EMID-703146

DEPARTMENT OF ENERGY
Environmental Management Los Alamos Field Office (EM-LA)
Los Alamos, New Mexico 87544

EMLA-24-BF7-2-1

March 29, 2024

Mr. Rick Shean
Designated Agency Manager
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6313

Subject: Submittal of the Drilling Work Plan for Chromium Groundwater Project Regional Aquifer Monitoring Well R-77, Revision 2

Dear Mr. Shean:

Enclosed please find two hard copies with electronic files of the "Drilling Work Plan for Chromium Groundwater Project Regional Aquifer Monitoring Well R-77, Revision 2." Enclosure 1 includes an electronic copy of a redline strikeout version of the work plan that shows the changes made as a consequence of the decision to change R-77 to a single-screen completion within the Chamita Formation. This work plan fulfills fiscal year 2024 proposed Milestone 7 of the 2016 Compliance Order on Consent Appendix B, under the Chromium Interim Measure and Characterization Campaign.

The drilling work plan for R-77 has been reformatted and streamlined for legibility and incorporation of comments. For example, NMED comments on the "Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-79, Revision 1" received January 22, 2024, have been incorporated into this work plan. Comments discussed at the March 5, 2024, submittal meeting have also been incorporated into this work plan.

If you have any questions, please contact Michael Erickson at (505) 309-1349 (michael.erickson@em-la.doe.gov) or Susan Wacaster at (505) 709-8704 (susan.wacaster@em.doe.gov).

Sincerely,

ARTURO DURAN

Digitally signed by ARTURO DURAN
Date: 2024.03.28 21:08:48 -06'00'

Arturo Q. Duran
Compliance and Permitting Manager
U.S. Department of Energy
Environmental Management
Los Alamos Field Office

Enclosure(s):

1. Two hard copies with electronic files (including a redline strikeout version):
   Drilling Work Plan for Chromium Groundwater Project Regional Aquifer Monitoring Well R-77, Revision 2 (EM2024-0138)

cc (letter and enclosure[s] emailed):
Laurie King, EPA Region 6, Dallas, TX
Raymond Martinez, San Ildefonso Pueblo, NM
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Drilling Work Plan for Chromium Groundwater Project Regional Aquifer Monitoring Well R-77, Revision 2

Proposed Monitoring Well R-77	Well Description: 5-in. completion, single screen Location: Mortandad Canyon, near the southeast corner of the CrEX-4 drill pad (NM State Plane Coordinates: x =1637816 y=1768586) (see location map in Figure 1) Total Depth: 1100 ft Angle: 90º (Vertical) Targeted Formation: Chamita Formation Estimated Elevation of the Ground Surface: 6754.5 ft Estimated Depth of Water Table: 927 ft Pad construction status: completed in April 2023 Geology: based on geologic framework model (Weston 2019, 701379) (youngest to oldest). Figure 2 shows a cross-section extending from R-42 to CrEX-4 and R-77. Screen locations are also shown for R-42 and CrEX-4. A preliminary proposed screen location is shown for R-77. A stratigraphic column for R-77 is shown in Figure 3, based on the geologic framework model. Figure 3 also shows an example well construction for R-77, but screen location and well construction materials are pending approvals from the New Mexico Environment Department (NMED) and the New Mexico Office of the State Engineer (NMOSE), respectively. The stratigraphic sequence (from youngest to oldest) includes: • Quarternary Alluvial Sediments (Qal) (0–40 ft) • Cerro Toledo Interval (Qct) (40–65 ft) • Otowi Member of the Bandelier Tuff (Qbo) (65–355 ft) • Guaje Pumice Bed (Qbog) (355–372 ft) • Puye Formation (Tpf) (372–394 ft) • Cerros del Rio Basalt (Tb4) (394–690 ft) • Puye Formation (Tpf) (690–929 ft) • Pumiceous Subunit of the Puye Formation [Tpf(p)] (929–957 ft) • Miocene Pumiceous Deposits (Tjfp) (957–1021 ft) • Chamita Formation (Tcar) (below 1021 ft)
Data Gaps	• Knowledge of chromium concentrations in the upper portion of the Chamita Formation near CrEX-4, which will potentially support performance monitoring of the interim measure and future remediation efforts • Characterization data associated with the Chamita Formation that includes transmissive riverine deposits, which could provide significant mass flux and rapid chromium transport • Water-level data to better delineate deeper flow paths • Deep head measurements evaluating hydraulic responses to pumping from nearby municipal, extraction, and monitoring wells

