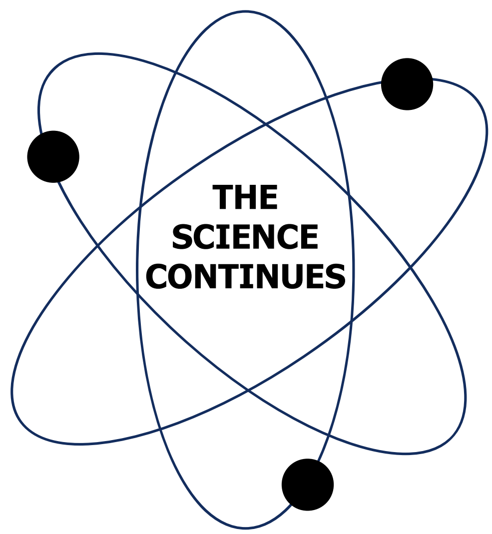
Welcome to the Groundwater Open House!

The Groundwater is Safe

Public water supply is safe from the impacts of historic underground nuclear testing. Current research shows contaminants in groundwater from nuclear testing will **not** reach public water supplies.

The Science Continues

Studies continue into the future to identify and track contaminated groundwater.



Long-term Monitoring

As part of a long-term monitoring program, ongoing scientific studies will continue into the future to maintain a current understanding of the extent of contaminated groundwater, and the direction and rate at which it is moving.

Log No. 2022-078 EMRP 003

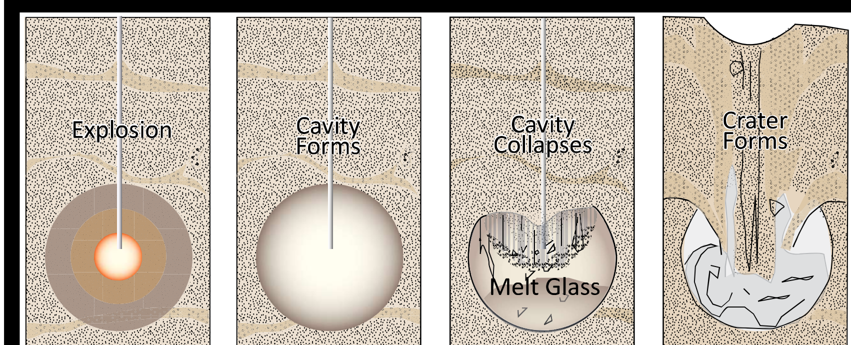
Historic Underground Nuclear Testing and Groundwater

Important Facts

What Occurred

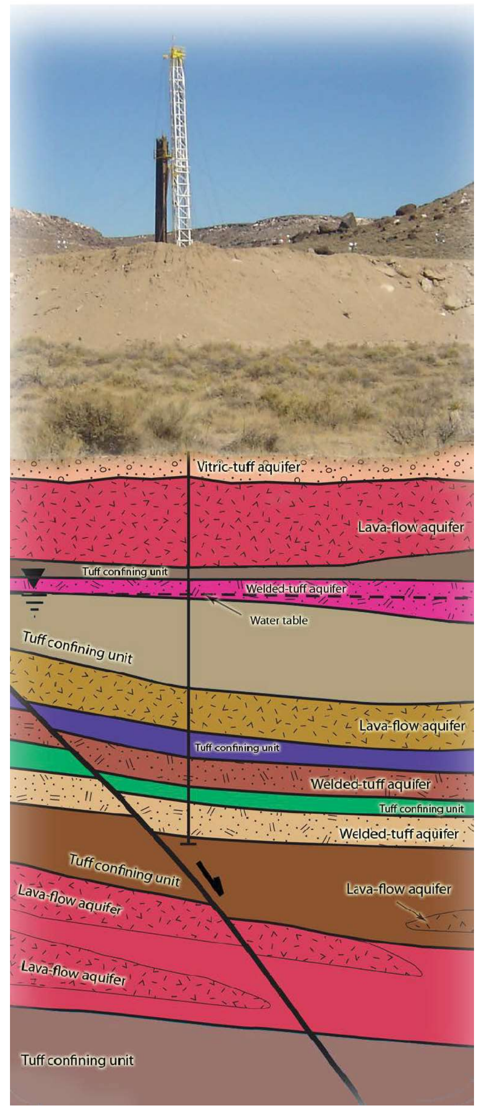
- 828 underground nuclear tests from 1951 to 1992
  - Up to 4,800 feet below the ground surface
  - One-third near, at, or below the water table
  - Some Nevada National Security Site (NNSS) groundwater contains radionuclides
  - The majority of radionuclides are tied up in the melt glass or adsorbed to the rocks surrounding the underground cavities

Stages of an Underground Nuclear Test



An underground nuclear explosion vaporizes the surrounding rock, resulting in a cavity. As the remaining rock cools, melt glass forms and settles to the bottom of the cavity. Cavities almost always collapse and in about 60% of the tests, continue collapsing to the surface and form a depression or subsidence crater.

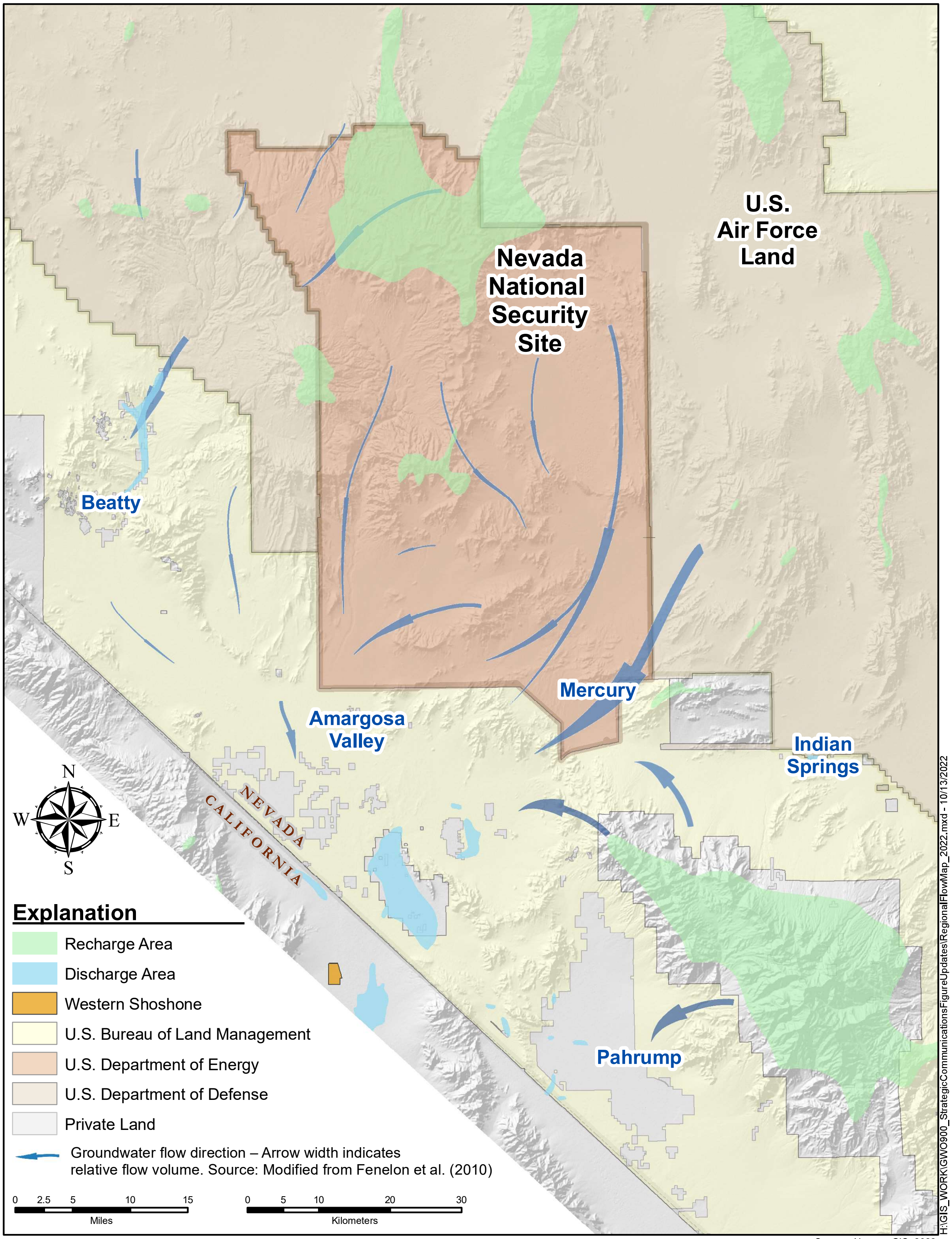
Important Factors



- Site characterization indicates the contaminants in groundwater are diluted or will decay to safe levels long before reaching public water sources
- No practical technology for vast-scale contaminant removal is available
- The NNSS has extremely complex underground hydrogeology
- Radionuclides are located deep underground
- Not all tests had equal potential to release radionuclides into groundwater

