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Work Plan for the Implementation of an In Situ Soil-Vapor Extraction Pilot Study at Technical Area 54, Material Disposal Area G, Los Alamos National Laboratory

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October 2007

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EXECUTIVE SUMMARY

The New Mexico Environment Department (NMED) approved the investigation report for MDA G in June 2007 and required Los Alamos National Laboratory to submit a corrective measures evaluation plan by October 15, 2007, and a soil vapor extraction (SVE) pilot study work plan by October 25, 2007.

Three subsurface vapor-phase volatile organic chemical (VOC) plume areas have been identified at MDA G. Under the corrective measures evaluation plan, SVE was proposed as a potential treatment technology for remediating the plumes. The Laboratory proposes to conduct a pilot study to determine whether active and/or passive soil vapor extraction systems can be effective in removing VOC contamination from the subsurface plumes at MDA G.

The SVE pilot study to be conducted in fiscal year 2008 will provide data to support the evaluation of remedial technologies in the corrective measure evaluation report due to NMED no later than September 12, 2008.

CONTENTS

Acronyms

bgs	below ground surface
CATOX	catalytic oxidation
DOE	Department of Energy

EPA	Environmental Protection Agency
FY	fiscal year
GAC	granular activated carbon
ITRD	Innovative Treatment and Remediation Demonstration
LANL	Los Alamos National Laboratory
MDA	material disposal area
NMED	New Mexico Environment Department
PCE	tetrachloroethane
PESP	Pilot Extraction Study Plan
ppmv	parts per million vapor
PVET	Pilot Vapor Extraction Test
scfm	standard cubic feet per minute
SVE	soil-vapor extraction
TA	technical area
TAG	Technical Advisory Group
TCA	1,1,1-tricholorethane
TCE	tricholorethylene
VOC	volatile organic compounds

1.0 INTRODUCTION

Material Disposal Area (MDA) G is a decommissioned (i.e., removed from service) subsurface site at Los Alamos National Laboratory (LANL or the Laboratory), established for the disposal of low-level radioactive waste, radioactively contaminated infectious waste, asbestos-contaminated material, and polychlorinated biphenyls. It is also used for the retrievable storage of transuranic waste. Portions of the disposal units at MDA G are covered with asphalt and concrete to house ongoing waste-management activities at the site. Three subsurface vapor-phase volatile organic chemical (VOC) plume areas have been identified at MDA G. The Laboratory's Corrective Actions Project has conducted extensive sampling and analysis to determine the nature and extent of the plumes and has developed a conceptual model to characterize the subsurface plumes. Analysis of collected data shows the site does not currently pose a potential unacceptable risk to human health or the environment. Under the corrective measures evaluation plan, soil vapor extraction (SVE) was proposed as a potential treatment technology for the plumes. The Laboratory proposes to conduct a pilot study to determine whether active and/or passive soil vapor extraction systems can be effective in removing VOC contamination from the subsurface plumes at MDA G.

The SVE pilot study to be conducted in fiscal year (FY) 2008 will provide data to design active and passive remediation systems and implementation strategies. The active extraction test will be designed to determine the relationship between applied suction and VOC extraction rate to treat the plumes and to reduce the source term. Additionally, the test will be designed to provide measurements of the radius of influence of the SVE system. Active removal of the current VOC plumes will reduce the ability of any remaining VOCs in the subsurface to diffuse toward the regional aquifer. By reducing VOC concentrations in the middle of the Bandelier Tuff, VOCs at greater depth will diffuse back up toward the lower concentration region created by the SVE system. Passive venting will be evaluated for its ability to mitigate postsource-treatment migration of contaminated pore gas by providing a barrier to diffusive and advective contaminant transport. The SVE pilot tests will provide data to determine the amount of time required for active extraction to reduce the source to a source mass that can be effectively controlled using passive venting and to determine if passive venting is more effective in treating the plumes than active extraction.

The active SVE pilot test will use equipment designs that were approved and deployed in 2006 in accordance with the Laboratory's engineering design, hazard analysis, and Integrated Work Management procedures during the SVE pilot test conducted at nearby MDA L. Data collected during the MDA L pilot test and vendor data will be used to develop a detailed start-up and operation plan for the pilot test at MDA G. During development of the start-up and operations plan, effluent treatment options will be evaluated including granular activated carbon (GAC), catalytic oxidation (CATOX), and a CATOX-Scrubber combination to minimize treatment and waste disposal costs related to use of the GAC.

The scope described in this work plan is based on investigations conducted at MDAs G and L over the last two decades, including the data and analysis determining the nature and extent of the plumes and site characteristics, a pilot extraction study plan, the results of an independent Technical Advisory Group study, and a SVE pilot test conducted at MDA L in 2006. All data indicate that SVE is a effective method for removing VOCs at MDA G.

2.0 BACKGROUND

MDA G is located in the east-central portion of the Laboratory at Technical Area (TA) 54, Area G, on Mesita del Buey (Figure 2.0-1). MDA G consists of inactive subsurface units that include 32 pits, 194 shafts, and 4 trenches with depths ranging from 10 to 65 ft below the original ground surface (Figure 2.0-2). The pits, trenches, and shafts are constructed in unit 2 (caprock) and unit 1 (subsurface) of the Tshirege Member of the Bandelier Tuff (consolidated tuff units). The regional aquifer is estimated to be at an average depth of approximately 930 ft below ground surface (bgs) at MDA G, based on data from wells in the vicinity of the area and the predictions of the hydrogeologic conceptual model for the Pajarito Plateau (LANL 1998, 059599, Appendix H). Area G is relatively flat, and portions of the disposal units at MDA G are covered with concrete and asphalt to support ongoing waste-management activities conducted at area G. Surface runoff from the site is controlled and discharges into drainages to the north (towards Cañada del Buey) and the south (towards Pajarito Canyon). Stormwater and sediment monitoring stations are distributed throughout the surface of Area G and in drainages leading to the canyons.

2.1 Site Investigation History

The New Mexico Environment Department (NMED) approved the investigation report for MDA G in June 2007 (NMED 2007, 096716) and required submittal of a corrective measures evaluation plan by October 15, 2007, and an SVE pilot study work plan by October 25, 2007 (NMED 2007, 098446).

2.2 Site Conditions

The Laboratory lies between the Jemez Mountains and the Rio Grande on the Pajarito Plateau. Bandelier Tuff, a thick sequence of ash-fall pyroclastics, caps the plateau. Erosion of the tuff over time has created a series of canyons separating the narrow, finger-like mesas that comprise the Pajarito Plateau. MDA G is situated atop one such mesa, Mesita del Buey.

The strata below MDA G are composed of nonwelded to moderately welded rhyolitic ash-flow and ash-fall tuffs interbedded within pumice beds. The rhyolitic units overlie a thick basalt unit, which, in turn, overlies a conglomerate formation. Figure 2.2-1 provides a schematic of the tuff stratigraphy. The three upper units make up the Tshirege Member of the Bandelier Tuff. Unit 2 (Qbt 2) and the upper portion of unit 1v (Qbt 1v) are fractured, and the fractures are often filled with calcite and/or clay. The Cerro Toledo interval (Qct) is made up of volcanoclastic sediments interbedded with minor pyroclastic flows. The Otowi Member (Qbo) of the Bandelier Tuff, a nonwelded to poorly welded unit that is not fractured, lies beneath the Cerro Toledo interval and consists of nonwelded to poorly welded tuff containing little evidence of fracturing (Reneau and Raymond 1995, 054709). The Cerros del Rio basalts lie beneath the tuffs and make up from 50% to 80% of the vadose zone beneath MDA G, with the greatest portion occurring at the eastern end (Ball et al. 2002, 071471). Characteristics of this unit vary widely, ranging from extremely dense with no effective porosity to highly fractured to vesicular (Turin 1995, 070225). Beneath MDA G, the water table for the regional aquifer is in the Cerros del Rio basalts. A complete summary of the site geology and geologic properties can be found in the MDA L investigation work plan (LANL 2004, 087624). Figure 2.2-2 shows the site conceptual model for MDA G.

Table 2.2-1 summarizes the geohydrologic and hydraulic properties for the stratigraphic layers and provides the bulk density, porosity, in situ permeability, moisture content by volume, percent saturation, saturated hydraulic conductivity, and an indication of the induration and fracturing of the various formations. The bulk permeability of the media can be inferred from data collected in wells at the site (Lowry 1997, 087818). Anemometry measurements from the site provide information on the bulk flow within the media. These data show that the Qbt and Qct stratigraphic layers produced three-quarters of the total air flow from the boreholes. Subsequent discrete point permeability measurements confirmed the Cerro Toledo has a higher permeability than the other stratigraphic layers (3–10 Darcies compared to

0.2–0.9 Darcies). Figure 2.2-3 shows both the anemometry and discrete point permeability measurements from borehole 54-01018.

