Drilling Work Plan for Regional Aquifer Well R-50

Primary Purpose	Regional aquifer well R-50 is being installed to satisfy a requirement from the New Mexico Environment Department (NMED) in a letter dated August 31, 2009 (NMED 2009, 106965), to further define the southern extent of chromium (Cr) contamination in the regional aquifer (Figure 1). R-50 will be located to intersect potential pathways for Cr migration from the Cr source in the vicinity of R-42 and R-28 that may be more southerly than those sampled at R-44 and R-45 (Figure 1). R-50 is expected to penetrate the top of regional saturation within Puye Formation fanglomerates at about 1068 ft depth. The well at R-50 is tentatively planned as a two-screen well with both screens within the regional zone of saturation (Figure 2). The purpose of a two-screen well is to evaluate the potential vertical distribution of Cr within the regional aquifer. The upper screen is provisionally targeted within the Puye Formation and the lower screen within pumiceous sediments of the upper Santa Fe Group. Final well design will be based on hydrogeological conditions encountered during drilling and will incorporate discussions with NMED. Figure 2 shows the stratigraphy and a conceptual well design for R-50. Figure 3 is a cross-section that shows the distribution of hydrostratigraphic units at R-50 relative to the stratigraphy and screen locations of wells R-28 and R-11, extending north into Sandia Canyon.
Conceptual Model	Elevated Cr concentrations detected in the regional aquifer at R-42 and R-28 are attributed to releases that occurred in the headwaters of Sandia Canyon. Flow to the east along Sandia Canyon delivered contaminants to the alluvial system downcanyon, then to perched intermediate groundwater (SCI-1, SCI-2) and to the regional aquifer. Perched intermediate or regional diversion to the south or southeast is believed to have transported contamination to groundwater beneath both Sandia and Mortandad Canyons (Figure 1). Current conceptual models speculate a potential for a component of southerly flow due to depositional anisotropy in sediments underlying the Cerros del Rio lavas. Well R-50 is placed to intercept potential migration in a more southerly direction than is currently monitored.
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 the zone of saturation. The following is a summary of the proposed methods by depth interval. • An 18-in. drill casing will be advanced with fluid-assisted air-rotary methods through the Tshirege member of the Bandelier Tuff and the Cerro Toledo interval to approximately 240 ft below ground surface (bgs). • A 16-in. drill casing will be advanced with fluid-assisted air-rotary methods to the top of the Cerros del Rio lavas at ~560 ft bgs. • Perched intermediate water is not expected to be present at this site, but if present it would likely be found at the top of the Cerros del Rio lavas. In the unlikely case that perched water may be encountered here, bentonite will be tremied into the borehole and the 16-in. casing lowered in and sealed in place on top of the lava. • A 15-in. open borehole will be advanced through the lavas and into the underlying Puye to approximately 950 ft bgs. No drilling fluid additives will be used below 950 ft. • A 12-in. drill casing will be advanced to a total depth (TD) of 1220 ft without the use of drilling fluid additives. Municipal water may be added to cool the drill bit as needed.

