Drilling Work Plan for Regional Aquifer Well R-47

Primary Purpose	Regional aquifer well R-47 is being installed to satisfy a recommendation made in the Technical Area 16 Well Network Evaluation and Recommendations (LANL 2012, 213573) and approved by the New Mexico Environment Department (NMED) Hazardous Waste Bureau. This assessment recommended installing one new regional groundwater monitoring well to augment the existing network to better define RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) contamination flow paths within the regional aquifer north of Cañon de Valle (Figure 1). The primary purpose of R-47 is to provide groundwater monitoring for high explosives (HE) and other potential contaminants in the regional aquifer downgradient of the 260 Outfall and beneath infiltration pathways associated with Cañon de Valle and perched groundwater systems in the area. The depth to the top of regional saturation at R-47 is expected to be approximately 1250 ft. The target depth for the R-47 borehole is 1350 ft, about 100 ft into the regional aquifer. The depth to water is uncertain, and the target depth may be adjusted once the water depth at this location is determined. Figure 2 shows the predicted geology and proposed well design for well R-47. The well is tentatively designed with one well screen placed near the water table in Puye Formation deposits. Final selection of well-screen length and position will be based on data obtained during drilling, including information from lithological logs of cuttings, water-level measurements, video logs, geophysical logs, and driller's observations. A final well design will be based on hydrogeological conditions encountered during drilling, and a revised well design document will be submitted to NMED for approval before well construction begins.
Conceptual Model	The primary migration route of contaminants associated with the 260 Outfall likely consisted of discharge of HE compounds as effluent from the outfall, surface flow of effluent to Cañon de Valle via a small tributary drainage, downcanyon transport of contaminants by surface water flow and alluvial groundwater, infiltration into the vadose zone, and subsurface migration of soluble contaminants to deep-perched groundwater and the regional groundwater. Modeling presented in the network evaluation (LANL 2012, 213573) and low, but increasing, RDX concentrations in downgradient well R-18 suggest northeast flow paths from infiltration zones in Cañon de Valle. The Technical Area 16 (TA-16) well network evaluation and recommendations report (LANL 2012, 213573) demonstrates that the previously proposed location for regional well R-47, near intermediate well R-47i, does not improve the detection of contaminants from TA-16. Recently installed well R-63, which was sited west of R-47i, provides better monitoring efficiency than the originally proposed R-47 location. Los Alamos National Laboratory (LANL) no longer proposes to install a regional well near intermediate well R-47i and proposes instead to locate the well 2700 ft (one-half mile) northwest of well R-47i (Figure 1).
Drilling Approach	Drilling will be conducted with methods selected to optimize the potential of completing the well without using drilling additives in, or immediately above, the target zone of saturation. A combination of open-hole and casing-advance methods will be employed. 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 intervals of perched groundwater.

Potential Drilling Fluids, Composition, and Use	Fluids and additives that may be used to facilitate drilling will be consistent with those previously used in the drilling program at LANL and already characterized geochemically. Fluids and additives previously authorized for use by NMED include • potable municipal water supply to aid in delivery of other drilling additives and cool 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 fluid used, depth at which drilling fluid is added to the borehole, amount in storage in 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 chemicals, other than those listed above, will be added without NMED's approval.
Hydrogeologic and Geochemical Objectives	• The primary objective is to monitor water quality in the regional aquifer downgradient of HE releases from the 260 Outfall. • A secondary objective is to establish water levels and gradients in the regional aquifer in this area. • Another secondary objective is to determine the vertical extent of perched-intermediate groundwater, if present. This secondary purpose will be addressed to the extent possible, but drilling methods will be optimized to accomplish the primary objective of monitoring water quality downgradient of HE releases from the 260 Outfall. • The final objective is to define the hydrostratigraphy of the site, characterizing rock units that can impact contaminant pathways in both the vadose and saturated intervals.
Potential Groundwater Occurrence and Detection	*Potential Perched Water:* This zone may be encountered during the drilling of R-47. Based on the occurrence of similar zones in nearby wells next to Cañon de Valle, perched groundwater may be present at the base of Qbt 3 within the Tshirege Member of the Bandelier Tuff and within the Puye Formation in the 750–800 and 1050–1100 ft below ground surface ranges. Drilling will be halted at a convenient point above the 750-ft depth and at depths of 900 ft and 1150 ft to evaluate the presence and vertical extent of perched-groundwater zones at this location. *Regional:* At approximately the 1250-ft depth, regional groundwater is expected to occur in fanglomerate deposits of 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.
Perched Groundwater Screening Sampling	Groundwater screening samples will be collected during drilling if perched groundwater is detected and if each zone produces sufficient water for sampling. Screening samples of perched 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 HE, tritium, and volatile organic compounds (VOCs) by off-site laboratories. The use of drilling fluids will likely continue through any potential perched-intermediate groundwater zones; therefore, careful evaluation of the analytical results is warranted.

