Pahute Mesa and Rainier Mesa Tour Booklet

Nevada Site
Specific Advisory Board

April 10, 2019

Prohibited Articles On Nevada National Security Site (NNSS) Public Tours

The following items are prohibited within the boundaries of the NNSS public tours. Tour escorts are required to do random checks.

- Cellular Phones
- Bluetooth Enabled Devices
- PDA, BlackBerry, etc.
- Computers
- Portable Data Storage Devices
- Global Positioning System (GPS)
- Cameras/Camcorders
- Binoculars
- Optical Instruments
- Geiger Counters
- Recording Devices
- Pets and Animals
- Explosives
- Ammunition
- Incendiary Devices
- Chemical Irritants
- Alcoholic Beverages
- Controlled Substances
- Any Item Prohibited by Law

Possession of these items may delay the tour and prevent your participation.

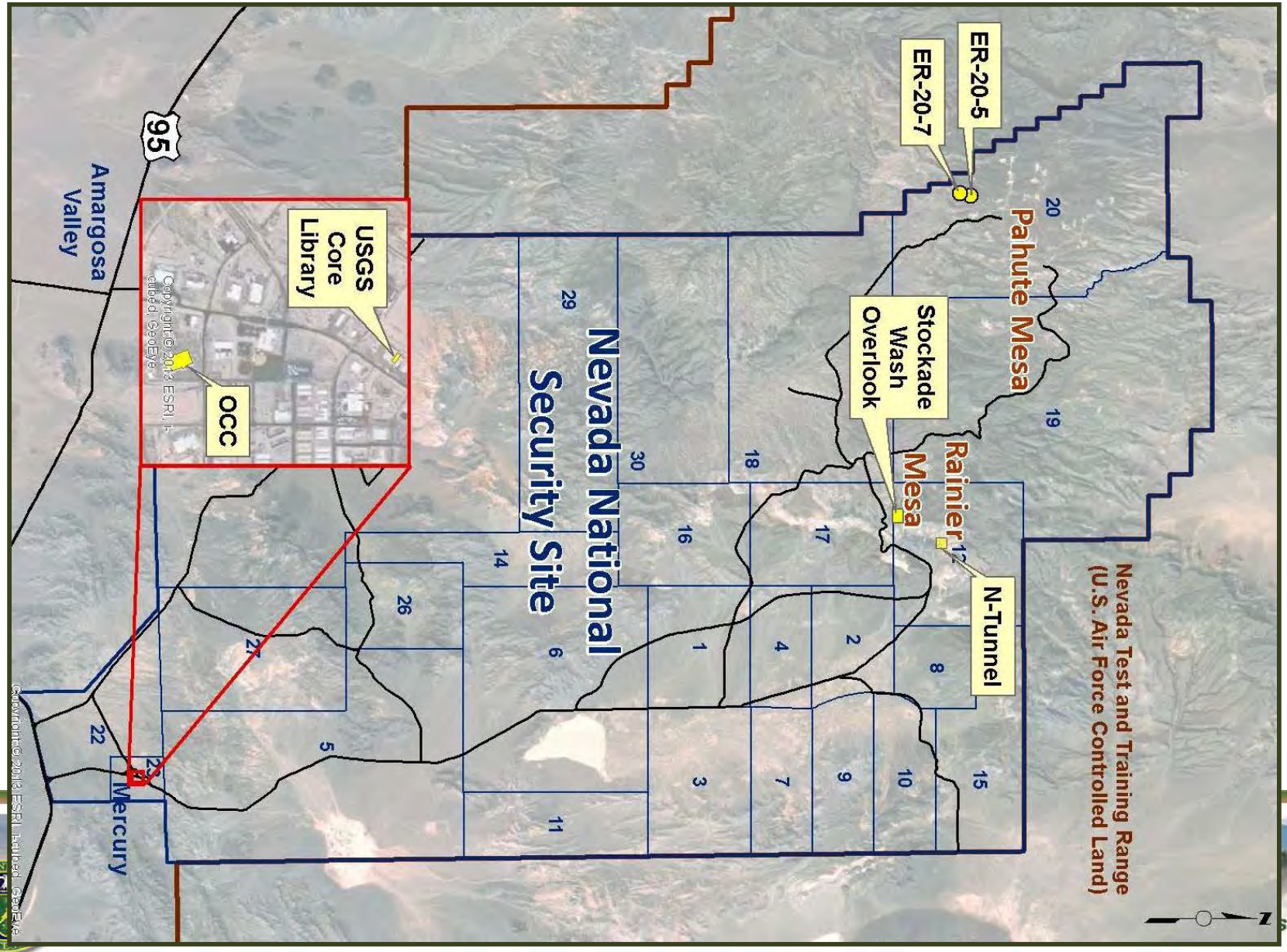
If at any point during the tour these items are discovered, the tour may be terminated.

Tour Agenda*

8:35 a.m.	Arrive at Mercury Badge Office.
9:10 a.m.	Depart for USGS Core Library.
9:15 a.m.	Arrive at USGS Core Library for overview on the NNSS and highlights of trip stops. Rest stop.
9:45 a.m.	Depart for Pahute Mesa – discussion of testing areas of Frenchman Flat and Yucca Flat on bus.
11:05 a.m.	Arrive at Well ER-20-5 for discussion of TYBO (name of nuclear detonation) near field drilling approaches, wells construction, Pahute Mesa hydrogeologic setting, underground test locations, and observation wells.
11:35 a.m.	Depart for Well ER-20-7.
11:45 a.m.	Arrive at Well ER-20-7 for continuation of discussion of TYBO/BENHAM (names of nuclear detonations) setting, observed groundwater contamination and hydrologic setting. Overview of ER-20-7 relative to the Oasis Valley Discharge Area and distal wells. Lunch, rest stop, and open discussion.
12:25 p.m.	Depart for Stockade Wash Overlook.
1:05 p.m.	Arrive at Stockade Wash Overlook. Exit bus for Rainier Mesa hydrogeologic overview discussion. Porta Potties available.
1:35 p.m.	Depart for N-Tunnel for discussion of Rainier Mesa underground testing areas.
1:55 p.m.	Arrive at N-Tunnel Portal for discussion of testing/tunnels and overview of hydrologeology.
2:25 p.m.	Depart for Blue Box.
3:15 p.m.	Arrive at Blue Box for rest stop.
3:30 p.m.	Depart for Gate 100.
3:35 p.m.	Drop off at Mercury and return to Las Vegas.
5:05 p.m.	Arrive Frank H. Rogers Science & Technology Building, LV.

** Subject to change*

Tour Map


Nevada Test and Training Range
(U.S. Air Force Controlled Land)
ER-20-5
ER-20-7
Pahute Mesa
Rainier Mesa
Stockade Wash Overlook
N-Tunnel
Nevada National Security Site
USGS Core Library
OCC
Amargosa Valley
95
Mercury
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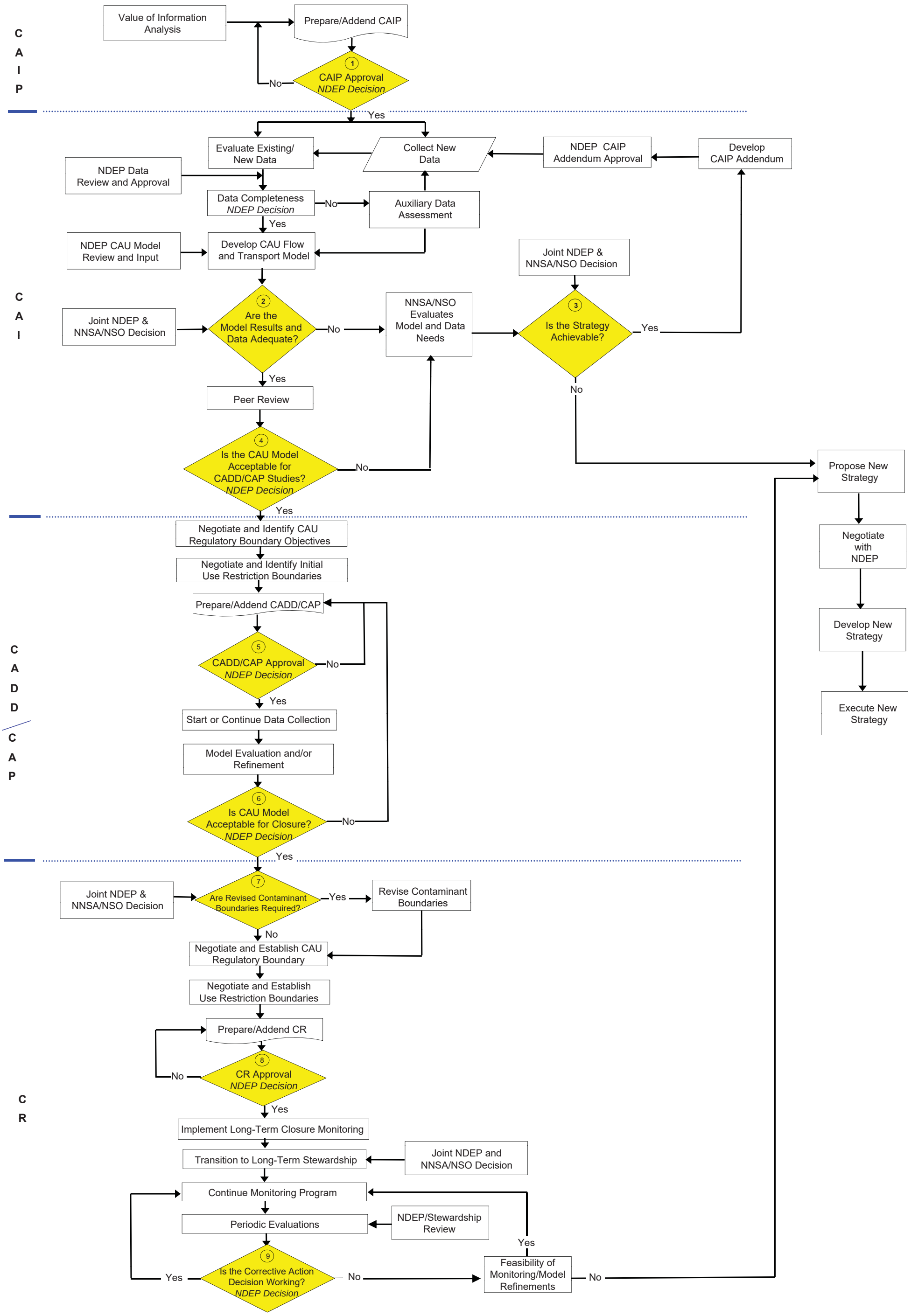
Copyright © 2013 ESRI, Tauber, GeoEye