Regional Groundwater Flow

Groundwater Flows from Recharge to Discharge



Source: Navarro GIS, 2022

NNSS Groundwater Program Timeline

Evolution of the NNSS Groundwater Program

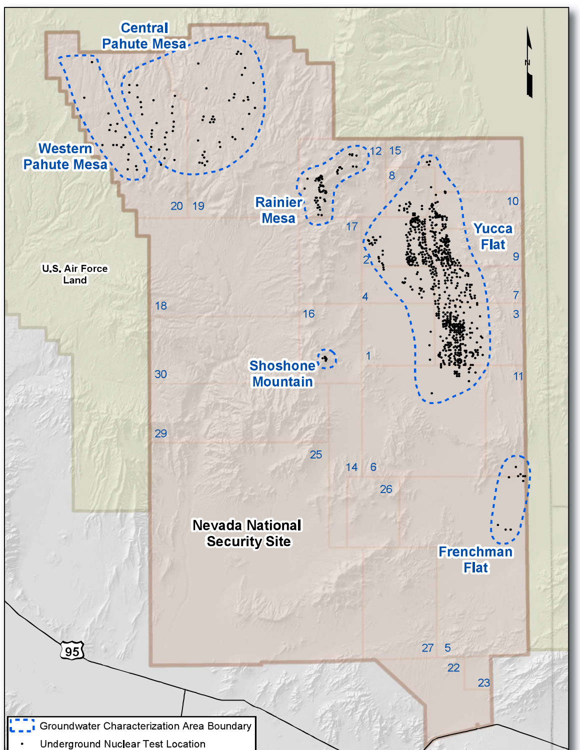
71 years of hydrogeologic data collection have contributed to a better understanding of the complex regional groundwater system

1951 First Underground Nuclear Test

1974 Radionuclide Migration Program Initiated

Pre-1989

- Scientific studies on radioactive releases in groundwater
- Significant data (geologic, geochemical, and hydrologic) collected
- Data still used today



1989 Environmental Management Program Created

1992 Final Underground Nuclear Test

1989-1993

- Installation of groundwater characterization wells
- Preliminary definition of contaminant concentration, distribution, and variability
- Defined groundwater pathways that may allow contaminant migration
- Developed a preliminary risk assessment to define the risks associated with contaminants
- Evaluated potential remedial methodologies and their ability to reduce defined risks

1996 *Federal Facility Agreement and Consent Order* (FFACO)

2009 First Groundwater Open House

2016 Frenchman Flat Transition to Long-term Monitoring

2020 Yucca Flat and Rainier Mesa Transition to Long-Term Monitoring

2022 Pahute Mesa Model Review Begins

1993-Present

- Drilling and sampling of characterization and monitoring wells
- Data interpretation
- Computer modeling
- Identifying contaminant extent and estimating potential risks
- Implementing a monitoring program to ensure continued protection of human health and the environment

Log No. 2022-078 EMRP 005

Radiation Basics

Radiation Exposure and You

YARDSTICK HERE

- Average person receives approximately 320 mrem* of radiation per year
- Medical procedures (such as dental or chest x-rays) expose the average person to another 298 mrem (not illustrated below)
- Total exposure to radiation from all sources, for the average person, is about 620 mrem/year
- Health effects (primarily cancer) have been demonstrated in humans at doses exceeding 5,000-10,000 mrem delivered at high dose rates; below this dose, estimation of adverse health effects is speculative

The Average Annual Dose of Radiation

Radon - 230 mrem

- Gas produced by natural breakdown of uranium in soil, rock, and water
- Migrates through porous areas like the ground and the foundation of your house

The Human Body - 31 mrem

- Large portion of our radiation exposure comes from within our own bodies and the bodies of others near us
- Potassium-40 and other radioactive isotopes found in the air, water, and soil are incorporated into the food we eat, then into body tissue
- Carbon-14, the same isotope used for carbon-dating in archaeology, is naturally occurring in our bodies

Cosmic - 30 mrem

- High-energy gamma radiation that originates in outer space and filters through the Earth's atmosphere in the form of rays such as sunlight
- Cosmic radiation increases with altitude

Terrestrial - 19 mrem

- Soil, rock, and clay are examples of material deposits in the earth that contain naturally radioactive materials like uranium and thorium
- Naturally radioactive materials are also present in construction materials

Consumer Products - 12 mrem

- Small amounts emitted from such household items as smoke detectors and televisions

Tritium - 4 mrem

- Drinking two (2) liters of water each day for a year that contains 20,000 picocuries of tritium per liter (allowable limit under the *Safe Drinking Water Act [SDWA]*)
- Equivalent to drinking 193 gallons (3½ 55-gallon drums) of water

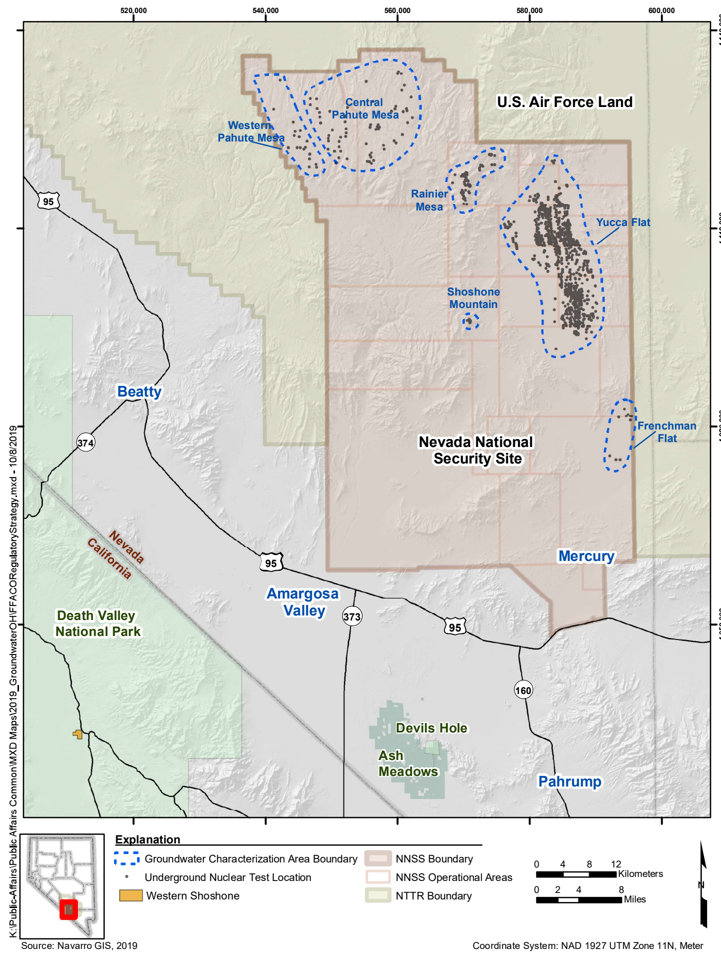
*mrem (millirem) is one one-thousandth of a rem, which measures biological impact, or "dose," of radiation

