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Closure Report Central Nevada Test Area Subsurface Corrective Action Unit 443

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Abbreviations

bgs	below ground surface
BLM	U.S. Bureau of Land Management
^{14}C	carbon-14
CADD/CAP	Corrective Action Decision Document/Corrective Action Plan
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CNTA	Central Nevada Test Area
CSM	conceptual site model
DDA	Data Decision Analysis
DOE	U.S. Department of Energy
FFACO	Federal Facility Agreement and Consent Order
FMP	Fluid Management Plan
ft	feet
GIS	geographic information system
^{129}I	iodine-129
ICs	institutional controls
LM	Office of Legacy Management
m/day	meters per day
MDC	minimum detectable concentration
msl	mean sea level
MV	monitoring/validation
NDEP	Nevada Division of Environmental Protection
pCi/L	picocuries per liter
QSM	*Department of Defense (DoD) Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories*
ROTC	Record of Technical Change
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
SGZ	surface ground zero

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Executive Summary

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) prepared this Closure Report for the subsurface Corrective Action Unit (CAU) 443 at the Central Nevada Test Area (CNTA), Nevada, Site. CNTA was the site of a 0.2- to 1-megaton underground nuclear test in 1968. Responsibility for the site's environmental restoration was transferred from the DOE, National Nuclear Security Administration, Nevada Field Office to LM on October 1, 2006. The environmental restoration process and corrective action strategy for CAU 443 are conducted in accordance with the Federal Facility Agreement and Consent Order (FFACO 1996, as amended 2011) and all applicable Nevada Division of Environmental Protection (NDEP) policies and regulations. This Closure Report provides justification for closure of CAU 443 and provides a summary of completed closure activities; describes the selected corrective action alternative; provides an implementation plan for long-term monitoring with well network maintenance and approaches/policies for institutional controls (ICs); and presents the contaminant, compliance, and use-restriction boundaries for the site.

Three emplacement boreholes—UC-1, UC-3, and UC-4—were drilled at CNTA for underground nuclear weapons testing. The three boreholes are included as part of CAU 443 and are identified as Corrective Action Sites (CASs) UC-1 Cavity CAS 58-57-001, Emplacement Well UC-3 CAS 58-30-01, and Emplacement Well UC-4 CAS 58-30-02. The underground nuclear test at CNTA, identified as Faultless, was conducted in borehole UC-1 at a depth of 3,199 feet below ground surface. The test resulted in a down-dropped fault block (also referred to as a graben) that extends to land surface. It also created a cavity with a collapse chimney that extends into the overlying alluvium. The detonation cavity (identified as UC-1 cavity CAS 58-57-001) is in low-permeability volcanic sediment and is the source of contamination. Well UC-1-P-2SR was directionally drilled a few weeks after the detonation in 1968 and completed in the UC-1 chimney and upper portion of the alluvium. Water levels in this well are still recovering from the dewatering effects of the detonation. Two additional tests were planned (UC-3 and UC-4 boreholes), but no further nuclear testing was conducted at CNTA.

The original corrective action strategy included developing a conceptual site model (CSM), preparing a numerical flow and transport model, calculating contaminant boundaries, negotiating compliance boundaries with NDEP, performing model validation, and monitoring groundwater. This strategy was executed through the Corrective Action Decision Document/Corrective Action Plan (CADD/CAP) phase, which selected the corrective action alternative Proof-of-Concept and Monitoring with Institutional Controls for implementation at the site. It was determined during the 5-year proof-of-concept monitoring and model validation process that the groundwater flow and transport model developed for the UC-1 detonation cavity (CAS 58-57-001) could not be validated because it failed to adequately predict head levels in wells drilled subsequent to the modeling effort. However, aquifer tests conducted on the monitoring/validation (MV) wells (MV-1, MV-2, and MV-3) indicated that the permeability of the volcanic section was less than expected, supporting the limited transport distances predicted by the model. This led to a revised corrective action strategy designed to validate the compliance boundary through monitoring and ICs, rather than relying predominantly on the numerical flow and transport model (FFACO 1996, as amended 2011). The revised approach was executed through the CADD/CAP Addendum, which included enhancements to the monitoring well network and CSM, and 5 years of monitoring to confirm that data were sufficient to proceed to the Closure Report phase. Unrestricted public access to the CNTA site increases the importance of having ICs around areas of potential contamination. For this reason,

the corrective action strategy includes a use-restriction area that envelops the negotiated compliance boundary and modeled contaminant boundary, and that controls public access to groundwater through restrictions applied to drilling and to the use of groundwater. NDEP approved the modeled contaminant boundary (NDEP 2004b) and compliance boundary (NDEP 2004a) for UC-1 and provided acceptance to move CAU 443 to the Closure Report phase in June 2015 (NDEP 2015).

Implementation of the corrective action for CAU 443 includes post-closure monitoring with ICs as part of the long-term stewardship of the site. This includes maintaining the concrete caps that cover the UC-3 and UC-4 boreholes, and groundwater monitoring at the UC-1 site. The groundwater monitoring network at UC-1 consists of 12 locations (wells and piezometers) in the alluvium, 7 locations (wells and piezometers) in the volcanic section, and 1 well in the UC-1 chimney that resulted from the underground nuclear test. The monitoring program is designed to (1) assess the effectiveness of the compliance boundary by monitoring for the radioisotopes of interest and (2) evaluate the effectiveness of monitoring locations within the groundwater flow system by monitoring hydraulic head to ensure that monitoring wells are located along potential contaminant migration pathways. LM will conduct periodic evaluations during the monitoring program to verify that the corrective action is working, and will routinely inspect the condition of the UC-3 and UC-4 concrete caps to ensure that the integrity of the concrete caps is maintained.

LM will provide groundwater monitoring reports to NDEP after the sampling events during the long-term monitoring program. These reports will summarize the annual site inspection results, provide recommendations for any corrective maintenance actions, provide a status on the ICs, and document the contaminant detection and hydraulic head monitoring results. The reports will include a potentiometric surface map of the upper alluvial unit inside the graben and hydrographs for comparable monitored units. These data will be evaluated with the detection monitoring results to determine if the data continue to support the CSM and demonstrate that the compliance and use-restriction boundaries are protective of human health and the environment.

1.0 Introduction

This Closure Report was prepared by the U.S. Department of Energy (DOE) Office of Legacy Management (LM) for the subsurface Corrective Action Unit (CAU) 443 at the Central Nevada Test Area (CNTA), Nevada, Site. Responsibility for the environmental site restoration was transferred from the DOE, National Nuclear Security Administration, Nevada Field Office to LM on October 1, 2006. The environmental restoration process and corrective action strategy for CAU 443 are conducted in accordance with the Federal Facility Agreement and Consent Order (FFACO) (FFACO 1996, as amended 2011) and all applicable Nevada Division of Environmental Protection (NDEP) policies and regulations.

The CNTA is north of U.S. Highway 6, approximately 30 miles north of Warm Springs in Nye County, Nevada (Figure 1). The U.S. Atomic Energy Commission (predecessor agency to DOE) acquired CNTA in the early 1960s to develop sites for underground nuclear testing that could serve as alternatives to the Nevada National Security Site (formerly known as the Nevada Test Site). Three emplacement boreholes—UC-1, UC-3, and UC-4—were drilled at CNTA for underground nuclear weapons testing. The three boreholes are included as part of CAU 443 and are identified as Corrective Action Sites (CASs) UC-1 Cavity CAS 58-57-001, Emplacement Well UC-3 CAS 58-30-01, and Emplacement Well UC-4 CAS 58-30-02 (Figure 1). The underground nuclear test, identified as Faultless, was conducted in borehole UC-1 at a depth of 3,199 feet (ft) below ground surface (bgs) on January 19, 1968. Two additional tests were planned (UC-3 and UC-4 boreholes), but neither was completed, and no further nuclear testing was conducted at CNTA. The site was decommissioned as a testing facility in 1973.

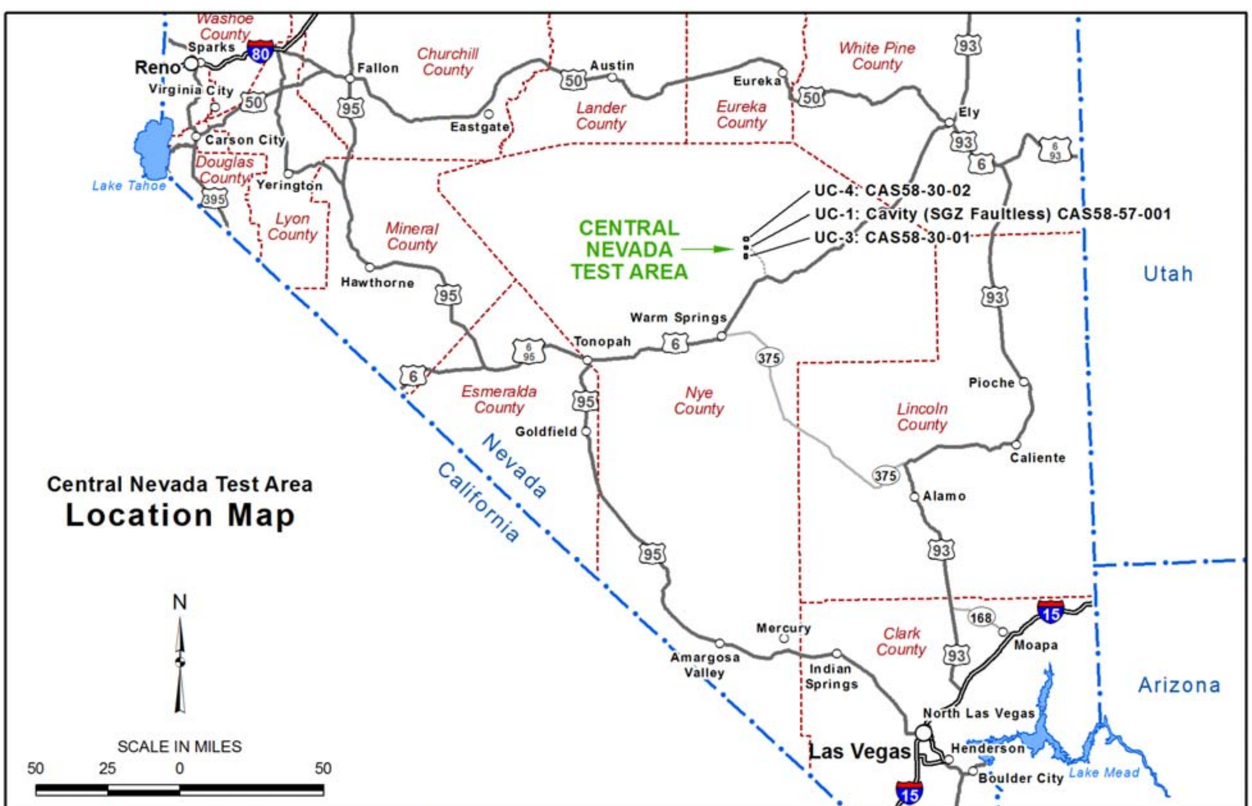

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Figure 1. Site Location Map

1.1 Purpose

This Closure Report provides justification for closure of CAU 443 and describes the corrective action that was selected for implementation during closure in accordance with the Corrective Action Decision Document/Corrective Action Plan (CADD/CAP) (DOE 2004) and Addendum to the CADD/CAP (DOE 2008). The CADD/CAP evaluates potential corrective action alternatives, provides rationale for the selection of the recommended corrective action alternative, presents the corrective action scope of work, and details the post-closure plan. The Addendum to the CADD/CAP incorporates findings from the corrective action scope of work, provides enhancements to the corrective action scope of work, and implements recommendations for changes to the corrective action plan. This Closure Report provides a summary of completed closure activities, describes the selected corrective action alternative, provides an implementation plan for long-term monitoring with well network maintenance and approaches/policies for institutional controls (ICs), and presents the contaminant, compliance, and use-restricted boundaries for the site.

1.2 Site Background and Regulatory Process

CNTA is on land administered by the U.S. Bureau of Land Management (BLM). The U.S. Atomic Energy Commission established two land withdrawals through Public Land Orders 4338 and 4748 in 1967 and 1969, respectively. The initial land withdrawal, Public Land Order 4338, included approximately 640 acres for land surrounding the UC-1 emplacement borehole. The second land withdrawal, Public Land Order 4748, was for two separate parcels of land totaling approximately 1,920 acres for land surrounding the UC-3 and UC-4 emplacement boreholes (Figure 2). The UC-3 emplacement borehole (CAS 58-30-01) is a 10 ft diameter borehole completed with 4.5 ft diameter steel casing that is cemented in place from ground surface to a depth of 4,782 ft bgs. The UC-4 emplacement borehole (CAS 58-30-02) is also a 10 ft diameter borehole, but is uncased and filled with drilling mud from ground surface to a depth of 5,500 ft bgs. These boreholes are secured at the surface by a welded steel plate and concrete cap. The UC-1 emplacement borehole was the location of the underground nuclear test, and the detonation cavity (CAS 58-57-001) that resulted from the test is the source of contamination, which includes radioactive fission products, uranium, plutonium, and tritium (DOE 2005). The yield of the Faultless test is reported to be 0.2 to 1 megaton. The test resulted in a down-dropped fault block (also referred to as a graben) that extends to land surface (Figure 3).

The two land withdrawals include three parcels (UC-1, UC-3, and UC-4) that total 2,560 acres and are spaced approximately 3 miles apart along a roughly north-south line (Figure 2). The total acreage is currently withdrawn from all forms of appropriation associated with mining laws and leasing. Public land surrounding CNTA is used for livestock grazing and ranching, with recreational use for the public. A total of 10 groundwater monitoring wells are located on or near the UC-1 withdrawal to monitor groundwater near the detonation cavity (Figure 3). There are no wells at CNTA that are used to supply water for livestock or human consumption, and no water rights are filed with the Nevada Division of Water Resources. The closest known water use is at Six Mile well, which is approximately 8.8 miles south of the site and used for livestock watering (Figure 2). No residences or other habitable structures exist on the CNTA site.

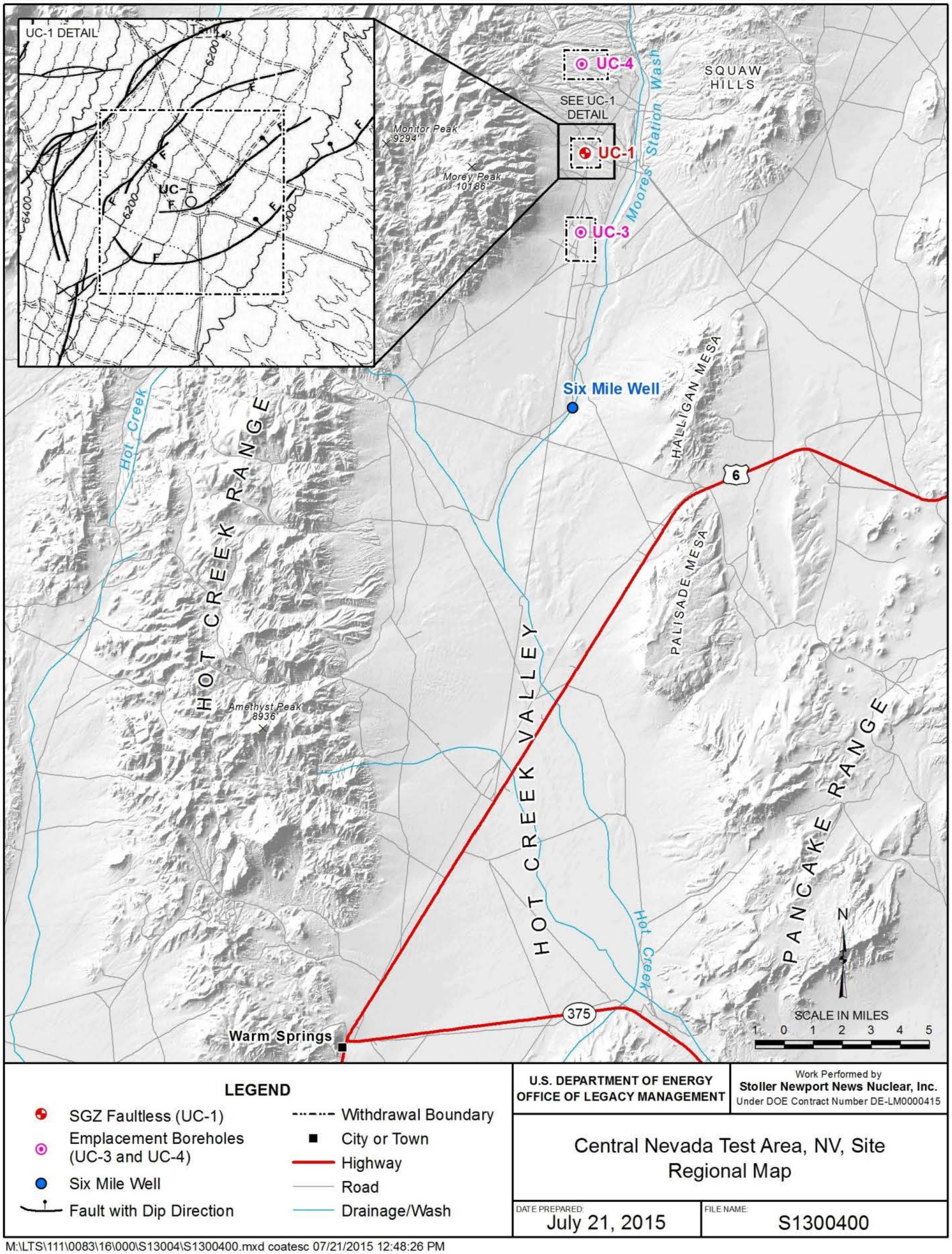

Figure 2. CNTA Regional Map

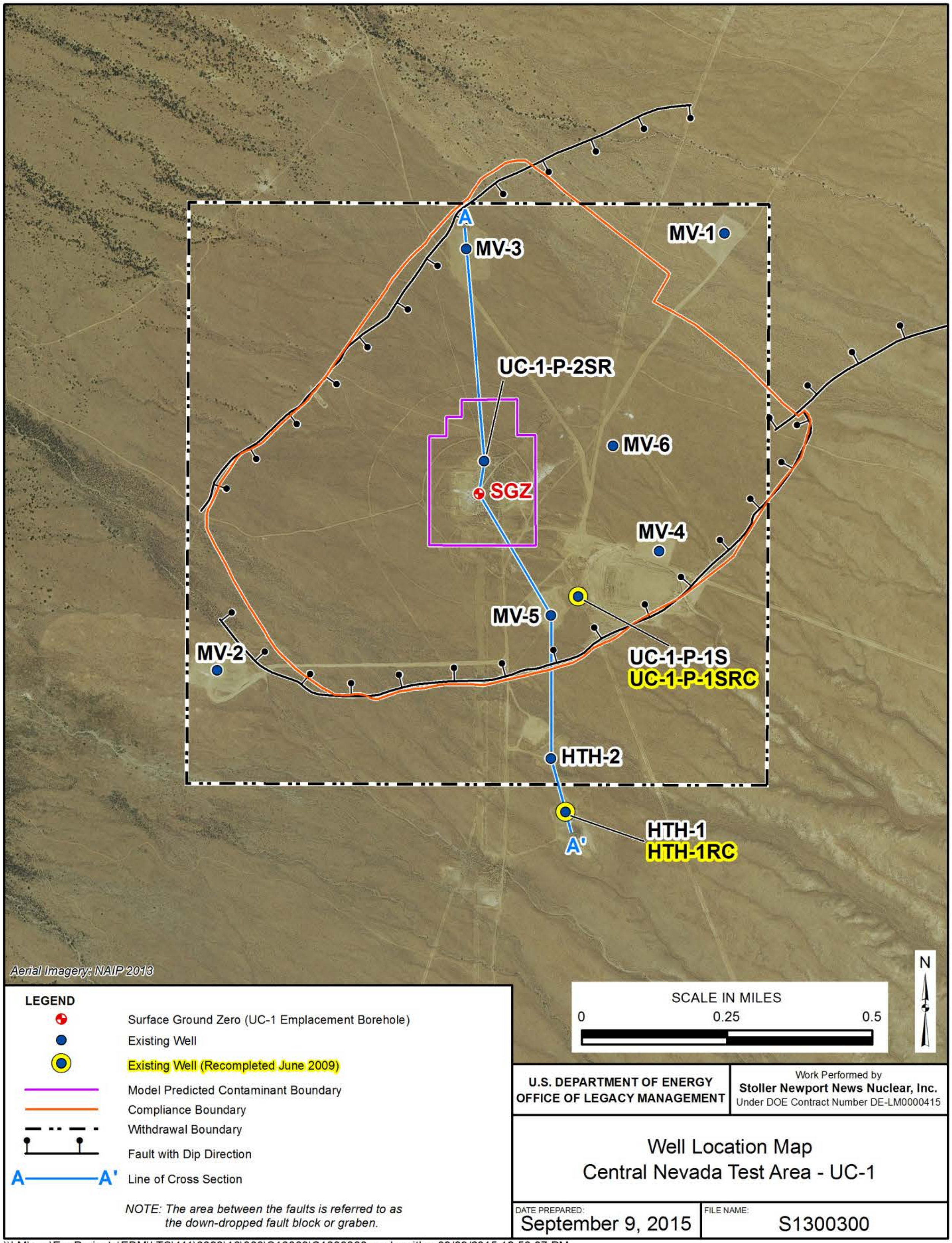

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Figure 3. Well Location Map, Central Nevada Test Area UC-1

The environmental restoration process and corrective action strategy for CAU 443 are conducted in accordance with the FFACO (FFACO 1996, as amended 2011) and all applicable NDEP policies and regulations. The corrective action strategy followed the original Underground Test Area strategy (FFACO 1996, as amended 2011), with modifications to accommodate site conditions. The approach included developing a conceptual site model (CSM) and a numerical flow and transport model, calculating contaminant boundaries, negotiating compliance boundaries with NDEP, performing model validation, and monitoring groundwater. This strategy was executed through the CADD/CAP phase, which selected the corrective action alternative Proof-of-Concept and Monitoring with Institutional Controls for implementation at the site. It was determined during the 5-year proof-of-concept monitoring and model validation process that the groundwater flow and transport model developed for the UC-1 detonation cavity (CAS 58-57-001) could not be validated because it failed to adequately predict head levels in wells drilled subsequent to the modeling effort. However, aquifer tests conducted on the new wells indicated that the permeability of the volcanic section was less than expected, supporting the limited transport distances predicted by the model. This led to a revised corrective action strategy designed to validate the compliance boundary through monitoring and ICs, rather than relying predominantly on the numerical flow and transport model (FFACO 1996, as amended 2011). The revised approach was executed through the CADD/CAP Addendum, which included enhancements to the monitoring well network and CSM, and 5 years of monitoring to confirm that data were sufficient to proceed to the Closure Report phase. NDEP approved the modeled contaminant boundary (NDEP 2004b) and compliance boundary (NDEP 2004a) for UC-1 and provided acceptance to move CAU 443 to the Closure Report phase (NDEP 2015).

