



# Department of Energy/National Nuclear Security Administration and Sandia National Laboratories

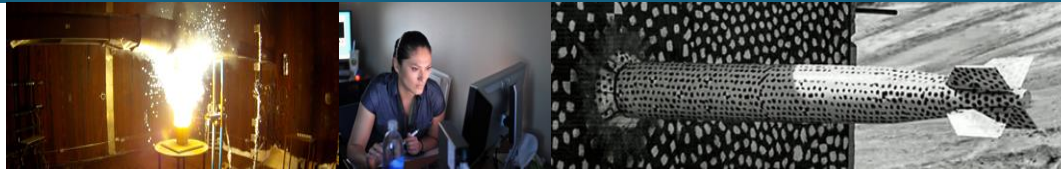
- Semi-annual public meeting
  - Virtual session held in response to New Mexico Executive and Public Health Orders
- Environmental activities at Sandia National Laboratories (SNL)
  - Environmental restoration activities
  - Stormwater monitoring and pollution control measures
  - Application for renewal of hazardous waste permit for post-closure care at SNL Chemical Waste Landfill
- Information resources
  - New Mexico Environment Department Hazardous Waste Bureau  
<https://www.env.nm.gov/hazardous-waste/sandia-national-laboratories/>
  - Sandia National Laboratories  
<https://www.sandia.gov/about/environment/index.html>  
[https://www.sandia.gov/about/environment/environmental\\_management\\_system/index.html](https://www.sandia.gov/about/environment/environmental_management_system/index.html)
- Questions? Send email to [envinfo@sandia.gov](mailto:envinfo@sandia.gov)

## Environmental Restoration Activities at Sandia National Laboratories



- Mission: identify, characterize, and remediate sites where hazardous materials may have been released to the environment.
- Current activities: investigations at three areas of concern (AOCs)
  - Burn Site Groundwater Investigation AOC
  - Tijeras Arroyo Groundwater Investigation AOC
  - Technical Area V Groundwater Investigation AOC
- Activities are regulated by the New Mexico Environment Department
  - 2004 Compliance Order on Consent under the Hazardous Waste Bureau
  - 2017 Discharge Permit for Technical Area V Groundwater Investigation AOC under the Ground Water Quality Bureau
- Drinking water standards serve as groundwater cleanup goals for human health and environmental protection
  - No drinking water wells in or near the contaminated groundwater
  - Boundaries of each area are defined
  - No one is drinking contaminated groundwater

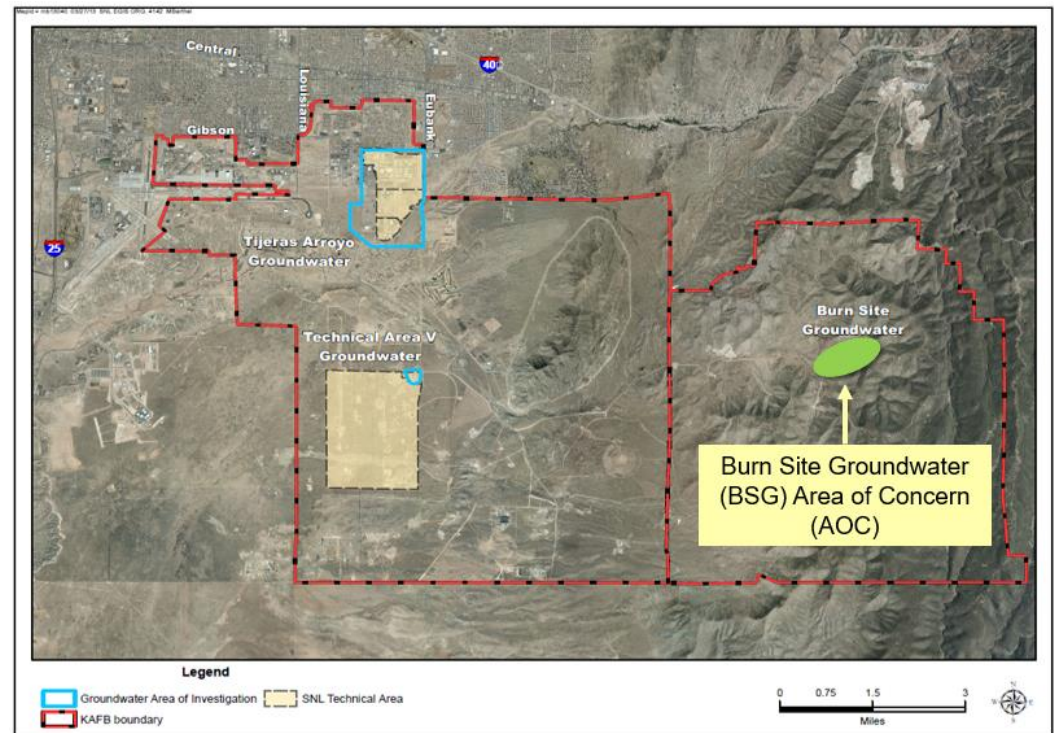
# Burn Site Groundwater (BSG) Investigation



*Michael Skelly  
Environmental Restoration Operations*



- The BSG Area of Concern is located in Lurance Canyon.
- In a remote area of the Manzanita Mountains.
- Lurance Canyon is a west-flowing drainage deeply incised into Paleozoic and Precambrian bedrock in moderately- to heavily-wooded pinon-juniper forest.



