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

EMLA-23-BF35-2-1

November 29, 2022

Mr. Rick Shean
Bureau Chief
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-80

Dear Mr. Shean:

Enclosed please find two hard copies with electronic files of the "Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-80." Submittal of this work plan fulfills fiscal year 2023 Milestone #4 of Appendix B of the 2016 Compliance Order on Consent. A pre-submittal meeting for the R-80 drilling work plan was held between the New Mexico Environment Department and the U.S. Department of Energy Environmental Management Los Alamos Field Office (EM-LA) on November 17, 2022.

If you have any questions, please contact Christian Maupin at (505) 695-4281 (christian.maupin@em-la.doe.gov) or Cheryl Rodriguez at (505) 414-0450 (cheryl.rodriguez@em.doe.gov).

Sincerely,

For M Lee Bishop
Digitally signed by For M Lee Bishop
Date: 2022.11.28 15:31:17 -07'00'

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:
   Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-80 (EM2022-0782)

cc (letter and enclosure[s] emailed):
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Drilling Work Plan for Groundwater Regional Aquifer Monitoring Well R-80

Primary Objectives and Purpose	The New Mexico Environment Department (NMED) Groundwater Quality Bureau (GWQB) issued a Notice of Violation to the U.S. Department of Energy (DOE) Environmental Management Los Alamos office (EM-LA) on June 6, 2022. The violation covered by 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 groundwater standard of 0.050 mg/L (50 µg/L) (NMED 2022, 702153). DOE prepared the "Regional Aquifer Monitoring Well R-45 Action Plan" (N3B 2022, 702350), which described the rationale for Well R-80. This Drilling Work Plan provides the objectives as presented in the R-45 Action Plan, the drilling approach, and the conceptual design for groundwater monitoring well R-80. The proposed location for this well is downgradient of R-45 where chromium concentrations may still be near regional background (approximately 10 µg/L), indicating that the leading edge of the chromium plume has not migrated that far downgradient. The new monitoring well will help to define one edge of a bounding box where hydraulic control of the chromium plume may be needed, and will support performance monitoring of the chromium interim measures (IM) system. Well R-45, a two-screen well located southwest of R-70 and flanked to the west by injection wells CrIN-1 and CrIN-2, has provided important information on the influence of IM operations in the eastern plume area (Figure 1). Pre-IM concentrations in both screens of R-45 were below 50 µg/L, but increased since the initiation of groundwater sampling in 2009, rising to ~40 µg/L in screen 1 (the shallow screen) and 20 µg/L in screen 2. Following sustained IM operations, chromium concentrations since 2019 have decreased to near background in screen 1, but have increased to greater than 50 µg/L in screen 2. Figure 1 shows the proposed location of well R-80 at approximately North American Datum 1983 (NAD 83) coordinates 1640971 ft easting and 1767611 ft northing. It is not within the 100-yr floodplain. Once installed, well R-80 will provide monitoring data in the southeastern portion of the chromium plume project area where chromium concentrations are not known. Identifying chromium concentrations to the southeast of R-45 and north of R-44 and R-13 will help define the nature and extent of the chromium plume and provide performance-monitoring data downgradient of R-45. Installation of two 20-ft screens in well R-80 will help define the vertical extent of the chromium plume. The shallower well screen will be installed at the approximate elevation of R-45 screen 2 (~100 ft below the water table, in the Puye formation [Tpf]). The deeper well screen will be installed to monitor the aquifer beneath the lower boundary of the chromium plume, should it be present in the upper screen, and to serve as a monitoring point in case of future migration of chromium (the bottom edge of the bounding box). The top of the deeper screen is located approximately 60 ft below the bottom of the shallower screen, in the Miocene pumiceous deposits (Tjfp). Figure 2 presents a cross-section from R-45 to SIMR-2, showing the stratigraphic sequence and screen positions of nearby wells and those proposed for well R-80. Figure 3 presents the conceptual design for well R-80. A separate, detailed design package, reflecting the information obtained during drilling, will be submitted to NMED for review and approval prior to well installation. The location proposed in this Drilling Work Plan is roughly 100 ft north of the location shown in the Action Plan. The location was changed after a field walkdown determined an optimal location based on field conditions such as road access, terrain conditions, floodplain location, and existing infrastructure. The revised location fulfills the objectives of the well as outlined in the Action Plan.

