Environmental Restoration Operations Overview

SAND2016-3690C

February 18, 2016

Purpose: present an overview of the remaining scope and challenges to arrive at a fully-funded exit strategy for the 3 Groundwater Areas

- ER Mission – Identify, characterize & remediate sites where hazardous &/or radioactive materials have been released
- Scope*:* 315 Solid Waste Management Units or Areas of Concern
- Schedule: program started in ~1989; “projectized” in 2004 and 2011
- Very successful, completed corrective action at *302 of 315 ER*

Compliance Order on Consent

- All ER activities regulated by *New Mexico Environment Department (NMED) under a Compliance Order on Consent (COoC)* signed by DOE, Sandia and NMED in 2004
- COoC includes fines and penalties – up to $10,000 / day
- COoC serves as the regulatory compliance driver for budget requests
- Very professional and courteous relationship with NMED

Remaining 12 ER Sites

5 “Soil sites”

3 “Active mission” sites (on original 2004 DOE-EM Baseline)

1 Mixed Waste Landfill

3 Groundwater Areas of Concern

- Burn Site
- Tijeras Arroyo
- Technical Area V

Focus on 5 Soil Sites & Groundwater

5 Soil sites

3 "Active mission" sites – *corrective action deferred, carried as an environmental liability (EL) in NNSA system*

1 Mixed Waste Landfill, *NMED Secretary Flynn issued Corrective Action Complete with Controls status on February 12*

3 Groundwater Areas of Concern with Contamination

- Burn Site
- Tijeras Arroyo
- Technical Area V

Focus is on remaining 8 ER Sites

- 5 Soil sites
- 3 Groundwater Areas of Concern
  - Burn Site
  - Tijeras Arroyo
  - Technical Area V

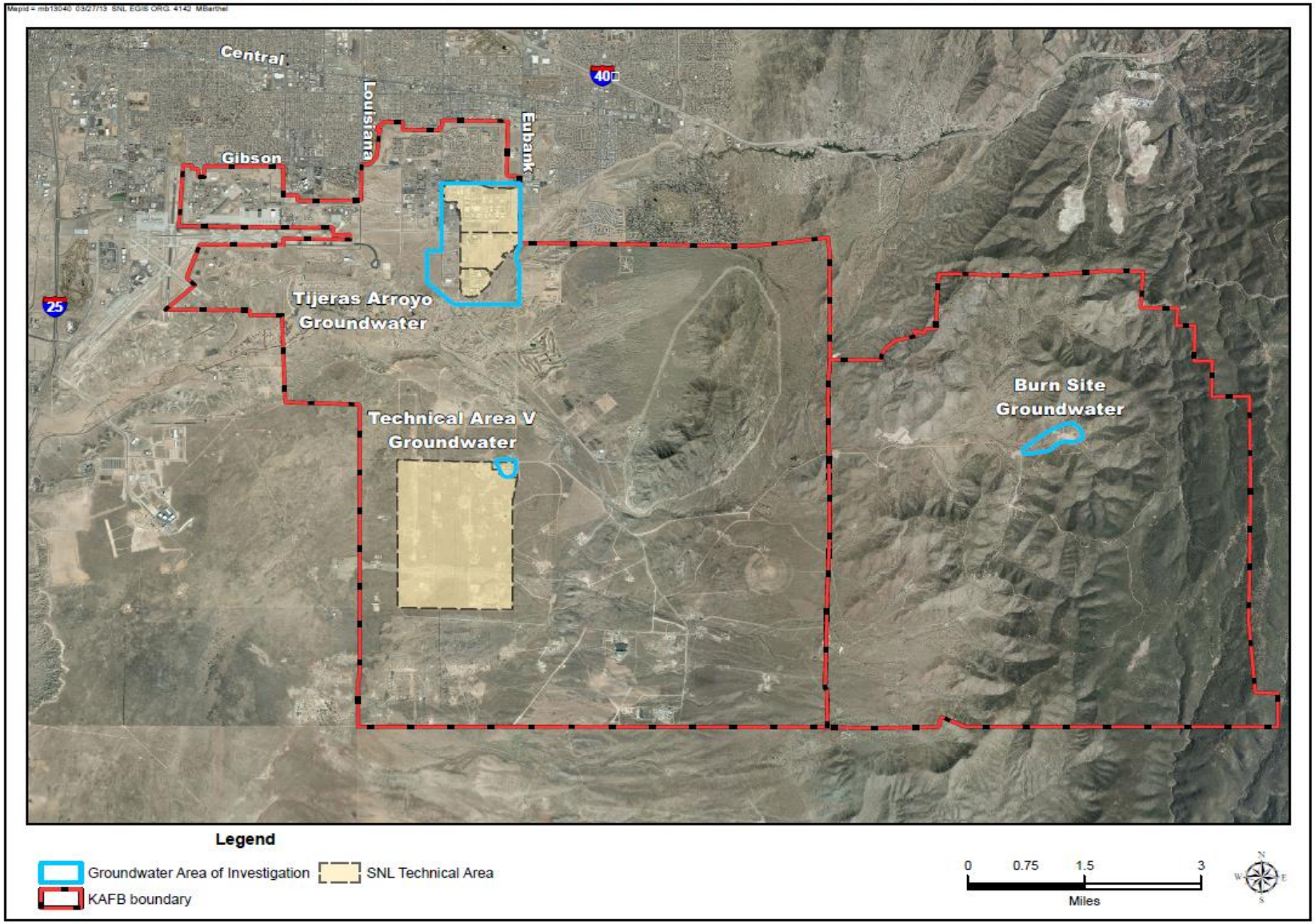
Five Soil Sites

- 2006 / 2008 requested Corrective Action Complete determination from NMED
- A 2010 letter from NMED requested additional groundwater characterization and assessment of these sites
- Required groundwater assessment work completed Feb. 2015
- Received Certificates of Completion from NMED in Jan. 2016
- Will request Corrective Action Complete status from NMED ~March 2016, with public meeting, possible Public Hearing

Remaining 8 ER Sites

- 5 Soil sites
- 3 Groundwater Areas of Concern
  - Burn Site
  - Tijeras Arroyo
  - Technical Area V

Sandia National Laboratories, New Mexico - Groundwater Areas of Concern



Key Points SNL Groundwater Contamination

- Water-supply wells are located in the northern part of KAFB
- Three sites are well characterized and not a threat to the Albuquerque/Bernalillo Co. water supply wells
- Per COoC, site characterization must be complete to the satisfaction of NMED
- At these sites, contamination levels are low, but above drinking water standards (Maximum Contaminate Levels – MCL) – thus creates risk
- 2010 Baselined exit strategy – monitor GW contamination levels and degradation products until contaminates dissipate/attenuate (will require decades)
- Challenges: stakeholder's exit strategies require re-alignment; scope changes to baseline require more time and budget; regulatory framework requires long public hearing cycles

Remaining 8 ER Sites

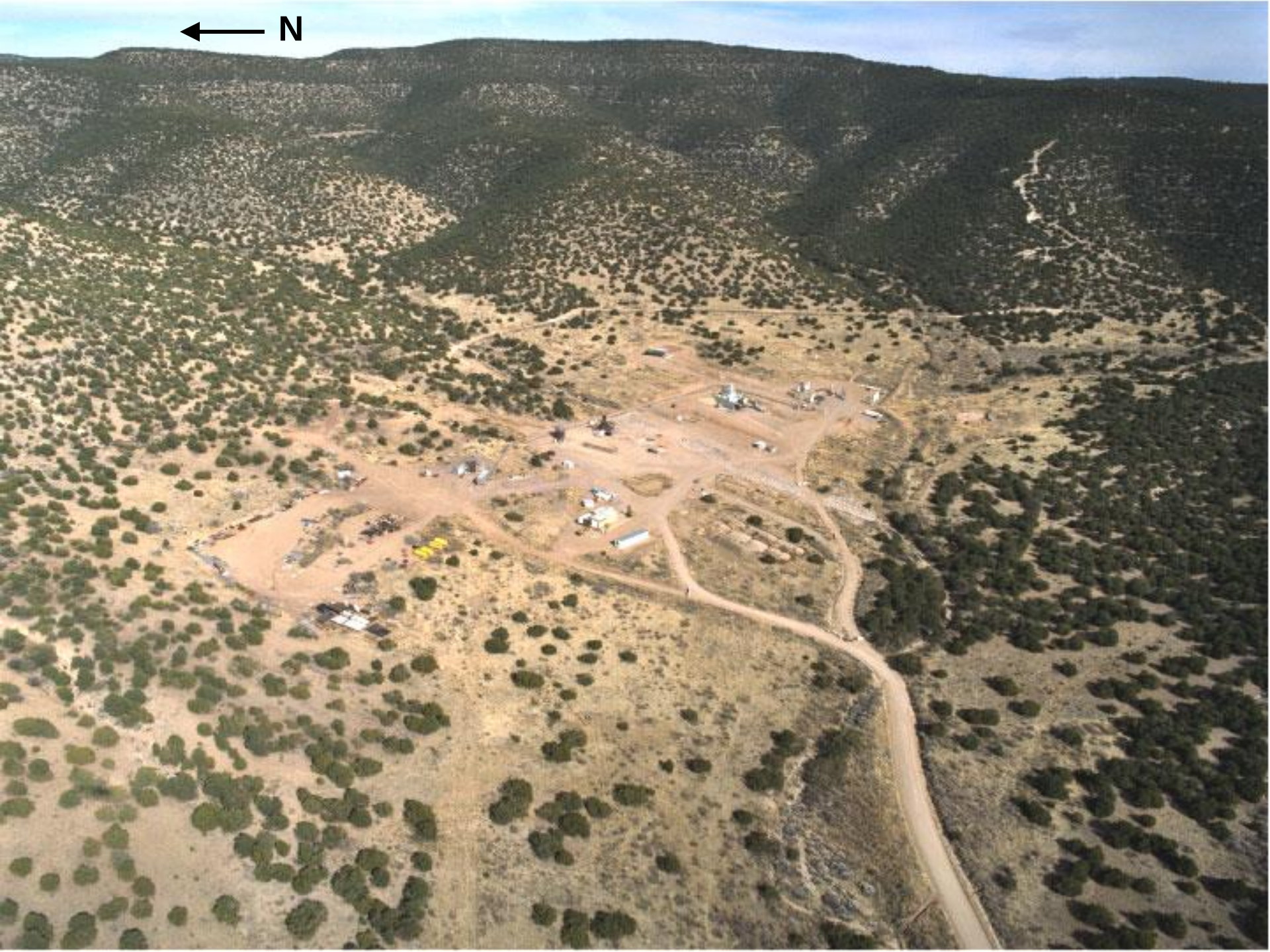
5 Soil sites

3 Groundwater Areas of Concern

- Burn Site
- Tijeras Arroyo
- Technical Area V

Burn Site GW AOC

- GW monitored since 1996
- GW occurs at ~100 to 200 ft deep in fractured bedrock
- Fractured bedrock causes complicated hydrology
- 9 mi. away from drinking-water supplies
- GW contaminated with nitrate, up to 42 ppm (regulatory standard is 10 ppm)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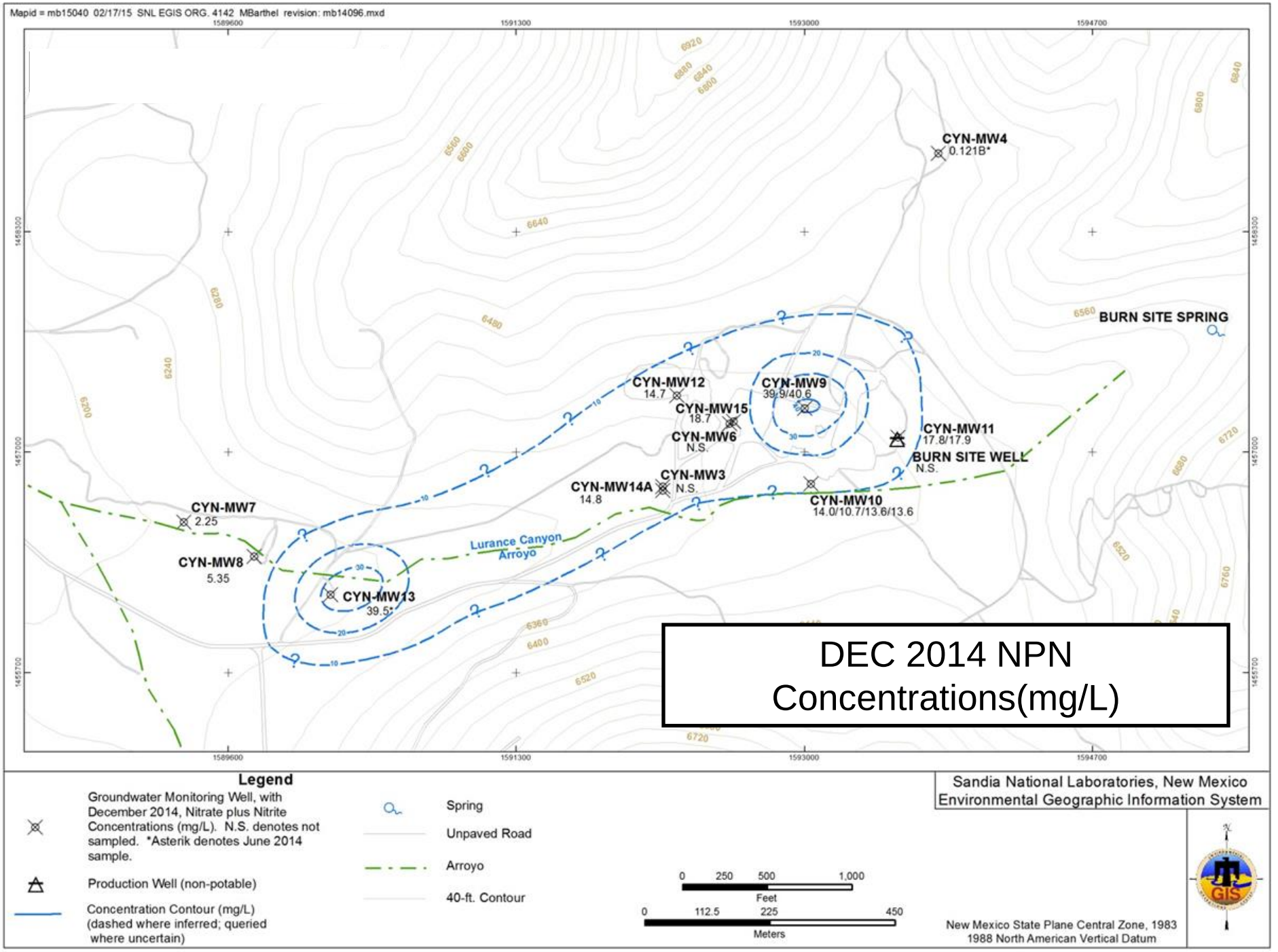

Mapid = mb15040 02/17/15 SNL EGIS ORG. 4142 MBarthel revision: mb14096.mxd
CYN-MW4
0.121B*
BURN SITE SPRING
CYN-MW12
14.7
CYN-MW9
39.9/40.6
CYN-MW15
18.7
CYN-MW6
N.S.
CYN-MW11
17.8/17.9
BURN SITE WELL
N.S.
CYN-MW3
N.S.
CYN-MW14A
14.8
CYN-MW10
14.0/10.7/13.6/13.6
CYN-MW7
2.25
CYN-MW8
5.35
CYN-MW13
39.5*
Lurance Canyon
Arroyo
DEC 2014 NPN
Concentrations(mg/L)
Legend
Groundwater Monitoring Well, with December 2014, Nitrate plus Nitrite Concentrations (mg/L). N.S. denotes not sampled. *Asterik denotes June 2014 sample.
Production Well (non-potable)
Concentration Contour (mg/L) (dashed where inferred; queried where uncertain)
Spring
Unpaved Road
Arroyo
40-ft. Contour
0 250 500 1,000
Feet
0 112.5 225 450
Meters
Sandia National Laboratories, New Mexico
Environmental Geographic Information System
New Mexico State Plane Central Zone, 1983
1988 North American Vertical Datum

Burn Site GW AOC

- EM/Internal Remedy Review review of strategy 2013- 2015
- EM/IRR - advocated “weight-of-evidence” process to determine origin of nitrates in GW
- Formally began weight-of-evidence process June 2014