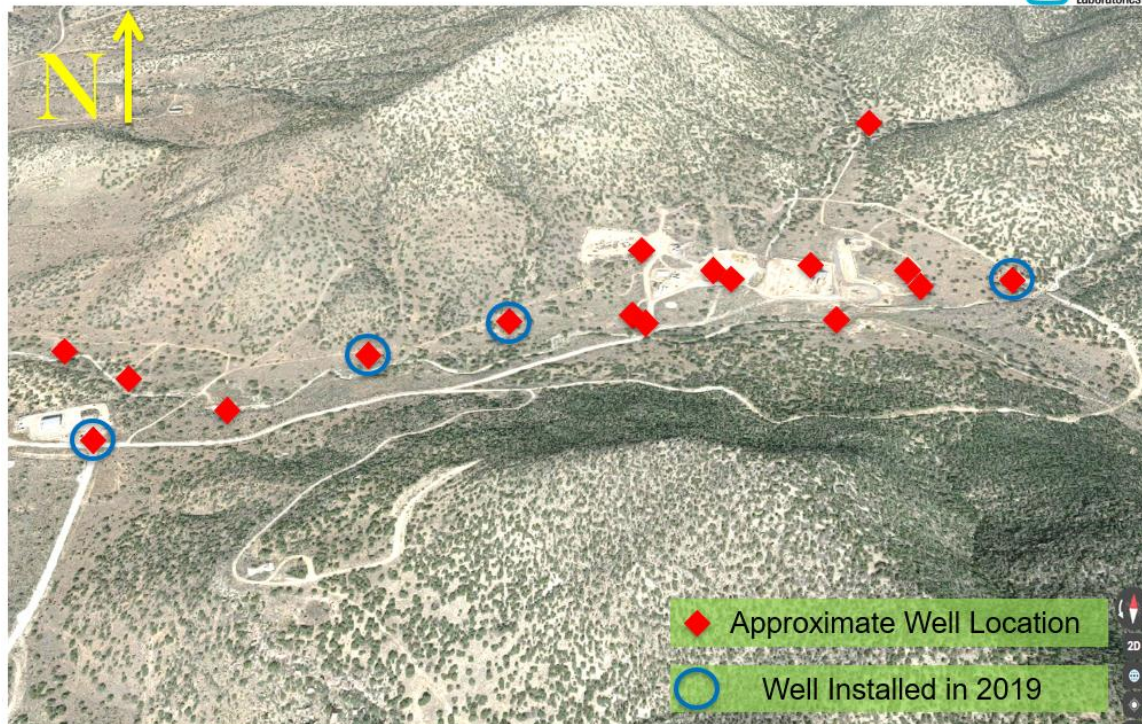
- SNL activities at the Burn Site testing area began in 1967; early site test activities included explosives testing, current use is fire-survivability studies (i.e., burn testing).
- Corrective action is required only for the groundwater in the BSG AOC.
- Groundwater occurs in Precambrian fractured bedrock that is recharged by infiltration of precipitation; flow is controlled by changes in rock type and faults/fractures.

## BSG Groundwater Monitoring

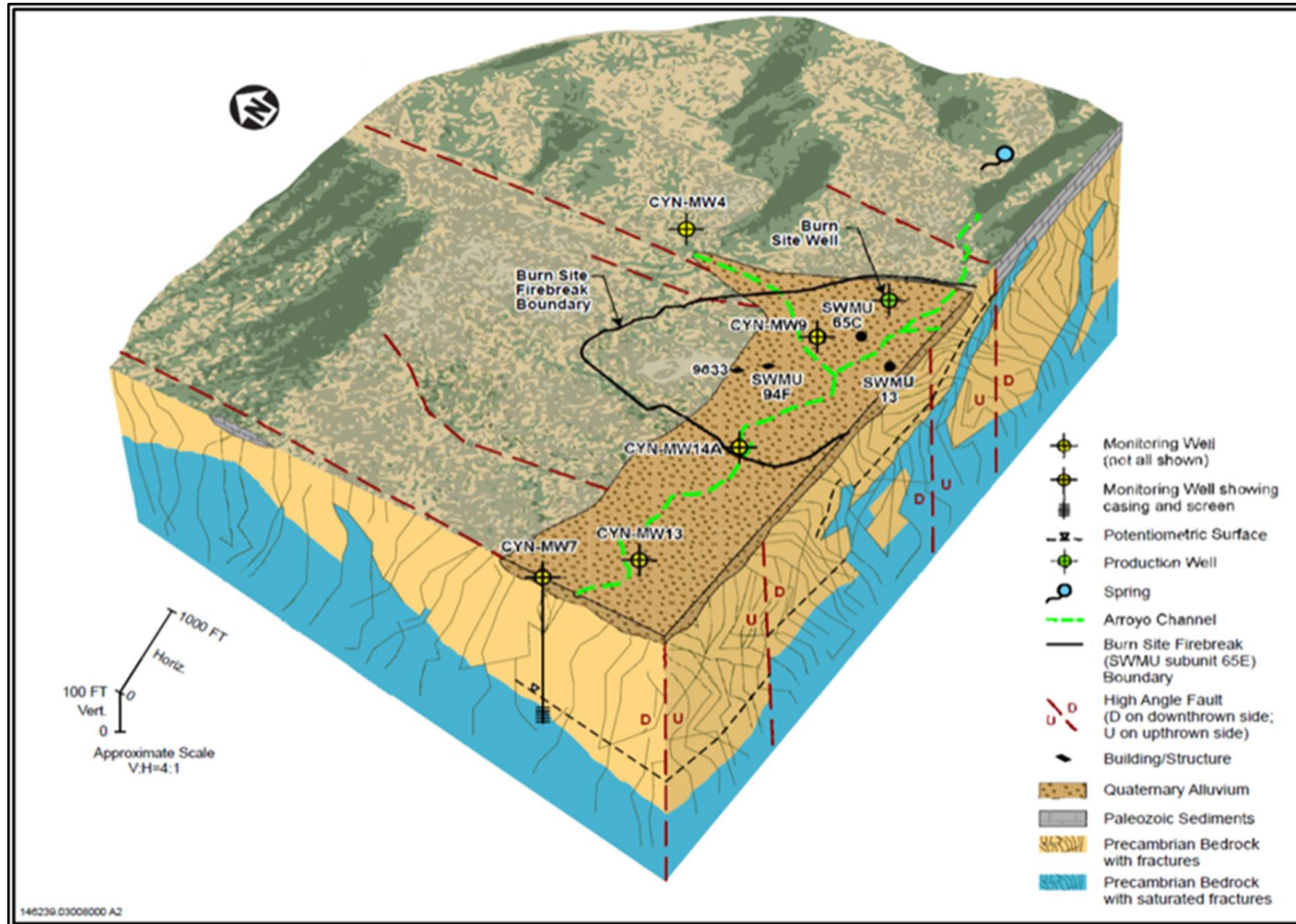


- Groundwater monitoring began in 1996.
- Depth to groundwater ranges from 45 to 360 feet below ground surface and groundwater flows to the west.
- The monitoring network consists of 16 monitoring wells and an inactive production well, with 4 wells installed in October/November 2019.

