

**FEDERAL FACILITY AGREEMENT AND CONSENT ORDER (FFACO)
RECORD OF TECHNICAL CHANGE (ROTC)**

Corrective Action Unit (CAU) Number: 98

CAU Description: Frenchman Flat

CAU Owner: Underground Test Area (UGTA) - Environmental Restoration (ER)

ROTC No. DOE/EMNV--0006-ROTC 1 **Page** 1 **of** 7

Document Type Post-Closure Monitoring Report **Date** 05/18/2023

The following technical changes (including justification) are requested by:

Kenneth Rehfeldt

Requestor Name

Navarro UGTA Project Manager

Requestor Title

Description of Change:

1. After Section 4.2.2, Page 14, add new section 4.2.3 and Table 4-3:

Section 4.2.3, Fluid Management Plan (FMP) Sampling

A Well-Specific Fluid Management Strategy Letter is required by the FMP (NSA/NSO, 2009) and approved by NDEP. As specified in the Well-Specific Fluid Management Strategy for each well, all fluids generated (purged) during sampling operations with ^{3}H activity less than 400,000 pCi/L are contained in either onsite unlined sumps or discharged to infiltration areas. If the ^{3}H activity is equal to or greater than 400,000 pCi/L, then fluids generated during sampling are contained in onsite lined sumps.

During the Frenchman Flat post-closure water-quality sampling, FMP samples were collected from ER-5-3-2, ER-5-5, RNM-2S, and UE-5n because the groundwater purged from these wells was discharged to an onsite sump or infiltration area. FMP samples collected for

Justification:

1. FMP sample results were not reported in the CY2018 closure monitoring report. The closure report states that validated analytical results will be reported.

UNCONTROLLED**FEDERAL FACILITY AGREEMENT AND CONSENT ORDER (FFACO)
RECORD OF TECHNICAL CHANGE (ROTC)****Corrective Action Unit (CAU) Number:** 98**CAU Description:** Frenchman Flat**CAU Owner:** Underground Test Area (UGTA) - Environmental Restoration (ER)ROTC No. DOE/EMNV--0006-ROTC 1 Page 2 of 7Document Type Post-Closure Monitoring Report Date 05/18/2023**Description of Change:**

analysis by a commercial laboratory had results below the FMP criteria for metals, gross alpha, and gross beta as listed in Table A.1-1 in the FMP (NNSA/NSO, 2009). RNM-2S had a ^3H result below 5 times the FMP criteria, and UE-5n had a ^3H result below 10 times the FMP criteria. Table 4-3 shows the FMP results for ER-5-3-2, ER-5-5, RNM-2S, and UE-5n.

In accordance with the FMP, ^3H monitoring samples were collected daily from the discharge line during sampling activities. The results of onsite ^3H monitoring were compared to the FMP ^3H discharge criteria; all results were below the discharge criteria.

FMP samples were not collected from Wells ER-5-3_p2 and ER-11-2 because these wells were sampled with a depth-discrete bailer and no water was discharged to a sump or infiltration area.

2. Change the numbering of original Tables 4-3, 4-4, 4-5, 4-6, and 4-7 to Tables 4-4, 4-5, 4-6, 4-7, and 4-8.
3. Two new references added to Reference List.
4. Three new acronyms added to Acronym List.
2. Table numbers changed with addition of new Table 4-3.
3. Added to Reference List - (NNSA/NSO, 2009) and (Navarro, 2023).
4. Added to Acronym List - Fluid Management Plan (FMP), Mercury (Hg), and Milligrams per liter (mg/L).

Justification:**Schedule Impacts:**

**FEDERAL FACILITY AGREEMENT AND CONSENT ORDER (FFACO)
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Document Type Post-Closure Monitoring Report **Date** 05/18/2023

No impacts to schedule.

ROTC applies to the following document(s):

- CY2018 Annual Closure Monitoring Report for Corrective Action Unit 98, Frenchman Flat Underground Test Area, Nevada National Security Site, Nevada (January 2018 – December 2018), Revision No. 1, July 2019, DOE/EMNV--0006.

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ROTC No. DOE/EMNV--0006-ROTC 1 **Page** 4 **of** 7

Document Type Post-Closure Monitoring Report **Date** 05/18/2023

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Table 4-3
FMP Sample Results

Well and ISPID	Sample Date	Metals								Radionuclides		
		As	Ba	Cd	Cr	Pb	Hg	Se	Ag	Gross Alpha	Gross Beta	³ H
		mg/L										pCi/L
ER-5-3-2_m1	01/30/2018	J 0.0072 J 0.0048	0.19 0.19	<0.00021 <0.00021	<0.00073 <0.00073	<0.0018 <0.0018	<0.000071 <0.000071	<0.003 <0.003	<0.00042 <0.00042	15.2	12.6	<330
ER-5-5_m1	01/24/2018	0.012 0.014	<0.00036 <0.00036	<0.00021 <0.00021	J- 0.0023 <0.00073	<0.0018 <0.0018	<0.000071 <0.000071	<0.003 <0.003	<0.00042 <0.00042	5.6	6.5	<370
RNM-2S_m1	01/22/2018	<0.002 0.011	J 0.0089 J 0.0088	<0.00021 <0.00021	<0.00073 <0.00073	<0.0018 <0.0018	<0.000071 <0.000071	0.0069 <0.003	<0.00042 <0.00042	5.1	9.5	82,000
UE-5n_m1	01/18/2018	0.012 J 0.0087	J 0.0053 J 0.005	<0.00033 <0.00033	<0.00051 <0.00051	<0.0013 <0.0013	<0.000071 SRM	<0.0027 <0.0027	<0.0011 <0.0011	4	8.7	130,000

Notes:

- (1) Values reported with a “|” indicate unfiltered | filtered sample results.
- (2) Only filtered samples were collected and reported when a single radionuclide result is shown.
- (3) For metals results, the numeric values reported in the table represent the MDL for that analysis; the “<” symbol indicates a sample result less than the MDL.
- (4) For radionuclide results, the numeric values reported in the table represent the MDL for that analysis; the “<” symbol indicates a sample result less than the MDL.