Remaining 8 ER Sites

5 Soil sites

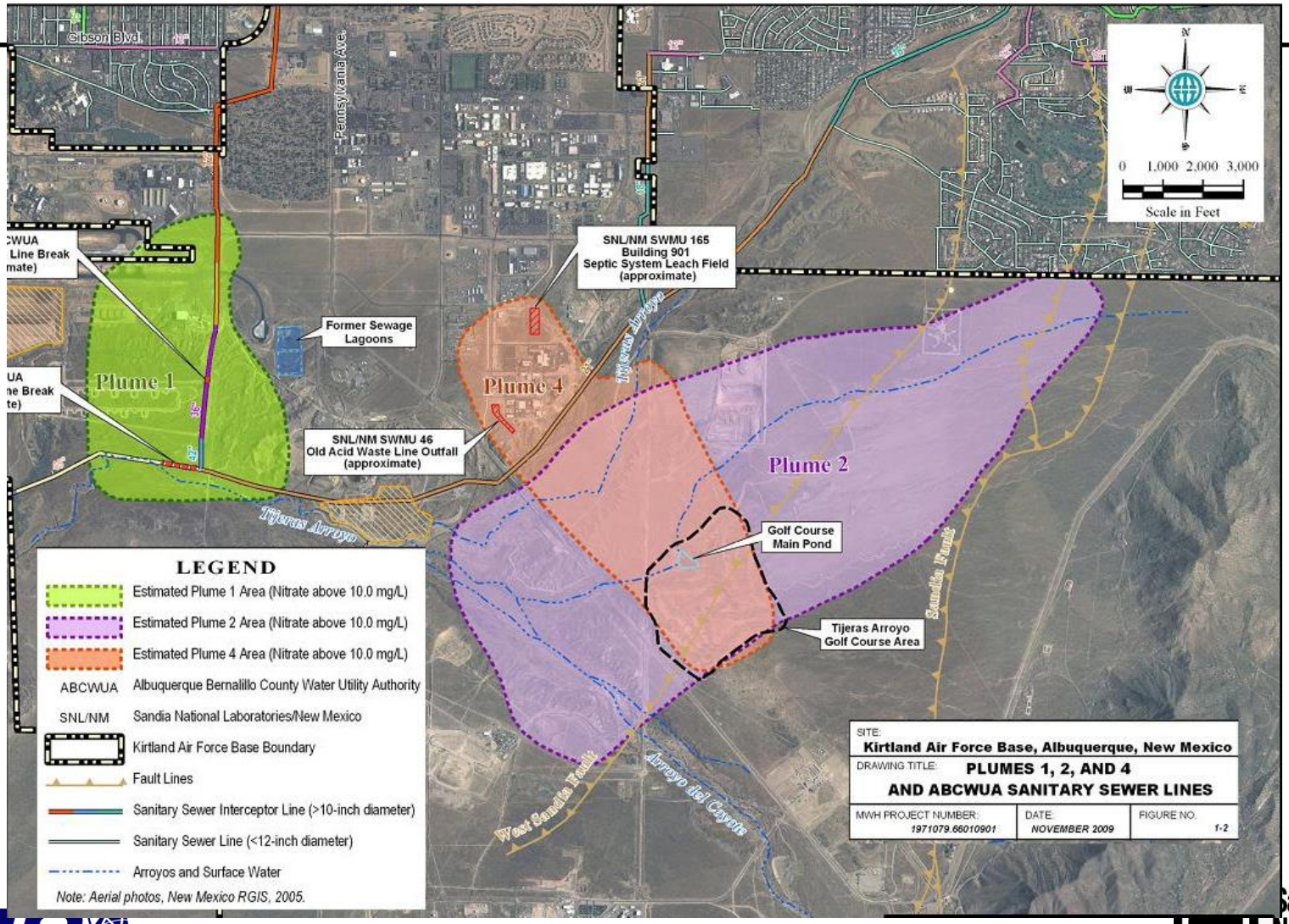
3 Groundwater Areas of Concern

- Burn Site
- → Tijeras Arroyo
- Technical Area V

Tijeras Arroyo GW AOC

- GW monitored since 1993
- Perched GW ~300 ft. below surface and ~ 200 ft above regional aquifer
- DOE responsible for ~30% plume, KAFB ~ 70% plume
- DOE portion contaminated with nitrate and TCE
  - Nitrate: up to 39 ppm (regulatory standard is 10 ppm)
  - TCE: up to 9 ppb (regulatory standard is 5 ppb)
- Updating the 2005 Corrective Measures Evaluation Report
- Perched GW under SNL is drying out

Boundary of Nitrate Plume 4 in Perched Aquifer (orange), Tijeras Arroyo GW above 10 ppm



Remaining 8 ER Sites

5 Soil sites

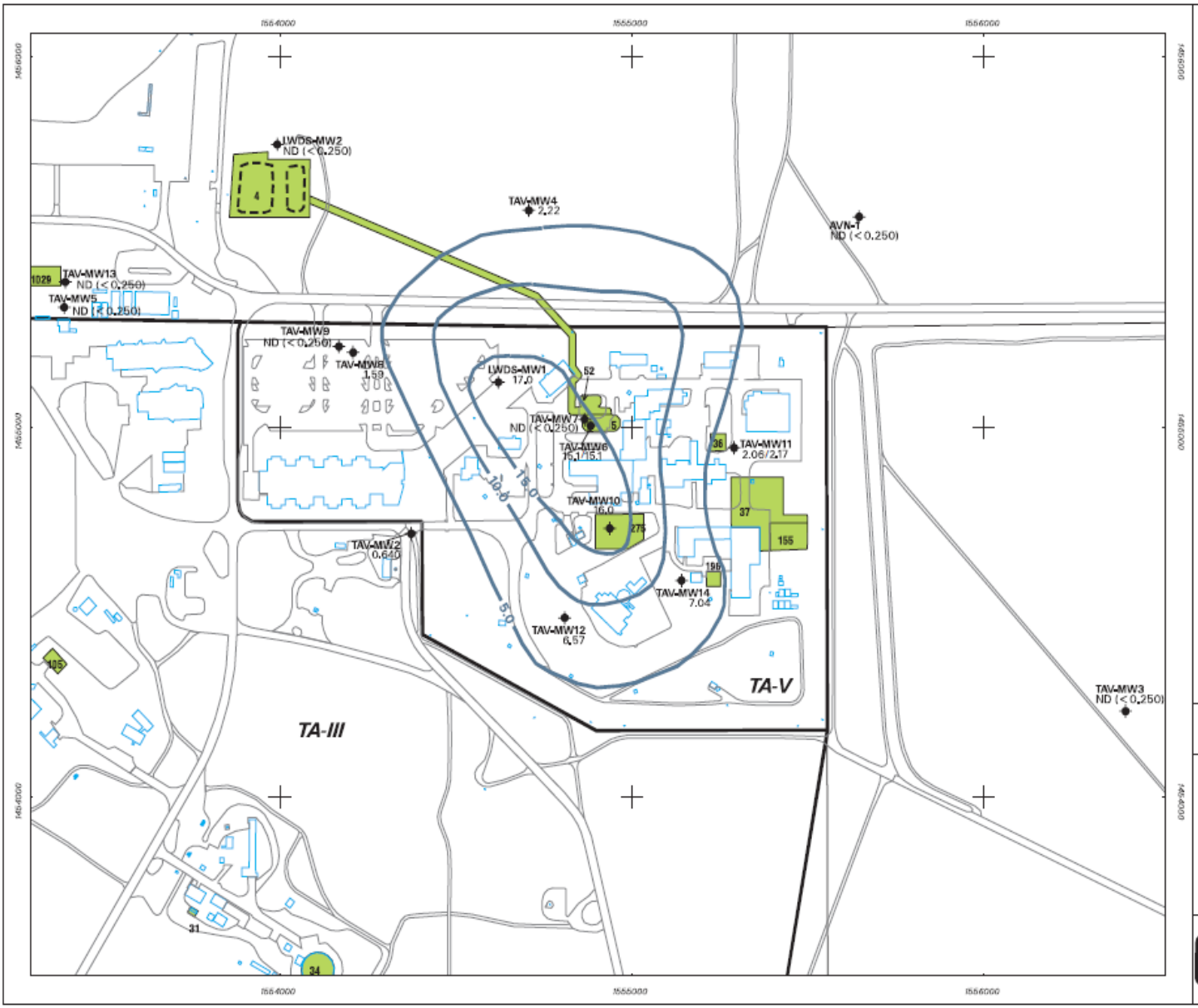
3 Groundwater Areas of Concern

- Burn Site
- Tijeras Arroyo
- → Technical Area V

Technical Area V GW AOC

TA-V GW AOC

- GW monitored since 1992
- GW occurs ~500 ft deep in unconsolidated sediments
- Contaminated
  - Nitrate: 0 to 14 ppm (std. = 10 ppm)
  - TCE: 0 to 19 ppb (std = 5 ppb)
- From high-volume waste-water disposal systems operated from ~1960 to 1990
- Small plume, 4 mi. away from drinking-water supplies



Legend

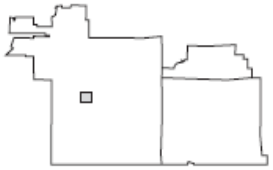
- Monitoring well, with November 2011 Trichloroethene concentrations (µg/L)
- Concentration contour (µg/L)
- Road, paved and unpaved
- Impoundment boundary
- Solid waste management unit (SWMU)
- Tech Area boundary
- Building

Notes:
1) Wells TAV-MW7, TAV-MW9 and TAV-MW13 are completed below the water table, and were not used for contouring.
2) Higher concentration from duplicate sample analytical results used for contouring.
3) ND = not detected; method detection limit indicated in parentheses.

0 300 600
Scale In Feet

0 72 144
Scale in Meters

Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1983 North American Horizontal Datum, 1988 North American Vertical Datum

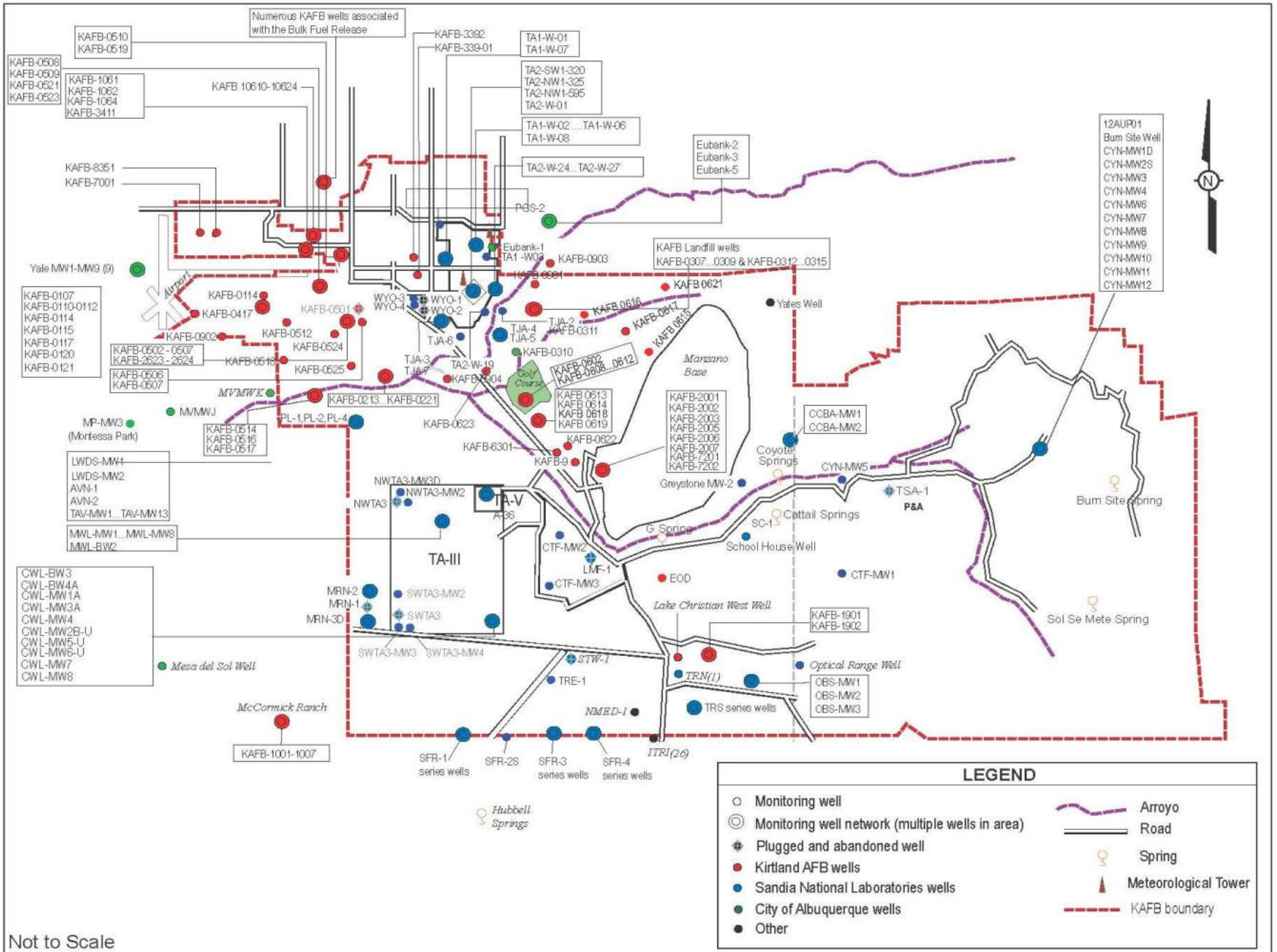


SNL GIS ORG. 4142	1:3600	MAPID=120049
Sandia National Laboratories, New Mexico Environmental Geographic Information System		
DHelfrich	dh120049.aml	01/20/12

TA-V GW AOC

- EM/IRR review of strategy 2013- 2015
- EM/IRR advocated treatability study to demonstrate in-situ treatment of nitrates and TCE
- Meeting January 29, 2015, NMED agree to TS
- TS Workplan in review with NMED

Backup Slides


Numerous KAFB wells associated with the Bulk Fuel Release
KAFB-0510
KAFB-0519
KAFB-0508
KAFB-0509
KAFB-0521
KAFB-0523
KAFB-1061
KAFB-1062
KAFB-1064
KAFB-3411
KAFB 10610-10624
KAFB-3392
KAFB-339-01
TA1-W-01
TA1-W-07
TA2-SW1-320
TA2-NW1-325
TA2-NW1-585
TA2-W-01
TA1-W-02....TA1-W-06
TA1-W-08
TA2-W-24...TA2-W-27
KAFB-8351
KAFB-7001
PGS-2
Eubank-2
Eubank-3
Eubank-5
12AUP01
Burn Site Well
CYN-MW1D
CYN-MW2S
CYN-MW3
CYN-MW4
CYN-MW6
CYN-MW7
CYN-MW8
CYN-MW9
CYN-MW10
CYN-MW11
CYN-MW12
Eubank-1
TA1 -W09
KAFB-0903
KAFB Landfill wells
KAFB-0307...0309 & KAFB-0312...0315
Yale MW1-MW9 (9)
Airport
KAFB-0114
KAFB-0417
KAFB-0501
WYO-3
WYO-4
WYO-1
WYO-2
KAFB 0621
Yates Well
KAFB-0107
KAFB-0110-0112
KAFB-0114
KAFB-0115
KAFB-0117
KAFB-0120
KAFB-0121
KAFB-0902
KAFB-0512
KAFB-0524
TJA-6
TJA-4
TJA-5
TJA-2
KAFB-0311
KAFB 0616
KAFB-0617
KAFB 0615
KAFB-0502 - 0507
KAFB-2623 - 2624
KAFB-0518
KAFB-0525
TJA-3
TJA-7
TA2-W-19
KAFB-0310
KAFB-0602
KAFB-0608...0612
Manzano Base
KAFB-0506
KAFB-0507
KAFB-0604
Golf Course
KAFB 0613
KAFB 0614
KAFB 0618
KAFB 0619
KAFB-2001
KAFB-2002
KAFB-2003
KAFB-2005
KAFB-2006
KAFB-2007
KAFB-7201
KAFB-7202
MVMWK
KAFB-0213...KAFB-0221
MVMWJ
MP-MW3
(Montessa Park)
PL-1,PL-2,PL-4
KAFB-0623
KAFB-0622
KAFB-6301
KAFB-9
KAFB-0514
KAFB-0516
KAFB-0517
CCBA-MW1
CCBA-MW2
Coyote Springs
CYN-MW5
Greystone MW-2
TSA-1
P&A
Burn Site Spring
LWDS-MW1
LWDS-MW2
AVN-1
AVN-2
TAV-MW1...TAV-MW13
NWTA3-MW3D
NWTA3-MW2
NWTA3
TA-V
A-36
G Spring
SC-1
Cattail Springs
School House Well
MWL-MW1...MWL-MW8
MWL-BW2
TA-III
CTF-MW2
LMF-1
CTF-MW3
EOD
CTF-MW1
CWL-BW3
CWL-BW4A
CWL-MW1A
CWL-MW3A
CWL-MW4
CWL-MW2B-U
CWL-MW5-U
CWL-MW6-U
CWL-MW7
CWL-MW8
MRN-2
MRN-1
MRN-3D
SWTA3-MW2
SWTA3
SWTA3-MW3
SWTA3-MW4
Lake Christian West Well
KAFB-1901
KAFB-1902
Sol Se Mete Spring
Mesa del Sol Well
STW-1
TRE-1
TRN(1)
Optical Range Well
OBS-MW1
OBS-MW2
OBS-MW3
McCormick Ranch
KAFB-1001-1007
NMED-1
TRS series wells
ITRI(26)
SFR-1
series wells
SFR-2S
SFR-3
series wells
SFR-4
series wells
Hubbell Springs
N
LEGEND
Monitoring well
Monitoring well network (multiple wells in area)
Plugged and abandoned well
Kirtland AFB wells
Sandia National Laboratories wells
City of Albuquerque wells
Other
Arroyo
Road
Spring
Meteorological Tower
KAFB boundary
Not to Scale