1.3 Geologic and Hydrologic Setting

CNTA is in the northern portion of the Hot Creek Valley (Figure 2), a north-south trending graben that is 68 miles long and located in the Basin and Range physiographic province. Surface and subsurface geologic data indicate that CNTA is within the Hot Creek Valley caldera complex, which contains several overlapping volcanic cauldrons. This caldera complex has been disrupted by basin-and-range style normal faulting that formed the Hot Creek Valley graben. Hot Creek Valley varies in width from 5 to 19 miles and contains two major stratigraphic units—a thick sequence of Quaternary- and Tertiary-age alluvial deposits (alluvium) underlain by a thick section of Tertiary-age volcanic rocks (volcanics). Borehole lithologic information obtained from groundwater monitoring wells installed at the site (Figure 3) indicates that the thickness of the alluvium in the vicinity of UC-1 (location of the Faultless test) ranges from 1,960 to 2,410 ft (DOE 2006). The Tertiary volcanics below the alluvium include tuffaceous sediments, welded and nonwelded tuffs, densely welded tuffs, and rhyolite lavas.

The Faultless test triggered numerous small earthquakes and aftershocks that resulted in surface subsidence and surface rupture along preexisting faults, caused strike-slip movement along previously unknown subsurface faults, and induced seismic activity as far away as 24 miles (McKeown and Dickey 1969). The Faultless test created a subsidence graben (also referred to as a down-dropped fault block) elongated to the northeast and parallel to preexisting faults in the Quaternary valley-fill deposits (Figure 3). The graben is bounded on the southeast, south, southwest, and northwest by curved faults, with an apparent hinge line at the northeastern end of the graben (Ekren et al. 1973). Maximum surface displacement after the test was 14.8 ft. In some places along the south side of the graben, dip on the faults is 77 degrees to the north, based on fault intercepts in post-shot boreholes and post-shot map data (Figure 3). High-speed photography showed that subsidence occurred immediately following the test, indicating that subsidence resulted from the immediate release of tectonic stress that was triggered by the underground test, and not from the collapse of the test cavity (McKeown et al. 1968; McKeown and Dickey 1969).

The Faultless test took place in the low-permeability volcanic section and created a cavity with a subsequent collapse chimney that extends into the overlying alluvium. Well UC-1-P-2SR was directionally drilled into the chimney a few weeks after the detonation in 1968. It was estimated that the UC-1 chimney extends upward to a depth of approximately 1,200 ft bgs based on drilling records that indicate a loss of circulation while drilling at this depth. The directional survey indicates that well UC-1-P-2SR began to deviate from vertical below 1,500 ft (4,600 ft above mean sea level [msl]) and was drilled to a measured depth of 3,554 ft bgs (3,513 true vertical depth). Well UC-1-P-2SR was perforated from measured depths of 1,148 to 2,792 ft (1,148 to 2,760 ft true vertical depth). The head level in the chimney is still recovering from the dewatering effects of the detonation. The water level in reentry well UC-1-P-2SR (at 5,614 ft above msl in early 2015) has increased more than 1,800 ft in the last 40 years (Figure 4) and is expected to rise another 150 ft to eventually reach the head level in the alluvial aquifer in this area (approximately 5,765 ft above msl). The rate of water level rise in UC-1-P-2SR is decreasing as the recovery proceeds, and it will be a number of decades before its water level stabilizes. Figure 5 is a cross-section of the UC-1 site depicting the UC-1 cavity and collapse chimney with faults, lithologic units, and head levels in the wells and piezometers.

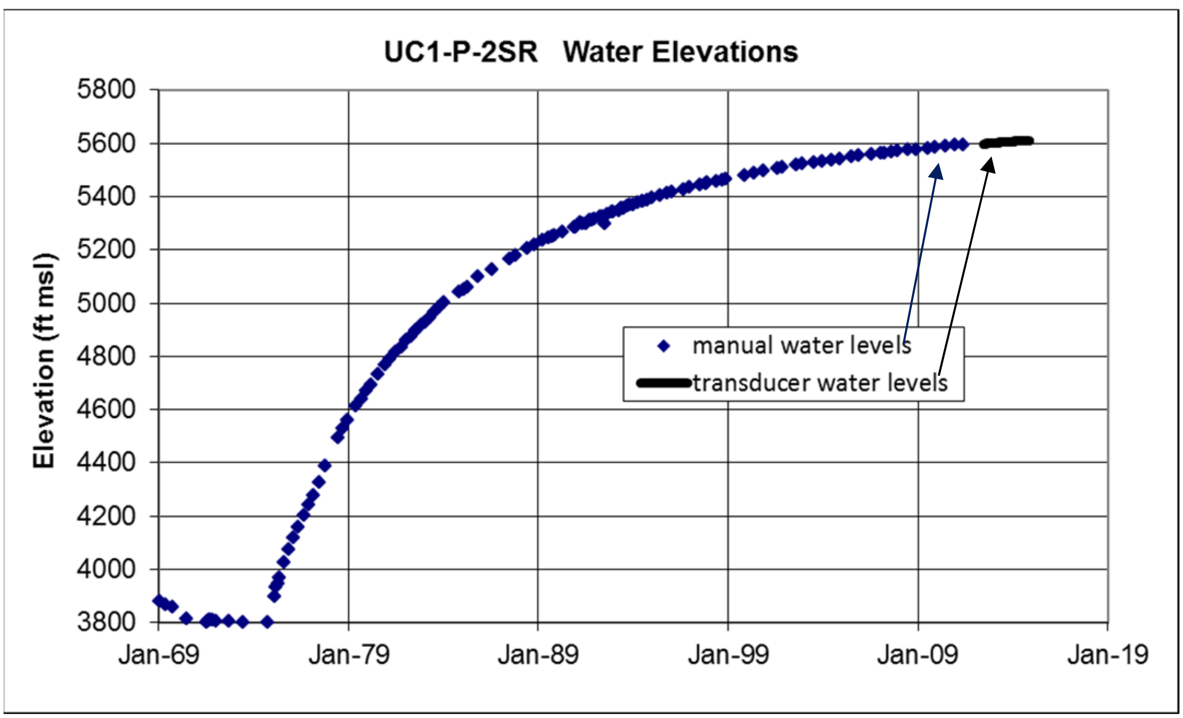

Figure 4. Water Level Elevations in Reentry Well UC-1-P-2SR (http://nevada.usgs.gov/doe_nv/sitepage_temp.cfm?site_id=383806116125951)

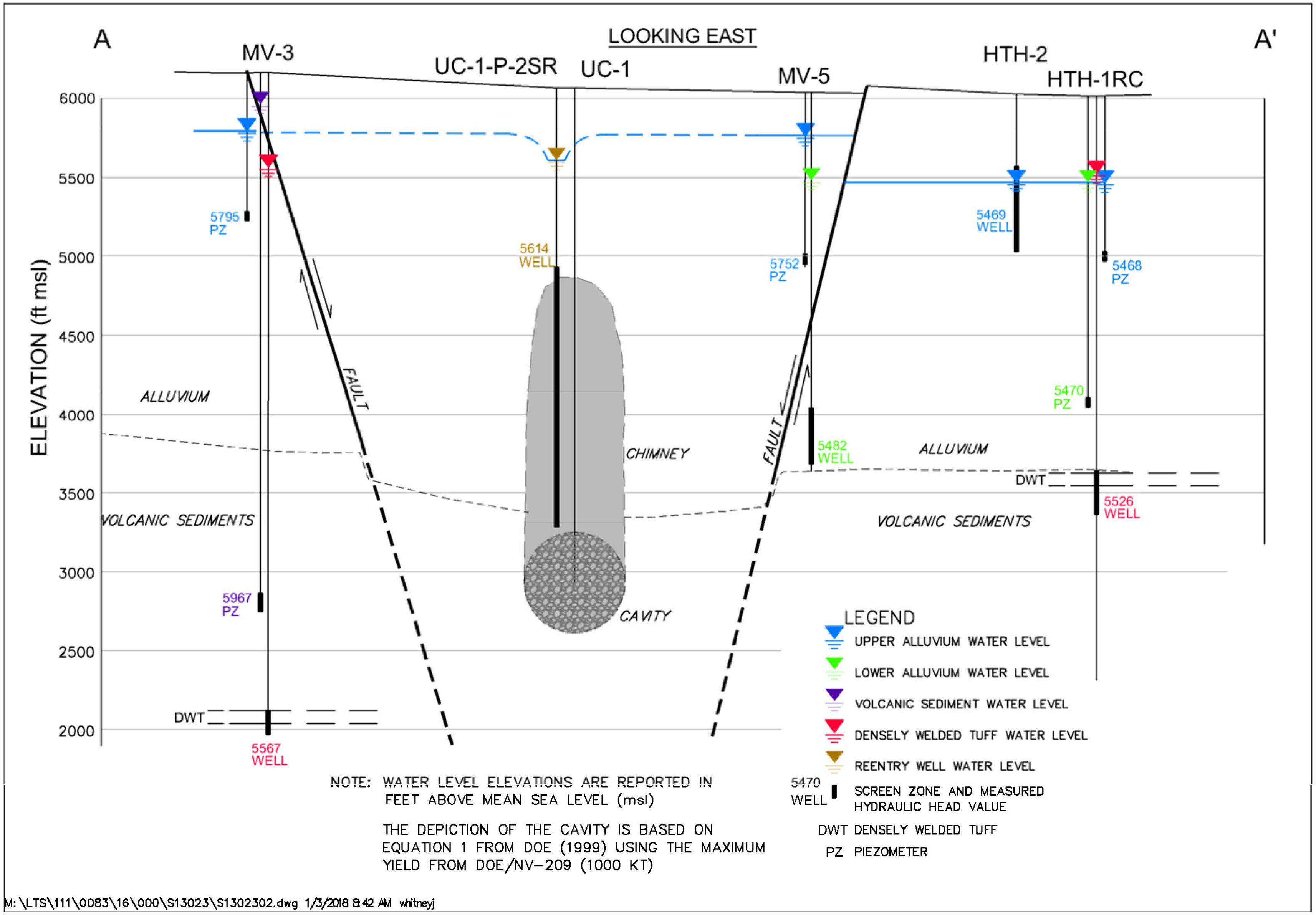

Figure 5. Cross Section View of A–A' Shown in Figure 3

Head levels at the site are highest in the volcanic sediments at the detonation elevation as shown by water levels (Figure 5) in the MV-3 well and piezometers (upper piezometer and lower piezometer). The increased head levels (pressure) at the detonation elevation are likely detonation related. This is most evident inside the graben where water levels are approximately 6,020 ft above msl in the MV-1 lower piezometer (Appendix C, Figure C-3), which is screened at the detonation elevation. The head distribution (Figure 5) at the site suggests that the most likely flow direction from the detonation zone is down, toward the densely welded tuff units. This downward vertical gradient is most pronounced inside the graben with water levels from MV-1 well and piezometers. It is expected that the potential for upward migration into the alluvium will increase as the water level in the chimney (UC-1-P-2SR) recovers from the dewatering effects of the detonation. Hydraulic head data collected at the site from 2007 through April 2015 are displayed as hydrographs in Appendix C.

Water levels at the HTH-1 location south of the graben also suggest an upward gradient from the upper part of the volcanic section to the overlying alluvium, though of less magnitude than is seen within the graben. Well HTH-1 was drilled to a depth of 3,704 ft bgs in September 1967, prior to the underground nuclear test, and was completed with steel casing. The well casing was cemented in place and perforated at various intervals from 150 to 3,665 ft bgs. The nuclear test caused an obstruction at 2,812 ft bgs that prevented access to the portion of the well below this depth. The well was recompleted in 2009 and renamed HTH-1RC. The recompletion included the installation of two piezometers (upper and lower alluvial unit) and a well (densely welded tuff) within the original well casing to allow water levels at different depths to be monitored. The well (HTH-1RC) isolated a densely welded tuff unit above the obstruction and detonation level, but the original well casing remains open below the obstruction to the original depth of 3,704 ft bgs. Monitoring results from HTH-1RC and the HTH-1 piezometers support the interpretation of an upward hydraulic gradient from the upper volcanic section to the alluvium (DOE 2010a). This interpretation is supported by flow logging and borehole logs that indicated flow was entering the well from below the obstruction at 2,812 ft bgs (Chapman et al. 1994).

Faults have been shown to influence flow at the site, primarily acting as barriers to flow. Head levels in the alluvial aquifer within the graben are about 250 ft higher than those in the alluvium south of the southeast-bounding graben fault. Any potential for contaminant migration from the detonation zone will be inhibited by the low permeability of the volcanic section in which the detonation occurred and the bounding graben faults that act as barriers to flow.

1.4 Selected Corrective Action Alternative

The corrective action alternative selected for implementation at CAU 443 was Proof-of-Concept and Monitoring with Institutional Controls (DOE 2004). The selected corrective action includes establishing a monitoring program, use restrictions, and other ICs to protect human health and the environment. This alternative was selected on the basis of results of the corrective action investigation and the detailed comparative analysis of the potential corrective action alternatives presented in the CADD/CAP. It was also determined that this alternative was superior in Implementability and Cost, and it met the requirement of Protection of Human Health and the Environment. The rationale for selecting this alternative was provided in the CADD/CAP and includes the following:

- Health risks are minimized by use of administrative controls to prevent worker exposure and public access to the contaminated groundwater.

- Only minimal waste from drilling and sampling will be generated. If groundwater in the monitoring wells is not contaminated, these wastes will not be hazardous or radioactive.
- It is easily implemented, although coordination of all entities is necessary to ensure compliance with administrative controls. The required services and materials are readily available.
- It provides a cost-effective method to protect human health and the environment and to meet closure requirements.

1.5 Closure Report Contents

This Closure Report presents a summary of the corrective action investigation and CADD/CAP activities (Section 2.0); final contaminant, compliance, and use-restriction boundaries (Section 3.0); a description of the corrective action and how it will be implemented (Section 4.0); reporting requirements (Section 5.0), records and data management (Section 6.0); quality assurance (Section 7.0); recommendation to issue a Notice of Completion and move CAU 443 from Appendix III to Appendix IV of the FFACO (Section 8.0); and a list of the references cited in this document (Section 9.0).

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2.0 Summary of Site Corrective Action Investigations and CADD/CAP Activities

Surface and subsurface contamination resulted from the underground nuclear test at CNTA. Contamination at the surface was identified as CAU 417. Surface restoration was completed in 1999, and the remediation activities are described in the *Closure Report for Corrective Action Unit 417: Central Nevada Test Area Surface, Nevada* (DOE 2001). Contamination in the subsurface is identified as CAU 443 and is the focus of this report. The remainder of this section summarizes site restoration activities associated with CAU 443.

2.1 Corrective Action Investigation

The corrective action investigation was performed in several stages from 1999 to 2003, as set forth in the Corrective Action Investigation Plan (CAIP) that was developed and approved in 1999 (DOE 1999). The CAIP focused on the UC-1 cavity (CAS 58-57-001) and UC-4 emplacement borehole (CAS 58-30-02) because it was determined during the seven-step Data Quality Objective process with NDEP that these sites had contaminants of potential concern. The Data Quality Objective process applied to UC-4 identified the drilling mud, which was used to fill the borehole, as the source of contamination and total petroleum hydrocarbons as the contaminants of potential of concern. The UC-1 cavity that resulted from the underground nuclear test was identified as the source of contamination and the radioisotopes that remain as contaminants of potential concern. The UC-3 emplacement borehole (CAS 58-30-01) was identified as having no contaminants of potential concern and requiring no further evaluation (DOE 1999). The specific objectives outlined in CAIP were as follows:

- Determine the characteristics of the groundwater flow system, sources of contamination, and transport processes to acceptable levels of uncertainty.
- Develop a credible numerical model of groundwater flow and contaminant transport for the UC-1 subsurface CAS and downgradient areas.
- Develop stochastic predictions of the contaminant boundary at an acceptable level of uncertainty.

These objectives were accomplished during the corrective action investigation, which included an evaluation of the UC-4 (CAS 58-30-02) emplacement borehole to determine a release function for the total petroleum hydrocarbons in the borehole (DOE 1999). Calculations were performed to determine the nature and extent of potential groundwater contamination near the UC-4 borehole. It was concluded from the analysis that no significant migration had occurred (Lyles et al. 1998).

Groundwater modeling was the primary activity of the corrective action investigation. Site data were used to develop a numerical flow and transport model to simulate the potential long-term migration of contaminants away from the UC-1 cavity. Three phases of modeling were conducted. The first involved the gathering and interpretation of geologic and hydrogeologic data into a three-dimensional numerical model of groundwater flow, and use of the output of the flow model for a transport model of radionuclide release and migration behavior (Pohlmann et al. 2000). The second modeling phase (known as a Data Decision Analysis [DDA]) occurred after NDEP reviewed the first model and was designed to respond to concerns regarding model uncertainty (Pohll and Mihevc 2000). The third modeling phase updated the original flow and transport model to incorporate the uncertainty identified in the DDA and focused the model domain on the region of interest to the transport predictions. This third phase culminated in the calculation of contaminant boundaries around the UC-1 detonation cavity (Pohll et al. 2003).

Groundwater modeling indicated that groundwater velocities at the UC-1 site were very low (because of very low hydraulic conductivities) and that the model-predicted contaminant boundaries would be very small. The boundaries were calculated for radionuclides that were produced by the underground test using risk-based and regulatory-based levels established in the Safe Drinking Water Act (SDWA) standards (Pohll et al. 2003). Although the regulatory- and risk-based calculations were based on slightly different risk thresholds, the contaminant boundary predictions were identical (Pohll et al. 2003). The final model-predicted contaminant boundary depicts the extent that groundwater contaminated with radionuclides exceeding the SDWA maximum contaminant levels would travel in 1,000 years at a 95% confidence level (Pohlmann et al. 1999, Pohll et al. 2003).

A compliance boundary was negotiated with NDEP that factored in modeling results and associated uncertainties with respect to the nuclear test's potential effects within the down-dropped fault block (Figure 3). The compliance boundary corresponds approximately to the surface expression of the fault block and is almost completely contained within the land withdrawal boundary. NDEP approved the compliance boundary in the letter dated June 11, 2004 (NDEP 2004a).

2.2 CADD/CAP and Recommendations

The CADD/CAP was developed and approved for CAU 443 in 2004 (NDEP 2004b). Results of the corrective action investigation and corrective action evaluation were presented in the CADD/CAP (DOE 2004). It was concluded during the corrective action investigation that the UC-3 (CAS 58-30-01) and UC-4 (CAS 58-30-02) emplacement boreholes required no further action and it was documented in the CADD/CAP that long-term stewardship of the site would include maintaining the integrity of the concrete caps that cover the boreholes (DOE 2004). The corrective action evaluation presented in the CADD/CAP was specific to the UC-1 cavity (CAS 58-57-001). The corrective action alternative selected for UC-1 was Proof-of-Concept and Monitoring with Institutional Controls (DOE 2004).

As part of the implementation of the CADD/CAP, three monitoring/validation (MV) wells (MV-1, MV-2, and MV-3) were installed in 2005 to monitor radioisotope concentrations and hydraulic heads in groundwater and to validate the flow and transport model developed for the UC-1 site. It was determined during the model validation process that hydraulic heads observed in the MV wells were in disagreement with those predicted by the groundwater flow model, which meant that the model could not be validated. The heads measured at the MV wells and piezometers did not replicate the hydraulic heads predicted by the model and the model misrepresented some flow directions. Hydraulic head is a fundamental aspect of groundwater flow, and it becomes difficult to claim validation for a groundwater model whose predictions do not match measured heads. Nonetheless, the validation data reveal a hydrogeologic system characterized by extremely low permeability and absence of units that could provide rapid contaminant flow paths. This supports the radionuclide transport model results in that no far-field transport is expected to occur in the 1,000-year time frame agreement. The validation data and analysis are presented in *Validation Analysis of the Groundwater Flow and Transport Model of* *the Central Nevada Test Area* (Hassan et al. 2006) and summarized in the *Corrective Action Plan Path Forward Proposal, Central Nevada Test Area* (DOE 2007).