Underground Test Area (UGTA) Groundwater Closure Strategy

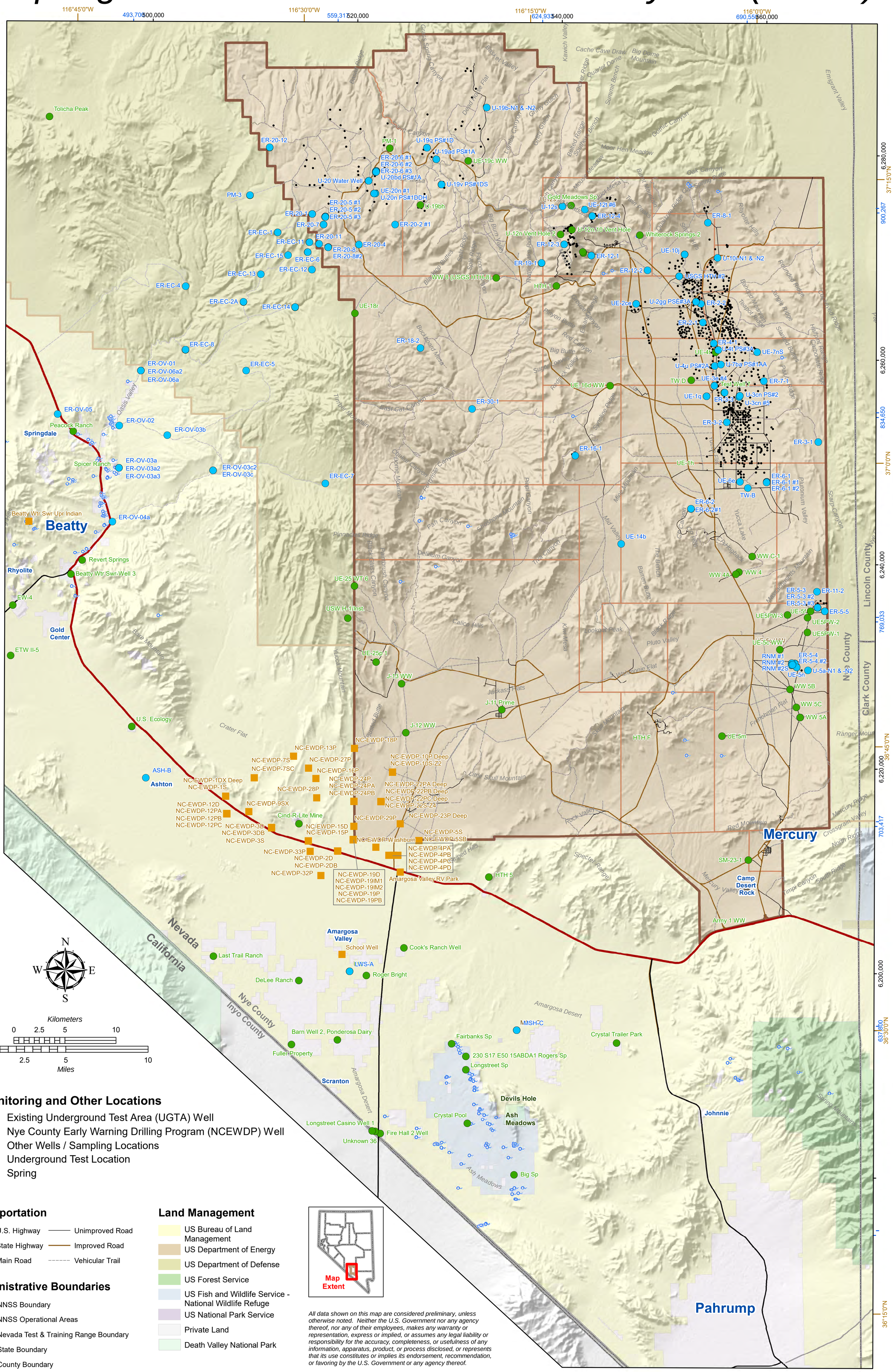


NSSAB FY 2019 Groundwater Work Plan Items

Item 1	Work Plan Item:	*Pahute Mesa Groundwater Sampling Well Prioritization*
	Deadline for Recommendation:	July 2019
	Description:	Background: Environmental Management (EM) NV plans to drill additional groundwater wells on/near Pahute Mesa. In support of this, the EM NV contractor will develop a white paper outlining the proposed well locations. The white paper will be presented to the NSSAB. NSSAB Scope: From a community perspective, provide a recommendation to EM NV that prioritizes the factors used by EM NV to prioritize proposed well locations.

Item 2	Work Plan Item:	*Changes to Approach for Pahute Mesa Completion*
	Deadline for Recommendation:	April 2019
	Description:	Background: EM NV is considering a more pragmatic approach for the closure of the Pahute Mesa Corrective Action Unit (CAU). NSSAB Scope: From a community perspective, provide a recommendation on if the more pragmatic approach is supported by the NSSAB and how it could be improved.

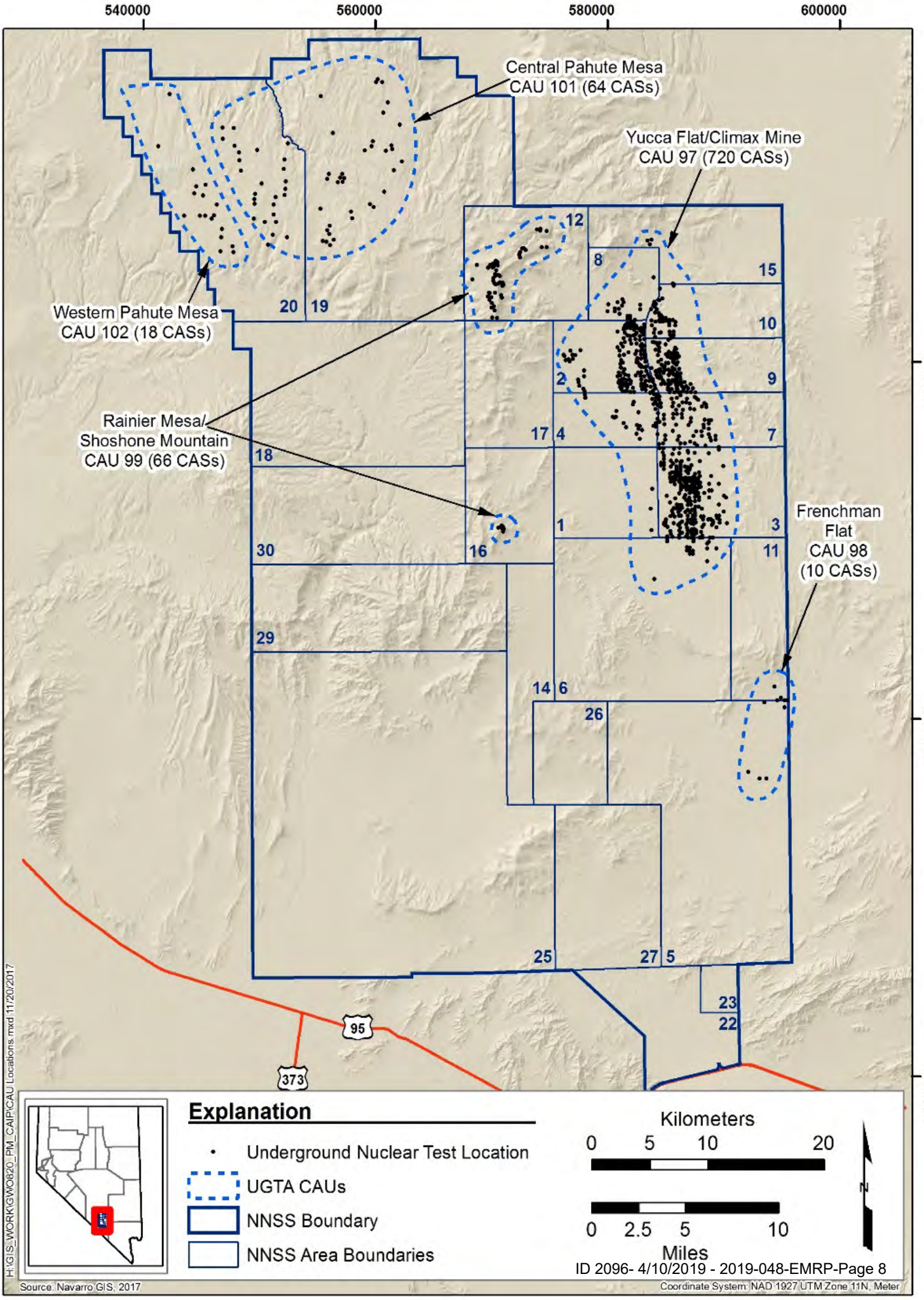
Monitoring & Hydrogeologic Investigation Wells and Springs of the Nevada National Security Site (NNSS)



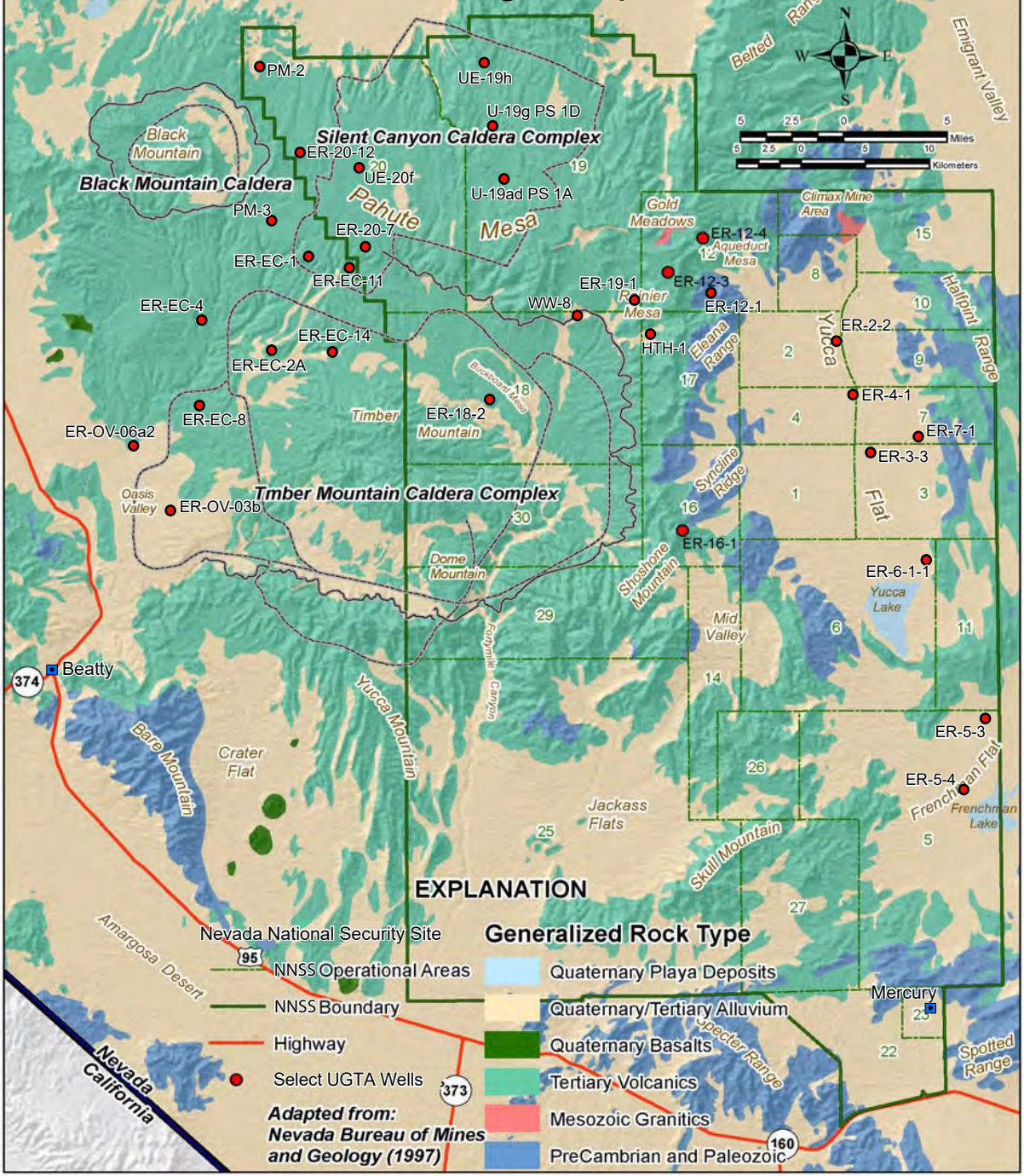
All data shown on this map are considered preliminary, unless otherwise noted. Neither the U.S. Government nor any agency thereof, nor any of their employees, makes any warranty or representation, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use constitutes or implies its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof.