Oblique Aerial View of the BSG AOC; View is toward the North



# Conceptual Site Model for the BSG AOC



## BSG Groundwater Monitoring



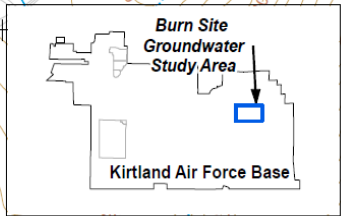
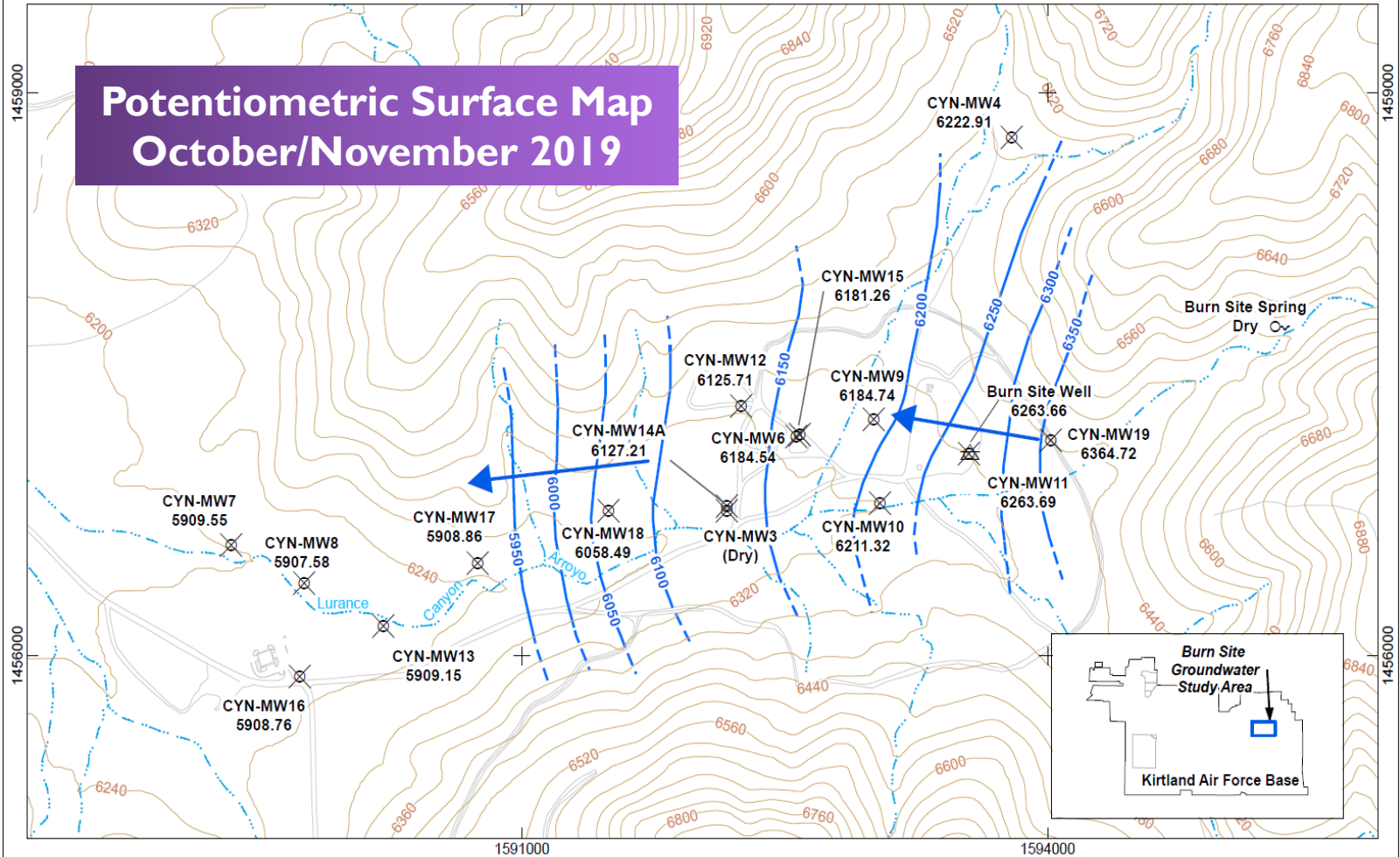
- Groundwater is contaminated with nitrate at concentrations slightly above the maximum contaminant level (MCL).
  - Nitrate has been detected above the MCL in several of the wells that are sampled.
  - The plume is approximately 60 acres.
  - Groundwater in the area is not used for any purpose; no one is drinking contaminated groundwater.
  - The nearest downgradient drinking-water supply well (KAFB-4) is 8.4 miles to the west.
  - Nitrate is typically derived from both man-made and natural sources, and may include ammonium nitrate slurry, wastewater discharges, and degradation of explosive compounds.
  - No other chemicals exceed the MCL.

Constituent of Concern	Maximum Concentration in 2019	MCL
Nitrate	40.3 milligrams per liter (well CYN-MW9)	10.0 milligrams per liter



Map ID = sc20105 1/24/2020 SNL EGIS 0643

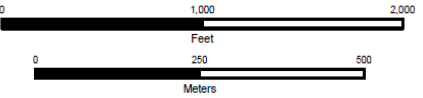
# Potentiometric Surface Map October/November 2019



### Legend

- Monitoring well, groundwater
- Potentiometric surface contour (ft amsl), dashed where uncertain
- Surface drainage, arroyo
- Road, unpaved
- Ground surface contour (40 ft)
- Inferred direction of groundwater flow
- 6221.95 Groundwater elevation (ft amsl) October/November 2019 datum (NAVD 88)
- Water supply well (non-potable)
- Spring

Sandia National Laboratories, New Mexico  
Environmental Geographic Information System



New Mexico State Plane Central Zone, 1983  
1988 North American Vertical Datum







- Completing characterization of the nature and extent of nitrate contamination before resuming the corrective action process and proposing alternatives for a remedy.
- Performed quarterly water level measurements and quarterly or semiannual groundwater sampling that was presented in the Annual Groundwater Monitoring Report submitted to the New Mexico Environment Department (NMED) in June 2020 (approved by NMED in August 2020).
- Recommendations for future characterization were submitted to the NMED in June 2018; and NMED responded in June 2018 requesting four wells.
- Submitted a Monitoring Well Installation Work Plan to NMED in January 2019; and approved by NMED in February 2019.
- Wells installed in October/November 2019.
- Submitted a Monitoring Well Installation Report to NMED in May 2020; and approved by NMED in July 2020.
- Met with NMED in September 2020 to discuss recent groundwater data.

