NMED
New Mexico Environment Department

PUBLIC MEETING – GROUNDWATER INVESTIGATION SITES AT SANDIA NATIONAL LABORATORY

APRIL 27, 2016

Kathryn Roberts
Resource Protection Division Director
New Mexico Environment Department

Agenda

- **Welcome/Introductions/Structure of Meeting –** Kathryn Roberts (RPD Director)
- **Overview of Nitrate Contamination** - Dennis McQuillan (NMED Chief Scientist)
- **Regulatory Status at BSG, TAV, and TAG** - Brian Salem (HWB)
- **Groundwater Data Collected at BSG, TAV and TAG** - Chris Armijo (DOE-OB)

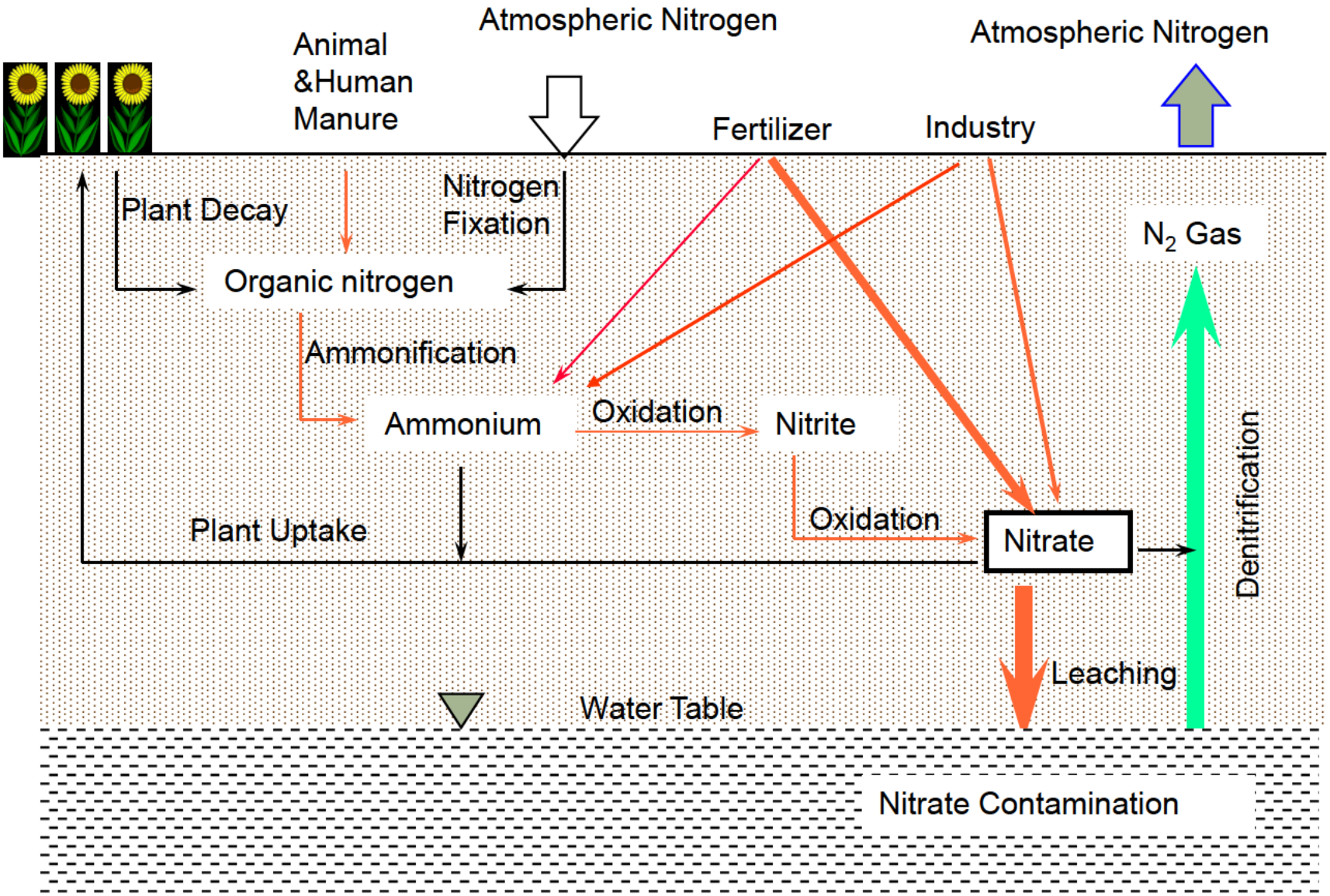
Introductions/Meeting Structure

- NMED RPD Director, Communications Director, HWB and DOE-OB, GWQB in attendance
- Also have staff from DOE/SNL and the ABCWUA
- Each presentation is ~10-15 minutes long
- Q & A will occur after all presentations
  - Note cards were provided for notes or to write down questions
- Presenters will take questions in a panel format
  - Moderated by NMED
- Please ask one question at a time – you will have the opportunity to ask additional questions
- Please be respectful of time

Overview of Groundwater Nitrate Pollution

Dennis McQuillan
Chief Scientist
New Mexico Environment Department

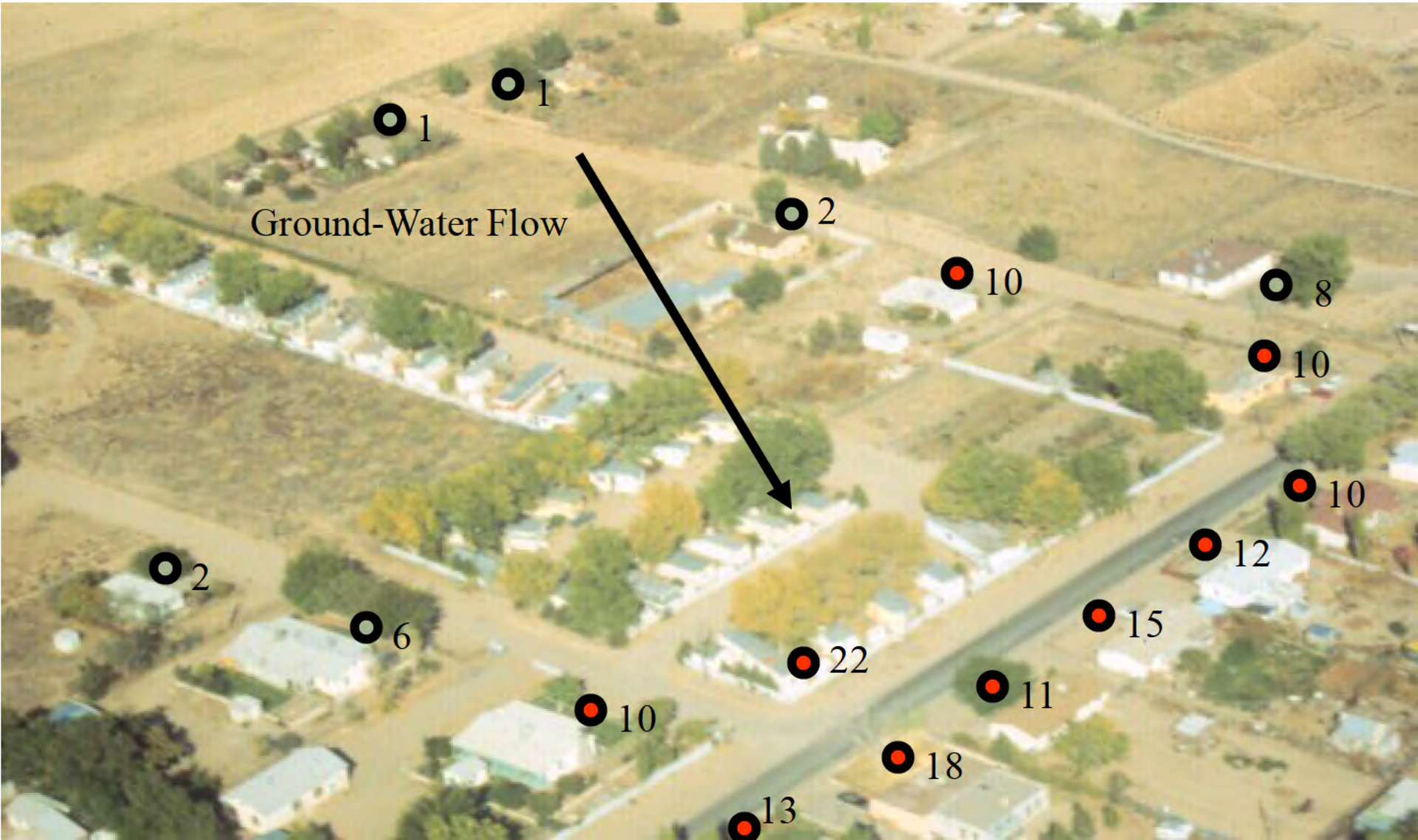
The Nitrogen Cycle



Nitrate in New Mexico

- 217 plumes of ground-water nitrate pollution
- 709 private and 81 public wells affected
- Two cases methemoglobinemia “blue baby syndrome”, several unconfirmed reports
- Sources: sewage, dairies, over-fertilization, explosives, munitions, nitric acid, natural geologic minerals, and evapotranspiration (ET) along ephemeral watercourses

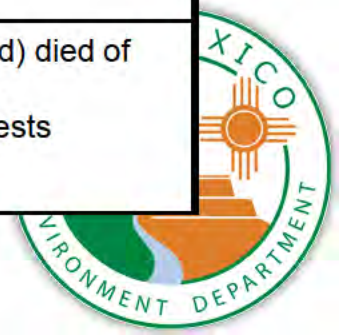
ABQ West Mesa NO_3-N (ppm)



Possible Infant Methemoglobinemia (MHG) Cases from Nitrate in Well Water in NM

Date	*Location*	*NO_3-N (ppm) In Well Water*	*Potential Nitrate Sources*	*Remarks*
1960s-70s	Blue Water	unknown	Uranium mill tailings, septic systems	anecdotal
1960s-70s	Carlsbad	unknown	Septic systems	anecdotal
1961	Albuquerque, Carnuel	132	Septic systems, black powder, marine rocks	Male infant recovered after hospitalization for MHG
1980	Albuquerque, Mountainview	47	Fertilizers, ET, septic systems	Male infant (5.5 mo. old) recovered after methylene blue treatment; 14.9% methemoglobin in blood
1996	Veguita	150-200	Fertilizers, ET, septic systems, dairy waste	Female infant (4 mo. old) died of cyanosis, post-mortem methemoglobin blood tests inconclusive

Of the 278+ cases of infant MHG reported by Walton (1951), none were in New Mexico.
Infant MHG became a notifiable condition in the State of New Mexico in 2006.



Observations Regarding MHG

It has long been observed that gastrointestinal illness may be a risk factor in the development of MHG from high nitrate in drinking water.

> **"…methemoglobinemia may occur in an infant following ingestion of water high in nitrates, especially if the infant is suffering from gastrointestinal disturbances." Walton (1951)**

> **"An association between methemoglobinemia and acute gastroenteritis in infants has been noted in several studies and may be due to acidosis from stool bicarbonate loss impairing the already immature function of the methemoglobin reductase system in these young patients." (Verive, 2011)**

Conclusions Regarding MHG

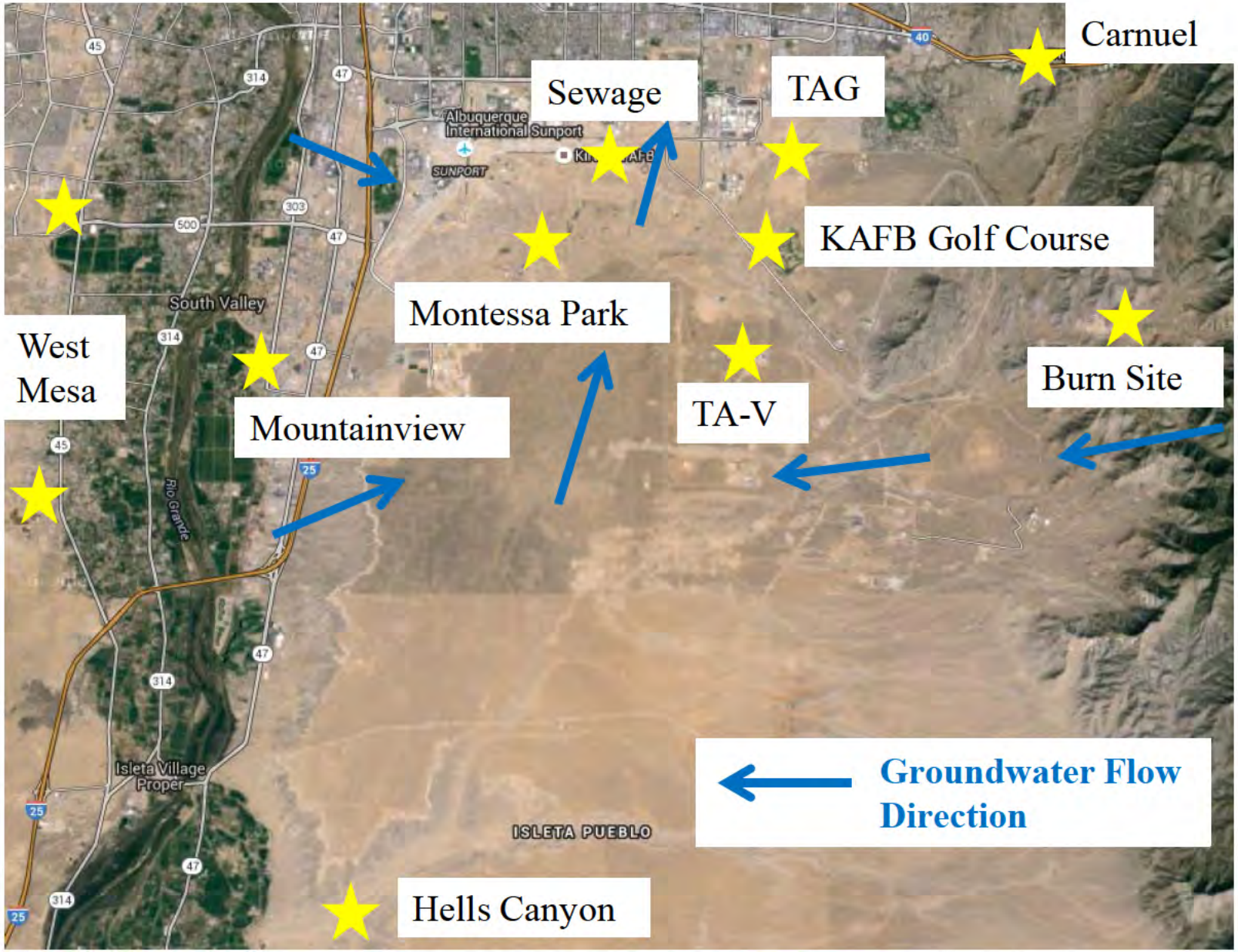
- **Infant MHG is a rare health condition in NM**
- **Infant MHG, when it occurs, has caused life-threatening conditions that require emergency medical attention.**

Free Well Water Testing

The New Mexico Environment Department has, for 30+ years, provided free nitrate tests to people who utilize private domestic wells.

Shannon and Aiden McQuillan measure specific conductance at a Water Fair in Pojoaque, NM, 2004.

