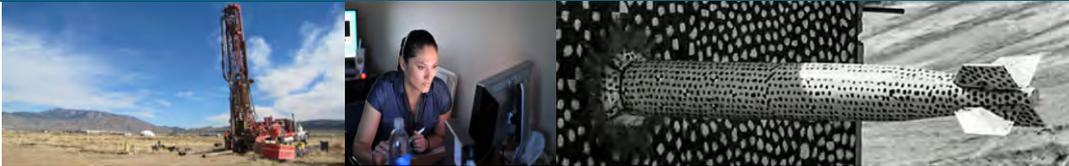




Sandia
National
Laboratories

Tijeras Arroyo Groundwater (TAG) Investigation



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Environmental Restoration Operations



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- The Tijeras Arroyo Groundwater (TAG) Investigation Area of Concern (AOC) covers approximately 1.8 square miles in the north-central portion of Kirtland Air Force Base (KAFB) and is located just south of the Wyoming and Eubank gates.
- Technical Areas I, II, and IV are located in the TAG AOC at Sandia National Laboratories (SNL).
- The Tech Areas were built on land that had been previously developed by commercial airline operators starting in 1928. This area was further developed by the U.S. military during World War II.
- Activities began in 1948 and have primarily involved weapons development and energy research.
- Two water-bearing units, the Perched Groundwater System (PGWS) and the Regional Aquifer, are present in the alluvial-fan sediments that consist mostly of sands and gravels. Twenty-one monitoring wells are currently sampled in the TAG AOC.