Source: Navarro GIS, 2019; NSTec, 2015; US Bureau of Land Management, 2012; USGS, 2010; ESRI, 2018.
Path: H:\GIS_WORK\GWO844_Monitoring&HydrogeologicInvestigationWells\Monitoring_Wells_and_Springs_20180515.mxd - 4/1/2019
Coordinate Systems: Latitude and Longitude values, 15 minute intervals; North American Datum 1927 Universal Trans Mercator Zone 11 North, meters; North American Datum 1983 State Plane Nevada Central, feet

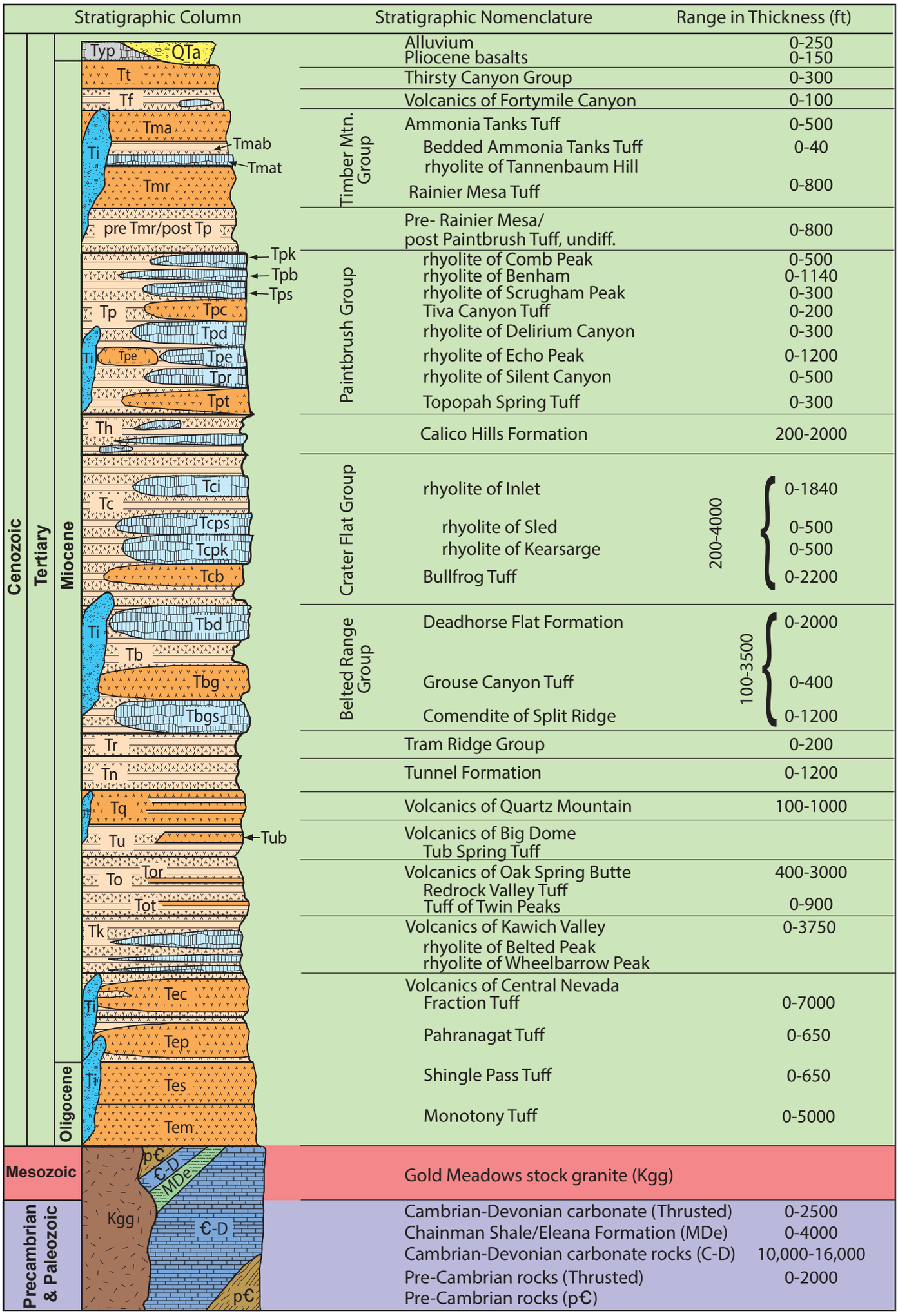
Underground Test Area (UGTA) Corrective Action Units (CAUs)



Generalized Geologic Map of the NNSS



Source: SNJV, 2005b

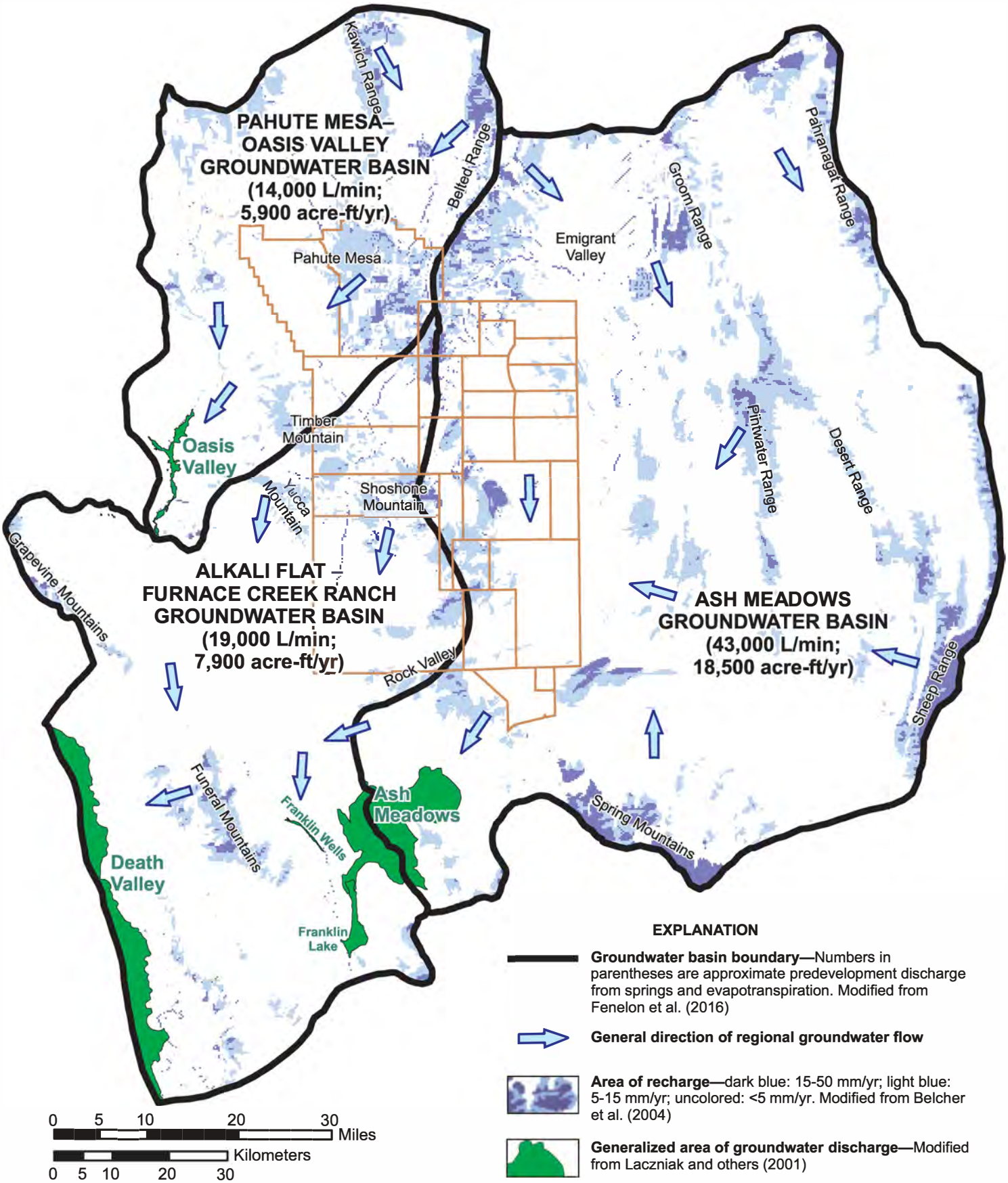


Explanation

- welded ash-flow tuff
- nonwelded and bedded ash-fall tuff
- basaltic lava
- rhyolitic lava
- inter-caldera intrusives
- alluvium
- limestone/ dolomite
- silty shale/ quartzite
- intrusive granite
- p€ sediments

Schematic Stratigraphic Column for the Pahute Mesa and Bench Areas

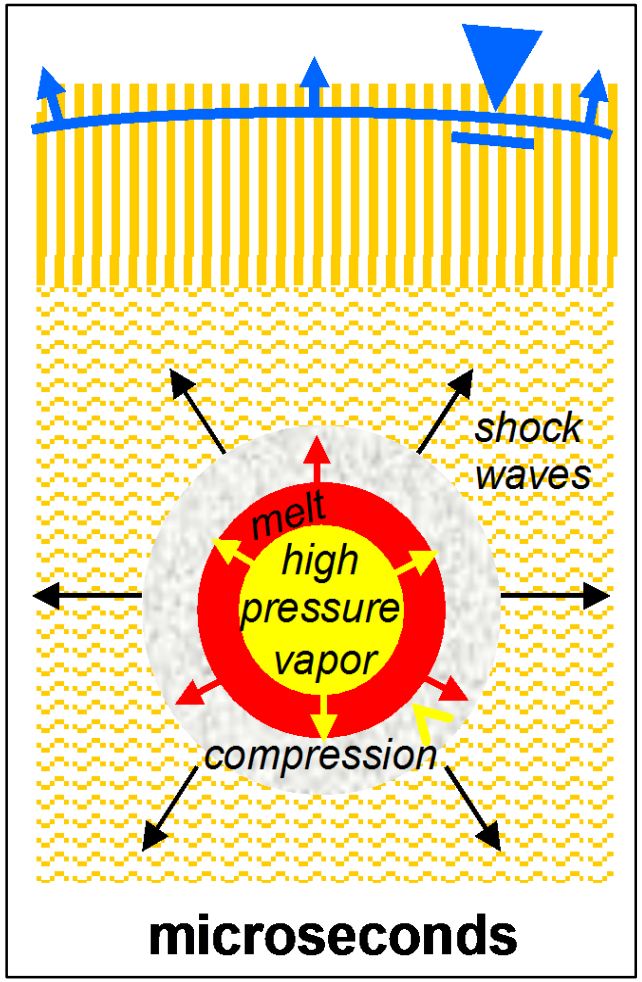
modified from NSTec 2014



Groundwater basins, areas of recharge and discharge, and general flow directions

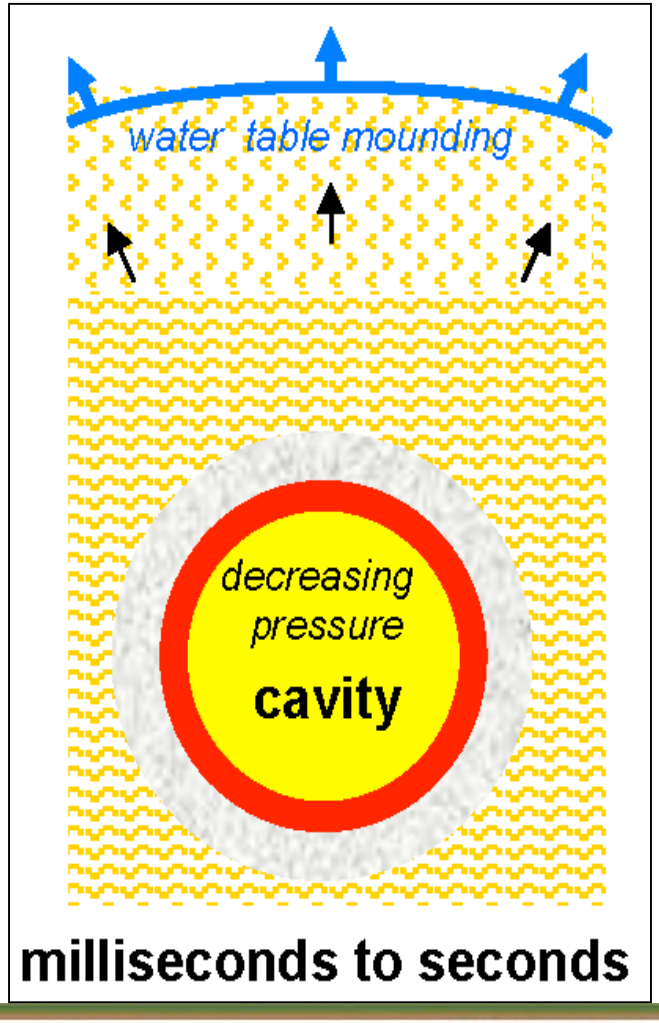
Underground Nuclear Test Detonation

- Instantaneous vaporization of rock, water, and device/diagnostic hardware
  - ~70 metric tons of rock per kiloton of yield is vaporized
- Gas includes all residual radionuclides
- Extremely high temperatures and pressures initiate compressive shock wave