2.2.1 MDA G Vapor Plumes

Three plume areas have been identified at MDA G (Figure 2.2-4). Pore-gas analytical results from the 2005–2007 boreholes detected VOCs in 38 boreholes in the vadose zone. Consistent with the ongoing quarterly pore-gas monitoring conducted since 1997, the maximum vapor concentrations were identified in the eastern portion of MDA G (in the vicinity of the shaft field west of Pits 2 and 4). Varying concentrations of contaminants found together, such as tetrachloroethene and Freon-113 in the vadose zone, indicate releases from different sources at MDA G. The MDA G investigation report and addendum describe the extent of contamination at MDA G and conclude that the nature and extent of contamination in surface and subsurface media has been defined (LANL 2005, 090513; LANL 2007, 096110).

2.3 Results of Previous SVE Studies

Several studies related to the effectiveness of SVE as a treatment option have been conducted as part of Corrective Action Program efforts to evaluate potential remediation technologies for VOC plume mitigation at TA-54. The pilot extraction study plan (PESP) was carried out between 1994 and 1997, an independent review of potential remedial actions was conducted by a U.S. Department of Energy (DOE) sponsored Technical Assistance Group (TAG) in 2001, and a SVE pilot test was conducted at MDA L in FY2006. The PESP provided a broad study of vapor extraction specific to TA-54, while the TAG reviewed the conclusions of the PESP. The 2006 SVE pilot test in MDA L reaffirmed the validity of SVE to remediate VOC plumes in situ. Results from each study are described below.

2.3.1 1995 Pilot Extraction Study at MDA L

The PESP proposed a strategy of remediating the VOC vapor-phase plume at MDA L through a process of active extraction to retract the plume to the vicinity of the source, followed by the long-term use of passive extraction techniques to maintain the plume in its contracted state. Various tests conducted by the Laboratory helped to define the process of vapor venting in Bandelier Tuff.

The pilot vapor extraction test (PVET) was performed over a 34-day period in September and October 1995 at the edge of the VOC vapor-phase plume. Borehole 54-01017 was completed as the extraction well for the test. Steel surface casing (8 in. in diameter) extended to a total depth of 75 ft, and the open borehole (9 in. in diameter) extended to a total depth of 150 ft below ground surface (bgs). A 5hp, 208V regenerative blower capable of up to 203 ft^3 per min and a maximum vacuum of 88 in. of water column were used to extract the soil gas. The system extracted subsurface air at a rate of 25 standard cubic feet per minute (scfm). Given the low contaminant concentration of the soil gas in this area, no vapor treatment system was required. Measurements of the extraction process, including the total flow from the well, well vacuum, extraction-air temperature, atmospheric pressure, soil-gas pressure, and soil-gas contaminant concentrations, were made during the test (ERM/Golder 1997, 070334). No known open wells or boreholes were within the extraction zone at MDA L during the PVET.

Analysis of the data showed that the influence of the extraction system extended approximately 140 ft horizontally from the extraction interval. It was determined that this radius of influence may be great enough that the plume at MDA L could be remediated and/or controlled with an SVE system.

Little change was seen in the soil-vapor contaminant concentrations or the measured pressures below the extraction interval. Fresh air from the surface was drawn down to the high-permeability region of the

Qbt and Qct stratigraphic layers (starting approximately 120 ft below ground surface [bgs]) and then moved laterally through this layer to the extraction well. Hence, these layers, which coincided with the highest contaminant concentration levels, provided a large percentage of the total extracted flow. Finally, data analysis using a pure resistive/capacitive circuit model estimated that the plume could be cleaned to the 99% level (i.e., 99% current concentrations) in 90 to 175 d.

The test demonstrated that organic vapors in the tuff media beneath MDA L move readily toward an extraction well with little or no sorption, making this technology well suited for plume control and/or remediation. Further, a comparison of the measured data with pretest modeling results showed that standard numerical and analytical modeling techniques can be used to predict air flow within the media. The strong correlation between the model and the measured data confirmed that discrete near-field measured permeability values were adequate in representing bulk flow in the media.

The main conclusions of PESP activities are as follows:

- During active vapor extraction, the vapor moved at the same velocity as the pore gas. By tracking the concentration at several depth intervals in several wells, it was concluded that the contaminant movement through the media was not retarded. This conclusion was further supported by the lack of a restart spike in the active extraction well.
- The Laboratory measured both the in situ horizontal permeability as a function of depth at several boreholes and the gross borehole flow using an anemometer. Pressure data from the active and passive extraction tests indicated that the vertical permeability was different from the measured horizontal permeability at some locations.
- The Laboratory also measured the flow in open boreholes induced by barometric pressure variations. Close agreement of the data with modeling efforts indicated that the flow into and out of a borehole is governed by the horizontal permeability and is reduced by the vertical penetration of barometric pressure variations into the earth from ground surface. In addition, the passive tests showed air flow rates at most locations across the mesa will be fairly similar, although occasionally a borehole will hit a cavity or fracture that alters the flow.
- Measured penetration of barometric pressure variations within the Bandelier Tuff and the underlying Cerros del Rio basalt showed that in unit 2, vertical gas motion is dominated by fracture flow.
- Based on induced subsurface vacuum pressure at steady state, the radius of influence of the PVET was approximately 140 ft. The test also indicated that the depth of influence was determined by the depth of the extraction well.
- Air velocities of the plume within the Qbt 1v(c) (colonnade) averaged approximately 1.6 ft/d.
- The PVET effect on trichloroethane (TCA) concentrations and negative-pressure propagation were different in various subunits of the Bandelier Tuff.
- The greatest change in TCA concentrations and air flow caused by the PVET occurred in Qbt 1v(c). This subunit demonstrates geohydrologic characteristics that are conducive to enhanced air flow, including induration supporting fractures, fine-grain size enhancing porosity, and overall higher permeability than the units above and below it.

2.3.2 Technical Advisory Group

In 2001, the TAG was formed by DOE’s Innovative Treatment and Remediation Demonstration (ITRD) group to provide technical assistance in selecting remedial actions for MDA L (LANL 2004, 087624,

Appendix H). The specific goals of the TAG were to evaluate the site and assess passive and active venting versus other applicable technologies to remediate the site. The TAG used a remediation technologies screening matrix that was originally developed by the U.S. Environmental Protection Agency (EPA) and the U.S. Air Force (LANL 2005, 089332). The screening matrix identifies processes used to remediate contaminated soil and ground water with some degree of success. In situ biological treatment, in situ physical/chemical treatment, in situ thermal treatment, ex situ biological treatment, ex situ physical/chemical treatment, ex situ thermal treatment, containment, and other treatment processes were considered. After reviewing the data, the team concluded that vapor extraction and natural attenuation were reasonable remediation methods. Because waste in the 34 disposal shafts constitutes a VOC vapor source term that is likely to continue to release contaminants into the formation, vapor extraction was deemed more feasible than natural attenuation. The TAG report (LANL 2004, 087624, Appendix H) listed the following as primary factors favoring vapor extraction:

- the absence of phase-separated liquid (free product),
- a large depth to the bottom of the plume (10 parts per million by volume [ppmv] of TCA at approximately 300 ft bgs),
- a very low organic carbon in tuff that resulted in easy desorption of adsorbed VOCs,
- the contaminant being only in unsaturated medium,
- reasonable soil flow characteristics, and
- high volatility and low sorption of the halogenated VOCs.

The combination of these factors indicates that contaminant removal rates by vapor extraction would be very high and that the site could be remediated by the process. In addition, an SVE system could control the plume near the source areas.

2.3.3 Methodology

SVE is an in situ unsaturated (vadose) zone soil remediation technology in which a vacuum is applied to the soil to induce the controlled flow of air, resulting in the removal of volatile and some semivolatile contaminants from the soil. The gas leaving the soil may be treated to recover or destroy the contaminants, depending on state air discharge regulations. Vertical extraction vents are typically used at depths of 5 ft or greater and have been applied successfully as deep as 300 ft. In VOC-contaminated soils with appropriate physical and chemical properties, SVE is a relatively inexpensive and efficient technology that can remove up to 99% of the VOC contaminants. For example, SVE technology was very effective at DOE’s Hanford Site in Washington. Over a period of 9 yr, the Hanford SVE system extracted a total of 170,000 lb of carbon tetrachloride from the vadose zone. Over this period, carbon tetrachloride concentrations decreased from initial concentrations of 30,000 ppmv to 40 ppmv. SVE was successfully demonstrated for treating the VOC plume beneath MDA L at TA-54, extracting approximately 800 lb of contaminants.

2.3.4 SVE Pilot Test at MDA L

In 2006, a SVE pilot test was conducted at TA-54 at MDA L over a period of 45 d of active extraction, and VOCs were removed from two different boreholes on opposite sides of the site. Two extraction boreholes were installed at MDA L: SVE-West, in the vicinity of Shafts 26–38; and, SVE-East, in the vicinity of Shafts 1–25. Each borehole was constructed with an extraction interval extending from 65 ft bgs to approximately 215 ft bgs. The upper 65 ft were cased with steel casing and the casing grouted in place; a basal grout plug was emplaced to eliminate the potential for short circuiting from below. The surface casing was set in concrete.