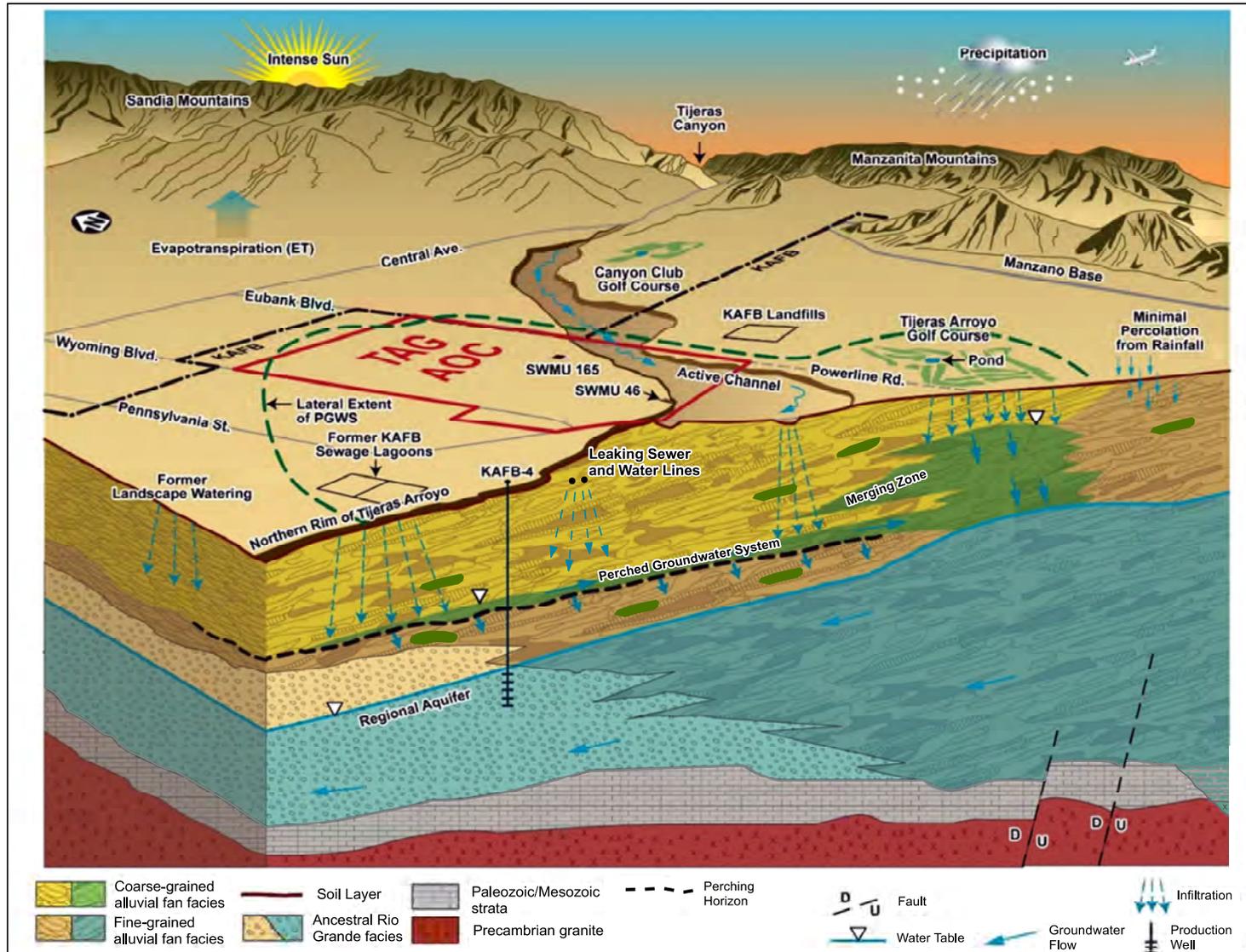
■ **Perched Groundwater System (PGWS)**

- The PGWS has a water table ranging in depth from approximately 270 to 330 feet below the ground surface across the TAG AOC. The water table slopes to the southeast.
- The PGWS was mostly created by manmade activities including sewage systems and waste-water outfalls. All of these discharge activities were eliminated in 1992.
- A thin layer of about 7 to 20 feet of saturated silty sand remains in the PGWS.
- Groundwater migrates slowly to the southeast at approximately 24 feet per year. A portion of groundwater also percolates slowly downward through the clayey Perching Horizon.
- The thickness of saturation in the PGWS is decreasing as the layer naturally dewateres at an average of approximately half a foot per year. This dewatering continues to occur.
- The PGWS merges with the Regional Aquifer near the Tijeras Arroyo Golf Course.

■ **Regional Aquifer**

- The Regional Aquifer occurs at a depth ranging from approximately 440 to 560 feet.
- The Regional Aquifer is vertically separated from the PGWS by approximately 200 feet of unsaturated strata, except where the two water-bearing units merge near the golf course.
- Groundwater in the Regional Aquifer flows west and northwest at approximately 55 feet per year.

