Drilling Work Plan for Regional Aquifer Well R-54

Primary Purpose	Regional aquifer well R-54 is being installed in Pajarito Canyon to enhance early-arrival regional aquifer monitoring for Material Disposal Area (MDA) L and to provide additional information toward determining the potential source(s) of contamination that may be found beneath Mesita del Buey (Figure 1). The proposed location is selected to be close to the southwestern lateral extent of the volatile organic compound (VOC) contamination within the vadose zone beneath MDA L. The well will also monitor for potential contaminants originating from sources elsewhere within the Pajarito Canyon watershed. The target depth for the R-54 borehole is 1050 ft below ground surface (bgs). R-54 is expected to penetrate the top of regional saturation in Cerros del Rio volcanic rock at 805-ft depth (Figure 2). To support development of a three-dimensional perspective on potential contaminants and groundwater flow within the regional aquifer, the well is planned to have an upper screen near the top of the regional zone of saturation within Cerros del Rio lavas and a lower screen within the underlying Puye Formation in a zone with good permeability properties. Screen separation will be a minimum of 50 ft to allow for the installation of a Baski sampling system. A final well design will be based on hydrogeological conditions encountered during drilling and will be submitted to the New Mexico Environment Department (NMED) for approval.
Conceptual Model	VOC contamination is present in the vadose zone beneath MDA L. The extent of contamination in the vadose zone occurs as an oblate shape aligned with the mesa configuration. It is uncertain whether one or more VOCs originating from MDA L is present in the regional aquifer. The location of well R-54 is specifically selected to supplement the existing groundwater monitoring network at Technical Area 54. The proposed location for R-54 supplements existing R-20 by monitoring closer to the known MDA L VOC footprint. This location is also near or within a canyon-floor potential infiltration zone and will therefore also provide monitoring for potential contaminants originating from other upgradient sources.
Drilling Approach	Drilling will be conducted with methods selected to optimize the potential of completing the well without the use of any drilling additives in or immediately above the target zone of saturation. A combination of open-hole and casing-advance methods will be used. Each interval of open hole or casing advance will be optimized to meet well objectives. Casing will be used to protect open-hole intervals above, to advance the borehole when open-hole drilling is not possible, and to secure the borehole through unstable zones or through significant perched groundwater intervals.
Potential Drilling Fluids, Composition, and Use	Fluids and additives that may be used to facilitate drilling are consistent with those previously used in the drilling program at Los Alamos National Laboratory (the Laboratory). Fluids and additives previously approved for use by NMED include • potable water and municipal water supply to aid in delivering other drilling additives and cooling the drill bit; • QUIK-FOAM, a blend of alcohol ethoxy sulfates, used as a foaming agent; and • AQF-2, an anionic surfactant, used as a foaming agent. Complete records will be maintained detailing the type, amount, and volume of drilling additive used; depth of drilling fluid added to the borehole; amount in storage in the borehole; and recovery volume of drilling fluid. No drilling fluids will be used within 100 ft of the regional aquifer, except potable municipal water. If the regional aquifer cannot be reached without adding drilling fluids, the situation will be discussed with NMED. No s will be added without approval from NMED.
Hydrogeologic and Geochemical Objectives	• The primary objective is to monitor groundwater quality of the regional aquifer near MDA L. • A secondary objective is to establish water levels and flow characteristics in the regional aquifer in this area and to monitor the effects of water production from