The extraction boreholes were located in close vicinity to disposal shafts and trenches used for both free liquid disposal and containerized liquid disposal. Surrounding boreholes were monitored for VOCs (TCA, tricholorethylene [TCE], trichlorofluoromethane [Freon-11], and tetrachloroethylene [PCE]) and pressure differential to analyze the effect on the plume. The pilot test used a skid mounted SVE system that exhausted into canisters filled with GAC during the pilot test. A total of approximately 800 lb of contaminants were removed from the two extraction boreholes in MDA L. The results of this pilot test confirmed previous tests and proved that SVE is a viable technique for in situ VOC remediation (LANL 2006, 094152).

A Brüel & Kjær (B&K) 1302 photoacoustic multi-gas analyzer was used to monitor primary contaminant concentrations (TCA, TCE, Freon-11, and PCE), as well as carbon dioxide (CO_2) and water vapor (H_2O) in extracted pore gas and in sampling ports in SVE monitoring boreholes. Surrounding boreholes were monitored using the B&K, and differential pressure readings, measure in kilopascals (kPa), were collected using a Dwyer Series 475 Mark III Digital manometer. (The manometer measures the difference between surface [i.e., atmospheric] and subsurface pressures.)

Extraction process measurements (including the total flow from the borehole, borehole vacuum, extraction air temperature and relative humidity) were collected using a Campbell Scientific CS-13X data logger. During the test, air flow from the extraction borehole was monitored using a Dwyer Series PE in-line orifice plate flow meter with a Dwyer model 677-8 differential pressure transducer. The orifice plate measures air flow by monitoring the differential pressure across the plate. The air flow rate was established by closing the SVE system’s dilution valve to the differential pressure corresponding with the desired flow rate (calculated per equations provided by Dwyer). Temperature and relative humidity were collected using a Viasala HMP45AC humidity and temperature probe. Vacuum pressure at the top of the extraction borehole was monitored using a 0–20 in.-Hg vacuum gauge.

The contaminated vapor effluent was directed for treatment through two epoxy-lined steel canisters containing 400 lb of granular active carbon (supplied by U.S. Filter Corporation) connected in series. The treated effluent was released from the second GAC vessel through a 10-ft tall stack. Effluent samples were collected from between the two treatment vessels and from the stack to ensure maximum use of the GAC while complying with site VOC standards.

The SVE pilot test provided data showing the effectiveness of vapor extraction for remediating the MDA L plumes. The combined mass removal from both SVE pilot test locations was estimated to be 800 lb of VOCs were extracted during approximately 45 d of active vacuum extraction. Differential pressure readings collected using a handheld manometer showed a measurable response to the vacuum extraction process at distances up to 132 ft. Similarly, B&K readings showed a reduction in VOC concentrations at distances up to 132 ft, with the strongest response in sampling ports ranging from 40 ft to 150 ft below the surface.

3.0 SVE PILOT STUDY SCOPE

SVE pilot tests will be conducted in two separate zones beneath MDA G. An active extraction test will be conducted in the Tshirege Member of the Bandelier Tuff to evaluate source removal and source control. A passive venting test will be conducted in the Otowi Member of the Bandelier Tuff to evaluate the ability of airflow from barometric pumping to mitigate postsource-treatment migration of contaminated pore gas by providing a barrier to diffusive and advective contaminant transport. The passive test will also determine the usefulness passive venting as an alternative VOC plume treatment method.

Upon receipt of vendor drawings and operating procedures, a detailed start-up and operations plan will be developed describing the following scope:

- One extraction borehole will be drilled and configured specifically to be used as a vapor extraction well. This borehole will be in the vicinity of the large shaft field in the north-central portion of the site (Figure 3.0-1), near the center of the VOC plume beneath this portion of MDA G. The borehole will be cemented at the bottom (approximately 142 ft to approximately 2 ft above the Tsankawi/Qbt 1g contact) to avoid short-circuiting of air-flow because of the higher permeability of the Tsankawi. The borehole will be cased from ground surface to 62 ft (Figure 3.0-2). The extraction well borehole will be logged for stratigraphic information. Core will be continuously collected to provide the actual locations of the various stratigraphic layers.
- A discrete dual-packer permeability test will be conducted in the extraction borehole at 1-m depth intervals to provide detailed permeability data for model calibration. Permeability measurements will be collected between dual packers at 1-m intervals to provide a detailed permeability depth profile for model calibration and to compare with earlier in situ permeability measurements from the PVET well in Area G, Zone 4.
- Monitoring boreholes will be constructed in existing boreholes located approximately 25 ft, 50 ft, 115 ft, and 135 ft away from the extraction borehole. (Figure 3.0-3). The existing boreholes will be instrumented with pore-gas monitoring ports located in each geologic unit to facilitate pore-gas sampling and pressure monitoring (Figure 3.0-4).
- Pretest VOC screening with a B&K, tritium sampling, and differential pressure monitoring will establish baseline conditions.
- Subsurface air will be extracted using the SVE system for up to 30 d or until a steady-state decrease in extracted VOC concentrations has been achieved, whichever is longer. The total flow from the extraction well, well vacuum, extraction air temperature, and atmospheric pressure will be measured at regular intervals during the extraction process. All pore-gas monitoring ports will be screened with a B&K to detect for changes in VOC concentrations; differential pressure measurements will be collected to determine the radius of influence of the vacuum.
- A radiological control technician will be on-site to monitor for tritium in the work area at the start of active extraction and periodically throughout the project as required by the radiological work permit application process.
- SVE cycling (on/off) will be used to further characterize the source zones by providing rebound data and to increase the overall rates of VOC removal.
- Following completion of the active SVE test, one extraction borehole will be drilled and configured specifically to be used as a passive vapor-extraction well. The passive venting borehole will be cased to a depth of 155 ft and drilled to an approximate depth of 190 ft to confirm the depth of the Cerros del Rio basalt (Figure 3.0-5). The bottom of the borehole will be grouted to a depth ofapproximately 2 ft above the Guaje Pumice/Cerros del Rio basalt to allow venting of air-flow from the Otowi Member and the higher permeability Guaje Pumice Bed.
- Pore gas and differential pressure monitoring will be conducted to evaluate the impacts of passive venting on contaminant rebound.

The active SVE pilot test will use equipment designs that were approved and deployed in 2006 in accordance with the Laboratory's engineering design, hazard analysis, and Integrated Work Management procedures during the SVE pilot test conducted at MDA L. Data collected during the MDA L pilot test will be used to develop a start-up and operations plan for the pilot test at MDA G. During planning for the test, effluent treatment options will be evaluated including, GAC, CATOX, and a CATOX-Scrubber combination to minimize treatment and waste disposal costs related to use of the GAC.

Measurements of the extraction process (e.g., total flow from the well, well vacuum, extraction air temperature), and soil gas contaminant concentrations will be collected during the test. Existing and/or currently planned monitoring wells may be used to monitor the contaminant concentrations.

Once active extraction is stopped, soil-gas monitoring will continue to show near-field rebound, which is caused by the remaining source or by an influx in the source term as a result of to drum ruptures, and to show the natural decay in concentrations outside the area of influence because of diffusion. The extraction system can be restarted periodically to control the vapor plume.

The passive-venting pilot test will continuously monitor the impact of barometric pressure changes on subsurface-surface pressure relationships and air flow. Passive-venting rates are such that treatment of VOC and tritium flowing into the atmosphere should not be needed. Results from the passive-venting test will be used to determine the likely effectiveness of this approach. Previously published results from tests performed on boreholes located at MDA L indicate that passive venting will help to control migration of the plume (Neeper 2002, 098639; Neeper 2003, 098640; Neeper and Stauffer 2005, 098641).

4.0 MONITORING AND SAMPLING PROGRAM

A B&K 1302 photoacoustic multigas analyzer will be used to monitor primary contaminant concentrations TCA, TCE, Freon-11, and PCE as well as carbon dioxide and water vapor in extracted pore gas and in sampling ports in SVE monitoring boreholes. Contaminant concentrations in surrounding boreholes will also be monitored using the B&K. Differential pressure readings, measure in kilopascals (kPa), will be collected using a Dwyer Series 475 Mark III Digital manometer. Tritium samples will be collected periodically to evaluate the impact of SVE on tritium concentrations in the subsurface.

Extraction process measurements (including the total flow from the borehole, borehole vacuum, extraction-air temperature, and relative humidity) will be collected using a Campbell Scientific CS-13X datalogger. During the test, air flow from the extraction borehole will be monitored using a Dwyer Series PE in-line orifice plate flow meter with a Dwyer model 677-8 differential pressure transducer. The air-flow rate will be established by closing the SVE system's dilution valve to the differential pressure corresponding with the desired flow rate (calculated per equations provided by Dwyer). Temperature and relative humidity will be collected using a Viasala HMP45AC humidity and temperature probe. Vacuum pressure at the top of the extraction borehole will be monitored using a 0–20 in.-Hg vacuum gauge.

To determine the near-source effects on the extraction system, all ports in the SVE monitoring wells will be sampled immediately before, during, and after extraction. Data will be collected from ports within, above, and below the extraction interval to determine the effect of the SVE on these zones. Baseline data will be collected for 2 wk before testing begins, and data will continue to be collected for several weeks after the blowers are turned off to monitor contaminant rebound.