Log No. 2022-078 EMRP 007

Regulatory Strategy

Federal Facility Agreement and Consent Order

Under a binding legal agreement, the State of Nevada Division of Environmental Protection must review and approve advancement to each stage of NNSS groundwater corrective action activities



Investigation Stage

- Gather new data to enhance models developed for each underground nuclear test area
- Review geology, hydrology, sampling, groundwater and transport models, and modeling approach

Decision/Action Stage

- Develop a model evaluation plan to challenge and refine model forecasts
- Use model evaluation plan to identify locations for new wells or data collection activities
- Use data collected to defend that each area is acceptable for closure

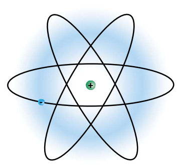
Closure Stage

- Negotiate use restrictions and regulatory boundaries
- Establish institutional controls and requirements
- Develop long-term closure monitoring program

Understanding Tritium in Water

- Radioactive form of hydrogen with a half-life* of 12.3 years
- Decays to levels acceptable under the *SDWA* standards within 200 years from the 1992 Test Ban originating from the source levels known to occur at NNSS
- Regulatory safety standard for drinking water is 20,000 pCi/L
- Naturally occurs in surface waters, such as Lake Mead, at 10 to 30 pCi/L

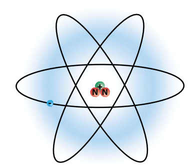
A person who drinks more than 730 liters of water per year containing 20,000 picocuries of tritium per liter would receive about the same dose of radiation one would get during a typical commercial flight between Los Angeles and New York



Hydrogen Atom

One proton
No neutrons
One electron

Why Analyze for Tritium?



Tritium Atom

One proton
Two neutrons
One electron

Comprises more than 95% of the radionuclide inventory

Moves easily with groundwater

Longer-lived radionuclides of concern, such as plutonium, are slow-moving or immobile

Unless relatively high levels of tritium are present, longer-lived radionuclides are not observed

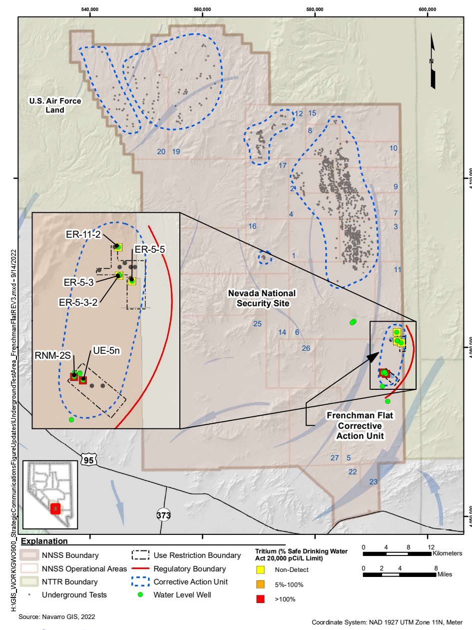
*"Half-life" refers to the amount of time it takes for half the amount of a radioactive substance to decay

Log No. 2022-078 EMRP 008

Frenchman Flat

History

- Ten (10) underground nuclear tests conducted between 1965 and 1971
  - Nine (9) in alluvium and one (1) in a volcanic unit
  - Nine (9) detonated above but near the water table, each less than 20 kilotons
  - One (1) test (less than one [1] kiloton) detonated below the water table
  - Represents a small fraction (0.1%) of the total NNSS underground nuclear test radionuclide inventory



Timeline

1999–2010 (Characterization)

- Five (5) wells drilled and tested
- Investigations (geologic, hydrologic, chemistry) completed
- Models developed based on investigations
- External peer review team recommended progressing to model evaluation

2011–2016 (Model Evaluation)

- Negotiated regulatory boundary objective (DOE and NDEP)
  - Protect receptors downgradient of the Rock Valley fault system from radionuclide contamination
- Two (2) wells drilled and tested; surface-magnetic surveys developed
- Models refined based on new model evaluation data
- NDEP approved advancement to Closure Report stage

2017–Present (Long-Term Monitoring)

- Negotiated and implemented use-restriction and regulatory boundaries (DOE and NDEP)
  - If SDWA standards are exceeded at the regulatory boundary, DOE is required to submit a plan to NDEP to meet the regulatory boundary objectives
- Negotiated and implemented monitoring program (DOE and NDEP)
  - Sample six (6) wells every year through 2020, then every six (6) years thereafter
  - Measure water levels in 16 wells four (4) times per year through 2020, then in 16 wells every year thereafter
  - Verify water usage, institutional controls, and triggers every year

What We Know

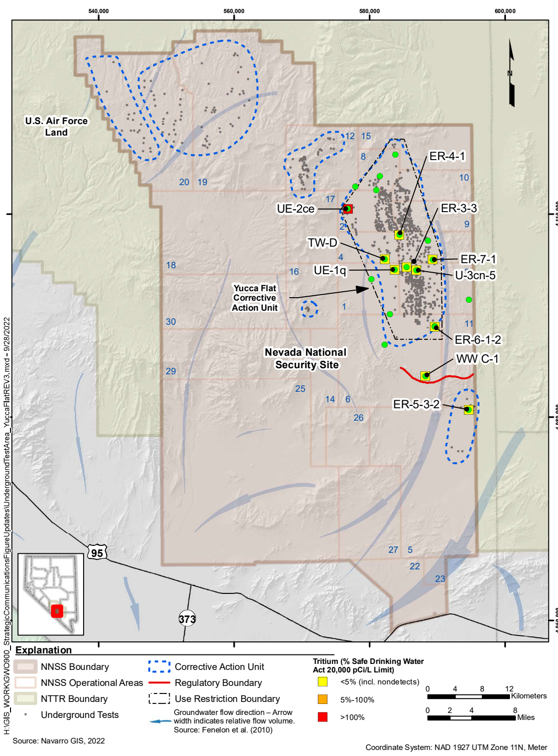
- Frenchman Flat is a closed-drainage basin surrounded by mountain ranges and hills
- Groundwater flows slowly (~1 meter/year) south–southeastward across the basin with minor leakage into the regional carbonate aquifer as the volcanic units thin and/or are offset by faults associated with the Rock Valley fault system
- The Rock Valley fault system is the expected groundwater flow pathway from the Frenchman Flat basin
- Contaminants resulting from underground nuclear testing are not expected to migrate out of the basin within the next 1,000 years
- Sampling results indicate radionuclides do not exceed SDWA standards, except near test cavities and in groundwater in the central portion of the basin that has been impacted by a radionuclide migration experiment (RNM-2S and UE-5n)
- The main contaminant of concern is tritium, which will decay below SDWA standards within 200 years

Log No. 2022-078 EMRP 010

Yucca Flat/Climax Mine

History

- Located in the northeastern part of the NNSS
- 656 tests in Yucca Flat (YF) and three (3) in Climax Mine (CM)
  - Conducted between 1951 and 1992
  - Represents about 39% of the NNSS radionuclide inventory
- In YF, all detonations conducted in vertical shafts
  - About 31% of the radionuclide inventory is more than 100 meters above the water table



Timeline

2000–2016 (Characterization)

- Ten (10) wells drilled and tested
- Investigations (geologic, hydrologic, chemistry) completed
- Models developed based on investigations
- External peer review team recommended progressing to model evaluation

2017–2019 (Model Evaluation)

- Negotiated regulatory boundary objectives (DOE and NDEP)
  - Verify that radionuclide contamination from the YF/CM CAU is contained within the YF basin, thus not impacting the Frenchman Flat lower carbonate aquifer or downgradient receptors
- Three (3) wells drilled; two (2) wells tested; and nine (9) data collection activities completed
- Models refined based on new model evaluation data
- NDEP approved advancement to Closure Report stage

2020–Present (Long-Term Monitoring)

- Negotiated and implemented use-restriction and regulatory boundaries (DOE and NDEP)
  - If SDWA standards are exceeded at the regulatory boundary, DOE is required to submit a plan to NDEP to meet the regulatory boundary objectives
- Negotiated and implemented monitoring program (DOE and NDEP)
  - Sample ten (10) wells every six (6) years
  - Measure water levels in 25 wells every year
  - Verify water usage, institutional controls, and triggers every year

