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

EMLA-24-BF9-2-1

October 27, 2023

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 Groundwater Regional Aquifer Monitoring Well R-79, Revision 1

Dear Mr. Shean:

Enclosed please find two hard copies with electronic files of the "Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-79, Revision 1." Submittal of this work plan fulfills fiscal year 2024 proposed Milestone 4 of Appendix B of the 2016 Compliance Order on Consent. Enclosure 1 includes an electronic copy of a redline strikeout version of the report that shows the changes made as a consequence of the decision to change R-79 to a single-screen completion.

If you have any questions, please contact Amanda White at (505) 309-1336 (amanda.white@em-la.doe.gov) or Cheryl Rodriguez at (505) 414-0450 (cheryl.rodriguez@em.doe.gov).

Sincerely,

Digitally signed by BRIAN HARCEK
Date: 2023.10.27 10:27:07 -06'00'

For 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 Groundwater Regional Aquifer Monitoring Well R-79, Revision 1 (EM2023-0624)

cc (letter and enclosure[s] emailed):
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Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-79, Revision 1

Primary Objectives and Purpose	This drilling work plan presents the objectives, drilling approach, and conceptual design for groundwater regional aquifer monitoring well R-79. The primary objective is to identify lateral extent of chromium contamination in a portion of the plume that the existing monitoring well network does not cover, north of R-70 and west of R35a and R-35b. The goal is to provide information that defines one side of a bounding area where hydraulic control of the chromium plume is needed, thereby supporting performance monitoring of the chromium interim measures (IM) system. Well R-79 is proposed as a single-screened well. The proposed location for R-79 is between R-11 and R-35a/R-35b (see Figure 1), in an area that may or may not be within the capture zone created by the IM system. Chromium concentrations at wells R-35a/R-35b reflect background chromium concentrations. Well R-70 has been completed with (1) a 41-ft upper screen (screen 1 from 963.0 to 1004.0 linear feet or measured depth [MD]; 872.9 ft to 910.0 ft vertical depth below ground surface [bgs]) within the lower part of the Puye Formation and (2) a 20.5-ft lower screen (screen 2 from 1048.0 to 1068.5 linear ft or MD; 949.9 ft to 968.5 ft vertical depth bgs) in the lower part of the pumiceous Puye Formation. Chromium concentrations at R-70 screen 1 are approximately 11 µg/L and currently are measured in a range of about 150-185 µg/L in screen 2. Installation of well R-79 will help define the vertical extent of the chromium plume through the installation of a single well screen and zonal sampling throughout the Puye Formation, pumiceous Puye Formation, and Miocene pumiceous units. The well screen will be installed at the approximate depth of well R-70 screen 2 (approximately 60 ft below the water table, in the pumiceous Puye Formation – Tpf[p]). A combination of geophysical logging and sampling during and after well drilling will inform the placement of the screen. The screen location is intended to measure current concentrations and to monitor trends as the plume evolves. The screened interval will be 20 ft in length. Figure 2 presents two cross-sections: a west-east cross-section that extends from R-43 to R-35a/R-35b and a north-south cross-section from the proposed R-79 location to SIMR-2. The figure shows the stratigraphic sequence and screen positions of nearby wells and of well R-79. Figure 3 presents the conceptual design for R-79, with the understanding that a separate and detailed design package that reflects the information obtained during drilling and initial data collection will be submitted to the New Mexico Environment Department (NMED) for review and approval. Well R-79 has also been described in the “Regional Aquifer Monitoring Well R-45 Action Plan” (R-45 Action Plan) (N3B 2022, 702350). The NMED Groundwater Quality Bureau (GWQB) issued a notice of violation to the U.S. Department of Energy (DOE) Environmental Management Los Alamos Field Office on June 6, 2022 (NMED 2022, 702153). This notice was based on measured concentrations of total dissolved chromium in the regional aquifer at well R-45 screen 2 that exceeded the 20.6.2.3103 New Mexico Administrative Code (NMAC) groundwater standard of 0.050 mg/L (50 µg/L). The location of well R-79 in the R-45 Action Plan was approximate and did not include any information gathered based on field conditions, such as access and terrain conditions. The revised location fulfills the objectives of the upper screen interval requirement of the well outlined in the R-45 Action Plan.