Potential Drilling Fluids, Composition, and Use	The following fluids and additives that may be used are consistent with those previously used in the drilling program at Los Alamos National Laboratory (Laboratory) and have been characterized geochemically: • potable water and 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 • AQF-2, an anionic surfactant used as a foaming agent
Hydrogeologic and Geochemical Objectives	• Primary objective is to provide a regional aquifer monitoring well downgradient of elevated Cr concentrations in the regional aquifer at R-42 and R-28. • Secondary objective is to test for hydrologic communication with wells R-42, R-28, R-44, R-45, and R-13.
Potential Groundwater Occurrence & Detection	• *Regional:* 1068 ft: Regional groundwater is expected to occur in fanglomerates 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 because of distance from potential zones where Cr contaminant infiltration to the regional aquifer may be occurring.
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) in the Earth and Environmental Sciences Division's Geochemistry and Geomaterials Research Laboratory.
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 Order. These samples will be analyzed for the full suite of constituents, including radiochemistry, metals/cations, general inorganic chemicals, volatile organic compounds, and stable isotopes. • 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 15-in. open borehole before the 12-in. casing is lowered in, if conditions allow. • A full suite of geophysical logs is expected to be run in the cased borehole. The logs will be collected by Schlumberger, Inc., and may include Neutron Porosity, Triple Lithodensity, Elemental Capture, Natural Gamma, and Spectral Gamma logs. If open borehole conditions exist, Accelerator Porosity Sonde (Neutron Porosity), Array Induction, Combined Magnetic Resonance, Natural and Spectral Gamma, Elemental Capture, and Formation Micro-Imager logs may be collected. These logs will be used to characterize the hydraulic properties of saturated rocks in the regional aquifer. The geophysical logs will also be used to select the well screen depth. The suite and timing of geophysical logging will depend on borehole conditions.
Well Completion Design	Two 10-ft well screens will be placed at approximately 1090–1100-ft and 1160–1170-ft depth in the regional aquifer.

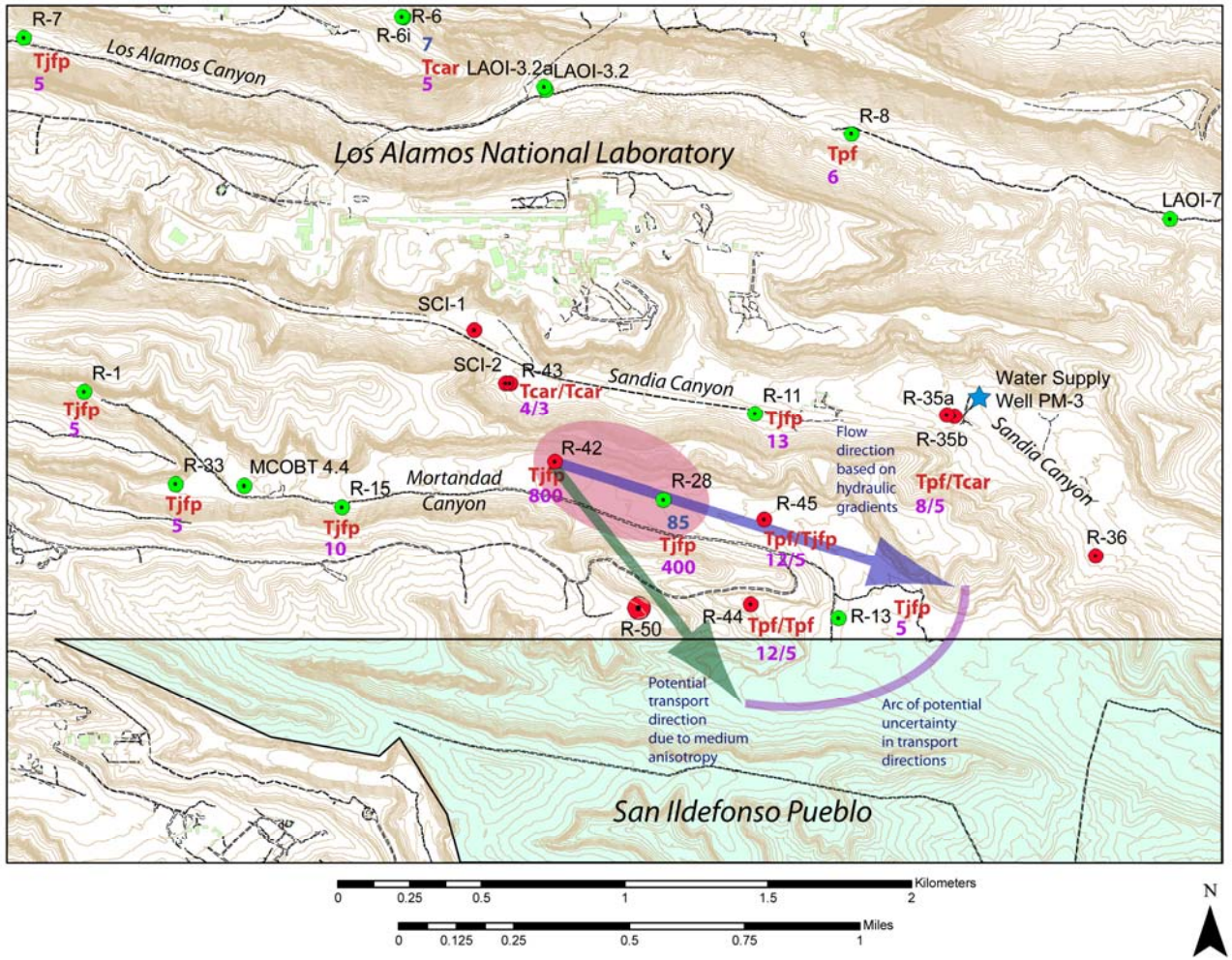