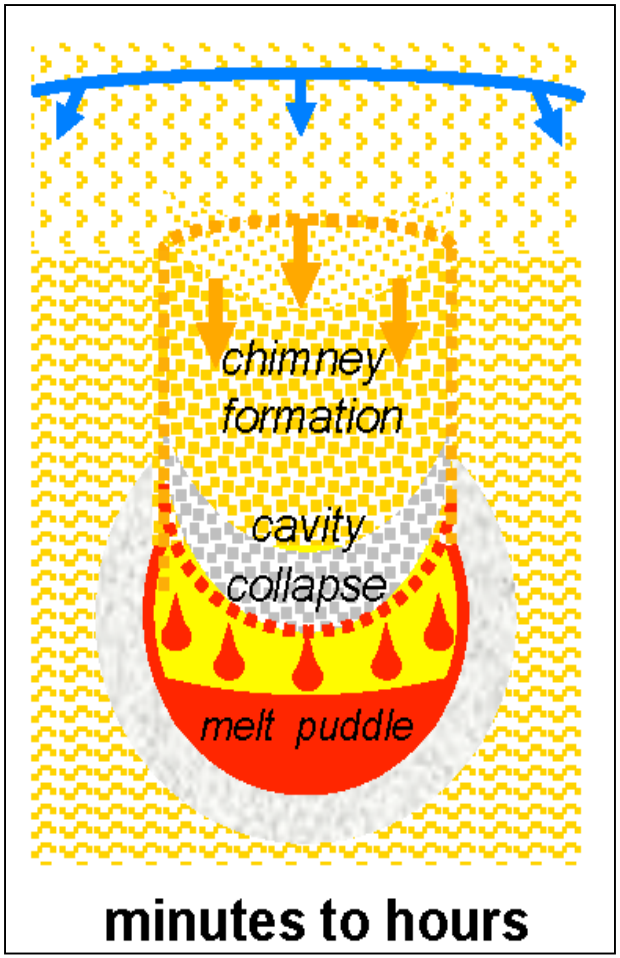
Cavity Formation

- Gas expansion with heat contained in the cavity
  - Cavity reaches maximum size ~80-500 milliseconds after detonation
- Radiating shock wave melts, crushes, fractures and compresses surrounding rock
- Elastic unloading/rebound helps contain cavity gases; some exceptions
- Water table mound created



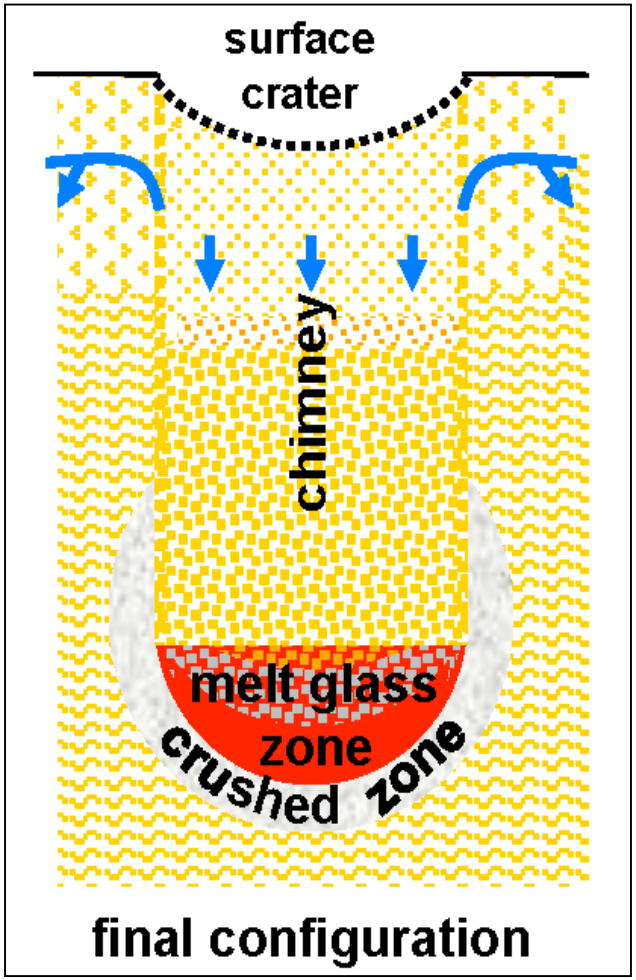
Cavity Collapse

- Cavity expansion leads to decreasing pressures and high temperatures
- Gases condense in order of molecular vapor pressure
- Aggregate melt glass “puddle” forms
  - ~700 metric tons of rock per kiloton of yield is melted
- Overburden begins to collapse into open cavity to form “rubble” chimney
- Remaining gases circulate in void spaces
- Steam condenses to water

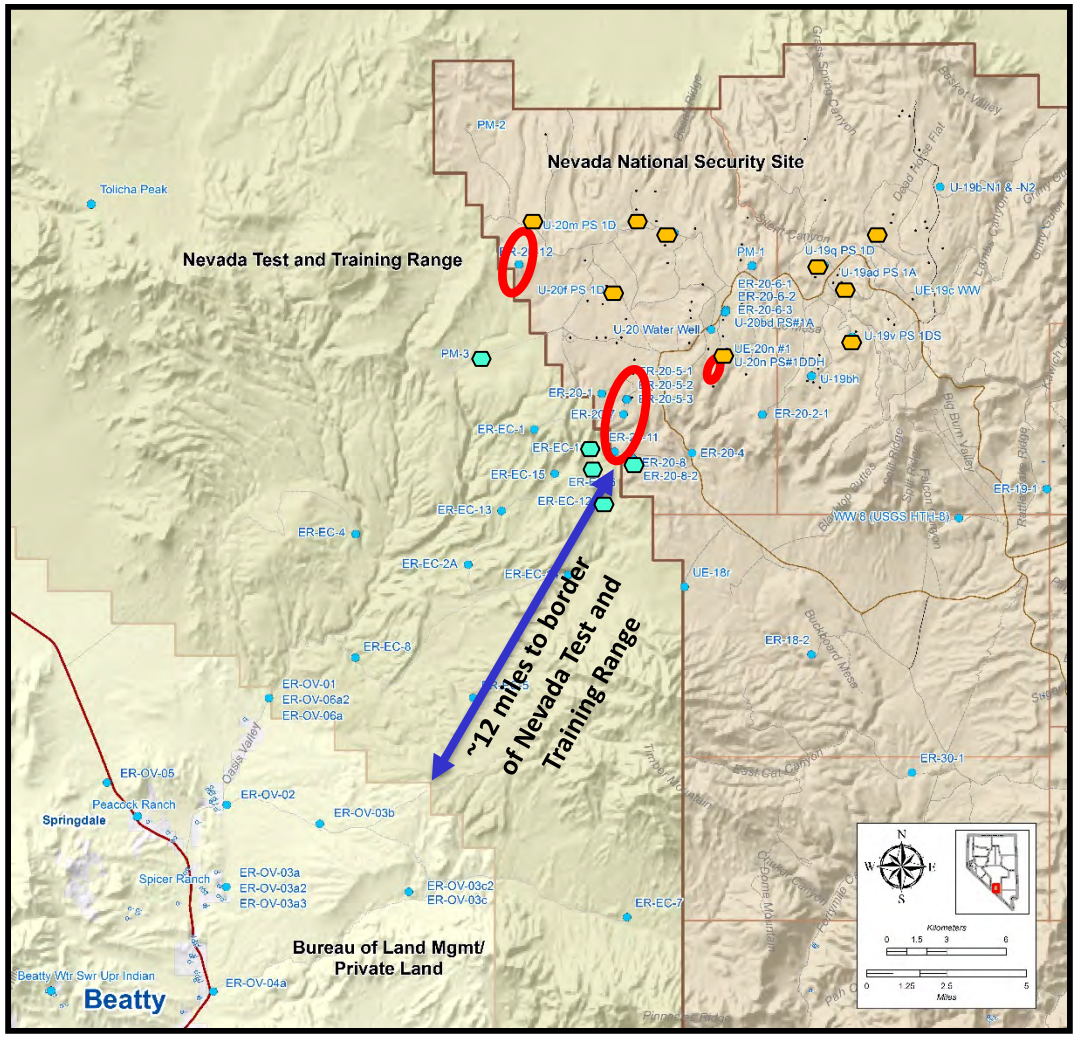


Final Configuration

- Chimney collapse usually proceeds fairly rapidly
- Collapse may continue to surface and form a surface crater
- Lower temperatures and/or groundwater mound promote return of liquid saturation to cavity zone
- High temperature in melt glass zone and surrounding rock dissipates over years to decades



Tritium Measurements on Pahute Mesa



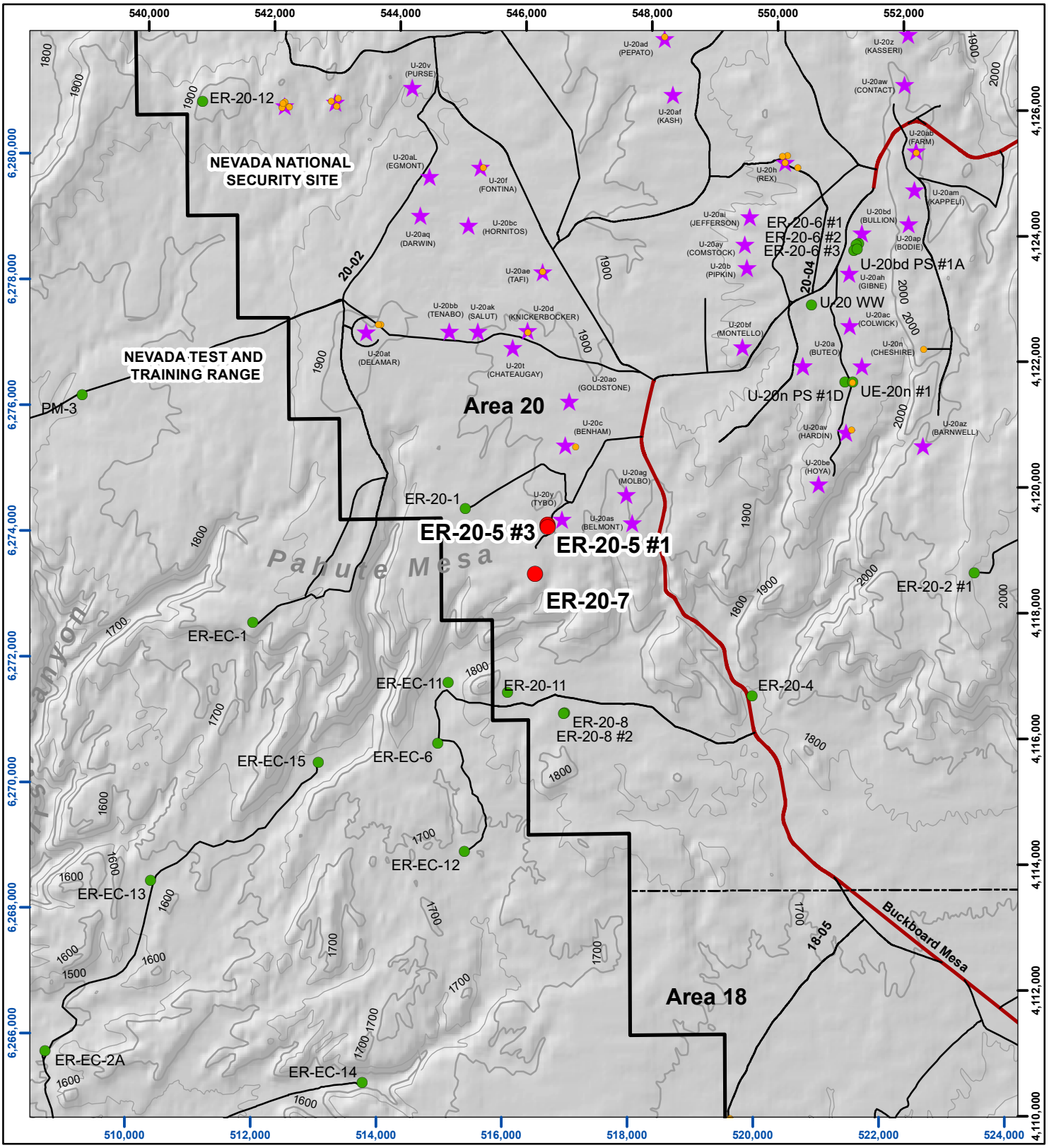
Detected migration above the SDWA* Standard

Post Shot (Source) Sample Locations above the SDWA* Standard

Tritium Detections below the SDWA Standard

*Safe Drinking Water Act (SDWA)