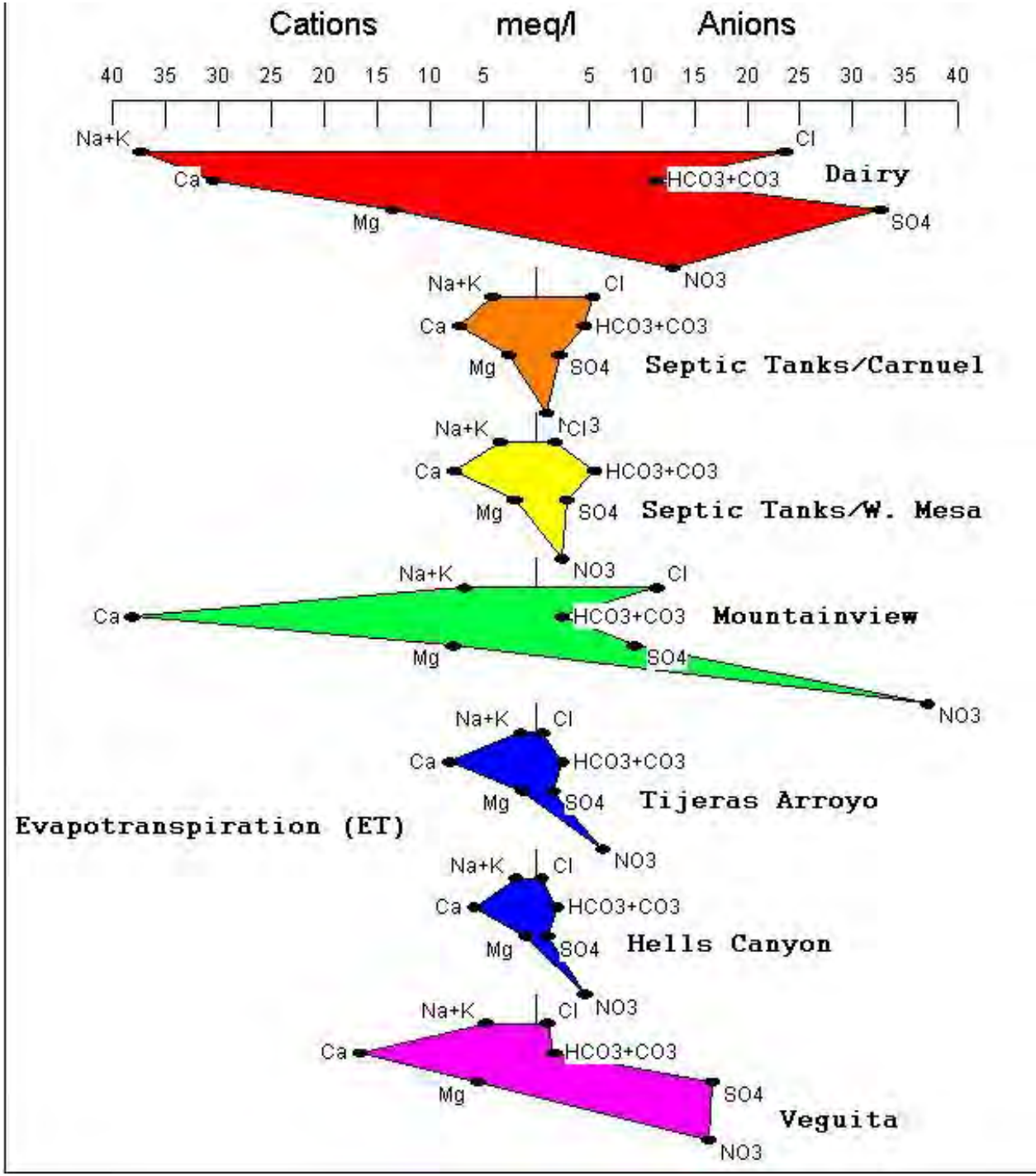
Nitrate Contamination



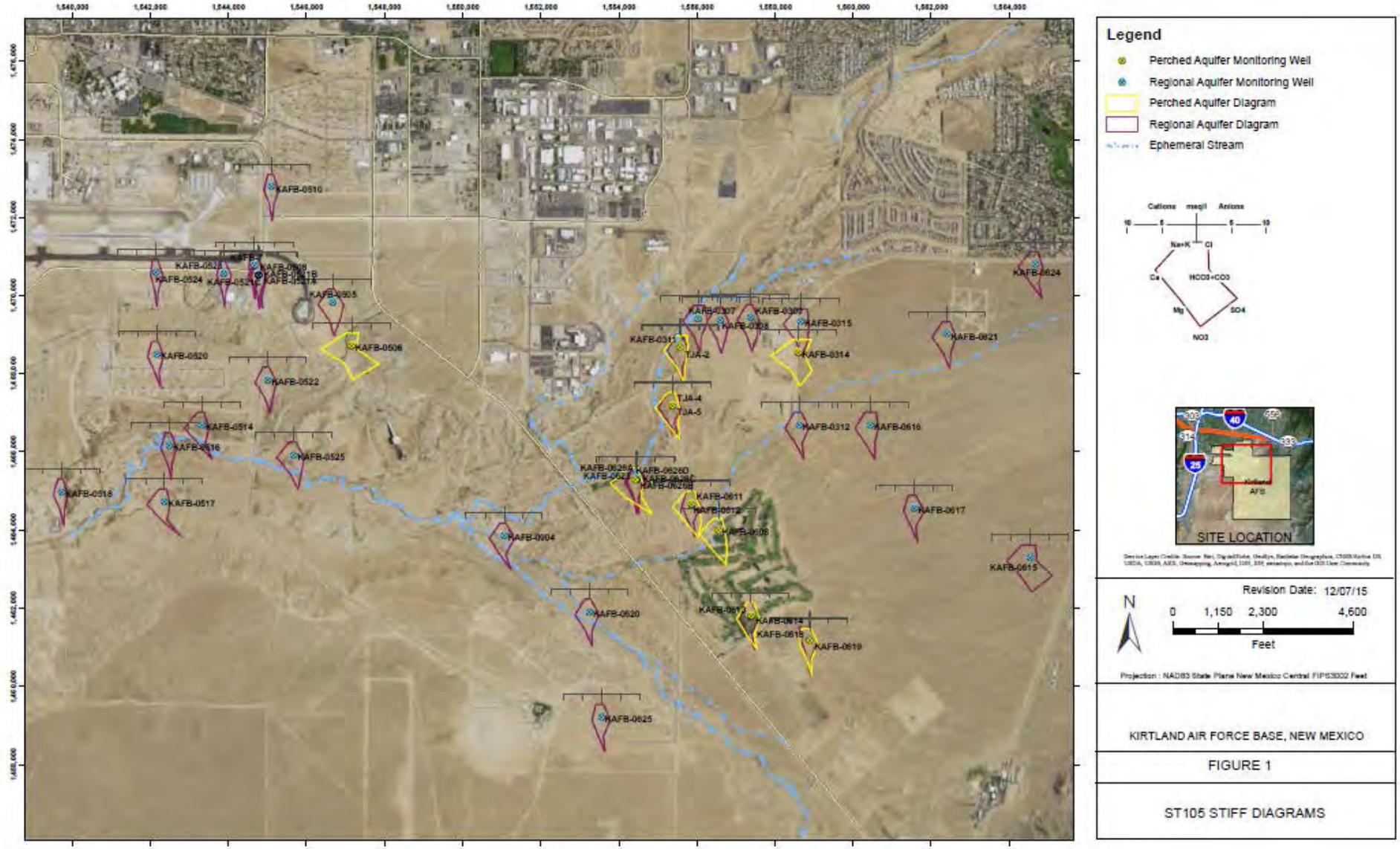
Plume Geochemistry

- Nitrate is often accompanied by elevated levels of other solutes that may be diagnostic in source identification.
- Chloride is typically elevated in nitrate plumes caused by human and animal waste.
- Denitrification can increase bicarbonate.

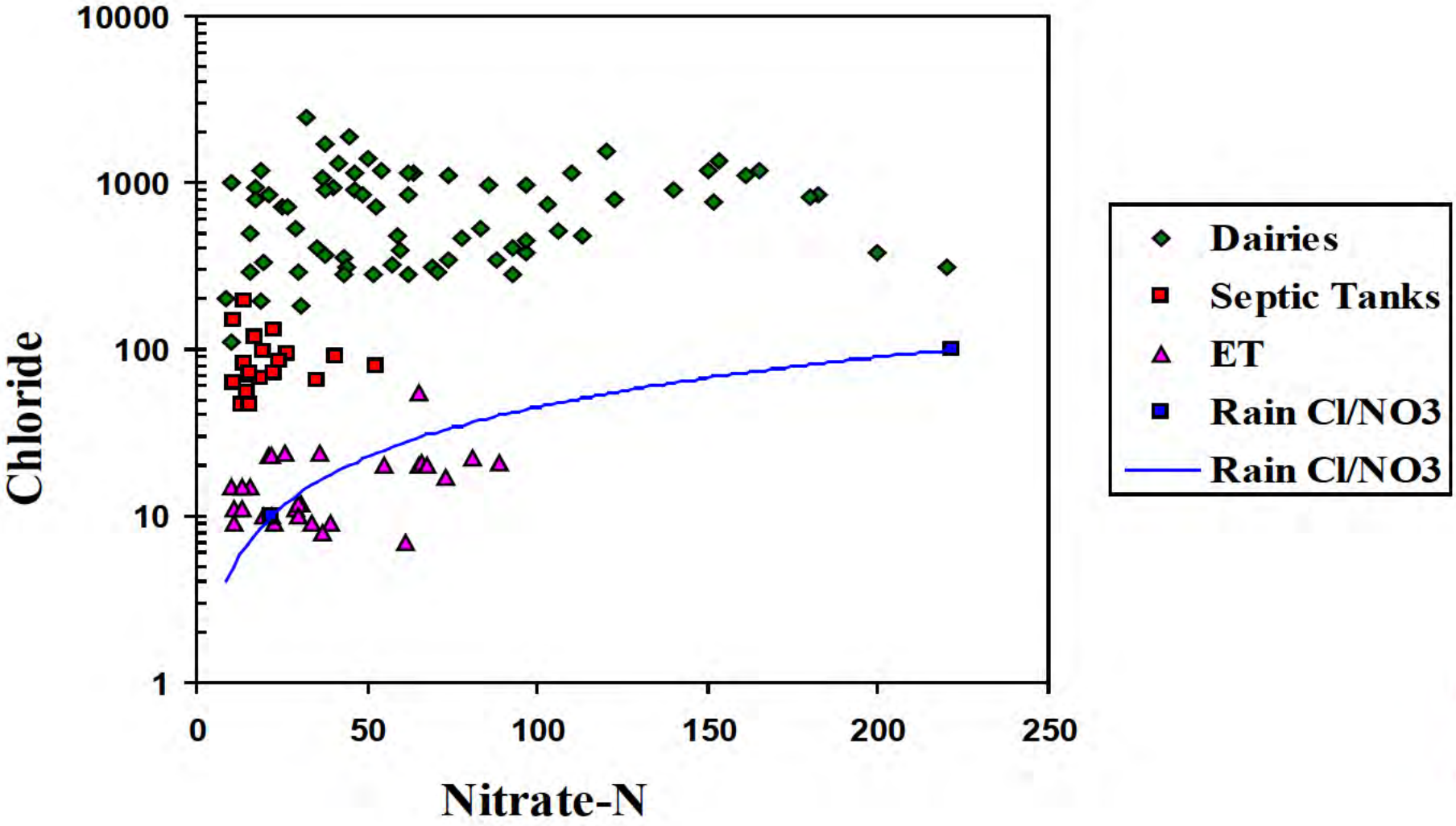
Stiff Diagrams for Nitrate Contaminated Groundwater