MDL = Method detection limit

mg/L = Milligrams per liter

pCi/L = Picocuries per liter

Hg = Mercury

J = Result is estimated.

J- = Result is estimated bias low.

SRM = Sample result missing.

Source: Analytical Services Database (Navarro, 2023)

NNES, see Navarro Nevada Environmental Services, LLC.

NNSA/NFO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office.

NNSA/NSO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office.

NNSA/NV, see U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office.

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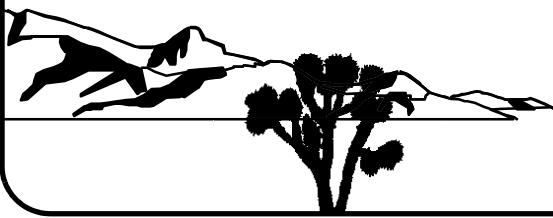
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(January 2018–December 2018)

Controlled Copy No.: UNCONTROLLED
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**CY2018 ANNUAL CLOSURE MONITORING REPORT
FOR CORRECTIVE ACTION UNIT 98,
FRENCHMAN FLAT,
UNDERGROUND TEST AREA,
NEVADA NATIONAL SECURITY SITE, NEVADA**

(JANUARY 2018–DECEMBER 2018)

U.S. Department of Energy,
Environmental Management Nevada Program
Las Vegas, Nevada

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FOR CORRECTIVE ACTION UNIT 98,
FRENCHMAN FLAT,
UNDERGROUND TEST AREA,
NEVADA NATIONAL SECURITY SITE, NEVADA**

(JANUARY 2018–DECEMBER 2018)

Approved by: /s/ Tiffany Gamero Date: 07/16/2019

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List of Acronyms and Abbreviations

General Acronyms and Abbreviations

acre-ft/yr	Acre-foot per year
BLM	Bureau of Land Management
CADD	Corrective action decision document
CAI	Corrective action investigation
CAIP	Corrective action investigation plan
CAP	Corrective action plan
CAS	Corrective action site
CAU	Corrective action unit
CB	Contaminant boundary
COC	Contaminant of concern
CR	Closure report
CY	Calendar year
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/NV	U.S. Department of Energy, Nevada Operations Office
DRI	Desert Research Institute
EM	Environmental Management
FFACO	<i>Federal Facility Agreement and Consent Order</i>
FS	U.S. Forest Service
ft	Foot
FWS	U.S. Fish and Wildlife Service
gal	Gallon
GIS	Geographic Information Systems
kt	Kiloton
LCA	Lower carbonate aquifer
m	Meter
MCL	Maximum contaminant level
MDL	Minimum detection level
mg/kg	Milligrams per kilogram
M&O	Management and operating

List of Acronyms and Abbreviations (Continued)

mrem/yr	Millirem per year
NA	Not available
NAD	North American Datum
NDEP	Nevada Division of Environmental Protection
NDWR	Nevada Division of Water Resources
NGVD	National Geodetic Vertical Datum
N-I	Navarro-Intera, LLC
NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
NNSS	Nevada National Security Site
NTTR	Nevada Test and Training Range
NWIS	National Water Information System
pCi/L	Picocuries per liter
RBMS	Requirements-Based Management System
REOP	Real Estate/Operations Permit
ROTC	Record of Technical Change
RWMC	Radioactive Waste Management Complex
SDWA	<i>Safe Drinking Water Act</i>
SNJV	Stoller-Navarro Joint Venture
SU	Standard unit
UGTA	Underground test area
UR	Use Restriction
USAF	U.S. Air Force
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
µg/L	Micrograms per liter
µS/cm	Microsiemens per centimeter

List of Acronyms and Abbreviations (Continued)

Symbols for Elements and Compounds

Ag	Silver
Al	Aluminum
Am	Americium
As	Arsenic
Ba	Barium
Br	Bromide
C	Carbon
Ca	Calcium
CaCO ₃	Calcium carbonate
Cd	Cadmium
Cl	Chlorine
CO ₃	Carbonate
Cr	Chromium
Cs	Cesium
Eu	Europium
F	Fluorine
FD	Field duplicate
Fe	Iron
³ H	Tritium
HCO ₃	Bicarbonate
I	Iodine
K	Potassium
Li	Lithium
Mg	Magnesium
Mn	Manganese
Na	Sodium
Nb	Niobium
Pb	Lead
Pu	Plutonium
R	Regular sample

List of Acronyms and Abbreviations (Continued)

Se	Selenium
Si	Silicon
SiO ₂	Silicon dioxide
SO ₄	Sulfate
Sr	Strontium
Tc	Technetium

Executive Summary

Corrective Action Unit (CAU) 98: Frenchman Flat on the Nevada National Security Site was the location of 10 underground nuclear tests. CAU 98 underwent a series of investigations and actions in accordance with the *Federal Facility Agreement and Consent Order* to assess contamination of groundwater by radionuclides from the tests. A Closure Report completed that process in 2016 and called for long-term monitoring, use restrictions (URs), and institutional controls to protect the public and environment from potential exposure to contaminated groundwater. Three types of monitoring are performed for CAU 98: water quality, water level, and institutional control. These are monitored to determine whether the URs remain protective of human health and the environment, and to ensure that the regulatory boundary objectives are being met. Monitoring data will be used in the future, once multiple years of data are available, to evaluate consistency with the groundwater flow and contaminant transport models because the contaminant boundaries calculated with the models are the primary basis of the UR boundaries.

