Drilling Work Plan for Well R-55i

Primary Purpose	Perched-intermediate well R-55i is being installed to satisfy a requirement by the New Mexico Environment Department (NMED) to install a perched groundwater-monitoring well near regional aquifer well R-55. Perched groundwater was identified at this location while R-55 was being drilled to the regional aquifer. The proposed site for well R-55i is located on the R-55 drill pad in Cañada del Buey about 2000 ft east of Material Disposal Area (MDA) G (Figure 1). R-55i will supplement the monitoring of perched groundwater east of MDA G provided by well R-23i (Figure 1). The R-55i borehole is expected to penetrate the top of perched saturation at a depth of approximately 500 ft. Perched groundwater occurs within highly stratified phreatomagmatic deposits and Totavi-like riverine sediments that are present between two Cerros del Rio lava flows. Groundwater appears to be perched above a clay-bed aquitard extending from 565 to 605 ft. The target total depth (TD) for the R-55i borehole is set at 565 ft, the top of the clay-bed aquitard. Figure 2 shows the predicted geology and proposed design for well R-55i. The well is provisionally designed with a single 20-ft well screen placed within the upper part the perched groundwater. Actual well screen lengths and positions will be based on data acquired during drilling, including information from lithological logs of cuttings, water-level measurements, video logs, geophysical logs, and driller's observations. A final well design document will be submitted to NMED for approval.
Conceptual Model	The R-55/R-55i perched groundwater occurs beneath Cañada del Buey, a dry canyon system that is not likely to be an important source of infiltration for perched groundwater. Water levels measured while drilling through the perched system at regional well R-55 (6033 ft-elevation) are lower than those measured in the three well screens at R-23i (6072–6122-ft elevation), located 0.7 km to the southeast in Pajarito Canyon. The R-55/R-55i perched groundwater may represent the downgradient portion of a perched groundwater system mounded beneath lower Pajarito Canyon. Pajarito Canyon is a relatively wet canyon system with a greater potential for infiltration of surface water and alluvial groundwater than Cañada del Buey. Alternatively, perched groundwater at R-55/R-55i may be related to perched groundwater encountered at wells R-12 (water level at 6073 ft-elevation) or R-10 (water level at 6058 ft elevation). The geochemistry of water samples from R-55i will be compared with that found in surrounding perched-intermediate wells to determine if any of these groundwaters are related. It is unlikely that the perched groundwater at R-55/R-55i extends westward beneath MDA G. Drilling was halted and borehole videos were obtained to look for perched groundwater when wells R-22, R-39, R-41, R-49, and R-57 were drilled, but none was detected.
Drilling Approach	Drilling will be conducted with methods selected to optimize the potential of completing the well without the use of 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 the perched groundwater interval.

Potential Drilling Fluids, Composition, and Use	Fluids and additives that are consistent with those previously used in the drilling program at Los Alamos National Laboratory (LANL) and have been characterized geochemically may be used to facilitate drilling. Fluids and additives previously authorized for use by NMED include • potable water, 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 of drilling fluid 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 perched groundwater, except potable municipal water. If the perched groundwater cannot be reached without the addition of drilling fluids, the situation will be discussed with NMED. No chemicals, other than those listed above, will be added without approval from NMED.
Hydrogeologic and Geochemical Objectives	• The primary objective is to monitor water quality in perched groundwater east of potential hazardous- or radioactive-chemical releases from MDA G. • A secondary objective is to establish water levels for perched groundwater in this area. • Another secondary objective is to determine if perched-intermediate groundwater at R-55/R-55i is related to other groundwater occurrences in the region. This secondary purpose will be addressed by comparing the geochemistry of groundwater at R-55i with that of surrounding perched-intermediate wells.
Potential Groundwater Occurrence and Detection	Perched intermediate groundwater is expected to occur at a depth of 500 ft in phreatomagmatic deposits and Totavi-like riverine sediments that are present between two Cerros del Rio lava flows. 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	No groundwater screening samples will be collected from the borehole during drilling because water samples collected from the completed well are more representative of groundwater conditions.
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 radionuclides, metals/cations, general inorganic chemicals, high explosives, volatile organic compounds, and stable isotopes. Subsequent groundwater samples will be collected under the Interim Facility-Wide Groundwater Monitoring Plan.
Geophysical Testing	LANL's borehole video camera, natural gamma, and induction tools will be used in the open borehole if conditions allow. The suite and timing of geophysical logging will depend on borehole conditions.