Progress of Sandia's Environmental Restoration Operations

John R. Cochran

Environmental Restoration Operations

Project Manager

Sandia National Laboratories

October 27, 2015

Joe Estrada

Environmental Restoration Operations

Federal Project Director

DOE/NNSA

Sandia Field Office

SAND2015-xxx C. Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000

Overview of Sandia's Environmental Restoration Operations

- Mission – Identify, characterize & remediate sites where hazardous &/or radioactive materials have been released
- Scope: 315 sites
  - Legally - Solid Waste Management Units or Areas of Concern
  - For presentation - Environmental Restoration sites or "ER sites"
- All activities regulated by New Mexico Environment Department (NMED) under the 2004 Compliance Order on Consent (COoC)
- DOE/NNSA and Sandia Corporation are in compliance with: Compliance Order on Consent, Federal and State requirements

Overview of Sandia's Environmental Restoration Operations

- Very successful, completed corrective action at 302 of 315 ER sites through the NMED regulatory process
- 13 ER sites remain in corrective action process
- Presentation will review progress in completing corrective action at these 13 ER sites
- Focus on progress made during last 6 months

Remaining 13 ER Sites

6 “Soil sites”

3 “Active mission” sites with deferred corrective action

1 Mixed Waste Landfill

3 Groundwater Areas of Concern

- Burn Site
- Tijeras Arroyo
- Technical Area V

Remaining 13 ER Sites

6 Soil sites

~~3 "Active mission" sites with deferred corrective action~~

1 Mixed Waste Landfill

3 Groundwater Areas of Concern

- Burn Site
- Tijeras Arroyo
- Technical Area V

Remaining 10 ER Sites

- 6 Soil sites **(Five plus One)**
- 1 Mixed Waste Landfill
- 3 Groundwater Areas of Concern
  - Burn Site
  - Tijeras Arroyo
  - Technical Area V

Five Soil Sites

- “Soil sites” to separate them from the landfill and the groundwater areas of concern
- A 2010 letter from NMED requested additional groundwater characterization of these ER sites (ER sites 8/58, 68, 149 & 154)
- All required groundwater characterization work has been completed and the results documented
- In letter dated February 24, 2015, NMED stated that corrective action activities have been completed, and that Certificates of Completion may be requested for these sites
- In letter dated September 4, 2015, Certificates of Completion were requested for the five soil sites

One “New” Soil Site

- “New” release site, discovered in 2012
- Voluntary corrective actions completed at this site (ER site 502)
- Remaining concentrations in soil below cleanup criteria
- Reported the results to NMED in November 2013 and are awaiting NMED review

Remaining 10 ER Sites

6 Soil sites (five plus one)

1 Mixed Waste Landfill

3 Groundwater Areas of Concern

- Burn Site
- Tijeras Arroyo
- Technical Area V

Mixed Waste Landfill

Mixed Waste Landfill

- Implementing Long Term Monitoring and Maintenance Plan (the LTMMP)

- October 17, 2014 DOE and Sandia requested a Permit Modification, for NMED to grant Corrective Action Complete with Controls status to the MWL
- NMED hosted a public comment period on their intent, pending public comment, to approve Corrective Action Complete with Controls status for the MWL
- Public Hearing was requested during the public comment period

Mixed Waste Landfill

- NMED hosted 2 meetings in attempts to resolved differences, without Public Hearing, meetings unsuccessful
- Public Hearing was held July 8 – 11, 2015
- DOE and Sandia participated in Public Hearing
- Next Steps:
  - Hearing Office will issue a report with recommendations to the Secretary of the Environment, and
  - Secretary of the Environment will make a final determination
- To better inform the community, DOE/Sandia made presentations to:
  - Albuquerque/Bernalillo County Water Utility Authority Governing Board on August 19 and to their
  - Water Protection Advisory Board on September 11

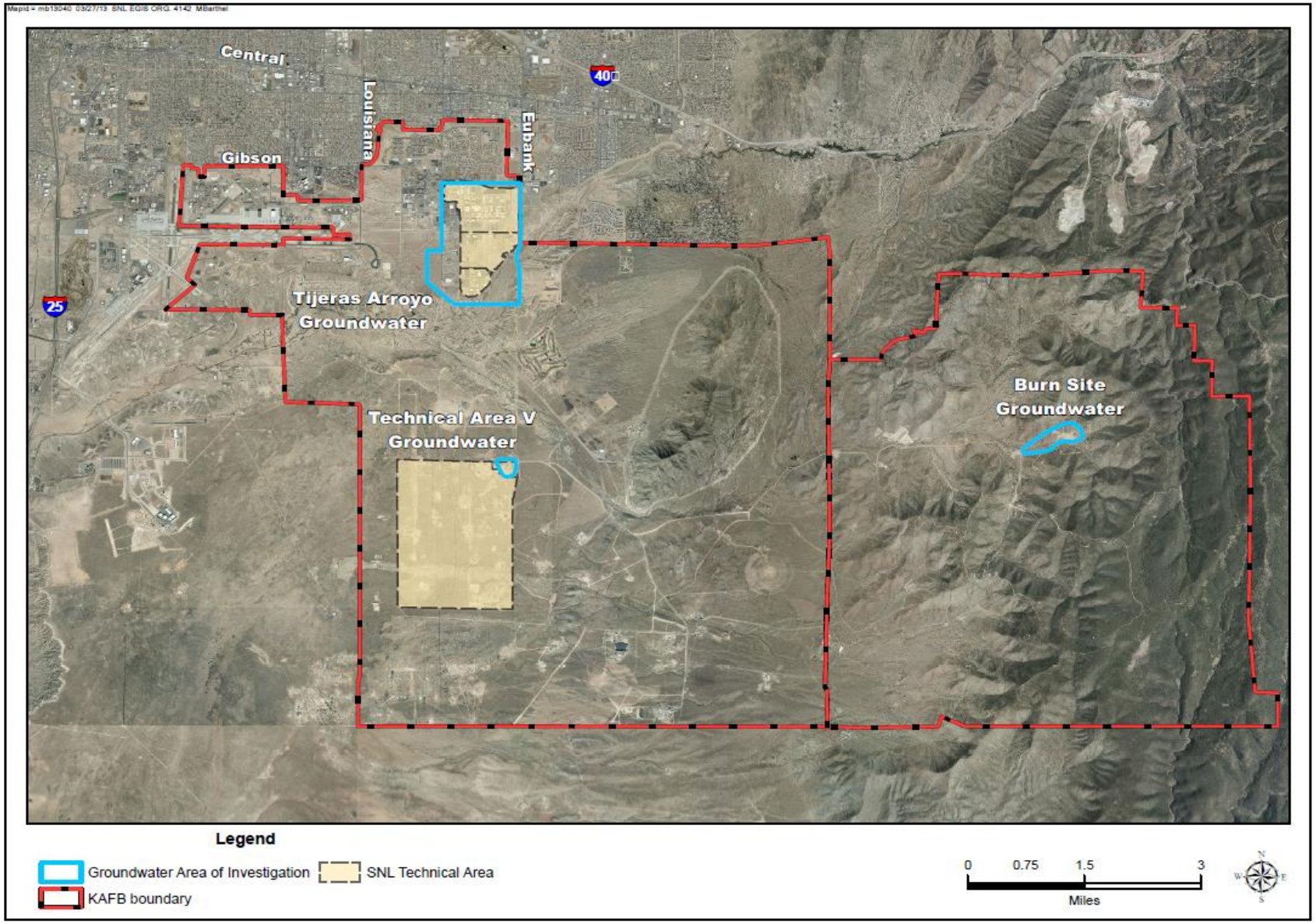
Remaining 10 ER Sites

6 Soil sites (five plus one)

1 Mixed Waste Landfill

3 Groundwater Areas of Concern

- Burn Site
- Tijeras Arroyo
- Technical Area V



Location of 3 Groundwater AOCs on KAFB

National Nuclear Security Administration

Sandia National Laboratories

Remaining 10 ER Sites

6 Soil sites (five plus one)

1 Mixed Waste Landfill

3 Groundwater Areas of Concern

→ Burn Site

Tijeras Arroyo

Technical Area V

Burn Site GW AOC

- Groundwater occurs ~100 to 200 ft deep in fractured bedrock
- GW contains nitrate, up to 42 ppm (regulatory standard is 10 ppm)
- On June 18, 2014, NMED approved extension of Corrective Measure Evaluation (CME) Report to March 31, 2016 to allow weight-of-evidence process to determine origin of nitrates in GW
- Currently conducting weight-of-evidence process
- Continuing to monitor the GW

Remaining 10 ER Sites

6 Soil sites (five plus one)

1 Mixed Waste Landfill

3 Groundwater Areas of Concern

- Burn Site
- → Tijeras Arroyo
- Technical Area V

Tijeras Arroyo GW AOC

- Perched GW occurs:
  - ~250 ft. below surface, and
  - ~ 250 ft above regional aquifer
- Perched GW contaminated with nitrate and TCE
  - Nitrate: up to 39 ppm (regulatory standard is 10 ppm)
  - TCE: up to 9 ppb (regulatory standard is 5 ppb)
- Updating the 2005 Corrective Measures Evaluation (CME) Report submitted to NMED, with new data from SNL and KAFB (by December 2, 2016)
- Continuing to monitor the GW

Remaining 10 ER Sites

6 Soil sites (five plus one)

1 Mixed Waste Landfill

3 Groundwater Areas of Concern

- Burn Site
- Tijeras Arroyo
- → Technical Area V

Technical Area V GW AOC

- Regional GW occurs 500 ft. below surface
- Contaminated with nitrate and TCE
  - Nitrate: up to 14 ppm (regulatory standard is 10 ppm)
  - TCE: up to 19 ppb (regulatory standard is 5 ppb)
- NMED agreed to consider possible bioremediation, and extended due date for CME Report to November 30, 2016
- Treatability Study Workplan for in-situ bio remediation submitted to NMED on September x, 2015
- Continuing to monitor the GW

Summary of Status of Sandia's ER Operations

- Requested Certificates of Completion for 5 soil sites
- Voluntary Corrective Action completed at 1 soil site
- MWL: (1) LTMMP being implemented, (2) NMED held public comment period and Public Hearing (July 8-11) on their intent to grant corrective action complete with controls status to MWL
- Conducting Weight of Evidence Process at Burn Site GW AOC
- Updating CME Report on Tijeras Arroyo GW AOC
- Submitted Treatability Study Workplan to NMED for the treating the TA-V GW AOC

More Information & Questions

- On-line information ER documents hosted by NMED - http://www.nmenv.state.nm.us/HWB/snlperm.html
- On-line collection of ER documents hosted by UNM's Lobo Vault - http://repository.unm.edu/handle/1928/10963
- Annual Groundwater Monitoring Report for Sandia Labs - http://www.sandia.gov/news/publications/environmental_reports/index.html
- Send email questions to - envinfo@sandia.gov
- Call Sandia National Laboratories Community Involvement - 284-5200

Backup Slides

Mixed Waste Landfill - Background

- 2.6 acre landfill
- Operational 1959 to 1988
- GW monitoring & other field investigations began 1990
  - 500 feet to groundwater, groundwater is not contaminated
  - Very little rain, 500 feet of dry absorb soils
  - Wastes will not migrate to groundwater
- Natural evapotranspirative (ET) cover recommended as remedy (2003)
- Public Hearing on remedy in 2004

Summary of Long-Term Monitoring Parameters, Frequencies, and Methods Mixed Waste Landfill, Sandia National Laboratories, New Mexico

.

Sampling Media	Monitoring Parametersa/ Constituents of Concern	Monitoring Frequencya	Number of Samples Per Event	Locations	Monitoring Method	Comments
Air	Radon	Year 1 – Quarterly Year 2 – Quarterly Year 3 – Semiannual Year 4 – Semiannual Year 5 and subsequent years – Annual	17	10 detectors placed at corners and midpoints of perimeter fence 5 detectors placed on completed cover 2 detectors at background locations (TBD)	Track-etch detectors (at breathing level); sampling and analysis per Appendix C	Samples are time-weighted average and will be collected over a 3-month period.
Surface Soil	Tritium	Annual	4	One sample collected from each corner of the MWL ET Cover.	Grab samples of soil collected; moisture extracted and analyzed for tritium using liquid scintillation	Samples will continue to be collected from the original MWL ground surface at the four corners of the ET Cover.
Vadose Zone	VOCs in soil vapor	Year 1 – Semiannual Year 2 – Semiannual Year 3 – Semiannual Year 4 and subsequent years – Annual	17	Samples collected from 3 perimeter multi-port FLUTe™ or equivalent wells (5 sampling ports per well) and 2 single-port soil-vapor monitoring points installed through the ET Cover	Sampling and analysis per Appendix D (Compendium Method TO-15 or equivalent). Table 3.4.1-1 presents list of analytes	The 3 multiport FLUTe™ wells or equivalent are proposed and located at the MWL perimeter. Sampling ports planned for depths of 50, 100, 200, 300, and 400 ft bgs. The 2 single-port soil-vapor monitoring points have a sampling port approximately 35 ft below the original ground surface.
Vadose Zone	Moisture content underneath the ET Cover	Year 1 – Semiannual Year 2 – Semiannual Year 3 and subsequent years – Annual	171	3 soil-moisture monitoring access tubes Measurements obtained at 1-ft increments from 4 ft to 25 ft bgs, then 5-ft increments to total depth of the access tube (200 linear ft)	Soil-moisture monitoring per Appendix E	Moisture content in vadose zone beneath the cover is measured using a neutron probe to evaluate moisture infiltration through the ET Cover.

Summary of Long-Term Monitoring Parameters, Frequencies, and Methods Mixed Waste Landfill, Sandia National Laboratories, New Mexico

.

Sampling Media	Monitoring Parametersa/ Constituents of Concern	Monitoring Frequencya	Number of Samples Per Event	Locations	Monitoring Method	Comments
Ground water	VOCs, metals, tritium, radon, gamma-emitting radionuclides (short list), and gross alpha/beta activity	Semiannual	4	MWL compliance groundwater monitoring well network: MWL-BW2, MWL-MW7, MWL-MW8, and MWL-MW9	Sampling and Analysis per Appendix F. Table 3.5.4-1 lists specific analytes and EPA Methods[b]	Monitoring wells MWL–MW4, MWL-MW5, and MWL-MW6 will be retained for information only.
Biota – Surface Soil	RCRA Metals plus Cu, Ni, V, Zn, Co, and Be; and gamma-emitting radionuclides (short list)	Annual	Up to 4 (2 each, if they exist)	Variable - ant hills and animal burrows on the MWL ET Cover located during ET Cover inspections, if present	Grab sampling and analysis of surface soil at animal burrow and/or ant hill feature per Appendix G	Soil sampling will be performed in August or September to evaluate potential for mobilization of contaminants by biota. If no features are identified, no samples will be collected.
Biota – Cover Vegetation	Gamma-emitting radionuclides (short list) in vegetation	Annual	Up to 2 if they exist	Variable - potentially deep-rooted vegetation overlying former disposal areas located during ET Cover inspections, if present	Grab sampling and analysis of vegetation, including the plant and root system per Appendix G	Vegetation sampling will be performed in August or September to evaluate potential for mobilization of contaminants by plants. If no potentially deep-rooted plants are present, no samples will be collected.