Hydraulic heads from different depths at the MV-1, MV-2, and MV-3 locations (upper piezometer, lower piezometer, and well) indicate that the most likely transport direction from the UC-1 detonation zone is down, toward densely welded tuff units below the detonation cavity. This is consistent with regional data that were used to develop the numerical flow and transport models. Aquifer tests performed on the MV wells (MV-1, MV-2, and MV-3) that were completed in densely welded tuff indicate hydraulic conductivity values ranging from 8.5×10^{-6} to 6.7×10^{-5} meters per day (m/day), much lower than were expected (Lyles et al., 2006). If the numerical model were re-run using these lower hydraulic conductivity values, groundwater flow velocities would be slower, and transport distances would be less than those predicted by the original model. This conclusion is supported by the anomalously long time it is taking the water level in well UC-1-P-2SR (UC-1 chimney) to recover to its pre-test level. The 40-plus years of recovery (Figure 4), compared to water level recovery within a year or two in many other test environments, confirms a chimney complex that is surrounded by low-permeability material.

On the basis of these evaluations, LM proposed a new strategy and revised corrective action/closure process that did not include a revised flow and transport model, but did include enhancements to the monitoring network and a new 5-year proof-of-concept monitoring period to validate the compliance boundary. This included a seismic reflection survey to assist in the placement of new wells designed to enhance the monitoring network within the alluvium. The new strategy was proposed to NDEP in the *Corrective Action Plan Path Forward Proposal, Central Nevada Test Area* (DOE 2007). NDEP approved the proposal and suggested the new strategy be presented in an Addendum to the CADD/CAP (NDEP 2007).

2.3 CADD/CAP Addendum

The new strategy and revised corrective action/closure process was described in a CADD/CAP addendum (DOE 2008) that was developed and approved in 2008 (NDEP 2008). The revised corrective action/closure process was designed to enhance the monitoring of the alluvial aquifer. The alluvial aquifer was previously not monitored except for water levels in the upper piezometers of wells MV-1, MV-2, and MV-3. Hydraulic heads from different depths at these locations (upper piezometer, lower piezometer, and well) indicate that the most likely transport direction from the UC-1 detonation zone is down, toward densely welded tuff units below the detonation cavity. The original well network was designed to monitor this most likely transport pathway. However, given the potential for processes like prompt injection and convective mixing in the nuclear chimney, migration into the alluvial aquifer cannot be ruled out. Alluvial wells are more productive than those in the deeper volcanic section, making the alluvial aquifer the most likely source for future groundwater development and, therefore, the most likely access path to potential receptors.

To assist in the placement of the new wells (MV-4 and MV-5), a seismic reflection survey was conducted across the UC-1 site in late 2007. Approximately 7.8 miles of seismic reflection data (five individual lines) were acquired along site roads that cross the major faults that delineate the subsidence graben on the surface. The seismic data imaged the graben-bounding faults at depth and revealed numerous, previously unknown faults in the subsurface. Seismic reflections interpreted as the water table are offset by many of these faults, suggesting that the faults act as barriers to groundwater flow in the upper part of the alluvial aquifer and probably deeper

(Stoller 2008). Results from the seismic survey are provided in the December 2008 Seismic Survey Report for CAU 443 (Stoller 2008).

The monitoring well network was enhanced in 2009 with the installation of two wells (MV-4 and MV-5), and the recompletion of two existing wells (HTH-1 and UC-1-P-1S) for the dual purposes of monitoring the alluvial aquifer and validating the compliance boundary at the site (Figure 3). The MV-4 and MV-5 wells were designed and positioned not only to monitor for potential contaminant migration in the alluvial aquifer but also to confirm that the southeast-bounding graben fault acts as a flow barrier. The wells were drilled in locations where they would penetrate the downthrown block within the graben and cross the fault into the upthrown block outside the graben. The wells were installed as dual completions with a piezometer in the shallow alluvial aquifer within the graben (downthrown block) and a well in the lower alluvial aquifer outside the graben (upthrown block). Results from the drilling program are provided in the 2009 Well Completion Report for CAU 443 (DOE 2009a).

Well UC-1-P-1S was recompleted and renamed UC-1-P-1SRC[1], providing a monitoring location within the upper alluvial aquifer inside the graben. Well HTH-1 was recompleted with two piezometers (upper and lower alluvial aquifer) and a well (upper volcanic section) to allow monitoring of three hydrostratigraphic units at this location. Hydraulic head data from the well and piezometers can be used to estimate the vertical flow direction at this location within the alluvial aquifer and between the upper volcanic section and lower alluvial aquifer. The horizontal flow direction in the lower alluvial aquifer southeast of the graben can be estimated at this location using head data from the HTH-1RC lower piezometer along with head data from the MV-4 and MV-5 wells (Figure 3). A low-flow bladder pump was installed in the HTH-1RC well for collecting water samples from the volcanic section south of the detonation (DOE 2009a). Monitoring results from HTH-1RC support a previous identification (based on flow logging) of an upward hydraulic gradient from the upper volcanic section to the alluvium (DOE 2010a). The vertical flow direction in the well below the obstruction (2,812 ft bgs) is unknown.

The revised corrective action/closure process, as outlined in the CADD/CAP Addendum (DOE 2008), indicated that aquifer tests would be performed on wells MV-4 and MV-5 and on recompleted well HTH-1RC. This strategy was modified slightly because the original well design for HTH-1RC was changed to include two piezometers and did not allow for the installation of a submersible pump or aquifer testing. To accommodate this change, an aquifer test was conducted on recompleted well UC-1-P-1SRC. Aquifer test results suggest that the hydraulic conductivity of the alluvial aquifer decreases with depth, grading from a productive aquifer in the upper alluvium (hydraulic conductivity of 1.0 m/day) to a poor producer in the lower alluvium (hydraulic conductivity of 1.2×10^{-4} to 5.0×10^{-4} m/day). The low hydraulic conductivity of the lower part of the alluvial aquifer is more comparable to that of the densely welded tuff units tested in the MV-1, MV-2, and MV-3 wells (8.5×10^{-6} to 6.7×10^{-5} m/day) and is likely similar to the hydraulic conductivity of the upper part of the underlying volcanic sediments. The Hydrologic Testing Report for CAU 443 (DOE 2010b) provides a more detailed summary of results from the hydrologic testing.

The CADD/CAP Addendum was revised in July 2013 with a Record of Technical Change (ROTC) to enhance the monitoring well network with a new well at the site. The ROTC also replaced the terms “proof-of-concept” and “5-year proof-of-concept monitoring” with

[1] *RC* indicates that the well has been recompleted.

"conceptual model evaluation" to be more consistent with the corrective action strategy outlined in Appendix VI of the FFACO (DOE 2013). The new well (MV-6) was installed in September 2013 to monitor the upper alluvial aquifer inside the graben and confirm the CSM. Results from the 2013 drilling program are provided in the 2013 Well Completion Report for CAU 443 (DOE 2014).

2.4 Conceptual Model Evaluation

The 2009 drilling program enhanced the monitoring network with seven new monitoring locations (wells and piezometers) in the alluvial aquifer and one in the upper volcanic section. The monitoring well network was further enhanced in 2013 with the installation of well MV-6 completed in the upper alluvial aquifer inside the graben. Data from the monitoring network have been collected and evaluated since the first MV wells (MV-1, MV-2, and MV-3) were installed in 2005. These data have been evaluated as part of the Conceptual Model Evaluation phase to ensure that the monitoring network is adequate for surveillance of the site, as per the CADD/CAP (DOE 2004). It was specified further in the CADD/CAP Addendum (DOE 2008) that this would be demonstrated by verifying that the groundwater system is stable and that radioisotopes of interest (tritium, carbon-14 [^{14}C], and iodine-129 [^{129}I]) remain below the laboratory-required minimum detectable concentrations[1] at sampled locations outside the modeled contaminant boundary and compliance boundary (Figure 3). Results of the monitoring and evaluation have been provided to NDEP annually from 2006 through 2014 in groundwater monitoring reports.

Detection monitoring results obtained since monitoring began continue to indicate that tritium, ^{14}C, and ^{129}I concentrations remain below their laboratory required minimum detectable concentrations at all sampled locations outside the modeled contaminant boundary and compliance boundary (Figure 3). Detection monitoring results obtained from well UC-1-P-2SR inside the modeled contaminant boundary indicate tritium concentrations that are consistent with historical results and/or within the range of laboratory uncertainty for the sampled intervals. Flow-logging data obtained from this well also indicate that groundwater continues to enter the well from approximately 1,450 to 1,640 ft bgs, with flow upward and downward from this zone. Hydraulic head data from well UC-1-P-2SR suggests a downward gradient that continues to increase as the water levels in this well recover.

The effectiveness of the monitoring network has been evaluated to ensure that well locations are within the flow field of each unit at the site. In the vicinity of the site, groundwater in the upper alluvial aquifer is the most likely to be accessed. This unit is capable of producing significant quantities of water due to its relatively high permeability. A potentiometric map of the upper part of the alluvial aquifer (Figure 6) was constructed using the April 2015 head levels from seven locations: MV-4PZ, MV 5PZ, MV-6, UC-1-P-1SRC, MV-1UPZ, and MV-2UPZ, all of which are screened at depths ranging from 600 to 1,000 ft bgs, and well UC-1-P-2SR, which is perforated from the depths of 1,148 ft to 2,792 ft and spans the alluvium into the chimney. The interpretation shown on Figure 6 suggests that horizontal flow in the upper alluvium is toward the UC-1 chimney, where the water level in well UC-1-P-2SR is still recovering from the detonation. Away from the influence of the UC-1 chimney, horizontal flow is to the

[1] Required minimum detectable concentrations: tritium = 400 picocuries per liter (pCi/L), ^{14}C = 5 pCi/L, ^{129}I = 0.1 pCi/L.

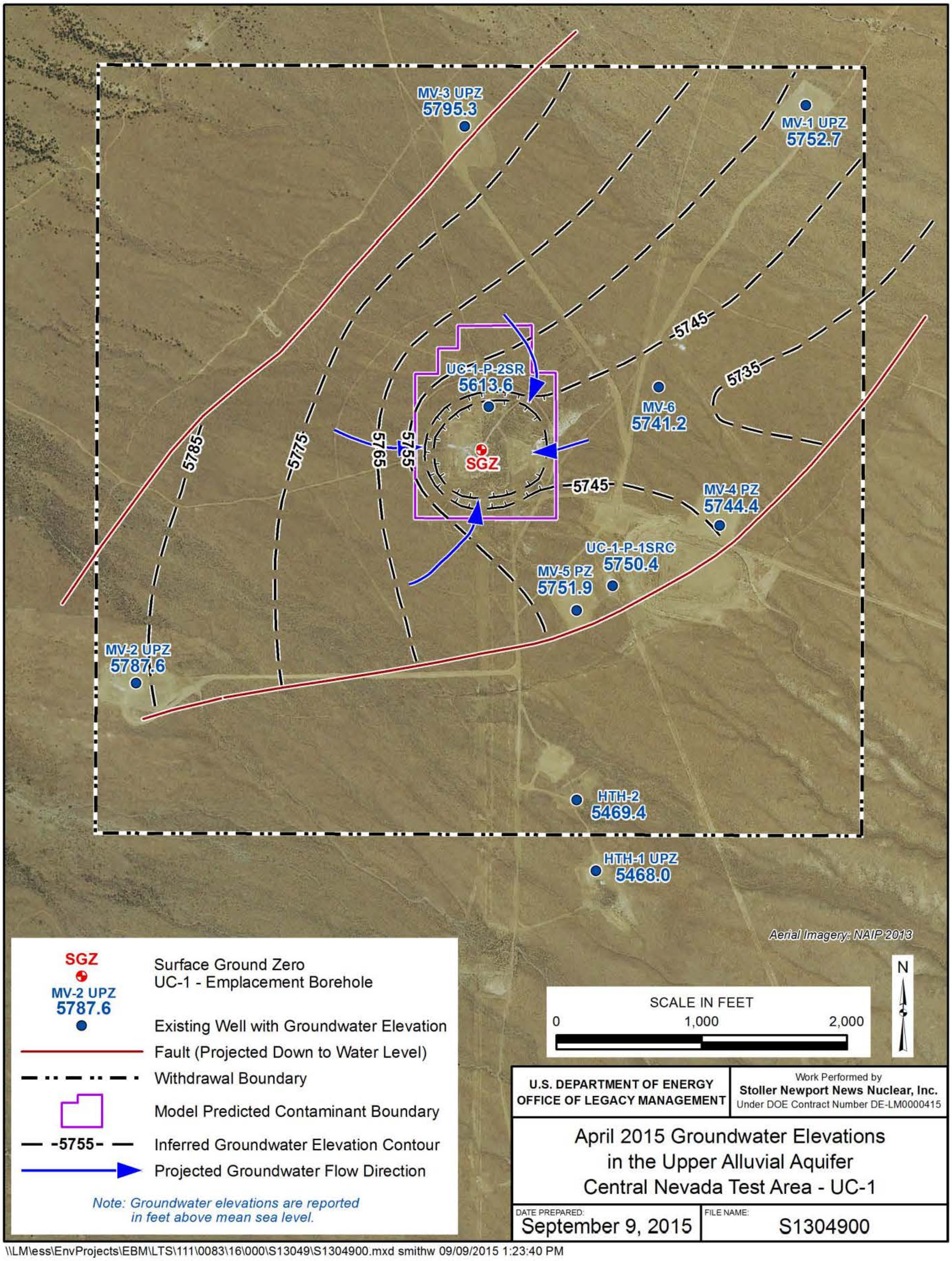

Figure 6. April 2015 Groundwater Elevations in the Upper Alluvial Aquifer CNTA, UC-1

east-southeast and is likely diverted to the east-northeast by the southeast-bounding graben fault, which acts as a barrier to flow. As drawn, the contours indicate a gradient reversal between the detonation and MV-6 well that will gradually dissipate as heads in the vicinity of the detonation zone recover. Well HTH-2 and the HTH-1 upper piezometer, both south of the southeast-bounding graben fault, have head levels about 250 ft lower than alluvial aquifer locations inside the graben, confirming that the southeast-bounding graben fault is a barrier to flow. Flow in the alluvial aquifer is controlled on a large scale by topography, which slopes from northwest to southeast in the vicinity of the site. Locally, flow is diverted by features such as faults. Depiction of groundwater flow directions within the graben has an inherent degree of uncertainty, given the structural complexity caused by the detonation and the limited data available within the graben.

The downward vertical gradient at the site makes the most likely transport path downward, through the low-permeability volcanic sediments and densely welded tuff units below the detonation zone. The volcanic section near and below the detonation is monitored by wells MV-1, MV-2, and MV-3, which are screened in densely welded tuff units. Well MV-2 has been interpreted as hydraulically upgradient of wells MV-1 and MV-3 based on head levels collected at the site to date. However, it is possible that the densely welded tuff in which well MV-2 is screened does not correlate with the densely welded tuff units in wells MV-1 and MV-3 (Figure 7). Given the numerous faults at the site, it is also likely that the MV-1, MV-2, and MV-3 wells are fault separated at the depth of the densely welded tuffs. Even with these uncertainties, the interpreted northeast flow in this section is supported by the geometry of the major graben faults at this depth. The southeast-dipping fault converges with the northwest-dipping fault to the southwest, limiting flow in all directions except to the northeast (Figure 8). This would direct flow from the detonation zone to the northeast toward MV-1. The intersection of faults at the MV-2 location at depth could also explain the erratic water levels in the MV-2 lower piezometer and the inability of the well to reach its planned depth due to drilling problems (DOE 2006). The permeability of the MV-2LPZ screened interval (completed in the volcanic sediments) could not be tested but is very low, as evidenced by its water level response to relatively minor perturbations. It took more than 6 months for water levels to recover after the installation (“slug-in”) of a direct-read transducer in 2010 and another 6 months to recover after its removal (“slug-out”) in 2012 (Appendix C Figure C3).

2.5 Move to Closure Phase

LM recommended that a Closure Report be prepared for subsurface CAU 443 in the letter dated June 4, 2015 (DOE 2015b). This recommendation is based on hydraulic head and radioisotope data that continue to support the CSM, as seen and confirmed with well MV-6 data. NDEP approved moving to the closure phase for CAU 443 in the letter dated June 9, 2015 (NDEP 2015).

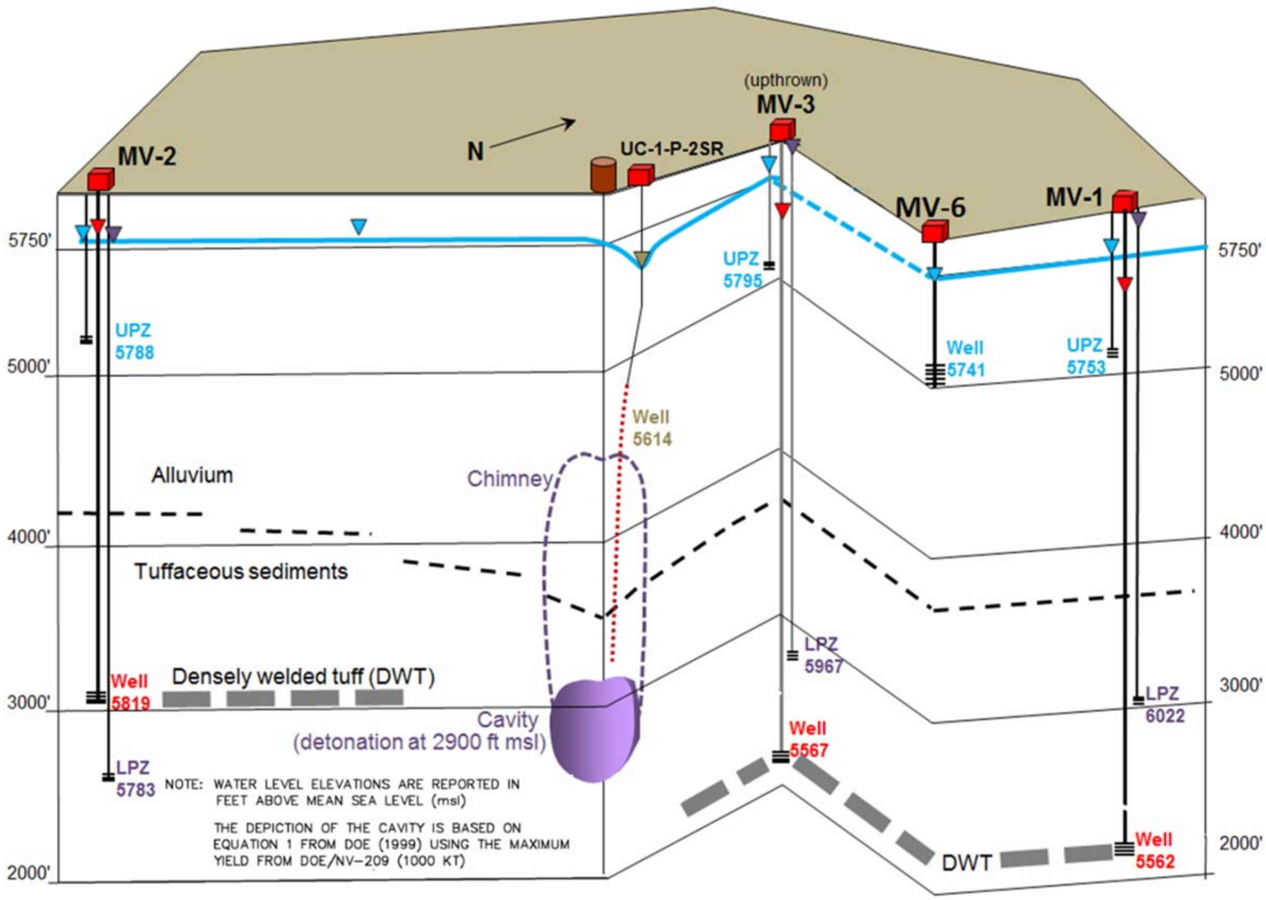

Figure 7. Fence Diagram (East-West) Showing Wells and Piezometers in Relation to Detonation

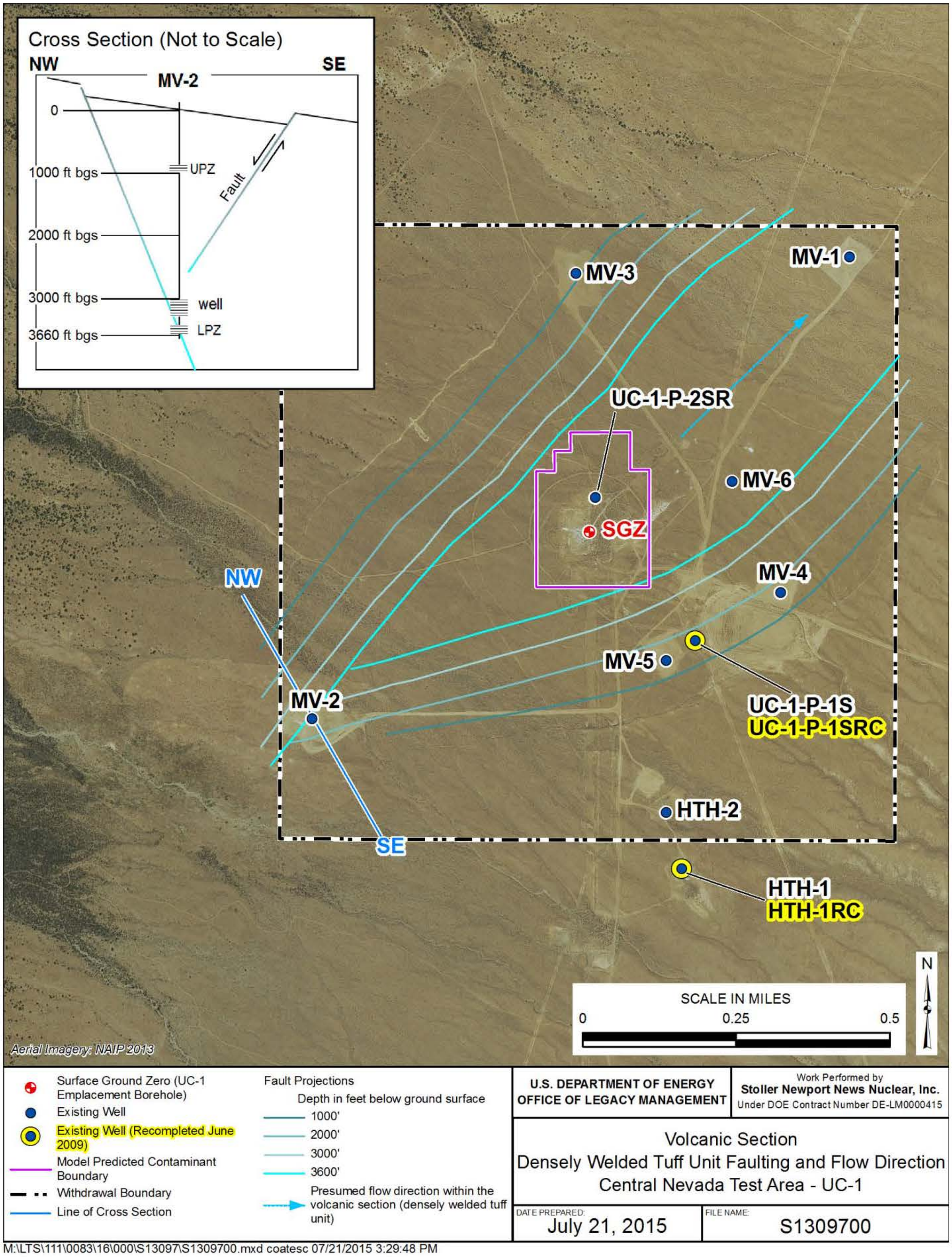

Figure 8. Volcanic Section—Densely Welded Tuff Unit Faulting and Flow Directions

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3.0 Boundaries and Objectives

The contaminant and compliance boundaries for UC-1 were developed and negotiated with NDEP during the corrective action process and documented in the CADD/CAP. The decision to maintain the model-predicted contaminant boundary was a joint decision with NDEP that was documented in the CADD/CAP Addendum. The boundaries and their objectives are presented in the following sections.