Drilling Approach	The proposed drilling approach for well R-79 is fluid-assisted air-rotary with casing-advance methods. Telescoping casing sizes between 24 in. and 10 in. with dual-rotary methods are recommended to advance the borehole to a depth within the upper 96 ft of the regional aquifer. This approach will produce a borehole that can accommodate a minimum 2-in. annular filter pack around the 5-in. nominal diameter well screen. The pumiceous Puye Formation is estimated at approximately 890 ft bgs, and the Chamita Formation is estimated at approximately 949 ft bgs. The total depth is estimated at 930 ft bgs, approximately 19 ft above the Chamita Formation. When the depth of the borehole reaches the saturated Puye Formation, the recommended drilling method is to use flooded-reverse circulation rather than conventional circulation. This will allow hydrostatic pressure(s) and water level(s) across the formations to remain stable (maintain static water level) controlling heave, while allowing the borehole to advance to total depth. Beyond the requirement to use flooded-reverse circulation, the selected drilling subcontractor will be responsible for using drilling and well-completion methods that are best suited for the conditions encountered. All drilling and completion operations will conform to the guidance provided in Appendix F of the 2016 Compliance Order on Consent (Consent Order). Well completion will follow New Mexico Office of the State Engineer (NMOSE) regulations concerning well construction including, but not limited to (1) the hanging of the casing throughout well construction and (2) industry standard centralizers allowing for a minimum 2-in. annular space in a vertical well. Drilling subcontractors are required to have a New Mexico Well Driller's License.
Drilling Fluids, Composition, and Use	Fluids and additives may be used to facilitate drilling, including those previously authorized for use by NMED: • Potable water (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. Use of additives may be necessary to advance drilling and maintain borehole integrity throughout the regional aquifer. Complete records will be maintained detailing the type, amount, and volume of fluid and additives used and the depth at which fluids or additives were added to the borehole.
Potential Groundwater Occurrence and Detection	Perched-intermediate groundwater samples have been collected within the chromium plume area, indicating that perched-intermediate groundwater may be present near the proposed location for well R-79. Methods used to identify perched-intermediate groundwater during drilling will include driller's observations and water-level measurements. If perched-intermediate groundwater is encountered, then measures will be taken to seal the zone before advancing the borehole to ensure that the perched water does not migrate downhole during drilling operations. The top of the regional aquifer is projected to occur at approximately 834 ft bgs.