National Nuclear Security Administration

Sandia National Laboratories

Overview of Groundwater Protection at

Sandia National Laboratories, New Mexico

Pam Puissant
Department 4142

Michael Skelly
Department 6234

Regulators of SNL's Groundwater Programs

- **New Mexico Environment Department (NMED) Hazardous Waste Bureau**
  - Has primacy over US EPA Region 6 since the early 1990s
  - Regulated mainly under the Compliance Order on Consent
  - RCRA Permit also has requirements, especially on newly discovered groundwater issues
  - Meetings held on an as-needed basis

- **NMED DOE Oversight Bureau**
  - Collects split samples and other QA/QC based on a Memo of Understanding with DOE SFO
  - Continuous data sharing
  - Technical meetings held monthly

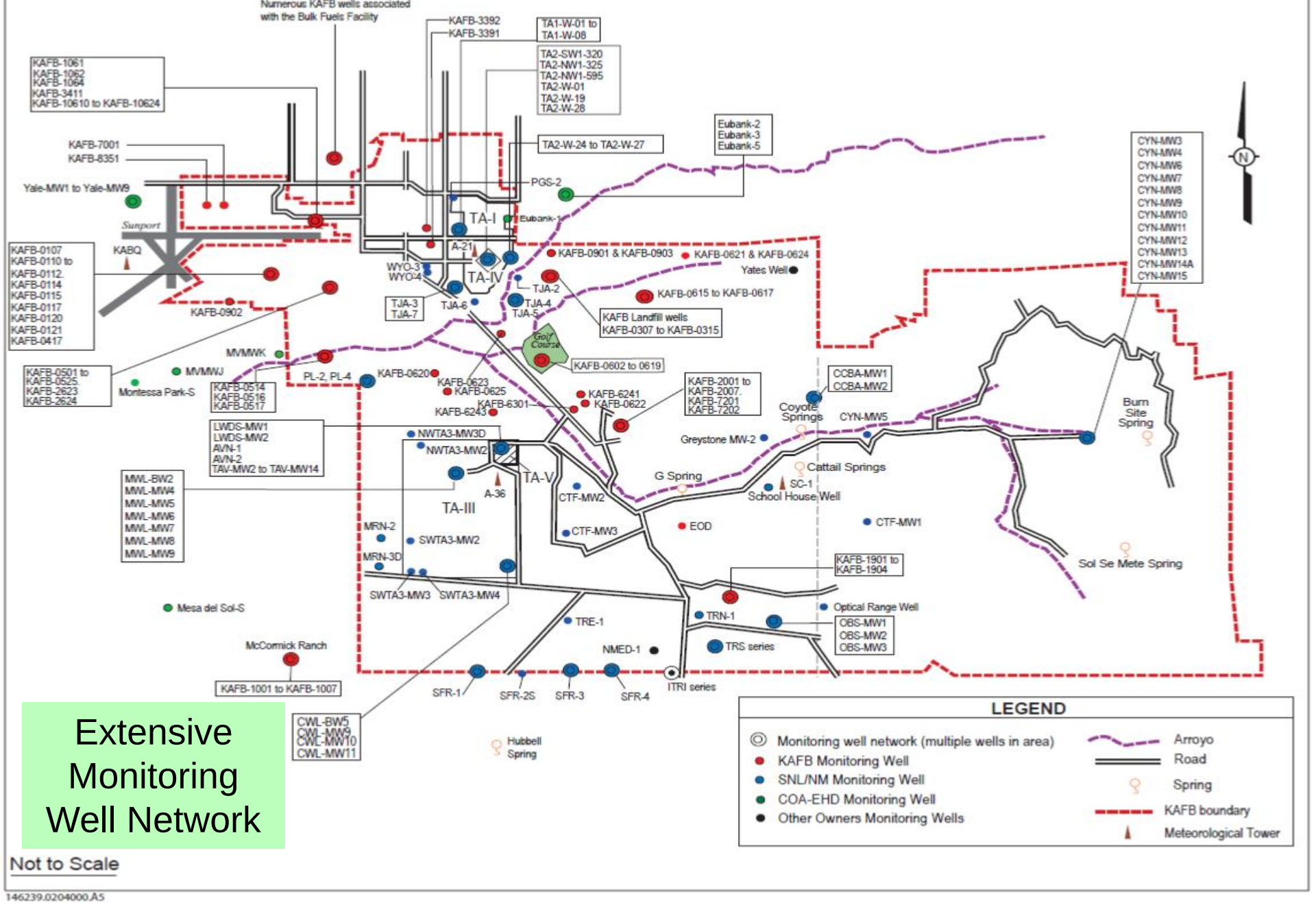
Regulators of SNL's Groundwater Programs

- **NM Office of the State Engineer**
  - Permission required for the installation and decommissioning of groundwater monitoring wells
  - Meetings held as needed

- **"Others"**
  - KAFB—land use permits for SNL wells on KAFB property
  - Albuquerque Bernalillo County Water Utility Authority/Water Protection Advisory Board—reviews SNL groundwater program based on public concerns
  - Albuquerque Environmental Health Department—data sharing
  - Public—Citizen groups, semi-annual meetings and hearings

General Groundwater Conditions at Sandia

- Groundwater in two regimes, basin-fill aquifer & bedrock aquifer
- Depths to groundwater is 100 ft (bedrock) to 550 ft (basin fill)
  - Perched groundwater system (minor aquifer above the regional water table) near Tijeras Arroyo (~300 ft deep)
- Natural flow from the mountains to the Rio Grande
- Current groundwater flow NW toward KAFB & ABCWUA production wells
- Slow flow rates (a few ft/yr to 10's of ft/yr), except on the west side of the base (100's ft/yr)
- Water table declinling 1 to 2 ft/yr due to pumping, except for wells in the far north that are currently showing an increase
- Water-supply wells are located in the northern part of the base
- Minimal recharge from rain--except in mountains & along channels



Extensive Monitoring Well Network

Not to Scale

146239.0204000.A5

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Seven Groundwater Projects at SNL

1. **Long-Term Stewardship Groundwater Monitoring Program**--detection monitoring to ensure that current operations are not degrading groundwater
2. **Chemical Waste Landfill**—detection monitoring of a remediated landfill
3. **Mixed Waste Landfill**—detection monitoring of a closed, covered landfill
4. **Burn Site Groundwater**--contamination regulated as Solid Waste Management Unit (SWMU) with nitrate above regulatory standard and perchlorate above NMED screening level
5. **Tijeras Arroyo Groundwater**--contamination regulated as SWMU with nitrate and trichloroethene (TCE) contamination above regulatory standards
6. **Technical Area V**--contamination regulated as SWMU with nitrate and TCE above regulatory standards
7. **Miscellaneous SWMUs**--Six small sites, each with one to three wells, with routine characterization monitoring

Relationship of Long-Term Stewardship and Environmental Restoration

- Memorandum of Understanding—defines roles and responsibilities to assure regulatory compliance
- ER takes SWMUs and AOCs to Site Closure or Remedy Selection
- LTS maintains Institutional Controls and/or implements Long-Term Monitoring Requirements
- Synergies—shared staff, shared resources (ERFO, SMO), same regulators, maintain historical knowledge
- Different funding sources—ER funded by DOE EM, LTS funded by NA-533/MW PMU

Long-Term Stewardship Groundwater Monitoring Program

- Protecting groundwater resources at Sandia & surrounding area
- Determine impact, if any, of current operations on quality/quantity of groundwater
- Establish baseline water quality and groundwater flow information
- Provide stakeholders an update of groundwater data for Sandia investigations through the publication of an *Annual Groundwater Monitoring Report*, included as an appendix to the *Annual Site Environmental Report*

Chemical Waste Landfill

- 1.9 acre landfill, operational from 1962 to 1981
- TCE discovered in 1990 in groundwater prompted remediation via soil-vapor extraction and excavation of contaminated soils and debris.
- Currently regulated under a Post-Closure Care Permit
- 4 groundwater monitoring wells sampled semiannually, no analytes above regulatory standards
- 5 soil-vapor monitoring wells sampled annually

View to the NE, Well being Installed on the North Side

Mixed Waste Landfill

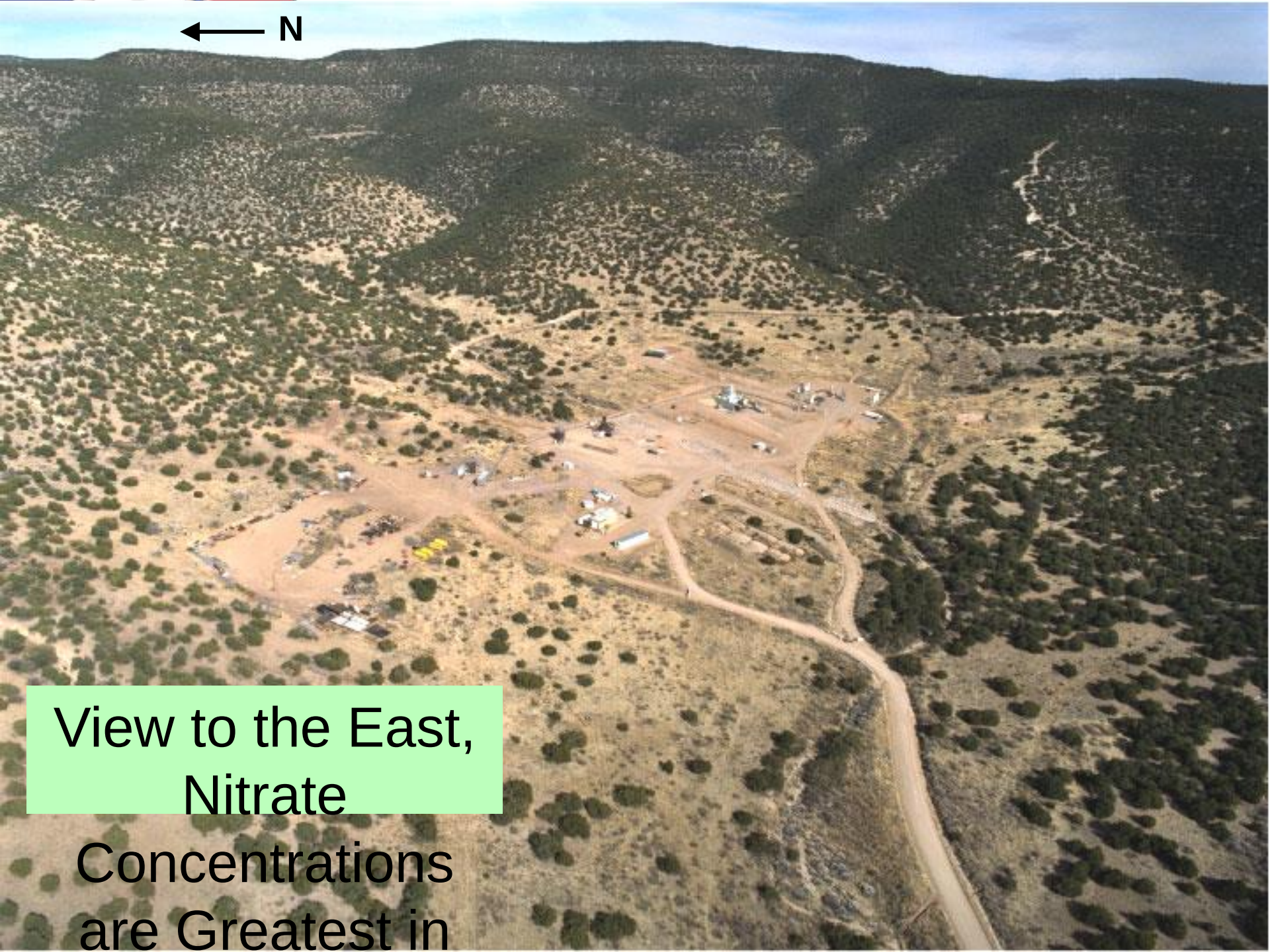
- 2.6 acre landfill, operational 1959 to 1988
- Groundwater monitoring & other field investigations began 1990
- Public Hearing on remedy in 2004
- NMED issued Final Order in 2005; selecting evapotranspirative cover w/ bio-intrusion barrier as remedy (constructed in 2009)
- 4 groundwater monitoring wells sampled annually, no analytes above regulatory standards
- Hearing for the Corrective Action Complete proposal scheduled to start July 8, 2015

Mixed Waste Landfill

Corrective Measures Evaluation Process for BSG, TAG, and TAV

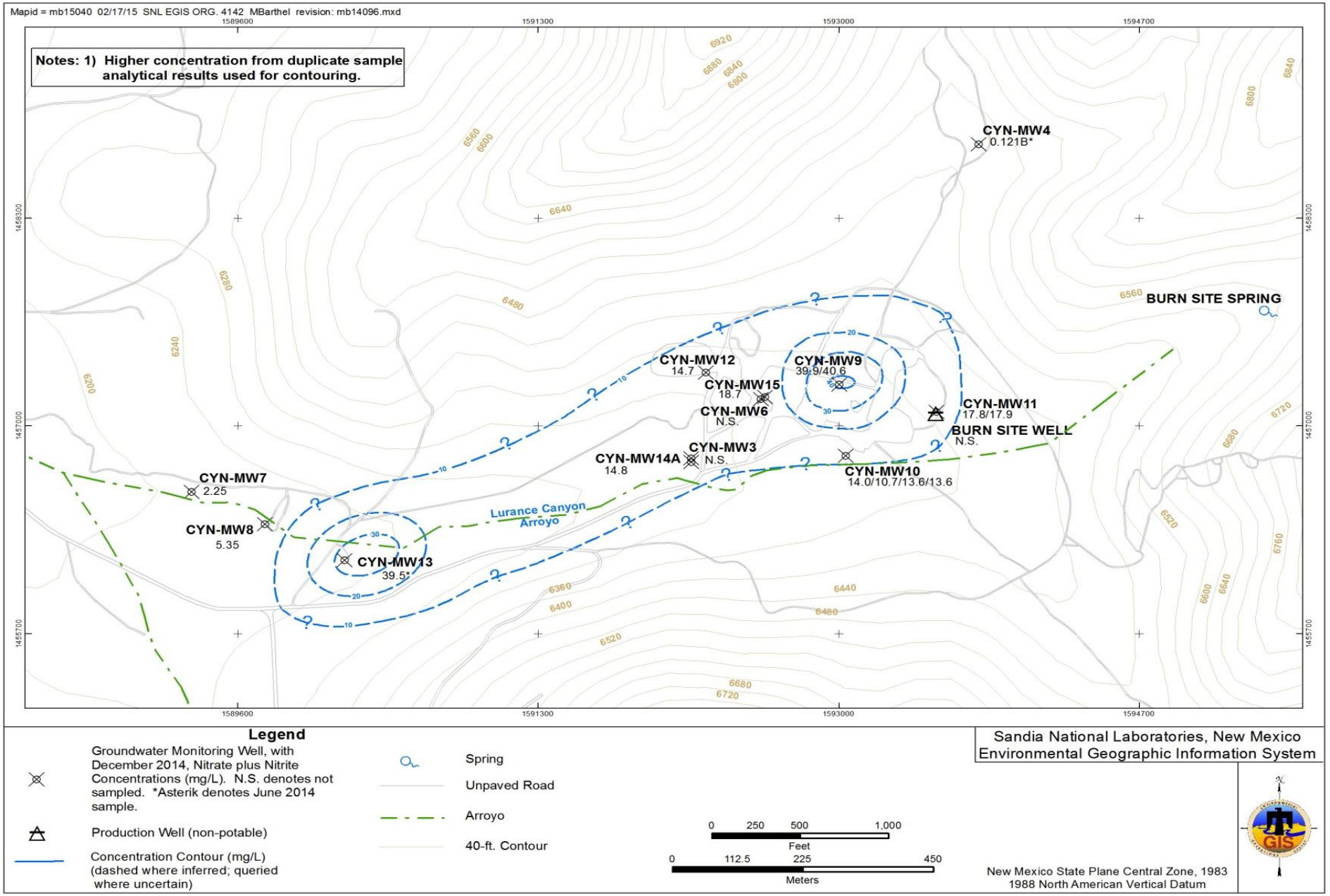
Possible remedial alternatives identified in CME Work Plans:

- **Groundwater Monitoring**
- **Monitored Natural Attenuation (MNA)**
- ***In Situ* Bioremediation (ISB) followed by Groundwater Monitoring**
- **ISB followed by MNA**
- **Pump and Treat followed by Groundwater Monitoring**
- **Pump and Treat followed by MNA**


N
View to the East, Nitrate Concentrations are Greatest in

Burn Site Groundwater

- Groundwater monitored since 1996
- Groundwater occurs at ~100 to 300 ft below ground surface (bgs) in fractured bedrock
- Currently monitoring 10 wells
- Contaminated with nitrate (5 to 6 wells) and perchlorate (1 well)
  - Nitrate: 0 to 37 parts per million (ppm) (regulatory standard is 10 ppm)
  - Perchlorate: 0 to 9 parts per billion (ppb) (no drinking water standard established)
- Small plume very far away from drinking-water supplies
- Tentative source—suspected wide-spread non-point source from use of high explosives, with a possible contribution from natural nitrate sources



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View of Tijeras Arroyo Groundwater Site

View to the South, Nitrate Concentrations are Greatest in Southern Portion of the Site

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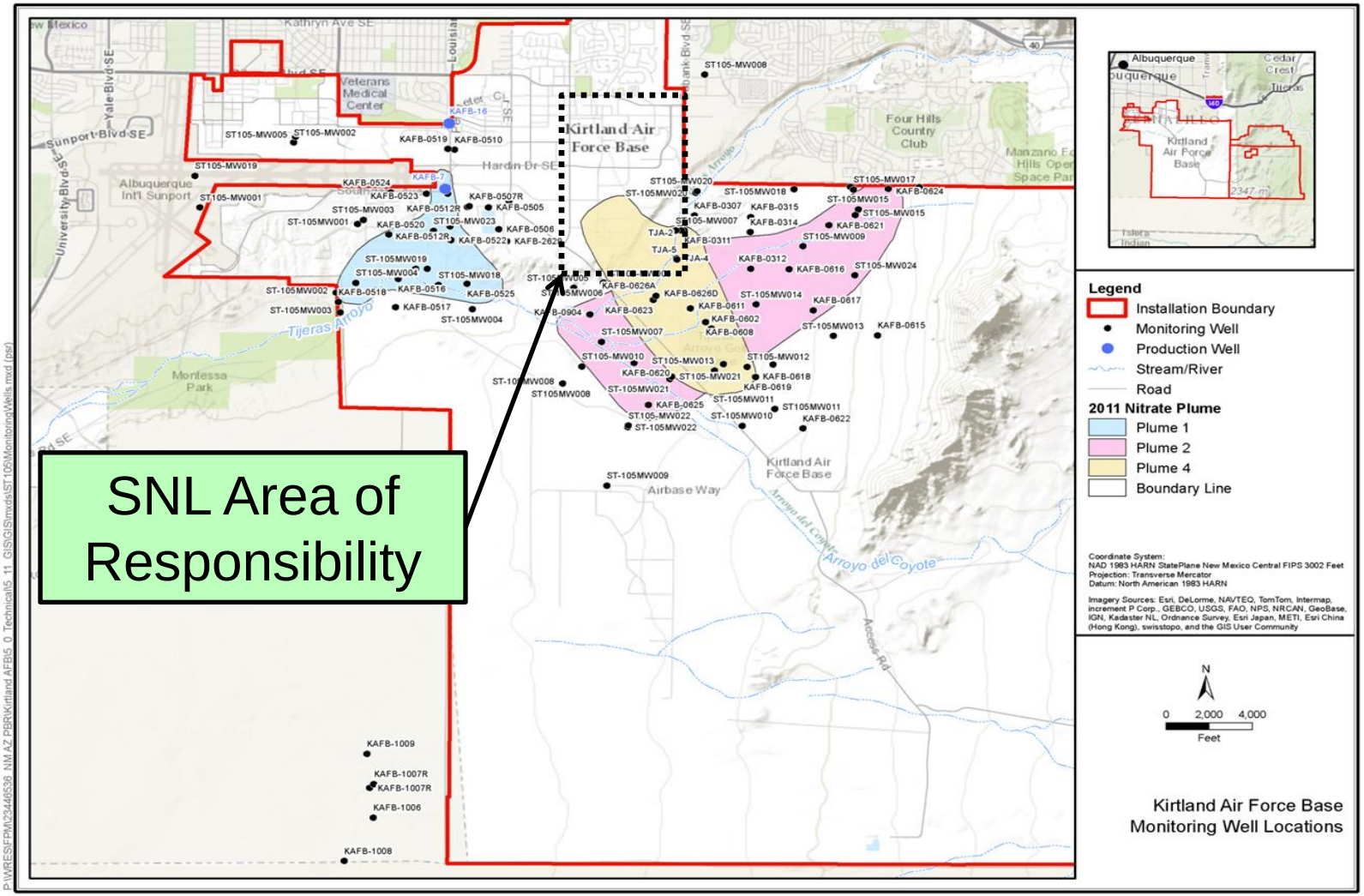
Tijeras Arroyo Groundwater