Six wells were sampled for water-quality monitoring in 2018. Contaminants of concern were detected only in the two source/plume wells already known to contain contamination as a result of a radionuclide migration experiment. Tritium concentrations in both of these wells, RNM-2S and UE-5n, remain above the *Safe Drinking Water Act* maximum contaminant level of 20,000 picocuries per liter but declined in 2018 as compared to measurements in 2017. All other contaminants of concern are below the minimum detection level plus analytical error.

The water-level monitoring network includes 16 wells. Depth to water measured in 2018 is generally consistent with recent measurements for all wells. Many wells continue to exhibit a long-term downward trend in water level, despite small increases in measured water levels in 2018. The sharp 2016 decline in water level in Well ER-5-3-2 remains unexplained, with the lower level persisting through 2018. Rising water-level trends continue to be observed in two relatively deep wells (ER-5-3 deep piezometer and ER-5-4-2), and also in former supply Well WW-5A. The current supply wells exhibit relatively erratic water levels associated with pumping activities.

Institutional control monitoring confirmed the URs are recorded in U.S. Department of Energy and U.S. Air Force land management systems, and that no activities within Frenchman Flat basin are occurring that could potentially affect the contaminant boundaries. Survey of groundwater resources

in basins surrounding Frenchman Flat similarly identify no current or pending development that would indicate the need to increase monitoring activities or would otherwise cause concern for the closure decision.

The URs continue to prevent exposure of the public, workers, and the environment to contaminants of concern by preventing use of potentially contaminated groundwater.

1.0 Introduction

Corrective Action Unit (CAU) 98: Frenchman Flat on the Nevada National Security Site (NNSS) was the site of 10 underground nuclear tests (Figure 1-1). As a result of these activities, some of the groundwater at and near these underground nuclear tests was impacted. The U.S. Department of Energy (DOE), Environmental Management (EM) Nevada Program has addressed the groundwater impacts through actions conducted in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) Underground Test Area (UGTA) Strategy (FFACO, 1996 as amended).

The *Underground Test Area (UGTA) Closure Report for Corrective Action Unit 98: Frenchman Flat Nevada National Security Site, Nevada* (NNSA/NFO, 2016b), establishes the contaminant boundaries (CBs), regulatory boundary and regulatory boundary objectives, monitoring program, use restrictions (URs), and other institutional controls agreed to by the DOE, EM Nevada Program and the Nevada Division of Environmental Protection (NDEP) for closure of CAU 98. The CBs depict the model-forecasted probabilistic extent of radionuclide-contaminated groundwater from underground nuclear testing over 1,000 years (Figure 1-2). The URs are based primarily on the model-forecast CBs, and define the areas requiring institutional controls as negotiated between NDEP and EM Nevada Program. The URs protect site workers from inadvertently contacting, or site activities from affecting, potentially contaminated groundwater. The Regulatory Boundary objective for CAU 98 is to protect receptors downgradient of the Rock Valley fault system from radionuclide contamination. This negotiated boundary aligns with the Rock Valley fault system groundwater pathway out of the Frenchman Flat basin.

The Closure Report (CR) calls for an annual long-term monitoring report (this report) documenting the groundwater monitoring analytical results, monitoring system inspections, and institutional control verifications.