Stiff Diagrams for KAFB/SNL

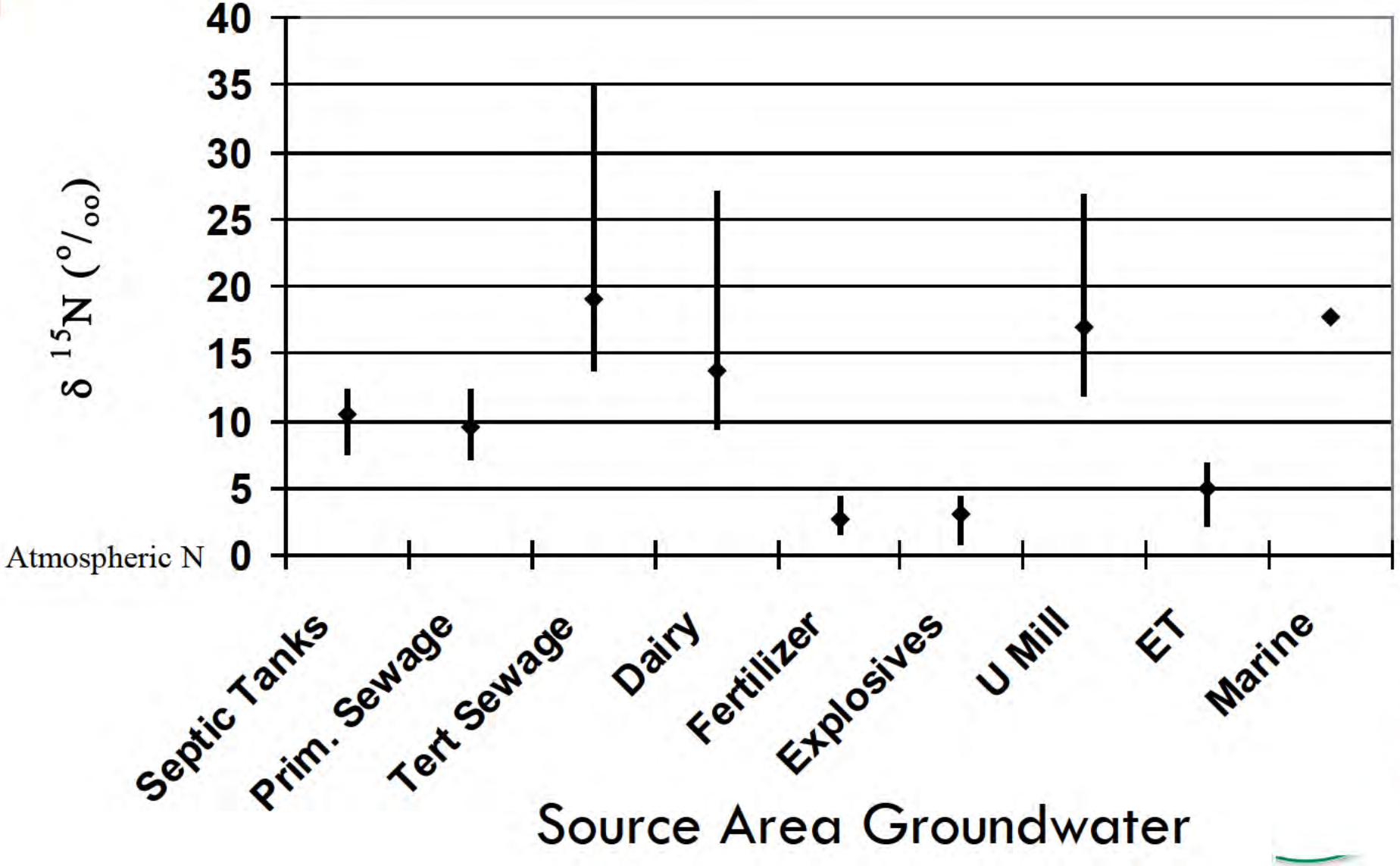


GW Nitrate-Chloride Relationships



Stable Isotopes of Nitrogen, ^{14}N and ^{15}N

$\delta\ ^{15}N$



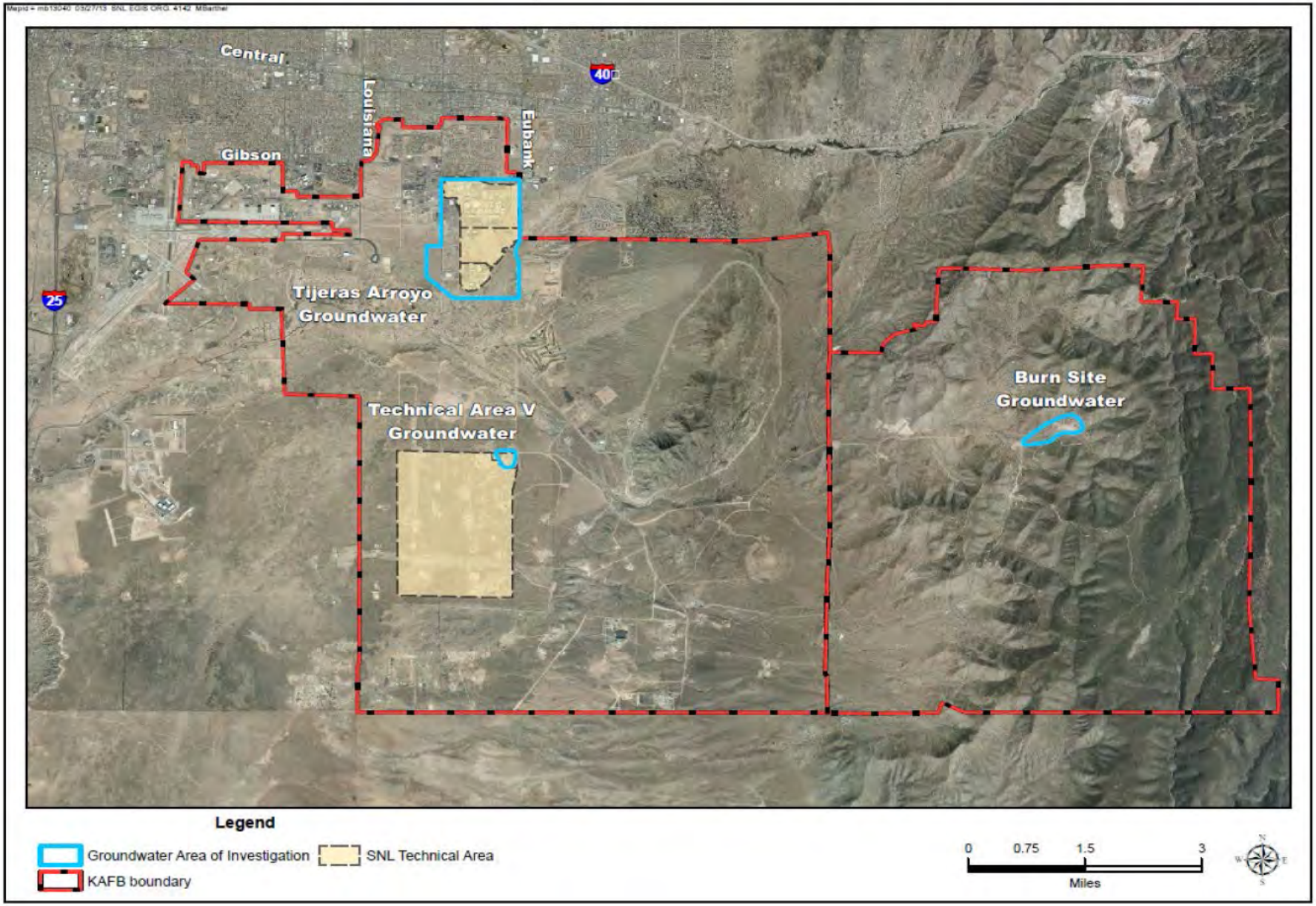
Nitrate Abatement

- State and local governments have been extending water and sewer service into communities affected by nitrate for decades.
- Nitrate contaminated groundwater can be land applied for irrigation (less than 200 pounds per acre per year) as a bio-remediation method.

Burn Site, TA-V and Tijeras Arroyo Current Conditions and Regulatory Review

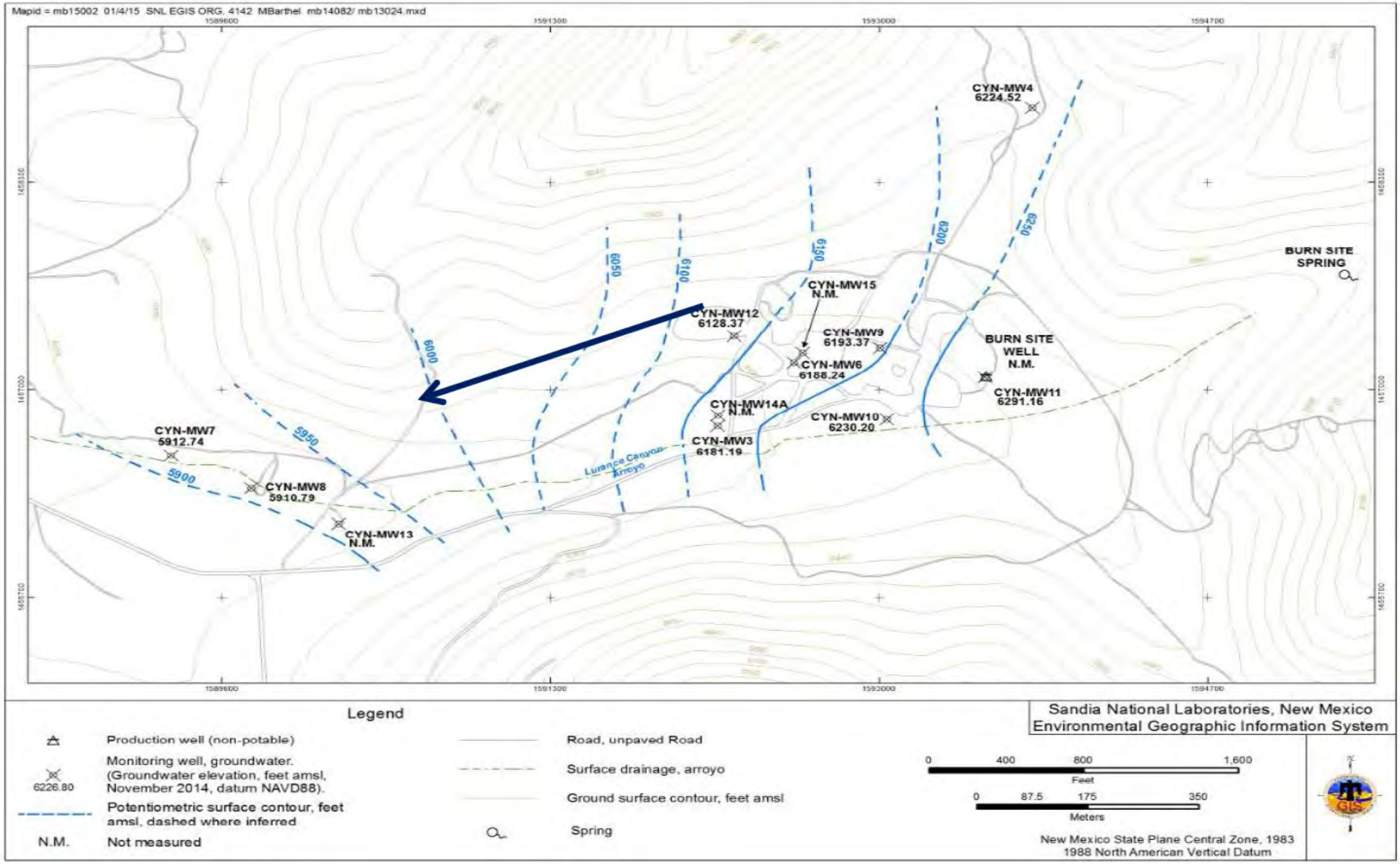
Brian Salem
Hazardous Waste Bureau
New Mexico Environment Department

Location of Burn Site Groundwater Site

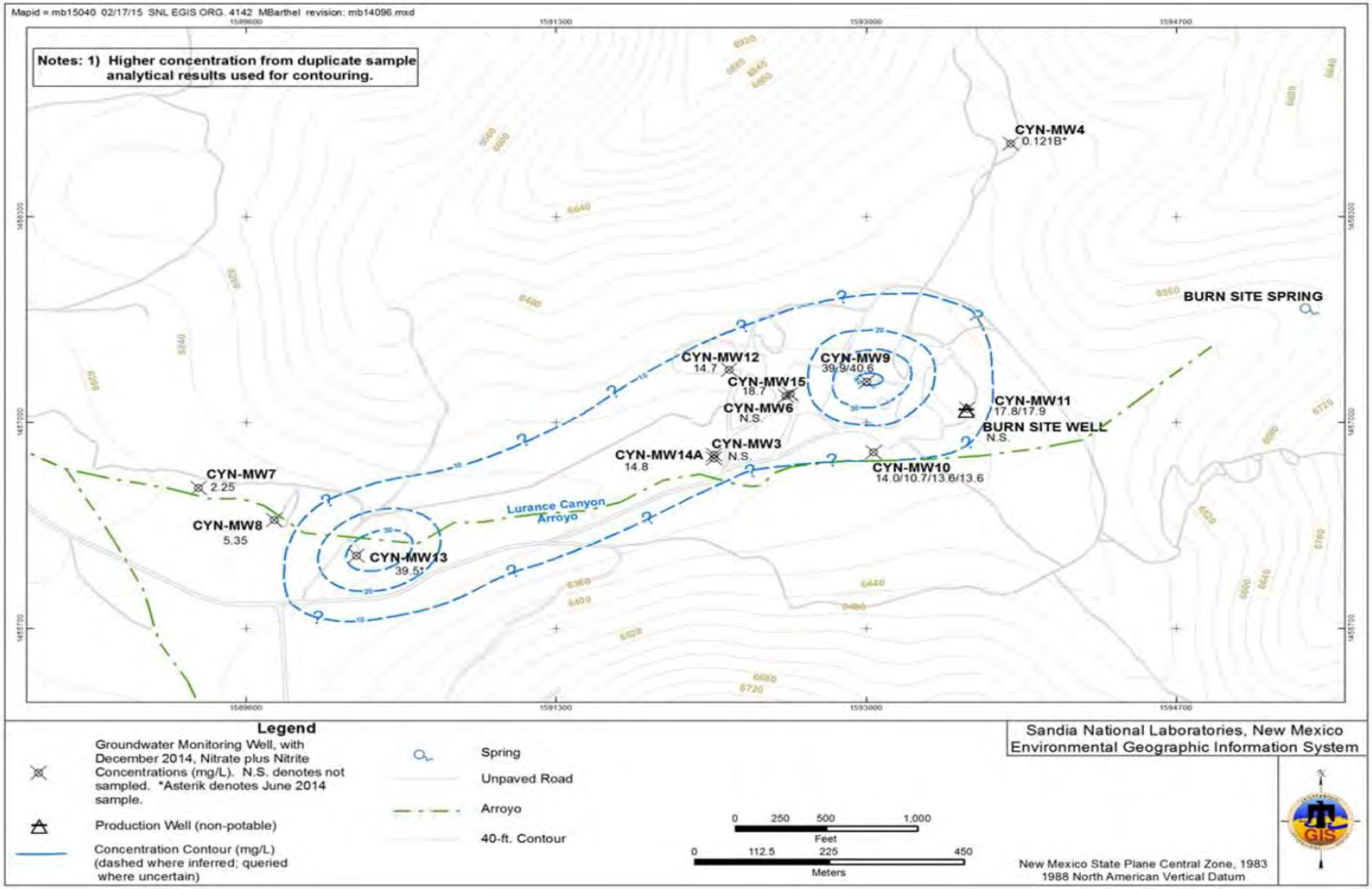


Burn Site Air Photo Looking North East

Burn Site GW Flow Direction



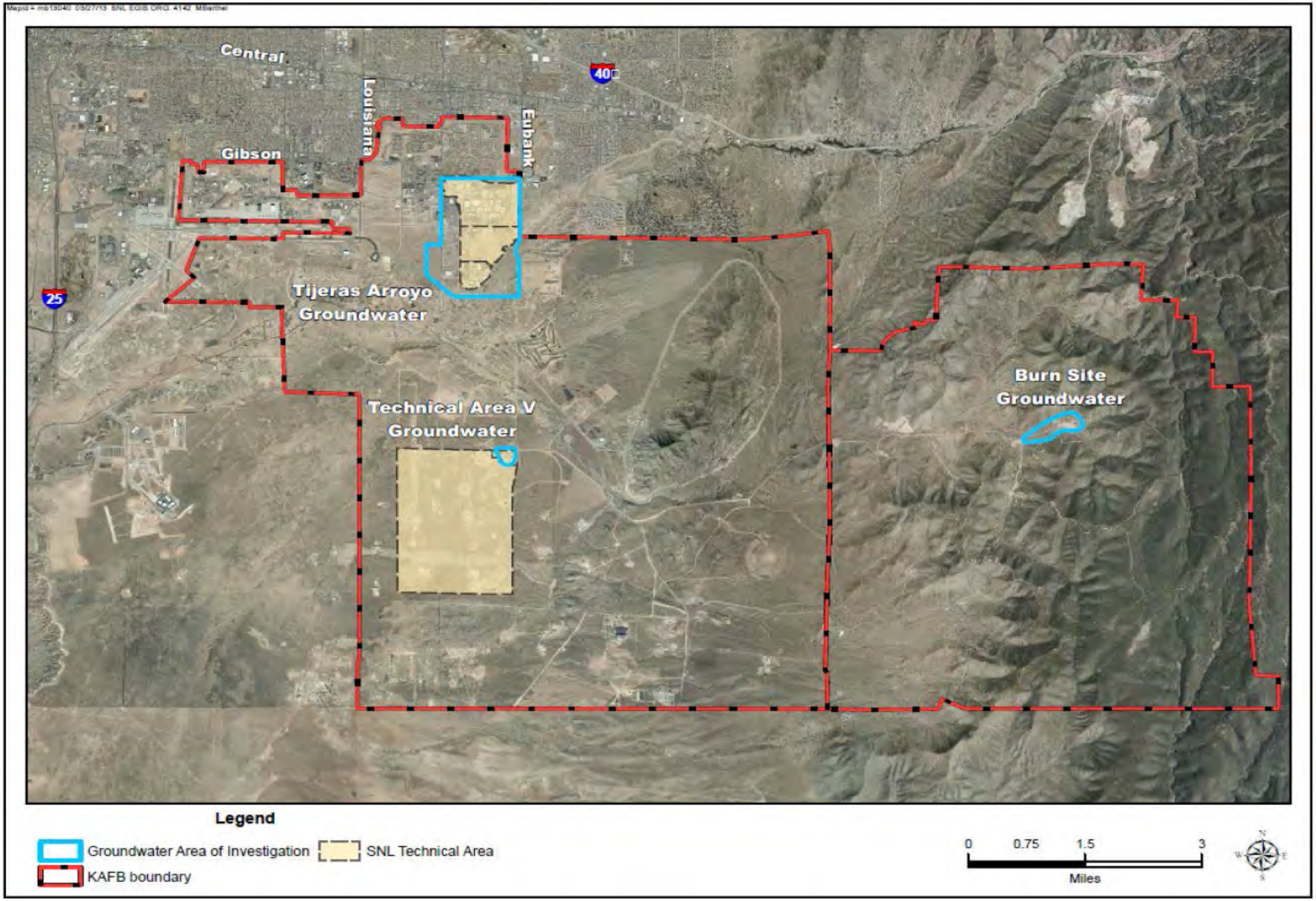
Burn Site Nitrate GW Concentrations



Environmental Oversight of Burn Site GW

- GW occurs ~100 to 325 ft. below ground surface in fractured and faulted bedrock
- GW contains nitrate, up to 42 ppm (standard is 10 ppm)
- Perchlorate detected in only one MW at below action levels
  - Detections range from .006-.009 ppm (action level .015 ppm adopted 2015)
  - Detected regularly since 2004
- GW is monitored semi-annually in 12 MW
- Aquifer Pump Test Work Plan will be submitted by June 8, 2016
- Additional Monitor Well Installation Plan to NMED in 2017
- Updated Current Conceptual Model (CCM) and Corrective Measure Evaluation Report to NMED by October 14, 2020