Well Completion Design	The well screen will be placed within a productive portion of the phreatomagmatic and Totavi-like riverine deposits that make up the perched groundwater zone. Figure 2 shows the proposed well design for well R-55i.
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 approval from NMED. • 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 the well is in a significant water-producing horizon. The most likely test will be a 24-h constant-rate pump test.
Investigation-Derived Waste Management	Investigation-derived waste (IDW) will be managed in accordance with Standard Operating Procedure (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 will 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/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 for 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.

Investigation-Derived Waste Management (continued)	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-55i is proposed for completion on September 30, 2011.

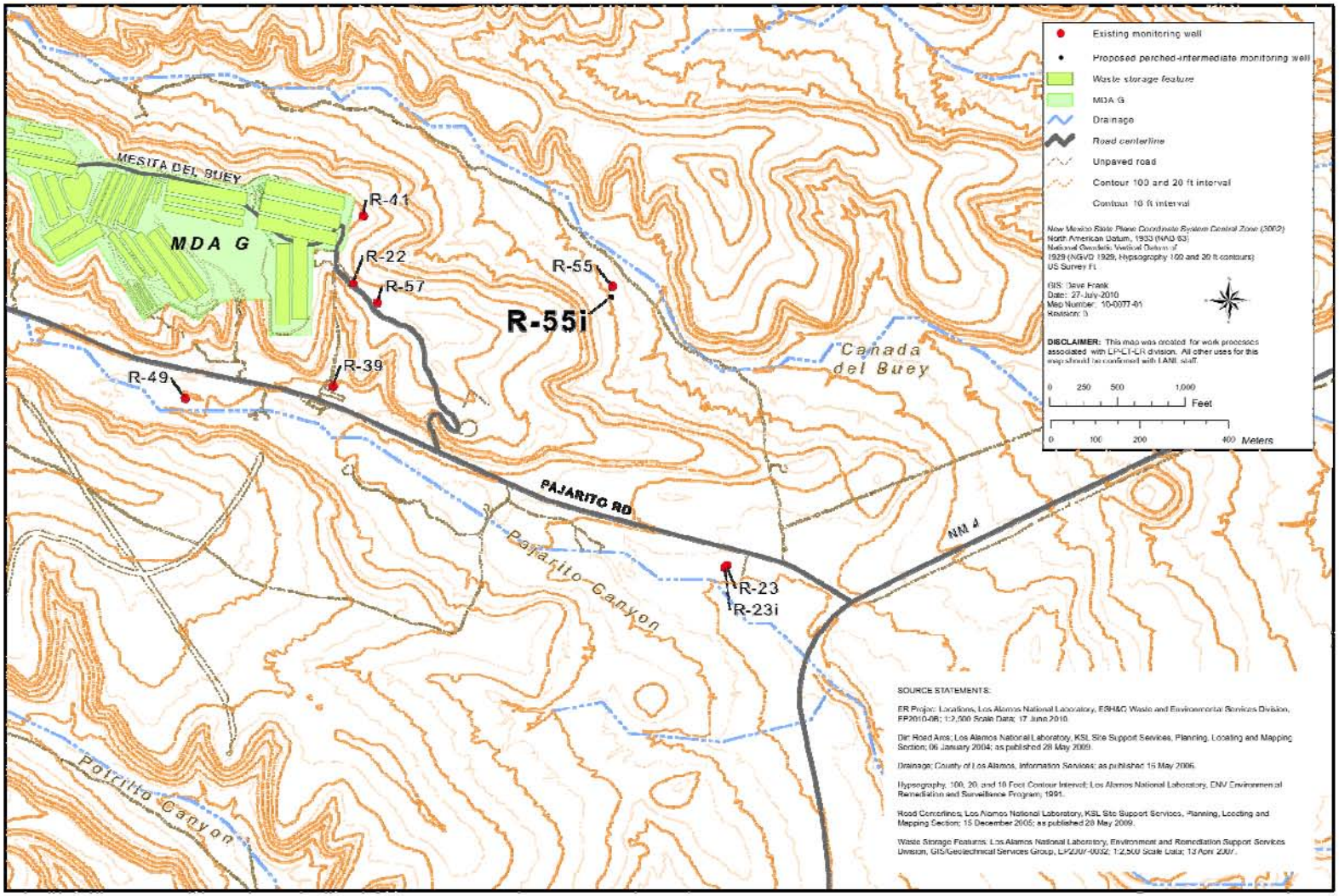

Figure 1 Proposed location for well R-55i

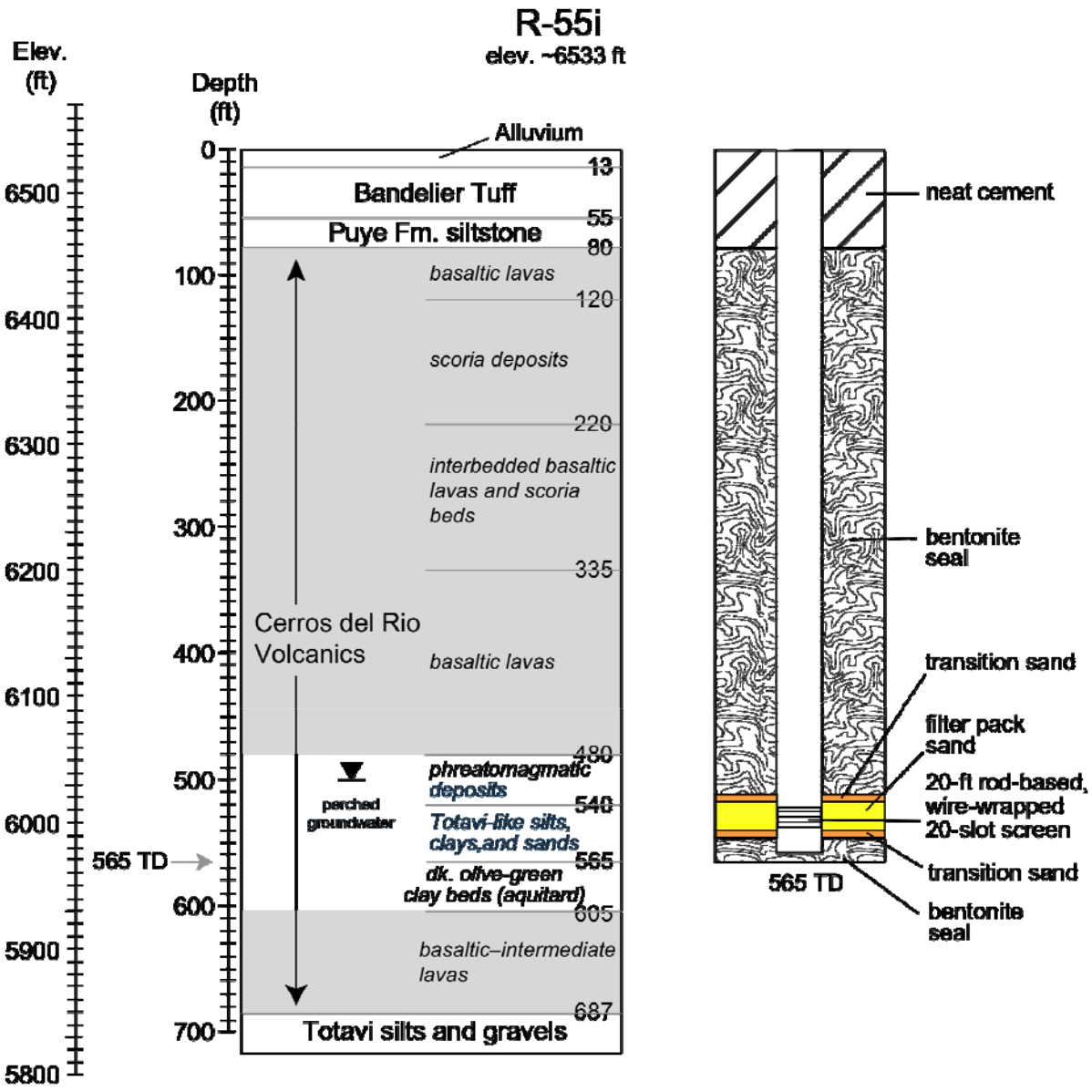

Figure 2 Predicted geology and proposed well design for well R-55i