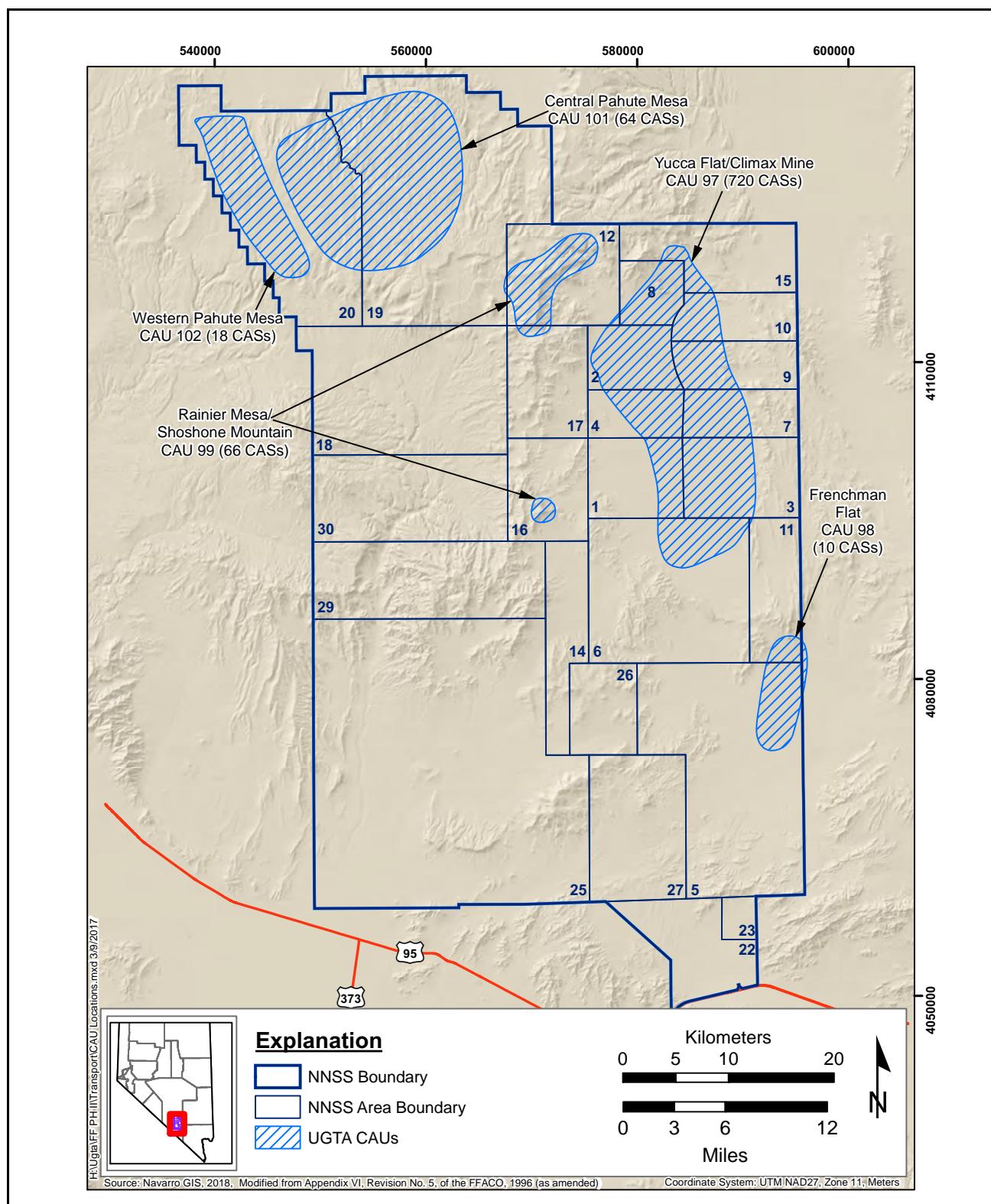


Figure 1-1
Location of Frenchman Flat CAU and Other UGTA CAUs within the NNSS

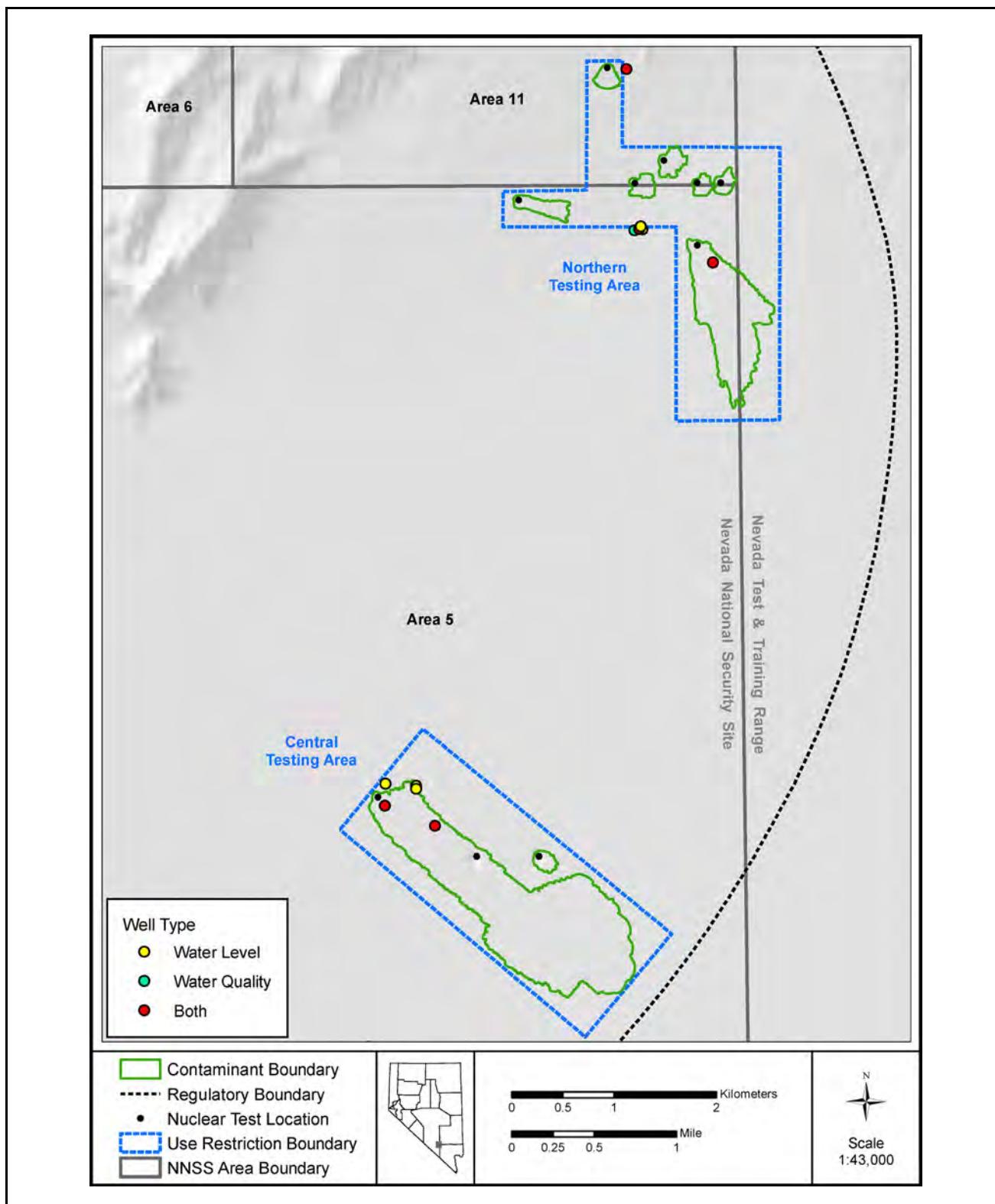


Figure 1-2
Contaminant, Use Restriction, and Regulatory Boundaries for CAU 98

2.0 Site Location and Background

CAU 98 is located in the Frenchman Flat closed drainage basin on the NNSS (Figure 1-1). The NNSS is approximately 65 miles northwest of Las Vegas, Nevada, and Frenchman Flat is in the southeastern portion of the site. The first nuclear test at the NNSS occurred at Frenchman Flat in 1951, and additional atmospheric tests occurred in the basin through 1962.

Ten underground nuclear tests were conducted in Frenchman Flat between 1965 and 1971. Seven were detonated in the northern part of CAU 98, and three were in the central part (Table 2-1). Although only the CAMBRIC test was conducted below the water table, radionuclide contamination of groundwater is assumed for all of them because the others were detonated within 100 meters (m) (328 feet [ft]) of the water table (DOE/NV, 1997). All of the tests were detonated in alluvium with the exception of PIN STRIPE, which was detonated within volcanic rock (vitric tuff). All of the tests have yields less than 20 kilotons (kt) (NNSA/NFO, 2015).

Table 2-1
Underground Nuclear Tests within CAU 98

Test Name	CAS Number	Hole Name	Test Date	Latitude (NAD 27)	Longitude (NAD 27)	Depth (ft bgs)	Yield (kt)
Central Testing Area							
CAMBRIC	05-57-003	U5e	05/14/1965	36.823384	-115.966836	967	0.75
DILUTED WATERS	05-57-002	U5b	06/16/1965	36.818049	-115.956061	632	<20
WISHBONE	05-57-001	U5a	02/18/1965	36.818008	-115.949229	574	<20
Northern Testing Area							
DERRINGER	05-57-004	U5i	09/12/1966	36.875888	-115.950695	837	7.8
DIAGONAL LINE	11-57-005	U11g	11/24/1971	36.879227	-115.934707	868	<20
DIANA MOON	11-57-003	U11e	08/27/1968	36.877213	-115.931075	794	<20
MILK SHAKE	05-57-005	U5k	03/25/1968	36.871719	-115.931131	868	<20
MINUTE STEAK	11-57-004	U11f	09/12/1969	36.877213	-115.92850	868	<20
NEW POINT	11-57-002	U11c	12/13/1966	36.877255	-115.937912	785	<20
PIN STRIPE	11-57-001	U11b	04/25/1966	36.887452	-115.940797	970	<20

Source: Modified from NNSA/NFO (2015) to NAD 27 coordinate system.

CAS = Corrective action site

NAD = North American Datum

In addition to nuclear testing, Frenchman Flat was the location of a long-term radionuclide migration experiment related to the CAMBRIC underground test. The Area 5 Radioactive Waste Management Complex (RWMC) is located in Frenchman Flat (see [Figure 4-1](#)) and receives low-level radioactive waste generated at the NNSS and other DOE sites.

2.1 *Summary of Corrective Action Activities*

