safety ❖ performance ❖ cleanup ❖ closure

Nevada National Security Site

Groundwater Questions and Answers

U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office

With its complex geology and 1,360 square miles of remote desert terrain, the Nevada National Security Site is a challenging environment for those studying the area's groundwater and the movement of contaminants caused by historic underground nuclear tests. Of the 828 tests, which took place from 1951 to 1992, roughly one-third occurred near, below, or directly within the water table (the zone beneath the surface that is saturated with water) at depths ranging from approximately 90 to 4,800 feet. Nevada National Security Site scientists are working to understand where radiological contamination is present and forecasts where the contamination is moving. This information will be used to implement a long-term monitoring program designed for ensuring the protection of the public.

With these goals in mind, the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office employs a comprehensive strategy focused on drilling deep wells, sampling these and other wells on a routine basis, and developing computer models that give scientists three-dimensional pictures of the subsurface environment at the Nevada National Security Site. Nevada Site Office Underground Test Area (UGTA) staff work closely with the State of Nevada Division of Environmental Protection and other key technological organizations to put these pieces of information together so that an effective, long-term monitoring network can be put into place.

The Nevada Site Office has made it a priority to keep the public informed about its drilling and sampling activities. This brochure contains commonly asked questions.

Topics

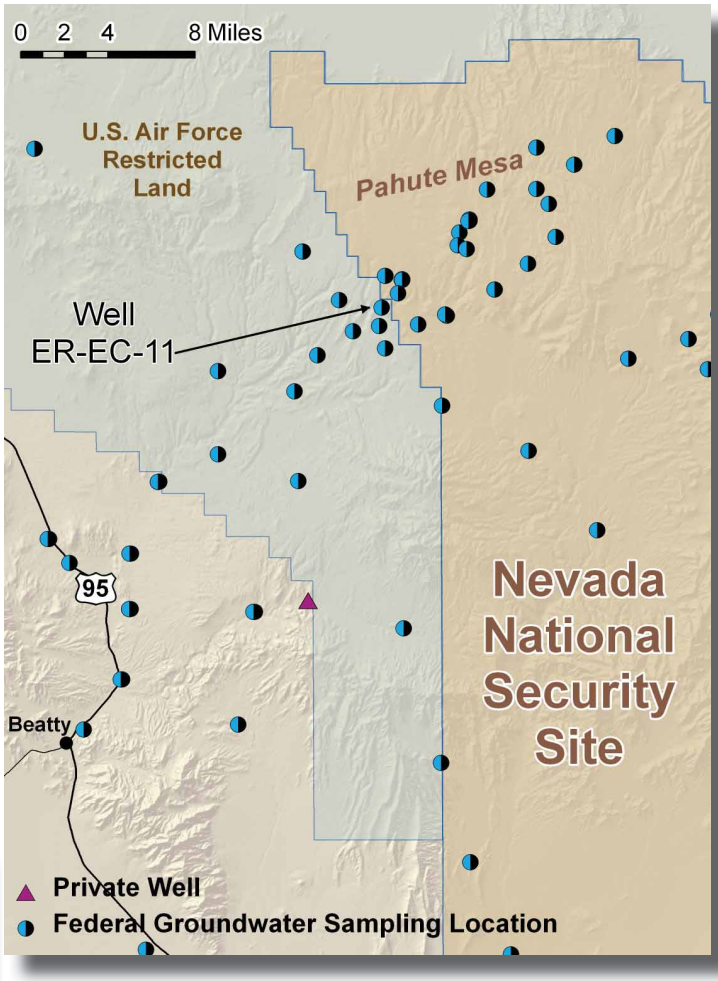
Q Has contamination from historic underground nuclear tests been found in groundwater beyond the Nevada National Security Site boundary?

A Yes. Detectable levels of tritium, which is a radioactive form of hydrogen, have been found on the restricted U.S. Air Force land adjacent to the Nevada National Security Site. In 2009, a Nevada-certified laboratory working independently of the U.S. Department of Energy verified the presence of tritium in water samples taken from well ER-EC-11 in the Western Pahute Mesa region. These findings support Nevada Site Office computer models that predicted tritium would be detected at this sampling location. Contamination has not been found in any additional wells beyond the Nevada National Security Site boundary.

