

Burn Site Groundwater Area of Concern Characterization Activities Update, August 2016



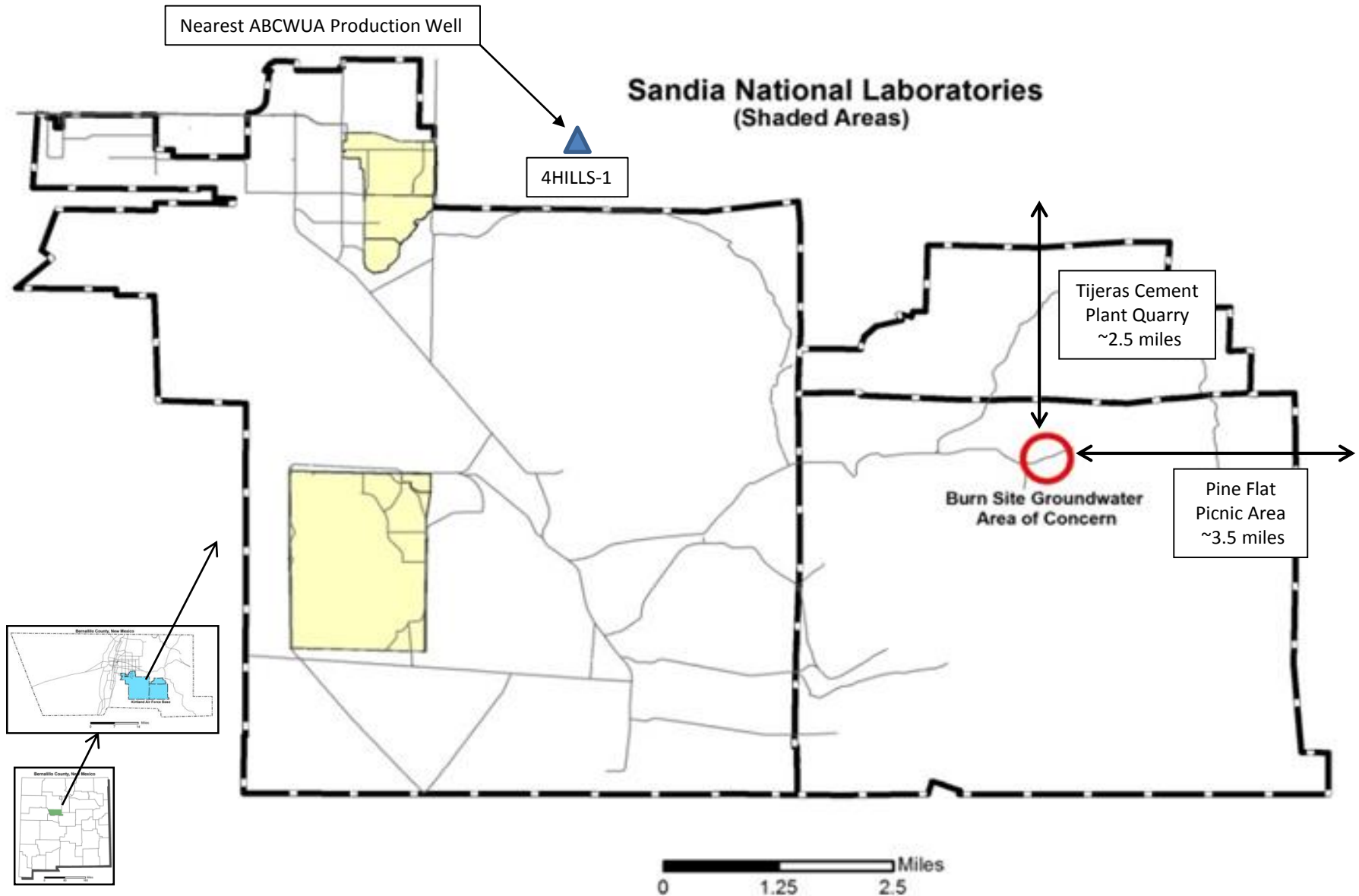
Michael F. Skelly
Sandia National Laboratories



Outline of Discussion

- Hydrogeologic Setting (complex)
- Site History
- Contaminant Distribution and Trends
- Recent Investigation Activities
- Future Work

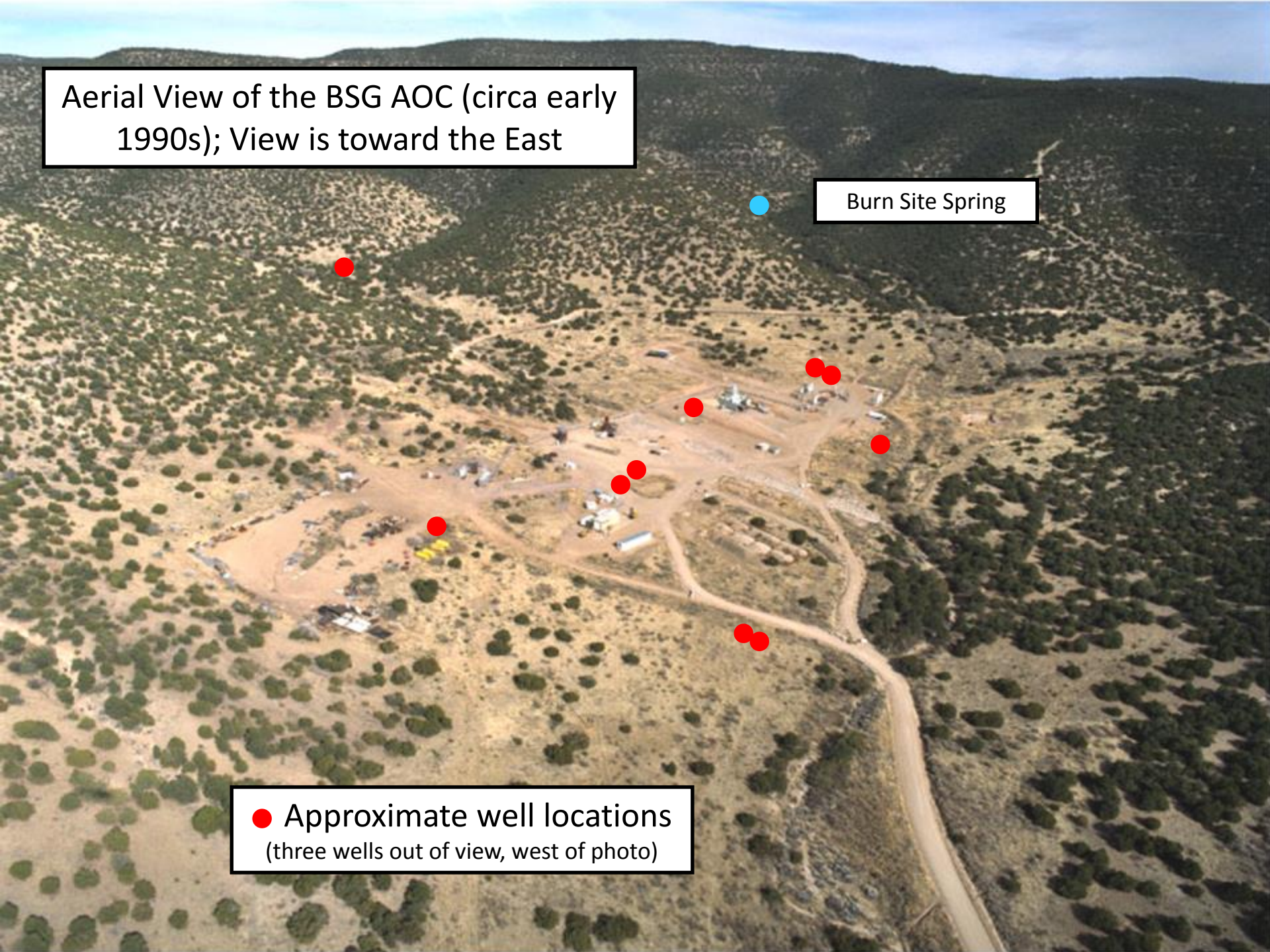
Location of Burn Site Groundwater Area of Concern