# Tijeras Arroyo Groundwater (TAG) Investigation



*John R. Copland*  
*Environmental Restoration Operations*



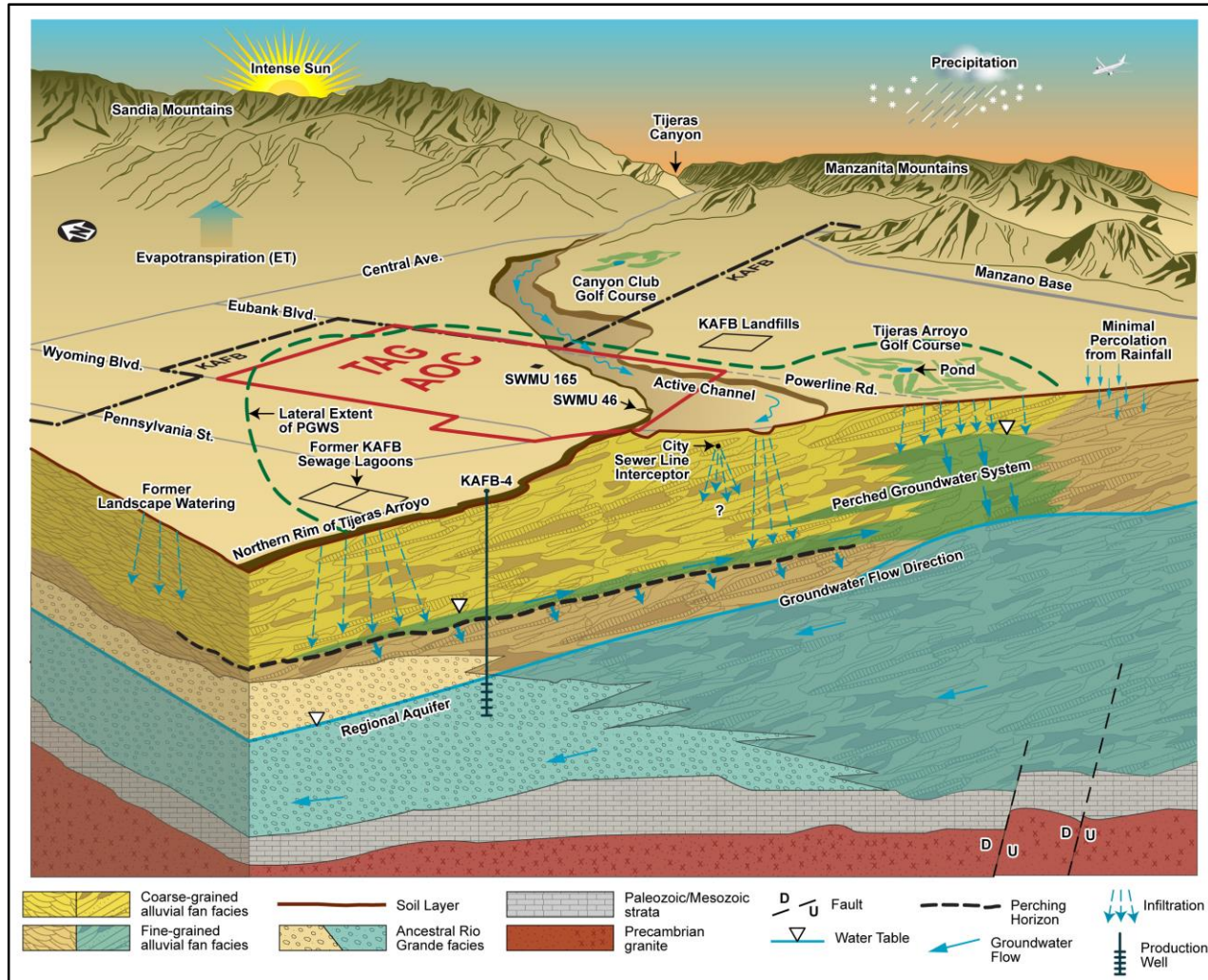
- The Tijeras Arroyo Groundwater (TAG) Investigation Area of Concern (AOC) covers 1.82 square miles (1,165 acres).
  - Located within the northern part of Kirtland Air Force Base (KAFB),
  - Encompasses Sandia National Laboratories (SNL) Technical Areas I, II, and IV.
- The facilities at TA-I, TA-II, and TA-IV were built on land that had been previously developed by commercial airline operators starting in 1928 and to a much larger degree by the military during World War II.
- SNL 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 (mostly sands and gravels) under the TAG AOC.
- Corrective action per NMED guidance is only required for elevated nitrate concentrations in the PGWS.

## TAG Groundwater Description



- Perched Groundwater System (PGWS)
  - The water table occurs at a depth ranging from approximately 270 to 330 feet below the ground surface across the TAG AOC.
  - The PGWS was created by manmade activities including sewage systems and wastewater outfalls. These activities were eliminated in 1992 resulting in the PGWS naturally dewatering (drying up) at approximately 0.5 feet per year. Landscape water has been reduced too.
  - A thin layer of 7 to 20 feet of saturation in the silty sands remains across much of the TAG AOC.
  - Thickness of the saturated layer is consistently decreasing; water mostly percolates downward.
  - Groundwater in the PGWS slowly flows southeast at approximately 24 feet per year and merges with the Regional Aquifer near Powerline Road on KAFB.
- Regional Aquifer
  - Depth to the Regional Aquifer ranges from approximately 440 to 560 feet below the ground surface across the TAG AOC.
  - Vertically separated from the PGWS by a clayey Perching Horizon and about 200 feet of unsaturated strata.
  - Groundwater in the Regional Aquifer flows west and northwest at approximately 55 feet per year.