5.0 SCHEDULE

The pilot SVE tests are scheduled to be completed in July 2008 to allow for input into the CME report, which is due to NMED no later than September 12, 2008. Meeting this date requires that the following activities take place on or before the dates given below:

- January 30, 2008: Finalize start-up and operations plan
- February 15, 2008: Finalize facility hazard categorization

- February 15, 2008: Submit start-up notification report and plan of action
- March 1, 2008: Complete unreviewed safety questions process
- March 10, 2008: Complete readiness review and management self-assessment
- March 15, 2008: Drill SVE extraction borehole and construct pore-gas monitoring wells
- April 15–30, 2008: Collect background data
- April 15–30, 2008: Install and test SVE system
- May 1–31, 2008: Conduct active SVE pilot test
- June 1–30, 2008: Monitor VOC concentration rebound
- June–July 2008: Conduct passive SVE pilot test
- August 2008: Finalize MDA G pilot test report

6.0 REFERENCES

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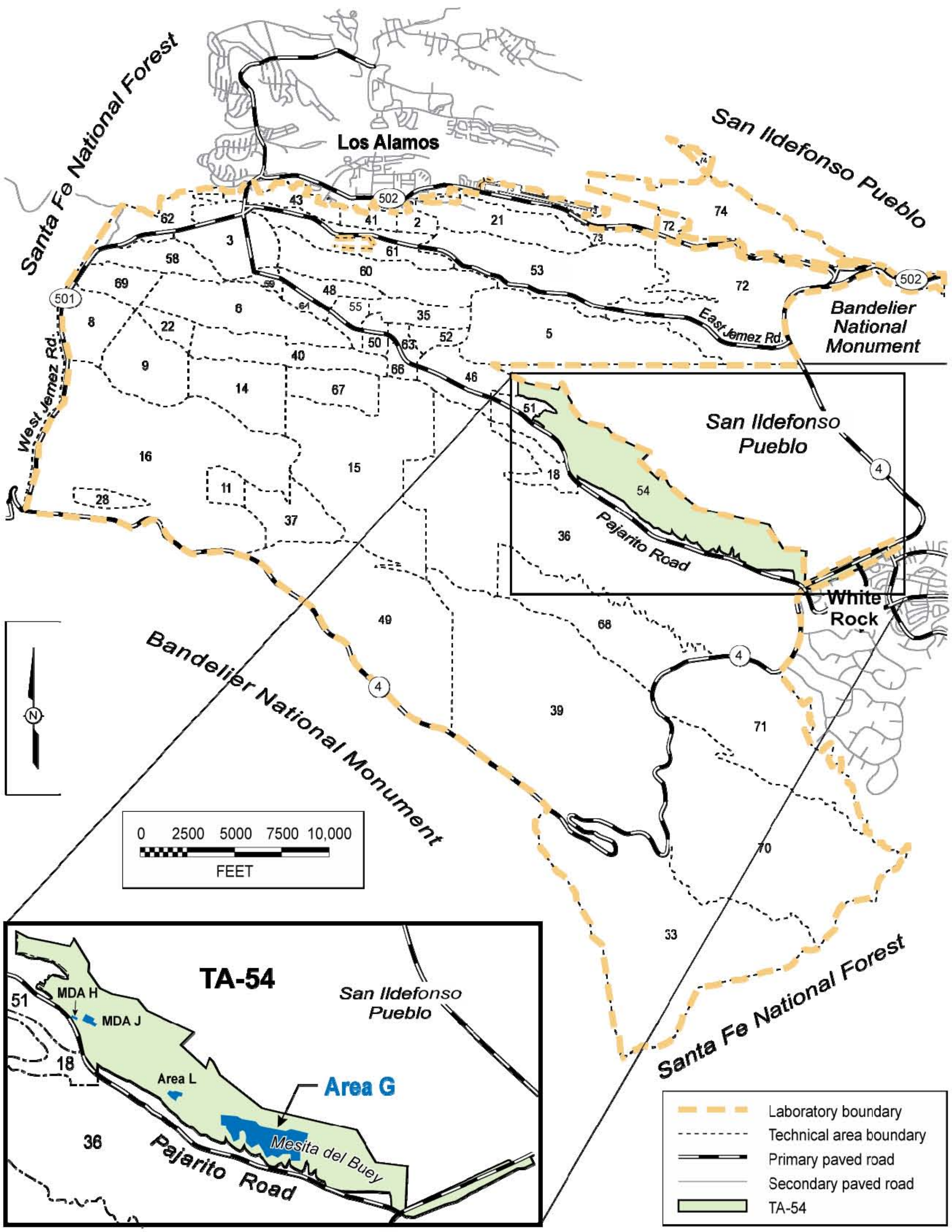