Drilling Work Plan Objectives	The primary objective of this drilling work plan is to describe the work requirements for drilling the new well into the Chamita formation with a well screen located within that same formation. • The top of the well screen is currently targeted at 25 ft below the top of the Chamita Formation and approximately 45 ft below the bottom of CrEX-4 screen 2. • The final screen location will be determined using the data collected during drilling (e.g., cuttings, grain-size analyses), groundwater zonal sampling, and geophysical surveys. • A separate and detailed design package, that reflects data obtained from drilling and characterization activities, will be submitted to NMED for review and approval prior to well completion. • Figure 3 shows the preliminary conceptual design. A secondary objective is to collect zonal groundwater samples prior to well completion. This will provide a vertical profile of chromium concentrations in the Miocene pumiceous deposits and the upper portion of the Chamita Formation. Any deviations from this drilling work plan, NMOSE requirements, and associated sampling and analysis plans will be communicated to NMED prior to execution of the deviation.
Drilling Approach	**Fluid-assisted, dual air-rotary above the water table.** The well will be drilled using fluid-assisted, dual air-rotary with casing-advance methods above the water table. This approach will produce a borehole that can accommodate a minimum 2-in. annular filter pack around the 5-in.-diameter well screen. The following conditions apply to this drilling method: • Telescoping casing sizes will follow the specifications of the NMOSE permit; if downhole conditions warrant any changes from permit specifications, NMED and NMOSE will be notified to determine if deviations from permitted conditions need to occur • This drilling method will be halted at approximately 20 ft above the estimated water table. • Identification of perched-intermediate zones will be based on drillers' observations and water-level measurements. • If perched-intermediate groundwater is encountered, NMED and NMOSE will be notified and additional actions will follow drilling permit conditions. **Dual rotary, flooded-reverse circulation below the water table**. When the borehole reaches a depth of approximately 20 ft below the top of the regional aquifer or is within the saturated portion of the aquifer, the drilling method will be switched to dual-rotary, flooded-reverse circulation with a tri-cone bit. This method allows hydrostatic pressure(s) and water level(s) to remain stable across the formations, maintaining static water level and controlling heave, while allowing the borehole to advance to total depth. In addition, there will be little to no borehole space between the undisturbed formation and the drive casings, which will assist with controlling and minimizing vertical water flow outside the drive casing and the potential for heaving sands within the Chamita Formation. Recirculated water will be used to remove cuttings during flooded reverse drilling. Water and cuttings circulated from the borehole will be separated at the surface and the water will be recirculated back into the borehole. The following conditions apply to this drilling method: • Telescoping casing sizes will follow the specifications of the NMOSE permit. If downhole conditions warrant any changes from permit specifications, NMED and NMOSE will be notified to determine if deviations from permitted conditions are required. • The borehole used to conduct zonal sampling will be drilled to a lesser diameter than the final well. • Water-quality samples may be collected at the surface to establish the geochemistry of the recirculated water used in drilling. • The depth of transition from air-rotary to flooded-reverse will follow NMOSE permit. Well completion will follow NMOSE regulations concerning well construction, including, but not limited to, hanging of the casing throughout well construction, and use of NMOSE-approved construction materials.