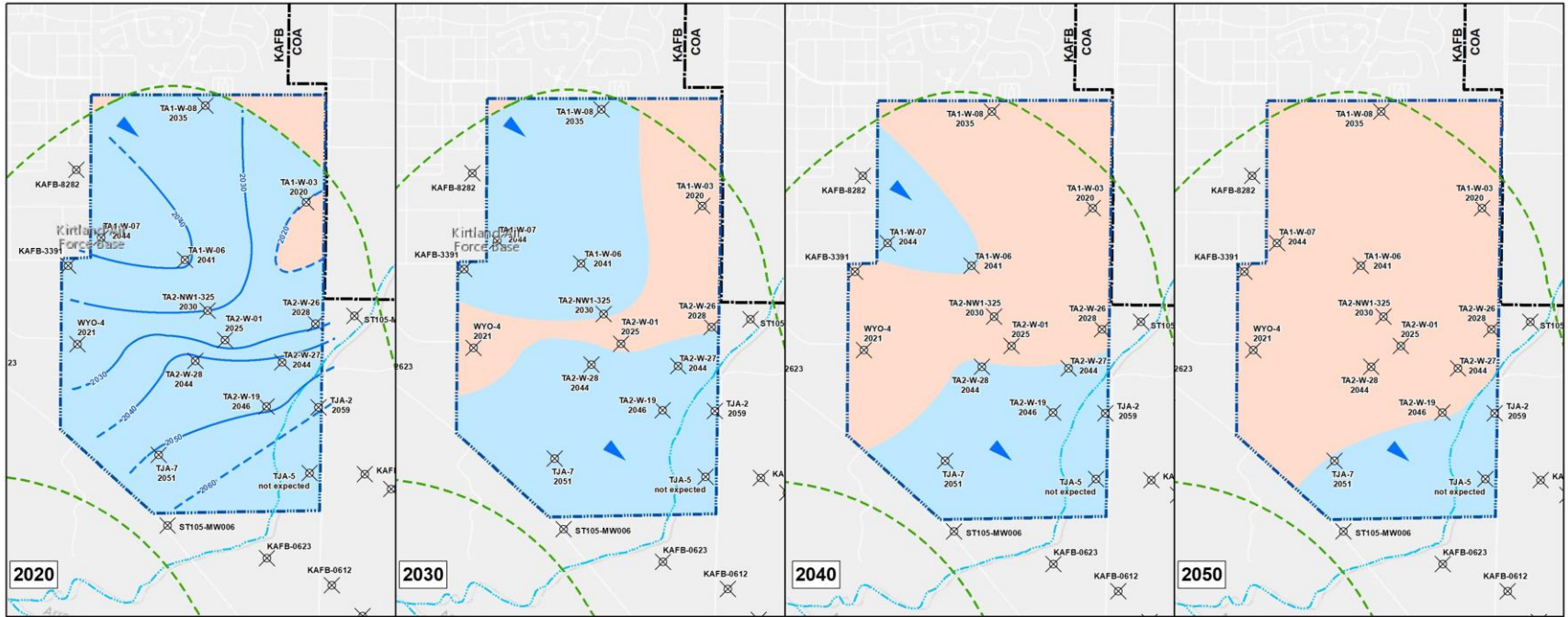
# Conceptual Site Model for the TAG Vicinity



## TAG Groundwater Monitoring



- Groundwater monitoring began in 1992.
  - The U.S. Department of Energy (DOE) and its prime contractor for SNL have installed 31 monitoring wells in the TAG AOC.
  - KAFB and the City of Albuquerque have installed 70 monitoring wells in the surrounding area. Cooperation and data sharing enhances our understanding of the hydrogeologic setting.
  - Monitoring wells screened in the PGWS yield small volumes of water (typically one to two gallons per minute).
- Groundwater in the PGWS is contaminated with nitrate at concentrations slightly above the maximum contaminant level (MCL).
  - The plume in the southeast corner of the TAG AOC is approximately 280 acres.
  - Nitrate is typically derived from both man-made and natural sources, and may include septic leach fields, wastewater discharges, fertilizers, and degradation of minerals and plant material in soil.
  - No other chemicals exceed the MCL.
  - Depending on location, PGWS monitoring wells will go dry in 5 to 44 years, except in the extreme southeast corner of the AOC.
  - Water from the PGWS is not used for any purpose at SNL; no one is drinking contaminated groundwater.



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

**TAG AOC**  
Kirtland Air Force Base

⊗ Monitoring well, Perched Groundwater System (PGWS)

**2020** Estimated year when water level declines to bottom of well screen

--- Estimated year of decline contour, dashed where uncertain shown at Year 2020 only

■ Predicted remaining extent

■ Water below screen in SNL/NM well

**Legend**

- Lateral extent of PGWS, October 2015
- ▶ Groundwater Flow direction, inferred from potentiometric surface
- Surface drainage, arroyo
- Tijeras Arroyo Groundwater (TAG) Area of Concern (AOC)
- Kirtland Air Force Base (KAFB) boundary

COA: City of Albuquerque  
SNL/NM: Sandia National Laboratories/New Mexico

0 1,250 2,500  
Feet

0 300 600  
Meters

ENVIRONMENTAL GEOGRAPHIC INFORMATION SYSTEMS  
**EGIS**  
WELLS

Service Layer Credits: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community  
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SNL EGIS ORG.4142  
New Mexico State Plane Central Zone, 1983  
1988 North American Vertical Datum  
SNL, EGIS Dept 4142 ce17573 11-10-17