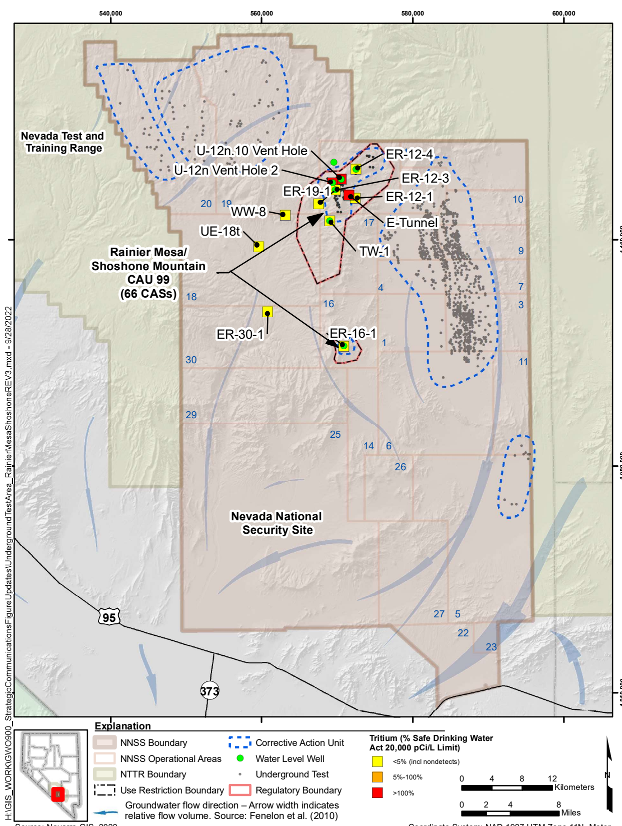
What We Know

- YF is a valley bounded by highland areas on all sides
- Depth to water table ranges from ~500 feet to ~1,900 feet
- Outflow from the basin is across the southern boundary
- Regional aquifer within deep carbonate rocks provides the only potential flow paths outside of the basin
- Little to no contamination observed in the regional carbonate aquifer and is expected to stay within the YF basin
- Main contaminant of concern is tritium, which will decay below SDWA standards within 200 years

Rainier Mesa/ Shoshone Mountain

History

- Located in the remote northern and central part of the NNSS
- 61 tests at Rainier Mesa (RM) and six (6) tests at Shoshone Mountain (SM)
  - Conducted between 1957 and 1992
  - Two (2) tests in vertical shafts on RM; all others in tunnels
- At RM, majority of tests located at or above regional water table; several tests in a thick zone of perched water
- At SM, all tests located substantially above the water table
- A small fraction (~8%) of the total 828 tests conducted at the NNSS
- Represents a small fraction (0.72%) of the radionuclide inventory at the NNSS



Timeline

2004–2018 (Characterization)

- Six (6) wells drilled and tested
- Investigations (geologic, hydrologic, chemistry) completed
- NDEP approved alternate modeling strategy
- Models developed based on investigations and alternative strategy
- Conducted external peer review of models
- NDEP accepted comment resolution and approved advancement to Closure Report stage

2019–Present (Long-Term Monitoring)

- Negotiated regulatory boundary objectives (DOE and NDEP)
  - RM: Protect receptors of groundwater from radionuclide contamination within the three downgradient groundwater basins (Pahute Mesa-Oasis Valley, Ash Meadows, and Alkali Flat-Furnace Creek) that receive recharge from RM
  - SM: Verify that radionuclide contamination does not reach the lower carbonate aquifer below SM
- Negotiated and implemented use-restriction and regulatory boundaries (DOE and NDEP)
  - If SDWA standards are exceeded at the regulatory boundary, DOE is required to submit a plan to NDEP to meet the regulatory boundary objectives
- Negotiated and implemented monitoring program (DOE and NDEP)
  - Sample 14 wells every six (6) years
  - Measure water levels in nine (9) wells every year
  - Verify water usage, institutional controls, and triggers every year

What We Know

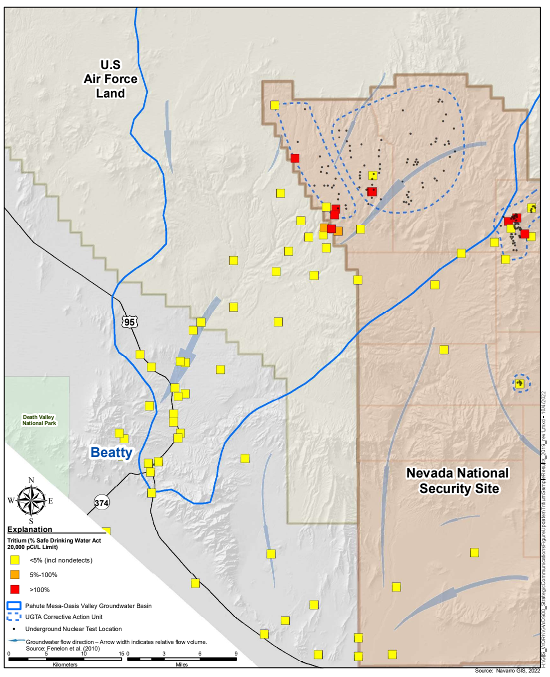
- RM is located at a higher elevation and receives more precipitation than the rest of the NNSS
- Groundwater moves downward through thick zones of rocks before reaching the water table
- At RM, groundwater also flows in perched zones via thin layers of higher-conductivity rocks
- At SM, radionuclides will not migrate in groundwater because the tests were conducted almost 3,000 feet above the water table
- Sampling results indicate radionuclides do not exceed SDWA standards, except in test cavities, sealed tunnels, and one (1) set of discharge ponds
- Contaminated groundwater expected to remain near the testing areas and is not expected to cross the NNSS boundary within 1,000 years
- The main contaminant of concern is tritium, which will decay below SDWA standards within 200 years

Log No. 2022-078 EMRP 012

Pahute Mesa

History

- 82 underground nuclear tests
  - 36 tests in Area 19 and 46 tests in Area 20
  - ~60% of the radionuclide inventory of the NNSS
  - All tests conducted in volcanic units
  - Location of the largest tests conducted on the NNSS
  - Three (3) plumes of radionuclides from underground nuclear tests have been observed
  - Leading edge of two (2) plumes have been detected on U.S. Air Force-controlled land



Timeline

1998–2008

- NDEP approved Phase I investigation plan
- Drilled and tested nine (9) new wells
- Model developed based on investigations performed since the early 1950s
- Internal peer reviews recommended additional investigations

2009–2022

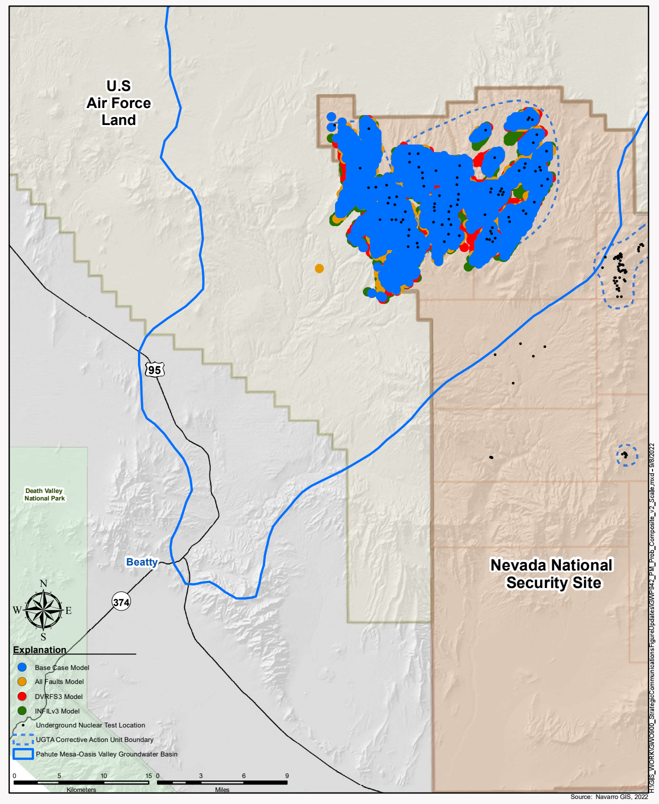
- NDEP approved Phase II investigation plan
- Drilled and tested 11 new wells
- Data and models updated based on new hydrogeological, geochemical, and geophysical data
- Water sample data used to calibrate the transport model