Geophysical Testing	Neutron logging measures the amount of hydrogen in the formation in either a water- or air-filled borehole. The hydrogen content typically provides a good measure of moisture content in the unsaturated zone and porosity in the saturated zone. Gamma surveys employ a scintillation detector to measure the gross gamma radiation activity of the formation. Naturally occurring gamma radiation comes from the decay of potassium-40 plus the uranium and thorium decay series. Typically, these elements occur in varying concentrations within different strata, and the gamma log can be used to estimate porosity and relative content of fine-grained material. Geophysical logging will be conducted through the saturated interval in the regional aquifer when the borehole has been drilled to total depth. Neutron and gamma surveys will be executed to quantify the top of regional water table, identify geologic contacts, and identify zones of higher permeability for well screen placement. The geophysical data will be used in conjunction with drill cuttings, driller's observations, and screening/zonal water-quality samples to identify intervals within the aquifer that are suitable for screen placement.
Cuttings Characterization	Cuttings will be collected from the length of the borehole. Cuttings collection and characterization methods will be used to optimize representative retention of the fine-grained fraction, particularly within the regional aquifer. Split samples of all cuttings collected during drilling will be provided to NMED.
Well Development	The well filter pack may be developed by both mechanical and chemical means. Mechanical means may include airlift swabbing, bailing, and pumping. Chemical means include the use of additives to remove clays and/or chlorination to kill bacteria that may be introduced during well completion. Filter pack development during placement will be considered complete when less than 1/10 ml/L of sand is passing through the well screen as determined by an Imhoff cone. A submersible pump will be used in the well development process after construction of the well. Sand production will be measured with a Rossum sand tester. The completion of well development will be determined by monitoring groundwater parameters (pH, specific conductance, dissolved oxygen, turbidity, and oxidation-reduction potential [E_h]), and total organic carbon (TOC). During development activities, water samples will be collected in the field and submitted to an analytical laboratory to determine turbidity and TOC. The target water-quality parameters are turbidity at less than 5 nephelometric turbidity units and TOC at less than 2 mg/L. The target sand production quantity is less than 1 mg/L. Chemical development methods that may be used include AQUA-CLEAR PFD (or a similar product to remove clays) and/or chlorination with sodium hypochlorite, unless chlorination is prohibited by NMED. Well development will be considered complete when (1) groundwater parameters have stabilized (using the U.S. Environmental Protection Agency [EPA] [(Yeskis and Zavala 2002, 204429)] method per the Consent Order), (2) target water-quality parameters and sand production quantities are met, and (3) 200% of the volume of water introduced into the aquifer during drilling and well construction activities (less amount of water removed during these same activities) has been pumped from the well.
Single-Well Aquifer Testing	An aquifer test plan that includes a standard operating procedure (SOP) for conducting single-well aquifer tests using the NMED Hazardous Waste Bureau's aquifer test guidance as a reference will be submitted for NMED's review and comment before conducting NMED-approved hydraulic testing.

Water-Quality Sampling	If perched-intermediate groundwater is encountered, attempts will be made to collect screening-level samples using airlifting 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, low-level tritium, and metals/trace elements. While advancing the borehole using the flooded-reverse drilling method, there will be minimal migration of formation waters to the borehole because the formation water pressures are stable. Hence, any water samples collected during drilling will not be representative of formation waters, so water quality sampling will occur after reaching total depth. When the regional aquifer depth has been established at approximately 834 ft bgs, the borehole will be drilled to total depth of approximately 930 ft bgs and a series of temporary wells will be constructed in the approximate 11.75-in. borehole to collect zonal samples. Stainless-steel well casing with a 10-ft stainless-steel screen will be lowered into the drill casing to total depth of 930 ft bgs, and the annular space around the well screen will be filled with 10/20 or proximal size filter-grade silica sand (adjacent to screen slots) extending 1 to 2 ft above and below the screened interval and with 20/40 transition sand emplaced 5 ft above and below the primary filter pack interval. The 10-in. drill casing will be retracted just enough to expose the screen interval to the native formation, and this zone will be developed and sampled. The temporary, stainless-steel well casing will be retracted approximately 20 ft above the last sampling zone within the 10-in. drill casing, and another temporary well will be completed with filter pack and transition sand (as noted above). This next zone will be developed and sampled. This process will continue up through the regional aquifer interval from the bottom of the well to the water table, a length of approximately 96 ft. To collect a sample in each zone, a 3- or 4–in. submersible pump will be deployed in the temporary well on stainless-steel drop pipe to purge and sample. The well construction and purging/sampling will be repeated in 20-ft intervals up through the interval targeted for the upper screen. For example, samples will likely be taken starting at 925 to 915 ft (lowest screen interval placement with a 5-ft well sump), then 905 ft to 895 ft (pulled up 20 ft), then 885 to 875 ft, etc., until there is no longer enough submergence to support pumping water to surface or up to five possible sampling zones. After the zonal sampling is completed, the remaining temporary well casing will be removed and the borehole will be drilled back down to a total depth of 930 ft bgs. With the data collected from drilling, zonal sampling, and geophysical surveys, the screen location will be determined, and the bottom of the borehole will be plugged and abandoned with bentonite pellets or neat cement up to approximately 20 ft below the bottom of the designed screen interval. The purge volumes for each sampling interval will follow this approach: 5 casing volumes for 11.75-in. borehole at a (nominal) length of 10 ft plus introduced water volume for the 20-ft drilling interval being sampled plus 10%. For example, 1 casing volume: (5.6 gal./ft)(20 ft) = 112 gal.; (112 gal.)(5) = 560 gal.; 560 gal. + introduced volume = X; (X)(1.1) = purge volume. Samples from each of these zones will be analyzed for dissolved major cations and anions, fluoride, bromide, low-level perchlorate, total organic carbon, low-level tritium, and metals/trace elements. These samples also will be provided to NMED, managed under NMED chain-of-custody protocols. These geochemistry data, along with the geophysics data and information from drill cuttings and driller's observations, will be used for the well-design package submitted to NMED for review and approval. After final well development with a temporary pumping system, the first groundwater samples will be collected from the well at the end of the single well aquifer test. These 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.