## TAG Groundwater Monitoring

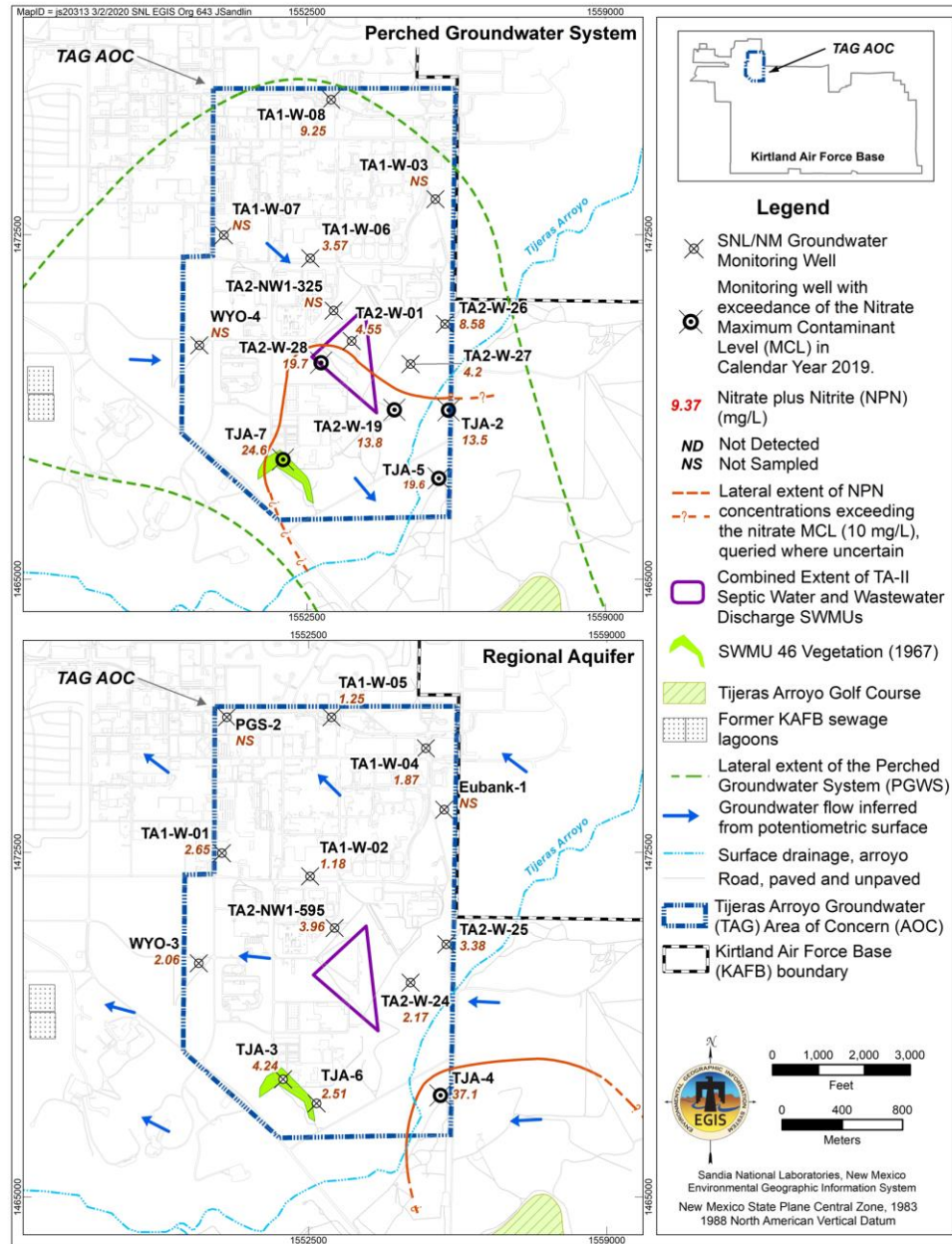


- Elevated nitrate concentrations in the PGWS do not pose a threat to drinking water in the Regional Aquifer. SNL operations have not contaminated the Regional Aquifer.
- The nearest drinking-water production well in the Regional Aquifer is KAFB-20, which is located approximately 1 mile to the west of the elevated nitrate concentrations in the PGWS.
- The nearest Albuquerque Bernalillo County Water Utility Authority well is Ridgcrest 1 which is located approximately 2 miles to the north of the elevated nitrate concentrations in the PGWS.

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 (well TJA-2, one-time exceedance)	0.700J micrograms per liter (well TJA-3); <0.300 micrograms per liter (well TJA-4)	5 micrograms per liter



# Maximum 2019 Nitrate Concentrations in the PGWS and the Regional Aquifer

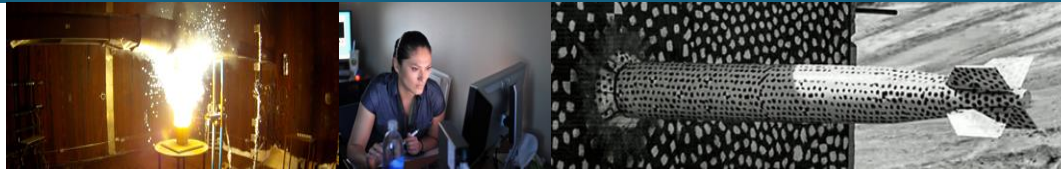


## Current Status and Recent Activities



- 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 New Mexico Environment Department (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:
  - Monitored natural attenuation using the existing well network.
  - In-situ bioremediation requiring installation of numerous wells.
  - Groundwater extraction and treatment requiring installation of numerous wells.
- All three remedial alternatives require the semiannual sampling of both water-bearing units.
- NMED HWB is anticipated to select a remedial alternative in 2021.

# Technical Area-V Groundwater Investigation



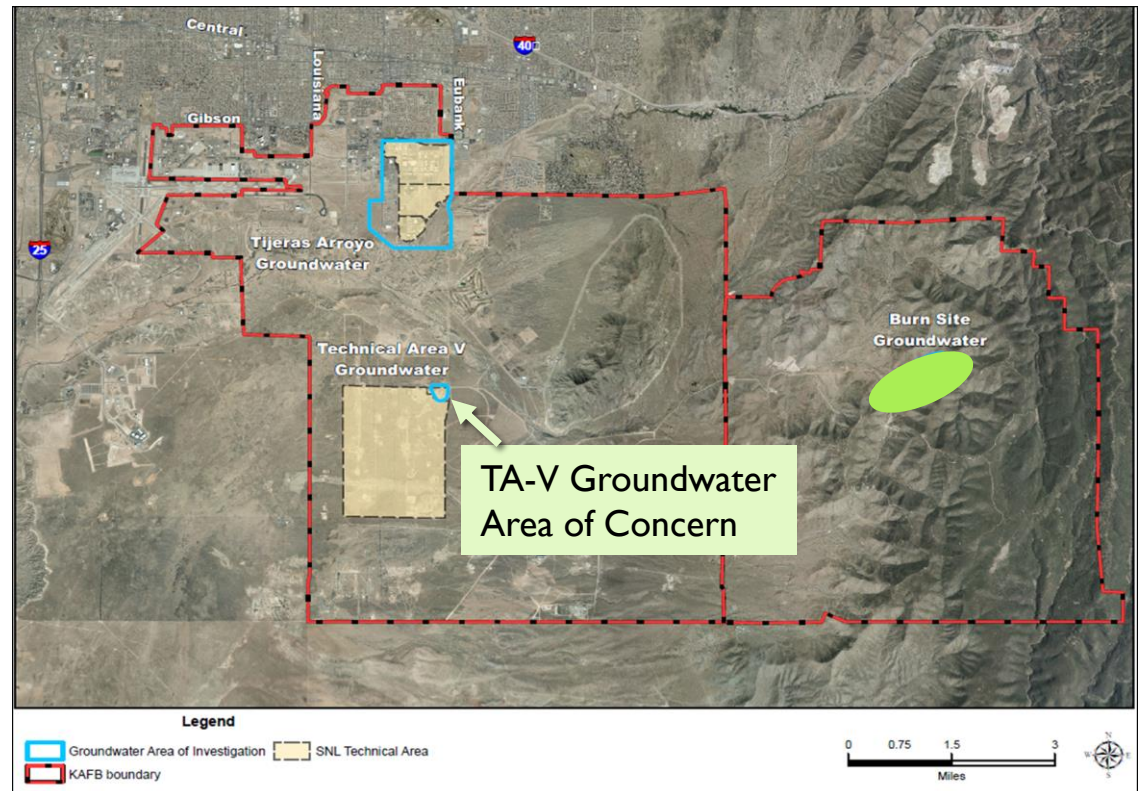
Jun Li  
Environmental Restoration Operations

## TA-V Groundwater Area of Concern Site Description



- TA-V Groundwater Area of Concern (AOC) is located at Sandia National Laboratories (SNL) Technical Area-V (TA-V).
  - TA-V covers 35 acres.
  - TA-V is an industrial area in the west-central portion on Kirtland Air Force Base (KAFB).