What We Know

- Groundwater flow is southwest from Pahute Mesa to Oasis Valley in volcanic aquifers
- Groundwater flow is slow
- At the present rate of movement, tritium or other radionuclides in excess of SDWA limits ARE NOT expected to travel beyond federally controlled land surrounding the NNSS in 1,000 years
- Tritium is the only radionuclide measured in concentrations exceeding SDWA standards near the NNSS boundary and decays to safe levels in 200 years
- All radionuclide measurements are expected to be in compliance with SDWA standards in Oasis Valley

Pahute Mesa
Modeling Results & Path Forward

- The figure shows the contaminant boundary forecasts for a base case and three (3) alternative flow models
- Each contaminant boundary represents a probabilistic model forecast that delineates the maximum extent of radionuclide-contaminated groundwater above SDWA limits over 1,000 years
- For each alternative flow model, the contaminant boundary perimeter is defined by the ground surface area that is obscured by the colored dots



- Multiple flow models explore uncertainty in the impact of faults (All Faults) and various recharge models (DVRFS3 and INFILv3 models) on groundwater flow directions and rates when compared to a base case

Pragmatic Approach

- Use the measured contaminant data to the fullest extend possible
- Models must match measured data (water levels, tritium, aquifer parameters)
- This reduces uncertainty
- Focus on monitoring contaminants that are moving off the site toward Oasis Valley
- Use models to help determine if new monitoring wells should be drilled and, if so, where to drill
- Goal is to develop a robust monitoring well network that is protective of human health and the environment

Path Forward

- Complete Phase II modeling
- External peer review
- Develop Model Evaluation Plan
- Conduct model evaluation; collect new data; and refine models as necessary
- Request NDEP approval to move to closure

Nye County Tritium Sampling and Monitoring Program

Nye County Natural Resources and Federal Facilities Office

Figure 1: Map showing the general area (blue oval) of the Nye County Tritium Sampling and Monitoring Program (TSaMP). The TSaMP focus is on areas downgradient (south) and off the NNSS. Blue triangles are locations of CEMP stations in communities surrounding the Nevada National Security Site (NNSS). Map is from the CEMP Website at: (www.cemp.dri.edu).

Introduction

The Nye County Tritium Sampling and Monitoring Program (TSaMP) was started in 2015 through a grant from United States Department of Energy (DOE) - EM Nevada Program. The TSaMP's primary objective is to independently verify no detectable migration of tritium has occurred downgradient (south) of the Nevada National Security Site (NNSS). In 2015 the TSaMP worked in conjunction with the Community Environmental Monitoring Program (CEMP), conducted by the Desert Research Institute (DRI), to establish 10 "core wells" locations downgradient (south) of the Nevada National Security Site (NNSS), in the vicinity of Beatty, Lathrop Wells, and Amargosa Valley Nevada (Figure 1). The 10 "core wells" include 5 previously installed Nye County monitoring wells: NC-GWE-OV-1, NC-GWE-OV-2, NC-GWE-8PA, EWDP-13P, and EWDP-24P; and 5 community wells: Amargosa Elementary School, Amargosa Valley RV Park, Beatty Water and Sanitation supply well, Never Give Up (previously Northwest Academy), and Baileys Hot Springs (Figure 2). Beginning in 2016, the program added an additional 10 "selected locations" which are either unique wells or springs, and are chosen based on input from the CEMP, Nevada Site Security Advisory Board (NSSAB), public outreach, and logistical needs. Figure 3 shows maps depicting the locations of the 20 tritium samples taken each year, (2016 to 2021).

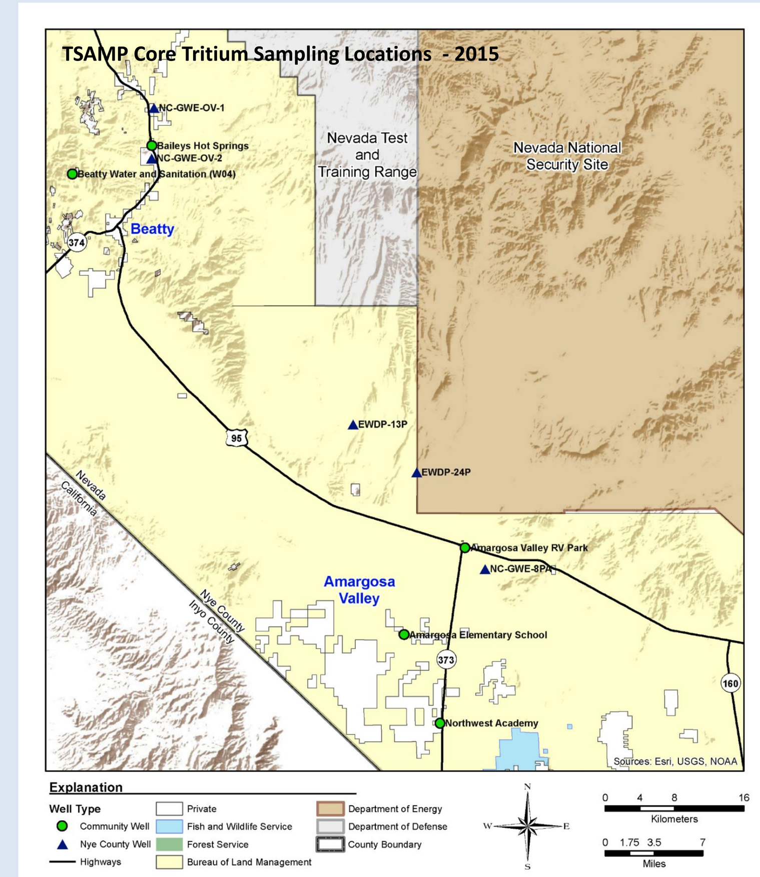


Figure 2: Map showing the location of the 10 TSaMP "core wells" consisting of 5 Nye County monitoring wells: NC-GWE-OV-1, NC-GWE-OV-2, NC-GWE-8PA, EWDP-13P, and EWDP-24P; and 5 community wells: Amargosa Elementary School, Amargosa Valley RV Park, Beatty Water and Sanitation supply well, Never Give Up (previously Northwest Academy), and Baileys Hot Springs.

2015 through 2021 Sampling

The TSaMP program has collected and analyzed a total of 130 samples from both "core wells" (2015 to 2021) and "selected locations" (2016 to 2021). Additionally, 27 duplicate samples and 18 blanks samples were taken to meet the Nye County NRFF Quality Assurance requirements. Starting in 2018, and each year thereafter, private wells were added to the "selected locations" which helped to increase public involvement and increase the spatial coverage within the sampling area. Also, starting in 2020, the TSaMP started resampling up to 3 previously sampled "selected locations" to confirm that by using the unenriched sampling method, tritium levels have remained undetectable through at these locations.

2015 through 2021 Results

All samples (locations, duplicates, and blanks) collected to date under the TSaMP came back from the lab as non-detects, I.e., had activities below the detection limits of the analysis method of 278 to 313 picocuries per liter (<278 pCi/ L to <313 pCi/L) (see Table 1), or less than 1.5% of the Safe Water Drinking Act limit (SWDA) limit for tritium of 20,000 pCi/L.

Future Years (2022 – 2025)

The Nye County Community Tritium Groundwater Monitoring Program Grant has recently been extended to August 16, 2026, meaning that the TSaMP program will continue to sample wells and springs until the end of 2025.