Although well ER-EC-11 (located on U.S. Air Force restricted land) is not used for drinking water, it is important to note that tritium levels at this well measured below the U.S. Environmental Protection Agency (EPA) *Safe Drinking Water Act* standard of 20,000 picocuries per liter, which is the standard used for determining whether or not water is safe for human consumption.

This is the first time radioactively-contaminated groundwater resulting from historic nuclear testing has been found beyond the Nevada National Security Site border.

ER-EC-11 is the first well off the Nevada National Security Site that has shown any groundwater contamination caused from underground nuclear testing.



Q Is contaminated water from the Nevada National Security Site a risk to the public?

A No. Based on the most current scientific information available, there is no immediate risk to public health. All data indicates groundwater contaminants associated with Nevada Site Office activities are confined to federal land. The 4,500 square miles of U.S. Air Force restricted land provides a large buffer zone between potential contaminants and public-accessible water. The location of the well where contamination was detected (well ER-EC-11) is 14 miles from the nearest private well. According to a range of computer model predictions, contamination is not expected to reach this private water source for at least 100 years and may, in fact, never travel this distance.

During 2009 and 2010, UGTA installed eight new wells on and surrounding Pahute Mesa to gather more geologic and hydrologic information about the area's subsurface. In addition, data will be gathered from two more Pahute Mesa wells scheduled for drilling in the summer of 2012. This data will help scientists continue to refine the computer model and understand the movement of contaminants.

Did You Know?

Tritium is the most common radionuclide found in groundwater at the Nevada National Security Site. While the majority of this tritium is a direct result of nuclear production and testing, it is also found naturally in air and some water.

Construction costs for each well, which can include excavation, equipment, and various infrastructure needs, are between $4 million to $6 million. Funding was provided, in part, through the American Recovery and Reinvestment Act of 2009.

Q Did the Nevada Site Office expect groundwater contamination to migrate beyond the Nevada National Security Site boundary?

A Yes. Computer models predicted radionuclides in groundwater would move beyond the Nevada National Security Site boundary within 50 years of the first nuclear detonation on Pahute Mesa (1966) and that this migration would occur in the vicinity of the test, which is near the northwest border of the Nevada National Security Site. These predictions were first published in 1997 in a U.S. Department of Energy report entitled *Regional Groundwater Flow and Tritium Transport Modeling and Risk Assessment of the Underground Test Area, Nevada National Security Site, Nevada.* Additional sampling allowed scientists to further refine the computer model, and in February 2009, these refined computer model predictions were published in the *Phase I Central and Western Pahute Mesa Transport Model and Phase II Central and Western Pahute Mesa Corrective Action Plan.*

Q What would happen if groundwater contamination exceeding EPA standards is found off the Nevada National Security Site?

A If groundwater contaminants from Nevada National Security Site activities were verified at a public or private drinking water source beyond the test site boundary, and the levels exceeded EPA drinking water standards, the Nevada Site Office would immediately coordinate with the State of Nevada to shut down the well and pursue an alternate water supply.