Conceptual Site Model for the TAG Vicinity



TAG Groundwater Monitoring



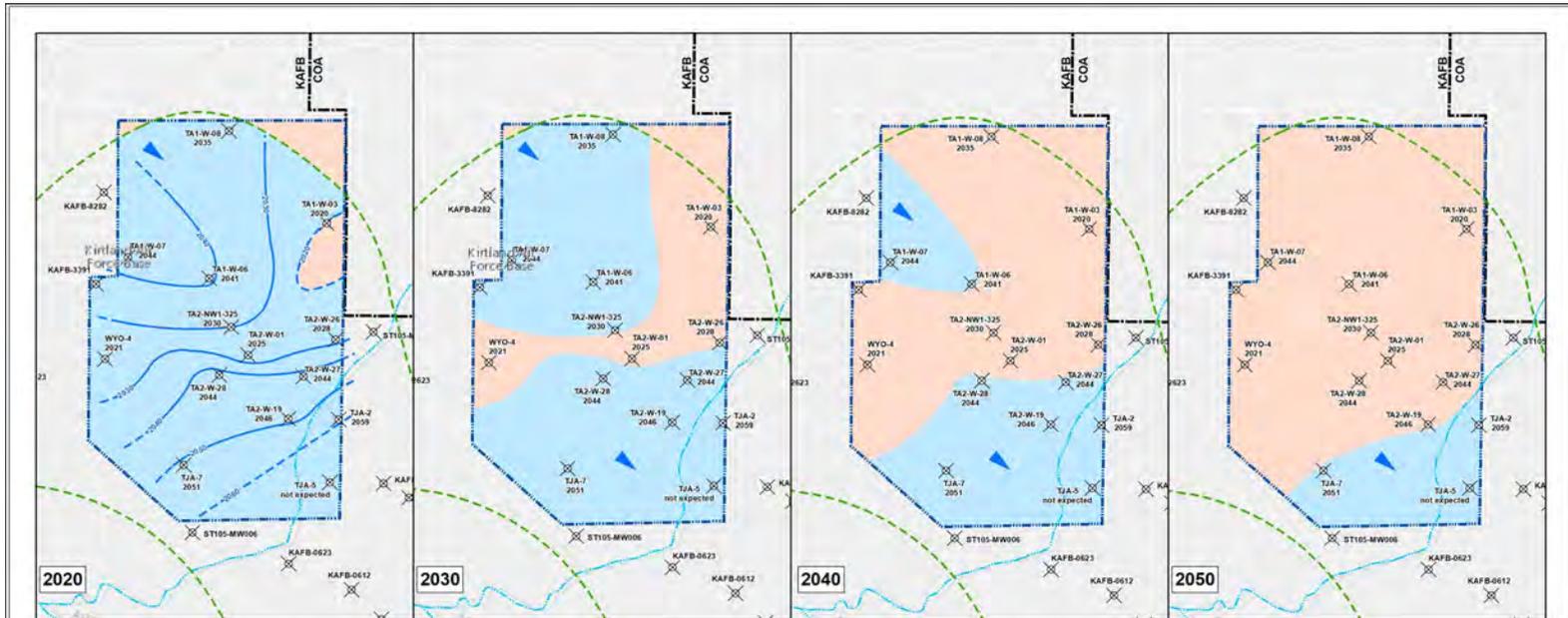
- Began collecting groundwater samples at TAG AOC in 1992.
- Installed 31 monitoring wells in the TAG AOC.
- Groundwater samples are analyzed for volatile organic compounds, metals, nitrate, and radionuclides.
- The KAFB Environmental Restoration Program and the City of Albuquerque - Environmental Health Department have installed 89 monitoring wells in the surrounding area.
- In addition to groundwater sampling conducted by SNL, KAFB, and the City personnel, the United States Geological Survey has also independently collected groundwater samples for the purpose of evaluating naturally occurring nitrate sources in sediments below the Tijeras Arroyo floodplain.
- Cooperation and data sharing between the four entities enhances our understanding of the hydrogeologic setting in a broad perspective.



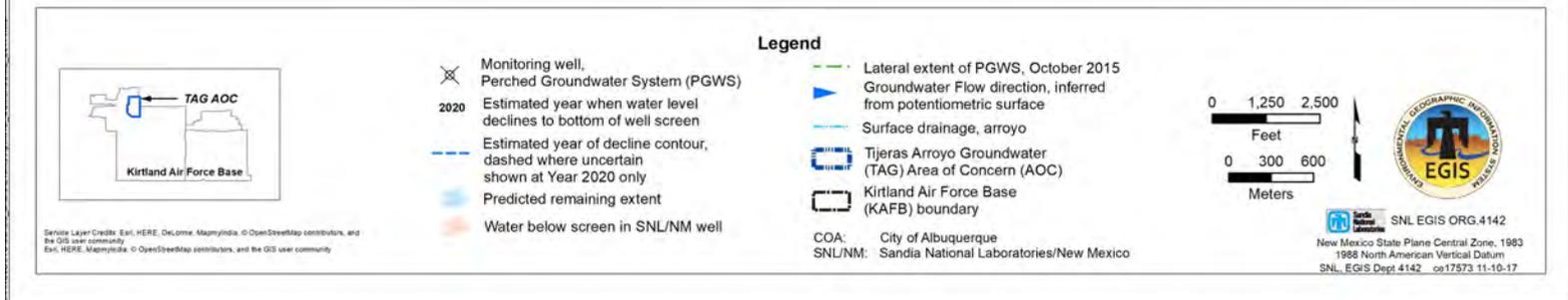
- Groundwater in the PGWS is contaminated with nitrate at concentrations above the maximum contaminant level (MCL).
- Therefore, corrective action per New Mexico Environment Department (NMED) guidance is required for elevated nitrate concentrations in the PGWS.
- Nitrate can be produced by both man-made and natural sources. Possible nitrate sources include septic leach fields, wastewater discharges, nitrate fertilizers, and the degradation of minerals and plant material in soil.
- Monitoring wells screened in the PGWS yield only small volumes of water typically at one to two gallons per minute. Water from the PGWS is not used for any purpose at SNL; no one is drinking contaminated groundwater.
- Depending on location, PGWS monitoring wells will go dry in 5 to 44 years, except in the extreme southeast corner of the AOC. This is shown on the next slide.