Drilling Approach	The proposed drilling approach for R-80 is fluid-assisted air-rotary with casing-advance methods. Telescoping casing sizes between 24 in. and 10 in. and dual-rotary methods are recommended to advance the borehole within the upper 225 ft of the regional aquifer. This approach will produce a borehole that can accommodate an approximate 2-in. annular filter pack around the 5-in.-diameter well screen. The top of the pumiceous Puye formation is estimated at 975 ft below ground surface (bgs), and the top of the Chamita formation is estimated at 1066 ft bgs. The total depth is estimated at 1080 ft bgs, approximately 14 ft into the Chamita formation. Once the depth of the borehole reaches the top of the pumiceous Puye formation, well above the Chamita formation in which flowing sands may be encountered, 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, controlling heave while allowing the borehole to advance to total depth. For other conditions encountered during the drilling of the well, the selected drilling subcontractor will have the responsibility to use drilling and well-completion methods that are suited for the conditions encountered. All drilling and completion operations will conform to the guidance provided in Appendix F of the June 2016 Compliance Order on Consent. Well completion will follow New Mexico Office of the State Engineer regulations concerning well construction, including, but not limited to, the hanging of the casing throughout well construction, and 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, including those previously authorized for use by NMED, may be used to facilitate drilling: • 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 goal is to stop use of drilling fluids and additives 100 ft above the regional aquifer, but use of additives below this depth may be necessary to advance drilling and maintain borehole integrity. Records will be maintained detailing the type, amount, and volume of fluid and additives used and the depth at which fluids and/or additives were added to the borehole.
Potential Groundwater Occurrence and Detection	Perched-intermediate groundwater was encountered and samples were collected above the regional aquifer water table at nearby well R-45 (LANL 2009, 106427), indicating that perched-intermediate groundwater may be present in the vicinity of the proposed location for R-80. Methods used to identify perched-intermediate groundwater during drilling will include driller's observations, water-level measurements, and borehole video, if appropriate. If perched-intermediate groundwater is encountered, 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 855 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 logging and gamma surveys will be executed to quantify the top of the 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 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 following construction of the well. Sand production will be measured with a Rossum sand tester. The completion of well development will be determined by monitoring the groundwater turbidity and total organic carbon (TOC). During development activities, turbidity measurements will be collected in the field and TOC samples will be collected and submitted to an analytical laboratory. The target water-quality parameter measurements 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. If the target values for these water-quality parameters cannot be achieved utilizing mechanical well-development methods, the use of chemical well-development methods will be discussed with NMED. No additional chemicals will be added without NMED approval. Chemical development methods that may be used include AQUA-CLEAR PFD or a similar product to remove clays, and/or chlorination with sodium hypochlorite. Well development will be considered complete when target water-quality parameters and sand production quantities are met, and 200% of the volume of water introduced into the aquifer during drilling and well construction activities (less the amount of water removed during these same activities) has been pumped from the well.
Step-Drawdown Testing	Step-drawdown testing will be performed to investigate and record each well screen interval performance under controlled discharge conditions. This testing is essential for sizing the sampling pumps because local conditions cannot be reliably estimated from tests performed at nearby wells. Initial specific capacity will be determined for each screen interval and the data will be used to help select a suitable pump for the dedicated sampling system. Specific pumping rates for each step test will be determined in the field based on observations during well development.