Figure 2.0-1 Area G at Technical Area 54, Los Alamos National Laboratory

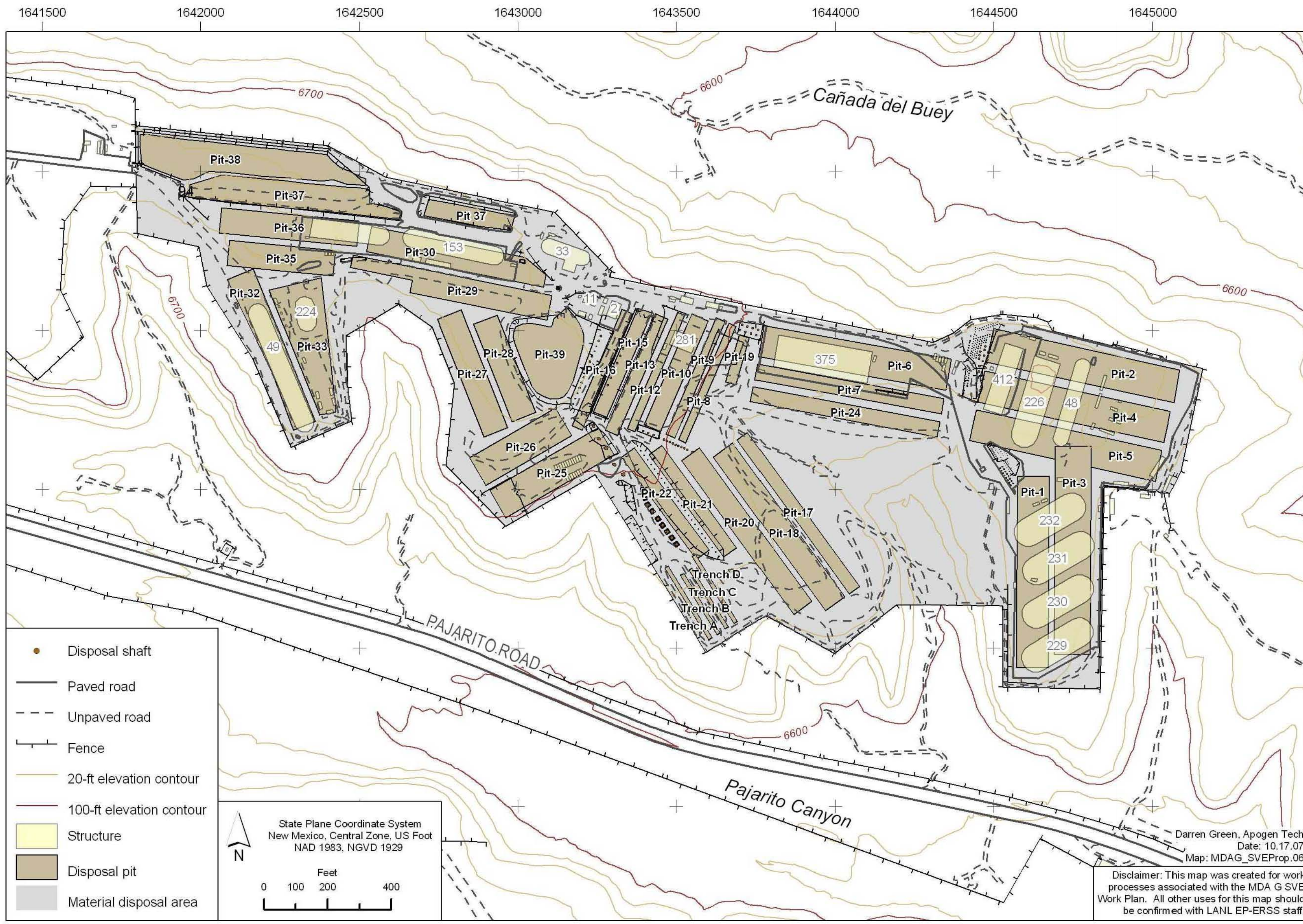


Figure 2.0-2 Pits, shafts, and trenches at MDA G

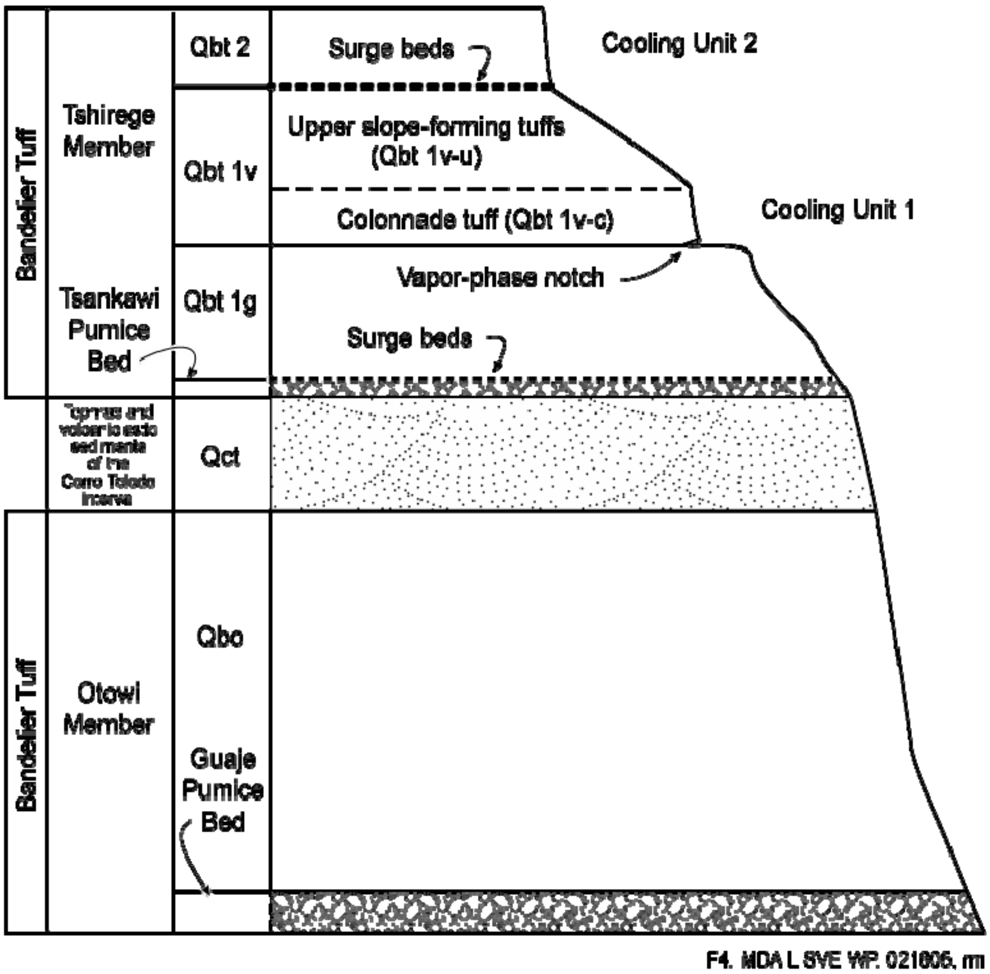
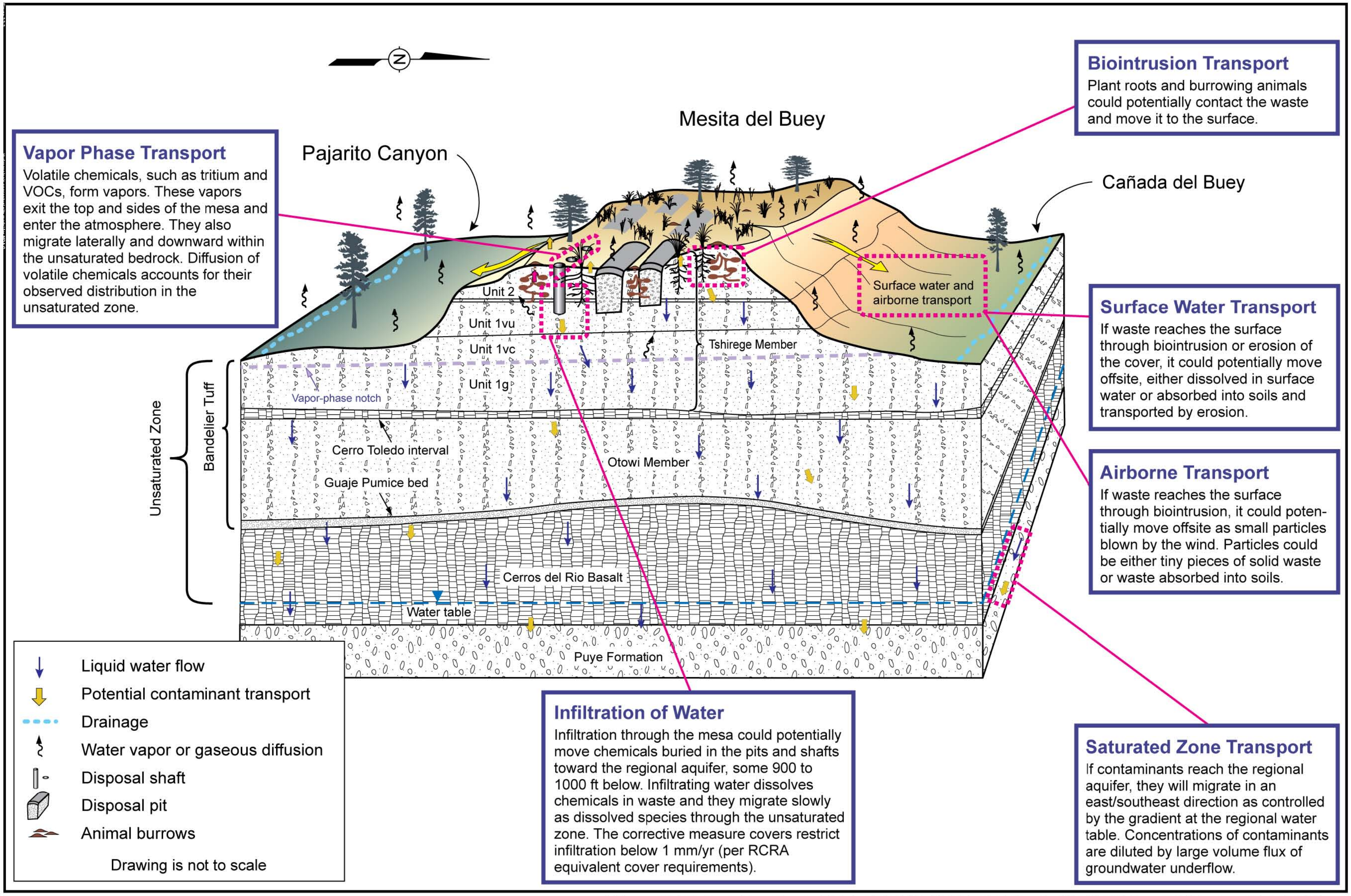


Figure 2.2-1 TA-54 site stratigraphy



J. Tauxe, 062101 after A. Kron_Rev. for F2.3-1, MDA H RS, 122001, RLM_Rev. for MDA H CMS Rpt., 051403, cf; modified 102207, ptm