3.1 Contaminant Boundary

The contaminant boundary for UC-1 is a model- predicted perimeter and lower hydrostratigraphic unit boundary that delineates the probable (95th percentile) extent of radionuclide-contaminated groundwater from the UC-1 Faultless underground nuclear test over a 1,000-year time period. The delineated extent is a volume and is projected upward to the ground surface to define the contaminant boundary perimeter in two dimensions. Contaminated groundwater is defined as water with radionuclide concentrations that exceed the SDWA standards (FFACO 1996, as amended 2011). This boundary was calculated using the 2003 flow and transport model that incorporates aspects of the original three-dimensional model and two-dimensional model used for the DDA. The 2003 model includes the uncertainty in the three-dimensional spatial distribution of lithology and hydraulic conductivity from the 1999 model, as well as the uncertainty in the other flow and transport parameters from the 2000 DDA model. Additionally, the 2003 model focuses on a smaller region than was included in the earlier models and assumes that groundwater will remain in steady-state or equilibrium conditions (DOE 2004). The methodology used to calculate the contaminant boundary is provided in the *Contaminant Boundary at the Faultless Underground Nuclear Test* (Pohll et al. 2003). The model-predicted contaminant boundary was included in the CADD/CAP and maintained in the CADD/CAP Addendum. Although data from wells MV-1, MV-2, and MV-3 did not validate the flow model, hydraulic conductivity data from these wells support the model-predicted contaminant boundary. Appendix B provides the NDEP approval of the CADD/CAP and model-predicted contaminant boundary for UC-1.

3.2 Compliance Boundary

The objective of the compliance boundary is to protect the public and environment from exposure to groundwater contaminated by the underground nuclear test. It is the area within which the radionuclides with concentrations above the SDWA standards are to remain. The compliance boundary for UC-1 is considerably larger than the model-predicted contaminant boundary (Figure 9). DOE and NDEP agreed that the compliance boundary should mimic the surface expression of the down-dropped fault block that resulted from the underground nuclear test. DOE was concerned about the pre-test nature of the data supporting the groundwater model and wanted to ensure that the boundary encompassed any test effects (NDEP 2004a). NDEP approved the compliance boundary in a letter dated June 11, 2004 (NDEP 2004a). Appendix B provides the NDEP approval of the compliance boundary.

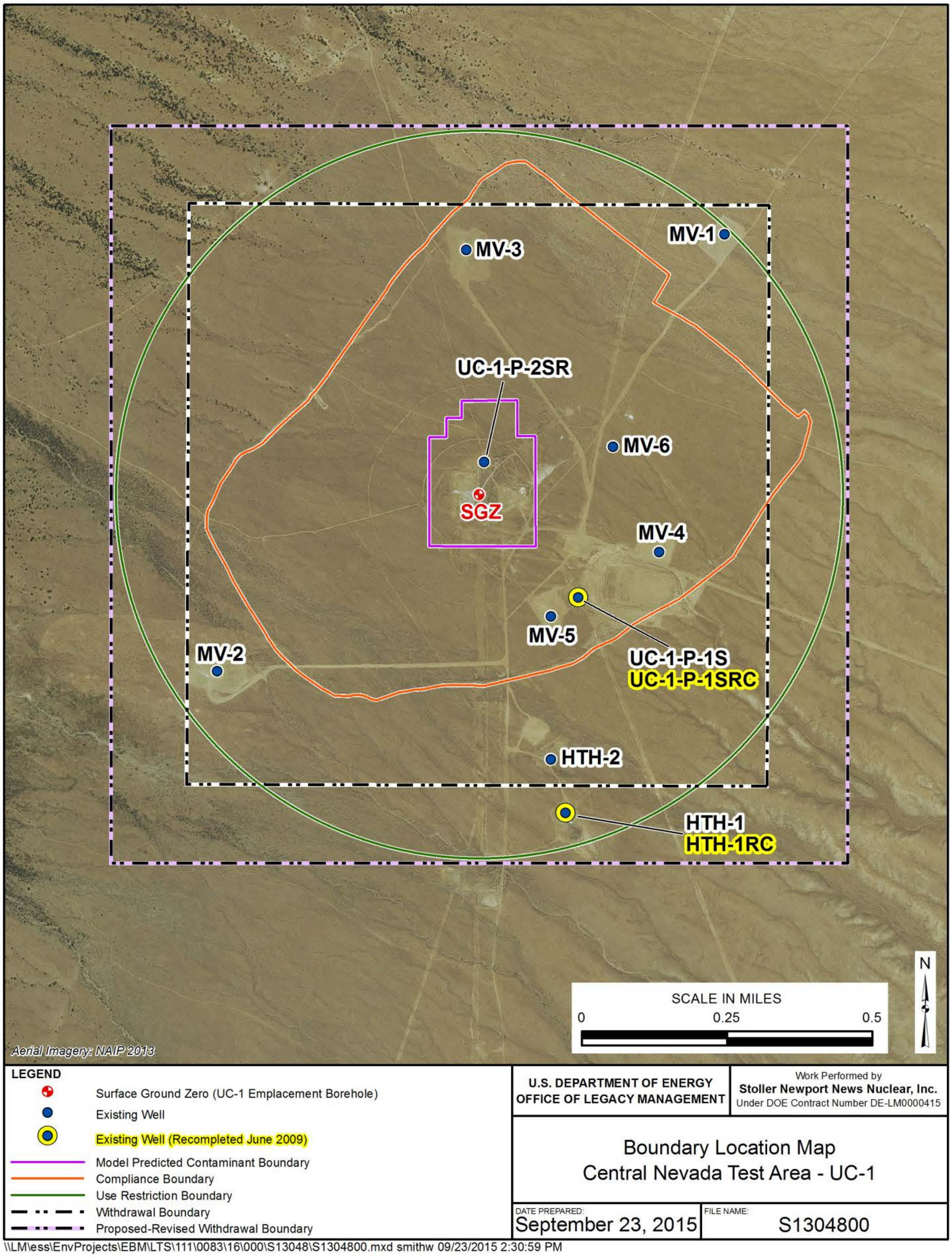

Figure 9. Boundary Location Map, CNTA, UC-1

3.3 Use-Restriction Boundary

The use-restriction boundary for UC-1 is intended to restrict subsurface intrusion actions while maintaining public access for surface activities. The use-restriction boundary extends out a distance of 3,300 ft from surface ground zero (SGZ). The boundary encompasses the model-predicted contaminant boundary and compliance boundary (Figure 9). The objective of this boundary is to restrict access to subsurface materials, including groundwater. The actions currently restricted are defined on a monument at UC-1 as follows:

> No excavation, drilling, and/or removal of materials is permitted without U.S. Government approval within a horizontal distance of 3,300 ft from the surface ground zero location (Nevada State coordinates N1,414,340 and E629,000, Nye County, Nevada). Any re-entry into U.S. Government drill holes within this horizontal restricted area is prohibited.

LM is currently working with BLM and the Nevada State Engineer’s Office to establish a process for implementing the necessary restrictions within the boundary. LM will include NDEP in the decision-making process to help establish effective restrictions for the site.

3.4 Land Withdrawal Boundary

The land withdrawals for CNTA comprise three parcels (UC-1, UC-3, and UC-4) that currently total 2,560 acres (Figure 2). The total acreage is withdrawn from all forms of appropriation associated with mining laws and leasing. LM is working with BLM to establish a process for implementing the necessary restrictions within the UC-1 withdrawal boundary. Depending on the results of these discussions, the size of the UC-1 withdrawal boundary may be increased to fully encompass the use-restriction boundary (Figure 9). LM will include NDEP in the decision-making process for these changes to help establish effective restrictions for the UC-1 site.

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4.0 Corrective Action Implementation

Implementation of the corrective action for subsurface CAU 443 includes post-closure monitoring with ICs as part of the long-term stewardship of the site. Long-term stewardship is designed to prevent exposure to radioisotopes that remain in the UC-1 cavity and ensure protection of human health and the environment. This includes maintaining the concrete caps that cover the UC-3 and UC-4 boreholes. This section establishes the long-term monitoring requirements, provides technical and administrative contingency plans for actions to be taken if monitoring results are not acceptable, and defines the ICs.

4.1 Long-Term Monitoring

The long-term monitoring program is designed to (1) assess the effectiveness of the compliance boundary by monitoring for the radioisotopes of interest and (2) evaluate the effectiveness of monitoring locations within the groundwater flow system by monitoring hydraulic head to ensure that monitoring wells are located along potential migration pathways. The monitoring program will provide time-series data (radioisotope and hydraulic head) from a network of monitoring wells and piezometers at the site. The configuration of the monitoring network and frequency of data collection is based on available data regarding current and expected future site conditions. The long-term monitoring program will be reviewed periodically (Section 4.3) and will be revised as necessary to adequately track changes in radioisotope concentrations and stability of the flow system over time. Table 1 provides the zone of completion (top and bottom) with elevations and lithologic unit monitored by wells and piezometers in the monitoring network.

4.1.1 Monitoring Network

The monitoring network for assessing the presence of the radioisotopes of interest includes wells and piezometers completed in the alluvium (upper and lower), densely welded tuff units, and UC-1 chimney (Table 2). The UC-1 detonation cavity is the source of contamination, and the associated collapse chimney created after the detonation extends into the alluvium. Table 2 provides the monitoring network with sampling frequency for the radioisotopes of interest. Appendix C, Table C1 provides the well descriptions with well completion information.

Well UC-1-P-2SR is a near-field monitoring well that is completed in the UC-1 chimney and upper portion of the alluvium inside the modeled contaminant boundary (Figure 3). This well is perforated from measured depths of 1,148 to 2,792 ft bgs (Figure 4). Water levels in the well are still recovering from the dewatering effects of the detonation (Figure 5). Hydraulic head data from site wells indicate a downward gradient from the source zone to the densely welded tuff units below the detonation level, making this the most likely flow direction and potential transport path (DOE 2015a). Samples from UC-1-P-2SR will be collected from discrete intervals using a depth-specific bailer (780 ft, 1,200 ft, 1,591 ft, and 2,192 ft bgs) within the UC-1 chimney and alluvium to assess changes in radioisotope concentrations within the detonation zone. The 780 ft bgs sample depth is not within the perforated section of the well but is sampled to provide information on the impact that sampling and hydrologic logging have on the concentrations within the well. Logging performed during previous sampling events has indicated that water flows into the well at the 1,591 ft sample depth and out at the 1,200 ft depth. The 2,192 ft sample depth will be sampled to determine if radioisotope concentrations in the chimney are changing. Hydrologic logging (temperature, pH, and specific conductance) will be conducted throughout the water column at the time of the sampling to evaluate if flow within the well is changing, relative to previous sampling events. Data obtained from sampling and hydrologic logging provide important information on the potential fate and transport of radioisotopes from the detonation cavity. Tools tripped in and out of the well during sampling events can cause mixing of zones with different concentrations. To limit mixing between the different sampled depths, UC-1-P-2SR will be sampled less frequently (Section 4.1.2).

Table 1. Monitoring Network with Zones of Completion and Unit Monitored

<table>
<tr><th>Monitoring Wells/Piezometers</th><th>TOC Elevation[a] (ft)</th><th>TSZ Elevation[a] (ft)</th><th>BSZ Elevation[a] (ft)</th><th>Screen Length (ft)</th><th colspan="2">Lithologic Unit Monitored</th></tr>
<tr><td>MV-1UPZ</td><td>6,069.98</td><td>5,190</td><td>5,130</td><td>60</td><td rowspan="9">Upper</td><td rowspan="13">Alluvium</td></tr>
<tr><td>MV-2UPZ</td><td>6,190.66</td><td>5,230</td><td>5,180</td><td>50</td></tr>
<tr><td>MV-3UPZ</td><td>6,167.75</td><td>5,287</td><td>5,227</td><td>60</td></tr>
<tr><td>MV-4PZ</td><td>6,019.45</td><td>5,101</td><td>5,041</td><td>60</td></tr>
<tr><td>MV-5PZ</td><td>6,040.85</td><td>5,023</td><td>4,963</td><td>60</td></tr>
<tr><td>MV-6</td><td>6,053.84</td><td>5,215</td><td>5,052</td><td>163</td></tr>
<tr><td>UC-1-P-1SRC</td><td>6,031.58</td><td>5,520</td><td>5,458</td><td>62</td></tr>
<tr><td>HTH-2</td><td>6,026.05</td><td>5,522</td><td>5,026</td><td>496</td></tr>
<tr><td>HTH-1UPZ</td><td>6,011.27</td><td>5,033</td><td>4,973</td><td>60</td></tr>
<tr><td>HTH-1LPZ</td><td>6,011.31</td><td>4,113</td><td>4,053</td><td>60</td><td rowspan="3">Lower</td></tr>
<tr><td>MV-4</td><td>6,019.57</td><td>4,300</td><td>3,996</td><td>304</td></tr>
<tr><td>MV-5</td><td>6,041.85</td><td>4,203</td><td>3,879</td><td>324</td></tr>
<tr><td>UC-1-P-2SR[b]</td><td>6,080.51</td><td>4,933</td><td>3,320</td><td>1,644</td><td>UC-1 Chimney</td></tr>
<tr><td>MV-1LPZ</td><td>6,069.91</td><td>3,067</td><td>3,007</td><td>60</td><td rowspan="2">Tuffaceous Sediments</td><td rowspan="7">Volcanic</td></tr>
<tr><td>MV-3LPZ</td><td>6,167.69</td><td>2,867</td><td>2,747</td><td>120</td></tr>
<tr><td>MV-1</td><td>6,070.57</td><td>2,319</td><td>2,160</td><td>160</td><td rowspan="5">Densely Welded Tuff</td></tr>
<tr><td>MV-2LPZ</td><td>6,190.39</td><td>2,643</td><td>2,583</td><td>60</td></tr>
<tr><td>MV-2</td><td>6,190.66</td><td>3,150</td><td>2,987</td><td>163</td></tr>
<tr><td>MV-3</td><td>6,168.27</td><td>2,121</td><td>1,959</td><td>162</td></tr>
<tr><td>HTH-1RC</td><td>6,011.70</td><td>3,654</td><td>3,354</td><td>300</td></tr>
</table>

BSZ = bottom of open interval/screen zone. TOC = top of casing. TSZ = top of open interval/screen zone.
[a] All elevations are true-vertical-depth corrected and reported in units of feet above mean sea level.
[b] UC-1-P-2SR well is perforated, not screened.
Coordinate system: U.S. State Plane System 1927 (Nevada Central Zone), Vertical Datum – NGVD29

The detection monitoring network is designed to monitor both the most likely transport path (densely welded tuff) near and below the detonation zone, and the most likely access path, the higher-permeability alluvial aquifer above the detonation zone. The well network that monitors for the presence of radioisotopes in the densely welded tuff units includes well MV-3 (inside the compliance boundary) and wells MV-1, MV-2, and HTH-1RC (outside the compliance boundary). Well HTH-1RC (recompleted in 2009) is screened above the detonation level, but the original well casing remains open below the HTH-1RC well screen, allowing contribution from the volcanic section below the detonation level. The MV-1 well is located in the most likely flow direction at this level based on the currently accepted conceptual model (Figure 8). The wells completed in densely welded tuff units will be monitored for radioisotopes less frequently (Section 4.1.2) because of the low permeability and limited potential transport distances.

Table 2. Monitoring Network with Sampling Frequency for Radioisotopes of Interest

Monitoring Wells/Piezometers	Monitoring Network and Sampling Frequency for Radioisotopes of Interest													Lithologic Unit Monitored	
	2016	2018	2020	2023	2026	2029	2032	2035	2038	2041	2044	2047	2050		
MV-1UPZ			TCI		T		TCI		T		TCI		T	Upper	Alluvium
MV-2UPZ															
MV-3UPZ															
MV-4PZ			TCI		T		TCI		T		TCI		T		
MV-5PZ															
MV-6	T	T	TCI	T	T	T	TCI	T	T	T	TCI	T	T		
UC-1-P-1SRC	T	T	TCI	T	T	T	TCI	T	T	T	TCI	T	T		
UC-1-P-2SR (depth 780 ft)			TCI				TCI				TCI				
UC-1-P-2SR (depth 1,200 ft)			TCI				TCI				TCI				
HTH-2			TCI		T		TCI		T		TCI		T		
HTH-1UPZ															
HTH-1LPZ														Lower	
MV-4	T	T	TCI	T	T	T	TCI	T	T	T	TCI	T	T		
MV-5	T	T	TCI	T	T	T	TCI	T	T	T	TCI	T	T		
UC-1-P-2SR (depth 1,591 ft)			TCI				TCI				TCI			UC-1 Chimney	
UC-1-P-2SR (depth 2,192 ft)			TCI				TCI				TCI				Volcanic
MV-1LPZ														Tuffaceous Sediments	
MV-3LPZ															
MV-1	T	T	TCI		T		TCI		T		TCI		T	Densely Welded Tuff	
MV-2LPZ															
MV-2	T	T	TCI		T		TCI		T		TCI		T		
MV-3	T	T	TCI		T		TCI		T		TCI		T		
HTH-1RC	T	T	TCI		T		TCI		T		TCI		T		

T = Analyze sample for tritium
C = Analyze sample for ^{14}C
I = Analyze sample for ^{129}I
Notes: Well UC-1-P-2SR is perforated from 1148 to 2792 ft bgs, and samples will be collected from discrete depths (780, 1,200, 1,591, and 2,192 ft bgs) within the well.

The alluvial aquifer monitoring network includes wells and piezometers that surround the portion of the chimney that extends into the alluvium. These wells provide hydraulic head data that can be used to estimate groundwater flow directions. The alluvial monitoring network includes wells MV-4, MV-5, MV-6, UC-1-P-1SRC, and HTH-2, and piezometers MV-1UPZ and MV-4PZ (Table 2). The wells MV-4, MV-5, MV-6, and UC-1-P-1SRC are inside the compliance boundary and will be monitored for the specified radioisotopes at an increased frequency (Section 4.1.2) to provide early detection of potential transport from the detonation zone. Well HTH-2 will be sampled less frequently (Section 4.1.2) because it is located outside the compliance boundary. The piezometers MV-4PZ (inside the compliance boundary) and MV-1UPZ (outside the compliance boundary) are not designed to be efficiently sampled (1.9-inch inside diameter) and will be sampled on a less frequent schedule.

Samples will be analyzed for tritium, ^{14}C, and ^{129}I during the long-term monitoring program. Tritium is currently the primary radioisotope of interest because of its initial abundance after the detonation and its mobility in groundwater. It was estimated from unclassified groundwater data from well UC-1-P-2SR (Davisson et al. 1994; Chapman et al. 1994) and estimates of the chimney volume (Pohlmann et al. 1995) that the calculated source term for tritium is 4.3×10^6 curies. The half-life of tritium is 12.3 years, and after 200 years it is estimated that the source of tritium will decay by 5 orders of magnitude. As the monitoring program progresses, the longer-lived radionuclides, ^{14}C (5,730-year half-life) and ^{129}I (1.57×10^7-year half-life), will become the primary focus of the long-term monitoring program.

4.1.2 Sampling Frequency

The sampling frequency is based on available data regarding the current and expected future site conditions. The sampling frequency may be altered with concurrence from NDEP. Selection of the sampling frequency for wells and piezometers in the monitoring network (Table 2) was based on several factors. These factors included an assessment of groundwater velocities for the monitored unit, location within the interpreted flow path from the source of contamination, likelihood for potential access to the monitored unit, difficulty in collecting a sample, and impact that sampling may have on the concentrations within the well. Since the alluvial unit is the most likely access path and has the highest groundwater velocities, the monitoring network wells (MV-4, MV-5, MV-6, and UC-1-P-1SRC) completed in the alluvium are sampled at an increased frequency relative to the wells completed in the low-permeability, densely welded tuff units (Table 2). It is expected that the sampling frequency of the reentry well UC-1-P-2SR will be reevaluated as water levels in the well continue to recover.