Regional 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 TA-16–related constituents, including tritium; metals/cations; general inorganic chemicals; VOCs; semivolatile organic compounds; HE compounds, including RDX and related degradation products; and stable isotopes. Subsequent groundwater samples will be collected in accordance with the requirements of the Interim Facility-Wide Groundwater Monitoring Plan (the Interim Plan).
Geophysical Testing	LANL'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, if required, for proper placement of the screen. The logs will be collected by Schlumberger, Inc., and for open-hole conditions, will include accelerator porosity sonde (neutron porosity), array induction, combined magnetic resonance, natural and spectral gamma, and formation microimager logs. In cased portions of the borehole, neutron porosity, triple lithodensity, 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 depths. The suite and timing of geophysical logging will depend on borehole conditions.
Well Completion Design	Figure 2 shows the proposed well design and predicted geology for well R-47.
Well Development	The well may be developed by both mechanical and chemical means. Mechanical means include swabbing, bailing, and pumping. Chemical means include the use of additives to remove clays and/or chlorination to kill bacteria introduced during well completion. • After initial swabbing and bailing, a submersible pump will be used to complete the development process. • Water-quality parameters will be measured in a flow-through cell. The parameters to be monitored are pH, specific conductance, dissolved oxygen, temperature, turbidity, oxidation-reduction potential, and total organic carbon (TOC). • If LANL is unable to bring the water-quality parameters to measure within the limits specified below, the use of chemical well development may be discussed with NMED. No chemicals will be added without NMED's approval. Chemical means that may be used include sodium acid pyrophosphate and AQUACLEAR PFD to remove clays, and/or chlorination to kill bacteria introduced during well completion. Well development will be considered complete when target water-quality parameters are met. The target water-quality parameters are turbidity <5 nephelometric turbidity units, TOC <2 ppm, and other parameters stable.
Hydraulic Testing	Hydraulic testing will be considered if a sufficiently robust zone within the regional aquifer is encountered. The most likely test will be a 24-h constant-rate pumping test.

Investigation-Derived Waste Management	Investigation-derived waste (IDW) 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 LANL 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 NOI (Notice of Intent) 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/well completion additives (e.g., drilling foam and 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-47 is proposed for completion by September 30, 2013. This date assumes that additional funding will be available beginning April 1, 2013, to support the proposed completion date. Monitoring conducted after R-47 is installed will be implemented under the Interim Plan and will support investigations and corrective actions at TA-16.

REFERENCES

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), March 2012. "Technical Area 16 Well Network Evaluation and Recommendations," Los Alamos National Laboratory document LA-UR-12-1082, Los Alamos, New Mexico. (LANL 2012, 213573)

