investigation Report for Material Disposal Area G, Consolidated Unit 54-013(b)-99, at Technical Area 54" (investigation report) (LANL 2005, 90513) to the New Mexico Environment Department (NMED). On July 26, 2006, the Laboratory received a notice of disapproval (NOD) (NMED 2006, 93385) that contained the requirements for additional investigation activities to determine the vertical extent of vapor phase volatile organic compound (VOC) contamination in the eastern and northern portions of MDA G. On November 13, 2006 LANL received Notice Of Approval For The "Work Plan For Supplemental Sampling At Material Disposal Area G, Consolidated Unit 54-03(b)-99" Los Alamos National Laboratory, Dated September 2006. EPA ID #NM0890010515, HWB-LANL-05-019

The drilling plan describes the requirements and activities necessary to extend four existing boreholes (BH-10, BH-26, BH-34, and BH-37), install a fifth borehole in the immediate vicinity of borehole BH-2, and complete each borehole as a vapor-phase monitoring well.

WASTE DESCRIPTION– The waste is excess soil and tuff drill cuttings from borehole drilling activities (Waste Stream # 3 from original WCSF), generic non-contact trash (Waste Stream # 2 from original WCSF) and Spent PPE and paper towels for dry decontamination (Waste Stream # 1 from original WCSF).

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CHARACTERIZATION, MANAGEMENT, AND DISPOSAL

WASTE # 3: BOREHOLE CUTTINGS

CHARACTERIZATION APPROACH: The borehole cuttings will be characterized using the characterization approach used during original drilling activities consisting of borehole characterization sample results, direct waste characterization sampling, and in addition, previous analytical results from the original activities will be used as supporting AK. If the analytical results fit the previous Waste Profile Form (WPF), this profile is still active and will be used. (See active Waste Profile Form # 39287).

STORAGE AND DISPOSAL METHOD: Borehole cuttings will be managed conservatively in a <90 day area until analytical results are returned and a full characterization is made. If it is determined that the cuttings are mixed hazardous waste, they will be disposed of at an authorized facility, if they are determined to be low level waste only, they will be disposed of at TA-54, Area G. The waste will be placed in an Area G WAC approved LLW container (roll-off) pending characterization.

WASTE # 2: MUNICIPAL SOLID WASTE (MSW)

CHARACTERIZATION APPROACH: MSW will be characterized based on acceptable knowledge (i.e., no contact of the wastes with environmental media). MSW will be segregated from all other waste streams.

STORAGE AND DISPOSAL METHOD: It is anticipated that the waste will be stored in plastic-lined trash cans, and then disposed of at the County of Los Alamos Landfill.

WASTE # 1: INVESTIGATION DERIVED WASTE (IDW)

CHARACTERIZATION APPROACH: This waste will be characterized based on the sample results of Waste #3 and/or direct waste sampling, along with previous analytical results from the original activities as supporting AK. If the analytical results fit the previous Waste Profile Form (WPF), this profile is still active and will be used. Contact waste will be segregated from cuttings and will be managed appropriately.

STORAGE AND DISPOSAL METHOD: All IDW will be managed conservatively in a <90 day area in appropriate containers. Based on the characterization of Waste #3, this waste either be disposed of at Area G at TA-54 as LLW or sent to an authorized facility as mixed hazardous waste.

SIGNATURES (Print name and then sign.)	**DATE**
Project Leader: John Hopkins	12/04/06
ERS-ECR Waste Management Coordinator: Karen Styers Karen Styers	11/27/06
SWRC Representative: Kelly Vanderpoel or John Tymkowych John M. Tymkowych	11/27/06
NWIS-SWO Representative: Andy U. Elicio	11/27/06

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Appendix G

Copy of November 2006
New Mexico Environment Department Letter
Approving the MDA G Supplemental Work Plan