Water-Quality Sampling (cont.)	All groundwater chemistry results for samples collected during drilling, well development, and hydraulic testing of regional aquifer well R-79 will be shared with NMED as soon as results are received from analytical laboratories.
Sampling System Installation	A typical 3- or 4-in. pump and motor will be installed to maintain sampling purge rates at or near 5 gallons per minute.
Investigation-Derived Waste Management	Investigation-derived waste will be managed according to 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 Newport News Nuclear BWXT-Los Alamos, LLC (N3B) requirements. The primary waste streams will 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 according to the NMED-approved "Decision Tree for the Land Application of Drill Cuttings" (April 2016). Drilling, purge, and development waters will be managed according to the NMED-approved "Decision Tree for Land Application of Drilling, Development, Rehabilitation, and Sampling Purge Water" (November 2016). Initially, drill cuttings and drilling fluids will be stored in a lined pit. Representative samples of the cuttings and fluids will be collected and analyzed, 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. Development and aquifer testing water that meets the requirements to be treated and land-applied will be managed under Discharge Permit 1793. Decontamination water will be containerized separately at the 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, transported to an appropriate accumulation area, and characterized using acceptable knowledge or the media with which it came in contact. Once dispositioned, the waste will be shipped off site or land-applied.
Schedule	Documentation of completion of well R-79 and collection of first samples is currently a target for fiscal year 2025 Consent Order Appendix B.
NMED/NMOSE Communication	NMED and NMOSE will receive email daily reports, including weekends and holidays. Weekly meetings with NMED and NMOSE will include updates and planned activities on the drilling status, from initiation of drilling operations to collection of initial groundwater samples from either perched waters 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. 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 (the Laboratory's) Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above).

N3B (Newport News Nuclear BWXT-Los Alamos, LLC), September 2022. "Regional Aquifer Monitoring Well R-45 Action Plan," Newport News Nuclear BWXT-Los Alamos, LLC, document EM2022-0318, Los Alamos, New Mexico. (N3B 2022, 702350)

NMED (New Mexico Environment Department), June 6, 2022. "Notice of Violation, Los Alamos National Laboratory Underground Injection Control Wells, DP-1835," New Mexico Environment Department letter to A.D.D.E.-L.a.J.M. (N3B) from J. Ball (NMED-GWQB), Santa Fe, New Mexico. (NMED 2022, 702153)

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)