- Groundwater monitored since 1992
- Groundwater occurs at ~300 ft bgs in a perched aquifer & 500 ft bgs in the regional aquifer in unconsolidated sediments
- Large area--covers forty square miles, DOE/Sandia responsible for less than 2 mi^2 of the total & limited to the perched aquifer (no production wells in perched system)
- Contaminated with nitrate (5 wells) & TCE (1 well)
  - Nitrate: 0 to 33 ppm (std. = 10 ppm)
  - TCE: 0 to 9 ppb (std. = 5 ppb)
- Suspected sources include former & active waste-water systems owned or operated by DOE/Sandia, KAFB and ABCWUA
- Revised Corrective Measures Evaluation Report to be submitted in 2015

Boundary of Nitrate Plume 4 in Perched Aquifer (tan), Tijeras Arroyo Groundwater above 10 ppm



View of Technical Area V Groundwater Site

View to the SW, TCE Concentrations are Greatest in Center of the Site

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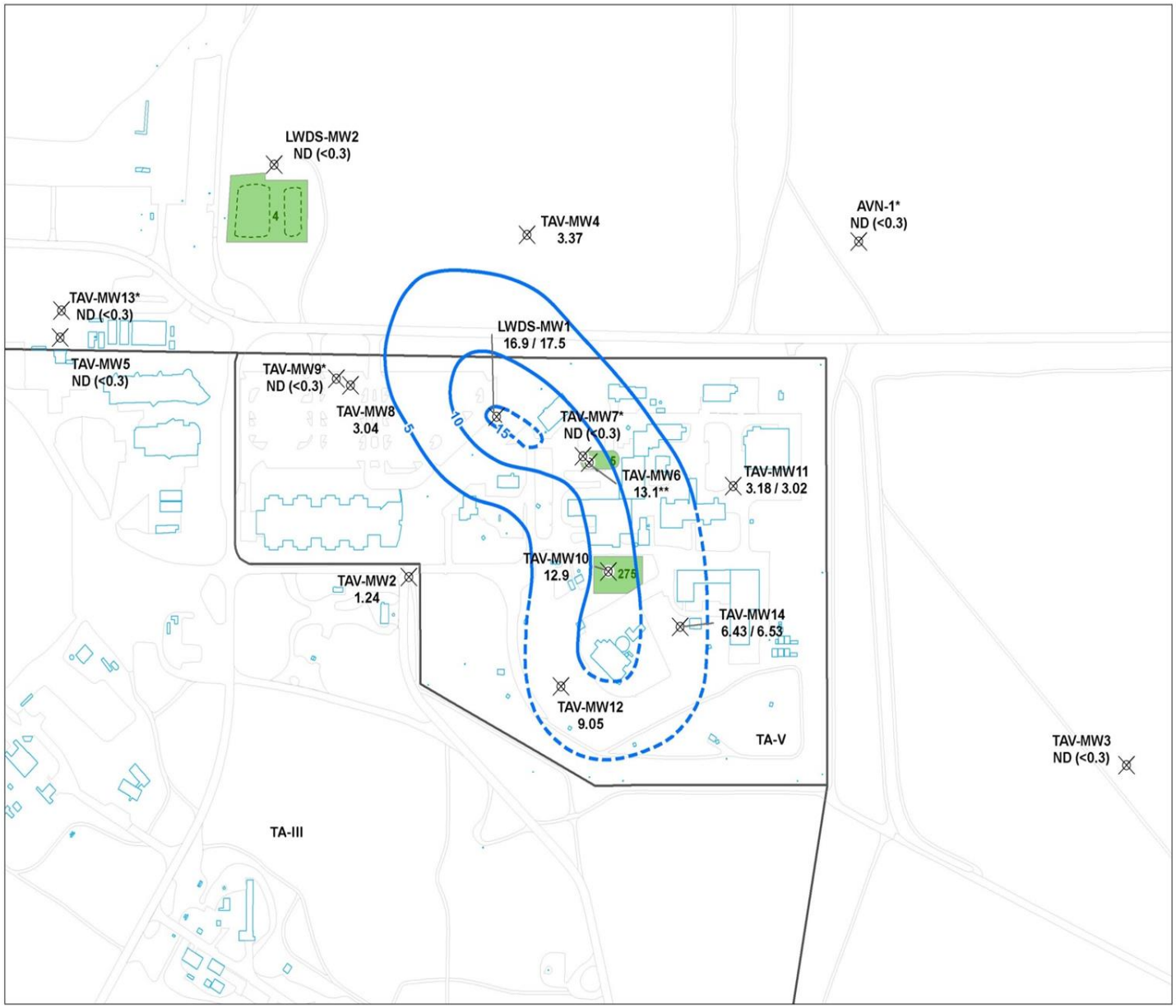
Technical Area V Groundwater

- Groundwater monitored since 1992
- Groundwater occurs ~500 ft bgs in unconsolidated sediments
- Contaminated with nitrate & TCE
  - Nitrate: 0 to 14 ppm (standard = 10 ppm)
  - TCE: 0 to 19 ppb (standard = 5 ppb)
- Suspected sources include high-volume waste-water disposal systems
- Small plume 4 mi. away from drinking-water supplies
- 16 groundwater monitoring wells sampled four times/yr
- 3 soil-vapor monitoring wells sampled four times/yr
  - low-level detections of TCE in vapor phase

- Corrective Measures Evaluation Report: November 2014



Legend

- Monitoring well, with 3.18 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

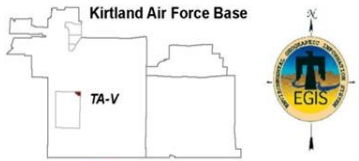
Notes:
* Wells AVN-1, TAV-MW7, TAV-MW9, and TAV-MW13 are completed below the water table, and were not used for contouring.

** 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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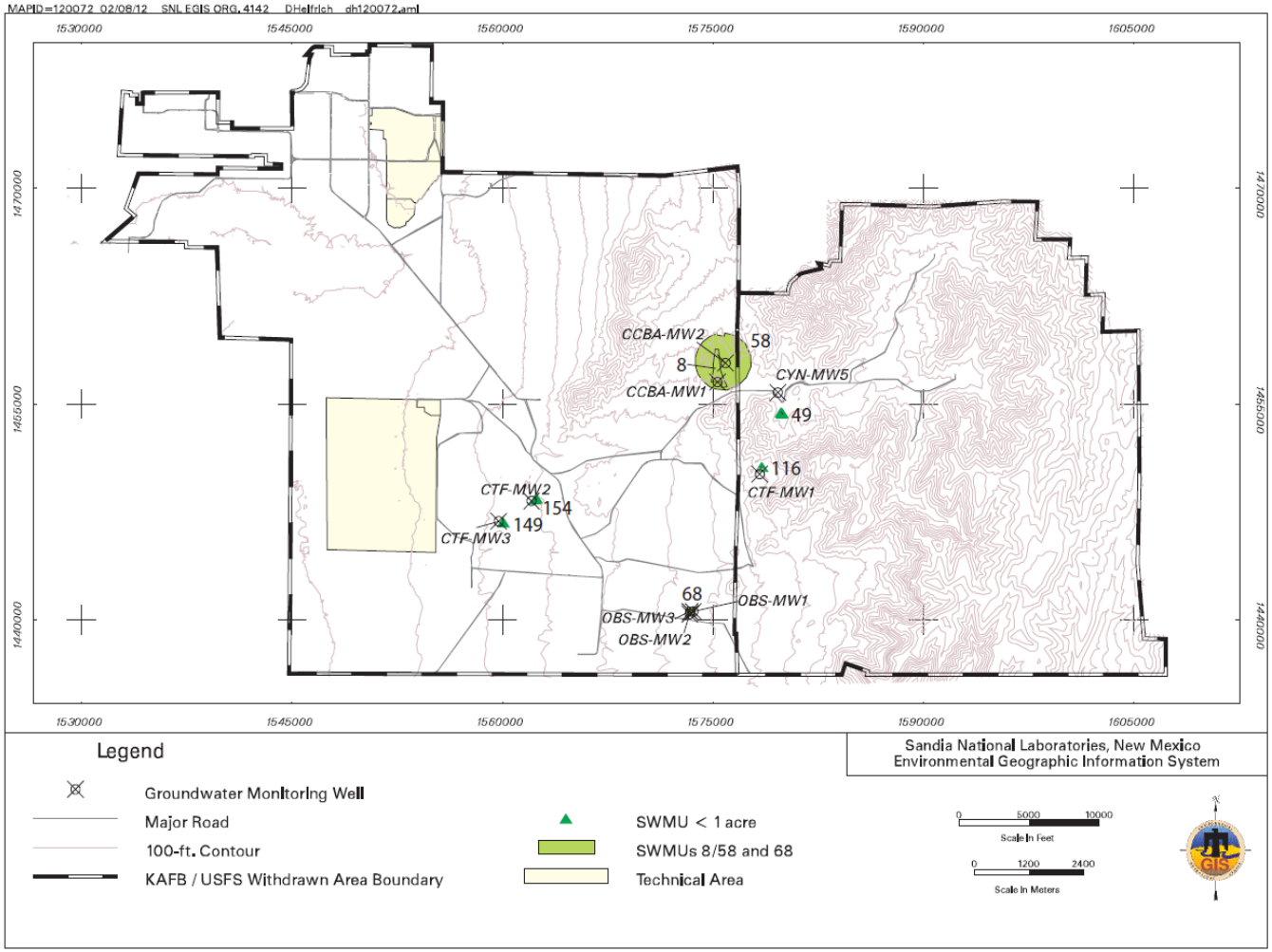
Miscellaneous Solid Waste Management Units

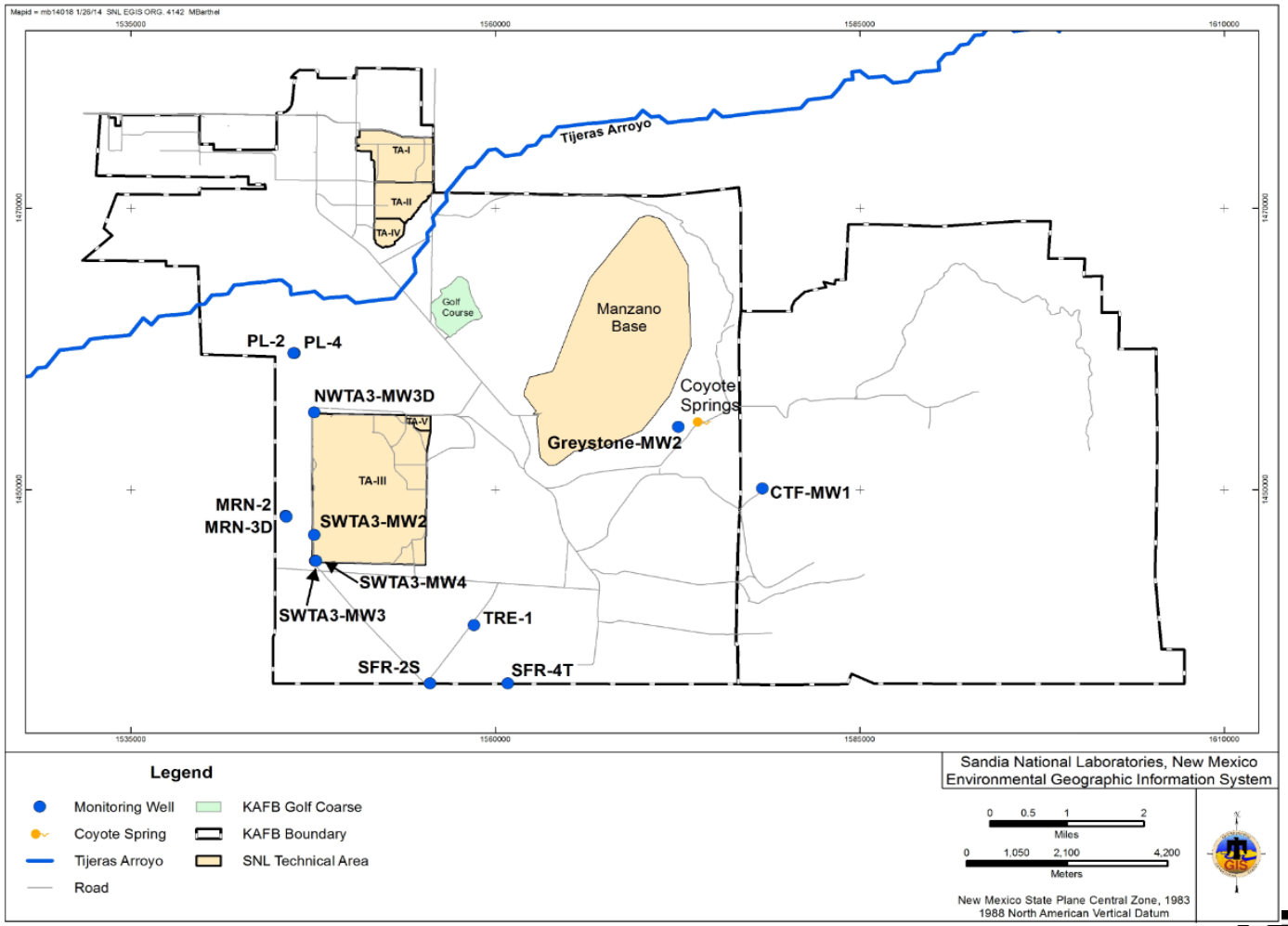


Key Points – SNL Groundwater

- Contamination levels are typically low, below or just above regulatory standards
- Contaminants most commonly nitrate & TCE
- Sites are well characterized and not a threat to KAFB or Albuquerque/Bernalillo Co. water supply wells
- Groundwater Monitoring Program and ER Operations will continue to characterize, monitor groundwater, and report data per NMED requirements

BACKUP SLIDES

Long-Term Stewardship Groundwater Monitoring Program



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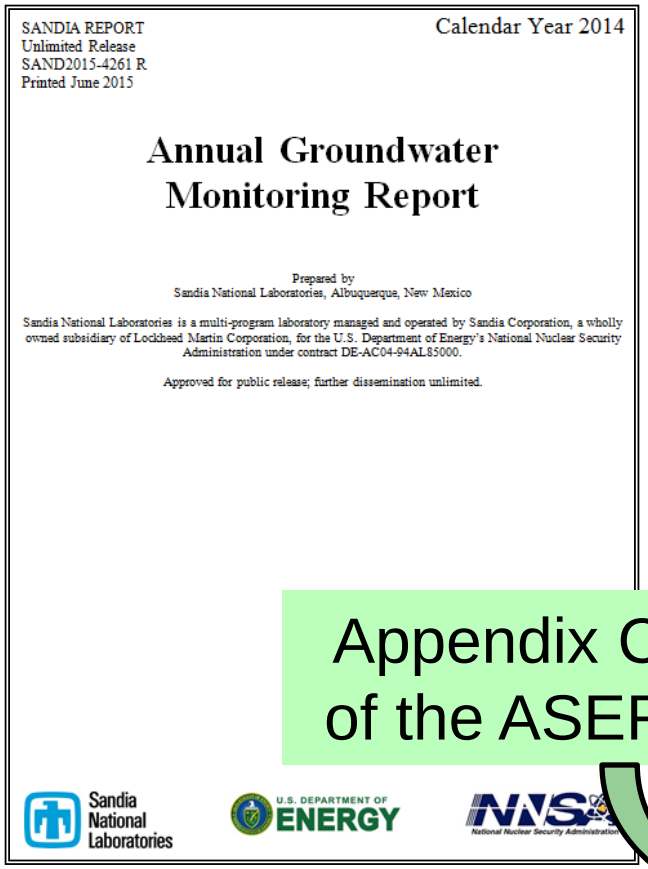
Groundwater Monitoring Program