Table 2 provides a recommended sampling schedule through 2050. The sampling planned for years 2020, 2032, and 2044 include the full suite of radioisotopes (tritium, ^{14}C, and ^{129}I), and data from these sampling events may be used to recommend changes to the monitoring network and sampling frequencies. Any changes or recommendations will be provided to NDEP for concurrence.

4.1.3 Laboratory Analyses/Methods

The analytical laboratory will use accepted procedures that are based on the specified methods to analyze the radioisotopes of interest (tritium, ^{14}C, and ^{129}I) in the long-term monitoring program (Table 3). The required minimum detectable concentrations (MDCs) for these radioisotopes were established in the CADD/CAP (DOE 2004), were maintained in the CADD/CAP Addendum (DOE 2008), and will continue during the post-closure monitoring. Table 3 provides the required MDCs for tritium, ^{14}C, and ^{129}I. The required MDCs for ^{14}C and ^{129}I are low because these analyses will be used to provide a baseline of background conditions for comparison during post--closure monitoring and may be increased when the monitoring network and sampling frequencies are reevaluated in years 2020, 2032, and/or 2044. The required MDCs will not be applicable for samples of ^{14}C and ^{129}I collected from the reentry well UC-1-P-2SR because of the known presence of these radioisotopes within the chimney.

Table 3. Radioisotopes of Interest, Required MDCs, and Compliance Levels

Radioisotope of Interest	Measurement Method	Required MDC (pCi/L)	Compliance Levels (pCi/L)
Tritium	Liquid Scintillation Counting	400	20,000
Carbon-14	Accelerator Mass Spectrometry	5[a]	2,000
Iodine-129	Accelerator Mass Spectrometry	0.1[a]	1

MDC = minimum detectable concentration required by the laboratory
pCi/L = picocuries per liter
[a] The required MDC is not applicable for samples collected from the reentry well UC-1-P-2SR

Commercial laboratories provide analytical services in accordance with the *Department of Defense (DoD) Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* (updated annually) to ensure that data are of known, documented quality. The QSM provides specific technical requirements, clarifies DOE requirements, and conforms to DOE Order 414.1C, *Quality Assurance*. The QSM is based on Volume 1 of The NELAC Institute (TNI) Standards (September 2009), which incorporates ISO/IEC 17025:2005(E), *General requirements for the competence of testing and calibration laboratories*. The QSM provides a framework for performing, controlling, documenting, and reporting laboratory analyses. Analytical data will be validated according to "Standard Practice for Validation of Environmental Data" in the *Environmental Procedures Catalog* (LMS/POL/S04325).

4.1.4 Water Levels

Water levels will be measured at all wells and piezometers in the monitoring network (Table 1) during scheduled sampling events and site inspections, using an electric water level tool and according to procedures specified in the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (SAP) (LMS/PRO/S04351, continually updated). The water level data will be used to assess the horizontal groundwater flow direction in the upper alluvial unit and monitor vertical gradients between the alluvial (upper and lower) and volcanic units (tuffaceous sediments and densely welded tuff). Data from the wells and piezometers completed in the upper alluvial unit will be contoured to provide a potentiometric surface within the graben. Past and future water level measurements will provide a historical record from which temporal changes in groundwater flow directions can be interpreted and provide further understanding of the CSM.

Transducers are currently installed in all wells and piezometers in the monitoring network to frequently monitor hydraulic head (Table 1). The transducer data are calibrated to manual water level measurements taken during sampling events and site inspections. Water levels and hydraulic head data will be used to monitor the quasi-steady state of the groundwater system. Hydrographs of the hydraulic head data will be maintained and evaluated for wells completed in the same geologic unit, having similar depths, or having similar locations (inside the graben or outside the graben). Transducers will only be maintained in wells and piezometers determined to be key to the monitoring program as agreed to with NDEP. Wells and piezometers that are currently not considered key to the hydraulic head monitoring network are those completed in the alluvium outside the southeast-bounding graben fault that acts as a flow barrier (HTH-2, HTH-1UPZ, and HTH-1LPZ).

4.1.5 Well-field Maintenance

Well-field maintenance will be conducted to maintain the integrity of the wells and piezometers in the monitoring network (Table 1). The condition of the wells and piezometers will be documented during annual site inspections (Section 4.1.6) and scheduled sampling events. Inspection of the wells and piezometers may include video logging to assess the condition of the casing and screened or perforated intervals. Maintenance may include redevelopment of the well or piezometer to increase the flow or efficiency within the screened interval. If corrective maintenance is required (e.g., pump failure or other damage to the well or piezometer that prevents the well’s/piezometer’s use as a monitoring location), LM will notify NDEP and develop a plan to implement any necessary corrective maintenance actions. Performance of corrective maintenance actions will depend on the well’s or piezometer’s location within the interpreted flow path from the UC-1 detonation cavity and chimney. This may require an analysis of the monitoring data from the location. Plans for any corrective maintenance actions will be provided in the Groundwater Monitoring Report (Section 5.0) for NDEP review and approval. Well or piezometer replacement may be included as a corrective maintenance action.

4.1.6 Annual Inspections of Monitoring Network and Use Restrictions

Annual site inspections will be conducted to assess the condition of the concrete caps that cover the UC-3 and UC-4 boreholes, inspect the condition of the monitoring network well boxes and other site features, and confirm that use restrictions remain in place and effective. The site inspectors will inspect for any evidence of land use changes or significant land disturbances. They will measure water levels in wells and piezometers in the monitoring network (Table 1) and photo-document any unauthorized land use and any damage to the monitoring network, site roads, and monument at SGZ. Site inspections will also be conducted during scheduled sampling events. Site inspection and sampling schedules will be provided to NDEP through the FFACO Field Activity Reporting process. Site inspection results will be summarized in the Groundwater Monitoring Report (Section 5.0). If unauthorized land use is observed, LM will notify BLM and send a letter to initiate any necessary corrective actions. NDEP will be included in any correspondence and corrective actions associated with CNTA.

4.1.7 Corrective Action Levels

Table 4 provides the corrective action levels and NDEP notification requirements. The CADD/CAP (DOE 2004) established groundwater compliance levels and laboratory-required MDCs for the radioisotopes of interest at CNTA. The compliance levels are consistent with the current SDWA maximum contaminant levels. The compliance levels and laboratory-required MDCs were maintained in the CADD/CAP Addendum and will be maintained during the post-closure monitoring program (Table 3). The compliance levels and laboratory-required MDCs were used to establish the action levels for the site (Table 4). If an action level is exceeded, LM will provide the required notifications to NDEP within 90 days of receiving the laboratory analytical results.

4.1.8 Waste Disposition

Waste generated during the long-term monitoring program will be managed in accordance with the Fluid Management Plan (FMP) for CAU 443 (DOE 2009b). The FMP provides guidance for managing fluids and associated materials generated during subsurface investigations and provides standards that govern their final disposal. NDEP is not a signatory to the FMP but was involved in negotiating the plan contents and approves the general conditions contained within the plan. All fluids produced during drilling, construction, development, testing, experimentation, or sampling of wells that support activities at CAU 443 shall be managed in accordance with the FMP.

4.2 Institutional Controls

Any restrictions provided as ICs that are required as part of the remedy will be used to meet the objectives of the surface and subsurface use restrictions described in Section 3.3 and will be needed in perpetuity. In accordance with DOE policy and guidance, the ICs will need to be visible to all future users of the site and resources, durable to last as long as restrictions are needed, and enforceable to ensure that no violations occur that would create a pathway for access to contaminated media. ICs will be established to limit access to areas of potentially contaminated material (including groundwater) and to notify DOE of activities around the site that have the potential to impact site closure activities. ICs can either be active, such as inspections of site features and land-use control, or passive, such as markers, public records, or other methods of preserving site history and knowledge of current site conditions. All ICs will be routinely monitored to verify performance.

Table 4. Monitoring Network with Action Levels for Radioisotopes of Interest

<table>
<tr><th rowspan="3">Monitoring Wells/Piezometers</th><th colspan="5">Action Levels for Radioisotopes of Interest</th><th rowspan="3" colspan="2">Lithologic Unit Monitored</th></tr>
<tr><th>Inside Contaminant Boundary</th><th colspan="3">Outside Contaminant Boundary, but Inside Compliance Boundary</th><th>Outside Compliance Boundary</th></tr>
<tr><th>>MCL</th><th>>2x MDC</th><th>>0.5 MCL</th><th>>MCL</th><th>>2x MDC</th></tr>
<tr><td>MV-1UPZ</td><td></td><td></td><td></td><td></td><td>Notify NDEP 3</td><td rowspan="11">Upper</td><td rowspan="15">Alluvium</td></tr>
<tr><td>MV-2UPZ</td><td></td><td></td><td></td><td></td><td>Notify NDEP 3</td></tr>
<tr><td>MV-3UPZ</td><td></td><td>Notify NDEP 1</td><td>Notify NDEP 2</td><td>Notify NDEP 3</td><td></td></tr>
<tr><td>MV-4PZ</td><td></td><td>Notify NDEP 1</td><td>Notify NDEP 2</td><td>Notify NDEP 3</td><td></td></tr>
<tr><td>MV-5PZ</td><td></td><td>Notify NDEP 1</td><td>Notify NDEP 2</td><td>Notify NDEP 3</td><td></td></tr>
<tr><td>MV-6</td><td></td><td>Notify NDEP 1</td><td>Notify NDEP 2</td><td>Notify NDEP 3</td><td></td></tr>
<tr><td>UC-1-P-1SRC</td><td></td><td>Notify NDEP 1</td><td>Notify NDEP 2</td><td>Notify NDEP 3</td><td></td></tr>
<tr><td>UC-1-P-2SR (depth 780 ft)</td><td>Notify NDEP 1</td><td></td><td></td><td></td><td></td></tr>
<tr><td>UC-1-P-2SR (depth 1,200 ft)</td><td>Notify NDEP 1</td><td></td><td></td><td></td><td></td></tr>
<tr><td>HTH-2</td><td></td><td></td><td></td><td></td><td>Notify NDEP 3</td></tr>
<tr><td>HTH-1UPZ</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>HTH-1LPZ</td><td></td><td></td><td></td><td></td><td></td><td rowspan="3">Lower</td></tr>
<tr><td>MV-4</td><td></td><td>Notify NDEP 1</td><td>Notify NDEP 2</td><td>Notify NDEP 3</td><td></td></tr>
<tr><td>MV-5</td><td></td><td>Notify NDEP 1</td><td>Notify NDEP 2</td><td>Notify NDEP 3</td><td></td></tr>
<tr><td>UC-1-P-2SR (depth 1,591 ft)</td><td>Notify NDEP 1</td><td></td><td></td><td></td><td></td><td rowspan="2">UC-1 Chimney</td></tr>
<tr><td>UC-1-P-2SR (depth 2,192 ft)</td><td>NA</td><td></td><td></td><td></td><td></td><td rowspan="8">Volcanic</td></tr>
<tr><td>MV-1LPZ</td><td></td><td></td><td></td><td></td><td></td><td rowspan="2">Tuffaceous Sediments</td></tr>
<tr><td>MV-3LPZ</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>MV-1</td><td></td><td></td><td></td><td></td><td>Notify NDEP 3</td><td rowspan="5">Densely Welded Tuff</td></tr>
<tr><td>MV-2LPZ</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>MV-2</td><td></td><td></td><td></td><td></td><td>Notify NDEP 3</td></tr>
<tr><td>MV-3</td><td></td><td>Notify NDEP 1</td><td>Notify NDEP 2</td><td>Notify NDEP 3</td><td></td></tr>
<tr><td>HTH-1RC</td><td></td><td></td><td></td><td></td><td>Notify NDEP 3</td></tr>
</table>

Radioisotopes of Interest = Tritium, ^{14}C, and ^{129}I
MCL = SDWA maximum contaminant levels: 20,000 picocuries per liter (pCi/L) for tritium, 2,000 pCi/L for ^{14}C, and 1 pCi/L for ^{129}I.
>0.5 MCL = Concentrations greater than 10,000 pCi/L for tritium, 1,000 pCi/L for ^{14}C, and 0.5 pCi/L for ^{129}I.
MDC = Minimum detectable concentration required by laboratory: 400 pCi/L for tritium, 5 pCi/L for ^{14}C, and 0.1 pCi/L for ^{129}I.
>2x MDC = Concentrations greater than 800 pCi/L for tritium, 10 pCi/L for ^{14}C, and 0.2 pCi/L for ^{129}I.
Notify NDEP 1 = Notification only, no action required.
Notify NDEP 2 = Modify the sampling plan (sampling locations and/or frequency) in consultation with NDEP.
Notify NDEP 3 = Develop a new strategy/path forward (new monitoring wells may be required) in consultation with NDEP.
NA = No action required because the sample location is inside the contaminant boundary and has detections above the MCL.
Note: All notifications (email or telephone call) shall be within 90 calendar days of receiving analytical data from laboratory.

Future use within the UC-1 use-restriction zone is restricted from any activity that may alter or modify the site closure conditions as approved by NDEP, unless appropriate concurrence is obtained in advance. ICs in effect or being established for the CNTA include:

1. **Federal ownership:** All CNTA lands are under federal jurisdiction. This controls land use. The CNTA is on land administered by BLM and the U.S. Forest Service as part of the Toiyabe National Forest. Land included in the National Forest and Public Lands of Nevada Enhancement Act (Public Law 100-550 [59], October 28, 1998) also includes a portion of UC-4. DOE established two land withdrawals through Public Land Orders 4338 and 4748 in 1967 and 1969, respectively. The total acreage is currently withdrawn from all forms of appropriation associated with mining laws and leasing. If the UC-1 withdrawal is modified to encompass the use-restriction zone it will be documented in a new Public Land Order for the site.
2. **Use-restriction zone:** LM is currently working with BLM to incorporate the use-restricted zone into their geographic information system (GIS) and increase the size of the UC-1 land withdrawal boundary (Section 3.4) to allow the use-restriction zone (Figure 9) to be fully encompassed within the withdrawal boundary. An increase of the size of the land withdrawal will provide additional restrictions outside the use-restricted area. DOE will not deny any reasonable request for access to the use-restricted area, but will retain the right of first refusal to any activities that have the potential to create an exposure pathway to subsurface contamination, while allowing as many beneficial uses of the land and resources as are safe. LM will include NDEP in the decision-making process to ensure that all parties are aware of any potential future activities at the site.
3. **Five-mile notification zone:** LM is pursuing agreements with BLM and the U.S. Forest Service for notification of any ground-disturbing activities within 5 miles from SGZ. This is intended as a courtesy notification only and will provide LM with notice of any wells (oil, gas, or mining) that may have the potential to impact site contamination. No restrictions are included between the 3,300 ft use-restriction zone and the 5-mile notification zone.
4. **Water use applications:** The State of Nevada Division of Water Resources (NDWR) is responsible for managing water use through appropriation of public waters. LM will consult NDWR annually to verify that no well permit applications have been submitted within the use-restriction zone and to obtain information about any well permits granted within the 5-mile notification zone.
5. **Federal oversight:** DOE maintains an active long-term surveillance and maintenance program for the CNTA site to maintain the remedy and ensure protectiveness of human health and the environment. This program includes the ICs, inspections, monitoring, and maintenance of DOE assets. Routine visits to the site for these activities provide a measure of oversight for ICs effectiveness.

4.3 Periodic Evaluation

LM will conduct periodic evaluations as new data become available following each sampling event as per Table 2 to ensure that the corrective action (post-closure monitoring with ICs) is effective. These data (analytical and hydraulic head) should continue to demonstrate the effectiveness of the monitoring system with respect to monitoring well locations within the flow field of each geologic unit that is being monitored at the site. The stability of the heads in each unit and the stability of the resulting gradients and consistency of flow directions will be assessed. Sample results and water level data will be compared with past results for trend analysis. Temporal changes will be evaluated in light of a CSM that considers transient shot effects and the faults acting as groundwater flow barriers. The continued slow dissipation of hydraulic heads at the test horizon may support preliminary indications concerning permeability of the material surrounding the detonation and interpreted transport velocity. Additionally, the alluvium will be monitored to evaluate the potential for upward transport from the detonation level.

Data from the monitoring network will continually add to knowledge about the groundwater system at the UC-1 site. As new data and information are added to the knowledge base, they should continue to support the CSM and decision for closure, thus reducing the uncertainties associated with the decision. Hydraulic head data will be used to contour a potentiometric surface within the graben and develop hydrographs for comparable monitored units. These data and interpretations, along with the detection monitoring results, will be evaluated to demonstrate that the compliance, withdrawal, and use-restriction boundaries are protective of human health and the environment. Results from the periodic evaluations will be included in the Groundwater Monitoring Reports (Section 5.0).

4.4 Performance Assessment

If data do not support the CSM, or indicate conditions that may call into question the ongoing validity of the closure decision, NDEP will be consulted and it may be necessary to develop a new strategy. Any new strategy may be provided as a path forward document for NDEP approval. A new strategy and path forward document would likely require a change or addendum to the Closure Report, which would be provided to NDEP for approval. Changes in resource use near CNTA (e.g., groundwater development) may also trigger a reevaluation of the closure conditions, even in advance of discernible impacts on hydraulic heads, in order for management options to be considered in a proactive, rather than reactive, time frame. The availability of new science or technologies for the remediation of the UC-1 detonation cavity may also trigger a reevaluation of the closure conditions and may be presented as a new strategy or path forward document for NDEP approval (Section 5.0).

5.0 Post-Closure Reporting

As part of the long-term stewardship of the site, LM will conduct post-closure monitoring and develop several reports, which may include the following.

Groundwater Monitoring Reports: Groundwater monitoring reports will be provided to NDEP after a scheduled sampling event as per Table 2. These reports will also include a summary of the annual site inspection results, provide recommendations for any corrective maintenance actions (Section 4.1.5), provide a status on the ICs, describe any change in resource use, and document the detection and hydraulic head monitoring results. The report will include a potentiometric surface map of the upper alluvial unit inside the graben and hydrographs for comparable monitored units. These data will be evaluated with the detection monitoring results to determine if the data continue to support the CSM and demonstrate that the compliance and use-restriction boundaries are protective of human health and the environment.

New Strategy/Path Forward Report: A new strategy/path forward report will be provided to NDEP if an action level is exceeded (as specified in Table 4), new data become available that do not support the CSM, a change in resource use (water, oil, or gas development) occurs that could impact the flow system near the site, or new science or technology becomes available for remediation of the UC-1 detonation cavity. The new strategy/path forward report will be provided to NDEP for review and approval. These documents will be finalized as an addendum to the Closure Report and provided to NDEP for approval.

Record of Technical Change: An ROTC will be used to make minor changes or updates to the Closure Report. This may include updating the sampling network and sampling frequency (Table 2). NDEP will review and approve all ROTCs before they are incorporated into the Closure Report.

The cleanup at DOE sites and plans for long-term management of the sites have benefited and are expected to continue to benefit from dialogue among state and federal regulators, stakeholder organizations, elected officials, and members of the general public. The groundwater monitoring reports, new strategy/path forward reports, and Closure Report with ROTCs will be provided to NDEP and made available to the public. These reports, along with other reports developed for the site, will be maintained at the following locations:

- The LM website, http://www.lm.doe.gov/CNTA/Sites.aspx, contains specific information about the CNTA site. Information on these webpages includes site records, the fact sheet, and a link to the Geospatial Environmental Mapping System for the site.
- Reports will be maintained on the Office of Science and Technical Information webpage, which is accessible to the public at http://www.osti.gov/scitech/.
- Limited information about the CNTA site will be maintained on the NDEP webpage, which is accessible to the public at http://ndep.nv.gov/boff/index.htm.
- Information about the CNTA site is also available by contacting Public Affairs at (970) 248-6363 or (970) 248-6000, or by sending an email request to public.affairs@lm.doe.gov.

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6.0 Records/Data Management

To support post-remediation maintenance of the CNTA site, LM maintains records at their office in Grand Junction, Colorado, and at the LM Business Center in Morgantown, West Virginia. These records contain critical information required to protect human health and the environment, manage land and assets, protect the legal interests of DOE and the public, and mitigate community impacts resulting from the cleanup of legacy waste. Site historical records about the environmental remediation and stewardship are included in the collection. All LM records will be managed in accordance with the following requirements:

- 44 USC 29, "Records Management by the Archivist of the United States and by the Administrator of General Services," *United States Code*, available online at http://www.law.cornell.edu/uscode/text/44/chapter-29
- 44 USC 31, "Records Management by Federal Agencies," *United States Code*, available online at http://www.law.cornell.edu/uscode/text/44/chapter-31
- 44 USC 33, "Disposal of Records," *United States Code*, available online at http://www.archives.gov/about/laws/disposal-of-records.html
- Title 36 *Code of Federal Regulations* Parts 1220–1239, Chapter 12, Subchapter B, "Records Management."
- DOE Order 243.1, *Records Management Program*, U.S. Department of Energy, Washington, DC, available online at http://energy.gov/sites/prod/files/2013/03/f0/DOE%20O%20243%201b_0.pdf
- LM Records Management Program procedures.

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7.0 Quality Assurance

Quality assurance measures for implementing the long-term monitoring program include using trained and qualified personnel and following established procedures. Water quality data will be collected in accordance with procedures specified in the DOE-LM SAP (LMS/PRO/S04351, continually updated). The SAP specifies procedures for data validation and requirements for sample collection, quality control samples, analytical methods and reporting limits, and field instrument calibration. The long-term care of the site and all activities related to the annual surveillance, monitoring, and maintenance of the site comply with DOE Order 414.1C, *Quality Assurance*; applicable requirements of Title 10 *Code of Federal Regulations* Part 830 Subpart A, "Quality Assurance Requirements"; and American National Standards Institute/American Society for Quality (ANSI/ASQ) E4-2004, *Quality Systems for Environmental Data and Technology Programs: Requirements with Guidance for Use*.