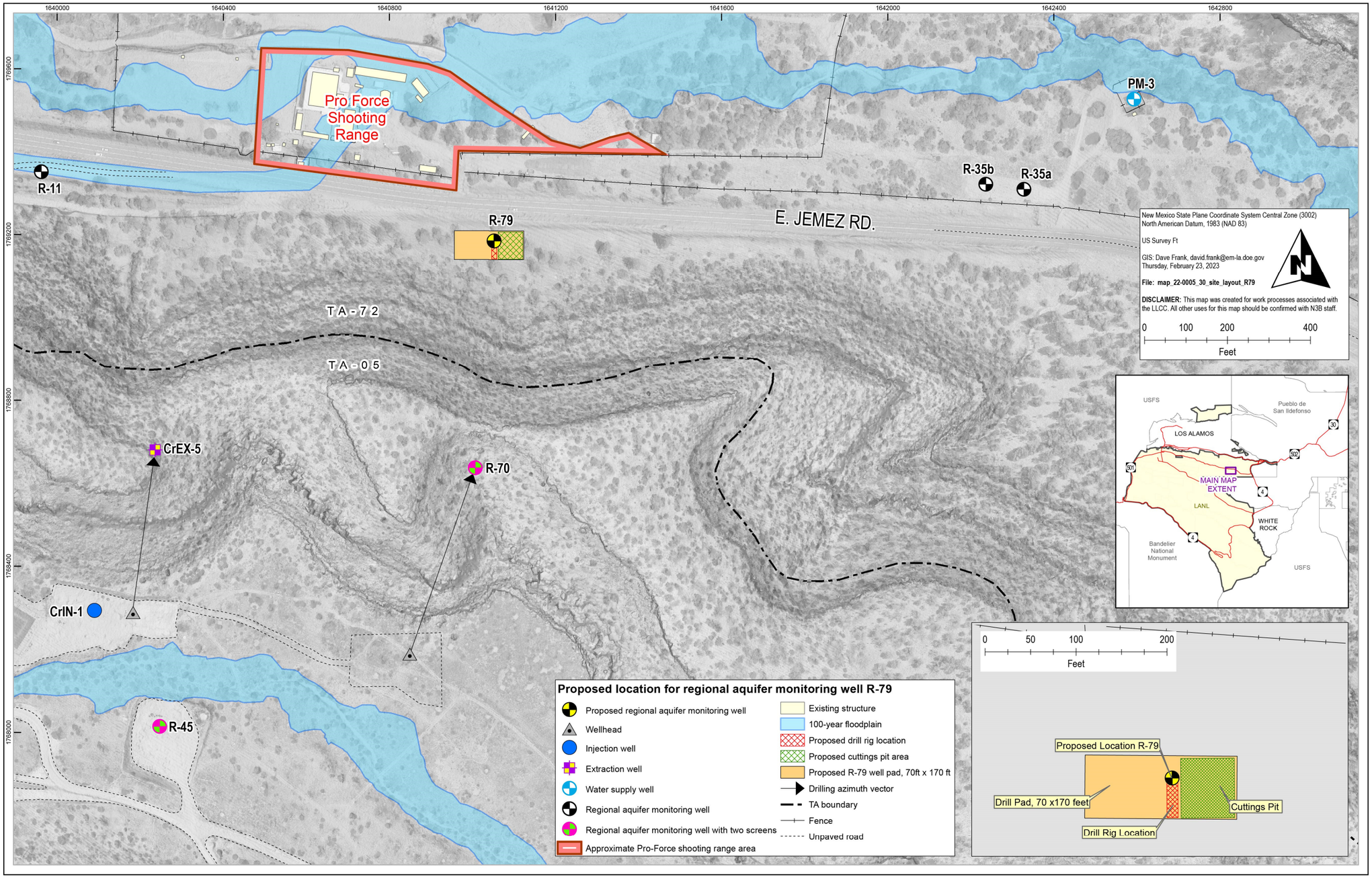

Figure 1 Proposed location for well R-79

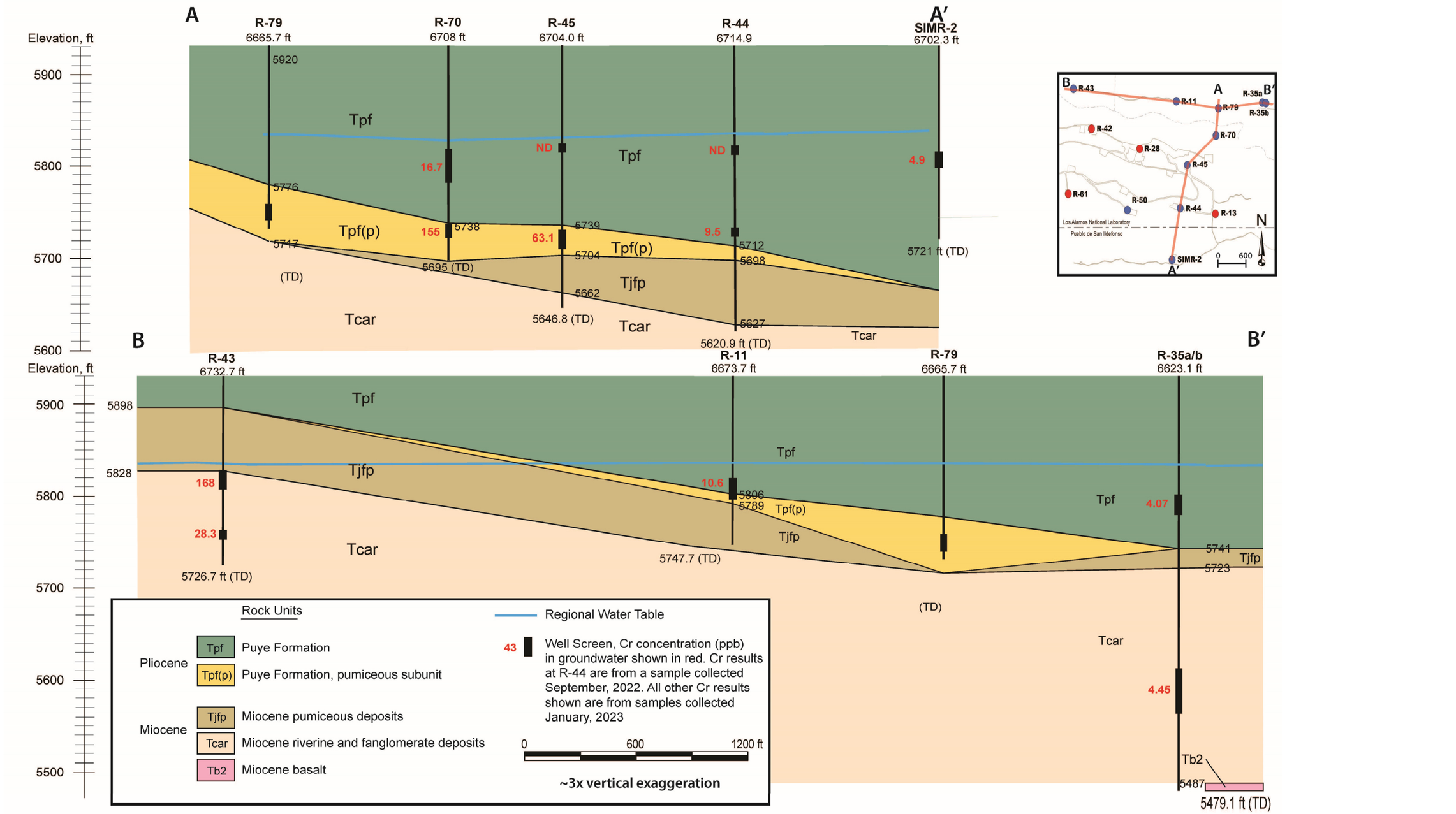

Figure 2 **Stratigraphy in the proposed R-79 area showing relations of the primary geologic units and well screens in nearby wells R-70, R-45, R-44, SIMR-2, R-43, R-11 and R-35a/b. Conceptual well-screen position for R-79 is also shown.**