SANDIA REPORT
Unlimited Release
SAND2015-4261 R
Printed June 2015

Calendar Year 2014

Annual Groundwater Monitoring Report

Prepared by
Sandia National Laboratories, Albuquerque, New Mexico

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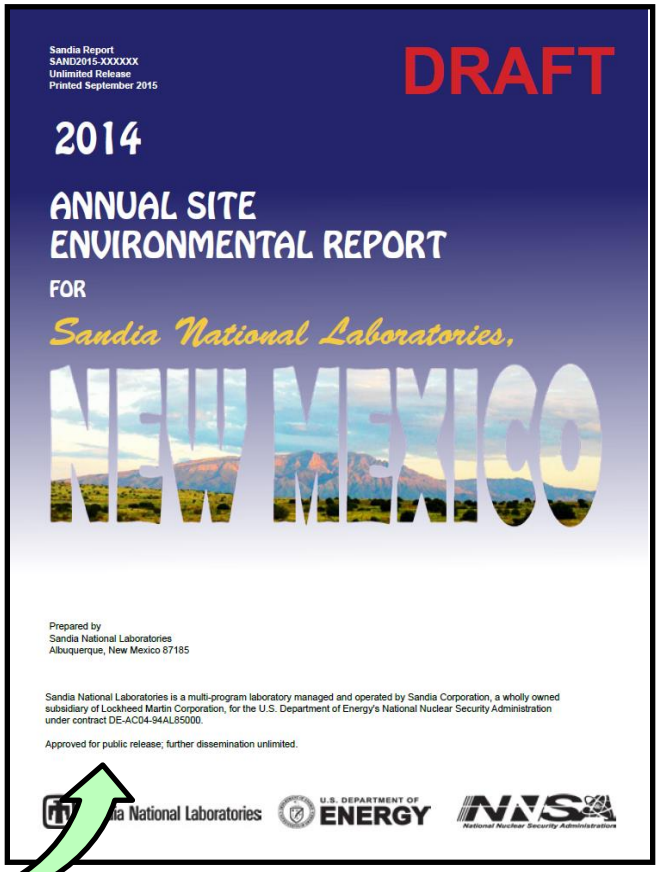
NNSA National Nuclear Security Administration

Appendix C of the ASER


Sandia Report
SAND2015-XXXXX
Unlimited Release
Printed September 2015

DRAFT

2014

ANNUAL SITE ENVIRONMENTAL REPORT

FOR

Sandia National Laboratories, NEW MEXICO

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185

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NNSA National Nuclear Security Administration

NNSA National Nuclear Security Administration

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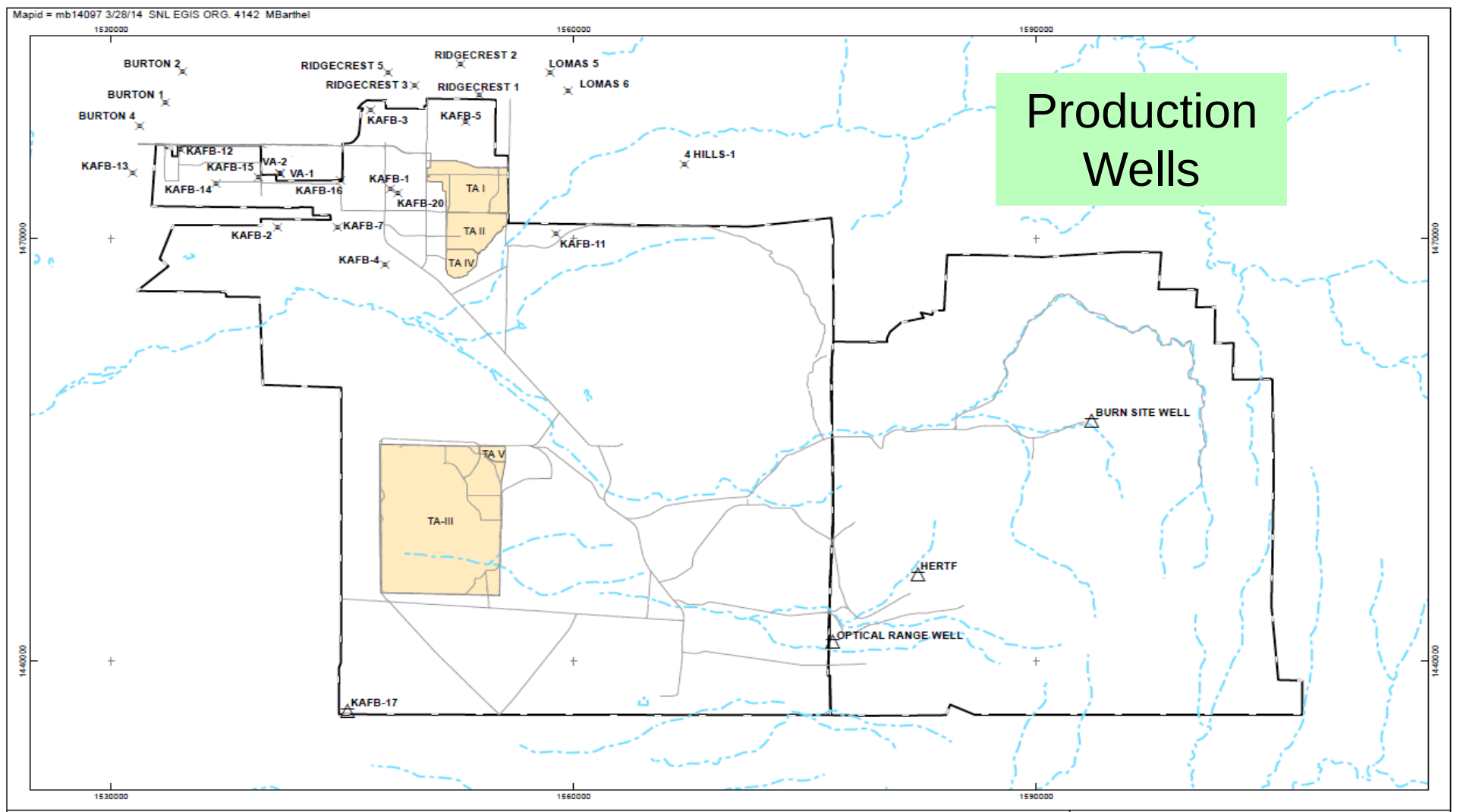
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1530000
1560000
1590000
1470000
1440000
Production Wells
BURTON 2
BURTON 1
BURTON 4
RIDGECREST 5
RIDGECREST 3
RIDGECREST 2
RIDGECREST 1
LOMAS 5
LOMAS 6
KAFB-3
KAFB-5
4 HILLS-1
KAFB-12
KAFB-13
KAFB-15
KAFB-14
VA-2
VA-1
KAFB-16
KAFB-1
KAFB-20
TA I
TA II
TA IV
KAFB-2
KAFB-7
KAFB-4
KAFB-11
BURN SITE WELL
TA V
TA-III
HERTF
OPTICAL RANGE WELL
KAFB-17
Legend
Production Wells
Production Well (non-potable)
Road
Surface drainage, arroyo
KAFB Boundary
SNL Technical
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

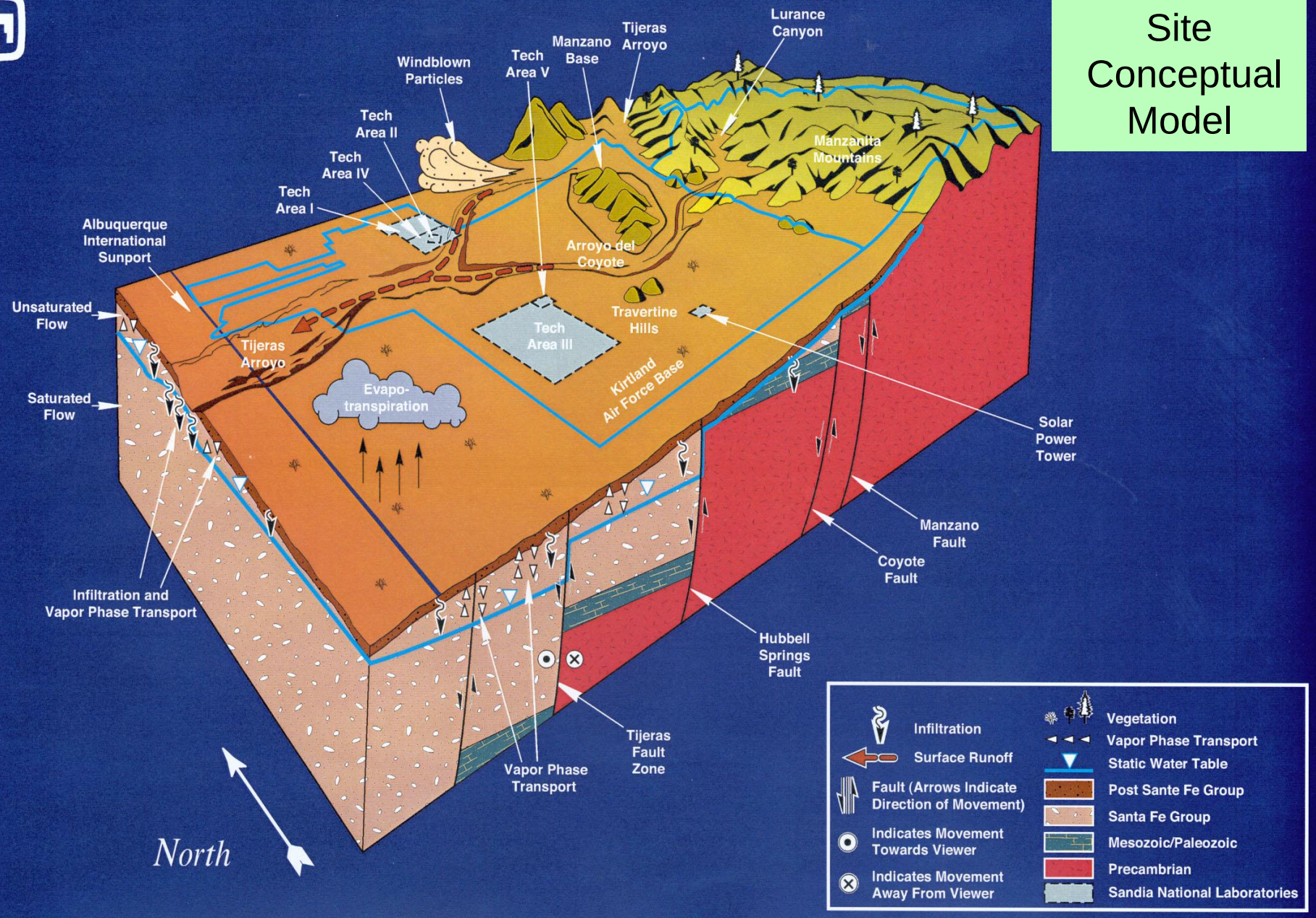

Water Level
Measurement

Sampling Pump System

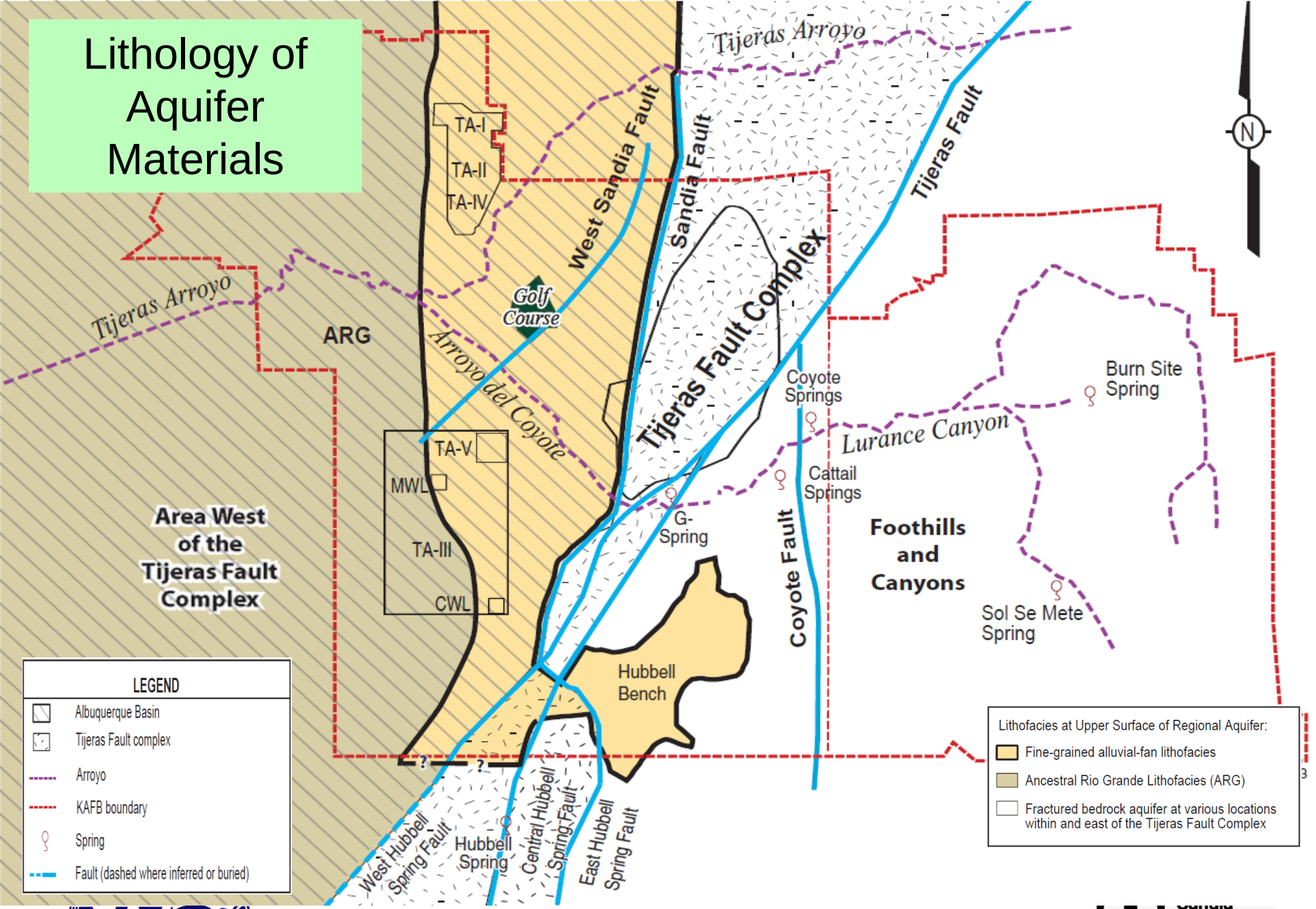

Groundwater
Sampling


Measuring Field
Analytical
Parameters

Site Conceptual Model



Lithology of Aquifer Materials



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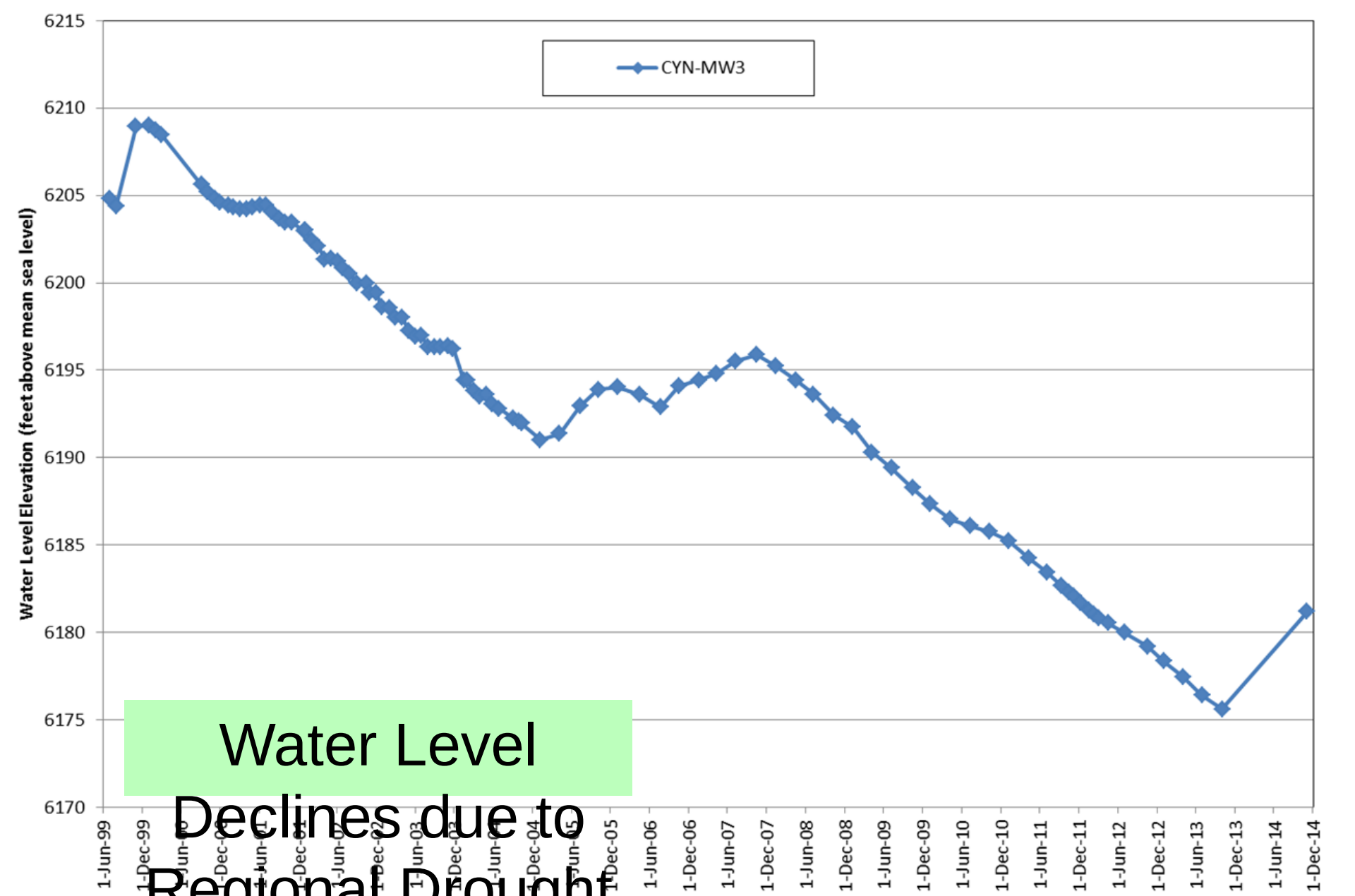