Location Map Showing Wells ER-20-7 and ER-20-5 and Surrounding Area



Explanation

- Select UGTA Well
- Existing UGTA Well
- UE Well
- Underground Nuclear Test
- 50-m Contours
- 100-m Contours
- Paved Road
- Unpaved Road
- NNSS Operational Area
- NNSS Boundary

0 1 2 3 Kilometers

0 0.5 1 1.5 Miles

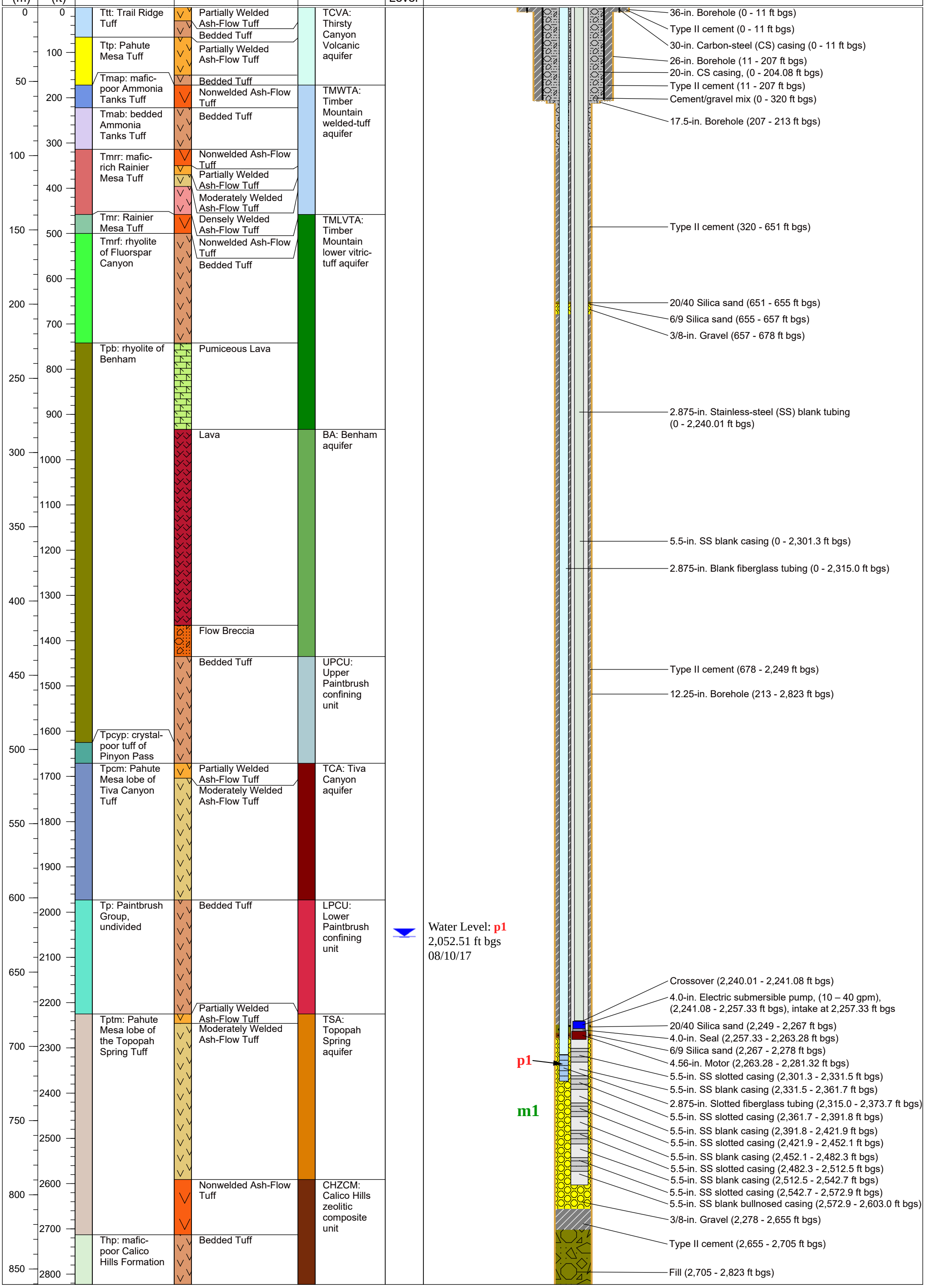
N

Source: Navarro GIS, 2017
Path: H:\Ugta\ER-20-7\ER-20-7_Well_Topo.mxd 3/27/2017

Map Projection: NAD 1983 UTM Zone 11N, Meters
Black tick marks and numbers are in NAD 1983 UTM Zone 11N, meters
Blue tick marks and numbers are in NAD 1983 State Plane NV Central, meters

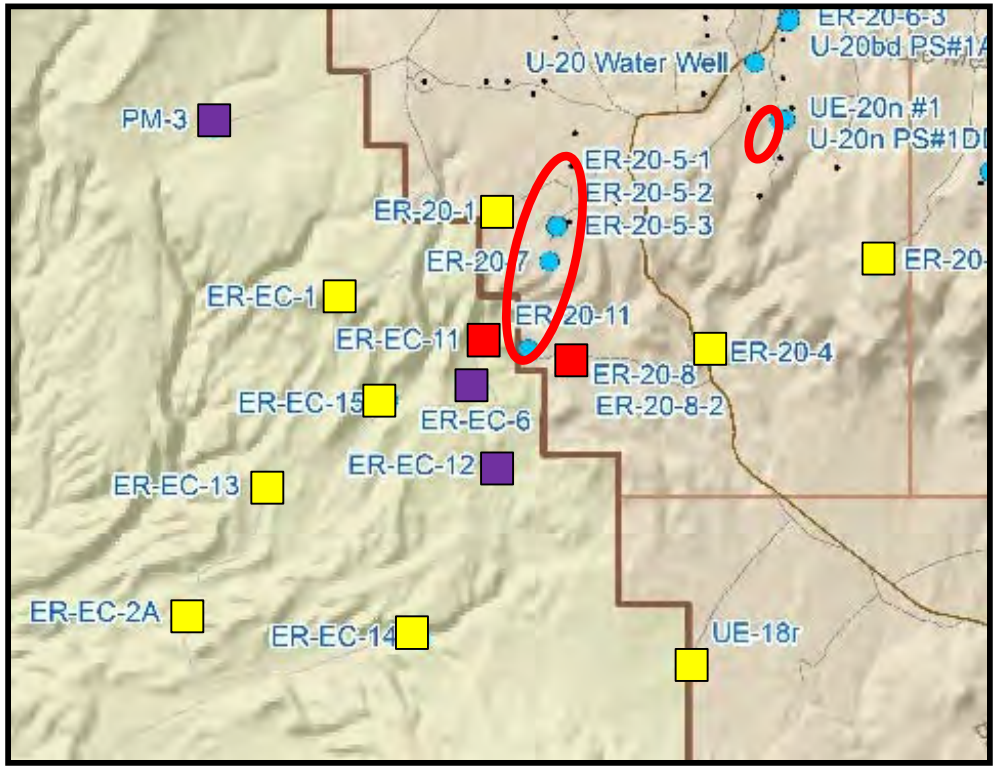
Well Construction Diagram for ER-20-5 #1

Well ID: ER-20-5 #1		UTM NAD 27	Northing: 4,119,208.3 m	Easting: 546,385.9 m
Start Date: 10/15/1995	Stop Date: 11/15/1995	NSPC NAD 83	Northing: 6,274,057.21 m	Easting: 516,737.51 m
Drilling Program: Pahute Mesa		Lat/Long NAD 83	Deg N: 37.219998	Deg W: 116.478066
Environmental Contractor: UGTA/IT		Surface Elevation	6,241.8 ft amsl	1,902.50 m amsl
Drilling Contractor: Welch and Howell		Drill Method:	Air Foam	Drilled Depth: 2,823 ft bgs
Well Construction Diagram (Current as of 03/19/2018)				



Source: Modified from Completion Report for Well Cluster ER-20-5, U.S. Department of Energy, Nevada Operations Office, 1997.; Phase II Pahute Mesa/Oasis Valley Model, N-I, 11/27/2013.
Int. Samp. Plan ID's (ISPIDS) - https://extranet.nv.doe.gov/Boreholes/ISPIDS.xlsx accessed on 03/19/2018.

Tritium Observed at TYBO-BENHAM* on Pahute Mesa



Detected migration above the SDWA Standard

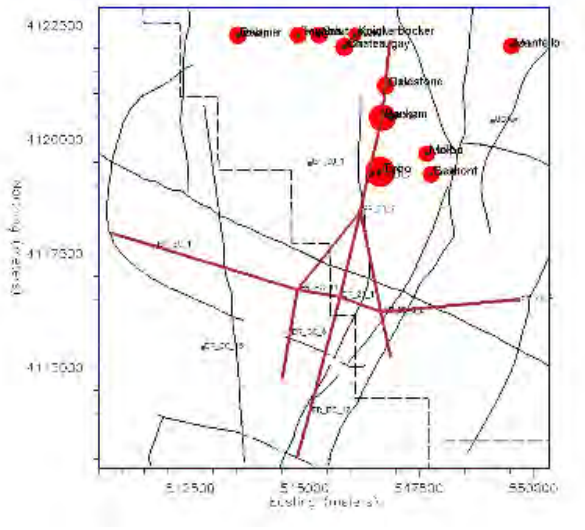
>10% MCL**

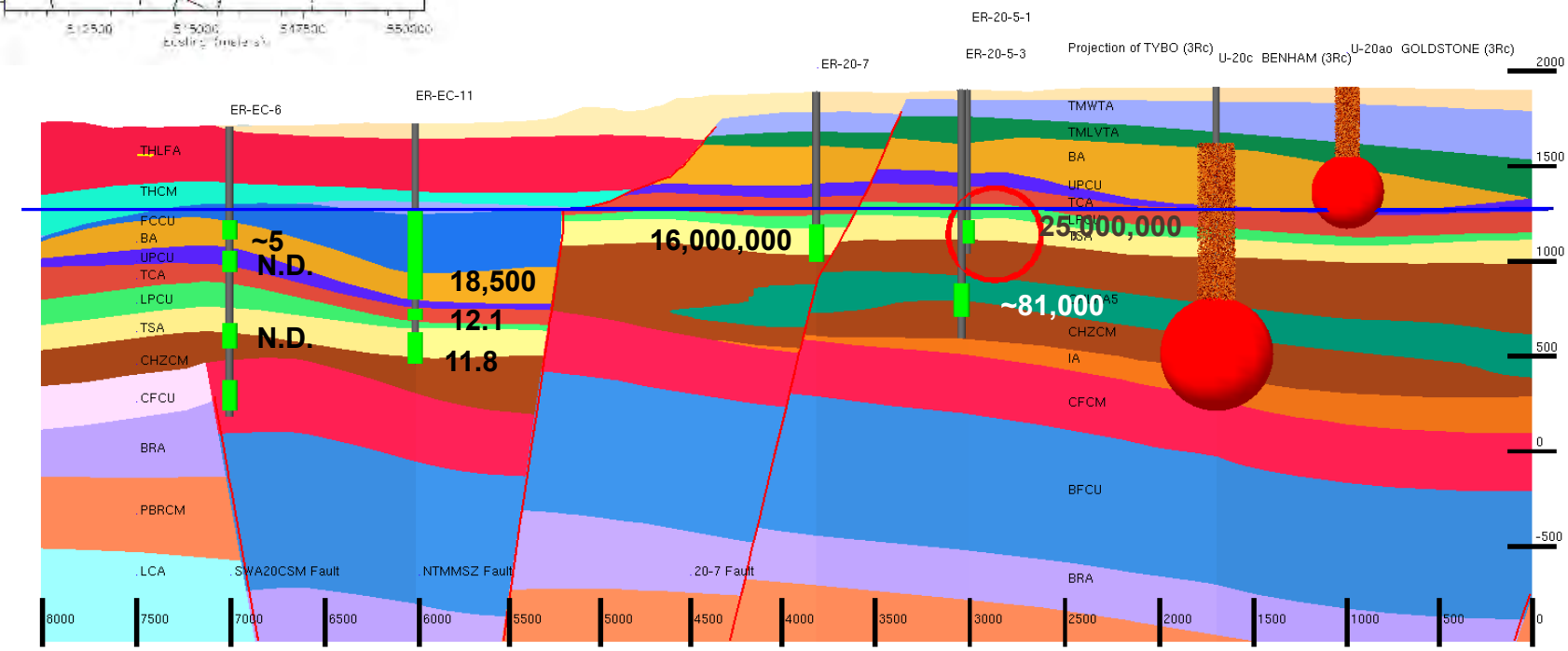
Low-Level Tritium

Non-Detect

*Name of nuclear detonation
**Maximum Contaminant Level (MCL)