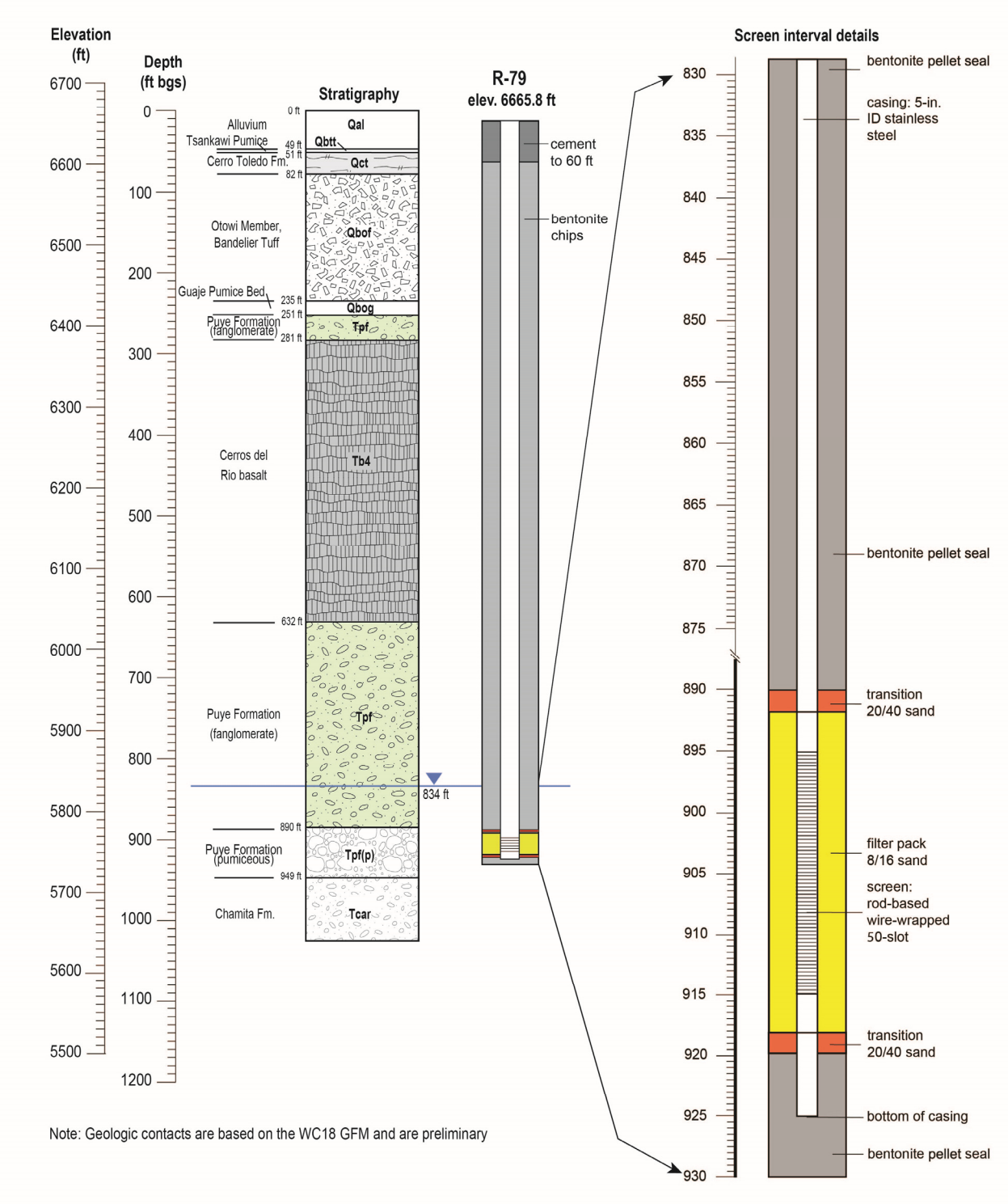

Figure 3 Conceptual well design for R-79