Figure 2.2-2 Hydrogeologic conceptual site model for MDA G

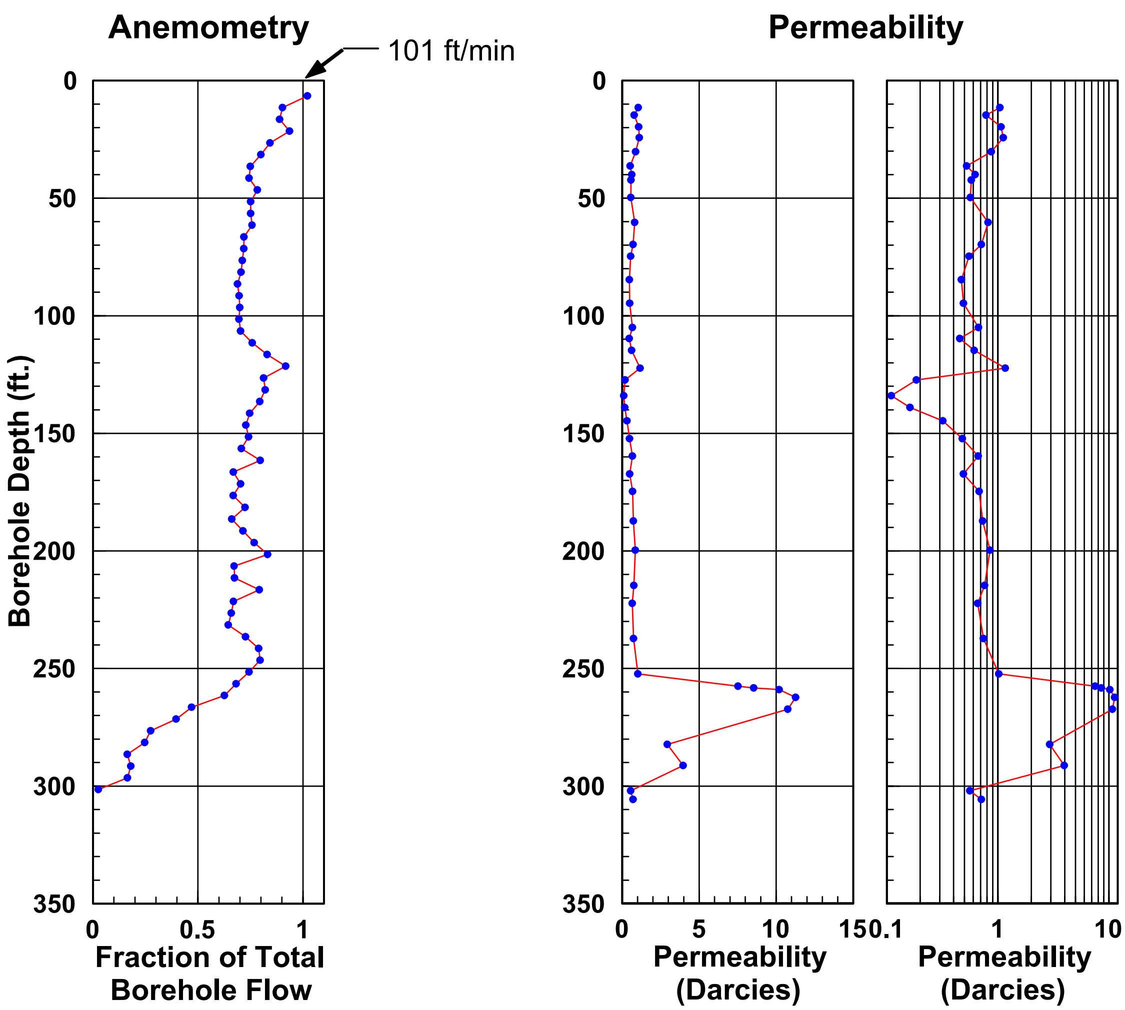


Figure 2.2-3 Open borehole anemometry and straddle packer permeability results for borehole 54-01018