TYBO-BENHAM North-South Cross Section with Observed Tritium Concentrations (pCi/L)



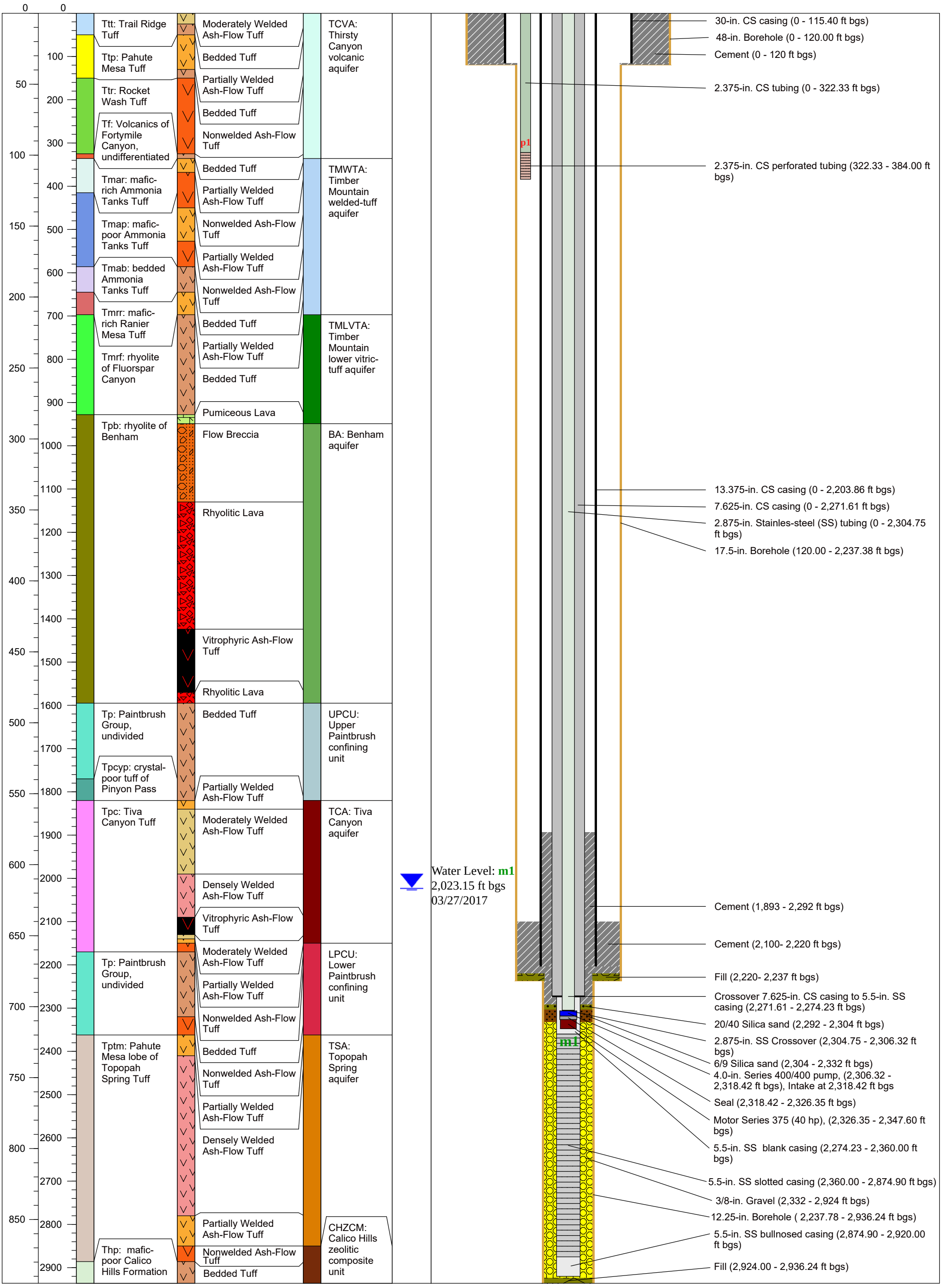


N.D. = Not Detected

Note: Cavity radius is calculated using the maximum of the announced yield range in DOE/NV--209 Rev. 16 (NNSA/NFO, 2015), and Equation 1 in UCRL-ID-136003 (Pawloski, 1999).

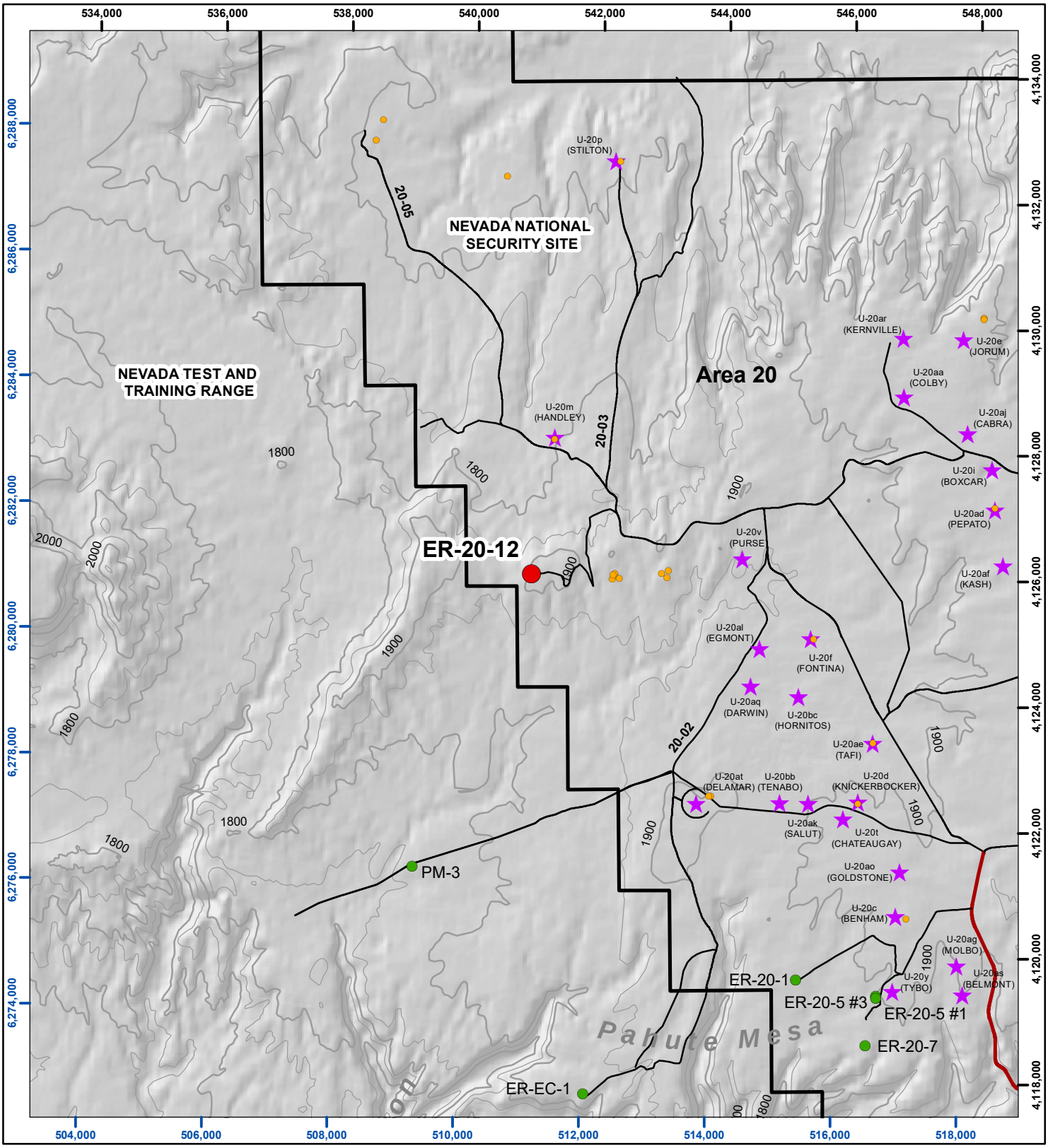
Well Construction Diagram For ER-20-7

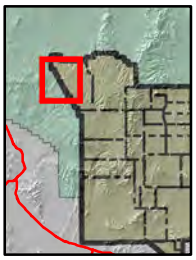
Well ID: ER-20-7		UTM NAD 27	Northing: 4,118,429.7 m	Easting: 546,218.4 m
Start Date: 06/06/2009	Stop Date: 07/07/2009	NSPC NAD 83	Northing: 6,273,279.1 m	Easting: 516,567.3 m
Drilling Program: Pahute Mesa Phase II		Lat/Long NAD 83	Deg N: 37.212989	Deg W: 116.480002
Environmental Contractor: UGTA/N-I		Surface Elevation	6,208.9 ft amsl	1,892.5 m amsl
Drilling Contractor: United Drilling Inc.		Drill Method:	Rotary Air Foam	Drilled Depth: 2,936.24 ft bgs
Well Construction Diagram (Current as of 08/27/2017)				



Source: Modified from Pahute Mesa Phase II ER-20-7 Well Development, Testing, and Sampling Data Report, N-I, 2011; Completion Report for Well ER-20-7, U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office, 2010.; Phase II Pahute Mesa/Oasis Valley Model, N-I, 11/27/2013; Navarro and NSTec Groundwater Sampling Records 2017.

Location Map Showing Well ER-20-12 and Surrounding Area





Explanation

- ER-20-12 Location
- Existing UGTA Activity Well
- UE Well
- Underground Nuclear Test
- 50-m Contour
- 100-m Contour
- Paved Road
- Unpaved Road
- NNSS Boundary

0 1 2 3 Kilometers

0 0.5 1 1.5 Miles

N

Source: Navarro GIS, 2015

Path: H:\GIS_WORK\GWO696 ER-20-12 Presentation\Criteria\ER-20-12_Topo.mxd 8/25/2015

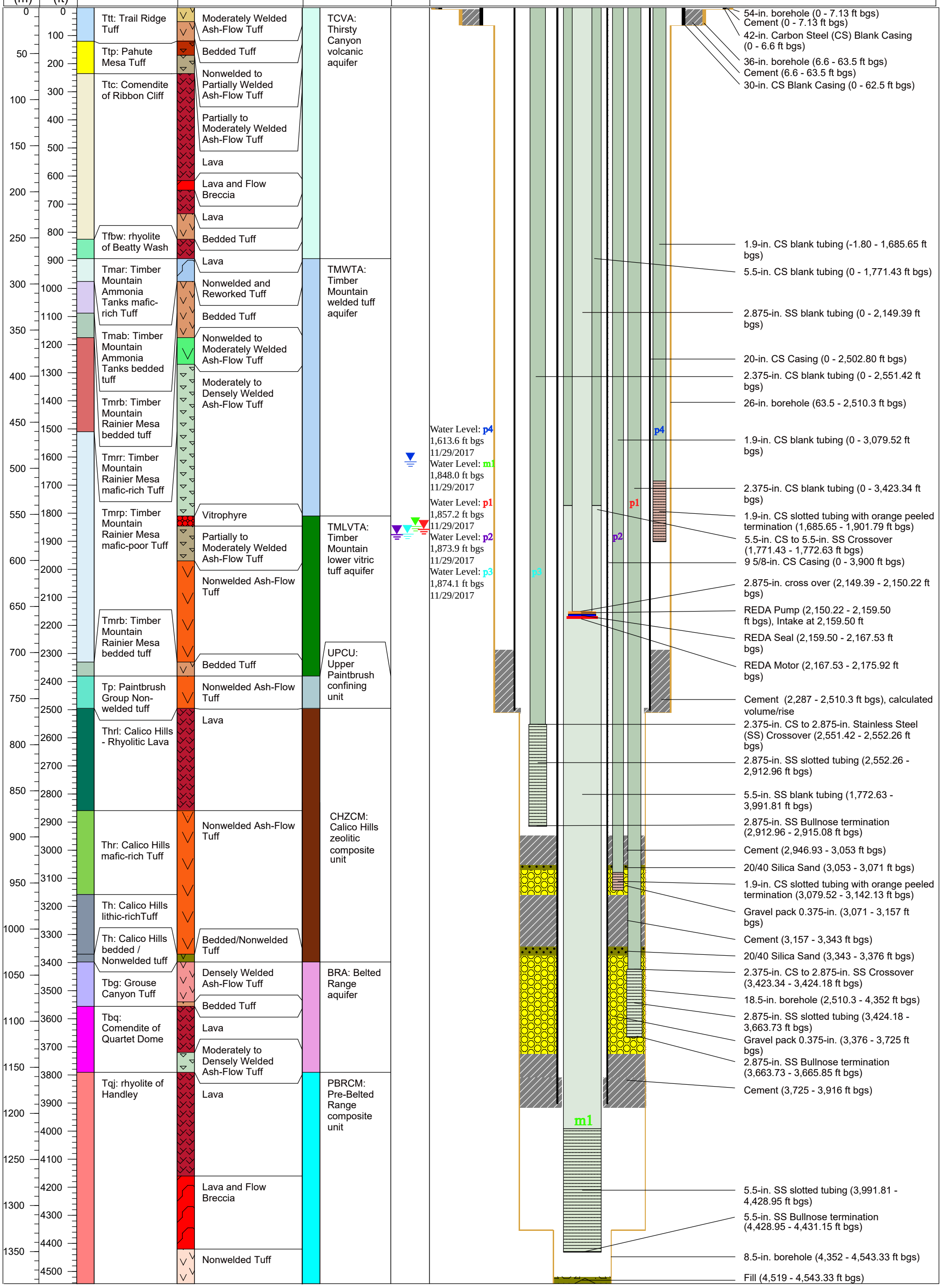
Map Projection: NAD 1983 UTM Zone 11N, Meters