LM environmental procedures are contained in the *Environmental Procedures Catalog* (LMS/POL/S04325), which incorporates American Society for Testing and Materials, DOE, and U.S. Environmental Protection Agency guidance. The quality of the monitoring data depends on the use of effective sampling and analysis procedures. Field quality assurance includes the collection and analysis of quality control samples as specified in the SAP. Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. Equipment blanks may be collected after sampling equipment has been decontaminated and before environmental samples have been collected. These blanks are useful in documenting the adequate decontamination of sampling equipment.

Data validation is performed to determine if data meet the specific technical and quality criteria, and to establish the usability and extent of bias of any data not meeting those criteria. Validation includes evaluating sample collection and field measurement activities against the requirements in the SAP, and evaluating laboratory analyses against the requirements in the reference analytical procedures and the QSM, when applicable. Items associated with field activities that are evaluated include completeness (all data were collected as planned), calibration and operational checks of field instruments, compliance with sampling protocols, and field quality control sample results. Validation of laboratory analyses includes assessment of Chain of Custody and receipt documentation, completeness of the analytical data, compliance with holding times and sample preservation requirements, quality control check performance, instrument calibration, and an assessment of potential outliers. Qualifiers are applied to the data based on the results of the validation.

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8.0 Recommendations

NDEP approval of this Closure Report will initiate implementation of the corrective action (Post-Closure Monitoring with ICs) for CAU 443 at CNTA. This includes groundwater monitoring at UC-1 (CAS 58-57-001) and maintaining the concrete caps that cover the UC-3 (CAS 58-30-01) and UC-4 (CAS 58-30-02) boreholes. NDEP approval will also signify that the closure process has been completed following the CADD/CAP (DOE 2004) and CADD/CAP Addendum (DOE 2008). On the basis of this approval, LM provides the following recommendations to NDEP:

- A Notice of Milestone Completion be issued by NDEP to DOE-LM for CAU 443 at CNTA if the use-restriction is not yet recorded in BLM's GIS system;
- A Notice of CAU Completion be issued by NDEP to DOE-LM for CAU 443 at CNTA when the use-restriction is recorded in BLM's GIS system; and
- The CAU 443 at CNTA be moved from Appendix III to Appendix IV of the FFACO, after the use-restriction is implemented by BLM (in accordance with Appendix E).

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9.0 References

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Appendix A

NDEP Approval for Moving to the Closure Report

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NEVADA DIVISION OF
ENVIRONMENTAL PROTECTION

STATE OF NEVADA
Department of Conservation & Natural Resources
Brian Sandoval, Governor
Leo M. Drozdoff, P.E., Director
Colleen Cripps, Ph.D., Administrator

June 9, 2015

RECEIVE DOE
JUN 15 2015
GRAND JUNCTION OFFICE

Mr. Mark Kautsky
Site Manager
U. S. Department of Energy
Office of Legacy Management
2597 Legacy Way
Grand Junction, CO 81503

RE: REQUEST FOR APPROVAL TO PROCEED TO THE CLOSURE REPORT FOR CORRECTIVE ACTION UNIT (CAU) 443: CENTRAL NEVADA TEST AREA – SUBSURFACE
Federal Facility Agreement and Consent Order (FFACO)

Dear Mr. Kautsky:

The Nevada Division of Environmental Protection, Bureau of Federal Facilities (NDEP) has reviewed the U.S. Department of Energy, Office of Legacy Management's (DOE-LM) request for approval to proceed to the Closure Report (CR) for CAU 443 (Step 5a of Section 5, Appendix VI of the FFACO, Offsites Corrective Action Strategy) letter dated June 4, 2015. The NDEP agrees it has accepted as final, the *2014 Groundwater Monitoring Report Central Nevada Test Area Subsurface CAU 443* (LMS/CNT/S12305), which summarizes data collected during the Corrective Action Decision Document/Corrective Action Plan (CADD/CAP) and CADD/CAP Addendum stages and recommends that a CR be prepared for CAU 443. Therefore, the NDEP approves of DOE-LM submitting a CR for CAU 443.

If you have any comments or questions on the above, please contact me at 702-486-2850, ext. 232, or Mark McLane at ext. 226.

Sincerely,

Chris Andres

Christine D. Andres
Chief
Bureau of Federal Facilities

CDA/MM

ec: EM Records, AMEM, NNSA/NFO, Las Vegas, NV
Navarro Central Files

cc: EM Records, AMEM, Las Vegas, NV
FFACO Group, PSG, NNSA/NFO, Las Vegas, NV
W. R. Wilborn, NNSA/NFO, Las Vegas, NV
R. F. Boehlecke, NNSA/NFO, Las Vegas, NV
Jeffrey Fraher, DTRA/CXTS, Kirtland AFB, NM
J. B. Chapman, DRI, Las Vegas, NV
L. Berry, SN3, Grand Junction, CO
R. Findley, SN3, Grand Junction, CO
R. Hutton, SN3, Grand Junction, CO

Appendix B

NDEP Approval: CADD/CAP Contaminant Boundary and Compliance Boundary

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LEO DROZDOFF, *Administrator*

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Water Quality Planning
Water Pollution Control
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Air Pollution Control
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ndep.nv.gov

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
Las Vegas Office
1771 East Flamingo Road, Suite 121-A
Las Vegas, Nevada 89119-0837

ERD.041220.0002

December 9, 2004

Mr. Robert M. Bangerter, Acting Director
Environmental Restoration Division
National Nuclear Security Administration
Nevada Site Office
P.O. Box 98518
Las Vegas, Nevada 89193-8518

Re: Submittal of Corrective Action Decision Document/Corrective Action Plan for Corrective Action Unit 443: Central Nevada Test Area – Subsurface, Central Nevada Test Area, Nevada, Revision 0, August 2004
Federal Facility Agreement and Consent Order

Dear Mr. Bangerter,

The Nevada Division of Environmental Protection, Bureau of Federal Facilities (NDEP) staff reviewed the final Correction Action Decision Document (CADD)/ Corrective Action Plan (CAP) for Corrective Action Unit (CAU) 443, Central Nevada Test Area – Subsurface. The CADD/CAP is hereby approved with comments, which are given below pursuant to Subpart XII.8.a of the Federal Facility Agreement and Consent Order (FFACO).

ACTION	ERD
INFO	TD, ESHD
NSO/MGR	✓
AMEM	✓
AMNS	
AMSO	
AMSSP	✓

Comments:

1. The document stated that neither Emplacement Well UC-3 nor UC-4 (CAS 58-30-01, CAS 58-30-02 respectively) was addressed in the subject document. Be advised that the outstanding issues associated with these two CASs will also need to be addressed prior to NDEP approval of the Closure Report for CAU 443.

2. The legend blocks on Figures 2-15, 2-16, 2-17, and 2-18 show a dotted line symbol for the land exclusion boundary, the 100 ft elevation contour, and the down drop block. The figures used solid not dotted lines. This may be confusing to the reader.

3. Section 5.4 - Required Authorizations, Notification, and Permits omitted the required air permit (#AP9999.1438) issued by NDEP in accordance with Nevada Administrative Code (NAC) 445B.22037.

4. In Section 8.0 - References, the Federal Facility Agreement and Consent Order (FFACO) is shown as "1996 (as amended)." This reference is used primarily with respect to Appendix VI, and it is important to note that the amendment was in 2000.

The CADD/CAP was not found to be Substantially Deficient pursuant to Subpart VIII.3.b of the FFACO and was received in a timely manner. Therefore, this letter serves as the Notice of Completion for this milestone pursuant to Subpart XXV.1 of the FFACO. Failure to address the above comments will cause NDEP to construe the subsequent document as Substantially Deficient pursuant to Subpart VIII.3.b of the FFACO.

NDEP recognizes that as corrective action work proceeds, information developed in the course of ongoing work may require or justify a change in the scope of remediation activities. Propose any changes to the scope of work approved in the CADD/CAP to NDEP as soon as possible.

CAU 443 has an associated land/site use restriction (LUR). Provide certification that the LUR was entered in the appropriate tracking system in the subsequent Closure Report.

If you have questions regarding this matter, please contact Don Elle of my staff at (702) 486-2874.

Sincerely,

Tim Murphy
Chief
Bureau of Federal Facilities

THM/DRE/CA/REN/MS

cc: R. E. Noack, NDEP, Carson City, NV
E. E. Shanholtz, Chief, DTRA/TDTNS, M/S 645, Mercury, NV
D. C. Loewer, DTRA/TDTNS, M/S 645, Mercury, NV
W. R. Griffin, SNJV/DTRA, M/S 645, Mercury, NV
T. A. Lantow, DTRA/TDTNS, M/S 645, Mercury, NV
John Esterl, DTRA/BDQE, Kirtland AFB, NM
Jeffrey Fraher, DTRA/TDTN, Kirtland AFB, NM
Kevin Flanagan, DTRA/GC, Ft. Belvoir, VA
P. L. Hall, TD, NNSA/NSO, Las Vegas, NV
K. A. Hoar, Director, ESHD, NNSA/NSO, Las Vegas, NV
P. A. Sanders, ERD, NNSNNSO, Las Vegas, NV

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ALLEN BIAGGI, *Administrator*

STATE OF NEVADA
KENNY C. GUINN
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ERD.040621.0004

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL PROTECTION

(Las Vegas Office)
1771 E. Flamingo Road, Suite 121-A
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June 11, 2004

Monica Sanchez
Director, Environmental Restoration Division
National Nuclear Security Administration
Nevada Site Office
P.O. Box 98518
Las Vegas, NV 89193-8518

ACTION	
INFO	ERD ESHD TD MGR
NSO/MGR	✓
AMEM	✓
AMNS	
AMSO	
AMSSP	✓

RE: Discussion of Compliance Boundary for Corrective Action Unit 443, Central Nevada Test Area (CNTA) Subsurface

The Nevada Division of Environmental Protection, Bureau of Federal Facilities (NDEP) concurs with the compliance boundary recommendations presented in the Discussion of Compliance Boundary for Corrective Action Unit 443, Central Nevada Test Area (CNTA) Subsurface.

Normally, the compliance boundary would be derived from the contaminant boundary. In the case of the CNTA, however, the contaminant boundary was modeled based on natural, steady-state conditions and did not take into account the region disturbed by the Faultless test. The Corrective Action Decision Document (CADD) needs to direct the reader to the relevant boundary lines in the figures as the scientific evidence and other factors are explained to make clear exactly how the compliance boundary was established.

Our concurrence is based upon the information and data provided to date and is subject to the qualifications of that information and data. Due to the uncertainty in the initial assumptions and input parameters over the 1,000-year period and the fact that elements that caused the down-dropped block have not been effectively quantified to date, information gathered during the implementation of the long-term monitoring system could change the model-simulated contaminant boundary. If data gathered under future conditions warrant, NDEP may request further investigation or require a renegotiation of the compliance boundary. If you have any questions regarding this matter please address them to either Michelle Stamates at (775) 687-9331 or me at (702) 486-2857.

Sincerely,

Terre Maize

Terre Maize
Chief
Bureau of Federal Facilities

TAM/DRE/REN/MS

cc: E. E. Shanholtz, DTRA, Mercury, NV
D. C. Loewer, DTRA, Mercury, NV
T. A. Lantow, DTRA, Mercury, NV
W. R. Griffin, BN/DTRA, Mercury, NV
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R. M. Bangerter, ERD, NNSA/NSO, Las Vegas, NV
W. R. Wilborn, ERD, NNSA/NSO, Las Vegas, NV

Appendix C

Hydrographs
(Hydraulic Head Data from 2007 through April 2015)
and Well Descriptions

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Hydraulic Head Data from 2007 through April 2015

The hydraulic head data were used during the conceptual model evaluation (formerly 5-year proof-of-concept monitoring) phase to assess the stability of the flow system (heads and resulting gradients in each geologic unit) and verify that groundwater monitoring wells are located along potential migration pathways. The head data were derived from water levels recorded in wells and piezometers at the site. The head results and interpretations of the groundwater flow system have been provided to NDEP annually in groundwater monitoring reports from 2006 through 2014. The hydraulic head data presented in this section are provided as a reference to the Closure Report. The data are displayed as hydrographs in Figures C1 through C4. Piezometers are distinguished from the wells at the monitoring locations by the notation “PZ.” For locations with two piezometers, “UPZ” and “LPZ” are used to denote the upper piezometer and lower piezometer, respectively.

Transducers are currently installed in all wells and piezometers in the monitoring network (Table 1 of the Closure Report) to monitor hydraulic head. The transducer data are calibrated to manual water level measurements taken during sampling events and site inspections. The manual water levels are collected using a water level tape and appear as individual symbols on the hydrographs. The data collected using transducers appear as lines due to the recording frequency of every few hours. The hydrographs are grouped by comparable monitored interval and location: alluvial wells southeast of the southeast-bounding graben fault, including well HTH-1RC in the upper volcanic section (Figure C1); alluvial wells northwest of the southeast-bounding graben fault (Figure C2); the volcanic section with open intervals near the detonation level (Figure C3); and the volcanic section with open intervals below the detonation level (Figure C4). Data gaps in the hydrographs are the result of transducers being removed for well-site activities or for the replacement of damaged transducers or cable. Abrupt changes in the data (example: Figure C2 data from MV-2UPZ mid-2009 and late-2009) are the result of manual water level measurements that are difficult to collect.

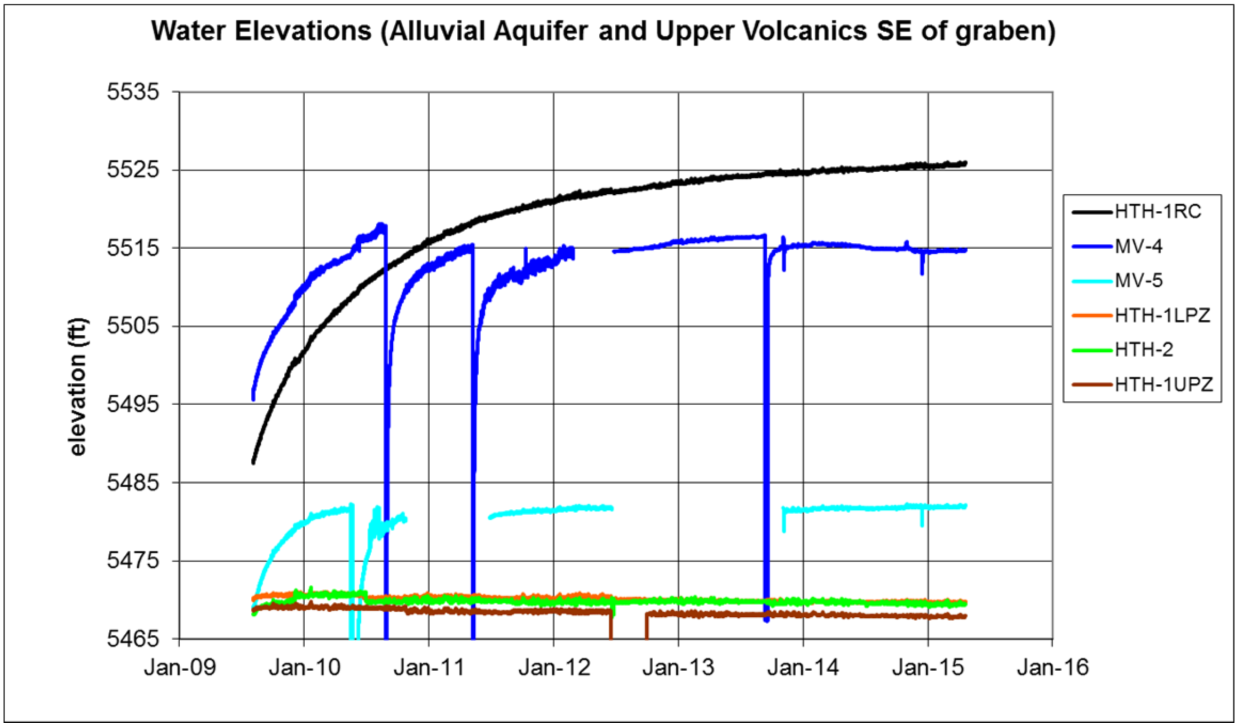

Figure C1. Water Level Elevations for the Alluvial Wells and Well HTH-1RC (Upper Volcanics) Southeast of the Down-Dropped Graben at the Screened Horizon

Figure C1 shows the hydrographs of alluvial wells and piezometers southeast of the graben (MV-4, MV-5, HTH-2, HTH-1UPZ, and HTH-1LPZ) along with well HTH-1RC (screened in the upper volcanic section below the alluvium). These data indicate that head levels in wells MV-4 and MV-5 have recently recovered from the 2010 aquifer testing and from the 2011 yearly sampling event during which several thousand gallons of water were purged. Low-flow bladder pumps were installed in wells MV-4 and MV-5 during the November 2013 sampling event to reduce the well purge volumes and the impact purging has on the water levels during sampling (DOE 2014). Water levels in well HTH-1RC continue to equilibrate after the recompletion in 2009. Prior to its recompletion, HTH-1 had been perforated across its entire saturated section, and its water level was a composite of several hydrogeologic units. The recompletion isolated zones in the upper and lower alluvium (HTH-1UPZ and HTH-1LPZ) and in the volcanic section (HTH-1RC). HTH-1RC isolated a densely welded tuff unit above the detonation level, but the original well casing remains open below an obstruction at 2,812 ft bgs to the original depth of 3,704 ft bgs, allowing contribution from the volcanic section below the detonation. The hydraulic head in the volcanic portion of HTH-1RC is higher than water levels measured in both the upper and lower alluvial piezometers at this location. This observation confirms that an upward gradient from the volcanic section to the alluvium exists in this area, as indicated by flow logging performed by Desert Research Institute in HTH-1 prior to the well's recompletion (DOE 2008).

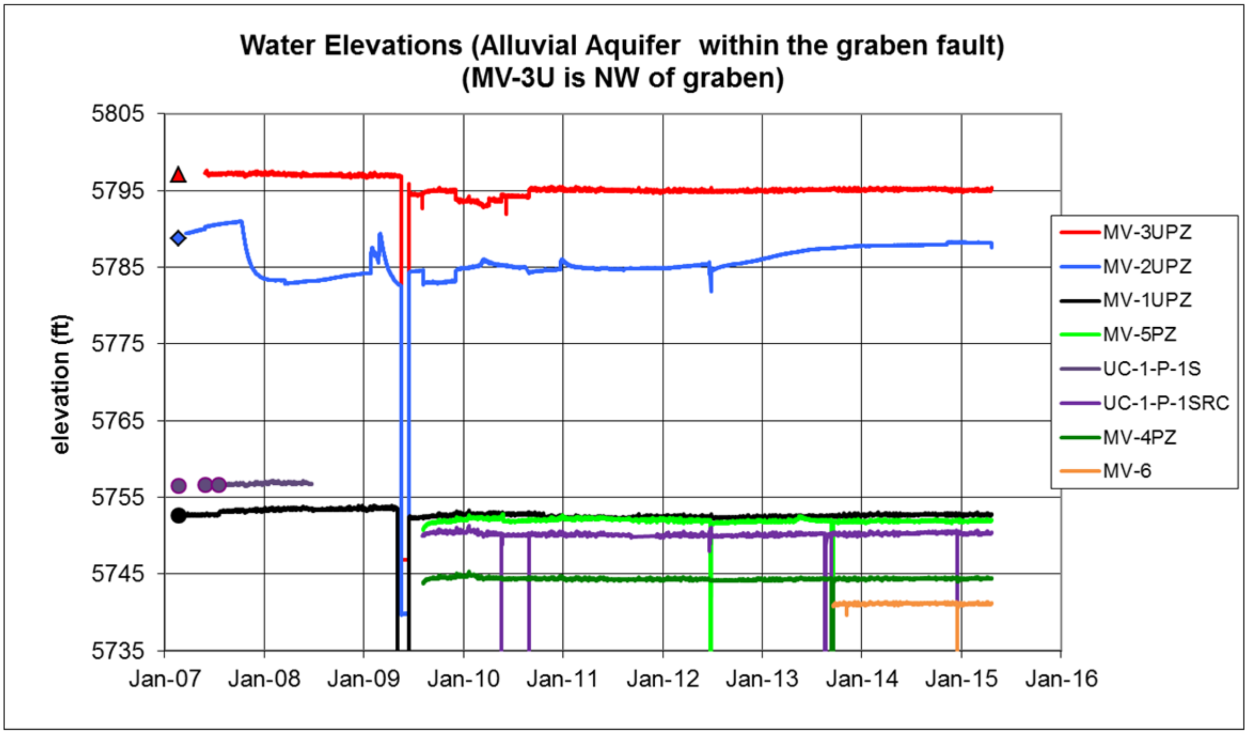

Figure C2. Water Level Elevations for the Alluvial Wells Northwest of the Southeast-Bounding Graben Fault

Figure C2 shows the hydrographs of alluvial piezometers and wells within and northwest of the graben. Erratic water levels in upper piezometer MV-2UPZ (Figure C2) are attributed to damage during its installation. The lower hydraulic heads observed after mid-2009 in the upper piezometers MV-1UPZ and MV-3UPZ are the result of attempts to further develop these piezometers. The recompletion of well UC-1-P-1S resulted in a screened interval about 400 ft above the previous open interval and a roughly 7 to 8 ft decrease in hydraulic head (Figure C2). The new completion is more isolated from the influence of deeper horizons where hydraulic heads have been higher. The hydraulic heads in the piezometers MV-4PZ and MV-5PZ (screened inside the down-dropped graben block) are approximately 250 ft higher than those in the MV-4 and MV-5 wells that are screened outside the graben to the southeast (Figure C1). Given these results, alluvial aquifer hydrographs were separated into two groups based on their screened location relative to the southeast-bounding graben fault. Hydraulic head data from the MV-4 and MV-5 wells and piezometers continue to support the conceptual model that the southeast-bounding graben fault acts as a barrier to flow.