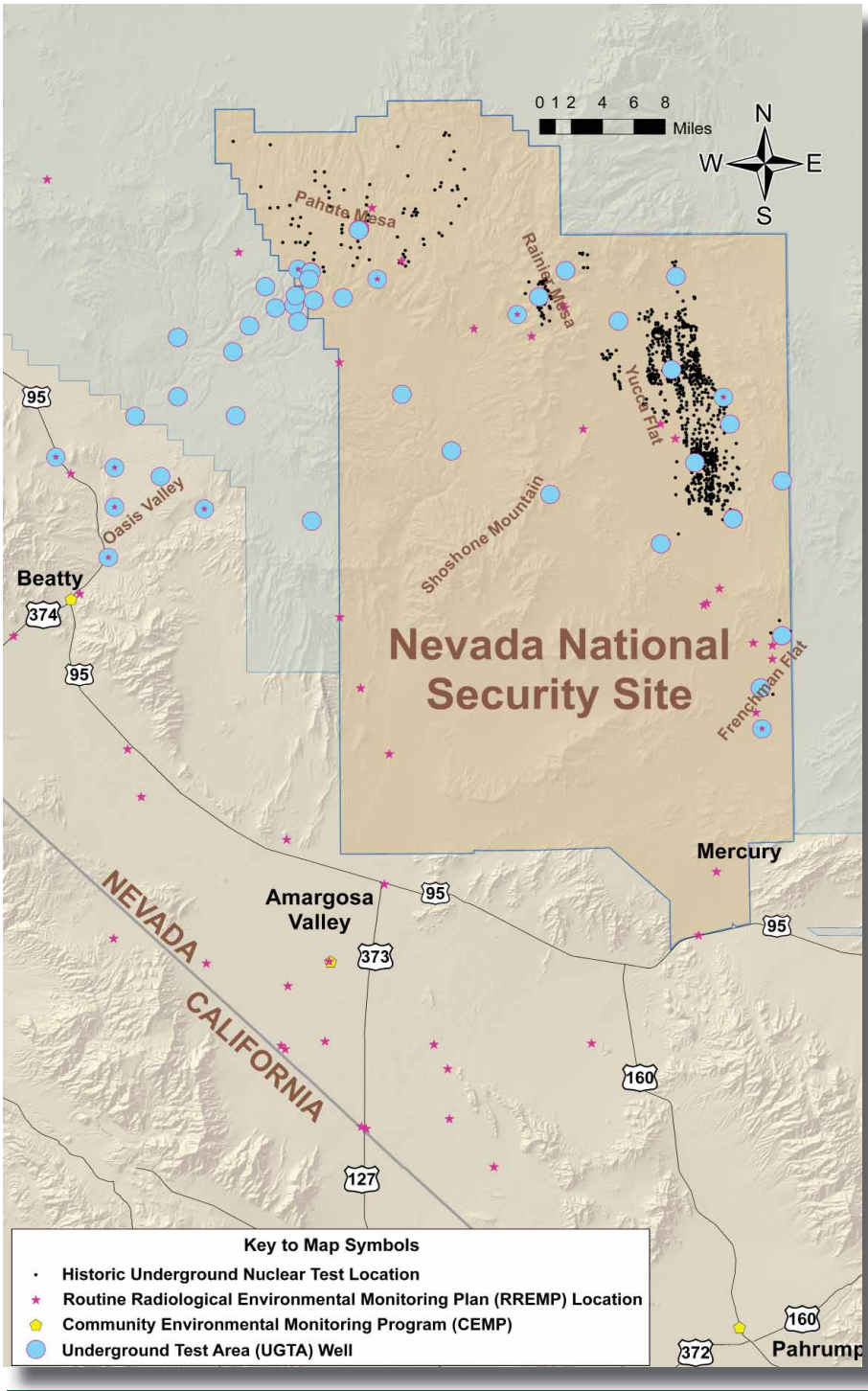
Safeguarding the public, the environment, and site workers is accomplished in part through a comprehensive monitoring program.

Q Can extensive contamination be removed from groundwater?

A No. At this time, no proven, cost-effective technology exists that removes deep, extensive tritium contamination from groundwater in complex geology.

Q A Who collects groundwater samples? Where? and How often?

Several groups regularly test water at and surrounding the Nevada National Security Site. The Nevada Site Office Routine Radiological Environmental Monitoring Program (RREMP) samples more than 60 locations, which include wells, springs, and surface water locations, at scheduled intervals ranging from once every three months to once every three years, to make sure radionuclide levels do not exceed *Safe Drinking Water Act* standards. If necessary, these sampling results can be used to supplement UGTA data. As previously mentioned, UGTA samples a network of deep wells to help determine where contaminants are present in groundwater, what direction these contaminants are moving, and how quickly.



In addition to RREMP and UGTA sampling efforts, the Community Environmental Monitoring Program (CEMP) performs independent, annual monitoring of 29 springs and water supplies in communities surrounding the Nevada National Security Site. Network stations in Nevada, Utah, and California provide information on community drinking water as well as airborne radiation levels and meteorological data. The Desert Research Institute manages this program and oversees the independent analysis of samples. To view the CEMP's most recent data, go to www.cemp.dri.edu.