Black tick marks and numbers are in NAD 1983 UTM Zone 11N, meters

Blue tick marks and numbers are in NAD 1983 State Plane NV Central, meters

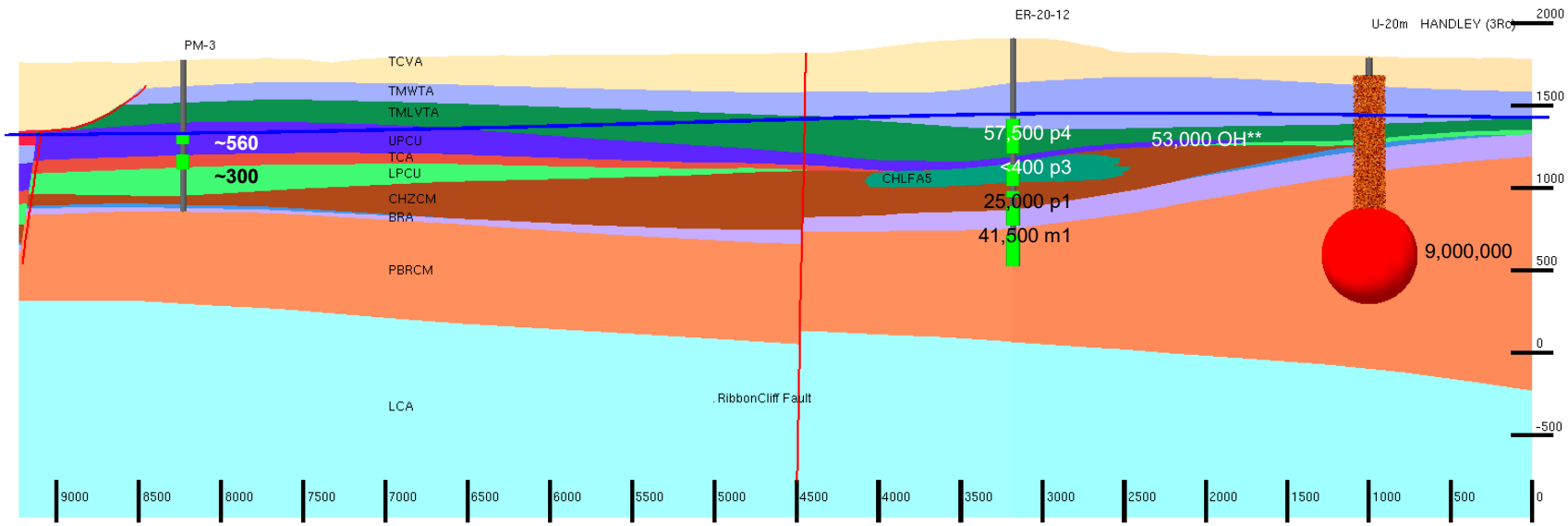
Well Construction Diagram for ER-20-12

Well ID: ER-20-12		UTM NAD 27	Northing: 4,125,952.84 m	Easting: 540,925.06 m
Start Date: 10/8/15	Stop Date: 1/6/16	NSPC NAD 83	Northing: 6,280,822.82 m	Easting: 511,298.95 m
Drilling Program: Pahute Mesa Phase II		Lat/Long NAD 83	Deg N: 37.281047	Deg W: 116.539246
Environmental Contractor: UGTA/Navarro		Surface Elevation	6,258.40 ft amsl	1,907.56 m amsl
Drilling Contractor: UDI		Drill Method:	Conventional-Air/Foam	Drilled Depth: 4,543.33 ft bgs
Current Well Construction Diagram (03/23/2018)				



Source: Modified from Completion Report for Well ER-20-12, Navarro 2016; U.S. Department of Energy, National Nuclear Security Administration, Nevada Field Office, 2016. Water Levels from USGS NWIS 03/23/2018
Int. Samp. Plan ID's (ISPIDS)- https://extranet.nv.doe.gov/Boreholes/ISPIDS.xlsx accessed on 03/23/2018

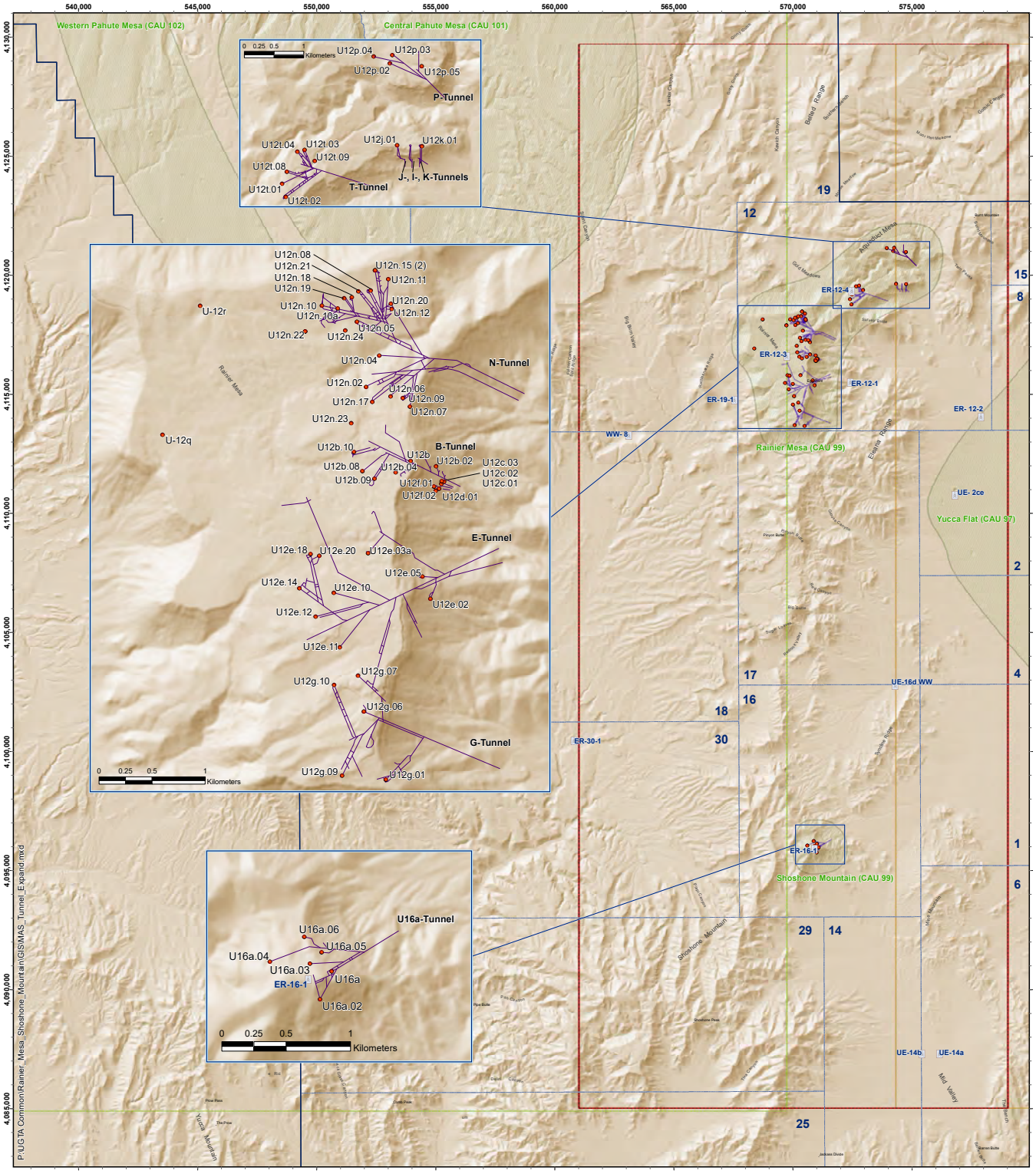
HANDLEY North-South Cross Section Showing Observed Tritium Concentrations (pCi/L)



**OH - Open hole (collected during drilling)

Note: Cavity radius is calculated using the minimum of the announced yield range in DOE/NV-209 Rev. 16 (NNSA/NFO, 2015), and Equation 1 in UCRL-ID-136003 (Pawloski, 1999).

Testing Locations in Rainier Mesa and Shoshone Mountain



Explanation

- RM/SM Wells
- RM/SM Corrective Action Sites
- NNSS Boundary
- NNSS Area Boundaries
- RM/SM Tunnels
- RM/SM HFM Boundary
- PM/OV HFM Boundary
- YF/CM HFM Boundary
- UGTA CAUs