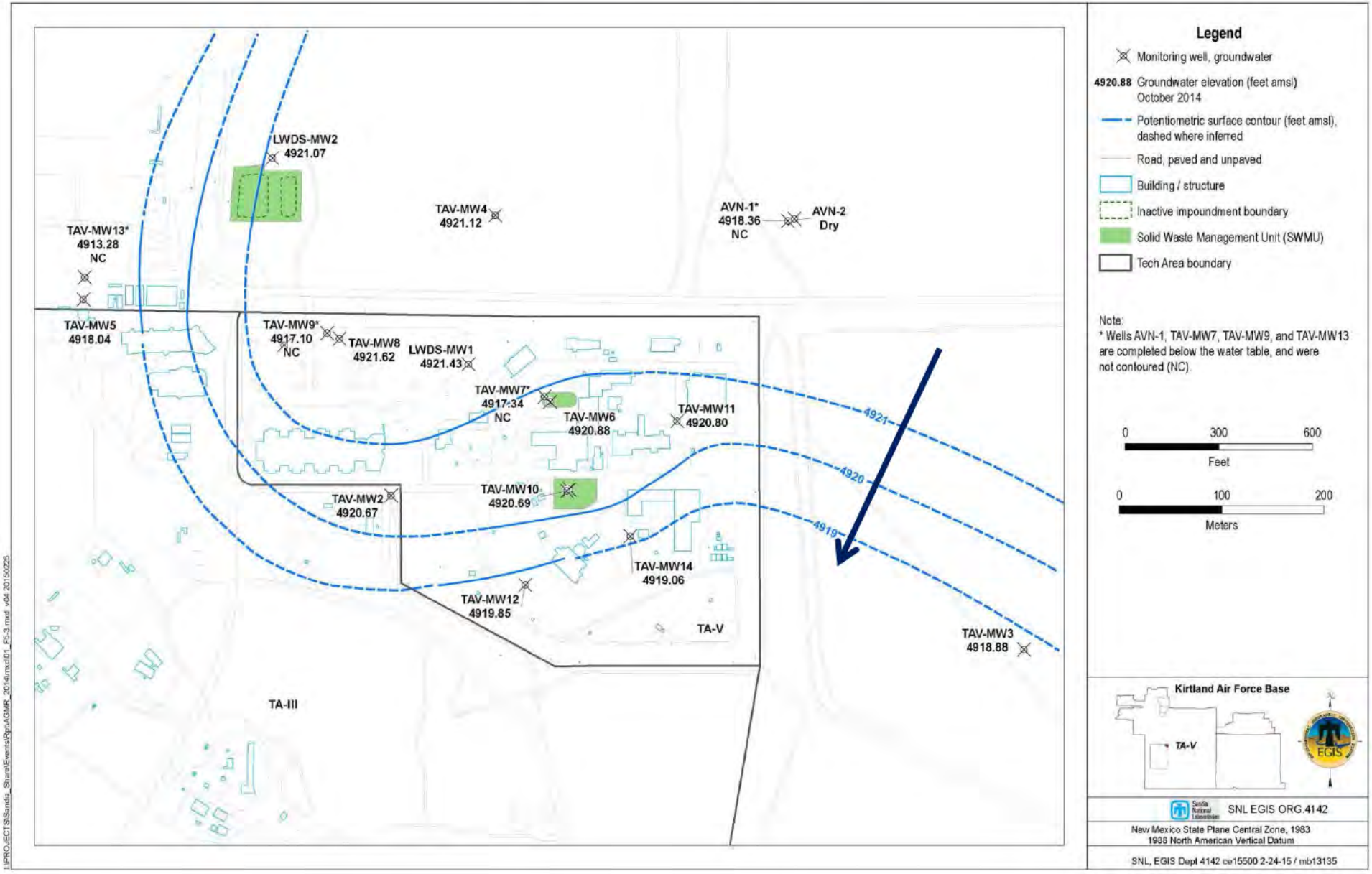
Location of TA-V Groundwater Site



Technical Area V GW

NNSA
National Nuclear Security Administration

TA-V GW Flow Direction



TA-V TCE GW Concentrations

Legend

- 3.18 Monitoring well, with October/November 2014 Trichloroethene concentrations (µg/L)
- Isoconcentration contour (µg/L), dashed where inferred
- Road, paved and unpaved
- Building / structure
- Inactive impoundment boundary
- Solid Waste Management Unit (SWMU)
- Tech Area boundary

Notes:
* Wells AVN-1, TAV-MW7, TAV-MW9, and TAV-MW13 are completed below the water table, and were not used for contouring.

** Data as of August 2014 for TAV-MW6.

ND = not detected, method detection limit indicated in parentheses.

0 300 600
Feet

0 100 200
Meters

SNL EGIS ORG.4142

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

SNL, EGIS Dept 4142 ce15503 2-24-15 / mb13135

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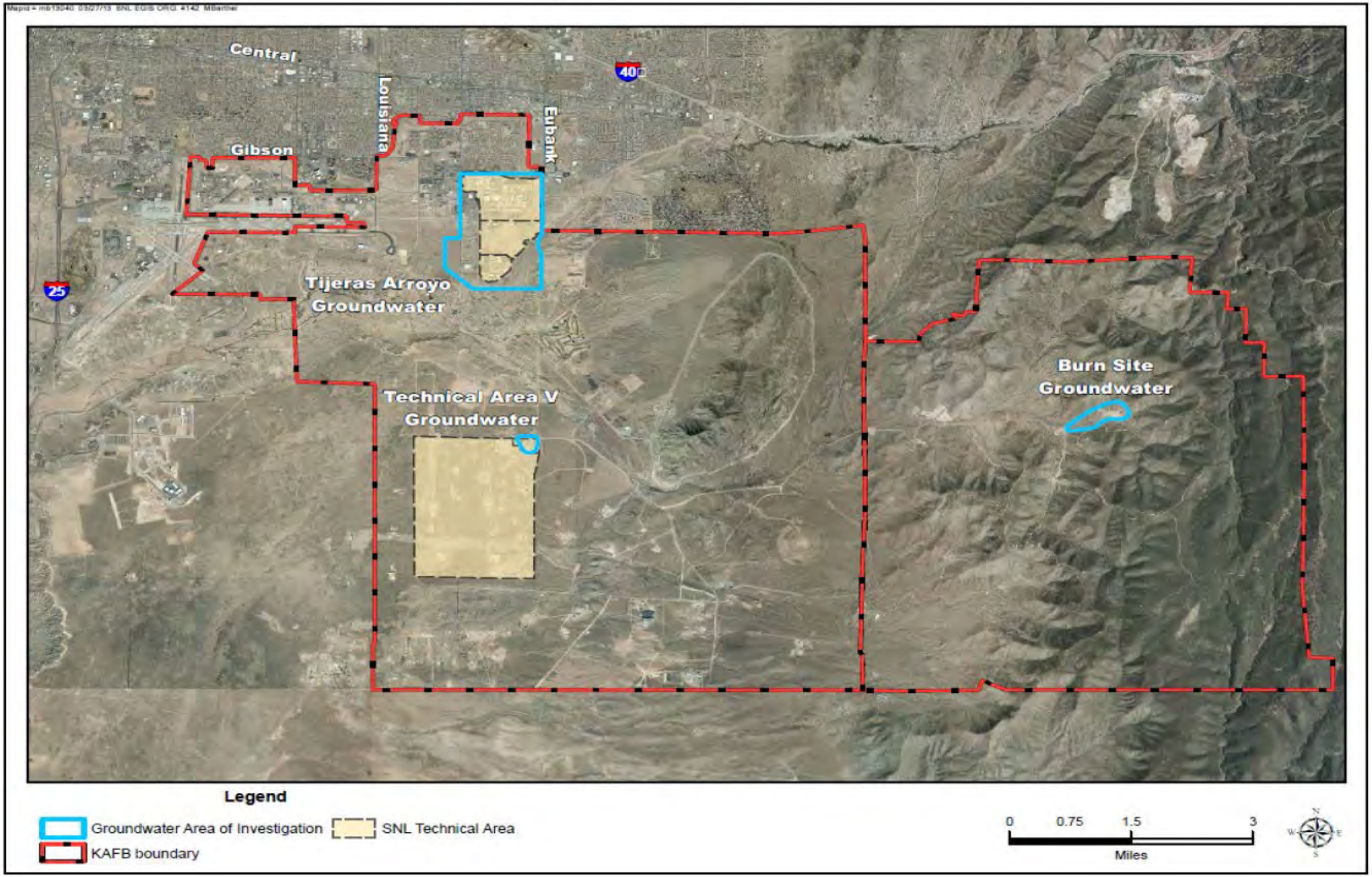
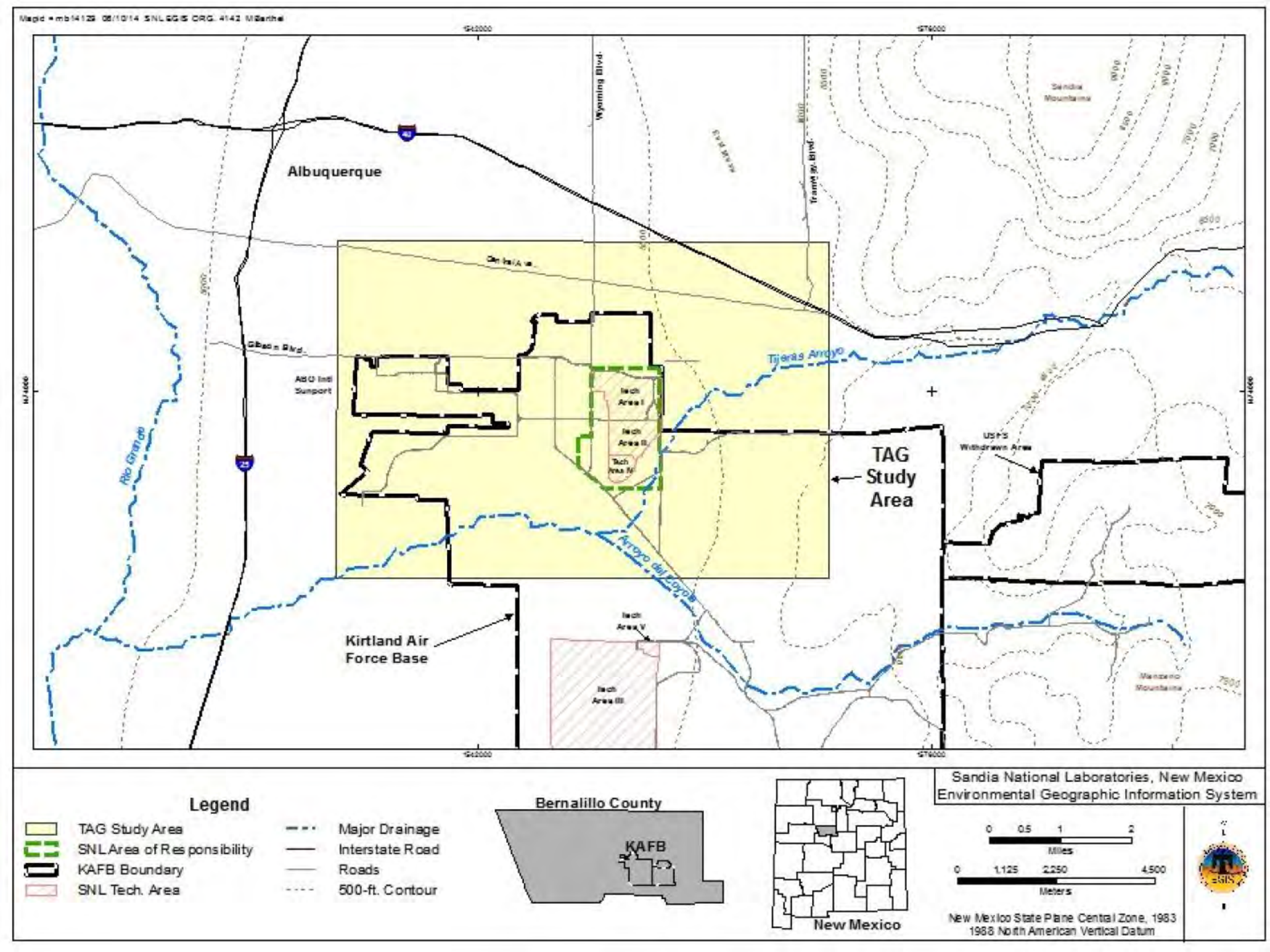
TA-V Nitrate GW Concentrations

Environmental Oversight of TA-V Groundwater

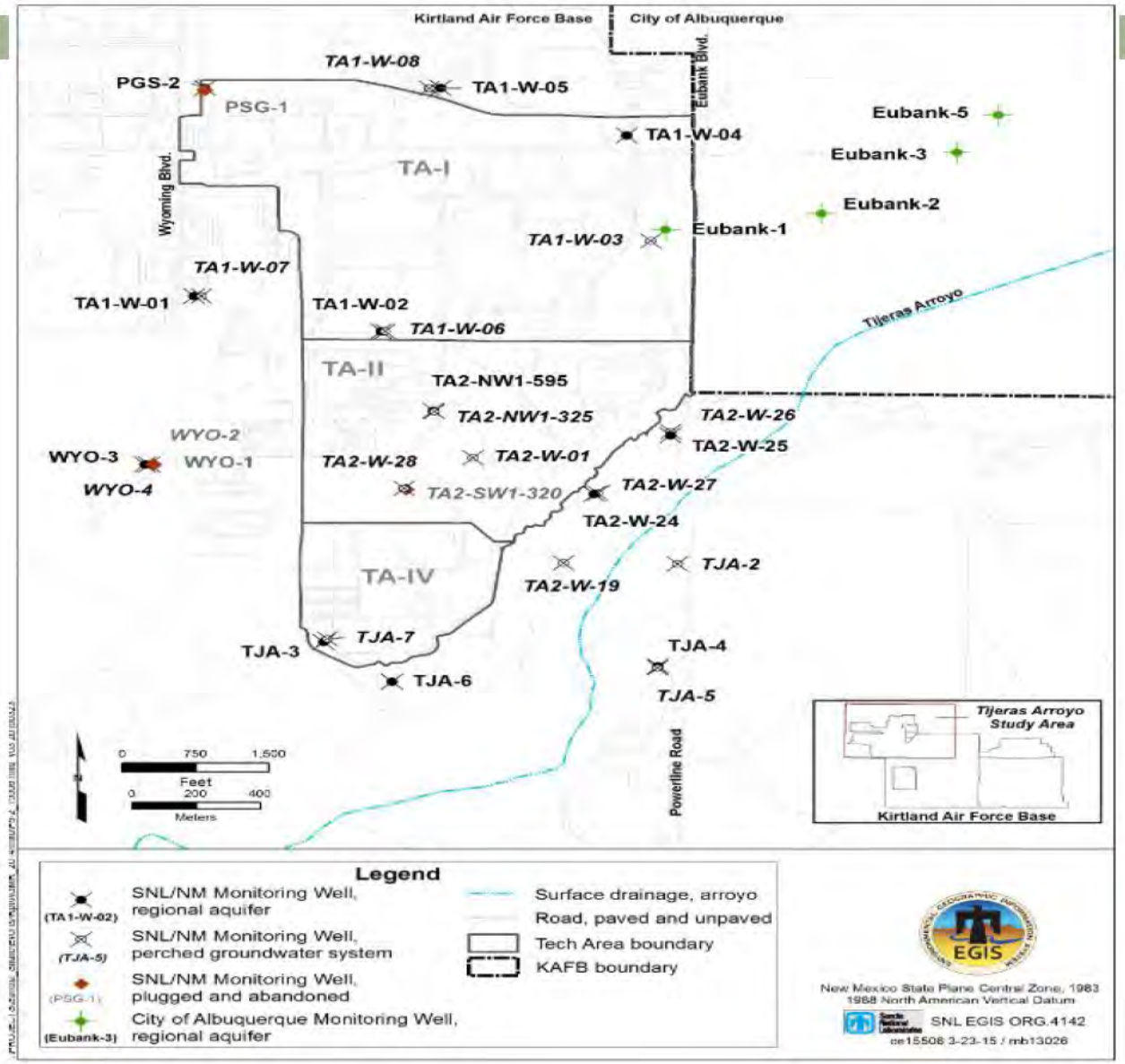
- Regional Groundwater occurs 500 ft. below the ground surface (bgs)
- Groundwater monitored at 18 Monitoring Wells (MW) since 1993
  - Nitrate: up to 14 ppm (standard 10 ppm)
  - TCE: up to .019 ppm (standard .005 ppm)
- 3 soil-vapor MWs installed in 2011 with 10 sampling ports from 50 to 500 ft
  - Sampled quarterly with low-level detections of TCE: ND to 2.5 ppmv
  - 31 VOCs detected, max total concentration is 2.813 ppmv including TCE at 350 ft bgs
  - Main contributor is TCE with highest concentrations at 350 to 500 ft bgs ports
  - Significant mass transfer not expected
- Groundwater monitored quarterly
- Revised Treatability Study Work Plan for in-situ bio remediation of GW
  - Submitted to NMED on March 28, 2016 and under review
  - Draft Notice of Intent for Discharge Permit submitted to GWQB
- Two additional MWs proposed to define Southern Extent of the GW Plume
- Current Conceptual Model (CCM) and Corrective Measures Evaluation (CME) Report due May 20, 2022