Aerial View of the BSG AOC (circa early 1990s); View is toward the East

Burn Site Spring

● Approximate well locations
(three wells out of view, west of photo)

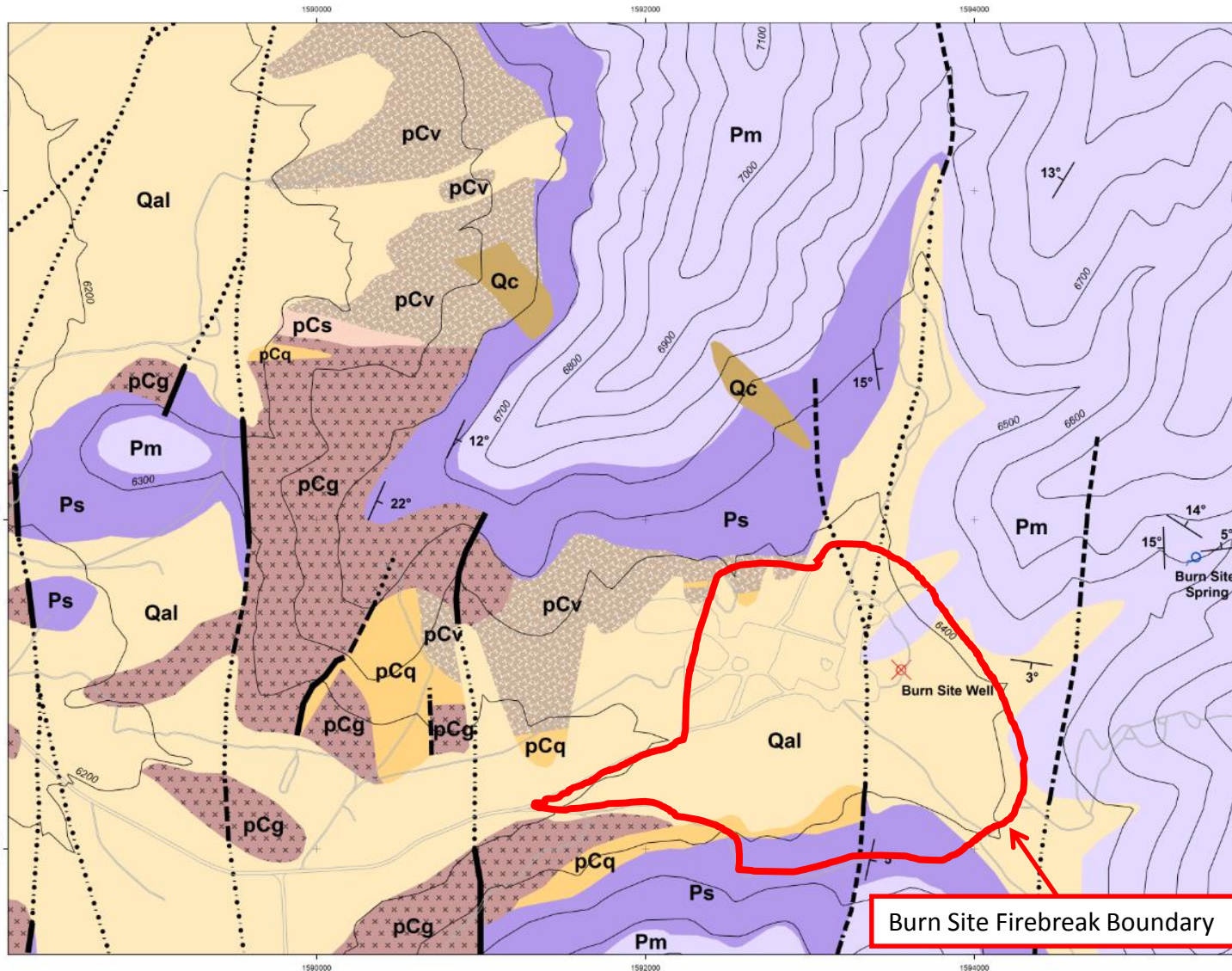




General Conditions at BSG AOC

- GW monitored since 1996.
- Potentiometric surface at ~90 to 326 ft deep (average of ~200 ft) in a very complex fractured-bedrock aquifer (schist/phyllite/granite).
- Semiconfined to confined conditions. Narrow fracture zones, poorly interconnected--only produce a few gpm.
- Currently sampling 10 wells and collecting water levels in 12 wells.
- Nitrate currently exceeds standard in 7 wells with historical maximum of 41.9 ppm (MCL = 10 ppm).
- Nitrate plume is ~8 mi. east of nearest downgradient drinking-water well.
- Coyote Springs (perennial) are ~3 miles downgradient, and has ~0.5 ppm nitrate.

BSG AOC Geologic Map



Legend

Quaternary Units

Alluvium = Qal

Colluvium = Qc

Pennsylvanian Units

Sandia Formation = Ps

Madera Group = Pm

Precambrian Units

Granite = pCg

Quartzite = pCq

Metavolcanic = pCv

Schist and Phyllite = pCs

Symbols

..... fault, concealed

— fault, normal, approximate

— fault, normal, certain

..... fault, normal, concealed

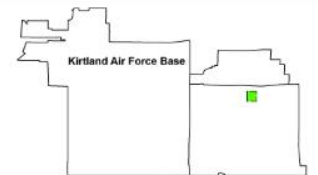
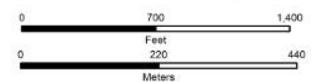
— Topographic contour, 100-ft interval

— Road, unpaved

⊗ Burn Site Well

⊙ Burn Site Spring

↗ Strike and dip (in degrees)