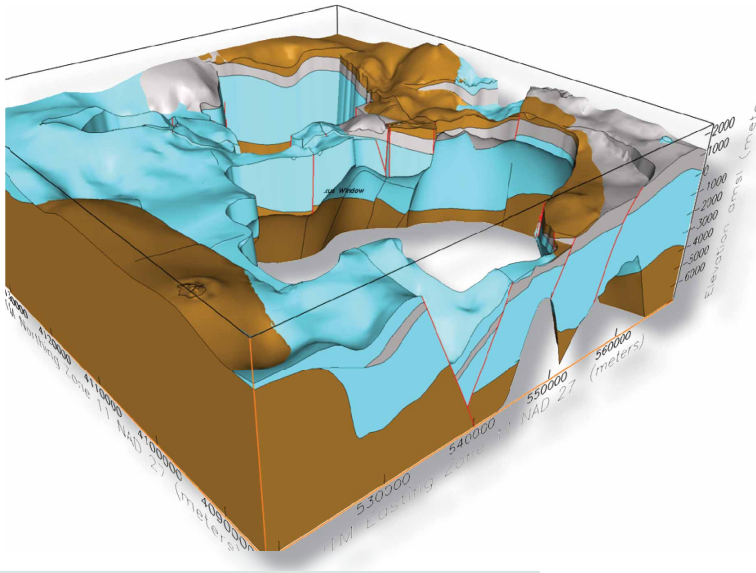
Did You Know?

Water sample results are available in Chapter Four of the Nevada National Security Site Environmental Report at www.nv.energy.gov/library/publications/aser.aspx

Q&A What are computer models and how are they used?

Computer models are three-dimensional, mathematical images that give scientists detailed glimpses into areas that are otherwise inaccessible. Computer models are especially useful at the Nevada National Security Site, as its vast scale and complex geology make it incredibly difficult to map the intricate subsurface. Information gathered from drilling, sampling, research, and geophysical analysis all become data points in the computer model, which then help scientists predict where and how quickly radioactive contaminants move in groundwater.

Experts periodically resample wells, or drill new ones, to see if sampling results are consistent with the models. This is the case in Frenchman Flat (located in the southeastern portion of the Nevada National Security Site) where two new model evaluation wells will be drilled in the spring of 2012.



A computer model is a computer-generated, three-dimensional representation of how water and contaminants move through complex geology.

Q&A How are well sites chosen?

The Nevada Site Office typically installs groundwater characterization wells at locations where additional sampling data would most benefit the computer model. For instance, in order to address uncertainty in Pahute Mesa models, UGTA drilled eight new characterization wells in the Pahute Mesa region during 2009 and 2010. Data relating to water chemistry, pressure levels, and temperature are gathered during this phase and entered into the current Pahute Mesa models to give scientists a clearer understanding of how groundwater moves through the subsurface. Drilling campaigns are an iterative process, meaning that data gathered from one or more wells is used to select the best location for the next well.

Stakeholder input has also played a role in the well selection process. The Nevada Site Specific Advisory Board (NSSAB), a group of volunteers from communities around the Nevada National Security Site, was instrumental in selecting the location of the first of the eight new wells drilled on Pahute Mesa.

Nevada Site Office staff brief State of Nevada Division of Environmental Protection (NDEP) representatives during a tour of a drill site. NDEP serves as the state regulator for Nevada National Security Site environmental activities.

Q In what direction does Nevada National Security Site groundwater flow?

A Nevada National Security Site groundwater, which is part of a larger regional flow system, predominantly moves in a southern direction toward Death Valley. Intensive UGTA activities are in place to ensure communities within this flow system remain protected from groundwater contaminated by historic underground nuclear testing.

Q Are Nevada National Security Site workers affected by contaminated groundwater?

A No. Sampling results indicate that historic nuclear testing has not impacted the Nevada National Security Site water supply network. Nine wells currently provide potable and non-potable water for Nevada National Security Site workers and operations. The State of Nevada Division of Environmental Protection regulates these nine wells to ensure compliance with the *Safe Drinking Water Act*, the *Clean Water Act*, and other state and federal regulations.