Well Development	The well may be developed by both mechanical and chemical means. Mechanical means include swabbing, bailing, and pumping. Chemical means include the use of sodium acid pyrophosphate or AQUA-CLEAR PFD to remove natural and added clays and/or chlorination to kill bacteria introduced during well completion. • After initial swabbing and bailing, a packer will be used to isolate the well screens during pumping development. • Water-quality parameters to be monitored include pH, specific conductance, temperature, turbidity, and total organic carbon (TOC). Target water-quality parameters: turbidity <5 nephelometric turbidity units, TOC <2 ppm, other parameters stable
Hydraulic Testing	If conditions allow at the completion of well installation and development, 24-h constant-rate pumping tests will be performed at both R-50 screens, each screen to be sealed and pumped separately. Response to pumping tests will be monitored at wells R-42, R-28, R-44, R-45, and R-13. Transducers to monitor pumping response are installed in all of these wells.
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 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 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	The NMED-completion date for R-50 is targeted for no later than February 23, 2010 (see attached Gantt schedule, Figure 4). This date is based on planned first availability of the appropriate drilling rig and crews. The first available drilling rigs of those currently mobilized to the Laboratory site are currently fully engaged in drilling of perched intermediate groundwater well CdV-16-37-1(i) and a cored 900-ft vadose zone monitoring well near Material Disposal Area T. Each of those two drilling projects is under a compliance schedule and expected to achieve completion in mid- to late October. Work to achieve the Laboratory's proposed NMED completion date for R-50 of February 23, 2010, is already underway, including contracting and site preparation. The schedule in Figure 4 presents the detail of activities that precede the mobilization date of November 25, 2009, shown in activity ID B140T51380. If either of the two active drilling rigs discussed above becomes available earlier than their respective schedule completion dates, the first available rig will be mobilized to the R-50 site to begin drilling, and the proposed NMED completion date of February 23, 2010, will be accelerated.