- SNL activities at TA-V began in 1961 and involve operating research reactors.
- Corrective action is required only for the groundwater at TA-V.
- Groundwater occurs approximately 500 feet below the ground surface at TA-V.



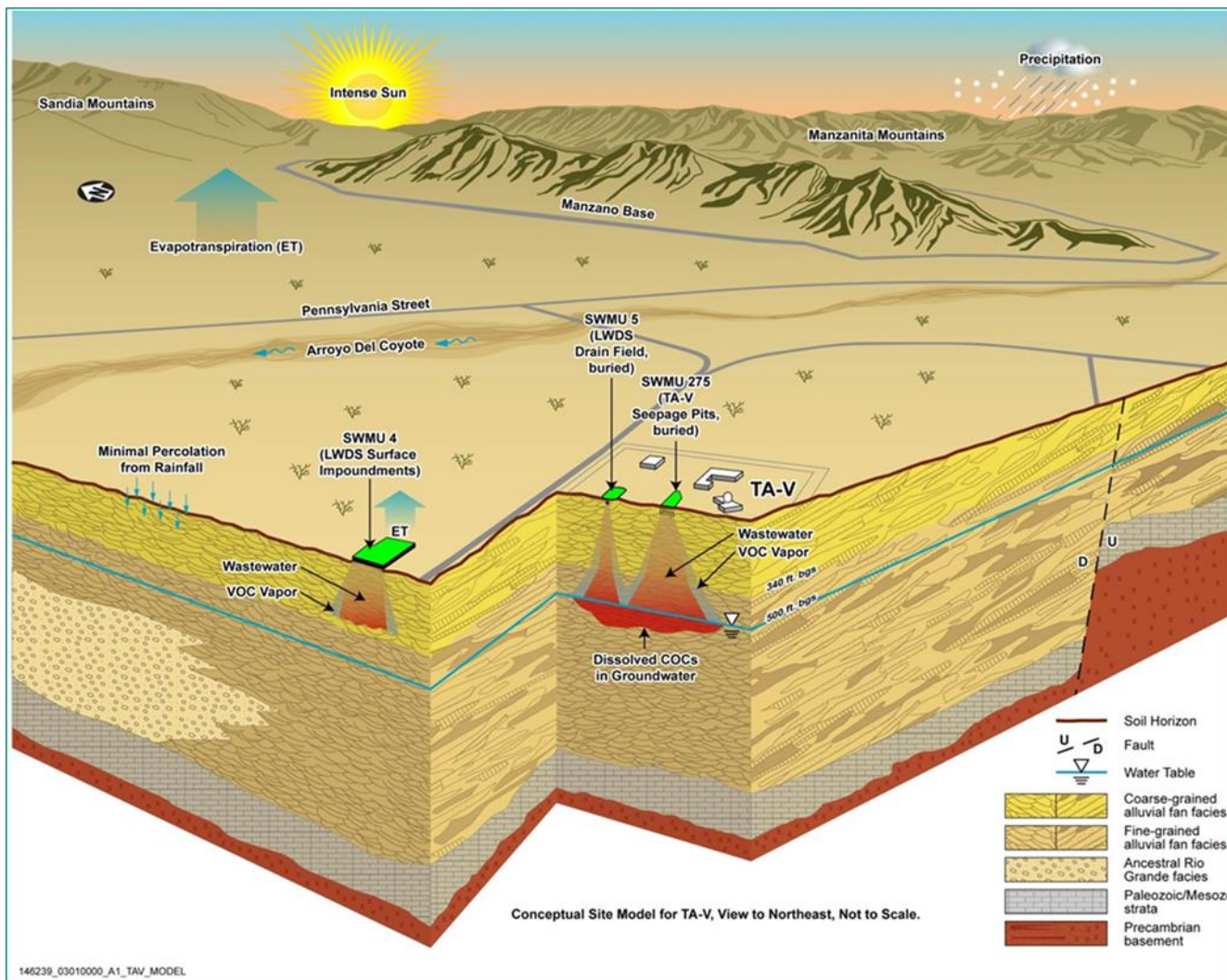
## TA-V Groundwater Monitoring



- Groundwater monitoring began in 1992.
  - Current monitoring network consists of 18 wells.
  - Groundwater is contaminated with nitrate and trichloroethene at concentrations above the U.S. Environmental Protection Agency maximum contaminant levels (MCLs) for drinking water.
  - The nitrate plume covers approximately 1.4 acres.
  - The trichloroethene plume covers approximately 13 acres.
  - No other constituents in groundwater exceed the MCLs.
  - Neither plume is moving beyond the current area.
  - The groundwater in this area is not used for any purpose.
  - The nearest downgradient drinking-water supply well (KAFB-4) is 2.7 miles to the north.
  - The plumes are not adversely impacting human health and the environment.

Constituent of Concern	Maximum Concentration in 2019	MCL
Nitrate	15.3 milligrams per liter (well TAV-MW10)	10 milligrams per liter
Trichloroethene	20.2 micrograms per liter (well LWDS-MW1)	5 micrograms per liter