Drilling Subcontractor Responsibilities	Drilling subcontractor is required to have a New Mexico Well Driller's License. The drilling subcontractor will provide input into the NMOSE permit, with responsibility for the following: • using drilling methods and selecting casing sizes that are best suited for the anticipated conditions, and providing recommendations on any potential changes based on downhole conditions; • providing technical approach for well completion that is best suited for the conditions encountered; • providing technical approach for sealing off formations (e.g., Chamita Formation, perched water) as required by NMOSE and/or NMED; and • conducting zonal sampling, using borehole and drive casing sizes best suited for the conditions encountered, as well as an approach for centralizing the temporary well during sampling. All drilling and completion operations will conform to the guidance provided in Appendix F of the 2016 Compliance Order on Consent (Consent Order). If the drilling subcontractor recommends changes to the specifications in the NMOSE permit and this work plan based on field conditions, N3B will notify NMED and NMOSE of the changes in the weekly meetings described in the Communications section below, follow up with an email notification, and pursue a variance to the drilling work permit, if needed.
Drilling Fluids, Composition, and Use	Fluids and additives may be used to facilitate drilling and maintain borehole integrity. Additives previously authorized for use by NMED include the following: • potable water, from municipal water supply, to aid in delivery of other drilling additives and to cool the drill bit; • QUIK-FOAM, a blend of alcohol ethoxy sulfates, used as a foaming agent to lift cuttings; and • AQF-2, an anionic surfactant, used as a foaming agent to lift cuttings. The use of any other fluids or additives will require prior approval from NMED. Complete records will be maintained detailing the type, amount, and volume of any fluid and additives used and the depth at which fluids or additives were added to the borehole.
Geophysical Logging and Gyroscopic Surveys	Geophysical logging will be conducted throughout the length of the borehole, within the drive casings, once it is drilled to total depth. Geophysical logging will be conducted to support the identification of geologic contacts and zones of higher permeability. Gyroscopic surveys will be executed to track the trajectory of the well in three dimensions. The following activities will be performed: • density logging • neutron logging • gamma logging • gyroscopic surveys
Cuttings Characterization	Cuttings will be collected from the length of the borehole, from ground surface to total depth. Characterization activities will include the following: • visual inspection of whole rock, plus-10, and plus-35 fractions to identify mineralogy and stratigraphic units; and • grain-size analyses of six progressively smaller mesh sizes, with the largest sieve mesh opening at 2 mm (#10) and the smallest at 0.063 mm (#230). ❖ Zones of higher permeability will be identified based on grain-size analyses. ❖ Hydraulic conductivity of sediments in the zone selected for well-screen placement will be calculated based on standard porosity-permeability relationships to support the selection of sands used in well design. Split samples of all cuttings collected during drilling will be provided to NMED.

Water-Quality Sampling	**Perched-intermediate Groundwater.** If perched-intermediate groundwater is encountered, attempts will be made to collect screening-level samples using air-lifting or bailing methods. Screening samples from perched-intermediate groundwater will be analyzed for dissolved major cations and anions, fluoride, bromide, low-level perchlorate, total organic carbon (TOC), low-level tritium, and metals/trace elements. Sealing of the perched zone will commence following approval from NMOSE. **Zonal Sampling in Groundwater.** Depth-discrete water-quality samples will be collected via the construction of a series of temporary wells once the borehole has been drilled to total depth. Because the zonal samples are not from a fully-developed well, the concentration data are considered qualitative and can be used to help identify an optimal screen location. Temporary well construction will be executed as follows: • The zonal well borehole will be drilled to a smaller diameter than the final well design. • A 3- or 4-in. submersible pump on a drop pipe will be deployed in the temporary well to purge and sample. • Well construction and purging/sampling will be repeated in approximately 20-ft intervals up through the saturated zone, until submergence is not sufficient to support pumping water up to surface. • A stainless-steel drop pipe and well screen will be used that is free from corrosion and physical defects prior to use. • A mill-slot well screen will be used. • Temporary wells will be constructed using transition sand selected to limit vertical flow during zonal sampling. • After zonal sampling is completed, the remaining temporary well casing will be removed and the borehole will be drilled back down to total depth, removing the filter pack material. • Purge volumes will be based on the stabilization of field parameters in the sampled water, which will be monitored to help determine when drill water has been purged and formation water is being sampled. • Samples from each interval will be analyzed at an analytical laboratory for dissolved major cations and anions, fluoride, bromide, low-level perchlorate, TOC, low-level tritium, and metals/trace elements. • Screening water-quality sample splits will be provided to NMED, either by making the drill site safe for NMED personnel to collect groundwater samples, or by having U.S. Department of Energy (DOE) personnel collect the samples using NMED chain-of-custody protocols. • Zonal sampling procedures will not interfere with the NMOSE permit, and any deviations from the zonal sampling plan will require prior NMED approval. **Groundwater Samples in Completed Well**. After final well development and at the end of the single-well aquifer testing, the first groundwater samples will be collected from the completed well. • Samples will be analyzed for metals, general inorganic chemicals (including nitrate, perchlorate, sulfate, etc.), semivolatile organic compounds, volatile organic compounds, and radionuclides (including low-level tritium). • Subsequent samples will be collected from the dedicated sampling system installed in the well. All groundwater chemistry results for samples collected during drilling, well development, and hydraulic testing of the new regional aquifer well will be shared with NMED as soon as results are received from analytical laboratories.