Location of Tijeras Arroyo Groundwater Site



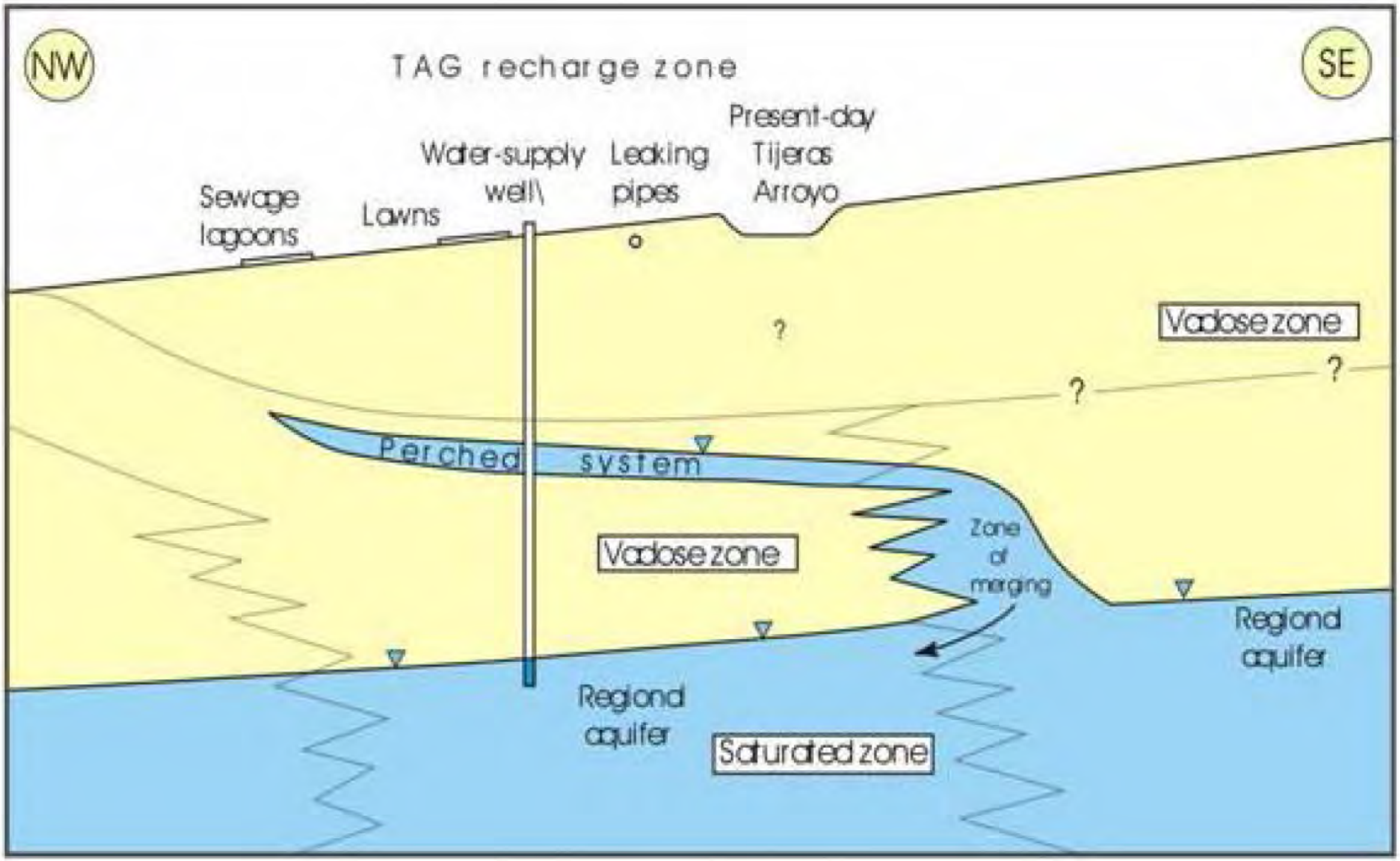

Albuquerque
Wyoming Blvd.
Tramway Blvd.
Sandia Mountains
Gibson Blvd.
ABQ Intl Sunport
Tijeras Arroyo
Rio Grande
Arroyo del Coyote
Tech Area I
Tech Area II
Tech Area III
Tech Area V
TAG Study Area
USFS Withdrawn Area
Kirtland Air Force Base
Manzano Mountains
Legend
TAG Study Area
SNL Area of Responsibility
KAFB Boundary
SNL Tech. Area
Major Drainage
Interstate Road
Roads
500-ft. Contour
Bernalillo County
KAFB
New Mexico
Sandia National Laboratories, New Mexico
Environmental Geographic Information System
0 0.5 1 2
Miles
0 1,125 2,250 4,500
Meters
New Mexico State Plane Central Zone, 1983
1988 North American Vertical Datum

TAG Monitor Well Locations



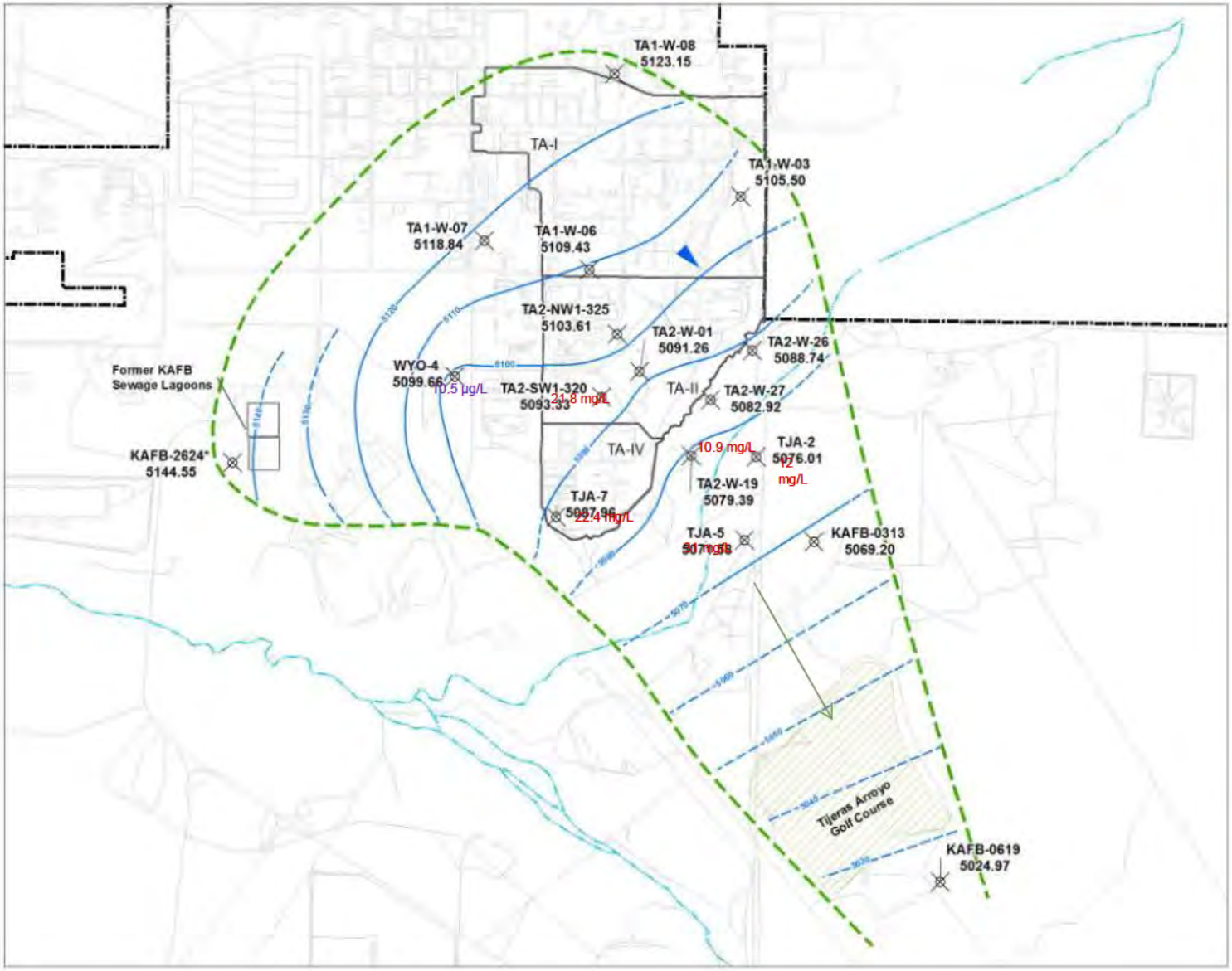
NEW MEXICO ENVIRONMENT DEPARTMENT

TAG GW Conceptual Model



Perched Aquifer Map

Nitrate and TCE above standards - Nov 2014

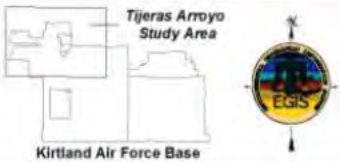


Legend

- Monitoring well, groundwater
- 5076.01 Groundwater elevation (feet amsl) October 2014
- Potentiometric surface contour (ft amsl) dashed where inferred
- Lateral extent of Perched Groundwater System, October 2014
- Inferred groundwater flow direction
- Surface drainage, arroyo
- Road, paved and unpaved
- Tijeras Arroyo Golf Course
- Former KAFB sewage lagoons
- Tech Area boundary
- KAFB boundary

Note:
*Well KAFB-2624 Spring 2014 value

0 2,000 4,000
Feet
0 500 1,000
Meters



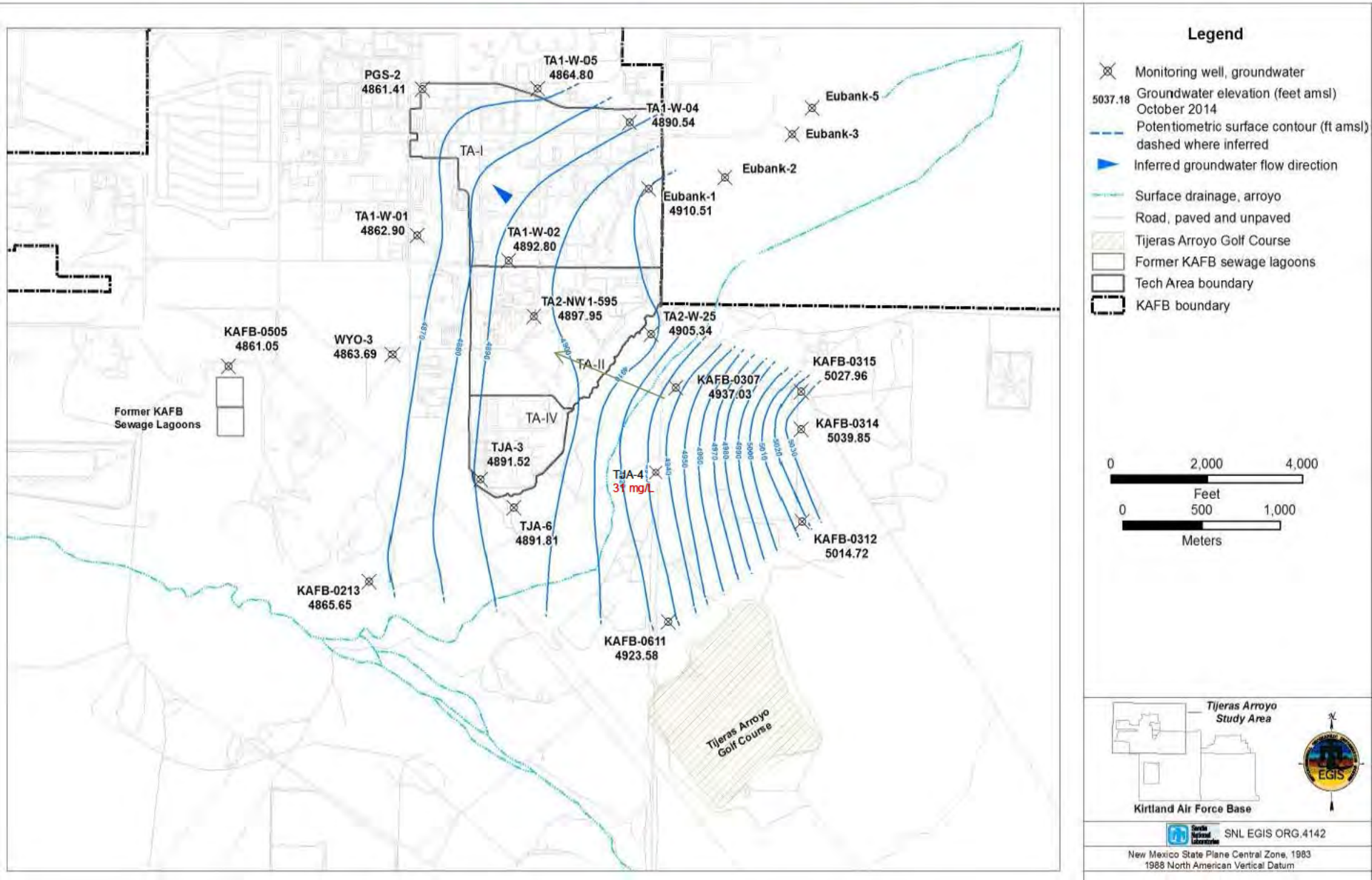
SNL EGIS ORG.4142

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

SNL, EGIS Dept 4142 ce15501 2-17-15 / mb14075

Regional Aquifer Map

Nitrate above standards - Nov 2014



Legend

- Monitoring well, groundwater
- 5037.18 Groundwater elevation (feet amsl) October 2014
- Potentiometric surface contour (ft amsl) dashed where inferred
- Inferred groundwater flow direction
- Surface drainage, arroyo
- Road, paved and unpaved
- Tijeras Arroyo Golf Course
- Former KAFB sewage lagoons
- Tech Area boundary
- KAFB boundary

0 2,000 4,000
Feet
0 500 1,000
Meters

SNL EGIS ORG.4142

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

Environmental Oversight of Tijeras Arroyo GW

- Approximately 40 sq mi in the north central portion of KAFB
- SNL and KAFB both have areas of responsibility
- A perched aquifer and the regional aquifer are both present
- Groundwater investigation and monitoring started in 1992
- Current monitoring well network:
  - Water level measurements in 30 MWs
  - Groundwater quality analysis in 21 MWs
- Multiple sources of contamination
  - Including former sewage lagoons, wastewater outfalls, septic systems, landfills, sewer lines and a golf course
- Two constituents of concern:
  - Nitrate
  - TCE

Environmental Assessment of TAG 2003 - 2014

- TCE Contamination in Perched Groundwater
  - TCE Maximum Contaminant Level (MCL) is .005 ppm
    - Ranges from ND to .011 ppm (.011 ppm - Nov 2014)
  - Other Perched Groundwater monitoring wells have always been below standards
- Nitrate Contamination in Perched Groundwater
  - Regulatory standard is 10 ppm
    - Ranges from 8.6 – 38.5 ppm
- Nitrate Contamination in Regional Groundwater
  - Maximum concentration 31 ppm
  - Only one MW above standard in Regional Groundwater

Environmental Monitoring and Reporting

- Annual GW monitor report submitted in June.
- Updated Current Conceptual Model and Corrective Measures Evaluation will be submitted to NMED by December 2, 2016
- Quarterly groundwater monitoring, sampling and analysis to continue

Groundwater Monitoring at Sandia National Laboratories at Burn Site, TA-V and Tijeras Arroyo

Chris Armijo
Department of Energy Oversight Bureau
New Mexico Environment Department

Acknowledgment: "This material is based upon work supported by the Department of Energy Office of Environmental Management under Award Number *DE-EM0002420*."