0 1.25 2.5 5 Miles

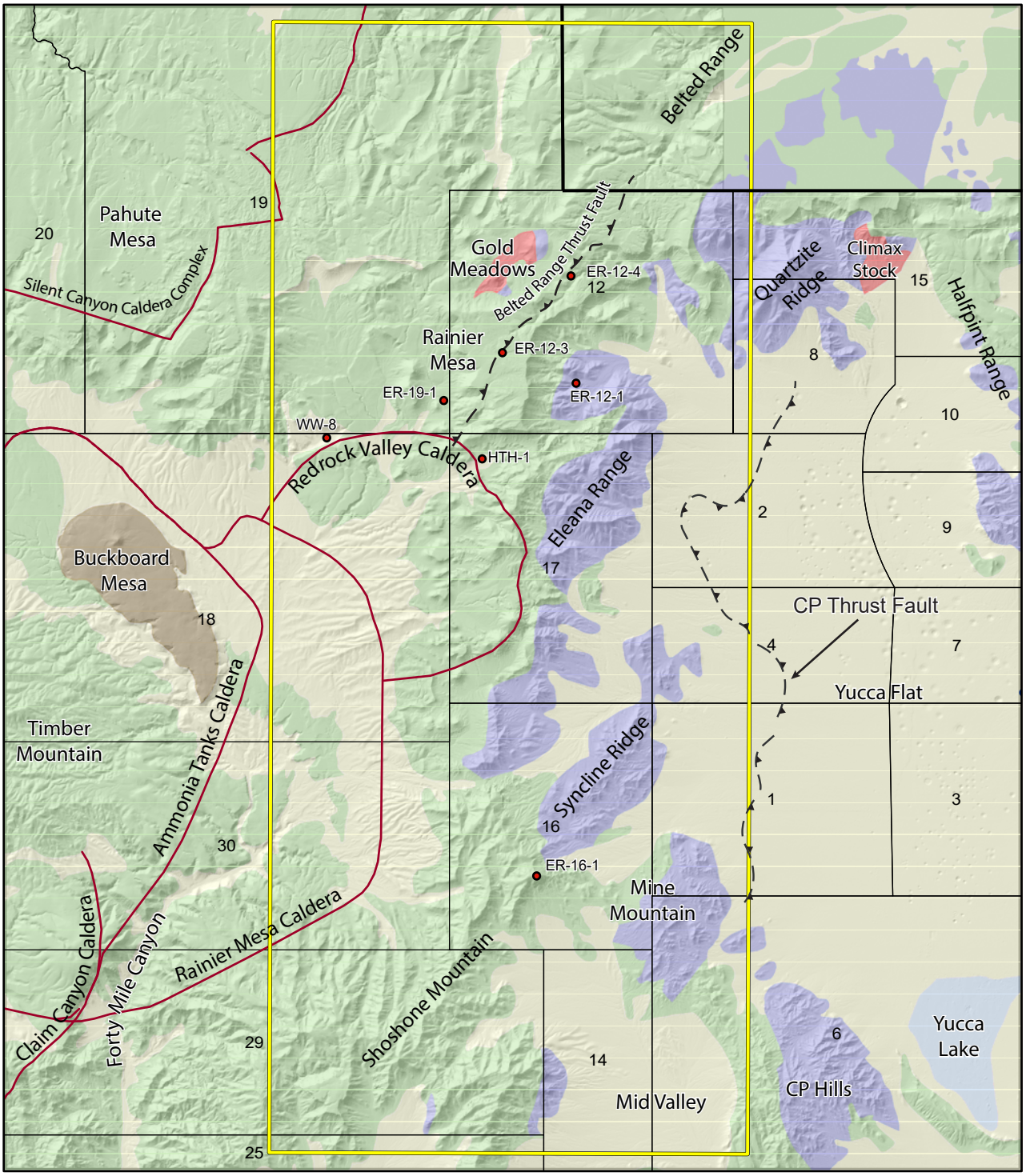
0 1.25 2.5 5 7.5 Kilometers

N

Coordinate System: UTM, NAD27, Zone 11, Meters

Note: While the formal names for the tunnel complexes at the NNSS are designated U12x, where x is a letter designator between a and t, a common shorthand has been adopted in this report where the letter is capitalized. For example, the U12t-Tunnel complex is called the T-Tunnel complex; similarly, the U12n-Tunnel complex is called the N-Tunnel complex.

Generalized Geologic Map of Rainier Mesa



Quaternary Playa Deposits
Pliocene Basaltic Rocks
Quaternary/Tertiary Alluvial Sediments
Tertiary Volcanic Rocks
Mesozoic Granitic Rocks
Paleozoic and Precambrian Sedimentary Rocks

Caldera Structural Boundaries
RM/SM Boundary
NNSS Operational Areas
NNSS Boundary
RM/SM UGTA Drill Holes

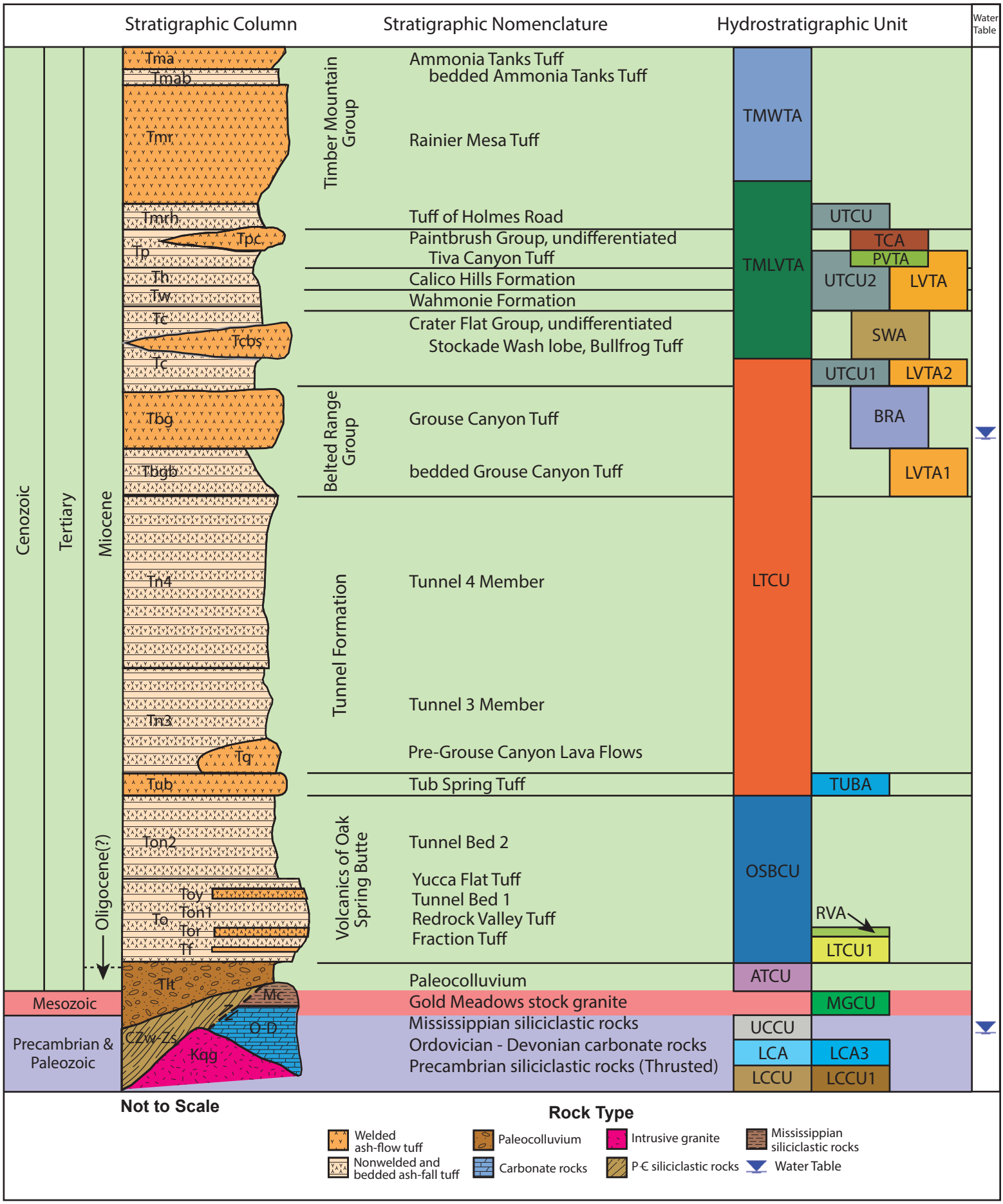
0 1.5 3 6 Kilometers
0 1.5 3 6 Miles

N W E S

Surface units from Nevada Bureau of Mines and Geology, 1996

Stockade Wash Overlook

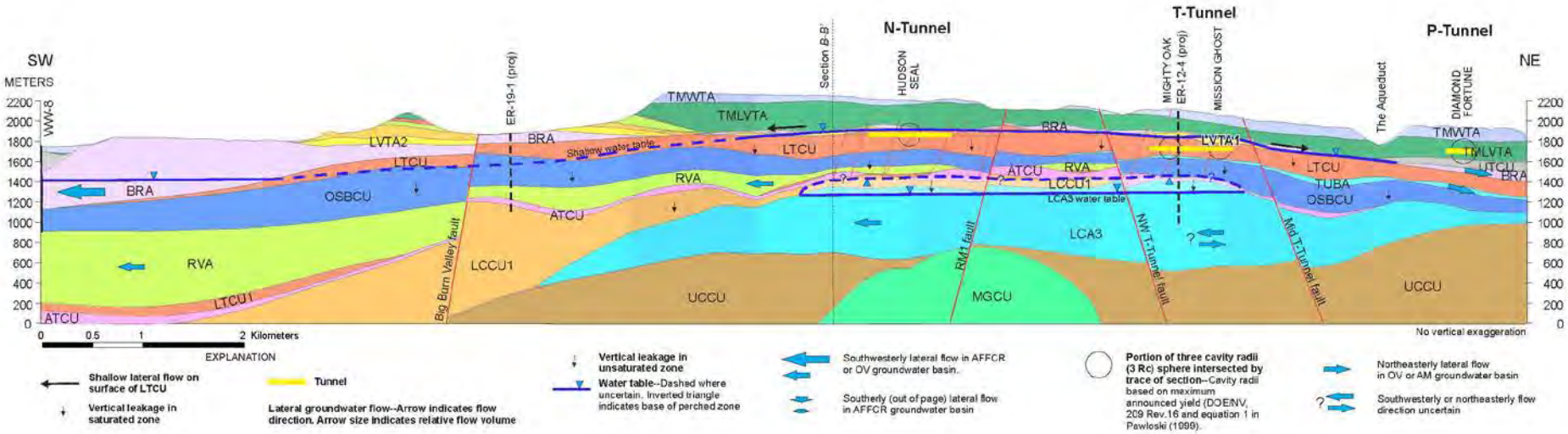
Stockade Wash Overlook, looking NE-E



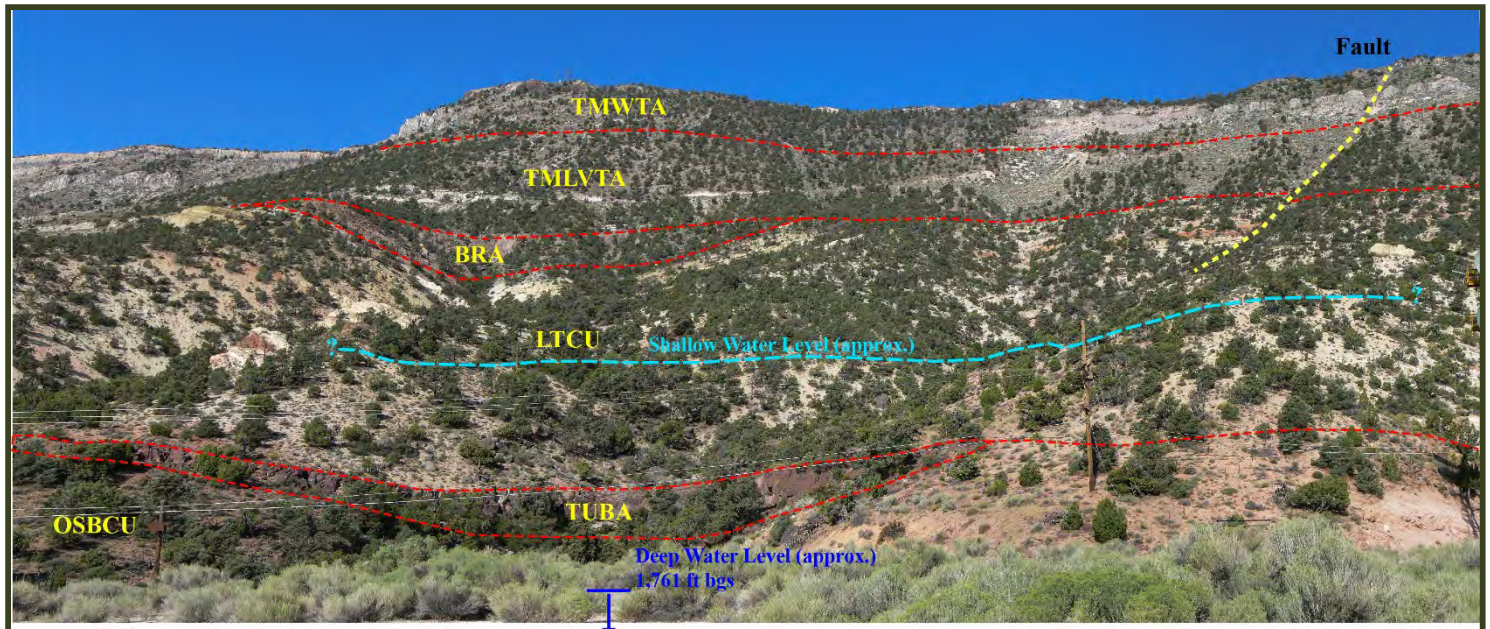
Simplified Stratigraphic Section and Hydrostratigraphic Units for the Rainier Mesa Area

Source: Modified from NSTec, 2007

Rainier Mesa Hydrostratigraphic Cross Section



N-Tunnel Area



N-Tunnel pad, looking approximately W-NW.