**Geologic Map of
The Burn Site Area
(Modified from Connell, 2008)**



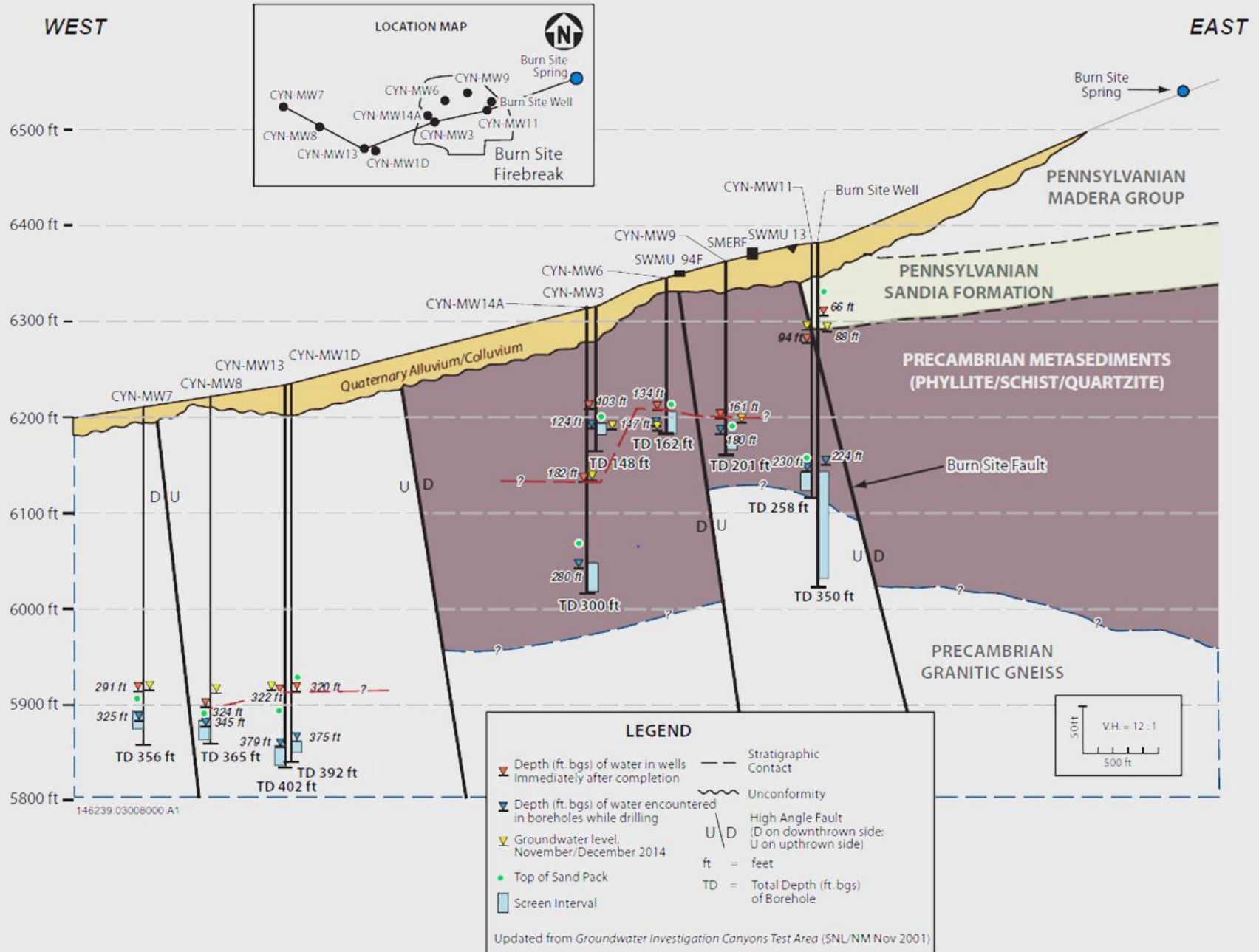
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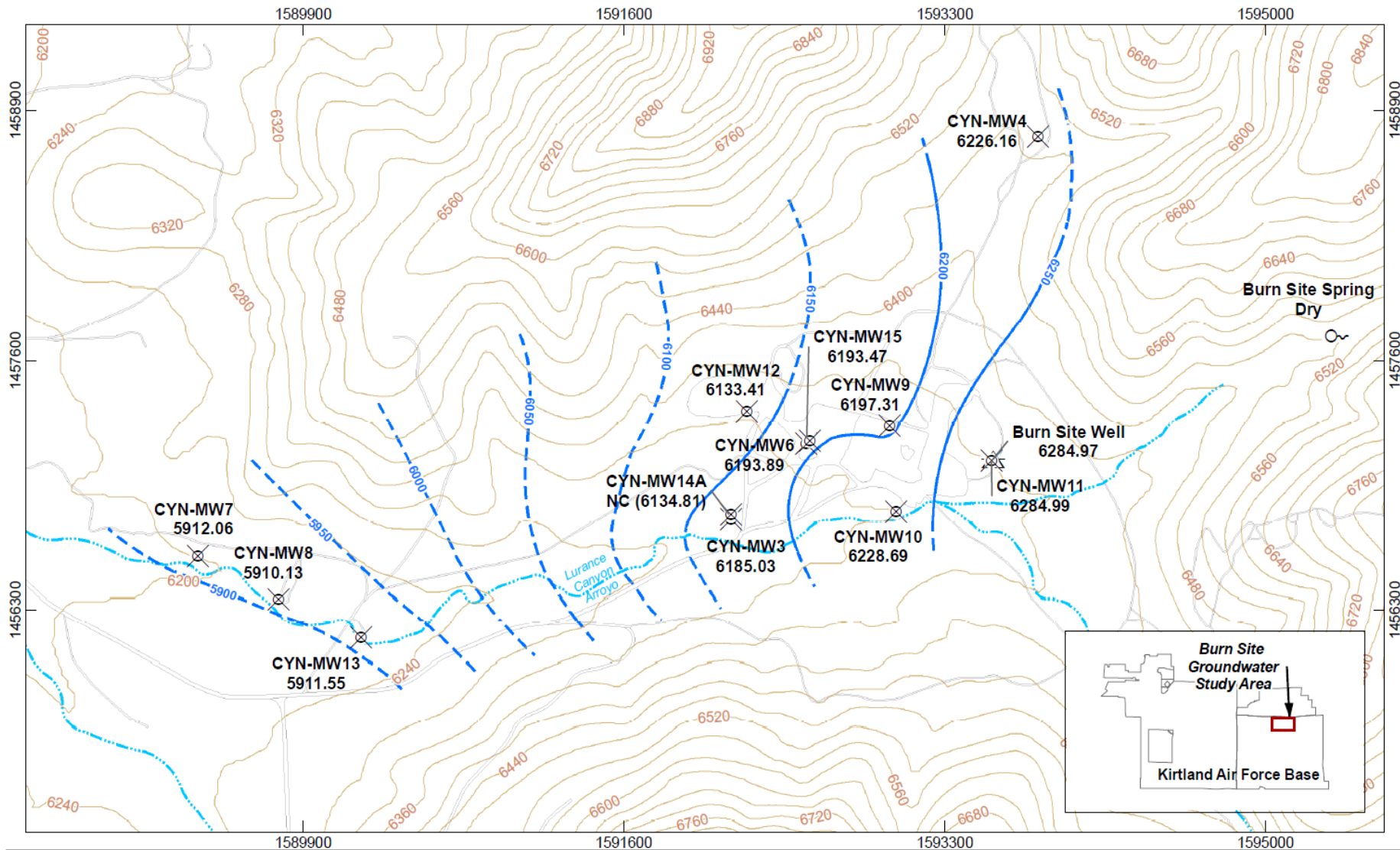
New Mexico State Plane Central Zone, 1983
1988 North American Vertical Datum