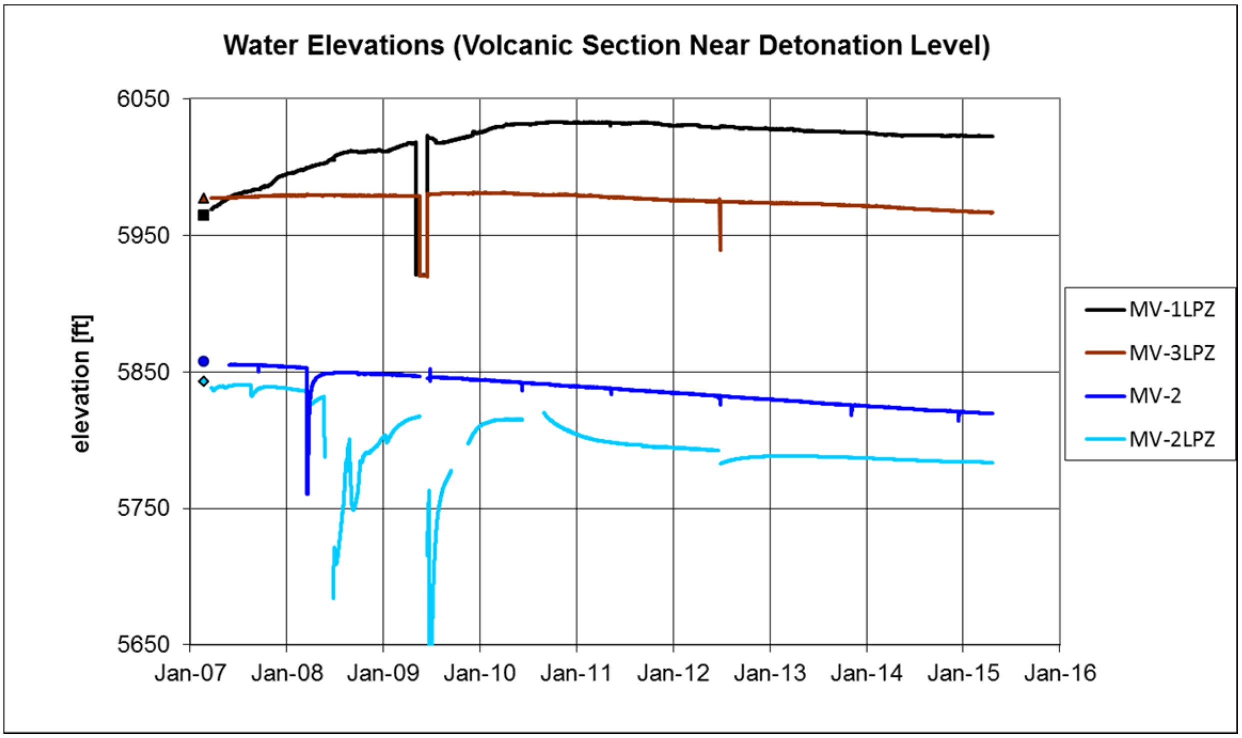

Figure C3. Water Level Elevations for the Well and Piezometers Screened in the Volcanic Section at or near the Level of the Detonation

Figure C3 shows hydrographs of the well and piezometers with open intervals near the detonation level. Water levels in the lower piezometer MV-1LPZ were rising after installation until they stabilized in 2011 and have been slightly declining since 2011. To investigate the cause of rapid water level declines and recoveries at the MV-2LPZ location, the Desert Research Institute ran a temperature log, collected a bailed sample, and measured the depth of the lower piezometer (MV-2LPZ) on August 5, 2008. It was determined that sediment had filled the lower piezometer MV-2LPZ to a depth 75 ft above the top of the screened interval. Additional development of this piezometer in the summer of 2009 lowered the sediment fill to the top of the screened interval. Head levels in MV-2LPZ appeared to recover in 2010 from the development, then steadily declined (at a decreasing rate) through 2011 and into 2012, when the head level dropped approximately 10 ft after well MV-2 was sampled. After this sampling event, the head levels in the lower piezometer MV-2LPZ recovered and have reverted to a decreasing trend. Sediment removal may not have completely solved the erratic head changes in this piezometer. The proximity of the MV-2LPZ screened interval to the northwest-bounding graben fault is the likely cause of its erratic water levels. It is expected that heads southeast of this fault (within the graben) are higher than heads to the northwest, outside the-graben. Gaps in the transducer data from the lower piezometer MV-2LPZ are the result of failures in the transducer. The abrupt water level increase (MV-2LPZ) in June 2010 followed by an abrupt decrease in June 2012 are the result of the installation (2010) and subsequent removal (2012) of a direct-read transducer with a ¼-inch cable. The transducer was placed more than 200 ft below water in case another sudden water level drop like in 2008 were to occur. Long-term, the head levels in the MV-2 well and piezometer continue to decline at a rate of approximately 5 ft per year.

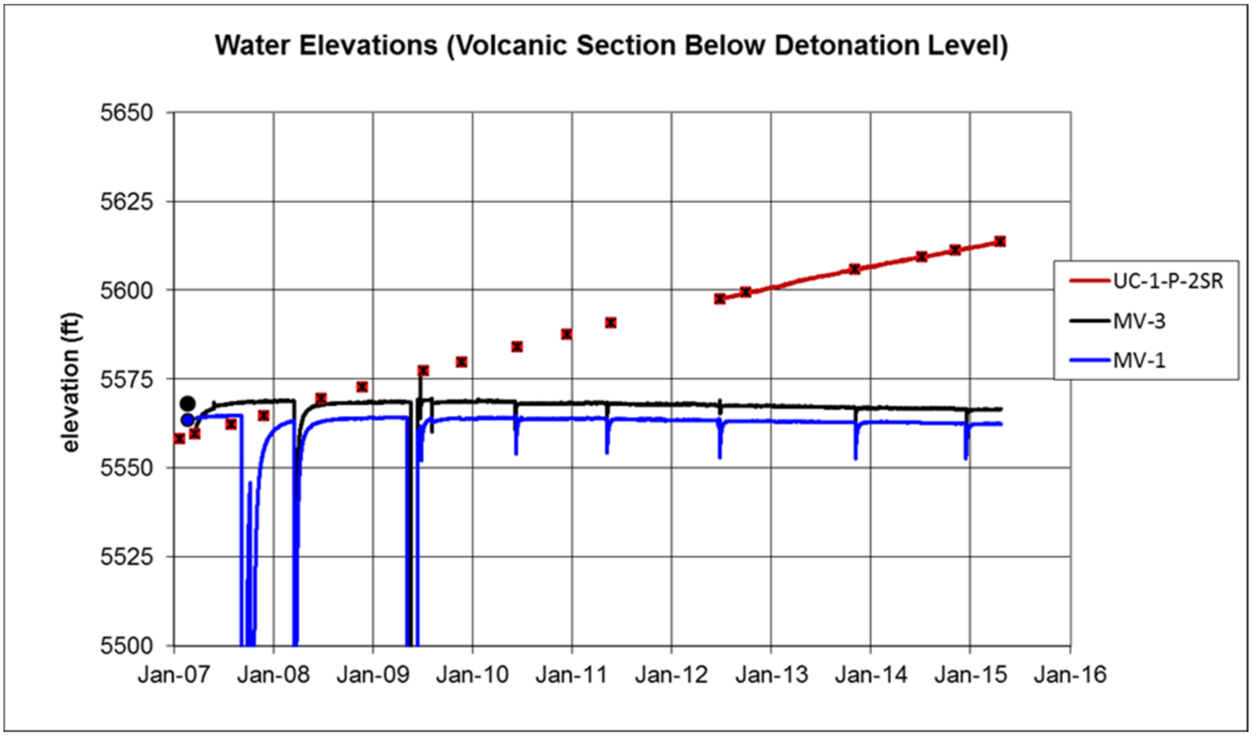

Figure C4. Water Level Elevations for the Wells Screened in the Volcanic Section Below the Level of the Detonation
(Water level elevations for reentry well UC-1-P-2SR [drilled into the chimney] are shown for reference.)

Figure C4 shows the hydrographs of wells with open intervals below the detonation level and reentry well UC-1-P-2SR. The composite head level from UC-1-P-2SR (chimney and alluvium overlying the detonation area) is higher than in the densely welded tuff units below the detonation zone. The composite head level of 5,611.2 ft measured in April 2015 continues to increase, though at a long-term decreasing rate. Well UC-1-P-2SR has perforations as high as 1,148 ft bgs in the alluvium, and its water level is expected to eventually reach a steady-state elevation of approximately 5,750 ft above msl (similar to other alluvial wells and piezometers within the graben).

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Table C1. Well Descriptions with Well Completion Information

Well/Piezometer ID	Northing (ft)	Easting (ft)	Construction Material	Material Type	Material Use	Interval (ft)	Stemming Material	Volume (ft^3)	Interval (ft)
MV-1	1416704.33	631162.16	Surface Casing	30-inch CS Casing	Blank	0–95	Cement Seal	378	0–95
			Intermediate Casing	20-inch CS Casing	Blank	0–1,050	Cement Seal	70	0–686
			Upper Piezometer Casing (MV-1UPZ)	2.375-inch CS Flush Joint Tubing	Blank	+1.0–879	Bentonite Chips	40	686–720
							Sand Pack (1 × 20)	90	720–760
							Sand Pack (6 × 12)	100	760–790
					Screen	879–939	1/8–1/4-inch Gravel Pack	180	790–998
					Sump w/bullnose	839–959	Cement Seal	75	998–1,050
			Secondary Casing	13.375-inch CS Casing	Blank	0–2,500	Cement Seal	285	2,150–2,500
			Lower Piezometer Casing (MV-1LPZ)	2.375-inch CS Flush Joint Tubing	Blank	+ 1.0–3,002	Cement Seal	1,118	0–2,828
							Sand Pack (1 × 20)	101	2,828–2,919
							Sand Pack (6 × 12)	13	2,919–2,932
					Screen	3,002–3,062	1/8–1/4-inch Gravel Pack	120	2,932–3,144
					Sump w/bullnose	3,062–3,082	Sand Pack (1 × 20)	35	3,144–3,166
			Monitor Well Casing (MV-1)	5.5-inch CS Casing (Internal Ceramic Coated)	Blank	+1.0–3,750	Cement Seal	470	3,166–3,584
							Sand Pack (1 × 20)	72	3,584–3,664
							Sand Pack (6 × 12)	75	3,664–3,704
					Screen	3,750–3,910	1/8–1/4-inch Gravel Pack	180	3,704–3,969
					Sump w/bullnose	3,910–3,954	Sand Pack (1 × 20)	16	3,969–3,990
							Cement Seal	70	3,990–4,102
MV-2	1412731.89	626545.87	Surface Casing	30-inch CS Casing	Blank	0–95	Cement Seal	75	0–95
			Intermediate Casing	20-inch CS Casing	Blank	0–1,050	Cement Seal	1,322	0–807
			Upper Piezometer Casing (MV-2UPZ)	2.375-inch CS Flush Joint Tubing	Blank	+1.0–960	Sand Pack (1 × 20)	55	807–850
							Sand Pack (6 × 12)	45	850–880
					Screen	960–1,010	1/8–1/4-inch Gravel Pack	90	880–1,035
					Sump w/bullnose	1,010–1,015	Cement Seal	25	1,035–1,050
			Secondary Casing	13.375-inch CS Casing	Blank	0–2,150	Cement Seal	216	2,000–2,150
			Monitor Well Casing (MV-2)	5.5-inch CS Casing (Internal Ceramic Coated)	Blank	+1.25–3,040	Cement Seal	2,247	0–2,927
							Sand Pack (6 × 9)	120	2,927–3,066
					Screen	3,040–3,202	1/8–1/4-inch Gravel Pack	180	3,066–3,260
					Sump w/bullnose	3,202–3,244	Cement Seal	425	3,260–3,410
			Lower Piezometer Casing (MV-2LPZ)	2.375-inch CS Flush Joint Tubing	Blank	+1.0–3,547	Sand Pack (6 × 9)	90	3,410–3,454
					Screen	3,547–3,607	1/8–1/4-inch Gravel Pack	210	3,454–3,660
					Sump w/bullnose	3,607–3,647			
MV-3	1416559.52	628809.43	Surface Casing	30-inch CS Casing	Blank	0–95	Cement Seal	76	0–95
			Intermediate Casing	20-inch CS Casing	Blank	0–1,053	Cement Seal	894	0–734
			Upper Piezometer Casing (MV-3UPZ)	2.375-inch CS Flush Joint Tubing	Blank	+1.0–880	Sand Pack (6 × 12)	95	734–798
					Screen	880–940	1/8–1/4-inch Gravel Pack	270	798–1,020
					Sump w/bullnose	940–960	Cement Seal	90	1,020–1,053
			Secondary Casing	13.375-inch CS Casing	Blank	0–2,516	Cement Seal	27.6	2,150–2,516
			Lower Piezometer Casing (MV-3LPZ)	2.375-inch CS Flush Joint Tubing	Blank	+1.0–3,300	Cement Seal	864	0–3,062
							Sand Pack (6 × 12)	13	3,062–3,197
					Screen w/ bullnose	3,300–3,420	1/8–1/4-inch Gravel Pack	270	3,197–3,430
			Monitor Well Casing (MV-1)	5.5-inch CS Casing (Internal Ceramic Coated)	Blank	+1.0–4,046	Cement Seal	19.5	3,430–3,647
							No. 6 Sand Pack	8.8	3,647–3,789
					Screen w/bullnose	4,046–4,209	1/8–1/4-inch Gravel Pack	36.2	3,789–4,220

Table C1 (continued). Well Descriptions with Well Completion Information

Well/Piezometer ID	Northing (ft)	Easting (ft)	Construction Material	Material Type	Material Use	Interval (ft)	Stemming Material	Volume (ft^3)	Interval (ft)
MV-4	1413816.79	630569.64	Surface Casing	24-inch CS Casing	Blank	0–100	Cement Seal	210	0–100
			Piezometer Casing (MV-4PZ)	2.375-inch CS Flush Joint Tubing	Blank	+1.0–918	Cement Seal	530	0–843
							3/8-inch Bentonite Chips	12.5	843–863
							No. 6 Sand Pack	11.2	863–881
					Screen	918–978	1/8–1/4-inch Gravel Pack	95.1	881–1,032
					Blank w/end cap	978–998			
			Bottom Seal	NA			Cement Seal	397.3	1,032–1,640
			Monitor Well Casing (MV-4)	5.5-inch CS Casing (Internal Ceramic Coated)	Blank	+1.0–1,719	No. 6 Sand Pack	39.8	1,640–1,701
					Screen	1,719–2,023	1/8–1/4-inch Gravel Pack	265	1,701–2,098
					Blank w/end cap	2,023–2,064			
			Bottom Seal	NA			Cement Seal	102.3	2,098–2,223
MV-5	1413231.5	629584.81	Surface Casing	24-inch CS Casing	Blank	0.0–100	Cement Seal	210	0–100
			Piezometer Casing (MV-5PZ)	2.375-inch CS Flush Joint Tubing	Blank	+1.0–1,018	Cement Seal	535	0–960
							3/8-inch Bentonite Chips	6.2	960–970
							No. 6 Sand Pack	16.9	970–997
					Screen	1,018–1,078	1/8–1/4-inch Gravel Pack	77.3	997–1,120
					Blank w/end cap	1,078–1,097			
			Bottom Seal	NA			Cement Seal	411.1	1,120–1,749
			Monitor Well Casing (MV-5)	5.5-inch CS Casing (Internal Ceramic Coated)	Blank	+1.0–1,839	3/8-inch Bentonite Chips	2.6	1,749–1,753
							No. 6 Sand Pack	16.3	1,753–1,778
					Screen	1,839–2,163	1/8–1/4-inch Gravel Pack	301.4	1,778–2,232
					Blank w/end cap	2,163–2,203			
			Bottom Seal	NA			Cement Seal	136.8	2,232–2,399
MV-6	1414770.9	630150.73	Surface Casing	14-inch CS Casing	Blank	0.0–98	Cement Seal	108	0–120
			Monitor Well Casing	5.5-inch Casing (CS with Internal Ceramic Coating)	Blank	+1.0–838	Cement Seal	512	0–783
							6/12 Sand Pack	18.3	783–811
					Screen	838–1,001	1/8–1/4-inch Gravel Pack	139	811–1,023
					Sump	1,001–1,021			
HTH-1RC [a]	1411444.64	629717.32	Surface Casing	13.375-inch CS Casing	Blank	0.0–52	Cement Seal	64	0–52
			Intermediate Casing	9.625-inch CS Casing	Blank	0–3,704	Cement Seal	4,730	0–3,704
			Upper Piezometer Casing (HTH-1UPZ)	1.25-inch CS Flush Joint Tubing	Blank	+0.8–979	Cement Seal	370	0.0–907
							3/8-inch Bentonite Chips	5.3	907–920
							No. 6 Sand Pack	10.2	920–945
					Screen w/end cap	979–1,039	1/8–1/4-inch Gravel Pack	55.1	945–1,080
			Bottom Seal	NA			Cement Seal	312.2	1,080–1,845
			Lower Piezometer Casing (HTH-1LPZ)	1.25-inch CS Flush Joint Tubing	Blank	+ 0.8–1,899	3/8-inch Bentonite Chips	4.1	1,845–1,855
							No. 6 Sand Pack	6.1	1,855–1,870
					Screen w/end cap	1,899–1,959	1/8–1/4-inch Gravel Pack	45	1,870–1,980
			Bottom Seal	NA			Cement Seal	125.4	1,980–2,280
			Monitor Well Casing (HTH-1RC)	4.0-inch CS Casing	Blank	+1.0–2,358	Bentonite Chips	4.2	2,280–2,290
							No. 6 Sand Pack	8.4	2,290–2,310
					Screen	2,358–2,658	1/8–1/4-inch Gravel Pack	221.6	2,310–2,812
					Blank w/end cap	2,658–2,678			
HTH-2	1411931.43	629585.29	Surface Casing	13.375-inch CS Casing	Blank	0.0–50	Cement Seal	69	0–50
			Monitor Well Casing	9.625-inch CS Casing	Blank	+1.0–504	NA		
					Screen	504–1,001	NA		

Table C1 (continued). Well Descriptions with Well Completion Information

Well/Piezometer ID	Northing (ft)	Easting (ft)	Construction Material	Material Type	Material Use	Interval (ft)	Stemming Material	Volume (ft^3)	Interval (ft)
UC-1-P-1SRC	1413403.26	629833.75	Surface Casing	20-inch CS Casing	Blank	0.0–30	Cement Seal	201	0–30
			Intermediate Casing	10.75-inch CS Casing	Blank	0–524	Cement Seal	600	0–524
			Monitor Well Casing (UC-1-P-1SRC)	5.5-inch CS Casing (Internal Ceramic Coated)	Blank	+0.82–512	Cement Seal	207.1	0–445
							3/8-inch Bentonite Chips	6	445–458
							No. 6 Sand Pack	14	458–488
					Screen w/end cap	512–574	1/8–1/4-inch Gravel Pack	40.5	488–584
			Bottom Seal	NA			Cement Seal	22.3	584–626
UC-1-P-2SR	1414634.37	628979.66	Surface Casing	20-inch CS Casing	Blank	0–181	Cement Seal	635	0–50
			Intermediate Casing	13.375-inch CS Casing	Blank	0–1,150	Cement Seal	1174	0–1,150
			Secondary Casing	9.625-inch CS Casing	Blank	0–1,950	Cement Seal	661	0–1,950
			Monitor Well Casing	8.75-inch CS Casing	Perforated	1,148–2,792	NA		

[a] Well HTH-1RC was recompleted within the original well casing (HTH-1) in 2009. The original casing (9.625-inch) was cemented in place and was gun perforated at various intervals from surface to the total depth of the borehole 3,704 ft bgs.
Note: The northings and eastings are provided in U.S. State Plane 1927 (Nevada Central Zone), horizontal datum NAD27

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Appendix D

Use Restriction Forms and Maps

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Use Restriction Information

CAU Number/Description: CAU 443 Central Nevada Test Area - Subsurface
Applicable CAS Number/Description: CAS 58-57-001 UC-1 Cavity

Contact (DOE AL/Activity): DOE Office of Legacy Management - Offsites Project

FFACO Use Restriction Physical Description:

Surveyed Area (UTM, Zone 11, NAD 83, meters):

UR Points	Northing (Y)	Easting (X)
UR-1	4275768.40	568935.08
UR-2	4275470.65	568223.56
UR-3	4275763.24	567509.89
UR-4	4276474.77	567212.13
UR-5	4277188.45	567504.71
UR-6	4277486.20	568216.24
UR-7	4277193.61	568929.91
UR-8	4276482.08	569227.66

Depth: No Excavation, drilling, and/or removal of materials below a depth of 20 feet within 3,300 feet of the UC-1 monument at surface ground zero.

Survey Source (GPS, GIS, etc): GPS

Basis for FFACO UR(s):

Summary Statement: The FFACO use restriction is established to prevent exposure to or inadvertent contact with the subsurface contaminated material and to limit activities that may impact the groundwater flow system at the UC-1 site (CAS 58-57-001, Cavity).