	municipal supply wells.
Potential Groundwater Occurrence and Detection	• *Perched*: Specific efforts will be made during drilling of R-54 to check for water production in the Guaje Pumice Bed (393–413 ft bgs), in the Puye Formation, and the upper part of the Cerros del Rio basalt section (413–715 ft bgs). • *Regional*: 805 ft bgs. Regional groundwater is expected to occur in Cerros del Rio lavas within the Puye Formation. • Methods for groundwater detection may include driller's observations, water-level measurements, borehole video, and borehole geophysics.
Core Sampling	No core collection is planned.
Groundwater Screening Sampling	• Groundwater screening samples will be collected during drilling at any perched horizon producing sufficient water for sampling. • Screening samples of groundwater will be analyzed for cations/metals (dissolved and total) and anions (dissolved) by the Earth and Environmental Sciences Division's Geochemistry and Geomaterials Research Laboratory and for high explosives (HE), tritium, and VOCs by off-site laboratories.
Groundwater Characterization Sampling	• Groundwater samples will be collected from the completed well between 10 and 60 d after well development, in accordance with the Compliance Order on Consent. These samples will be analyzed for the full suite of constituents, including radiochemistry, metals/cations, general inorganic chemicals, HE, VOCs, and stable isotopes. If R-54 is completed as a two-screen well as planned, the first characterization samples will be collected at the end of each constant rate pumping test through a stainless-steel discharge pipe. • Subsequent groundwater samples will be collected under the annual "Interim Facility-Wide Groundwater Monitoring Plan."
Geophysical Testing	• The Laboratory's borehole video camera, natural gamma, and induction tools will be used in the open borehole if conditions allow. • A full suite of geophysical logs will be run in the open borehole, if required, to ensure proper placement of the screens. The logs will be collected by Schlumberger, Inc., and will include Accelerator Porosity Sonde (Neutron Porosity), Array Induction, Combined Magnetic Resonance, Natural and Spectral Gamma, and Formation Micro-Imager logs. In cased portions of the borehole, Neutron Porosity, Triple Litho-Density, Elemental Capture, Natural Gamma, and Spectral Gamma logs will be collected. These logs will be used to characterize the hydraulic properties of saturated rocks in the regional aquifer. The geophysical logs also will be used to select the well screen depth. The suite and timing of geophysical logging will depend on borehole conditions.
Well Completion Design	A well screen will be placed within the Cerros del Rio basalt near the top of the regional aquifer and a deeper well screen will be placed within the Puye Formation.
Well Development	The well may be developed by mechanical means, including swabbing, bailing, and pumping. • After initial swabbing and bailing, a submersible pump will be used to complete the development process. • Water-quality parameters to be monitored: pH, specific conductance, dissolved oxygen, temperature, turbidity, total organic carbon (TOC) • If the Laboratory is unable to bring the water-quality parameters within the limits specified below, chemical well development may be used if approved by NMED. • Chemicals used for well development may include the use of sodium acid pyrophosphate or AQUA-CLEAR PFD to remove natural and added clays and/or

	chlorination to kill bacteria introduced during well completion.
Well Development (continued)	Target water-quality parameters: turbidity < 5 nephelometric turbidity units, TOC <2 ppm, other parameters stable
Hydraulic Testing	Pumping tests at both screens will be performed if hydrologic conditions permit. Each screen will be isolated and pumped separately. Response to pumping tests will be monitored at nearby wells.
Investigation-Derived Waste Management	Investigation-derived waste will be managed in accordance with Standard Operating Procedure (SOP) EP-SOP-5238, Characterization and Management of Environmental Program Waste (http://www.lanl.gov/environment/all/qa/adep.shtml). This SOP incorporates the requirements of applicable U.S. Environmental Protection Agency and NMED regulations, U.S. Department of Energy orders, and Laboratory requirements. The primary waste streams include drill cuttings, drilling water, development water, purge water, decontamination water, and contact waste. Drill cuttings will be managed in accordance with the NMED-approved Notice of Intent (NOI) Decision Tree for Land Application of IDW Solids from Construction of Wells and Boreholes (November 2007). Drilling, purge, and development waters will be managed in accordance with the NMED-approved NOI Decision Tree for Drilling, Development, Rehabilitation, and Sampling Purge Water (November 2006). Initially, drill cuttings and drilling water will be stored in lined pits. The cuttings may or may not contain residue of drilling additives, i.e., bentonite clay. The contents of the pits will be characterized with direct sampling following completion of drilling activities, and waste determinations will be made from validated data. If validated analytical data show these wastes cannot be land-applied, they will be removed from the pit, containerized, and placed in accumulation areas appropriate to the type of waste. Cuttings, drilling water, development water, and purge water that cannot be land-applied and are designated as hazardous waste will be sent to an authorized treatment, storage, or disposal facility within 90 d of containerization. Development water, purge water, and decontamination water will be containerized separately at their point of generation, placed in an accumulation area appropriate to the type of waste, and directly sampled. Contact waste will be containerized at the point of generation, placed in an appropriate accumulation area, and characterized using acceptable knowledge of the media with which it came in contact.
Schedule	Well R-54 is proposed for NMED completion on March 30, 2010. This date is consistent with the Laboratory's October 14, 2009, letter to NMED (LANL 2009, 107088) proposing an integrated well-installation schedule for wells that includes R-53 and R-54; both of these wells are specifically applicable to the collection of key groundwater data for MDA L. Monitoring conducted subsequent to installation of R-54 will be implemented under the "Interim Facility-Wide Groundwater Monitoring Plan" and will support investigations and potential corrective actions at MDA L and other sites in the vicinity as applicable.