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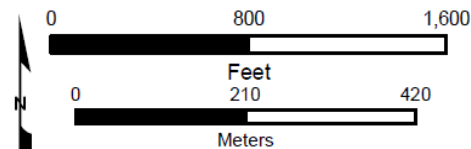
Burn Site Firebreak Boundary

Fence Diagram across BSG AOC





- Legend**
- ⊗ Monitoring well, groundwater
Groundwater elevation (ft amsl)
October 2015, datum NAVD 88
 - △ Production well (non-potable)
 - Spring
 - NC Not contoured
 - Potentiometric surface contour
(ft amsl), dashed where inferred
 - Surface drainage, arroyo
 - Road, unpaved
 - Ground surface contour (40 ft)



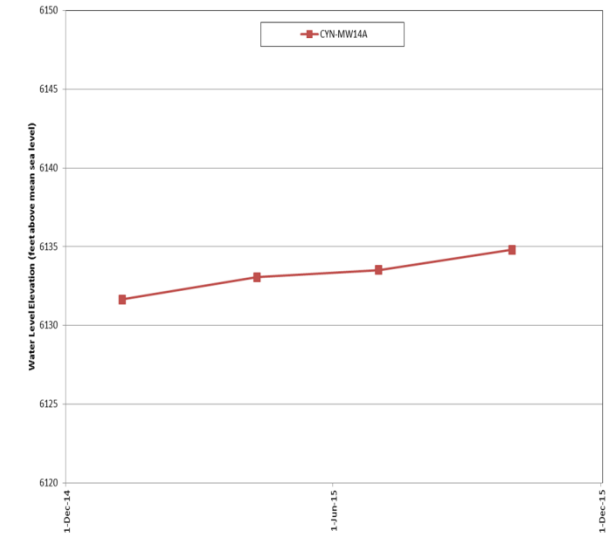
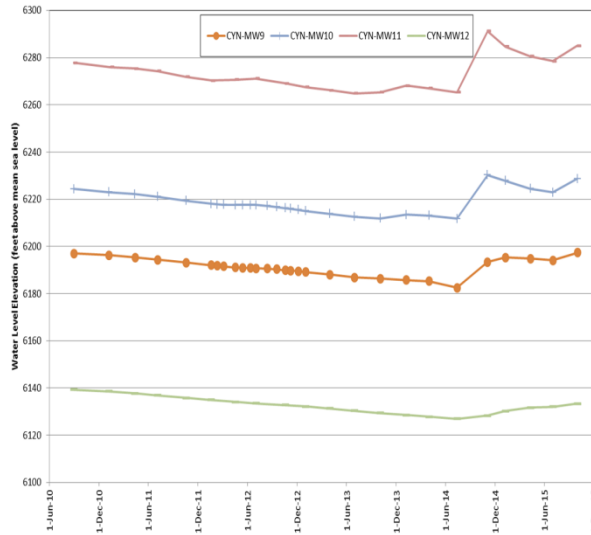
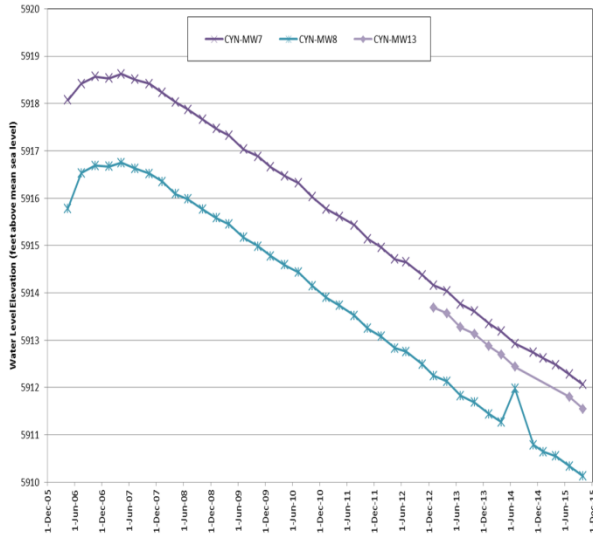
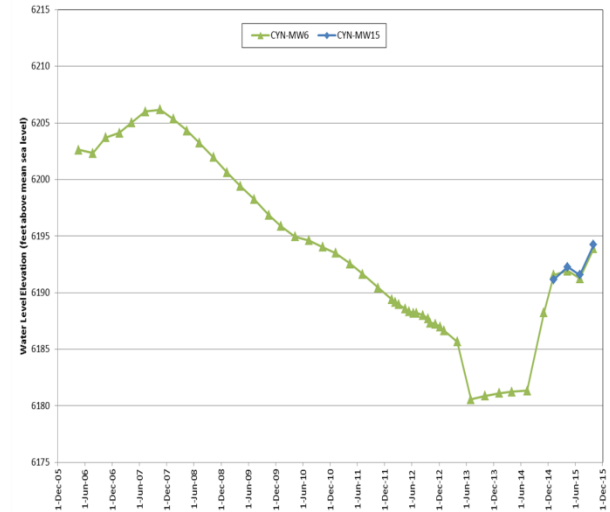
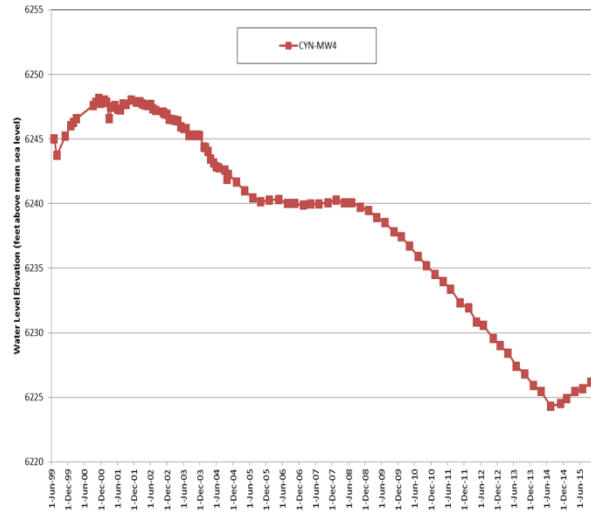
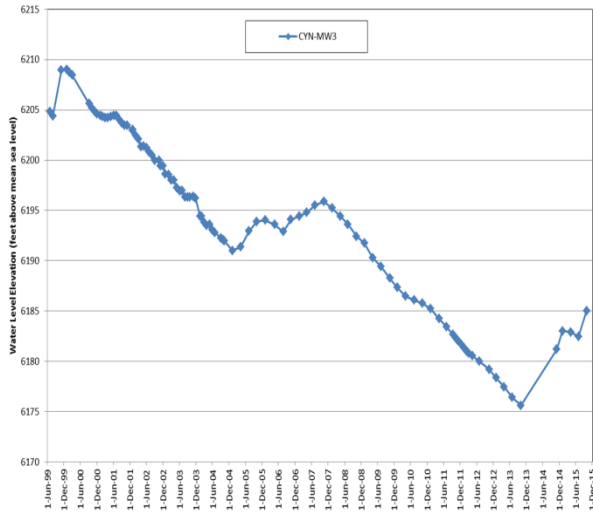
New Mexico State Plane Central Zone, 1983
1988 North American Vertical Datum