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.

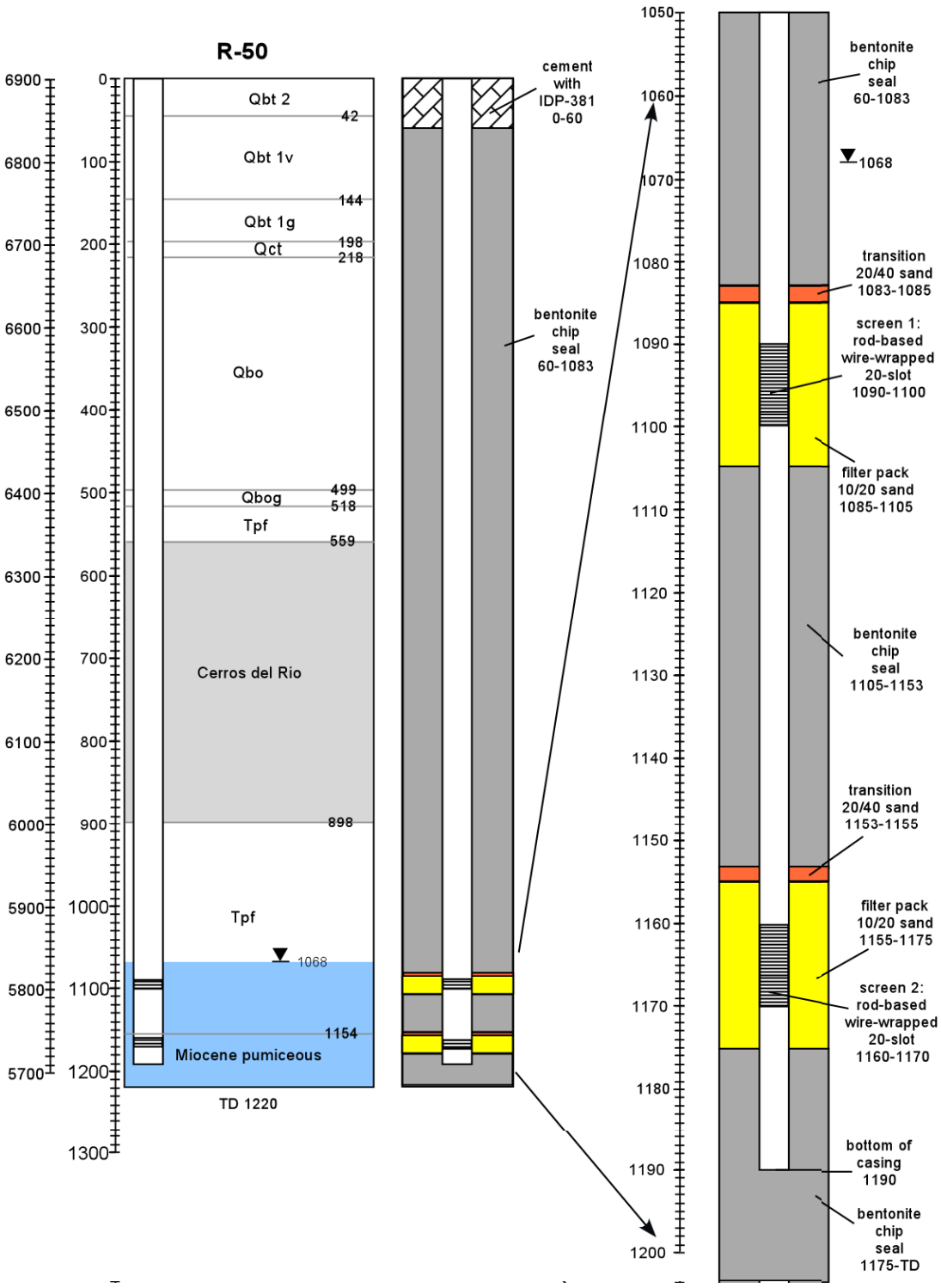
Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority.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

NMED (New Mexico Environment Department), August 31, 2009. "Modification of Approval of Drilling Work Plan for Los Alamos and Pueblo Canyons Groundwater Monitoring Well Installations, Direction to Install Chromium Investigation Well R-50," New Mexico Environment Department letter to D. Gregory (DOE-LASO) and D. McInroy (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2009, 106965)