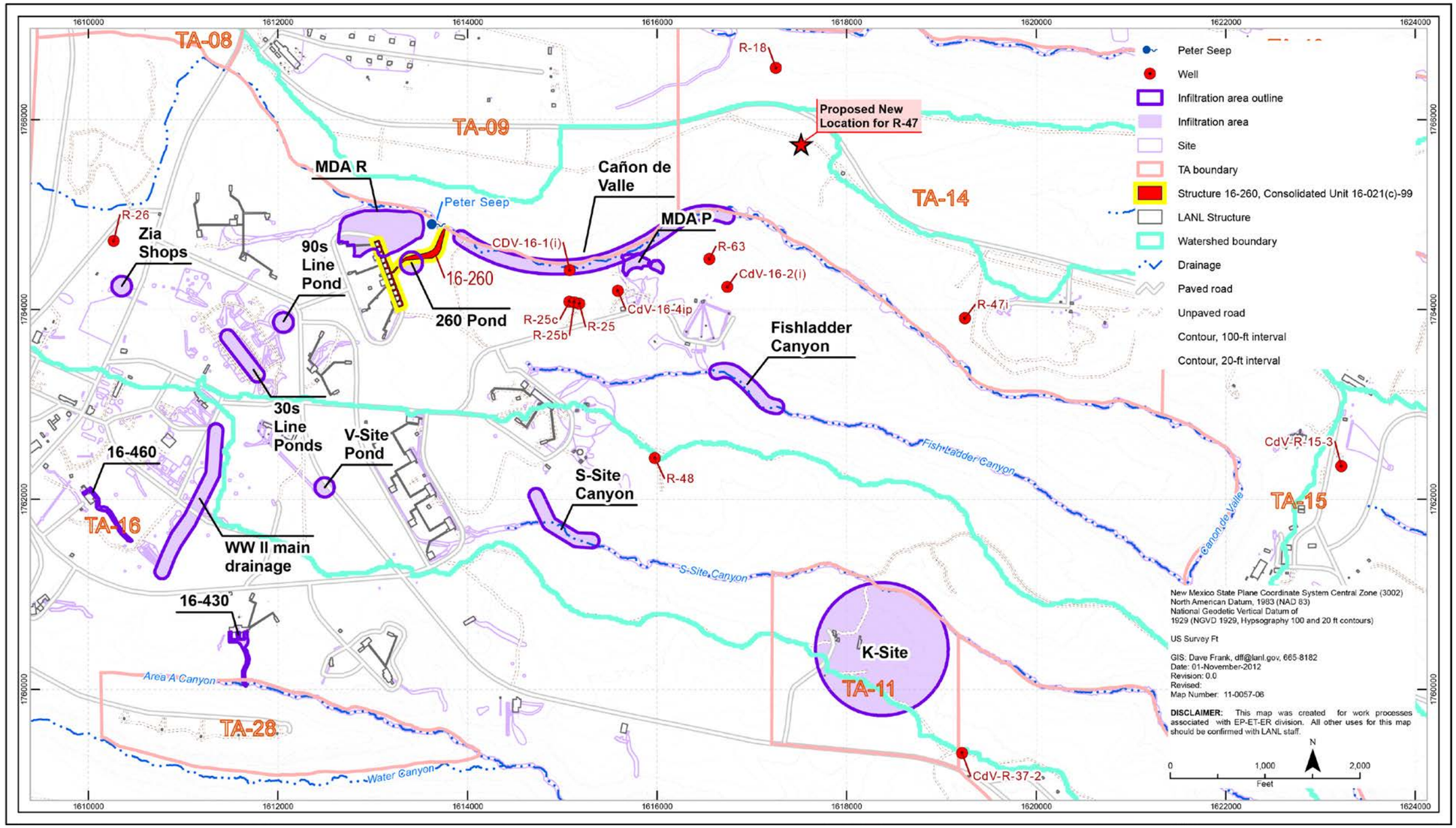

Figure 1 **Proposed location of well R-47**

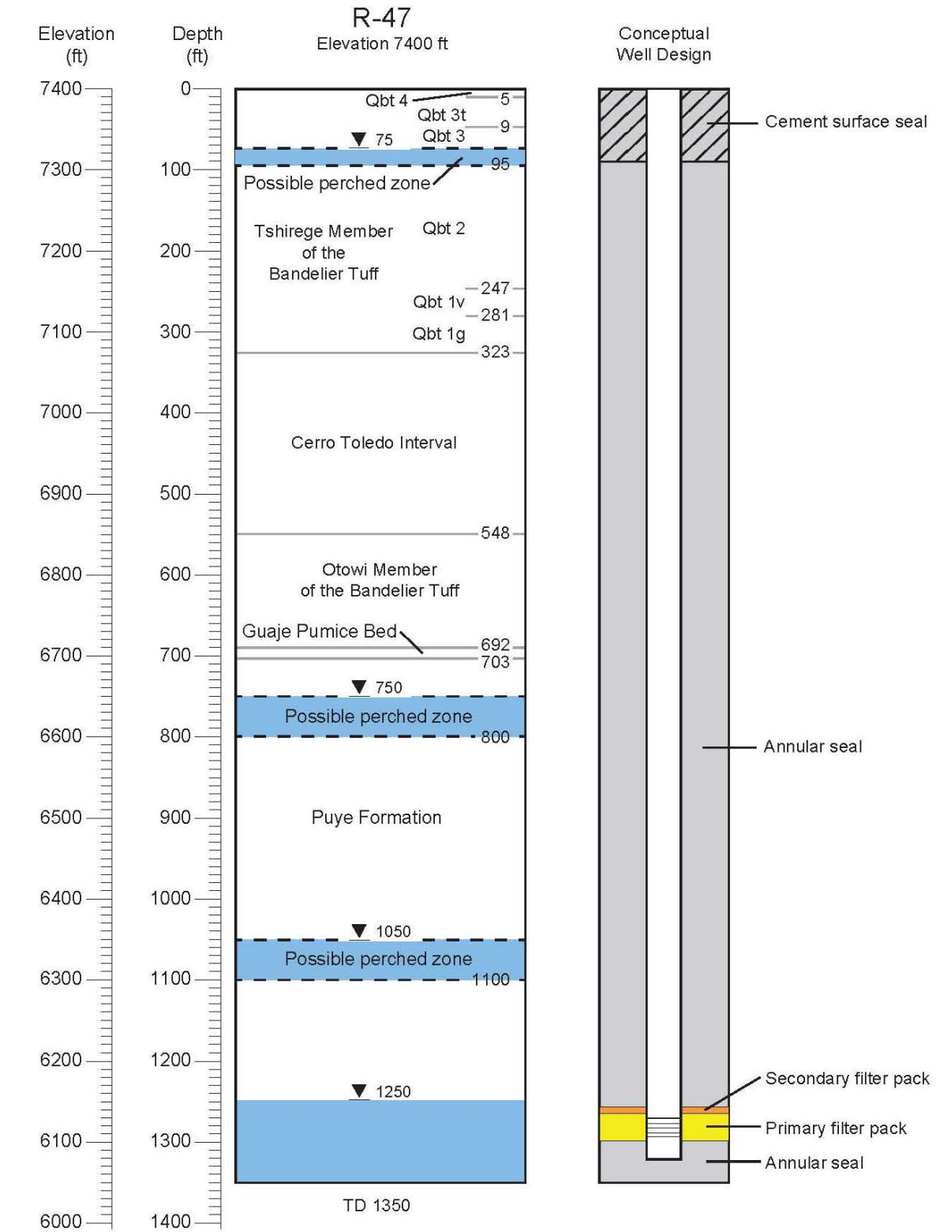

Figure 2 Predicted geology and proposed well design for well R-47