The corrective action strategy for CAU 98 follows the UGTA process defined in Appendix VI of the FFACO (1996, as amended). It is a four-stage sequential approach of a Corrective Action Investigation Plan (CAIP), Corrective Action Investigation (CAI), Corrective Action Decision Document (CADD)/Corrective Action Plan (CAP), and finally a CR. The process began for Frenchman Flat with a value of information analysis (IT, 1997) that guided development of the CAIP (DOE/NV, 1999). The CAIP focused efforts on development of a groundwater flow and transport model. Subsequent peer review of that model (IT, 1999 and 2000) led to a determination that additional data collection was required.

A CAIP addendum (NNSA/NV, 2001) prescribed data collection and modeling activities known as Phase II of the CAI. Phase II data collection included well drilling, geophysical investigations, and hydrogeologic and geochemical investigations, all providing data for a new groundwater flow and transport model (SNJV, 2006; NNES, 2010). A significant addition to the modeling process was a broader analysis of model uncertainty, including examination of alternate conceptual models. CBs were calculated using the models. The Phase II groundwater flow and transport model successfully completed peer review and was accepted by NDEP, closing out the CAI stage in 2010.

The CADD/CAP document (NNSA/NSO, 2011) presented the recommended corrective action alternative of closure in place with modeling, monitoring, and institutional controls. It also specified a model evaluation process designed to ensure that the existing models provide adequate guidance for developing monitoring and institutional controls for the site. Data collection activities occurred according to this plan, focused on addressing key uncertainties in the flow and transport models. Additionally, the EM Nevada Program and NDEP agreed to initial UR boundaries and CAU regulatory boundary objectives. Results of the model evaluation activities substantiated the suitability of the models for the purpose of developing monitoring and institutional controls. NDEP approval of the model evaluation report (N-I, 2014) ended the CADD/CAP stage in 2014.

The CR (NNSA/NFO, 2016b), approved by NDEP in 2016, describes the regulatory boundary objectives; and the final contaminant, UR, and regulatory boundaries agreed upon by NDEP and EM Nevada Program for CAU 98. It also specifies the monitoring program that will be followed for the first five years. The CR calls for an annual long-term monitoring report to verify corrective action effectiveness. This annual report, contained herein, serves to document groundwater monitoring analytical results and water levels, monitoring system inspections, and institutional control verifications.