Water Level Declines due to Regional Drought

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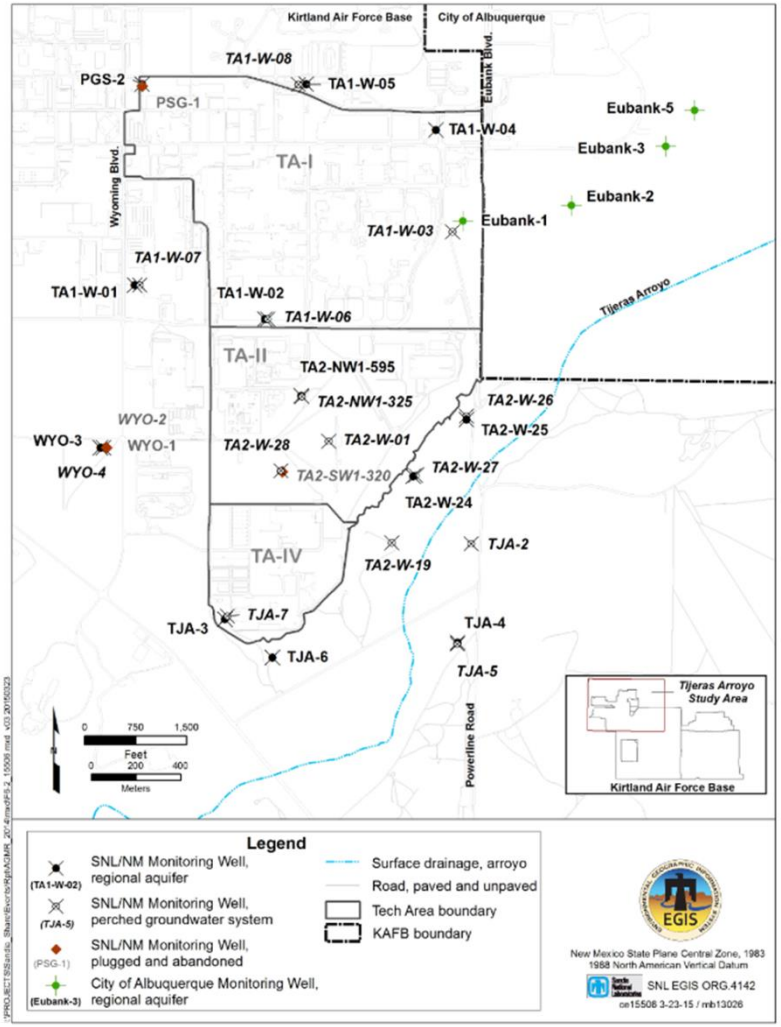
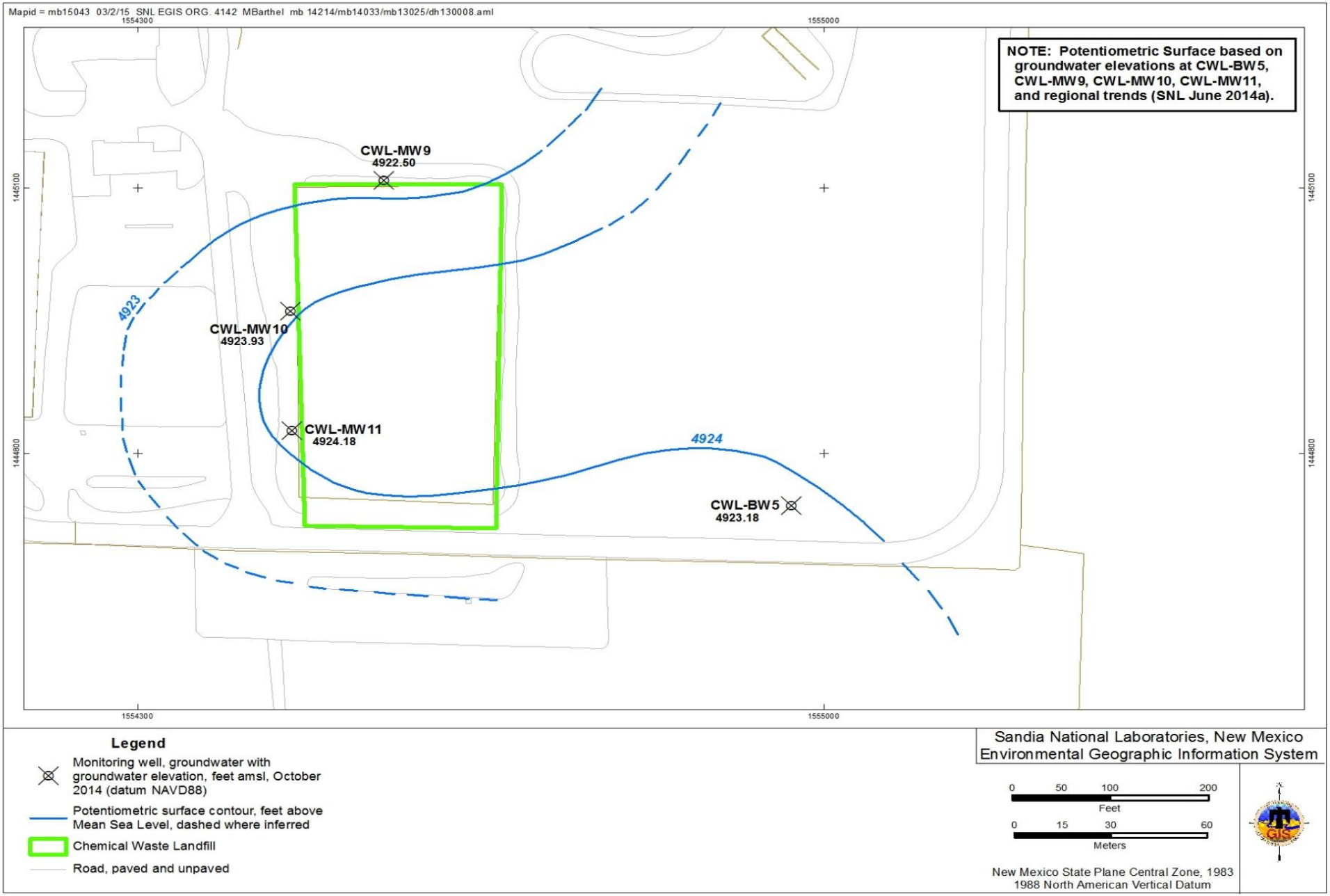
Tijeras Arroyo Groundwater Well Locations



Wells Paired--
Perched and
Regional Aquifer



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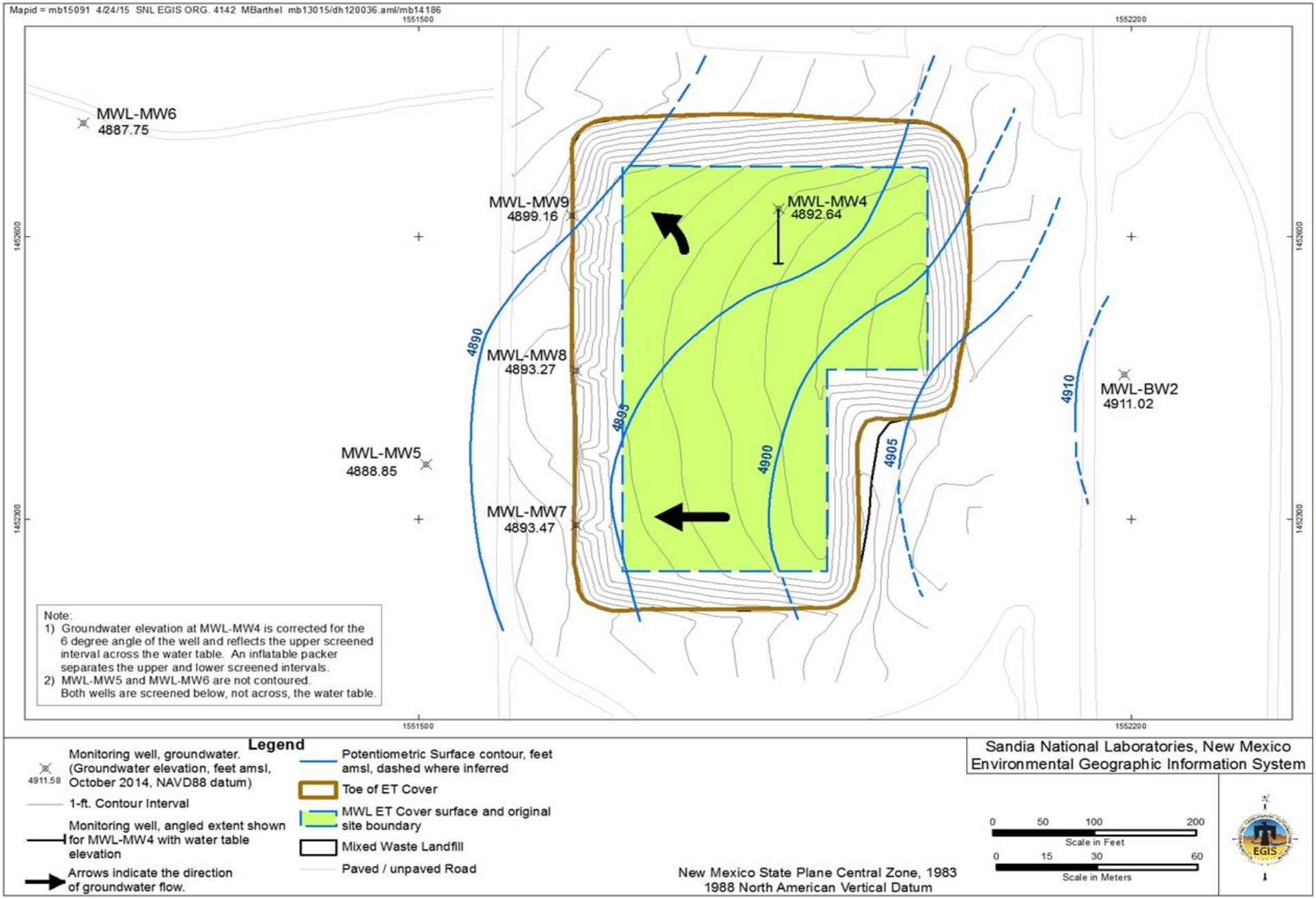
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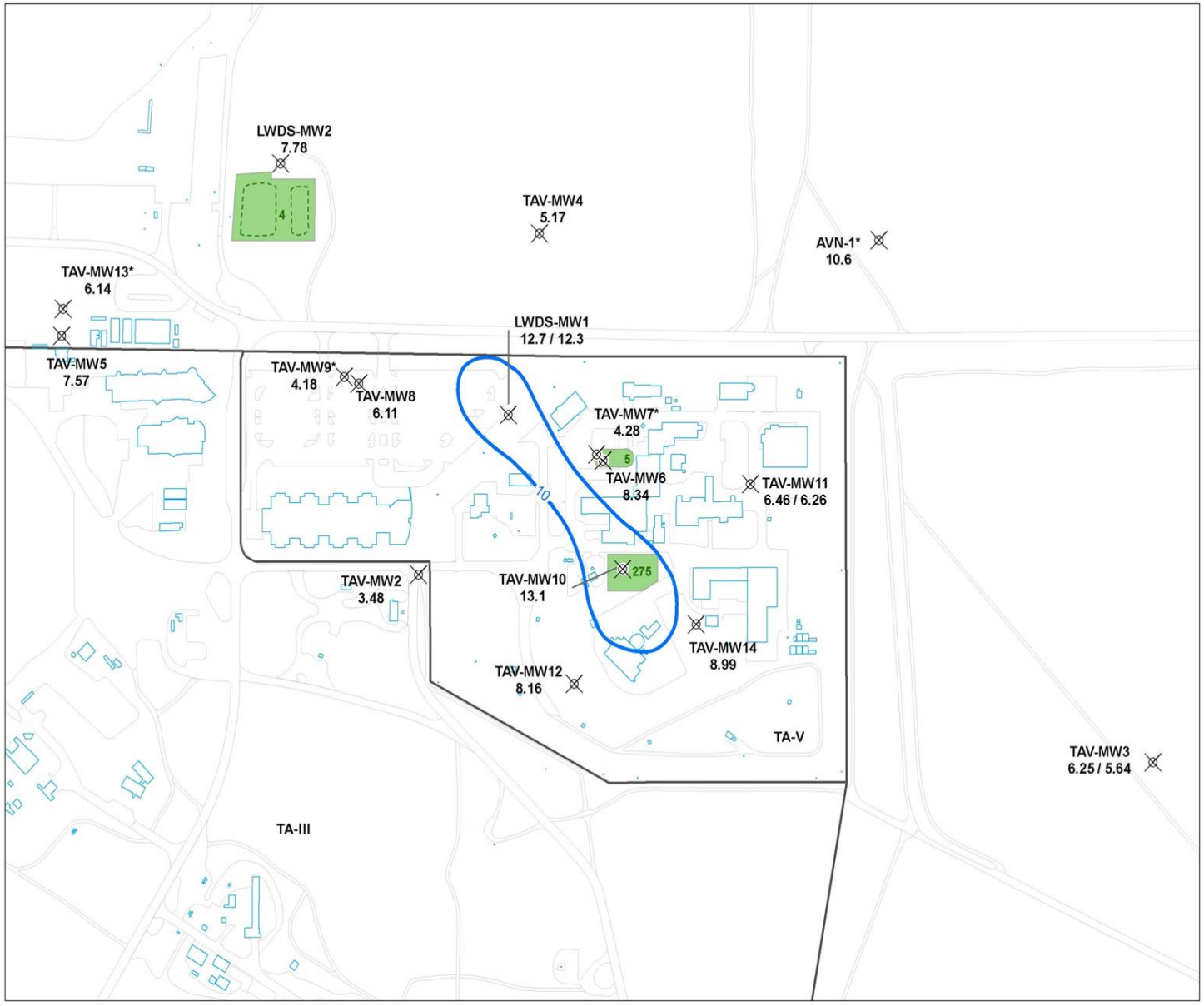
1551500
1552200
1452600
1452300
MWL-MW6
4887.75
MWL-MW9
4899.16
MWL-MW4
4892.64
MWL-MW8
4893.27
MWL-BW2
4911.02
MWL-MW5
4888.85
MWL-MW7
4893.47
4890
4895
4900
4905
4910
Note:
1) Groundwater elevation at MWL-MW4 is corrected for the 6 degree angle of the well and reflects the upper screened interval across the water table. An inflatable packer separates the upper and lower screened intervals.
2) MWL-MW5 and MWL-MW6 are not contoured. Both wells are screened below, not across, the water table.
Legend
Monitoring well, groundwater. (Groundwater elevation, feet amsl, October 2014, NAVD88 datum)
4911.58
1-ft. Contour Interval
Monitoring well, angled extent shown for MWL-MW4 with water table elevation
Arrows indicate the direction of groundwater flow.
Potentiometric Surface contour, feet amsl, dashed where inferred
Toe of ET Cover
MWL ET Cover surface and original site boundary
Mixed Waste Landfill
Paved / unpaved Road
Sandia National Laboratories, New Mexico
Environmental Geographic Information System
0 50 100 200
Scale in Feet
0 15 30 60
Scale in Meters
New Mexico State Plane Central Zone, 1983
1988 North American Vertical Datum
EGIS



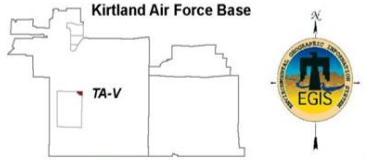
Legend

- 6.25 — Monitoring well, with October/November 2014 Nitrate plus Nitrite concentrations (mg/L)
- Isoconcentration contour (mg/L)
- Road, paved and unpaved
- Building / structure
- Inactive impoundment boundary
- Solid Waste Management Unit (SWMU)
- Tech Area boundary