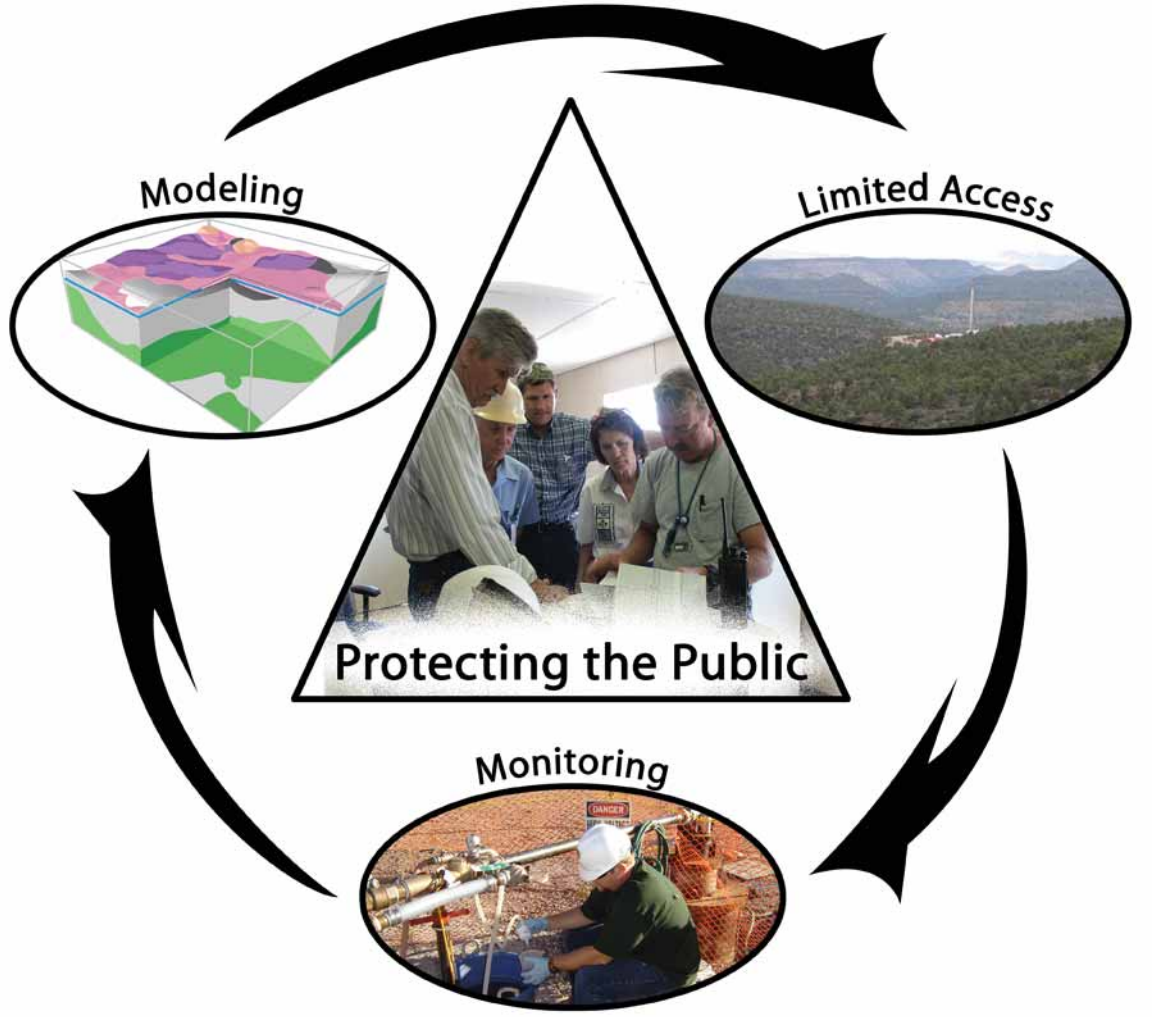
Q Which radionuclides are scientists testing for in groundwater samples?

A While tritium is the most common radionuclide found in Nevada National Security Site groundwater, the Nevada Site Office contracts independent laboratories to routinely test for a variety of other contaminants, such as chlorine, iodine, strontium, uranium, neptunium, technetium, carbon, cesium, plutonium, and krypton.

Scientists look for tritium first because its presence increases the potential for other contaminants. In other words, they do not expect to find other contaminants when tritium is low. Tritium is also likely to travel the furthest in groundwater.

Did You Know?

A radionuclide is a radioactive atom that can be produced through nuclear experiments, medical testing, or natural means. A picocurie is a general unit of measurement for levels of radioactivity and is most often associated with radioactivity in water. The word contaminant refers to any substance found at a particular location where it is not naturally occurring.



For further information or questions relating to
groundwater at the Nevada National Security Site, contact:

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
Office of Public Affairs
P.O. Box 98518
Las Vegas, NV 89193-8518
(702) 295-3521
envmgt@nv.doe.gov
www.nv.energy.gov

DOE/NV--618 REV4 • May 2011