Water-Quality Sampling	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 metals, semivolatile organic compounds, and general inorganic compounds. Water-quality samples will be collected at 20-ft intervals during advancement through the regional aquifer. Borehole water will be air-lifted to the surface while each new section of 20-ft drill casing is welded at the surface. Each sample will be collected from the air-lifted water just before continuing advancement of the casing string. While advancing the borehole using flooded-reverse drilling method, there will be minimal migration of formation waters to the borehole due to the stability of the formation water pressures. These screening-level samples will be analyzed for anions and metals with fast turnaround at the Geochemistry and Geomaterials Research Laboratory (GGRL) of Los Alamos National Laboratory (LANL or the Laboratory). This practice may not be conducted within the Chamita Formation and will depend on observed borehole stability. These groundwater samples will also be provided to NMED, managed under NMED chain-of-custody protocols. Once the borehole depth has been established at approximately 1080 ft bgs, a series of "temporary wells" will be constructed in the 10-in. borehole to collect zonal samples, using a method successfully employed previously in extraction well CrEX-2 (LANL 2017, 602595). A well string with a 5-ft stainless-steel screened interval will be lowered into the drill casing to total depth, 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 then be retracted to expose the screen interval to the native formation. These samples will also be provided to NMED, managed under NMED chain-of-custody protocols. 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 procedure will be repeated in 20-ft intervals up through the interval targeted for the upper screen. The purge volumes for each sampling interval will follow this approach: 20 casing volumes for 10-in. casing 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: (4.1 gal./ft)(10 ft) = 41 gal.; (41 gal.)(20) = 820 gal.; 820 gal. + introduced volume = X; (X)(1.1) = purge volume.] Samples from each of these intervals will be analyzed at the GGRL for anions and metals. These samples will also be provided to NMED, managed under NMED chain-of-custody protocols. These analytical 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. The first groundwater samples from the completed well will be collected at the end of the step-drawdown testing conducted in each of the two screens. 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.
Sampling System Installation	A two-screen Baski sampling system will be installed in the well. The system will use a typical 3- or 4-in. pump and motor to maintain sampling purge rates at or near 5 gallons per minute.

Investigation-Derived Waste Management	Investigation-derived waste will be managed in accordance with Standard Operating Procedure (SOP) N3B-EP-DIR-SOP 10021, "Characterization and Management of Environmental Programs Waste." This SOP incorporates the requirements of applicable U.S. Environmental Protection Agency 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 step-drawdown 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). Initially, drill cuttings and drilling fluids will be stored in a lined pit. Representative samples of the drill cuttings and drilling fluids will be collected and analyzed, and waste determinations will be made from validated data. If validated analytical data show that 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, placed in an appropriate accumulation area, and characterized using acceptable knowledge of the media with which it came in contact.
Schedule	Documentation of completion of well R-80 and collection of first samples is currently proposed as a Fiscal Year 2024 Appendix B Target.

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 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).

LANL (Los Alamos National Laboratory), May 2009. "Completion Report for Regional Aquifer Well R-45," Los Alamos National Laboratory document LA-UR-09-3065, Los Alamos, New Mexico. (LANL 2009, 106427)

LANL (Los Alamos National Laboratory), September 2017. "Completion Report for Groundwater Extraction Well CrEX-2," Los Alamos National Laboratory document LA-UR-17-27466, Los Alamos, New Mexico. (LANL 2017, 602595)

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)