Well Development	**Filter Pack Emplacement**. The well filter pack may be developed using both mechanical and chemical means. Mechanical means may include airlift swabbing, bailing, and pumping. Filter pack emplacement will be considered complete when less than 0.1 mL/L of sand is passing through the well screen, as determined using an Imhoff cone and sand tags, to indicate a stable level. **Well Development**. A submersible pump will be used in the well development process following construction of the well. The target pumping rate during will be determined during the filter pack placement from the airlift swabbing rates. A Rossum Sand Tester will be used during purging to help determine progress of the well-screen development in conjunction with field parameters. Dispersant chemical additives may be used to remove clays if turbidity criteria cannot be achieved (see criteria below). Chlorination may be used to kill any existing bacteria. The completion of well development will be determined by monitoring groundwater parameters (pH, specific conductance, dissolved oxygen, turbidity, oxidation-reduction potential, and TOC). During development activities, water samples will be collected in the field and submitted to an analytical laboratory to determine turbidity and TOC. Indicators of well development completion include the following: • Groundwater parameters have stabilized, as determined using the U.S. Environmental Protection Agency (EPA) method (Yeskis and Zavala 2002, 204429) per the Consent Order. • Target water-quality parameters have been met. ❖ Turbidity: less than 5 nephelometric turbidity units ❖ TOC: less than 2 mg/L ❖ Sand production quantity: less than 1 mg/L • The minimum volume of water to be pumped from the well is twice the volume introduced into the aquifer during drilling and well construction activities (less the amount of water removed during these same activities).
Single-Well Aquifer Testing	An aquifer test plan for conducting single-well aquifer tests, using the NMED Hazardous Waste Bureau's "Aquifer Performance Test Procedures for Hazardous Waste Facilities in New Mexico" as a reference, will be submitted for NMED's review and comment before conducting NMED-approved hydraulic testing.
Sampling System Installation	A sampling pump will be installed in the well. The pump will be a 3-or 4-inch submersible pump, sized to maintain flow rates at or near 5 gpm.
Investigation-Derived Waste Management	Investigation-derived waste will be managed according to Newport News Nuclear BWXT-Los Alamos, LLC (N3B) Administrative Procedure (AP) N3B-AP-TRU-2150, "Waste Characterization Strategy Form." This AP incorporates the requirements of applicable EPA and NMED regulations, DOE orders, and N3B requirements. • Primary waste streams include drill cuttings, drilling water, drilling fluids and additives, development water, purge water generated during single-well aquifer testing, decontamination water, and contact waste. • Drill cuttings will be managed in accordance with the NMED-approved "Decision Tree for the Land Application of Drill Cuttings" (April 2016). • Drilling, purge, and development waters will be managed in accordance with the NMED-approved "Decision Tree for Land Application of Drilling, Development, Rehabilitation, and Sampling Purge Water" (November 2016).

Investigation-Derived Waste Management (continued)	• Drill cuttings and drilling fluids will be stored in a lined pit. Representative samples will be collected for laboratory analysis. ❖ Waste determinations will be made from validated data. ❖ If validated analytical data show that wastes cannot be land-applied, they will be removed from the pit, containerized, and placed in accumulation areas appropriate for the type of waste. ❖ Development and aquifer-testing water that meets the requirements to be treated and land-applied will be managed under Discharge Permit 1793. ❖ Once properly dispositioned, waste will be shipped off-site or land applied. • Decontamination water will be containerized separately at the point of generation, placed in an appropriate accumulation area, 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	Drilling and completion of the new well and collection of first samples is a proposed fiscal year 2025 Appendix B target.
NMED/NMOSE Communication	• Weekly meetings with NMED and NMOSE will include updates on the drilling status and planned activities, from initiation of drilling operations to collection of initial groundwater samples from either the vadose zone or the regional aquifer. • NMED will receive a 15-day written notice (according to Section XXVII.B of the Consent Order) and invitation to observe collection of initial groundwater samples. • Daily driller logs will be sent electronically through the driller's distribution list. • The NMOSE-required driller's well record and log will be included in the well completion report.