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BSG Water Levels Over Time





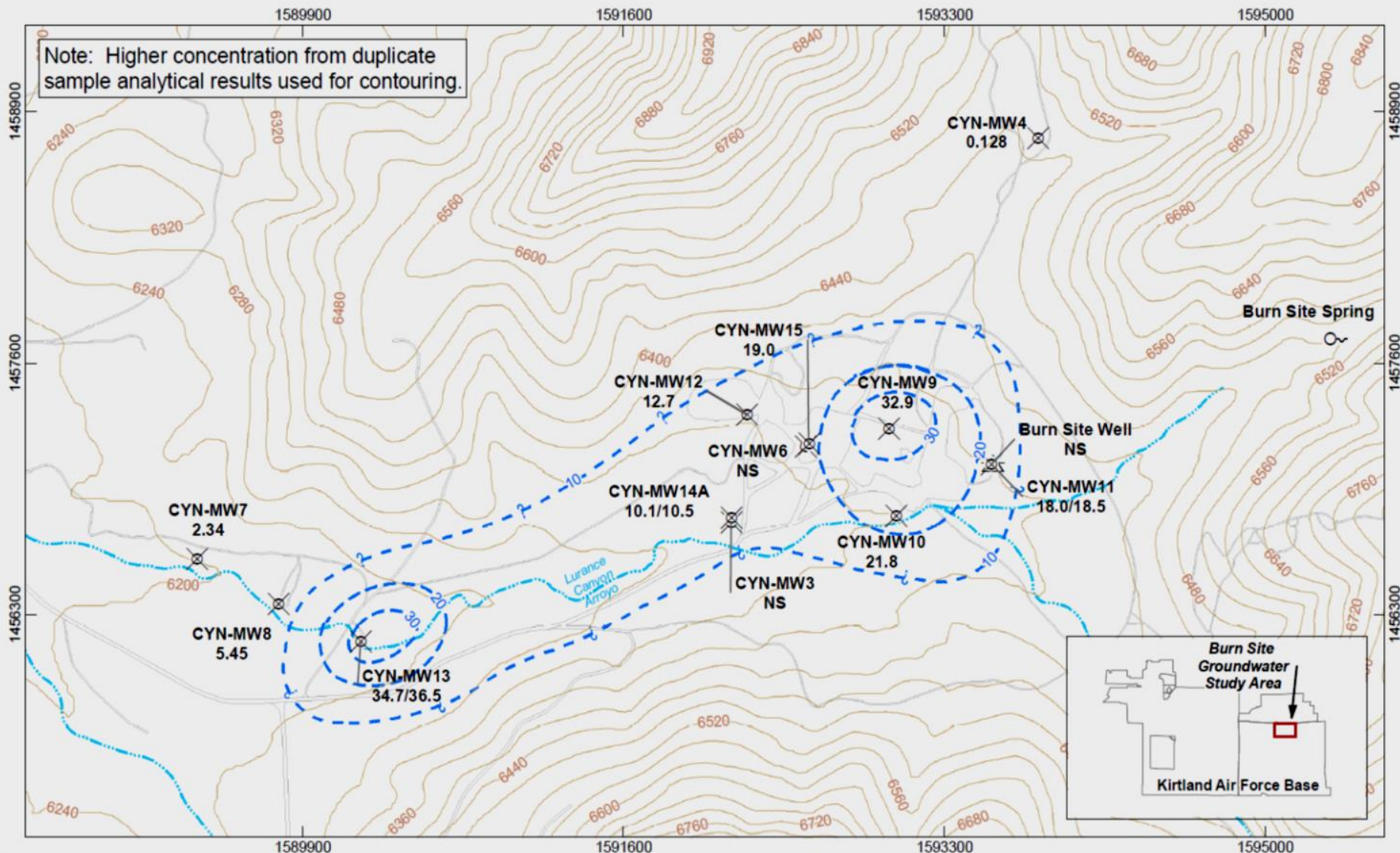
History of the Burn Site

- Groundwater characterization activities are regulated by NMED Hazardous Waste Bureau.
- The Lurance Canyon Burn Site and Lurance Canyon Explosive Test Site have been used since 1967.
- Historical operations included open detonation of HE compounds and open burning of HE compounds, liquid propellants, and solid propellants.
- Ammonium nitrate slurry tests conducted in 1969-1970.
- Burn testing using petroleum fuels began in early 1970s and has continued to the present.
- Early burn testing was conducted in unlined pits excavated in native alluvium and bedrock.

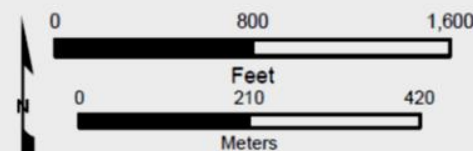


History of the Burn Site (continued)

- By 1975, portable, steel, burn pans were used for open burning with excess materials collected for reuse.
- Engineered burn units constructed in 1980 through 1983.
- Burn units used jet fuel.
- Research involves testing fire survivability of transportation containers, weapon components, simulated weapons, and satellite components.
- 16 SWMU subunits investigated for potential soil contamination; all approved for Corrective Action Complete.



- Legend**
- ⊗ Monitoring well, groundwater
 - 12.7 October/November 2015
 - △ Production well (non-potable)
 - Spring
 - NS Not sampled
 - Concentration contour (mg/L) dashed where inferred, queried where uncertain
 - Surface drainage, arroyo
 - Road, unpaved
 - Ground surface contour (40 ft)