# Conceptual Model of Groundwater Contamination Process at TA-V

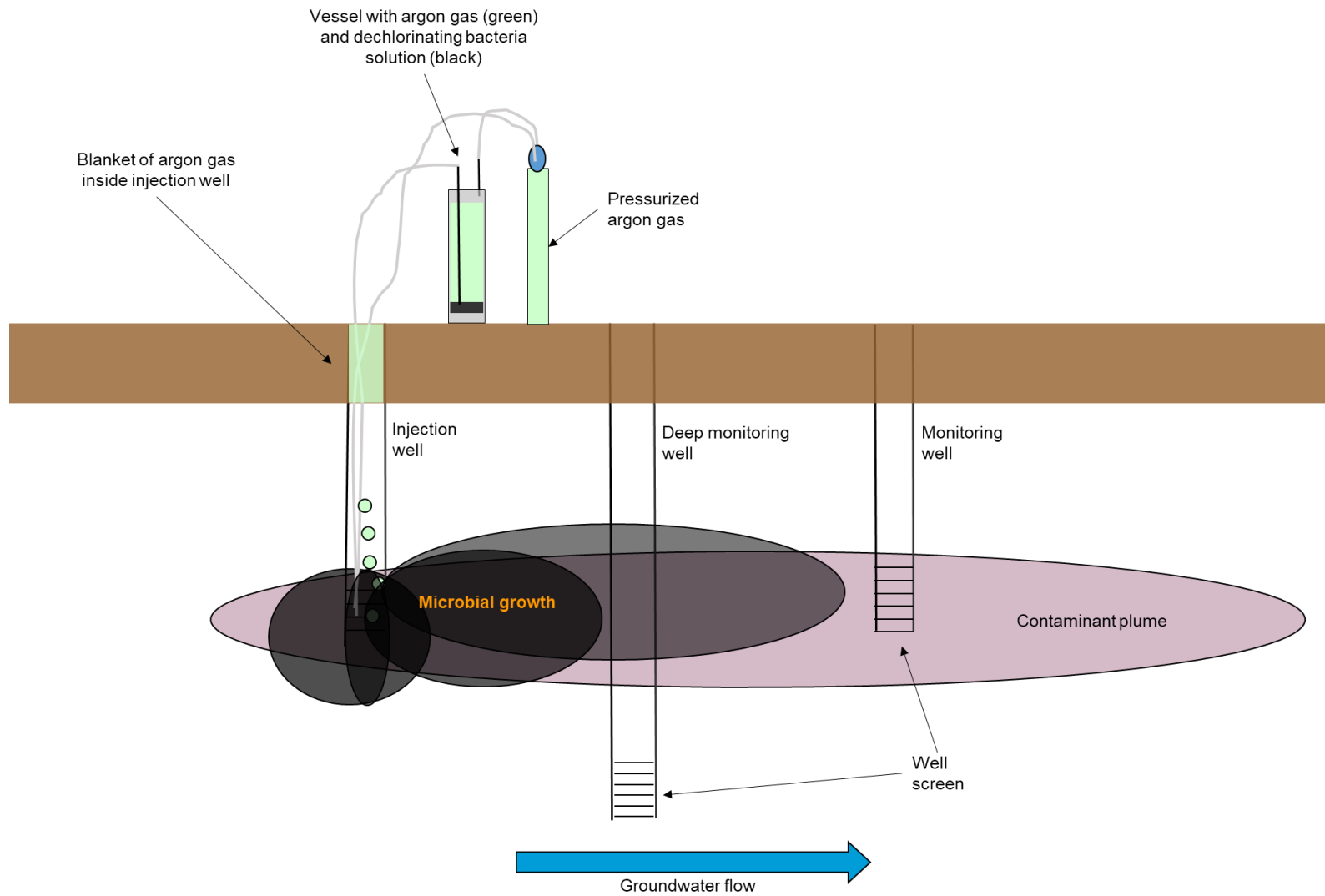


## Treatability Study: In-Situ Bioremediation



- The objective is to evaluate the effectiveness of in-situ bioremediation as a potential technology for remediation of the TA-V Groundwater AOC.
  - “In-situ” means treating the contamination in place (in the aquifer sediments).
  - “Bioremediation” means using biological processes (bacteria) to remediate the groundwater by degrading the nitrate and trichloroethene to levels below drinking water standards.
- The plan of the treatability study is to deliver bioremediation solution using one injection well first and possibly up to three injection wells.
- The New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) is the regulator for the investigation.
- Sandia has obtained the Discharge Permit DP-1845 from the NMED Ground Water Quality Bureau (GWQB) to use up to three injection wells to deliver bioremediation solution.
- Progress on the treatability study is provided to the NMED HWB and GWQB through quarterly reporting.

# Conceptual Model of In-Situ Bioremediation Process





## 7 In-Situ Bioremediation Treatability Study at TA-V

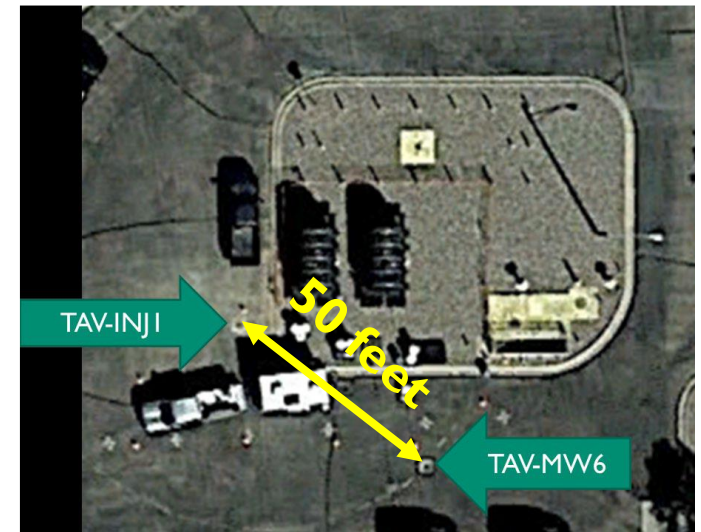
- Question to be answered: How large an area can be treated by the bioremediation solution injected?
  - Groundwater at TA-V is aerobic and biodegradation is not naturally occurring.
  - Bioremediation solution provides the nutrients and pH buffer for the bacteria to biodegrade nitrate and trichloroethene.
- Treatability Study at the first Injection Well TAV-INJ1
  - Injected approximately 531,000 gallons of bioremediation solution mixed with 123 liters of trichloroethene-degrading bacteria.
  - The solution was injected from November 2018 through April 2019.
  - Injection well TAV-INJ1 and monitoring well TAV-MW6 are monitored for the performance of in-situ bioremediation.
- One deep well and eight surrounding wells are being monitored to determine potential impact on groundwater quality caused by the bioremediation solution.



## Findings of Treatability Study at Injection Well TAV-INJ1



- Groundwater at injection well TAV-INJ1 has been maintaining optimal conditions for biodegradation.
- The inert tracer (bromide) injected with the bioremediation solution has reached monitoring well TAV-MW6.
- Dissolved oxygen level has decreased in the groundwater at well TAV-MW6; however, anaerobic condition is not established.
- No change in groundwater quality has been observed in the deep monitoring well and the eight surrounding wells.



- Delivery of bioremediation solution was limited by low hydraulic conductivities of the aquifer at TA-V.
- Infrastructure at TA-V limits installation of multiple injection wells for the success of the ISB technology across the entire lateral extent of the nitrate and TCE plumes.
- Findings of the treatability study of in-situ bioremediation at injection well TAV-INJ1 were shared with NMED HWB in September 2020.