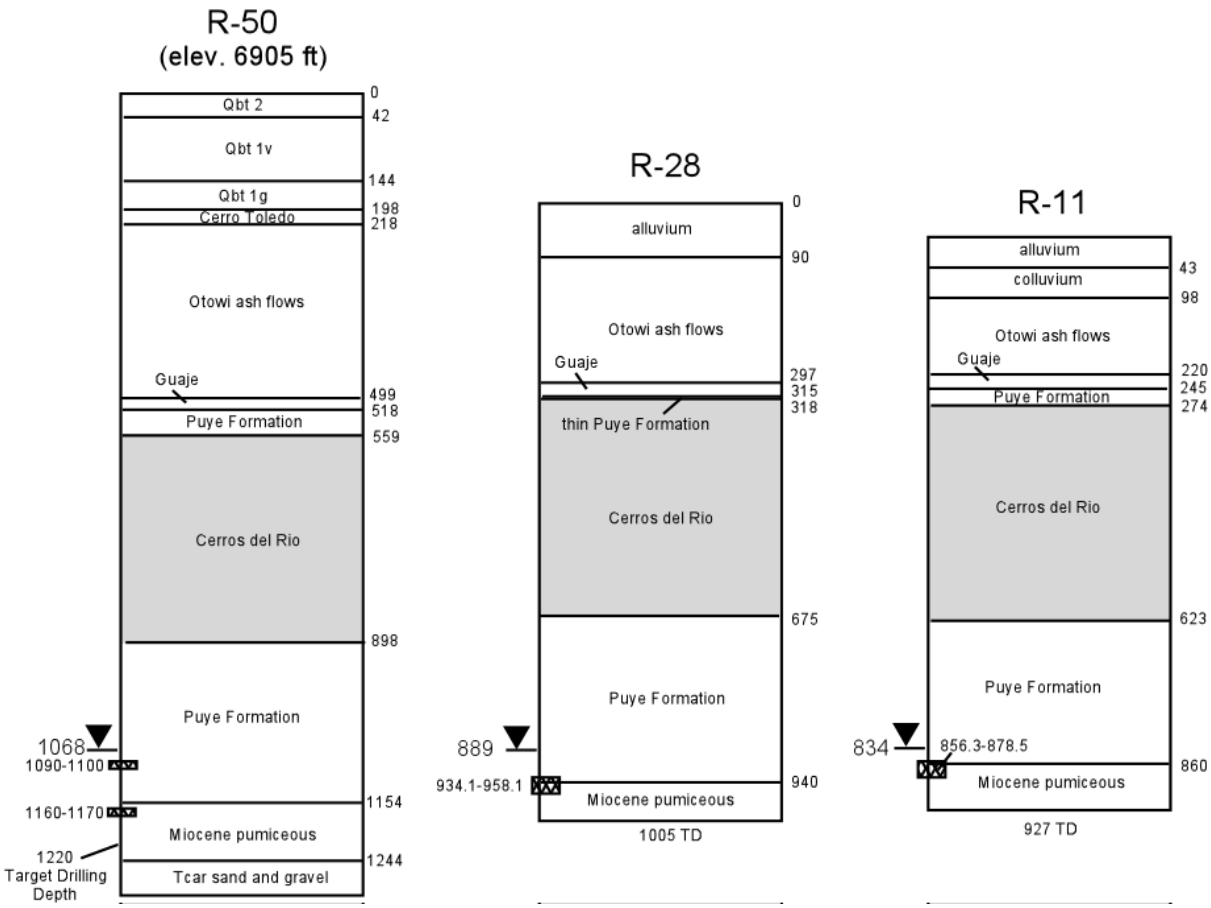
Note: The arrow in green represents the conceptual Cr transport vector to be tested at R-50.

Figure 1 **R-50 with surrounding wells. Text for selected wells in red identifies the stratigraphic unit within which the screen is located (Tpf = Puye Formation, Tjfp = Miocene pumiceous sediment, Tcar = Santa Fe Group). Text in purple indicates Cr concentrations in ppb. Where two stratigraphic designations and Cr concentrations are listed, the well has two screens, upper screen listed first.**



Note: Qbt = unit (2, 1v, 1g) of the Tshirege Member of the Bandelier Tuff; Qct = Cerro Toledo Interval; Qbo = Otowi Member of the Bandelier Tuff; Qbog = Guaje Pumice of the Otowi Member of the Bandelier Tuff; Tpf = Puye Formation.

Figure 2 Proposed well design for R-50



Note: Qbt = unit (2, 1v, 1g) of the Tshirege Member of the Bandelier Tuff.