DOE Oversight Bureau
-Sandia Oversight Section

- The DOE Oversight Bureau (DOE-OB) mission is to ensure that activities at DOE facilities in New Mexico are managed and controlled in a manner that is protective of public health and safety and the environment.
- The DOE-OB develops and implements monitoring and assessment programs at all DOE facilities in New Mexico: Los Alamos National Laboratory (LANL), Sandia National Laboratories/New Mexico (SNL/NM), and the Waste Isolation Pilot Plant (WIPP).
- These programs include both joint and independent evaluations of all media, including air, groundwater, surface water, wastewater, soils and sediments, and vegetation.

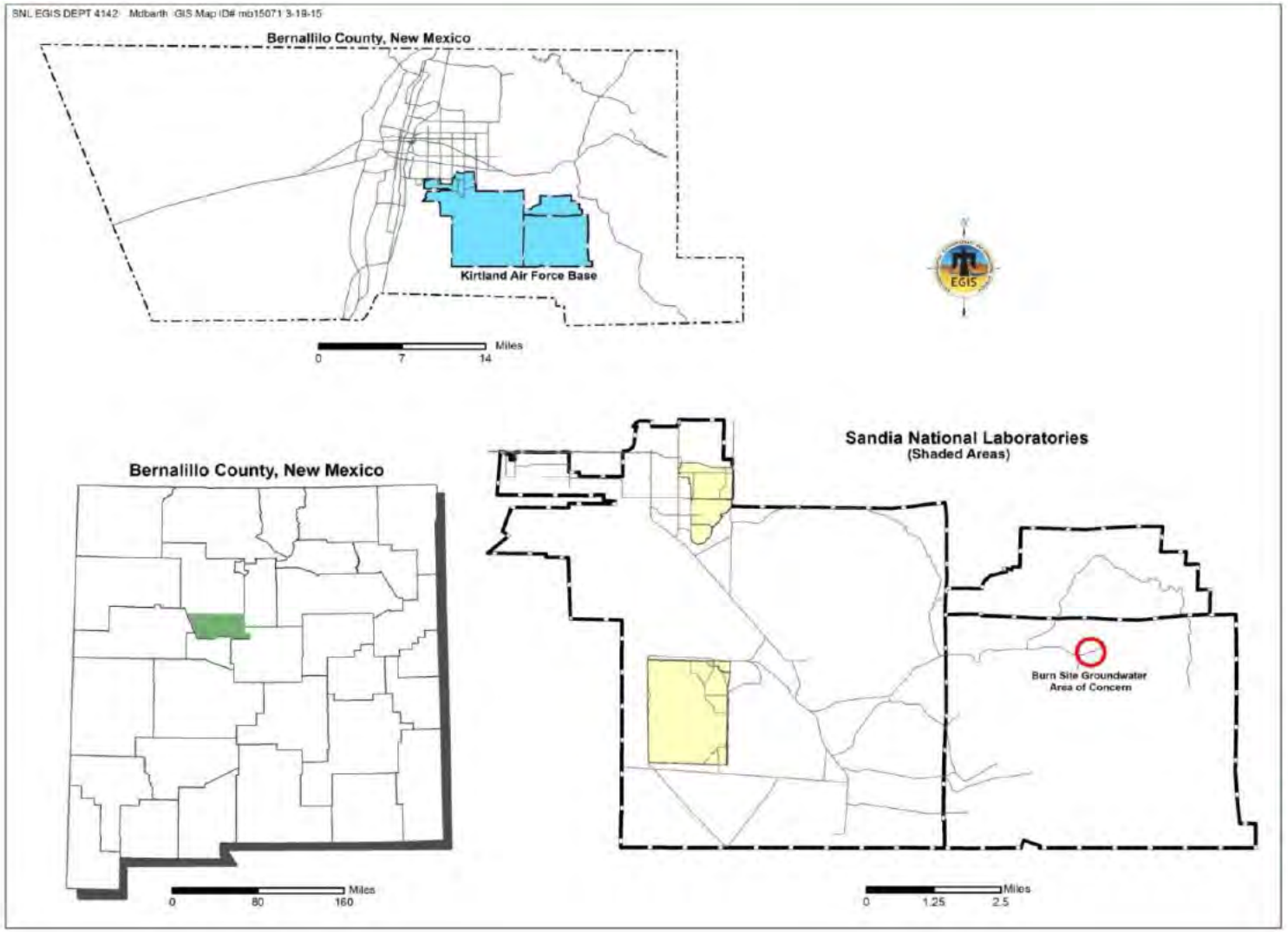
DOE-OB Groundwater Monitoring -Activities at SNL

- The DOE-OB conducts verification and supplemental sampling of SNL groundwater monitoring wells. The primary purpose of this sampling is to independently monitor and confirm groundwater quality at SNL.
- Split samples are collected using standard SNL procedures and equipment.
- A split sample is defined as one of two equivalent portions of the same sample that is analyzed separately, typically by different parties using different laboratories.

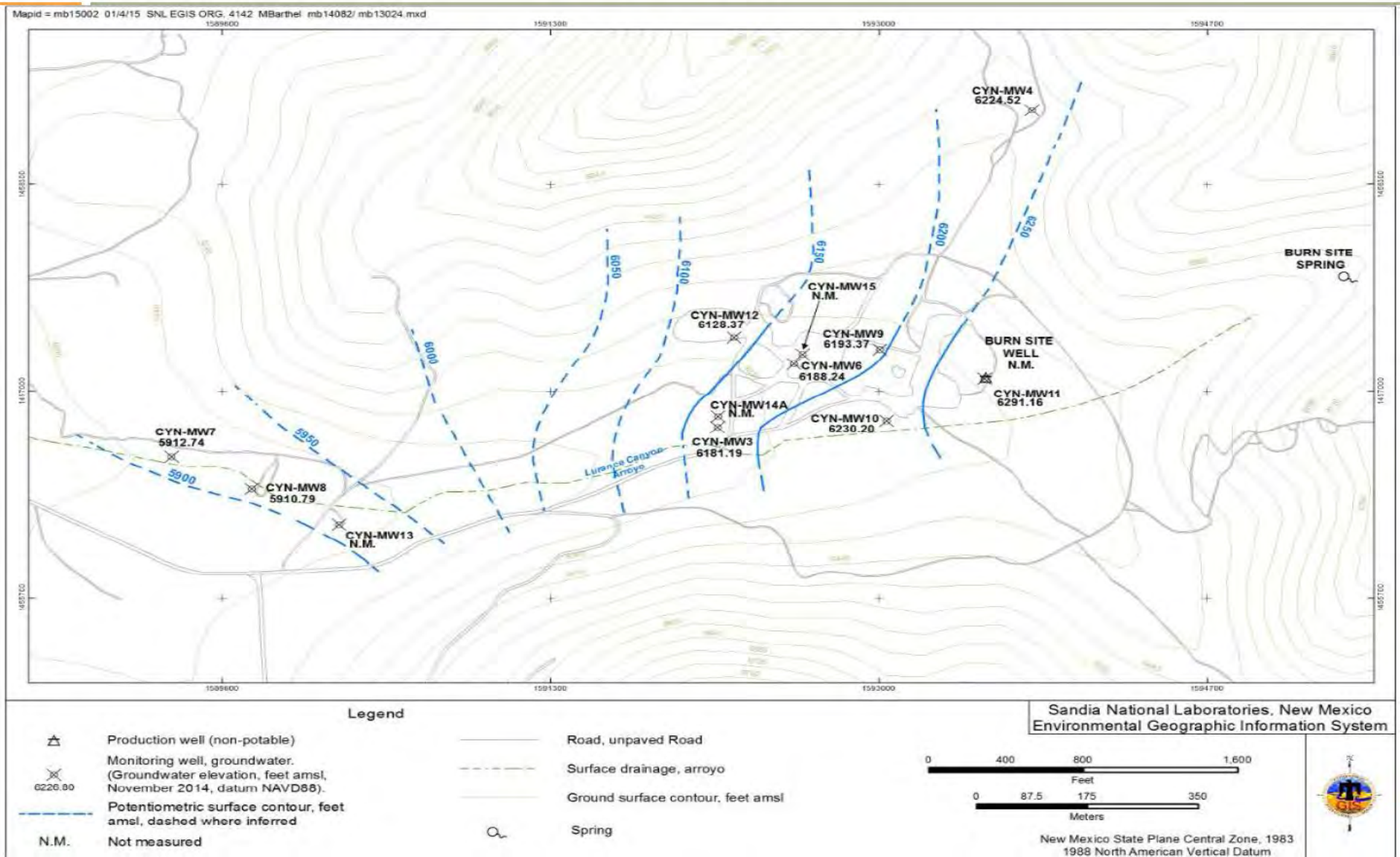
DOE-OB Groundwater Monitoring -Activities at SNL

- DOE-OB samples are analyzed by independent analytical laboratories using U.S. Environmental Protection Agency (EPA) approved methods.
- DOE-OB results are compared to EPA Maximum Contaminant Levels (MCLs)/drinking water standards and are also compared to the split sampling results to assure that the data DOE releases to the public is verifiable and accurate data.
- DOE-OB compares past and present results to determine if there is any change in groundwater quality at SNL/NM.