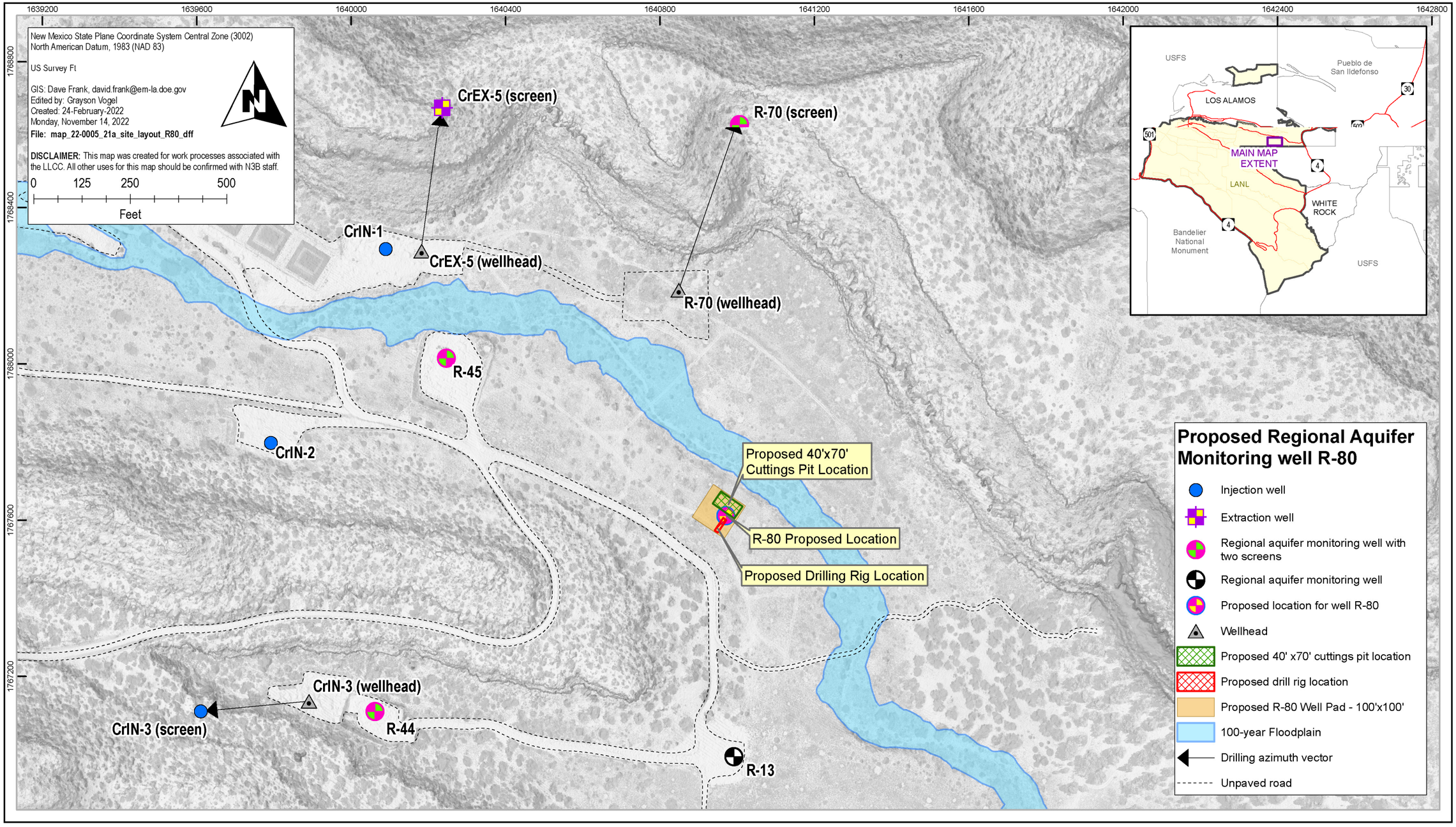


Figure 1 **Proposed location for R-80**

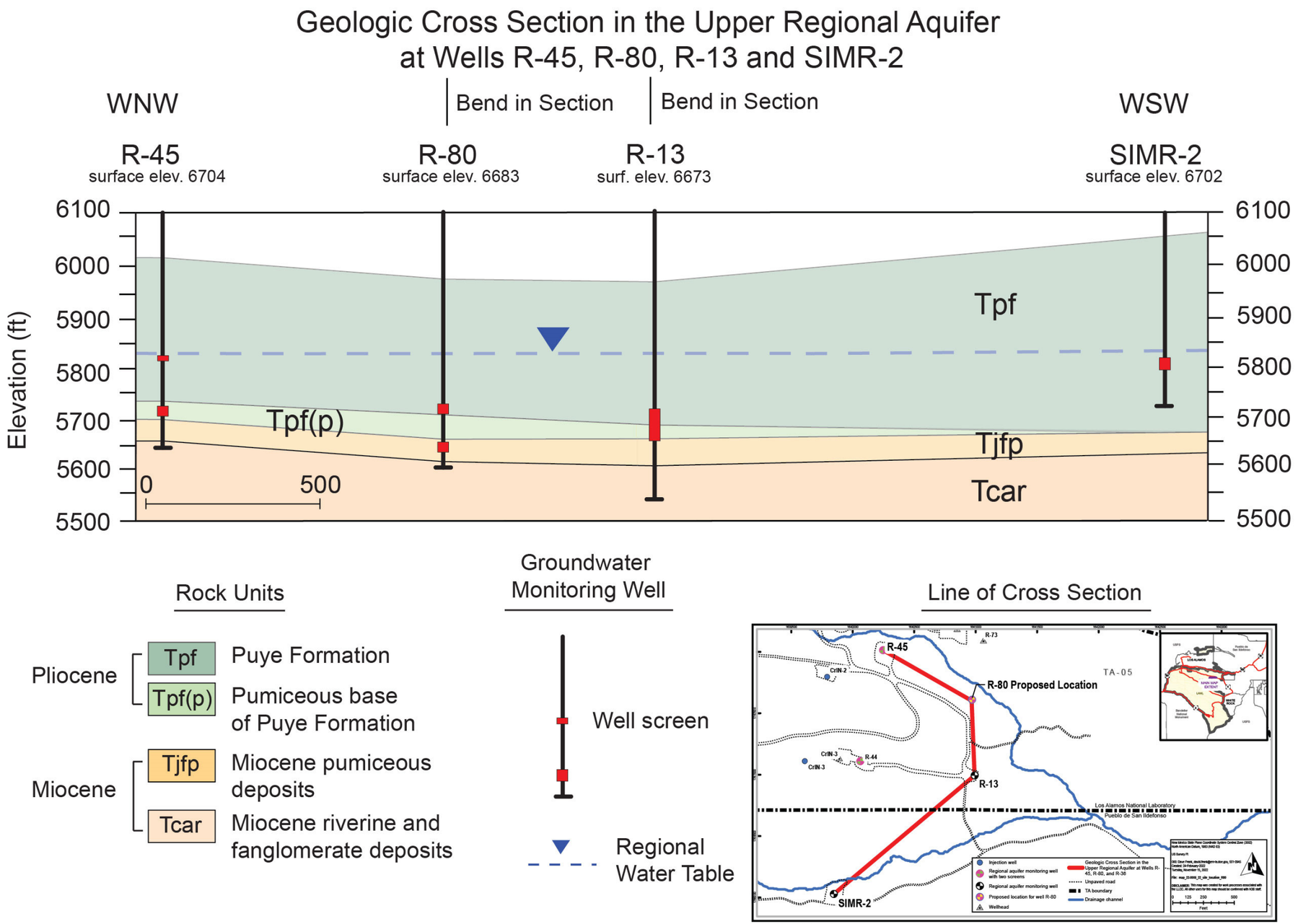
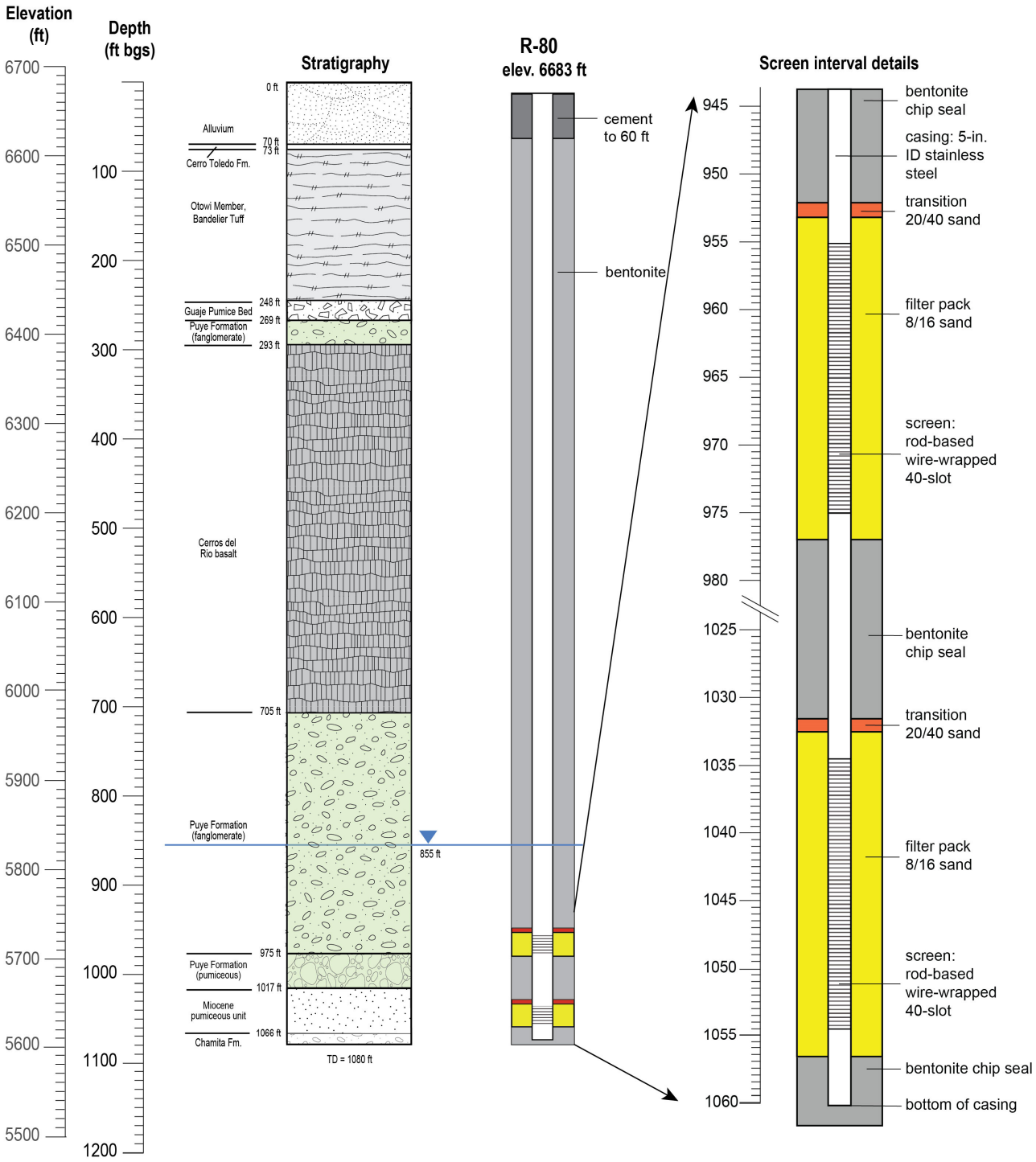


Figure 2 **Stratigraphy in the proposed R-80 area showing stratigraphic relations of the primary geologic units and well screens in nearby wells R-45, R-13, and R-36. Conceptual well-screen positions for R-80 are also shown.**



Note: Geologic contacts are based on the WC18 GFM and are preliminary

Figure 3 Conceptual well design for R-80