3.0 Geologic and Hydrologic Setting

Frenchman Flat is a closed-drainage topographic basin in the southeastern portion of the NNSS. It is defined by surrounding mountain ranges and hills, with a valley floor that slopes gently to a usually dry lake bed, Frenchman Lake playa. Total relief from the low-lying playa to the crest of the surrounding hills is about 1,700 ft. The basin is filled with sedimentary and volcaniclastic rocks above regionally deposited carbonate rocks (Bright et al., 2001).

The hydrogeology of the Frenchman Flat basin was the subject of intense investigation during the CAIP and CADD/CAP stages, as summarized in U.S. DOE 2011 and 2016b. Frenchman Flat basin contains two semi-independent aquifer systems: a semi-perched groundwater system in alluvial and volcanic rocks, and a deeper regional flow system in carbonate rocks (the lower carbonate aquifer [LCA]). The shallower semi-perched system is separated from the LCA by a thick sequence of tuff confining units that limit vertical flow. Water levels in both the alluvial and volcanic aquifers within Frenchman Flat are several meters higher than water levels in the LCA that underlies and surrounds the basin. Groundwater in the alluvial and volcanic rocks leaves the basin only by draining downward into the LCA or laterally into the LCA along the basin margins. In some parts of the basin, the intervening low-permeability tuff confining unit is overpressured, preventing vertical migration.

The shallow groundwater system has low horizontal hydraulic gradients, interpreted as indicating low flow rates, consistent with the limited groundwater recharge in the arid environment (NNES, 2010). Groundwater flow through the alluvial and volcanic units is driven by the limited recharge within the basin and by flow from an area of higher head in the CP sub-basin to the west. Flow within the deeper LCA in Frenchman Flat may be largely directed along the Rock Valley fault system ([Figure 3-1](#)), toward the southwest, a flow path addressed by the alignment of the regulatory boundary with the fault.

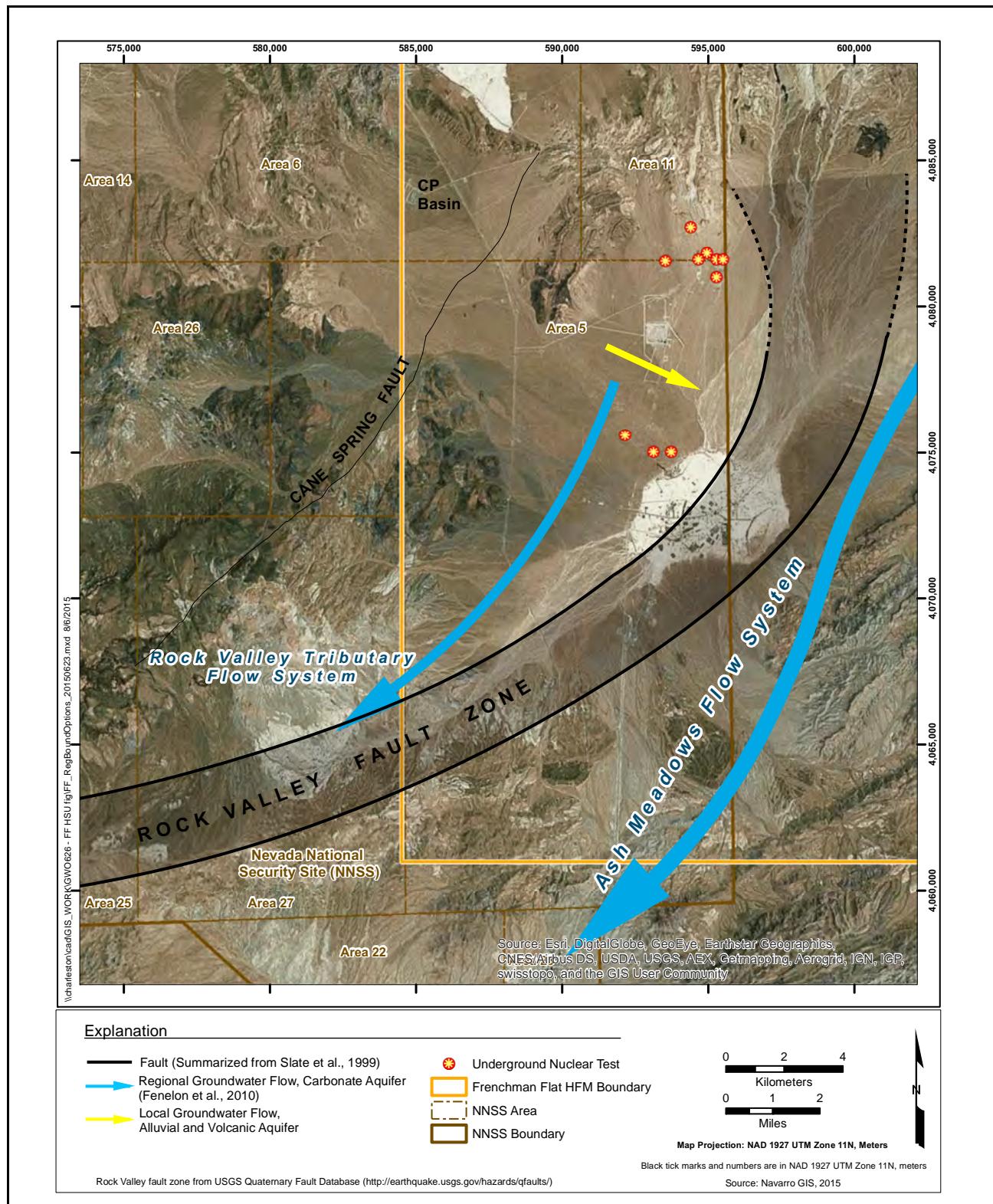


Figure 3-1
Representation of Rock Valley Fault System and Groundwater Flow Directions