Burn Site Groundwater (BSG) Location

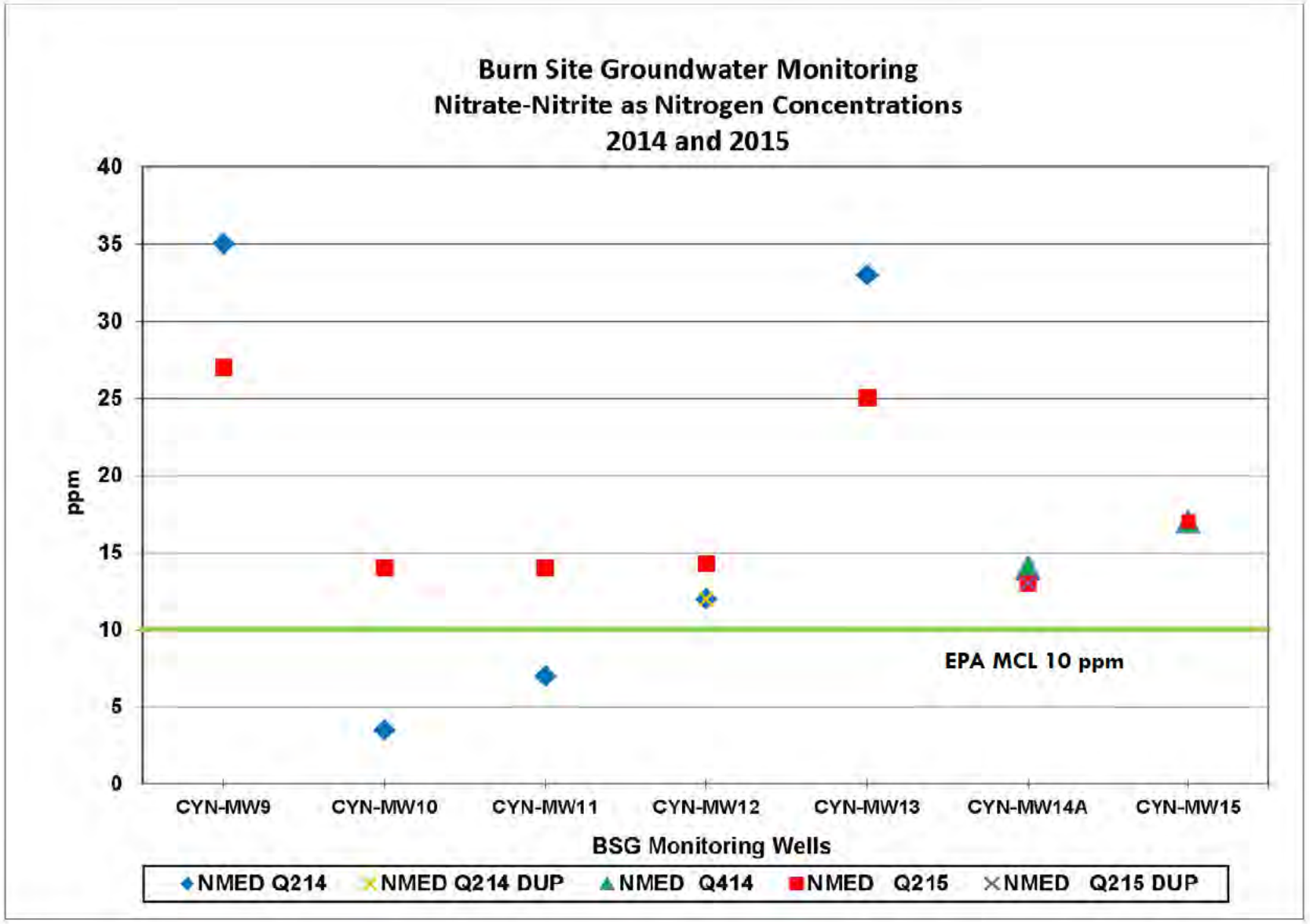


BSG Monitoring Well Locations and Flow Direction

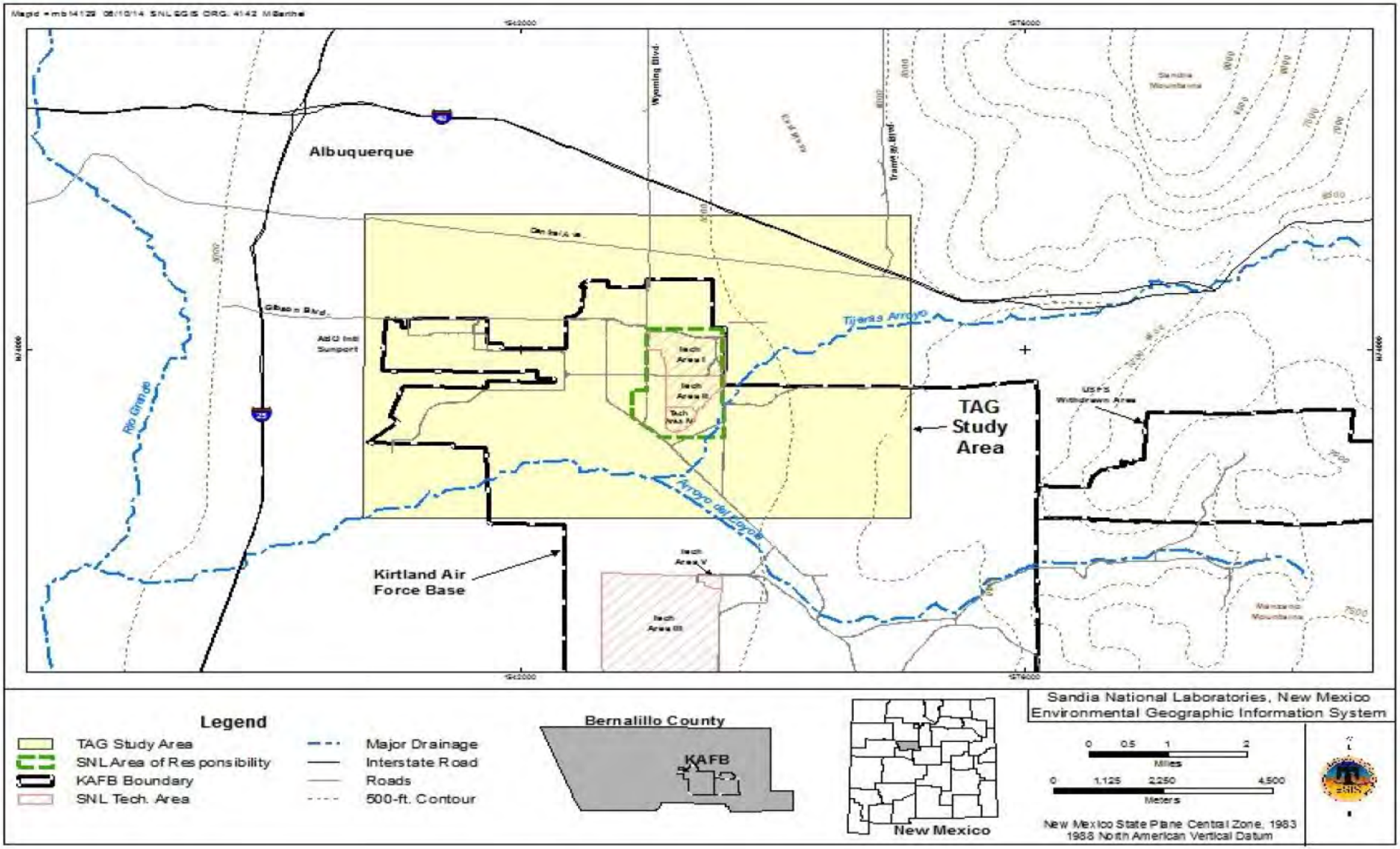


DOE-OB BSG Groundwater Monitoring Results During 2014-2015

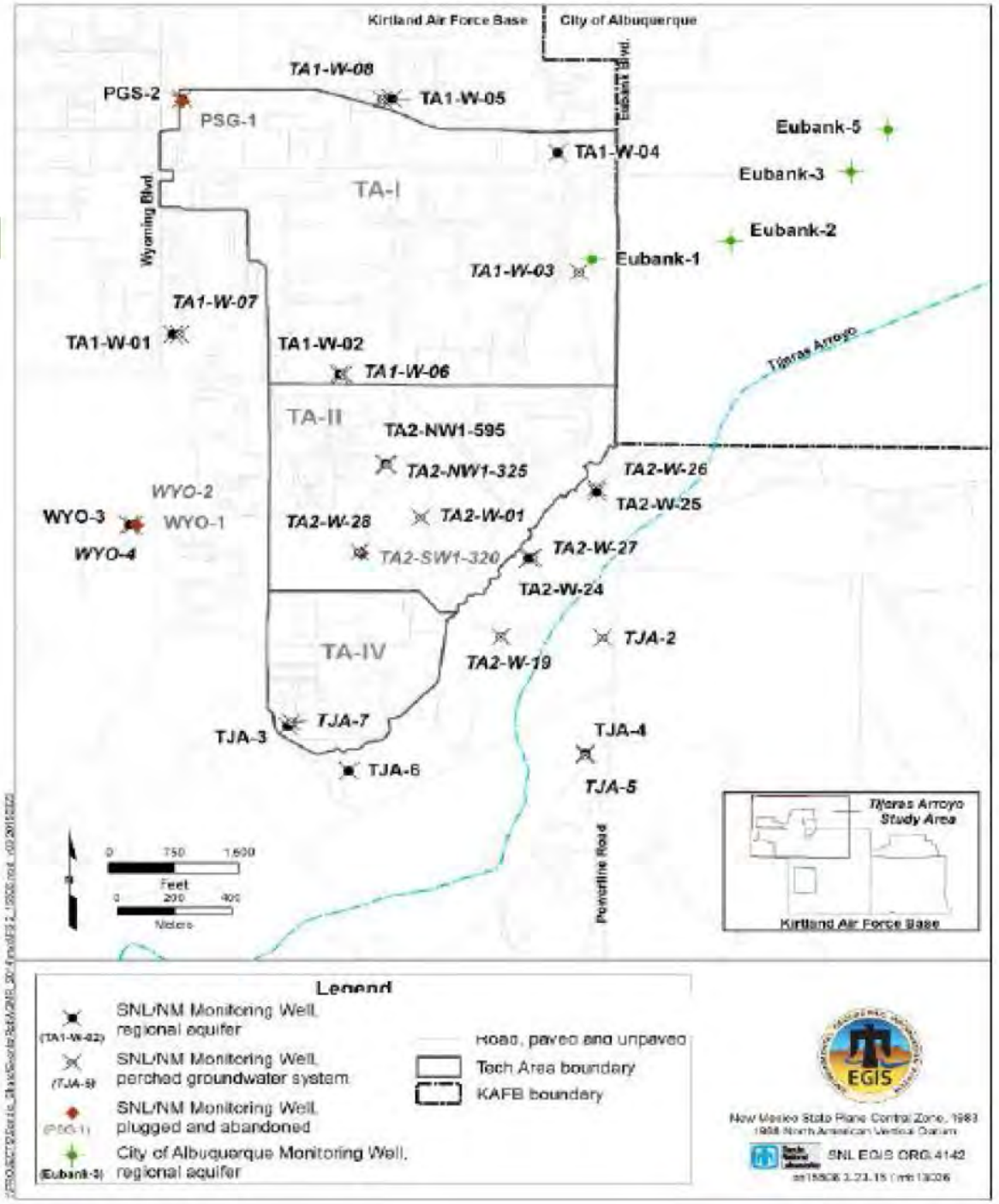
- No high explosives or diesel and gasoline range organics were detected above the method detection limits (MDLs).
- No parameters were detected above the federal drinking water standards, except for nitrates at monitoring wells CYN-MW9, CYN-MW10, CYN-MW11, CYN-MW12, CYN-MW13, CYN-MW14A and CYN-MW15.
- Perchlorate was analyzed at newly-installed wells CYN-MW14A and CYN-MW15. No results were above .004 ppm.


Burn Site Groundwater Monitoring
Nitrate-Nitrite as Nitrogen Concentrations
2014 and 2015
ppm
40
35
30
25
20
15
10
5
0
EPA MCL 10 ppm
CYN-MW9
CYN-MW10
CYN-MW11
CYN-MW12
CYN-MW13
CYN-MW14A
CYN-MW15
BSG Monitoring Wells
NMED Q214
NMED Q214 DUP
NMED Q414
NMED Q215
NMED Q215 DUP

Tijeras Arroyo Groundwater (TAG) Location

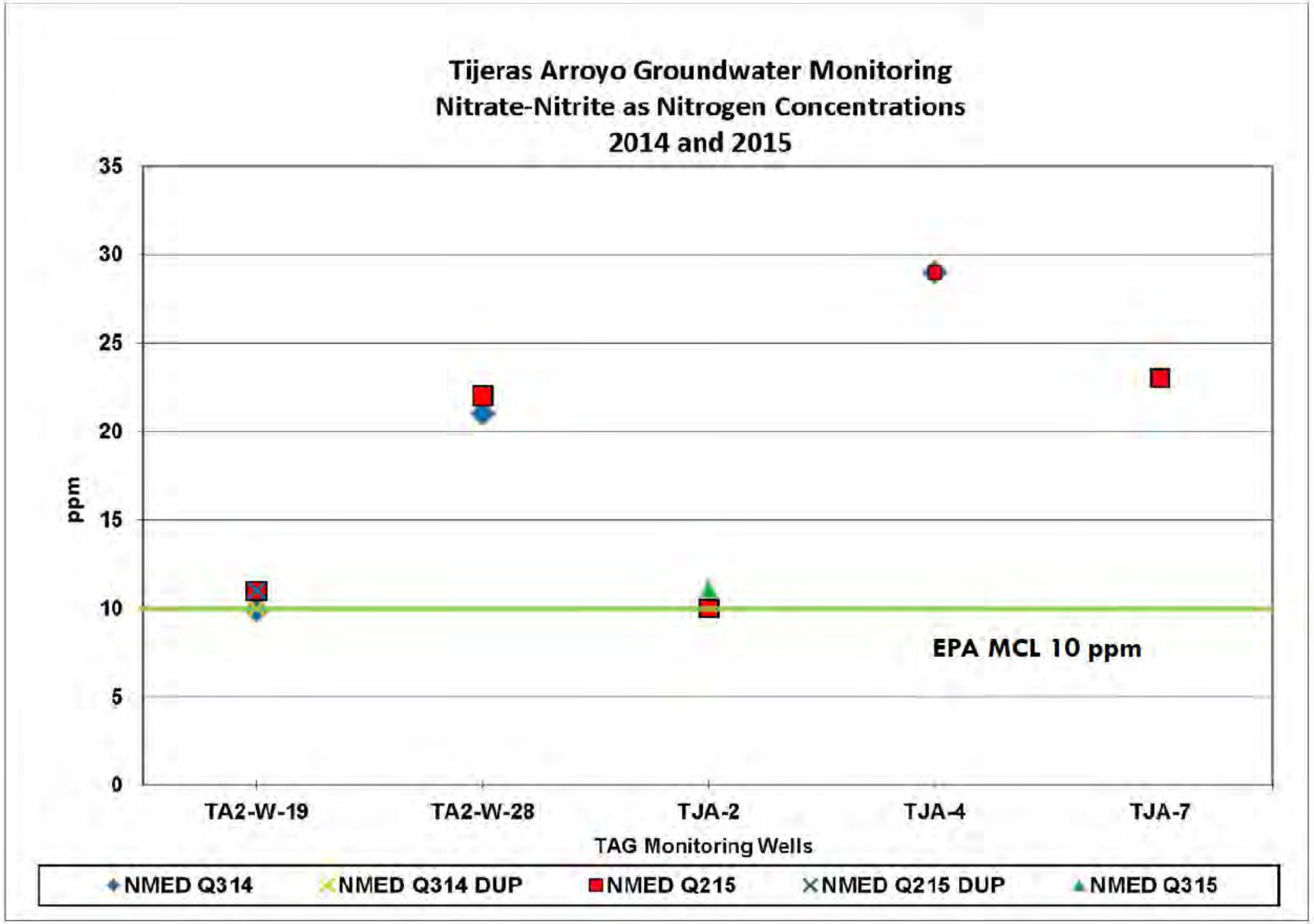


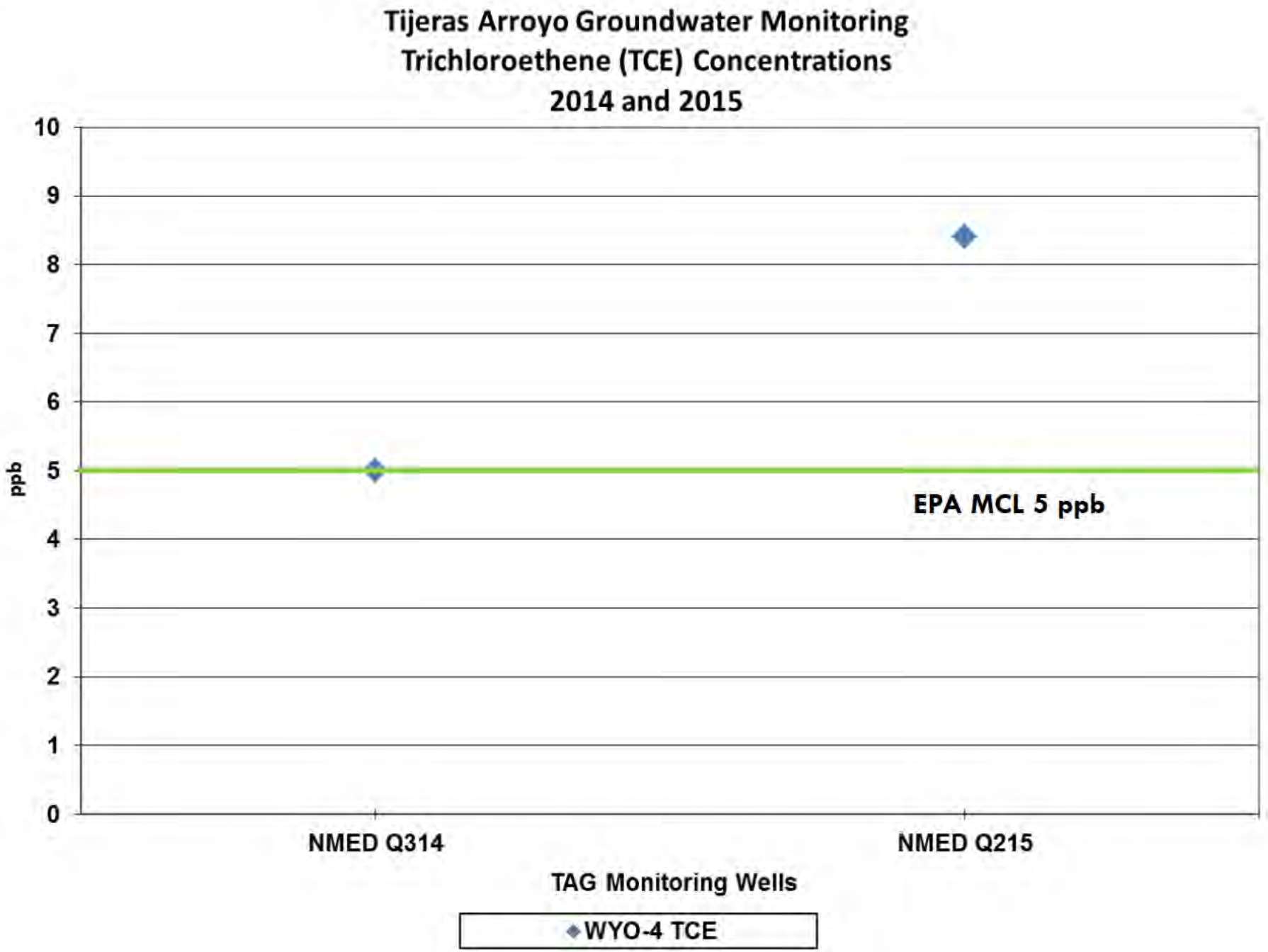
TAG Monitoring Well Locations



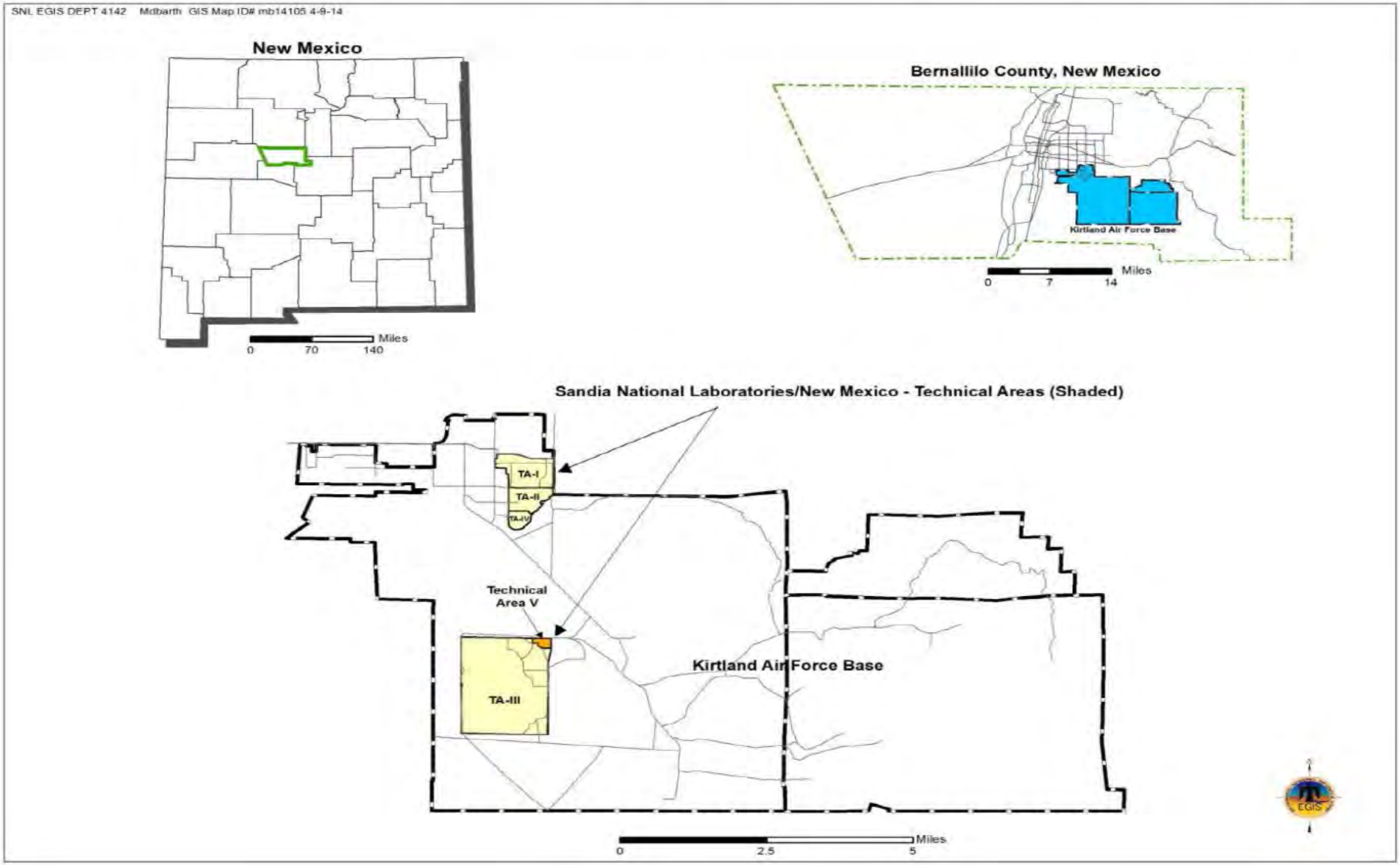
DOE-OB TAG Groundwater Monitoring Results During 2014-2015

- No metals or radionuclides were detected above established drinking water standard.
- No VOCs were detected at or above the drinking water standard except for TCE at monitoring well WYO-4. (Aug-14 .005 ppm and May-15 .008 ppm). TCE drinking water standard is .005 ppm.
- Nitrate concentrations were detected at or above the drinking water standard of 10 ppm at monitoring wells TA2-W-19, TA2-W-28, TJA-2, TJA-4 and TJA-7.