REFERENCES

The following reference list includes documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. ERIDs were assigned by Los Alamos National Laboratory's (LANL's) Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by LANL's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above).

Weston (Weston Solutions, Inc.), November 2019. "WC18 Update to the Los Alamos National Laboratory Geologic Framework Model," prepared for Tetra Tech, Inc., Contract No. 1158835, Los Alamos, New Mexico. (Weston 2019, 701379)

Yeskis, D., and B. Zavala, May 2002. "Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers," a *Ground Water Forum Issue Paper*, EPA 542-S-02-001, Office of Solid Waste and Emergency Response, Washington, D.C. (Yeskis and Zavala 2002, 204429)

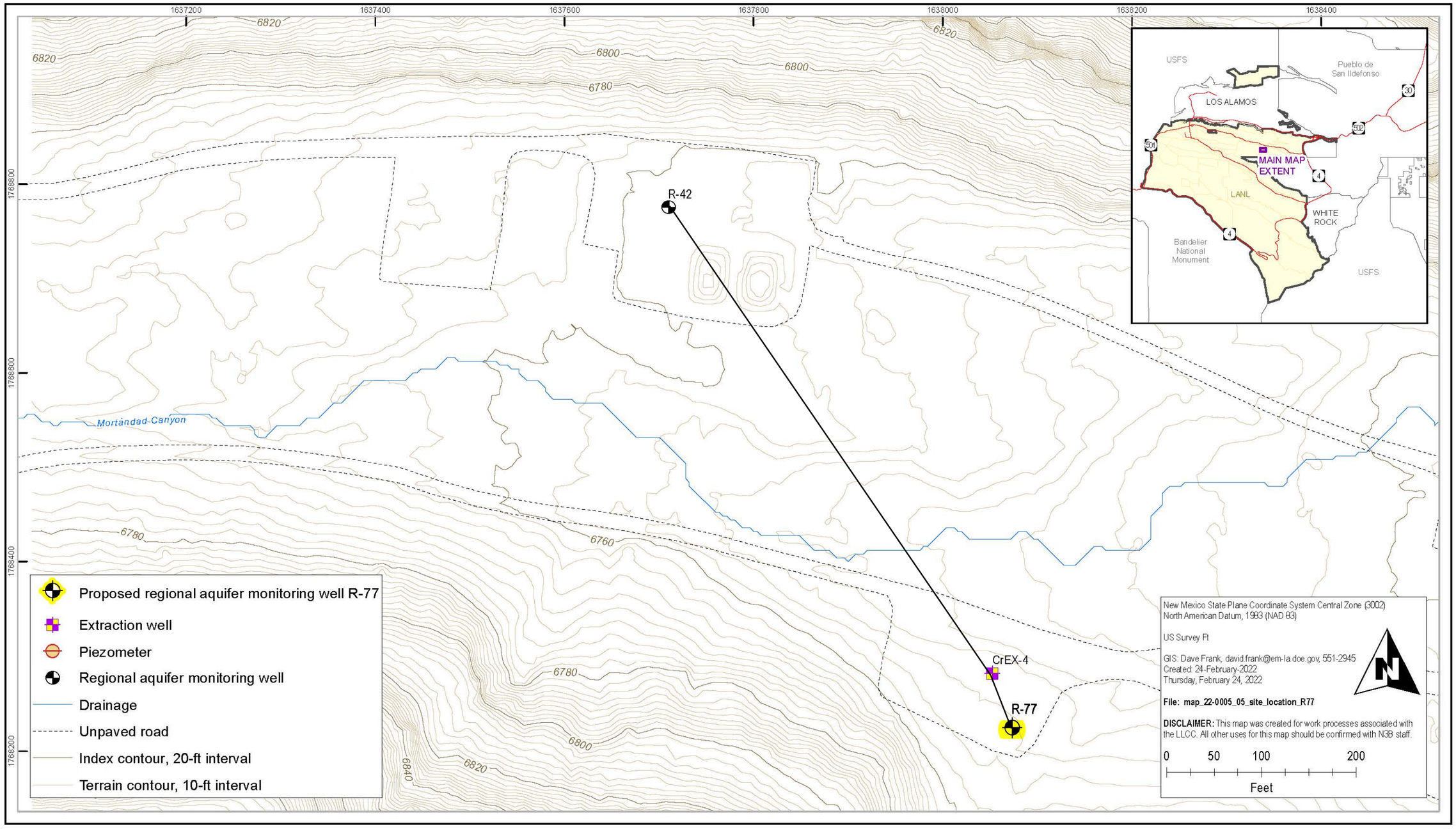

Figure 1 Proposed new well R-77 location

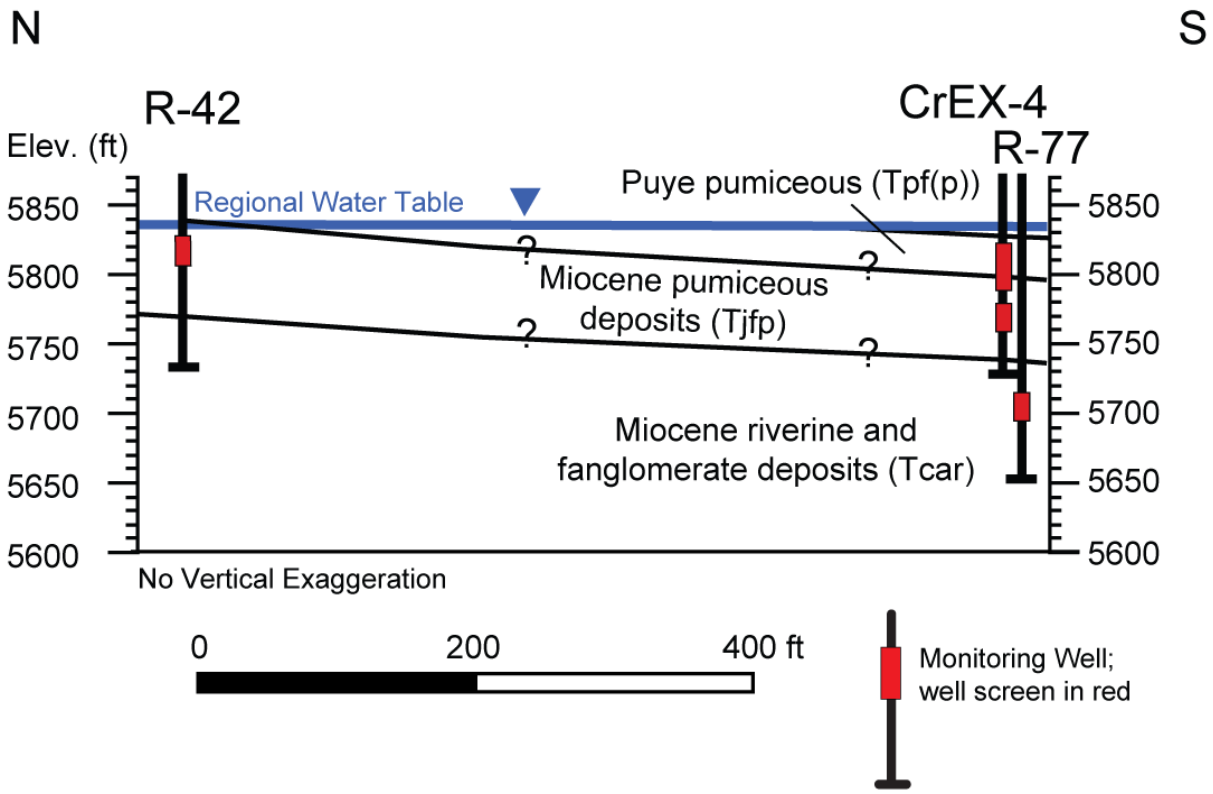

Figure 2 **Cross-section showing the stratigraphy and screen positions for nearby wells and the proposed location and well screen**