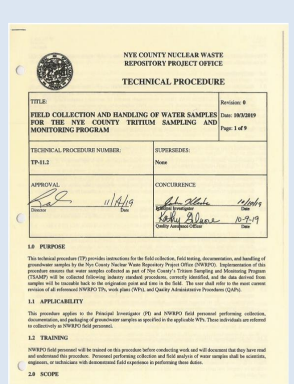
Are you interested in having your well tested?

The TSaMP is currently looking for private wells to sample. If you live within the monitoring area and would like to have your well tested for tritium at no cost, you can contact us at (775) 727- 4354, or send an email to John Klenke at jklenke@nyecounty.nv.gov

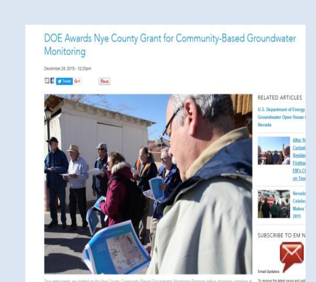
Nye County TSaMP Locations and Results (2015 - 2021)										
Locations				Results						
Sample Number (GWS-####)	Location	Latitude NAD83	Longitude NAD83	Tritium Activity (pCi/L) (2015)	Tritium Activity (pCi/L) (2016)	Tritium Activity (pCi/L) (2017)	Tritium Activity (pCi/L) (2018)	Tritium Activity (pCi/L) (2019)	Tritium Activity (pCi/L) (2020)	Tritium Activity (pCi/L) (2021)
0328, 0349, 0368, 0398, 0425, 0452, 0479	NC-GWE-OV-1	37.0061820	-116.7207580	<313	<288	<291	<282	<291	<292	<304
0329, 0360, 0369, 0399, 0426, 0453, 0480	NC-GWE-OV-2	36.9645540	-116.7229820	<313	<288	<291	<282	<291	<292	<304
0330, 0346, 0370, 0400, 0433, 0451, 0478	EWDP-13P	36.7444070	-116.5139540	<313	<288	<291	<289	<291	<292	<304
0331, 0342, 0371, 0396, 0423, 0450, 0477	EWDP-24P	36.7046597	-116.4479878	<313	<288	<291	<289	<291	<292	<304
0332, 0341, 0372, 0395, 0422, 0449, 0476	NC-GWE-8PA	36.6244220	-116.3770836	<278	<288	<291	<289	<291	<292	<304
0333, 0356, 0373, 0397, 0424, 0454, 0481	Amargosa Elementary School	36.5696120	-116.4609460	<278	<288	<291	<289	<291*	<292*	<304*
0334, 0352, 0374, 0401, 0428, 0455, 0482	Amargosa Valley RV Park	36.6417350	-116.3974740	<278	<288	<291	<289	<291	<292	<304
0335, 0363, 0375, 0402, 0429, 0456, 0483	Beatty Water and Sanitation (W04)	36.9514580	-116.8050020	<278	<288	<291	<289	<291	<292	<304
0336, 0351, 0376, 0403, 0430, 0457, 0484	Northwest Academy	36.4961660	-116.4235630	<278	<288	<291	<289	<291**	<292**	<304**
0337, 0350, 0377, 0404, 0431, 0458, 0485	Baileys Hot Springs	36.9747200	-116.7225000	<278	<288	<291	<289	<291	<292	<304
0344	NC-GWE-33PA	36.660738	-116.4958630		<288					
0345	EWDP-1DX-Shallow	36.7093128	-116.5883342		<288					
0353	Amargosa Narrows South Well 1	36.8802180	-116.7556910		<288					
0354, 0441	ER-OV-03a3	36.9988330	-116.7053380		<288			<291***		
0357, 0465	Crystal Park Well	36.4904530	-116.1617900		<288				<296***	
0358, 0466	Crystal Fire Department	36.4878479	-116.1698509		<288				<296***	
0359, 0464	Private Spring Oasis Valley (Colson)	37.0739000	-116.6912030		<288				<296***	
0362	Sarcobatus Flat Well	37.2507560	-116.9954100		<288					
0364	Fleur-de-Lis Spring	37.0382810	-116.7124720		<288					
0367	Beatty Water and Sanitation (W06)	36.9242060	-116.7997050		<288					
0378	Amargosa Desert 8	36.4849730	-116.1576250			<291				
0379	Amargosa Estates Water Co. Well 2	36.5096260	-116.5024110			<291				
0380	Beatty RV Park	36.9457100	-116.7164270			<291				
0381, 0487	Beatty Water and Sanitation Well No. 3	36.9049110	-116.7578260			<291				<304***
0382	ER-OV-01	37.0843870	-116.6811730			<291				
0383	HWWT Gravel Pit	36.5690610	-116.6149670			<291				
0384	NC-GWE-2P	36.6611350	-116.4657460			<291				
0385	Peacock Spring	37.0307600	-116.7556920			<291				
0386, 0486	Spicer Ranch (Goss) Spring	36.9954800	-116.7159330			<291				<304***
0387, 0488	USW VH-2	36.8058790	-116.5778190			<291				<304***
0405	Amargosa Estates Water Co. Well 1	36.5097440	-116.4940950				<282			
0406	Amargosa Valley Private Well-01	36.581	-116.544				<282			
0407	Bryan Spring	36.9841820	-116.7591000				<289			
0408	Beatty Water and Sanitation Well EW4	36.8333700	-116.8239330				<289			
0409	Crystal Private Well-01	36.511	-116.186				<289			
0410	ER-OV-03b	37.0274450	-116.6522820				<289			
0411	ER-OV-06a	37.0843870	-116.6811730				<289			
0412	Amargosa Valley Private Well-02-wellhead	36.554	-116.526				<289			
0413	Lower Indian Spring	36.9448140	-116.7967720				<289			
0414	Nye Co. Station #2	36.4115380	-116.4201070				<289			
0427	Amargosa Valley Private Well-04	36.503	-116.503					<291		
0432	NC-GWE-Felderhoff-25-1PA	36.617728	-116.409374					<291		
0434	EWDP-7S	36.725561	-116.557003					<291		
0435	Revert Springs	36.918395	-116.744640					<291		
0436	Cave Spring	36.945298	-116.794724					<291		
0437	Beatty Water and Sanitation Well 1	36.915371	-116.760698					<291		
0438	Amargosa Valley Private Well-03	36.540	-116.483					<291		
0439	AV-USPS	36.526006	-116.420433					<291		
0440	ER-OV-02	37.036055	-116.705061					<291		
0459	Beatty Private Well-01	36.910	-116.755						<292	
0460	EWDP-29P	36.682583	-116.448023						<292	
0461	Amargosa Valley Private Well-05	36.580	-116.508						<292	
0462	Amargosa Park well	36.568287	-116.459690						<296	
0463	ER-OV-04a	36.951334	-116.712560						<296	
0467	MW-4	36.920758	-116.616250						<296	
0468	ER-OV-05	37.046053	-116.772841						<296	
0489	AVPW-07	36.575	-116.614							<304
0490	Martell Market	36.568488	-116.553143							<304
0491	NB-WW-07	37.038692	-116.786455							<304
0492	ER-OV-06a2	37.084387	-116.681173							<304
0493	ER-OV-03a	36.998833	-116.705338							<304
0494	NB-WW-12	37.025508	-116.768091							<304
0495	AVPW-06	36.543	-116.597							<304
Note: Quality assurance samples, blanks and duplicates, are not included on this spreadsheet.										
*Amargosa Elementary School-2 (NOI 40463), is a replacement well for the abandoned well Amargosa Elementary School which was sampled 2015-2018.										
**Never Give Up is the name of the new property owners (and well), of the formerly named Northwest Academy (2015-2018).										
*** 4-year resampling of selected sample locations										

Table 1: Locations of all 130 TSaMP tritium samples (2015 to 2021) with tritium activities.