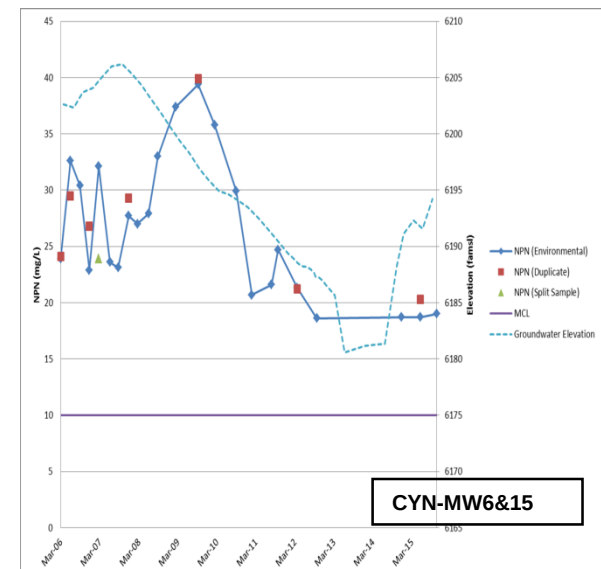
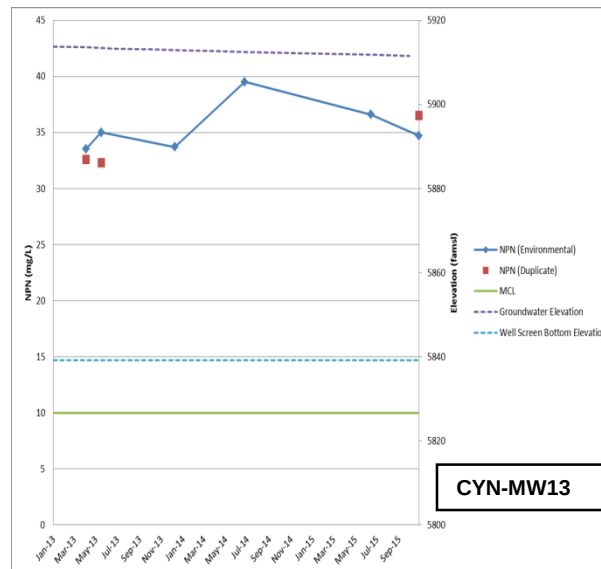
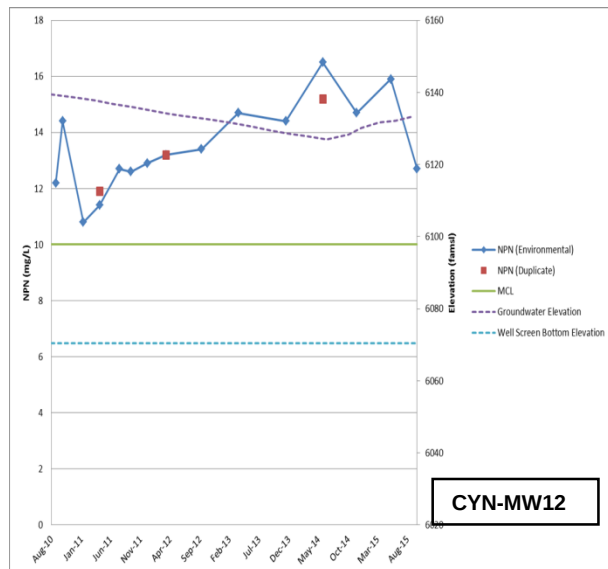
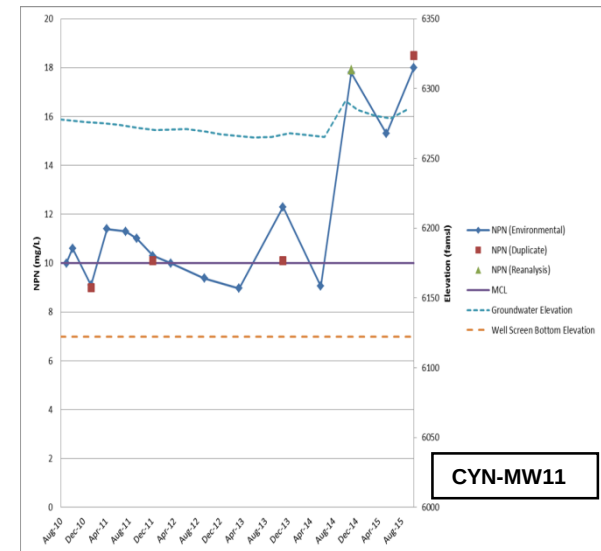
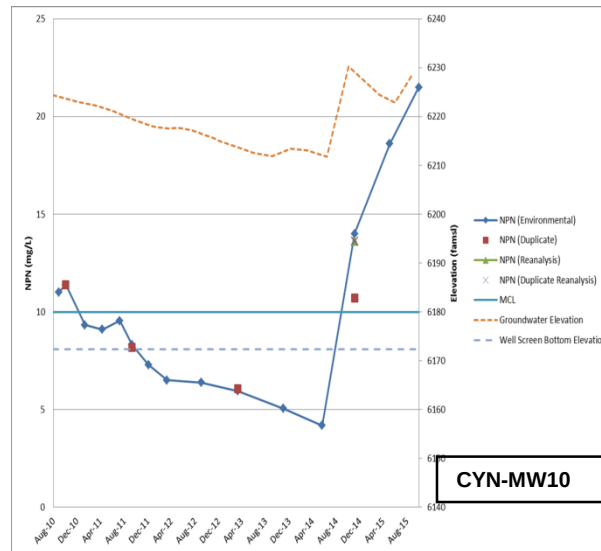
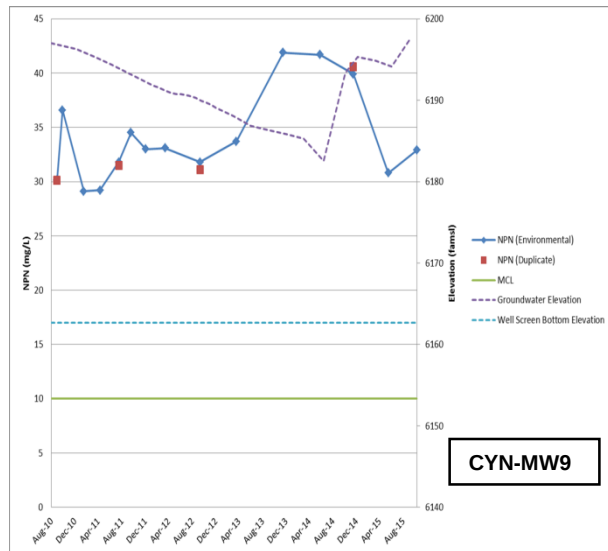
New Mexico State Plane Central Zone, 1983
1988 North American Vertical Datum



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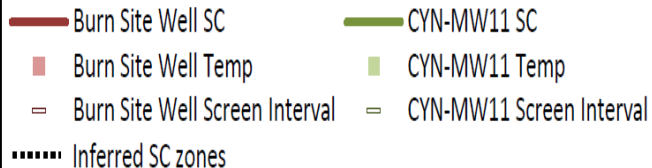
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BSG Nitrate Concentrations Over Time