The expected progression of dewatering within the PGWS is shown in 10 year intervals. Year 2020 is at the left side. Hydrograph estimates were used for creating the 2030, 2040, and 2050 panels. The tan areas show where monitoring wells are projected to no longer produce enough groundwater for sampling in those years.



Predicted lateral extent of the Perched Groundwater System (Years 2020-2050) when water level is estimated to decline to bottom of well screen.



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TAG Groundwater Monitoring



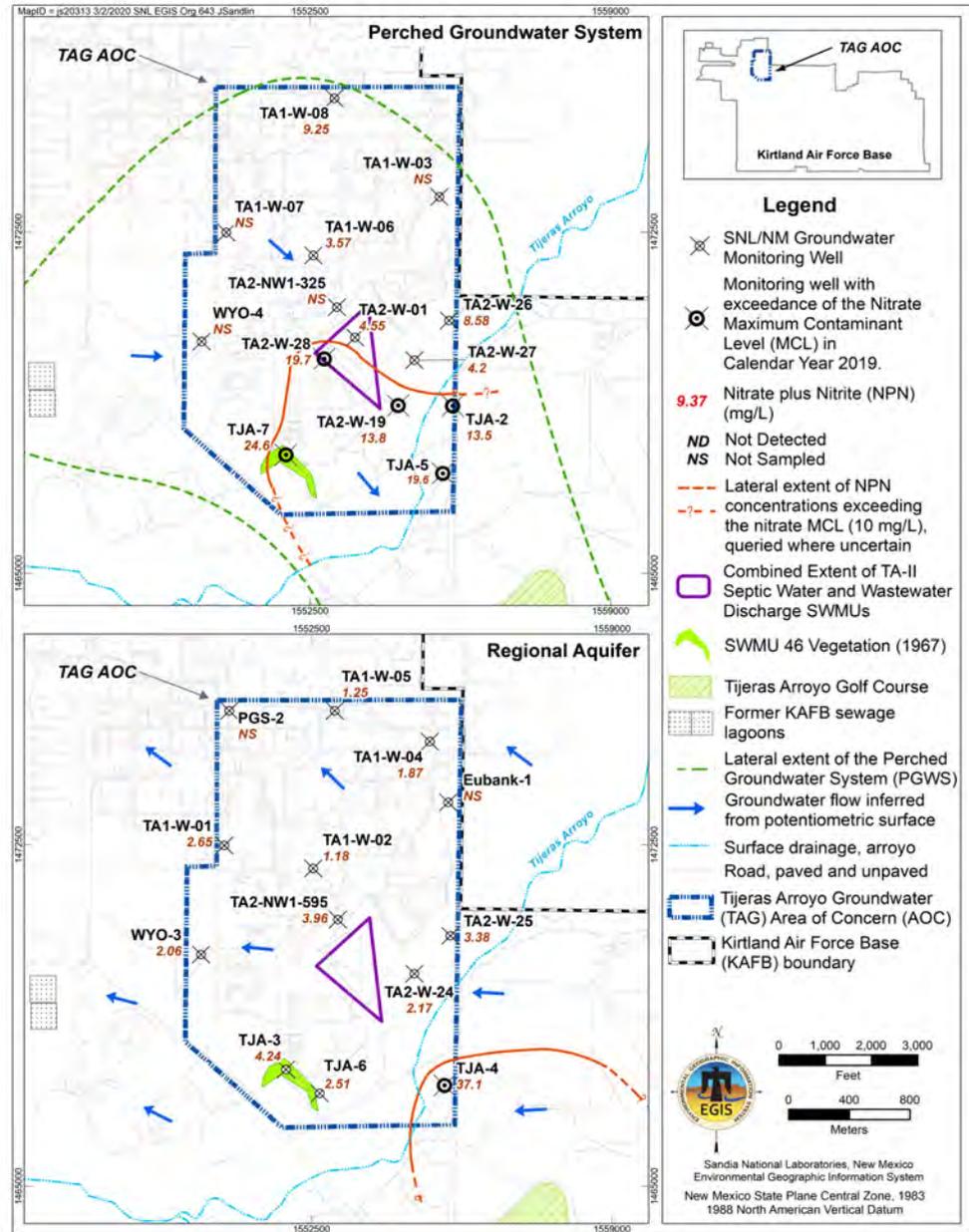
- Elevated nitrate concentrations in the PGWS do not pose a threat to drinking water in the Regional Aquifer. Sandia operations have not contaminated the Regional Aquifer. Computer modeling and ongoing groundwater sampling continue to demonstrate that the Regional Aquifer will not be impacted.
- The nearest drinking-water production well in the Regional Aquifer is KAFB-20, which is located approximately 1 mile to the west of the elevated nitrate concentrations in the PGWS.
- The nearest Albuquerque Bernalillo County Water Utility Authority well is Regional Aquifer well Ridgecrest 1, which is located approximately 2 miles to the north of the elevated nitrate concentrations in the PGWS.
- Two constituents of concern, nitrate and TCE, were identified by NMED in the 2004 Consent Order.