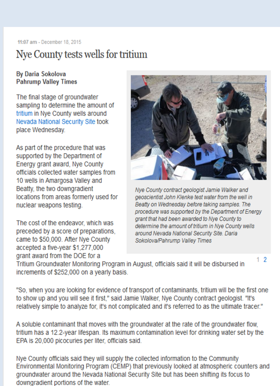
Sampling Procedure



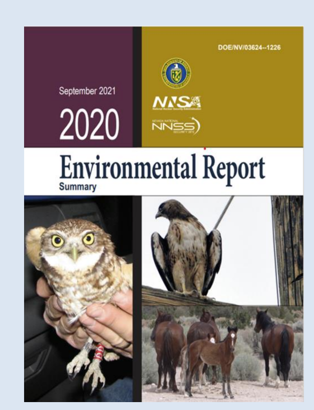
Samples are taken during the last quarter of each year (October through December). Wells such as the 5 Nye County monitoring "core wells" and "selected wells" without dedicated pumps are sampled using a portable positive displacement Bennett Water Sample Pump after purging at least 3 well volumes from each well. This process ensures that the resultant samples are representative of local groundwater conditions. Samples taken from community "core wells" and other "selected wells" with pumps are sampled from the dedicated pump discharge. These wells are purged prior to sampling to ensure that representative water samples are obtained. Samples from "selected springs" are taken directly from the natural water discharge. Standard water quality parameters (pH, temperature, and electrical conductivity) are measured at all locations sampled. The water samples are collected under the Nye County Chain of Custody, and are analyzed for tritium (H^3), by a commercial laboratory, which has previously been certified by the Nevada Department of Environmental Protection (NDEP). The Nye County Natural Resources and Federal Facilities (NRFF) office maintains quality control by applying the NRFF Quality Assurance Program protocols (WP-11, TPN-11.8, TP-11.2, and HSP-1.0) to all phases of the work.



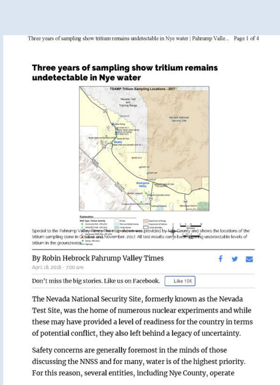
Public Outreach



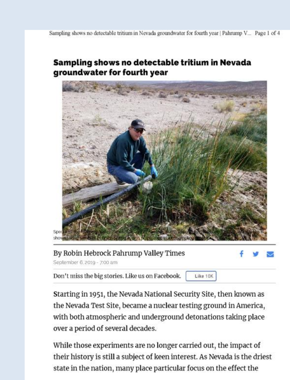
Under the DOE grant, Nye County TSaMP is responsible for providing public outreach and providing sampling methodology, data, and quality check results to the DOE. To achieve these goals, the TSaMP program has been featured in articles in the Pahrump Valley Times (9/25/15, 12/18/15, 4/29/16, 3/10/17, 4/18/18, 09/06/19, and 8/5/20), and has provided the sampling results to DOE annually for inclusion in the Nevada National Security Site Environmental Reports (2015 to 2021). TSaMP personnel conducted a tour in 2015 for the Nevada Site Specific Advisory Board (NSSAB) and Community Environmental Monitors (CEMP). The TSaMP QA program was surveilled in November 2018 by DOE, which resulted in improvements in communication protocols and updates to QA documentation. Nye County TSaMP personnel have attended and presented at community board meetings to solicit input on sample locations from the public. TSaMP has also presented posters at public outreach events such as DOE's Groundwater Open House events.



Tritium Primer



Samples are analyzed using a standard tritium analysis method (unenriched) by Radiation Safety Engineering, Inc. in Chandler Arizona. Tritium is a radioactive form of hydrogen with a half-life of 12.3 years. Tritium is analyzed in water because it is one of the most abundant radionuclides generated by an underground nuclear test. Because it is a constituent of the water molecule itself, it is one of the most mobile radionuclides. (NNSS Environmental Report 2014, http://www.nv.energy.gov/library/publications/aser.aspx). The Safe Drinking Water Act (SDWA) standard or maximum contaminant level (MCL) for tritium in drinking water is 20,000 pCi/L. A picocurie (pCi) is a unit of measure to quantify radiation and, is used to quantify the amount of tritium that is in the water. A picocurie is one-trillionth of a Curie, and 1 pCi/L is the amount of radioactive material in 1 liter of a gas or liquid that will produces 0.037 disintegrations per second.



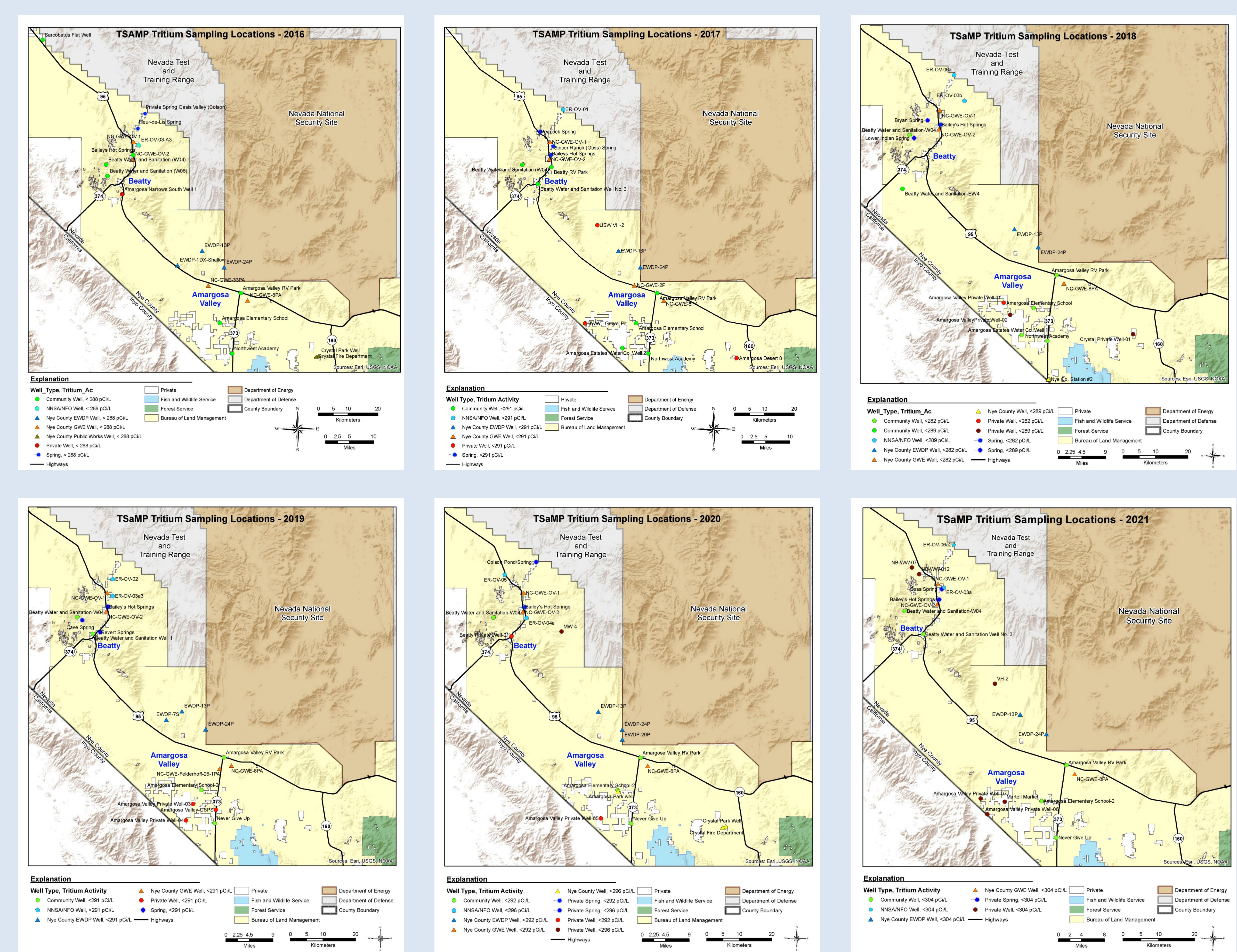
Reconnaissance fieldtrip with DOE EM personnel at Colson Pond (11/3/16)

TSaMP presentation at Beatty Town Board Meeting (11/4/19)

Sampling at Never Give Up (11/2/20)