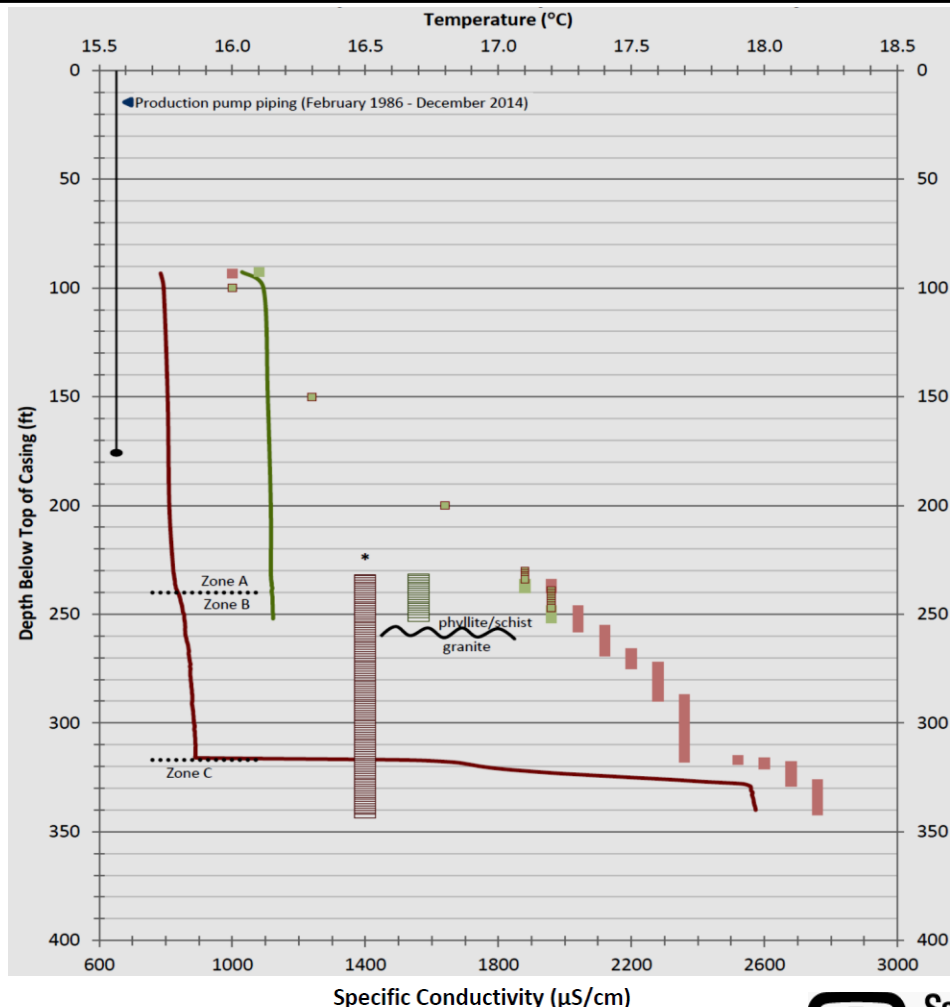
Vertical Profiling of Temperature and Conductivity (Preliminary)

Burn Site Well and Monitoring Well CYN-MW11 Profiles of Temperature and Specific Conductivity



Both wells were logged on 11 Dec 2015 with a Solnist Model 107 TLC meter. Driller recorded water-bearing fractures from 222 to 350 ft bgs. Well stickup is 1.8 ft. Borehole total depth was 350 ft bgs.

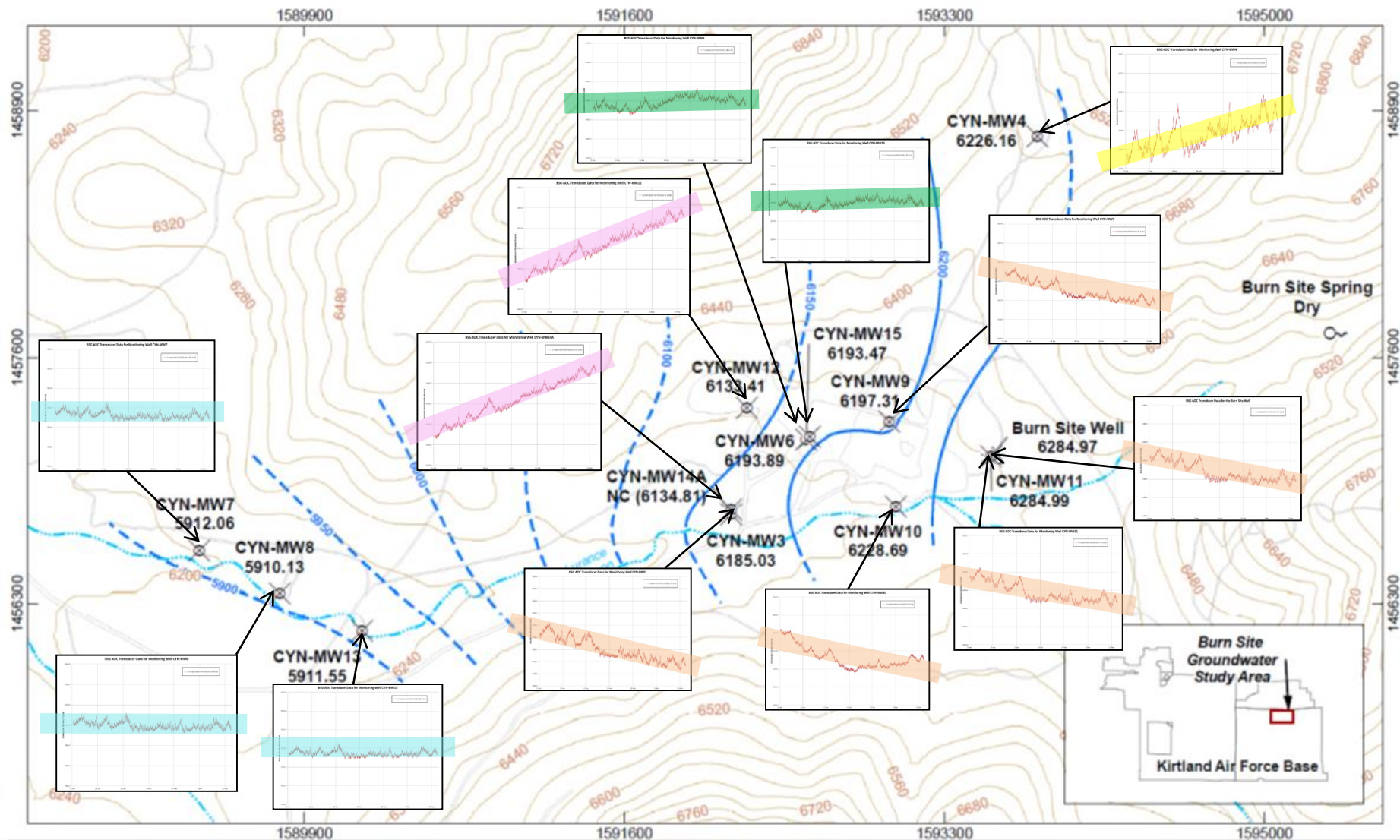
Burn Site Well used from 1986 to 2003 for nonpotable purposes





Long-Term Transducer Study (Preliminary)

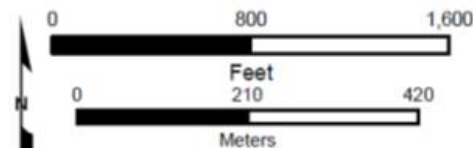
- Placed transducers in 13 wells (including Burn Site well).
- Collected water level and barometric data January 11 through March 13, every 10 min.
- Transducers set at 1 ft above the bottom of the well screen.
- Constructed plots of barometric data, uncompensated water levels, and compensated water levels over time.
- Currently calculating barometric efficiencies and preparing field summary report.
- Another round of data will be collected for several months before Aquifer Pumping Test.
- Preliminary Results (next slide):