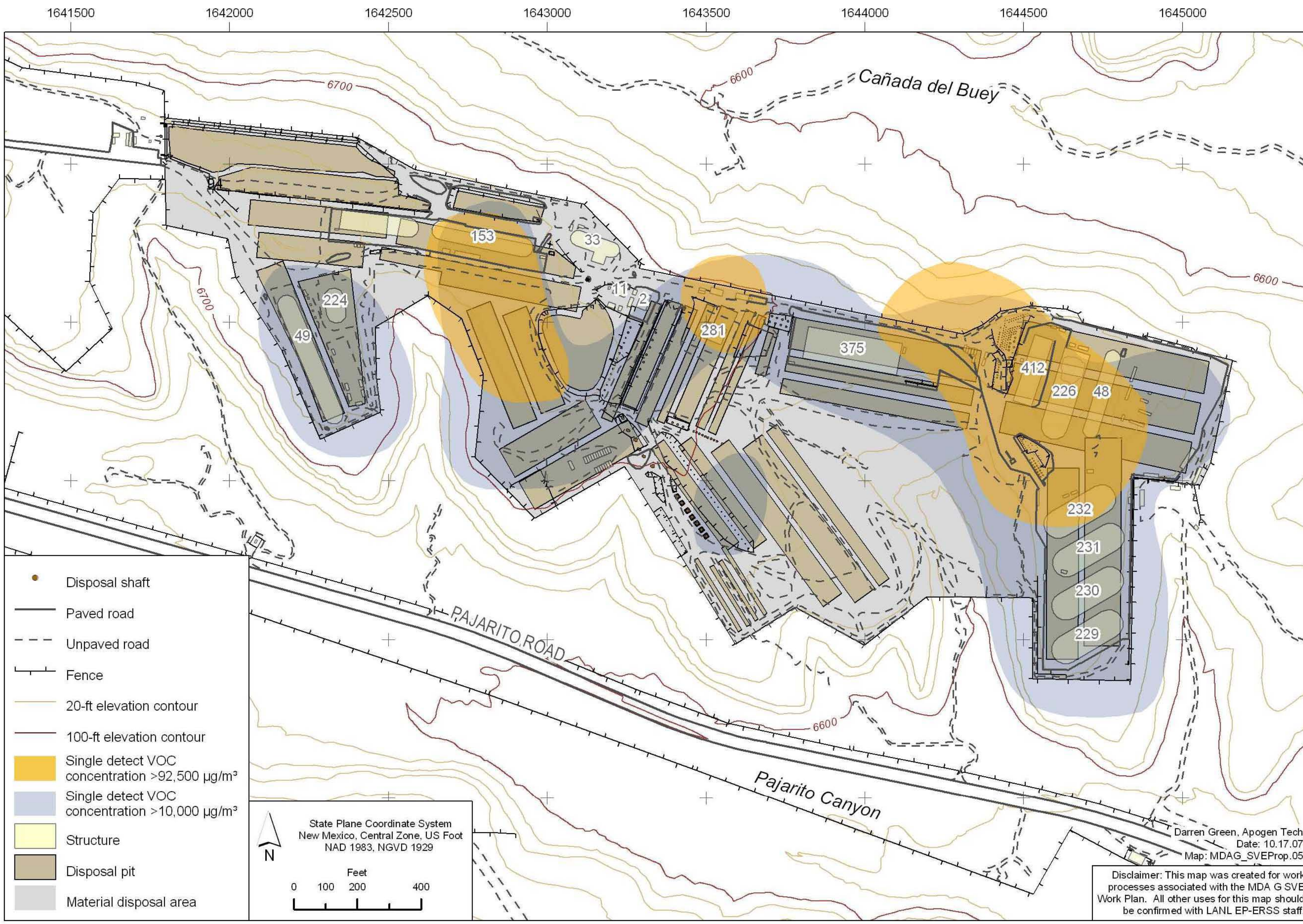


Figure 2.2-4 VOC plumes at MDA G

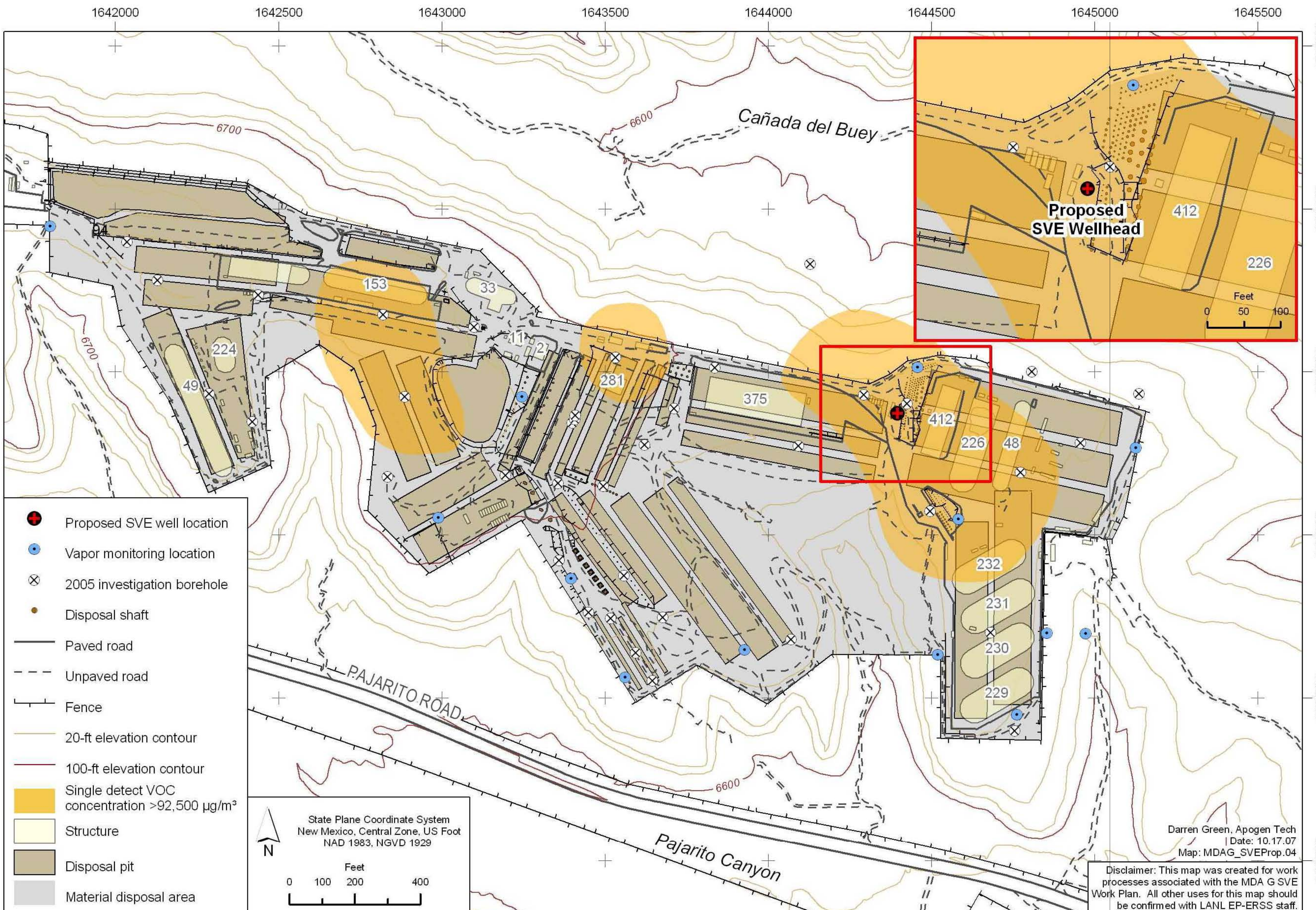


Figure 3.0-1 MDA G SVE pilot test location

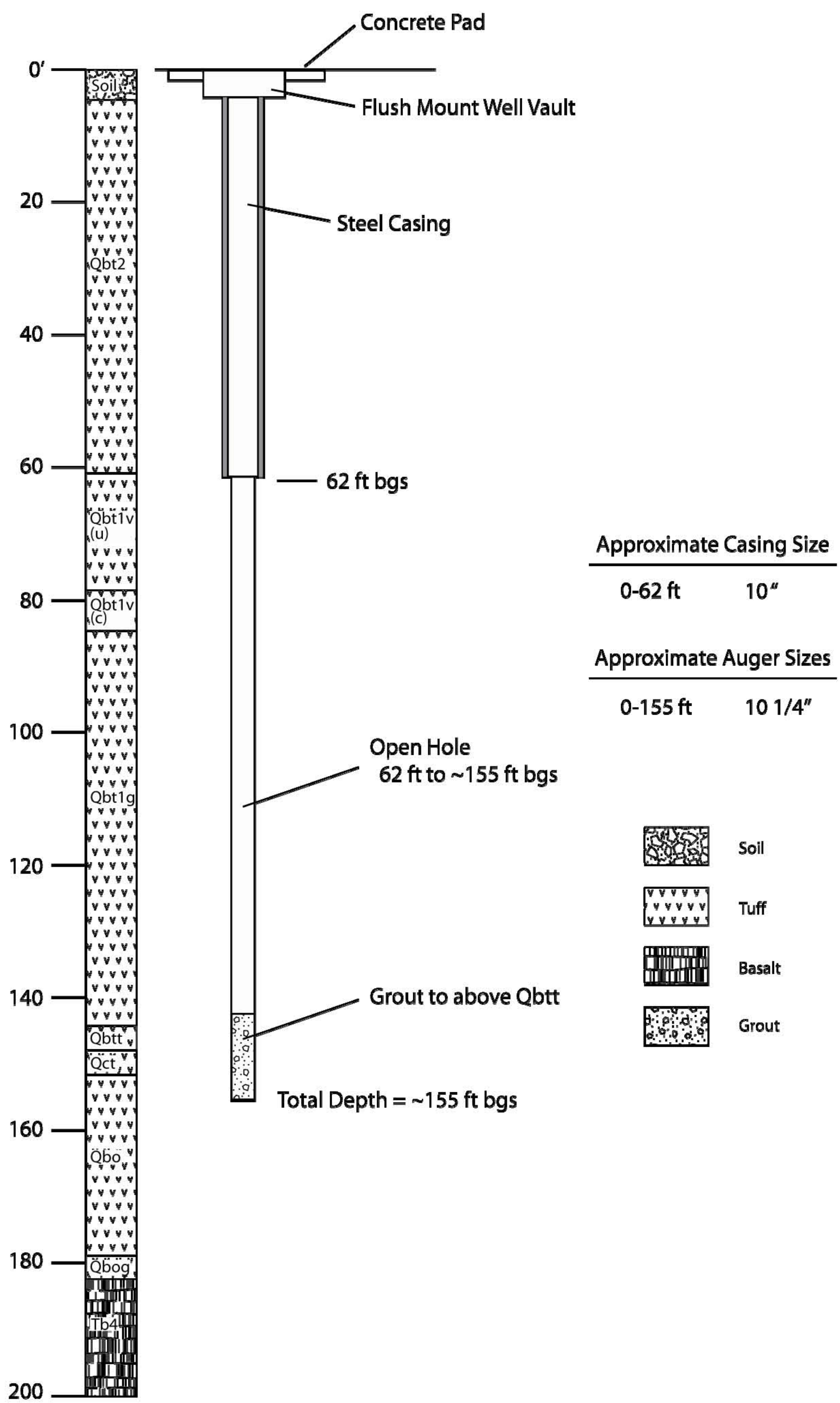


Figure 3.0-2 Active SVE borehole construction diagram

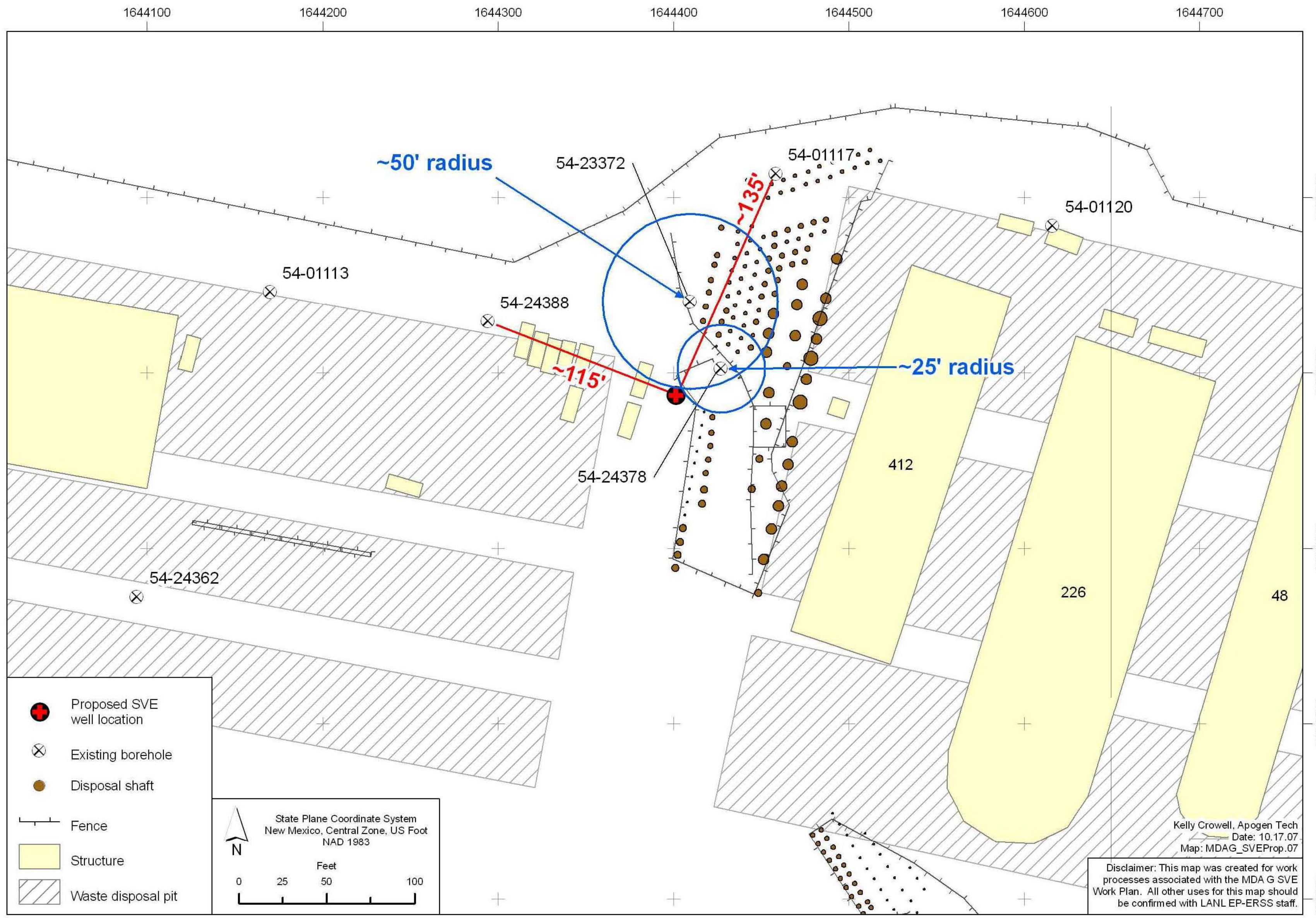


Figure 3.0-3 SVE monitoring borehole locations

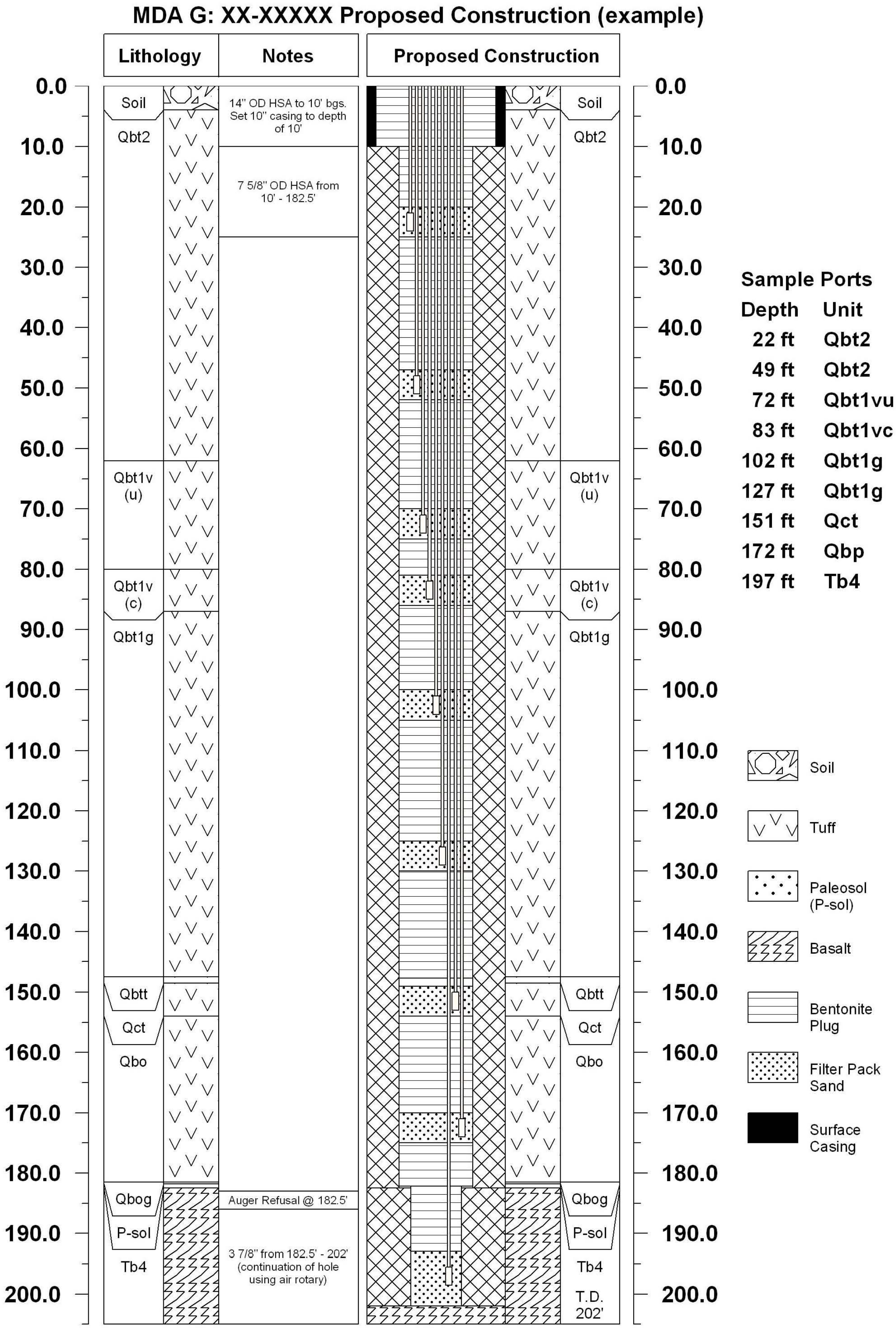


Figure 3.0-4 General SVE pore-gas monitoring well construction diagram

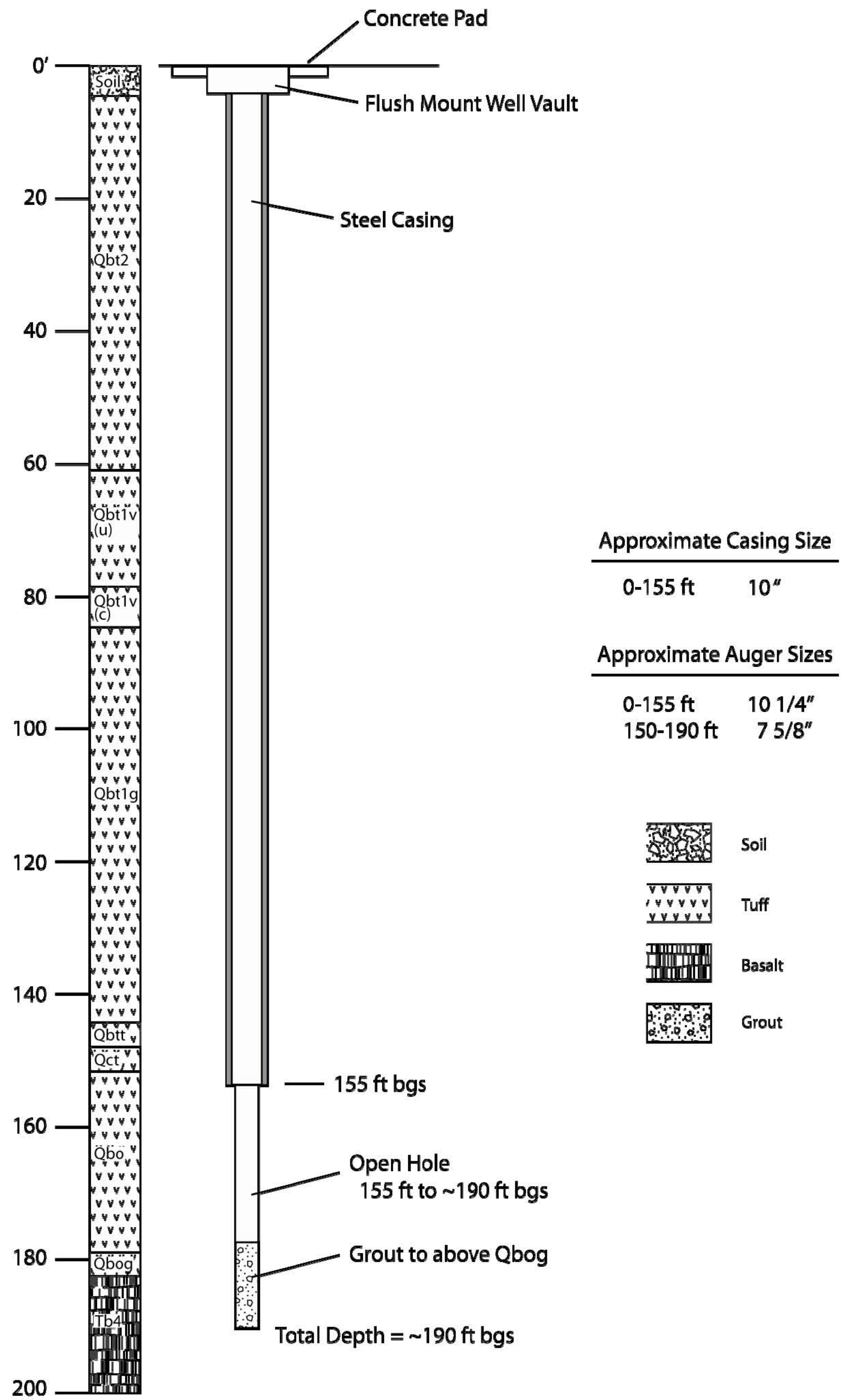


Figure 3.0-5 Passive SVE borehole construction diagram

Table 2.2-1
Geohydrologic and Hydraulic Properties for Stratigraphic Layers

Stratigraphic Units/Subunits		Hydraulic Properties[a]						Geohydrologic Characteristics[b]		
Stratigraphic Unit	Stratigraphic Subunit	Bulk Density (lb/in.³)	Porosity (%)	In Situ Permeability (Darcies)[c]	Volumetric Moisture Content (%)	Saturation (%)	Saturated Hydraulic Conductivity (ft/day)	Gravimetric Moisture Content (%)	Induration[d]	Fractures[e]