4.0 Monitoring Program Objectives and Activities

Three types of monitoring are performed for CAU 98: water quality, water level, and institutional control. The objective of all these monitoring activities is to determine whether the URs remain protective of human health and the environment, and to ensure that the regulatory boundary objective is met. To achieve these objectives, the water-quality and water-level monitoring will be used to evaluate consistency with the groundwater flow and contaminant transport conceptual and numerical models because the models are the primary basis for the URs. This evaluation will be performed at the conclusion of the five-year monitoring period.

4.1 Water-Quality Monitoring

Six wells in Frenchman Flat are sampled for water-quality monitoring ([Table 4-1](#); [Figure 4-1](#)). The objective(s) are specific to each well, but the general intent is to provide information useful to evaluating the groundwater flow and transport model, while also specifically measuring the concentration of contaminants of concern (COCs). The COCs are those radionuclides contributing to the CB, being tritium (^3H), carbon-14 (^{14}C), chlorine-36 (^{36}Cl), technetium-99 (^{99}Tc), and iodine-129 (^{129}I) (NNSA/NSO, 2011). On occasion, the UGTA Activity samples the CAU 98 monitoring wells for project investigations independent of the post-closure monitoring. These analyses are reported in [Appendix A](#).

The rationale for each monitoring well and general monitoring conditions is described in the following subsections. The wells are presented according to their location in either the Northern Testing Area (four wells) or Central Testing Area (two wells). The monitoring wells are categorized in the CR (NNSA/NFO, 2016b) into three types: characterization, source/plume, or early detection. The category is associated with a specific analytical suite.

Water-quality sampling in 2018 was conducted by Navarro in accordance with the “Field Operations” (FO-1202) Requirements-Based Management System (RBMS) procedure and the following desktop instructions: “Decontamination of Field Sampling Equipment” (DI-FO-02), “Field Quality Control Samples” (DI-FO-06), “Fluid Sample Collection and Field Filtration” (DI-FO-08), “Sample Handling and Shipping” (DI-FO-11), and “Water Quality Monitoring and Analysis”

Table 4-1
Water-Quality Monitoring Wells for CAU 98

Well Name	Latitude (NAD 27)	Longitude (NAD 27)	Aquifer	Sample Method	Category ^a	Sample Date
ER-5-3_p2	36.873091	-115.937985	Basalt Lava-Flow & Older Alluvial	Bailer	Characterization	01/31/2018
ER-5-3-2	36.873115	-115.938328	Lower Carbonate	Submersible Pump	Early Detection	01/30/2018
ER-5-5	36.870096	-115.930288	Alluvial & Basalt Rubble	Submersible Pump	Early Detection	01/24/2018
ER-11-2	36.887314	-115.938667	Lower Tuff Confining Unit	Bailer	Early Detection	02/05/2018
RNM-2S	36.822561	-115.966916	Alluvial	Submersible Pump	Source/Plume	01/22/2018
UE-5n	36.82072	-115.961447	Alluvial	Submersible Pump	Source/Plume	01/18/2018

^a Analytical suite for each category is as follows (bailed samples may have a reduced suite):

Characterization: alkalinity, pH, specific conductance, Anions (Br, Cl, F, SO₄), Total Metals (Ag, Al, As, Ba, Ca, Cd, Cr, Fe, K, Li, Mg, Mn, Na, Pb, Se, Si, Sr, Uranium), Gross alpha, Gross beta, Gamma emitters (²⁶Al, ⁹⁴Nb, ¹³⁷Cs, ^{152/154}Eu, ²³⁵U, ²⁴¹Am, ²⁴³Am), ³H (low-level or standard, see below), ¹⁴C, ³⁶Cl, ⁹⁹Tc, ⁹⁰Sr, ¹²⁹I, and ^{238/239/240}Pu.

Early Detection: ³H (low-level; MDL as low as 1 pCi/L).

Source/Plume: ³H (standard; MDL approximately 300 pCi/L), ¹⁴C, ³⁶Cl, ⁹⁹Tc, ¹²⁹I.

MDL = Minimum detection level

pCi/L = Picocuries per liter

Note: Because "U" is used as a qualifier within this document, "uranium" will be spelled out when used without an isotope number.

(DI-FO-15) (Navarro, 2018). Water-quality samples for the six monitoring wells were collected during January and February 2018 (Table 4-1). Analyses are performed by laboratories certified by the NDEP Bureau of Safe Drinking Water.

4.1.1 Northern Testing Area

ER-5-3_p2 (shallow piezometer) is completed in the basalt lava-flow aquifer and alluvium of the older altered alluvial aquifer. This well is the closest water-table monitoring location to five underground nuclear tests, including being generally downgradient of the DERRINGER test.

ER-5-3-2 is a deep well within the ER-5-3 well cluster, being completed in the LCA. This well monitors the carbonate aquifer to detect vertical migration of contaminants from upgradient tests.