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

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 ce15504 2-24-15 / mb13135

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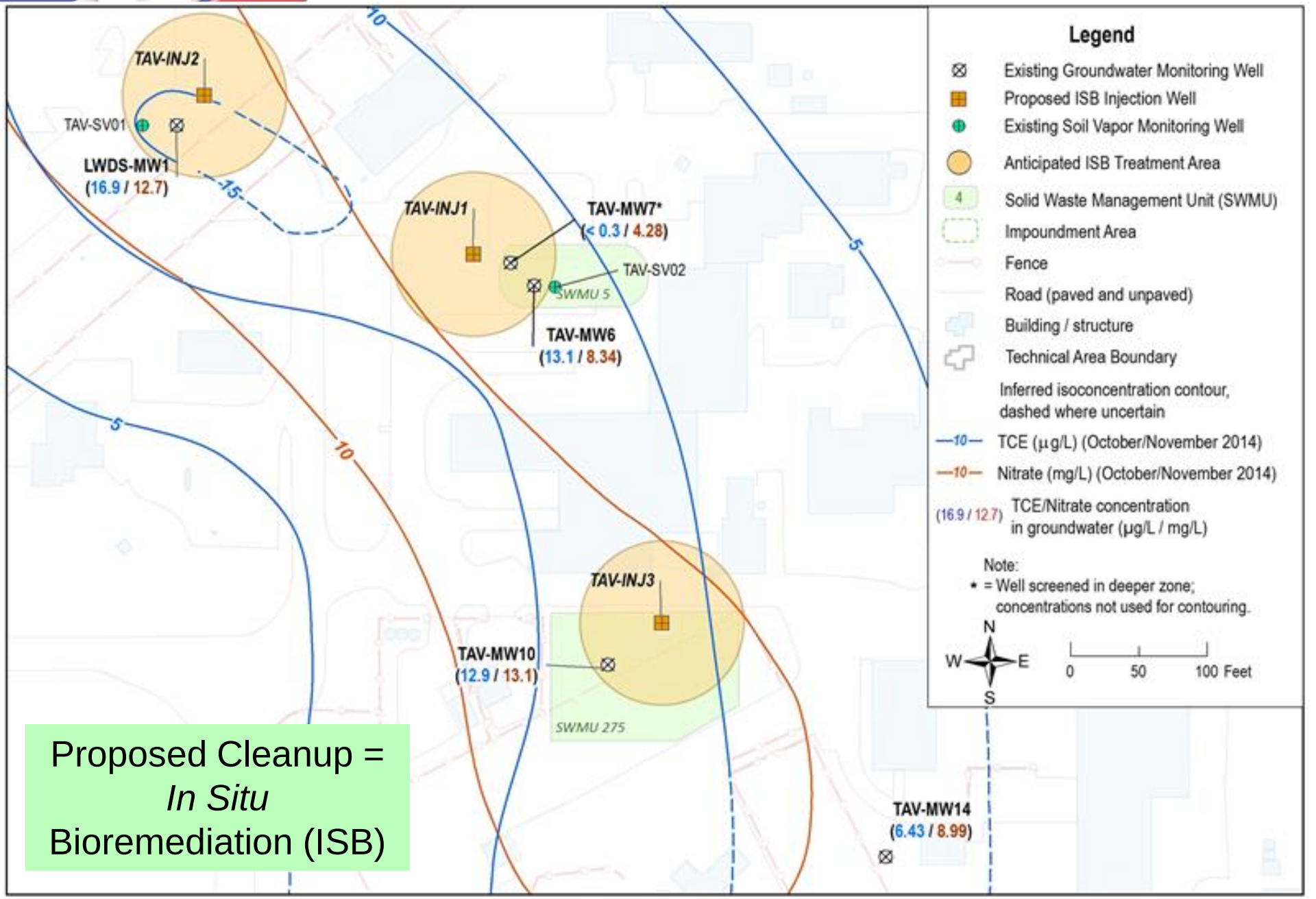

Proposed Cleanup = *In Situ* Bioremediation (ISB)

Miscellaneous Solid Waste Management Units

- No groundwater contamination detected above regulatory standards, except as noted
- **SWMU 8&58**—Explosives test area, two wells. Fluoride above drinking water standard in one well is naturally occurring
- **SWMU 49**—Septic system drain field, one well
- **SWMU 68**—Former burn site, three wells
- **SWMU 116**—Septic system drain field, one well
- **SWMU 149**—Septic system drain field, one well
- **SWMU 154**—Septic system drain field, one well. Trace concentration (less than one part per billion) of an explosive, RDX (no regulatory standard); and arsenic up 0.0774 ppm (regulatory standard is 0.01 ppm)

Miscellaneous Solid Waste Management Units

- No groundwater contamination detected above regulatory standards, except as noted
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- **SWMU 154**—Septic system drain field, one well. Trace concentration (less than one part per billion) of an explosive, RDX (no regulatory standard); and arsenic up 0.0774 ppm (regulatory standard is 0.01 ppm)

Two SWMUs just removed from Permit

Other Five SWMUs

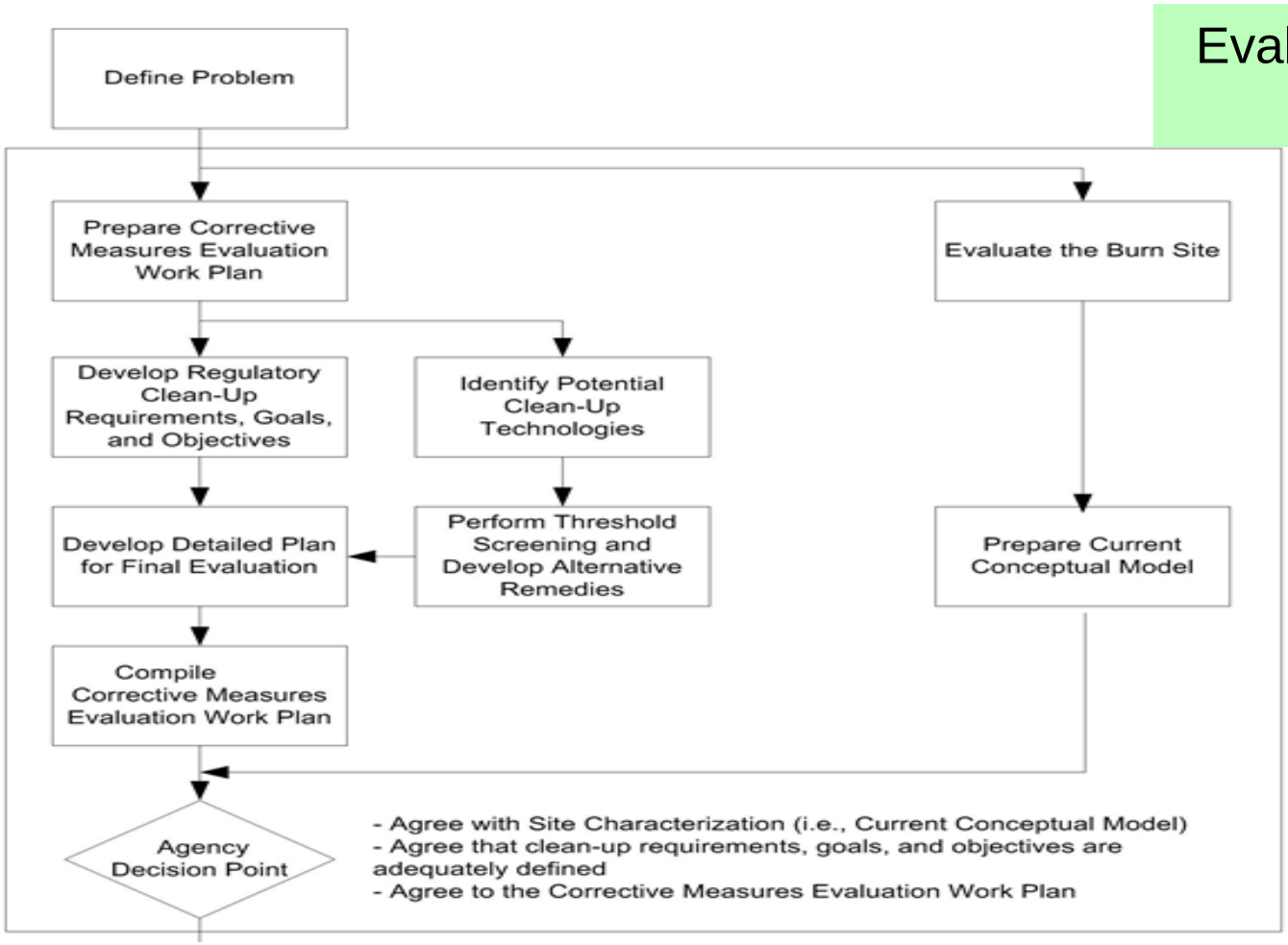
Corrective Measures Evaluation Process for BSG, TAG, and TAV

Possible remedial alternatives identified in CME Work Plans:

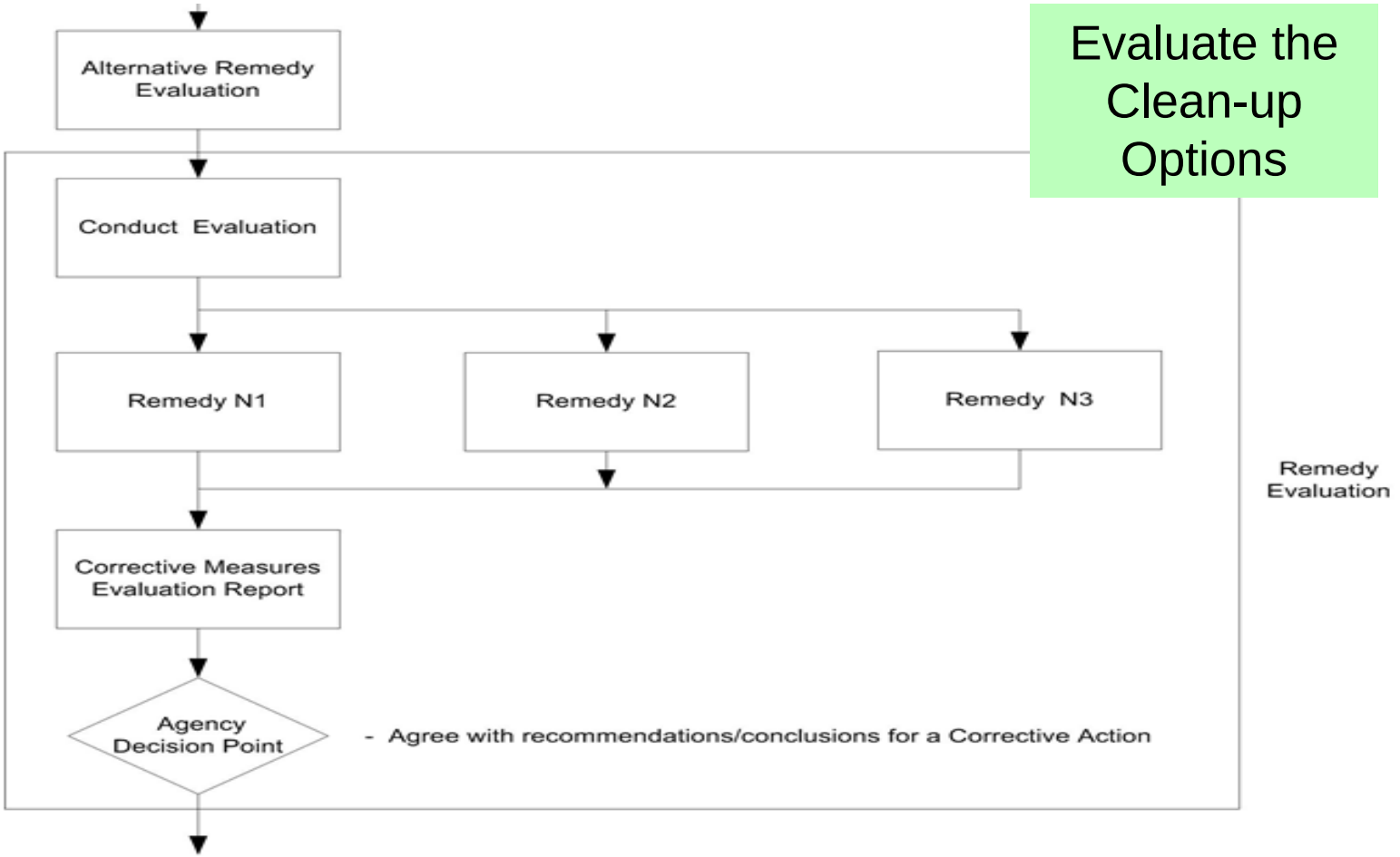
- ~~Groundwater Monitoring~~
- **Monitored Natural Attenuation (MNA)**
- ~~*In Situ* Bioremediation (ISB) followed by Groundwater Monitoring~~
- **ISB followed by MNA**
- ~~Pump and Treat followed by Groundwater Monitoring~~
- ~~Pump and Treat followed by MNA~~

Heavy Reliance on Natural Attenuation

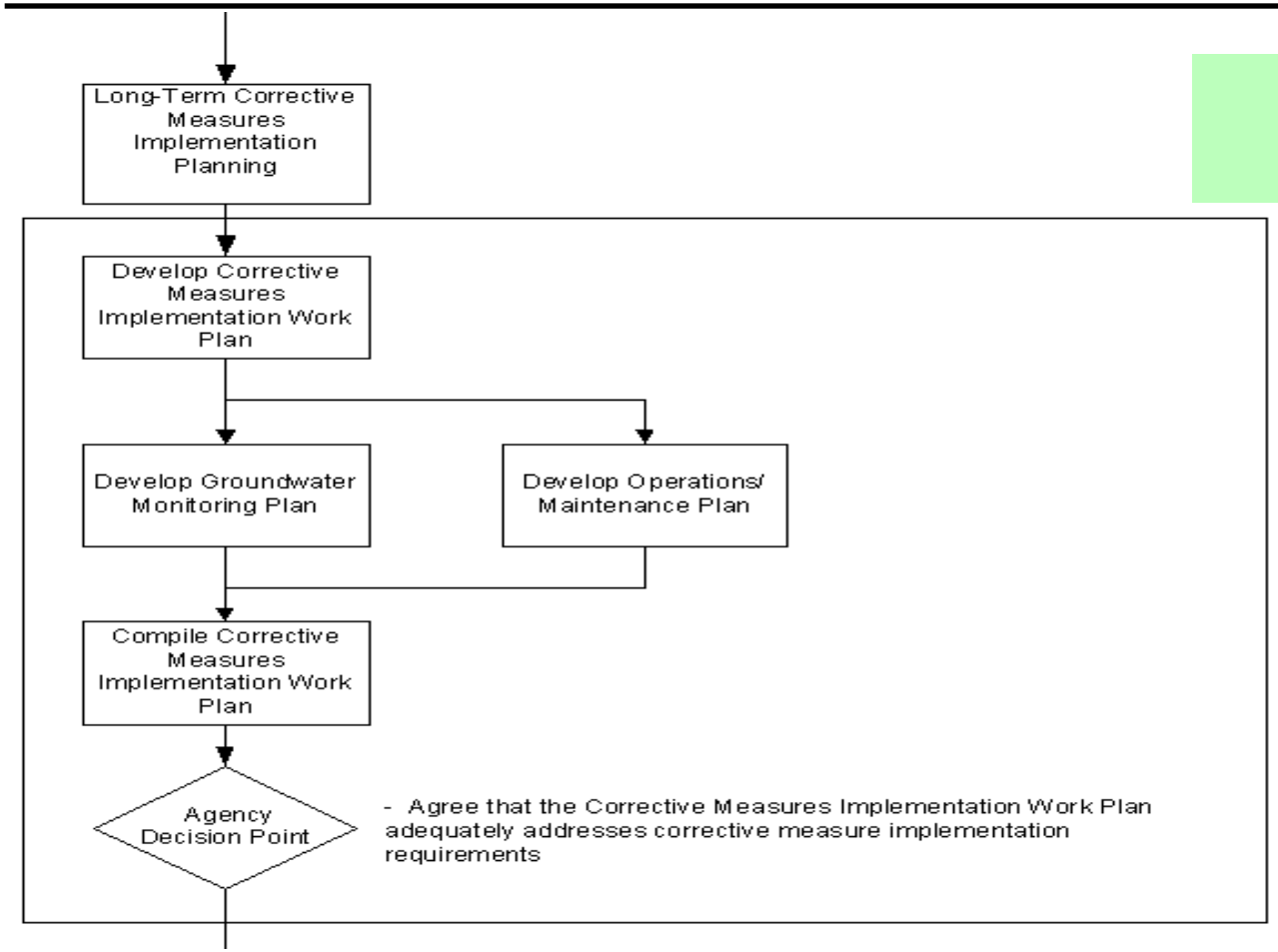
Corrective Measures Evaluation Process for BSG, TAG, and TAV



Corrective Measures Evaluation Process for BSG, TAG, and TAV



Corrective Measures Evaluation Process for BSG, TAG, and TAV



Plan the Cleanup

Corrective Measures Evaluation Process for BSG, TAG, and TAV