- Monitoring well, groundwater
 6228.69 Groundwater elevation (ft amsl)
 October 2015, datum NAVD 88
 Production well (non-potable)
 Spring
 NC Not contoured

Legend

- Potentiometric surface contour (ft amsl), dashed where inferred
 Surface drainage, arroyo
 Road, unpaved
 Ground surface contour (40 ft)



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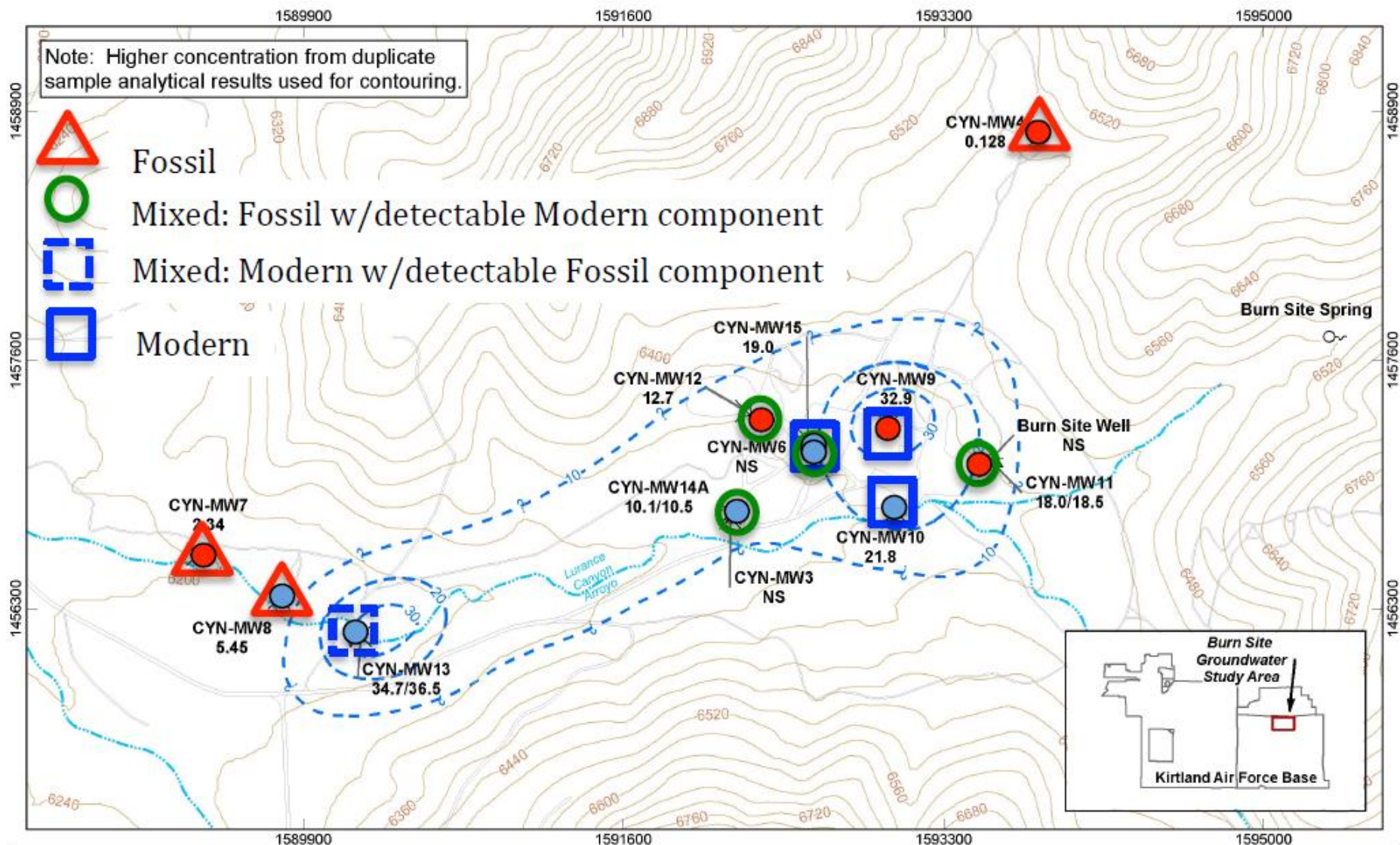


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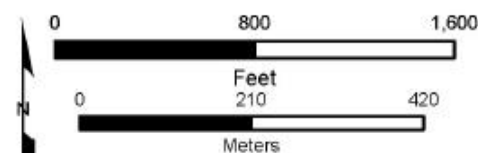


Stable Isotope Study

- Samples collected for analyses of stable isotopes, denitrification and groundwater age data.
- Analysis and interpretation performed by LLNL Environmental Radiochemistry Laboratory.
- Recent samples collected in September 2015, and compared to similar sample suite collected in October 2012.
- Sample suite: Tritium ; $^3\text{He}/^4\text{He}$; noble gases (He, Ne, Ar, Kr, Xe); stable isotopes of water ($^{18}\text{O}/^{16}\text{O}$, $^2\text{H}/^1\text{H}$); stable isotopes of nitrate ($^{15}\text{N}/^{14}\text{N}$, $^{18}\text{O}/^{16}\text{O}$); dissolved N; dissolved Ar; and TOC.
- Preliminary Results (next slide):



- Monitoring well, groundwater
12.7
October/November 2015
Nitrate plus Nitrite concentration, mg/L
- Production well (non-potable)
- Spring
- Not sampled
- Legend**
- Concentration contour (mg/L) dashed where inferred, queried where uncertain
 - Surface drainage, arroyo
 - Road, unpaved
 - Ground surface contour (40 ft)



New Mexico State Plane Central Zone, 1983
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Aquifer Pumping Test (In Preparation)

- Aquifer Pumping Test Work Plan submitted to NMED on June 6, 2016; approved by NMED on June 21, 2016.
- All wells instrumented, pumping at Burn Site Well.
 - Long-Term Transducer Study (round two).
 - Step-Drawdown Test.
 - Constant-Rate Test.
 - Interval sampling for nitrate in discharge water.
- Field work in the Spring 2017.
- Briefing with NMED Summer 2017.
- Report to NMED Spring 2018.



Future Work (Contingent on Funding from Congress)

- Share final results of Long-Term Transducer Study with NMED (Fall 2016).
- Share vertical profile groundwater sampling nitrate results with NMED (Fall 2016).
- Share final results/meet with NMED on the Stable Isotope Study (Fall 2016).
- Perform Aquifer Pumping Test (Spring 2017).
- Discuss future work activities with NMED (Summer 2017).
- Submit CCM to NMED (Fall 2020).
- Submit CME Report to NMED (Fall 2020).



Summary

- The BSG AOC is in an isolated location--nearest downgradient ABCWUA production well is ~8 miles away.
- Very complex hydrogeology.
- Considerable groundwater characterization work has been completed.
- SNL characterization activities are regulated by the NMED Hazardous Water Bureau.
- Nitrate is the only contaminant of concern and is only found at relatively minor concentrations.
- Nitrate from the BSG AOC will never reach production well at concentrations exceeding MCL.