Figure 3 Direct-line borehole-to-borehole cross-section (crossing mesas and canyons) from R-50 to the north through R-28 to R-11 (see Figure 1)

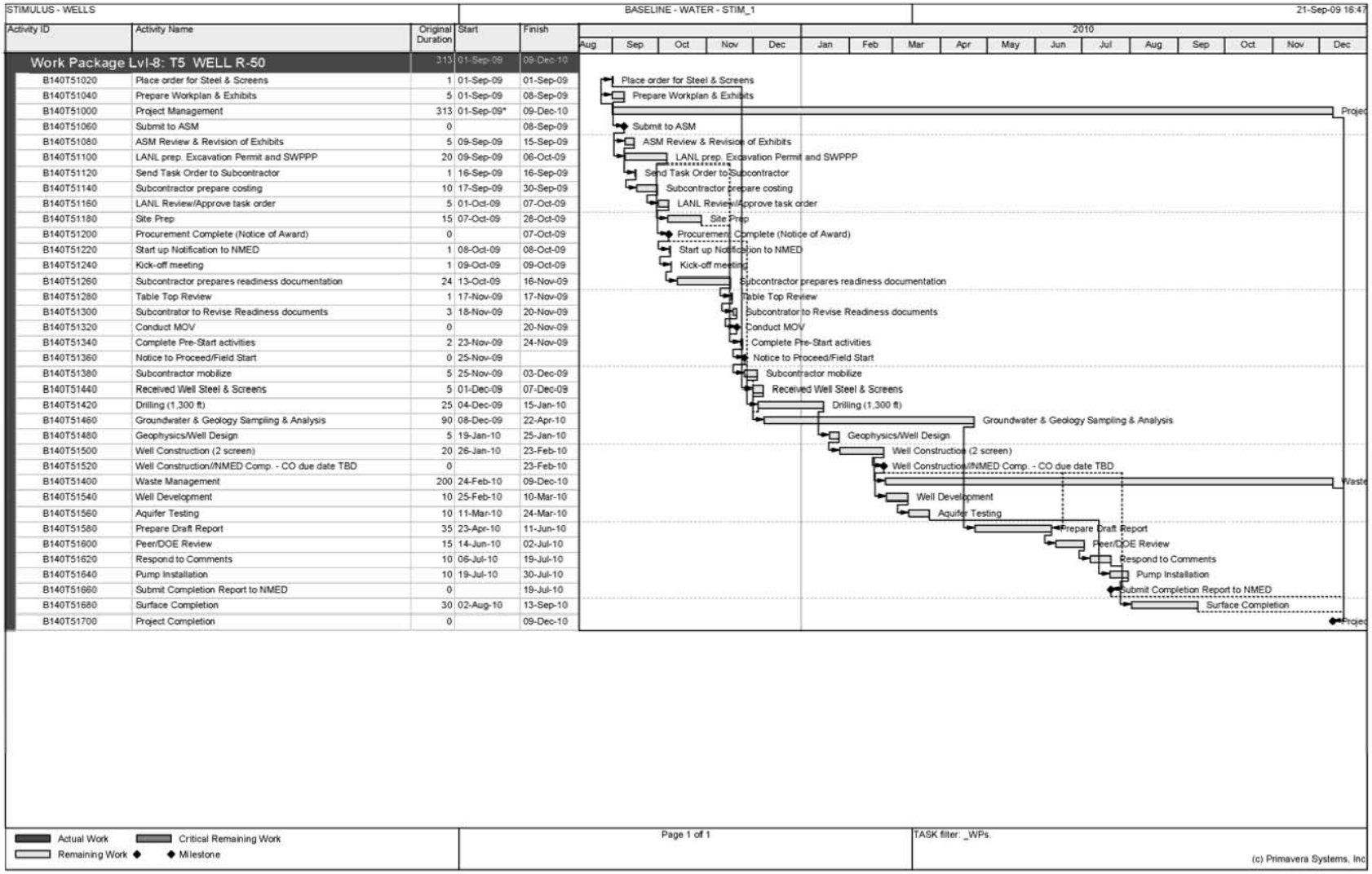


Figure 4 Detailed schedule for regional well R-50