2	2(u)	0.0495	45.7	0.5–1	2.57	5.7	1.24	2.12	Mod	Many
	2(l)							1.24	Strong	Many
1v(u)	$1v(u_2)$	0.0448	48.7	0.4–0.9	1.89	3.7	0.42	1.03	Slight	Mod
	$1v(u_1)$							1.79	Non	None
1v(c)	1v(c)	0.0426	49.3	0.1–1.2	10.88	21.3	0.47	5.11	Mod	Mod
1g	1g(u)	0.0415	46.2	0.5–1	8.94	16.9	0.53	5.77	Mod	Mod
	1g							5.83	Non	None
Tsankawi/ Cerro Toledo		0.0404	47.3	7–10	14	30.3	2.43	10.8	Mod	Rare
								8.49	Slight	Rare

[a] From Table 2-1, "Pilot Vapor Extraction Test at TA-54" (ERM/Golder 1997, 070334), values converted to English units.

[b] From MDAs L and G Resource Conservation and Recovery Act facility investigation boreholes.

[c] Straddle packer permeability results for borehole 54-01018, data collected from 10–310 ft bgs (Lowry 1997, 087818).

[d] Qualitative induration (hardness) scale: non=nonindurated; slight=slightly indurated; mod=moderately indurated; strg=strongly indurated.

[e] Qualitative fracture scale: none=not present; rare=few present; mod=some present; many=fractures abundant.