REFERENCE

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

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

LANL (Los Alamos National Laboratory), October 14, 2009. "Submittal of a Proposed Integrated Well-Installation Schedule," Los Alamos National Laboratory letter (EP2009-0496) to J.P. Bearzi (NMED-HWB) from M.J. Graham (LANL) and G.J. Rael (DOE-LASO), Los Alamos, New Mexico. (LANL 2009, 107088)

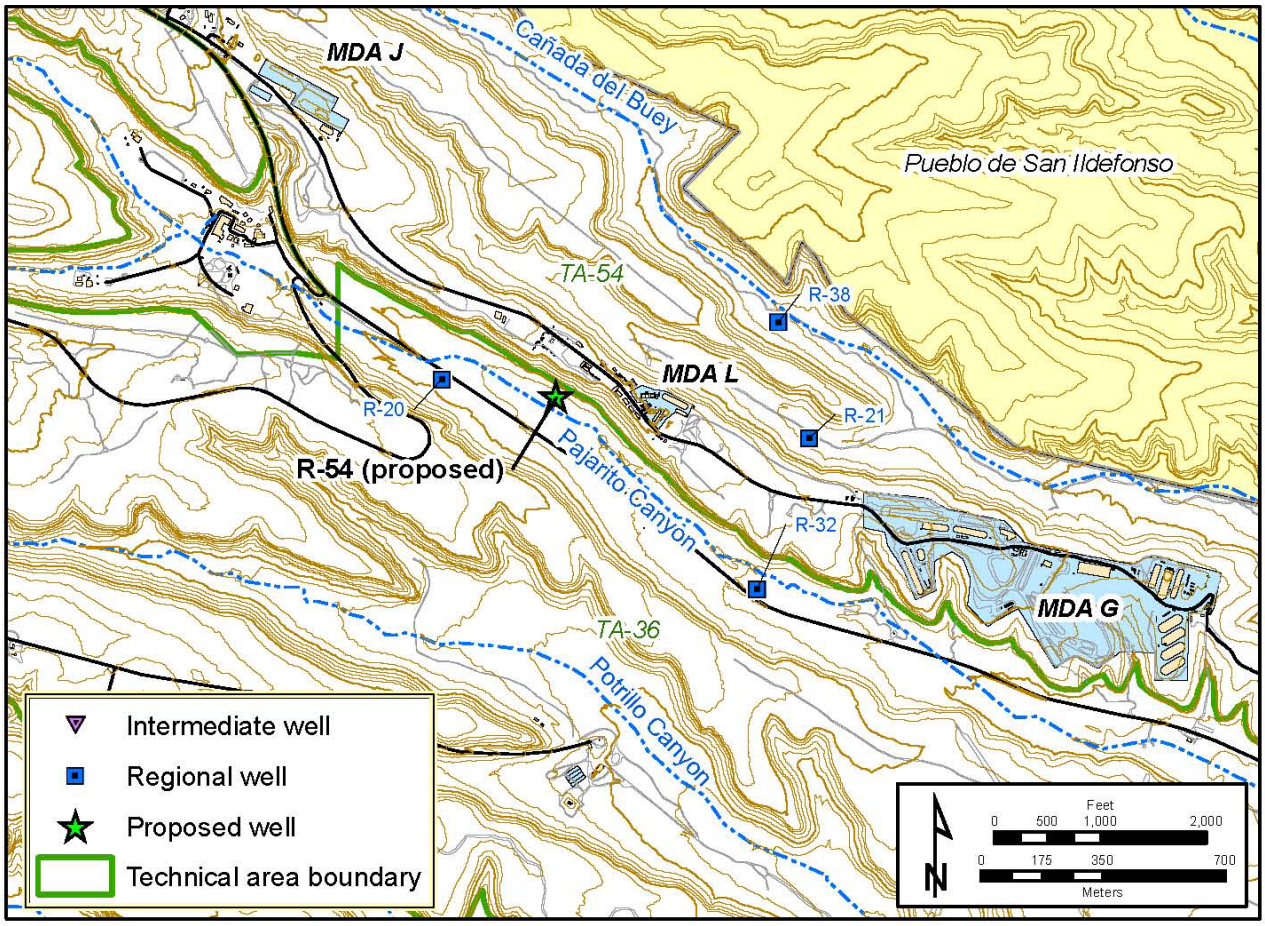

Figure 1 Proposed R-54 site

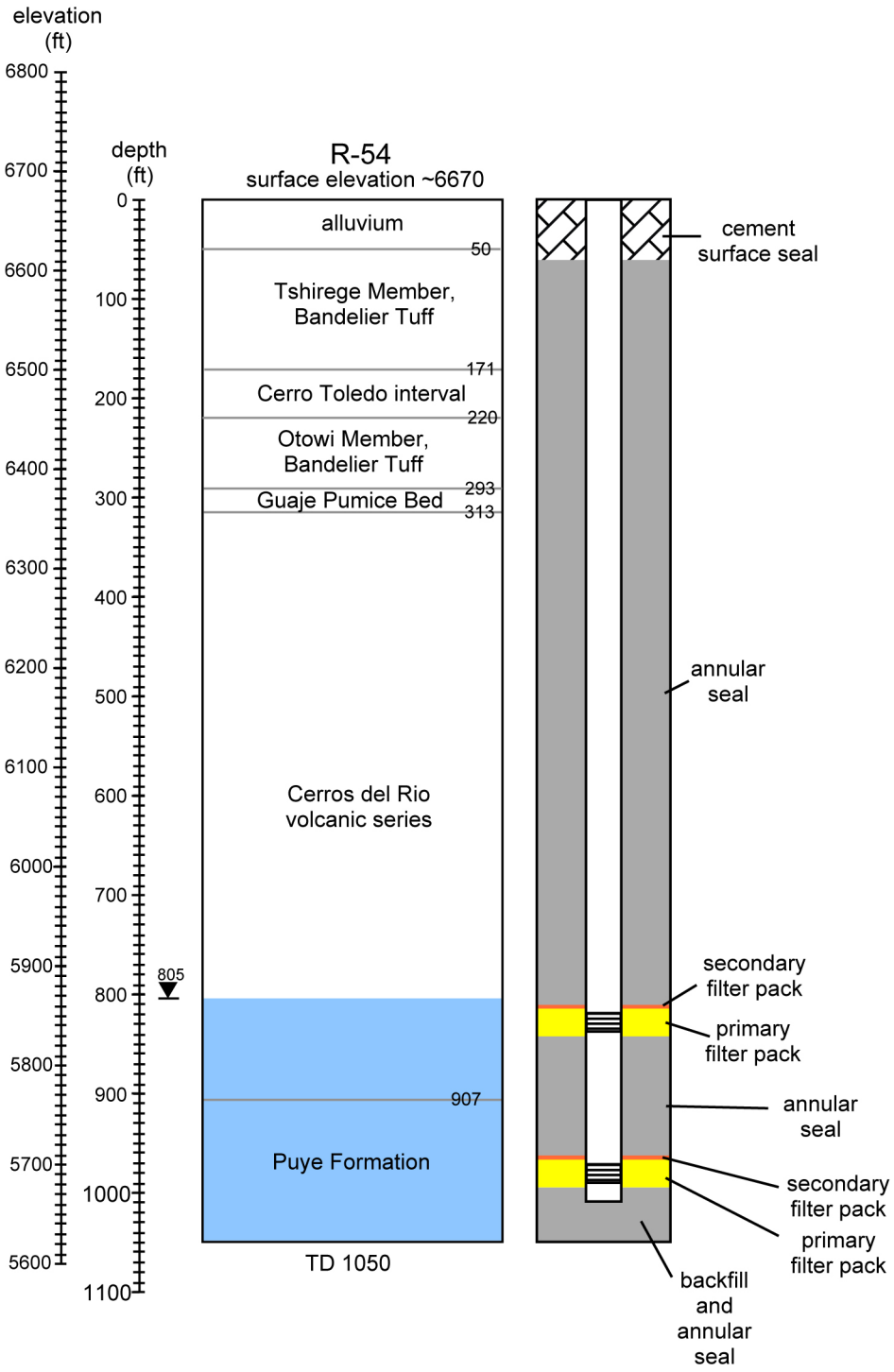

Figure 2 Predicted geology and well schematic for well R-54