Contaminants Table:

Maximum Concentration of Contaminants for CAU 443 CAS 58-57-001, Cavity			
Constituent	**Maximum Concentration**	**Action Level**	**Units**
Tritium	~21,000,000 at deepest sample depth[1]	Refer to Table 4 in the Closure Report	pCi/L

[1] = Sample collected from the reentry well UC-1-P-2SR. This well is completed in the UC-1 chimney and is perforated from measured depths of 1,148 to 2,792 ft bgs. The well is considered near-field and is within the model predicted contaminant boundary for the UC-1 site. Samples have been collected from discrete intervals within the well since its installation in 1968. The highest radioisotope concentrations have been detected at the deepest sample depth of approximately 2,615 ft bgs (Thordarson 1985 and LLNL 1992). All other wells installed at the UC-1 site have had no detections of radioisotopes above the laboratory required minimum detectable concentration.

Site Controls: The use-restriction is maintained in the U.S. Bureau of Land Management geographic information system as notice to potential land users. It is also documented on the UC-1 monument at surface ground zero.

Note: Effective upon acceptance of closure documents by NDEP

Use Restriction Information

Administrative Use Restriction Physical Description*:

Surveyed Area (UTM, Zone 11, NAD 83, meters):

UR Points	Northing	Easting

Depth: _____

Survey Source (GPS, GIS, etc): _____

*Coordinates for the Administrative Use Restriction exclude the area defined by the FFACO Use Restriction coordinates.

Basis for Administrative UR(s):

Summary Statement:____

Contaminants Table:

Maximum Concentration of Contaminants for CAU CAS ,			
Constituent	**Maximum Concentration**	**Action Level**	**Units**

Site Controls: _____

UR Maintenance Requirements (applies to both FFACO and Administrative UR(s) if Administrative UR exists):

Description: The site will be visually inspected to asses that the use restrictions remain effective.

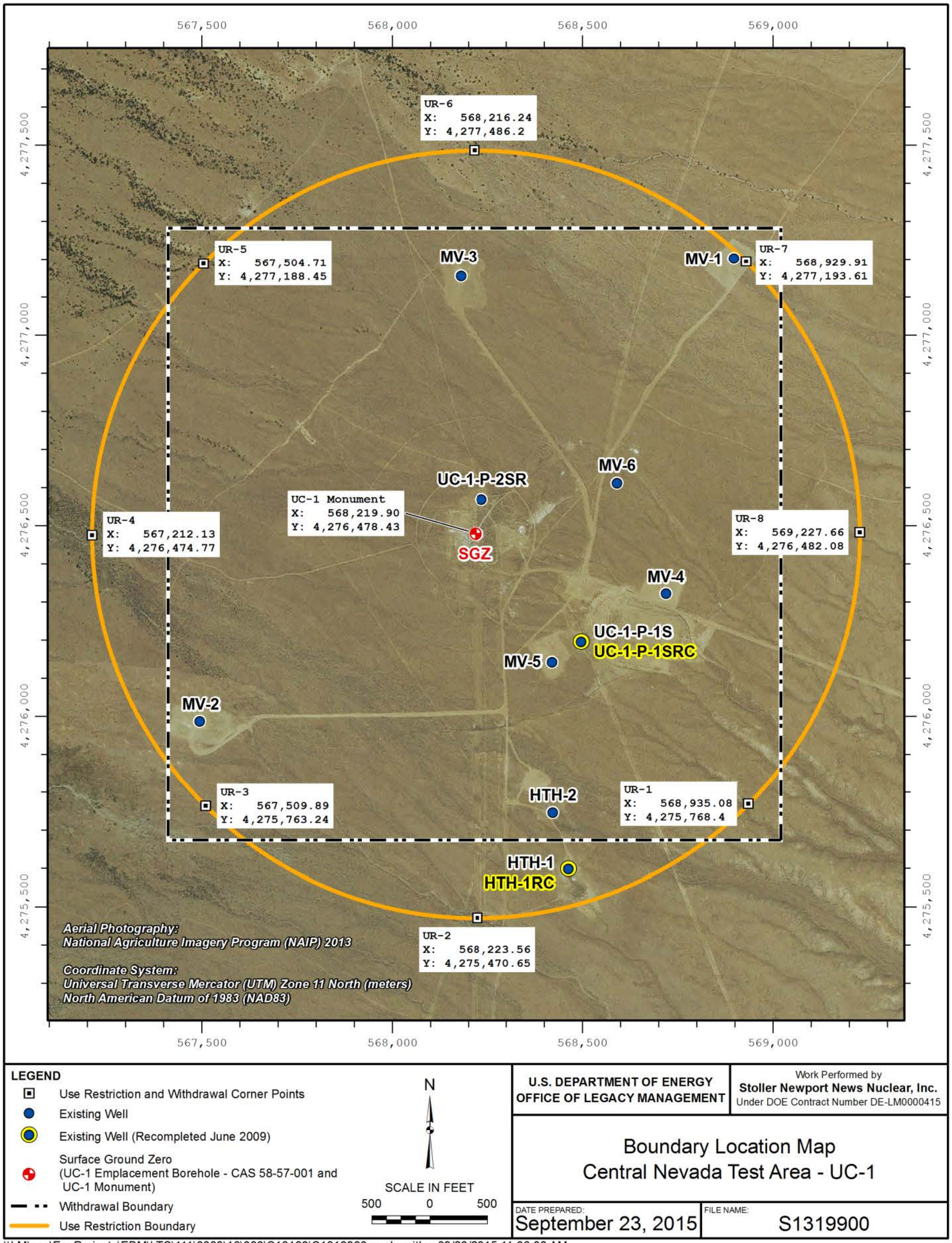
Inspection/Maintenance Frequency: Annual

The future use of any land related to this Corrective Action Unit (CAU), as described by the above surveyed location, is restricted from any DOE or Air Force activity that may alter or modify the containment control as approved by the state and identified in the CAU CR or other CAU documentation unless appropriate concurrence is obtained in advance.

Comments: None

Submitted By: Mark Kautsky **Date:** December 3, 2015

Note: Effective upon acceptance of closure documents by NDEP



U.S. DEPARTMENT OF ENERGY
OFFICE OF LEGACY MANAGEMENT

Work Performed by
Stoller Newport News Nuclear, Inc.
Under DOE Contract Number DE-LM0000415

Boundary Location Map
Central Nevada Test Area - UC-1

DATE PREPARED: September 23, 2015

FILE NAME: S1319900

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Appendix E

DOE Notification to BLM

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DOE Notification to BLM

A letter from the agency that maintains the surface (U.S. Bureau of Land Management and/or U.S. Forest Service) must be submitted to NDEP stating that the use-restriction information has been recorded in their GIS. If DOE is unable to include this letter with the Closure Report due to agency response times, DOE must provide documentation that use-restriction information has been sent to the appropriate agency with a request to record the use restrictions. NDEP will then issue a notice of milestone completion if this is the only unresolved issue. DOE must continue to submit monthly requests to the appropriate agency with a copy to NDEP. Once the appropriate agency acknowledges recordation, NDEP will issue the CAU Notice of Completion for the CAU.

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Appendix F

NDEP Comments with Record of Review and Response to Comments

NEVADA DIVISION OF
ENVIRONMENTAL PROTECTION

STATE OF NEVADA
Department of Conservation & Natural Resources
Brian Sandoval, Governor
Leo M. Drozdoff, P.E., Director
David Emme, Administrator

October 26, 2015

RECEIVED DOE
OCT 29 2015
GRAND JUNCTION OFFICE

Mr. Mark Kautsky
Site Manager
U. S. Department of Energy
Office of Legacy Management
2597 Legacy Way
Grand Junction, CO 81503

RE: Submittal of Draft Closure Report (CR) for Corrective Action Unit (CAU) 443: Central Nevada Test Area – Subsurface, September 2015, Federal Facility Agreement and Consent Order

Dear Mr. Kautsky,

The Nevada Division of Environmental Protection, Bureau of Federal Facilities (NDEP) has reviewed the U. S. Department of Energy, Office of Legacy Management's *Draft Closure Report (CR) for Corrective Action Unit (CAU) 443: Central Nevada Test Area – Subsurface,* received on September 30, 2015. While this letter serves as a Notice of Completion for the September 30, 2015 **Milestone Deadline** for the "Draft Closure Report," the NDEP has the following comments on the Report which should be addressed in the Final version:

1. Page vi, **Executive Summary**, First partial paragraph on page, last sentence: Please include references for the NDEP approved modeled contaminant boundary and compliance boundary.

2. Page 5, Section 1.2, **Site Background and Regulatory Process**, First paragraph, last sentence: Please include references for the NDEP approved modeled contaminant boundary and compliance boundary.

3. Page 12, Section 2.2, **CADD/CAP and Recommendations**, First paragraph, third sentence: Please correct the reference for the CAIP to "DOE (1999)."

4. Page 12, Section 2.2, **CADD/CAP and Recommendations**, Second paragraph, third sentence: Please replace, "As a result, the model misrepresented some flow directions." with the following reworked sentence from the preliminary draft: "The heads measured at the MV wells and piezometers did not replicate the hydraulic heads predicted by the model and the model misrepresented some flow directions."

5. Page 15, Section 2.4, **Conceptual Model Evaluation**, First paragraph, fourth and fifth sentences: These two sentences state that two objectives of the CADD/CAP and CADD/CAP Addendum were evaluated as part as part of the Conceptual Model Evaluation. However, the two objectives stated in the fourth sentence are not found in the November 2004 CADD/CAP and there are no additional objectives stated in the CADD/CAP Addendum. The objective of the overall FFACO strategy for underground nuclear test sites can be found on pages 11 and 52 of the CADD/CAP and corrective action objectives are stated on Page 59 of the CADD/CAP. Either provide a reference for the objectives stated on Page 15 of the Draft Closure Report or reword this paragraph.

6. Page 21, Section 3.1, **Contaminant Boundary**, Last two sentences: Please insert this sentence from the preliminary draft between the last two sentences of this paragraph in the Draft: "Although data from wells MV-1, MV-2, and MV-3 did not validate the flow model, hydraulic conductivity data from these wells support the model-predicted contaminant boundary."

7. Page 21, Section 3.2, **Compliance Boundary**, First paragraph, last sentence: Appendix B includes two copies of the December 9, 2004 letter but does not include the June 11, 2004 letter concerning the compliance boundary. Please correct this issue in Appendix B.

8. Page 33, Section 4.2, **Institutional Controls**, 2. **Use-restriction zone**, Second sentence: "LM will likely enter into ...." Please remove "likely."

9. Page 33, Section 4.3, **Periodic Evaluation**, First sentence: Please add "following each sampling event as per Table 2" between "LM will conduct evaluations as new data become available" and "to ensure that the...."

10. Page 34, Section 4.4, **Performance Assessment**, First sentence: Please add "NDEP will be consulted and" between "... validity of the closure decision" and "it may be necessary..."

11. Page 35, Section 5.0, **Post-Closure Reporting, Groundwater Monitoring Reports**, First and second sentences: Please add "as per Table 2" to the end of the first sentence. Additionally, in the second sentence, please replace "summarize" with "also include a summary of."

12. Page 35, Section 5.0, **Post-Closure Reporting, New Strategy/Path Forward Report**, Last sentence: Please replace "may be" with "will be."

13. Page 35, Section 5.0, **Post-Closure Reporting, Record of Technical Change,** Third Bullet: Please add "Limited" to the beginning of this bullet.

14. Page 39, Section 7.0, **Quality Assurance**, Second sentence: Please state which SAP will be used.

15. Page 41, Section 8.0, **Recommendations**, First bullet: Please change this bullet to read, "A Notice of Milestone Completion be issued by NDEP to DOE-LM for CAU 443 at CNTA if the use-restriction in not yet recorded in BLM's GIS system."

16. Page 41, Section 8.0, **Recommendations**: Please add a second bullet to read, "A Notice of CAU Completion be issued by NDEP to DOE-LM for CAU 443 at CNTA when the use-restriction in recorded in BLM's GIS system."

17. Page 41, Section 8.0, **Recommendations,** Last Bullet: Please change the last bullet to read, "The CAU 443 at CNTA be moved from Appendix III…"

18. Page D-1, Appendix D, **Use Restriction Forms and Maps**: Please explain why the preliminary draft had the sections titled "FFACO Use Restriction Physical Description" and "Basis for FFACO UR(s)" completed yet the Draft CR had this information removed and the sections titled "Administrative Use Restriction Physical Description" and "Basis for Administrative UR(s)" completed.

If you have any questions or comments regarding these comments, please contact me at (702) 486-2850, extension 232 or Mark McLane at extension 226.

Sincerely,

Chris Andres

Christine D. Andres
Chief
Bureau of Federal Facilities

ec: EM Records, AMEM, NNSA/NFO, Las Vegas, NV
Navarro Central Files
Mark McLane, NDEP

cc: EM Records, AMEM, Las Vegas, NV
FFACO Group, PSG, NNSA/NFO, Las Vegas, NV
W. R. Wilborn, NNSA/NFO, Las Vegas, NV
R. F. Boehlecke, NNSA/NFO, Las Vegas, NV
Jeffrey Fraher, DTRA/CXTS, Kirtland AFB, NM
J. B. Chapman, DRI, Las Vegas, NV
L. Berry, SN3, Grand Junction, CO
R. Findley, SN3, Grand Junction, CO
R. Hutton, SN3, Grand Junction, CO

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Record of Review

Due Date	Review No.	Project	Type of Review
	1	Central Nevada Test Area - Offsites Project	Draft Report - Technical Regulatory Review

Document Title and\or Number and Revision
Draft Closure Report, Central Nevada Test Area, Subsurface Corrective Action Unit 443, September 2015, LMS/CNT/S12760

Author
Mark Kautsky

Author's Organization
Department of Energy Office of Legacy Management

Author's Phone
(970) 248-6018

Reviewer
Christine D. Andres

Reviewer's Organization
Nevada Division of Environmental Protection

Reviewer's Phone
(702) 486-2850

Reviewers' Recommendation

- ☐ Release Without Comment
- ☐ Consider Comments
- ☒ Resolve Comments and Reroute for Review

Refer to the NDEP letter dated October 26, 2015

Signature of Reviewer and Date

- ☒ Comments Have Been Addressed

Mark Kautsky
2016.01.13 14:26:05 -07'00'

Signature of Author and Date

- ☒ Comment Resolution Satisfactory
- ☐ Comment Resolution Unsatisfactory

Christine Andres 1/14/16

Signature of Reviewer and Date

Item No.	Reviewer's Comments and Recommendation	Reqd. (Y/N)	Item No.	Author's Response (if required)
1	Page vi, Executive Summary, First partial paragraph on page, last sentence: Please include references for the NDEP approved modeled contaminant boundary and compliance boundary.	Y	1	The references were added as requested. The referenced letters are also provided as Appendix B of the report.
2	Page 5, Section 1.2, Site Background and Regulatory Process, First paragraph, last sentence: Please include references for the NDEP approved modeled contaminant boundary and compliance boundary.	Y	2	The references were added as requested. The referenced letters are also provided as Appendix B of the report.
3	Page 12, Section 2.2, CADD/CAP and Recommendations, First paragraph, third sentence: Please correct the reference for the CAIP to "DOE (1999)."	Y	3	The sentence was revised to include "it was documented in the CADD/CAP" so it is clear that the reference (DOE 2004) is to the CADD/CAP. The revised sentece is provided below. "It was concluded during the corrective action investigation that the UC-3 (CAS 58-30-01) and UC-4 (CAS 58-30-02) emplacement boreholes required no further action and it was documented in the CADD/CAP that long-term stewardship of the site would include maintaining the integrity of the concrete caps that cover the boreholes (DOE 2004)."

Record of Review (continuation)

Review No.: 1	Project: Central Nevada Test Area - Offsites Project

Item No.	Reviewer's Comments and Recommendation	Reqd. (Y/N)	Item No.	Author's Response (if required)
4	Page 12, Section 2.2, CADD/CAP and Recommendations, Second paragraph, third sentence: Please replace, "As a result, the model misrepresented some flow directions." with the following reworked sentence from the preliminary draft: "The heads measured at the MV wells and piezometers did not replicate the hydraulic heads predicted by the model and the model misrepresented some flow directions."	Y	4	The sentence was revised as requested.
5	Page 15, Section 2.4, Conceptual Model Evaluation, First paragraph, fourth and fifth sentences: These two sentences state that two objectives of the CADD/CAP and CADD/CAP Addendum were evaluated as part of the Conceptual Model Evaluation. However, the two objectives stated in the fourth sentence are not found in the November 2004 CADD/CAP and there are no additional objectives stated in the CADD/CAP Addendum. The objective of the overall FFACO strategy for underground nuclear test sites can be found on pages 11 and 52 of the CADD/CAP and corrective action objectives are stated on Page 59 of the CADD/CAP. Either provide a reference for the objectives stated on Page 15 of the Draft Closure Report or reword this paragraph.	Y	5	The fourth and fifth sentences were revised as follows: "These data have been evaluated as part of the Conceptual Model Evaluation phase to ensure that the monitoring network is adequate for surveillance of the site, as per the CADD/CAP (DOE 2004). It was specified further in the CADD/CAP Addendum (DOE 2008) that this would be demonstrated by verifying that the groundwater system is stable and that radioisotopes of interest (tritium, carbon-14 [14C], and iodine-129 [129I]) remain below the laboratory-required minimum detectable concentrations at sampled locations outside the modeled contaminant boundary and compliance boundary (Figure 3)."
6	Page 21, Section 3.1, Contaminant Boundary, Last two sentences: Please insert this sentence from the preliminary draft between the last two sentences of this paragraph in the Draft: "Although data from wells MV-1, MV-2, and MV-3 did not validate the flow model, hydraulic conductivity data from these wells support the model-predicted contaminant boundary."	Y	6	The sentence was revised as requested.
7	Page 21, Section 3.2, Compliance Boundary, First paragraph, last sentence: Appendix B includes two copies of the December 9, 2004 letter but does not include the June 11, 2004 letter concerning the compliance boundary. Please correct this issue in Appendix B.	Y	7	The June 11, 2004 letter is included in Appendix B as requested.
8	Page 33, Section 4.2, Institutional Controls, 2. Use-restriction zone, Second sentence: "LM will likely enter into ...." Please remove "likely."	Y	8	The word "likely" was removed and the section was updated to reflect the current path forward for implementing the use-restriction at the UC-1 site. The reivsed text is provided below. LM is currently working with BLM to incorporate the use-restricted zone into their geographic information system (GIS) and increase the size of the UC-1 land withdrawal boundary (Section 3.4) to allow the use-restriction zone (Figure 9) to be fully encompassed within the withdrawal boundary. An increase of the size of the land withdrawal will provide additional restrictions outside the use-restricted area. DOE will not deny

Record of Review (continuation)

Review No.: 1	Project: Central Nevada Test Area - Offsites Project

Item No.	Reviewer's Comments and Recommendation	Reqd. (Y/N)	Item No.	Author's Response (if required)
				any reasonable request for access to the use-restricted area, but will retain the right of first refusal to any activities that have the potential to create an exposure pathway to subsurface contamination, while allowing as many beneficial uses of the land and resources as are safe. LM will include NDEP in the decision-making process to ensure that all parties are aware of any potential future activities at the site.
9	Page 33, Section 4.3, Periodic Evaluation, First sentence: Please add "following each sampling event as per Table 2" between "LM will conduct evaluations as new data become available" and "to ensure that the...."	Y	9	The sentence was revised as requested.
10	Page 34, Section 4.4, Performance Assessment, First sentence: Please add "NDEP will be consulted and" between "... validity of the closure decision" and "it may be necessary..."	Y	10	The sentence was revised as requested.
11	Page 35, Section 5.0, Post-Closure Reporting, Groundwater Monitoring Reports, First and second sentences: Please add "as per Table 2" to the end of the first sentence. Additionally, in the second sentence, please replace "summarize" with "also include a summary of."	Y	11	The sentence was revised as requested.
12	Page 35, Section 5.0, Post-Closure Reporting, New Strategy/Path Forward Report, Last sentence: Please replace "may be" with "will be."	Y	12	The sentence was revised as requested.
13	Page 35, Section 5.0, Post-Closure Reporting, Record of Technical Change, Third Bullet: Please add "Limited" to the beginning of this bullet.	Y	13	The sentence was revised as requested.
14	Page 39, Section 7.0, Quality Assurance, Second sentence: Please state which SAP will be used.	Y	14	The sentence was revised to specify that the DOE-LM SAP will be used and the reference was added to the sentence.
15	Page 41, Section 8.0, Recommendations, First bullet: Please change this bullet to read, "A Notice of Milestone Completion be issued by NDEP to DOE-LM for CAU 443 at CNTA if the use-restriction in not yet recorded in BLM's GIS system."	Y	15	The sentence was revised as requested.
16	Page 41, Section 8.0, Recommendations: Please add a second bullet to read, "A Notice of CAU Completion be issued by NDEP to DOE-LM for CAU 443 at CNTA when the use-restriction in recorded in BLM's GIS system."	Y	16	The sentence was revised as requested.

Record of Review (continuation)

Review No.: 1	Project: Central Nevada Test Area - Offsites Project

Item No.	Reviewer's Comments and Recommendation	Reqd. (Y/N)	Item No.	Author's Response (if required)
17	Page 41, Section 8.0, Recommendations, Last Bullet: Please change the last bullet to read, "The CAU 443 at CNTA be moved from Appendix III..."	Y	17	The sentence was revised as requested.
18	Page D-1, Appendix D, Use Restriction Forms and Maps: Please explain why the preliminary draft had the sections titled "FFACO Use Restriction Physical Description" and "Basis for FFACO UR(s)" completed yet the Draft CR had this information removed and the sections titled "Administrative Use Restriction Physical Description" and "Basis for Administrative UR(s)" completed.	Y	18	The differences between the FFACO and Administrative use restrictions were initially unclear. After further discussions with the National Nuclear Security Administration, Nevada Field Office it was determined that the use-restriction should be categorized as an FFACO use-restriction. The use-restriction form has been revised to reflect this determination and includes other minor revisions.