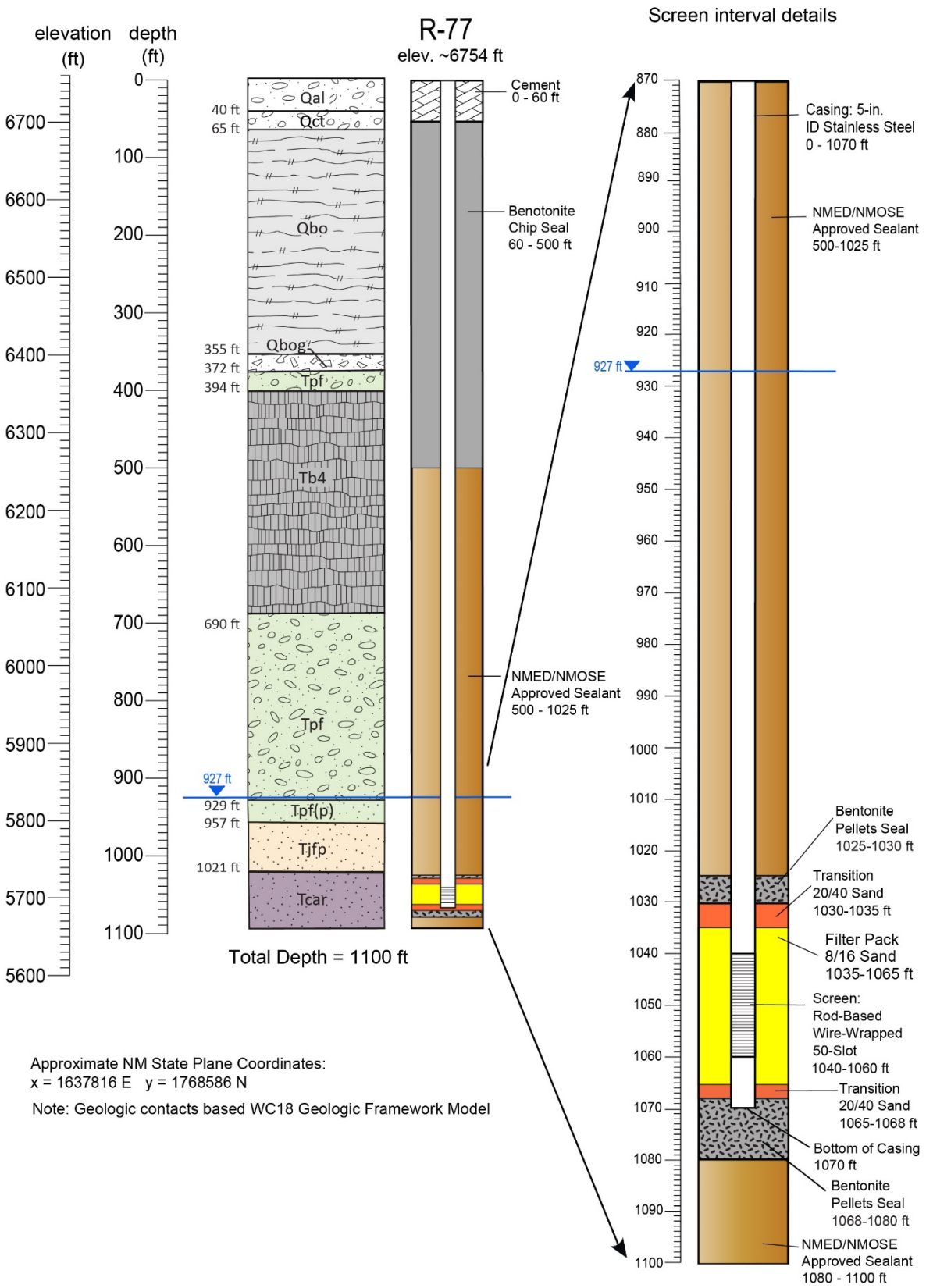

Figure 3 Conceptual well design for R-77