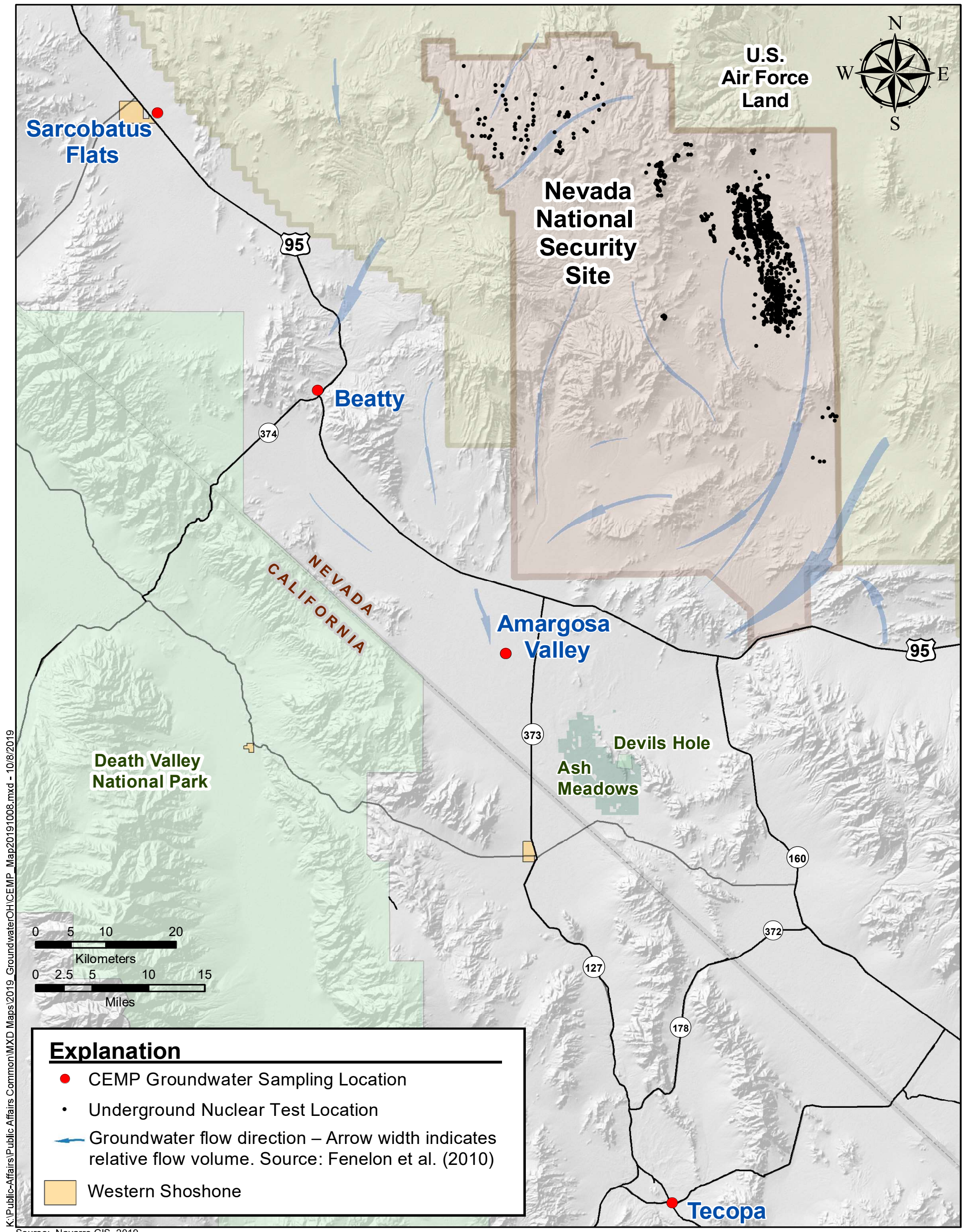
Sampling with Bennett Water Sample Pump at ER-OV-06a2 (12/21/21)

Figure 3: Maps showing locations of 20 tritium samples taken each year, (2016 to 2021) by the TSaMP program.



CEMP Groundwater Sampling

The Community Environmental Monitoring Program (CEMP) focuses on groundwater monitoring downgradient of the NNSS



Source: Navarro GIS, 2019

- CEMP provides off-site radiological monitoring in communities surrounding the NNSS
  - Radionuclides from underground testing have never been detected in water supplies serving CEMP communities
- U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office provides funding for Desert Research Institute to administer the program
- CEMP provides a hands-on role for public stakeholders
- Water sampling results available at **www.cemp.dri.edu**

Desert Research Institute

Log No. 2022-078 EMRP 015

Groundwater Demonstration

- The general principles of groundwater flow and transport can be demonstrated visually in a geologic display similar to an "ant farm"
- The display provides a sense of how groundwater behaves in nature
- Groundwater demonstrations can be requested for schools and community events by emailing emnv@emcbc.doe.gov

Groundwater is water that has infiltrated from surface sources (rain/snow) and accumulated in the subsurface

- Groundwater moves through pore spaces and fractures in various types of geologic layers
  - Geologic layers range from near-surface soils (such as sands and gravel) to deeper rock units (such as limestones and volcanic rocks)
- Groundwater moves within geologic layers at different rates and directions based on the geology, hydraulic properties (i.e., ability of water to flow through rock), and elevation of the water table

Log No. 2022-078 EMRP 016

Expanding Our Understanding of Groundwater

The U.S. DOE continues to gather information that expands scientific knowledge of location, type, quantity, direction of movement, and rate of radionuclide movement in groundwater

Identifying Information

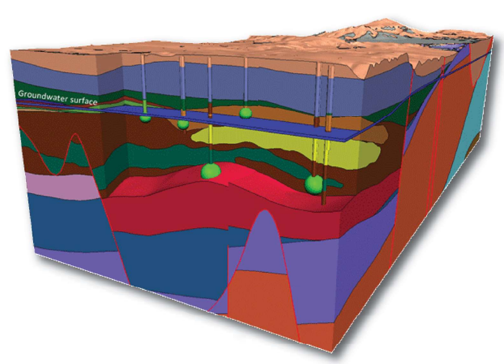
- Geology
- Hydrology
- Groundwater chemistry
- Radionuclide concentrations

Gathering Information

- Well drilling and construction
- Aquifer testing and water-level monitoring
- Water sample collection

Analyzing Information

- Computer simulations (modeling) of hydrogeology and groundwater flow and contaminant transport



Computer model of NNSS subsurface

Cavity dimension based on maximum announced yield identified in DOE/NV--209 Rev. 16 (NNSA/NFO, 2015) and Equation 1 in UCRL-ID-136003 (Pawloski, 1999).

Log No. 2022-078 EMRP 017

Justice40

Overview of Justice40 Initiative

- The Justice40 Initiative is a requirement of Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*
- The Justice40 Initiative is a government effort to deliver at least 40% of the overall benefits from certain federal investments to disadvantaged communities
- On July 20, 2021, the *Interim Implementation Guidance for the Justice40 Initiative* was released in accordance with Executive Order 14008
    - The guidance supports the Administration's comprehensive approach to advancing environmental justice, the fair treatment and meaningful involvement of all people with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies
- Federal agencies are directed to conduct robust stakeholder engagement and Tribal consultation as they implement the Justice40 initiative

EM Efforts under the Justice40 Initiative

- The focus of EM's environmental cleanup work under the Justice40 Initiative is soil and groundwater remediation
- NNSS will continue its efforts to engage its stakeholders on the Justice40 Initiative going forward
- An overview of EM sites and programs covered under the Justice40 Initiative can be viewed at: ***https://www.energy.gov/em/justice40-initiative***

Seven Areas of Federal Investment Covered by Justice40 Initiative

- Climate Change
- Clean Energy and Energy Efficiency
- Clean Transportation
- Affordable and Sustainable Housing
- Training and Workforce Development
- Remediation and Reduction of Legacy Pollution (EM's focused investment)
- Development of Critical Clean Water and Wastewater Infrastructure

Log No. 2022-077 EMRP