Constituent of Concern	Maximum Concentration in Perched Groundwater System, 2019	Maximum Concentration in Regional Aquifer, 2019	MCL
Nitrate	24.6 milligrams per liter (well TJA-7)	4.24 milligrams per liter (well TJA-3); 37.1 milligrams per liter (well TJA-4, merging zone)	10 milligrams per liter
Trichloroethene	5.71 micrograms per liter, at well TJA-2, this is a one-time exceedance since the well was installed in 1994. Sampled five times since the exceedance; all results were less than the MCL.	0.700J micrograms per liter (well TJA-3); <0.300 micrograms per liter (well TJA-4)	5 micrograms per liter

The 2019 maximum nitrate concentrations for the PGWS are shown in the upper panel. The lower panel shows results for the Regional Aquifer.

For the PGWS, the red line shows that nitrate exceeds the MCL at five monitoring wells in the southeast corner of the TAG AOC. The blue arrows show that groundwater flows to the southeast and away from production wells.

For the Regional Aquifer, one monitoring well in the far southeast corner of the TAG AOC exceeded the nitrate MCL. However, the groundwater sampled at merging-zone well TJA-4 is likely from an upgradient source such as the golf course.





- Results from ongoing water-level measurements and groundwater sampling will be presented in the next Annual Groundwater Monitoring Report that will be submitted to the NMED Hazardous Waste Bureau (HWB) in June 2021.
- The *Revised TAG Current Conceptual Model (CCM) and Corrective Measures Evaluation (CME) Report* was submitted to the NMED HWB in February 2018.
- Three remedial alternatives were proposed in the Revised CCM/CME report:
 1. Monitored natural attenuation using the existing well network. This involves sampling of 16 wells over a period of 41 years and is projected to cost \$7.8 M.
 2. Groundwater Extraction and Treatment would require the installation of 73 extraction wells and 25 performance-monitoring wells. The estimated total cost is \$61.5 M over a period of 27 years.
 3. In-situ Bioremediation would require the installation of 575 injection wells and 25 performance-monitoring wells. The estimated total cost is \$173.3 M over a period of 27 years.
- Each remedial alternative requires the semiannual sampling of both water-bearing units.
- In September 2020, a virtual meeting was held with personnel from SNL, DOE, and NMED HWB to discuss the Revised CCM and CME report.
- NMED HWB is anticipated to select a remedial alternative in 2021.