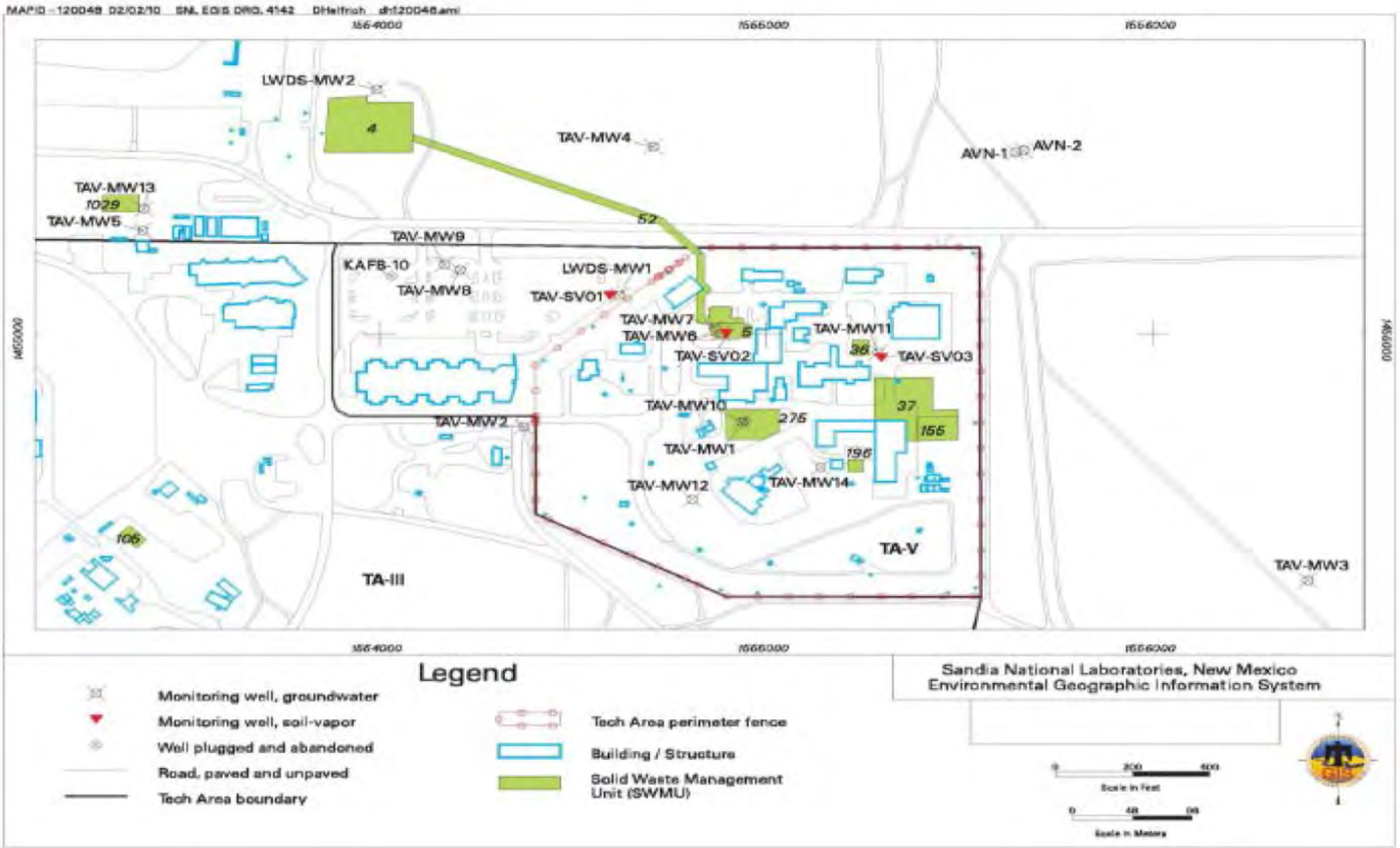

Tijeras Arroyo Groundwater Monitoring
Nitrate-Nitrite as Nitrogen Concentrations
2014 and 2015
35
30
25
20
15
10
5
0
ppm
EPA MCL 10 ppm
TA2-W-19
TA2-W-28
TJA-2
TJA-4
TJA-7
TAG Monitoring Wells
NMED Q314
NMED Q314 DUP
NMED Q215
NMED Q215 DUP
NMED Q315


Tijeras Arroyo Groundwater Monitoring
Trichloroethene (TCE) Concentrations
2014 and 2015
10
9
8
7
6
5
4
3
2
1
0
ppb
EPA MCL 5 ppb
NMED Q314
NMED Q215
TAG Monitoring Wells
WYO-4 TCE

Technical Area-V (TA-V) Groundwater Location

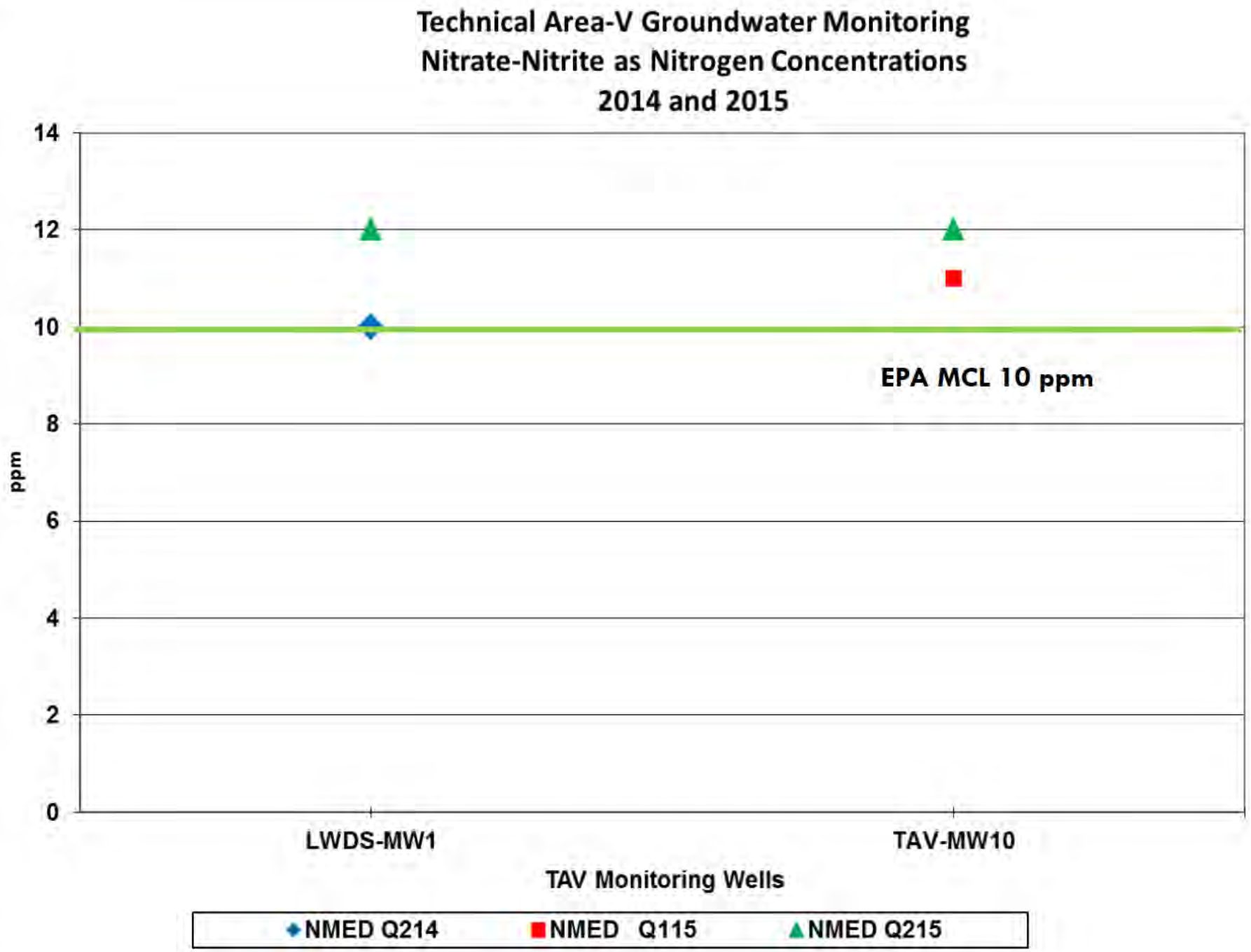


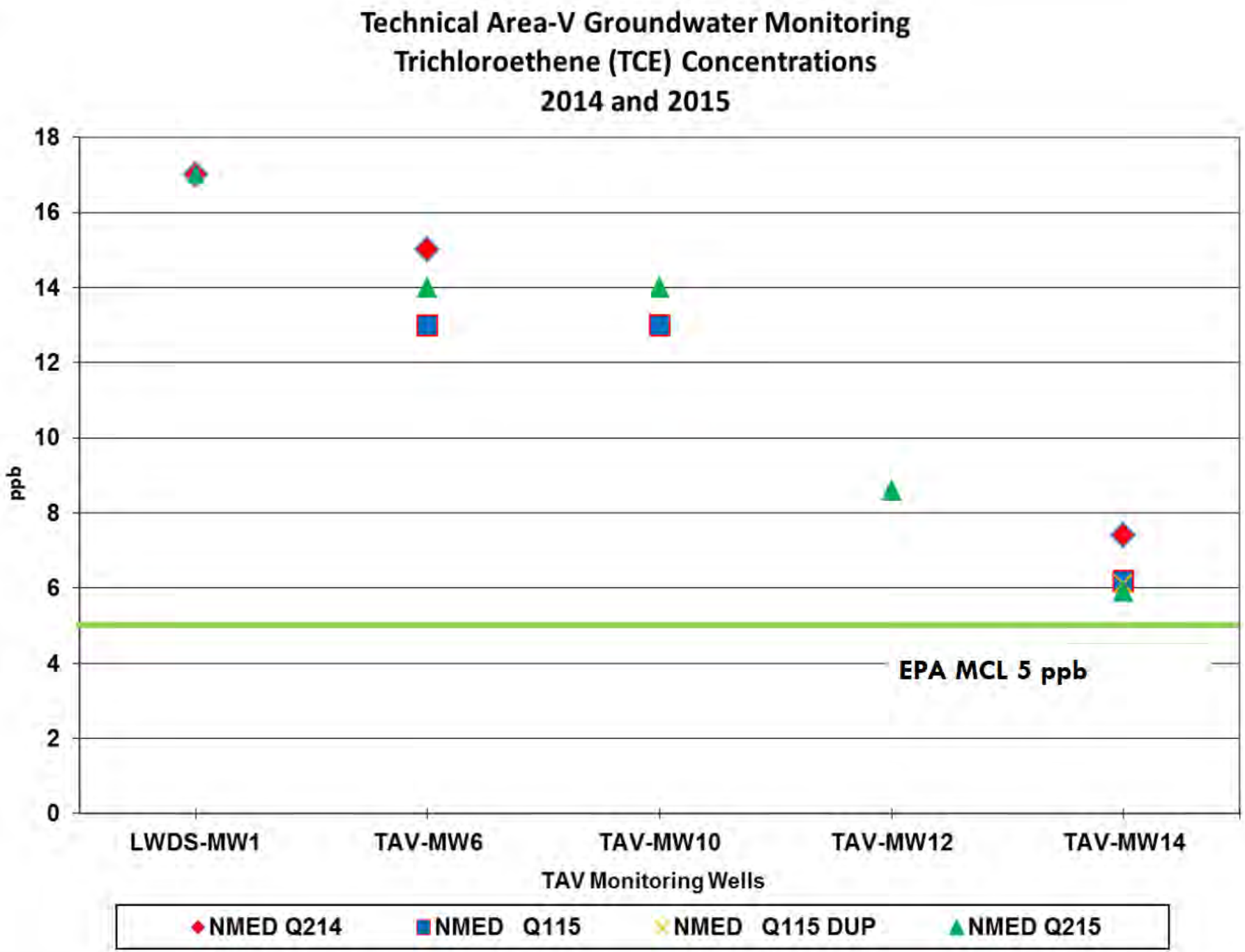
TAV Monitoring Well Locations



DOE-OB TAV Groundwater Monitoring Results During 2014-2015

- No metals or radionuclides were detected at or above established drinking water standard.
- TCE was detected above the drinking water standard at monitoring wells LWDS-MW1, TAV-MW6, TAV-MW10, TAV-MW12 and TAV-MW14.
- Nitrate concentrations were detected at or above the drinking water standard at monitoring wells LWDS-MW1 and TAV-MW10.


Technical Area-V Groundwater Monitoring
Nitrate-Nitrite as Nitrogen Concentrations
2014 and 2015
14
12
10
8
6
4
2
0
ppm
EPA MCL 10 ppm
LWDS-MW1
TAV-MW10
TAV Monitoring Wells
NMED Q214
NMED Q115
NMED Q215


Technical Area-V Groundwater Monitoring
Trichloroethene (TCE) Concentrations
2014 and 2015
18
16
14
12
10
8
6
4
2
0
ppb
EPA MCL 5 ppb
LWDS-MW1
TAV-MW6
TAV-MW10
TAV-MW12
TAV-MW14
TAV Monitoring Wells
NMED Q214
NMED Q115
NMED Q115 DUP
NMED Q215

Future Groundwater Monitoring

- DOE-OB staff will continue to collect split groundwater samples from monitoring wells at BSG, TAG, and TA-V.
- At a minimum, the analytes for groundwater sampling will consist of VOCs and Nitrates.
- DOE-OB will continue reporting BSG, TAG and TAV monitoring results to DOE.
- Data is available on the NMED DOE-OB webpage at: https://www.env.nm.gov/DOE_Oversight/SNL_Data.htm

Questions?