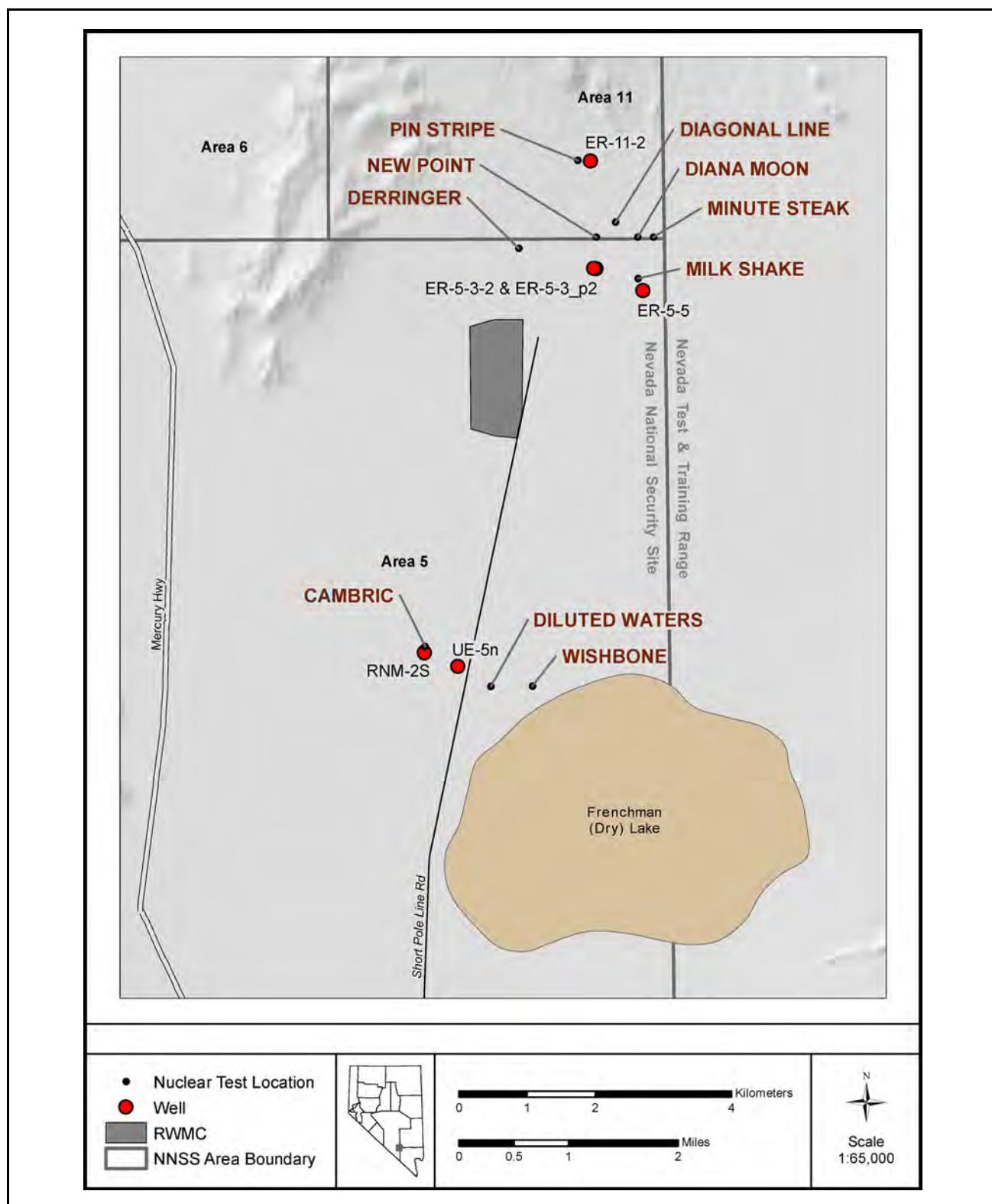


Figure 4-1
Location of Water-Quality Wells for CAU 98

ER-5-5 was drilled as a model evaluation well and is located within the CB calculated for the MILK SHAKE test. The well and its adjacent piezometer are completed in a thin basalt rubble zone and adjacent alluvium (the screened intervals of the well and piezometer are almost identical). It is located to monitor contaminant migration from the MILK SHAKE test.

ER-11-2 was drilled as a model evaluation well downgradient from the PIN STRIPE test. Geologic and hydrologic information from ER-11-2 revealed the presence of a fault-related barrier between the nuclear test and the monitoring well, and also found the well completed in a low-permeability aquitard. The well is identified for ${}^3\text{H}$ monitoring because of its proximity to the PIN STRIPE test.

4.1.2 Central Testing Area

RNM-2S is located south of the CAMBRIC underground nuclear test. It was completed in alluvium as the pumping well for a long-term experiment gathering data regarding migration of radionuclides through groundwater. Breakthrough of radionuclides originating from the CAMBRIC cavity was observed at RNM-2S within the first year of pumping (in 1975), and pumping continued for almost 16 years. RNM-2S monitors the contaminant plume from the CAMBRIC pumping test.

UE-5n is located southeast of the CAMBRIC test and is completed in alluvium. The water pumped as part of the long-term radionuclide migration experiment at the CAMBRIC test was discharged into a ditch adjacent to UE-5n and infiltrated to the water table. As a result, UE-5n is located within the CB associated with the CAMBRIC test. UE-5n monitors the natural attenuation of the radionuclide-contaminated water that infiltrated from the ditch.

4.2 Water-Quality Results

The analytical results for the COCs in CAU 98 monitoring wells are discussed in the following subsections. Results for additional parameters are reported in [Appendix A](#). Laboratory MDLs specified for the monitoring analyses are below the *Safe Drinking Water Act* (SDWA) standards (maximum contaminant level [MCL] values) for each radionuclide (CFR, 2018). In many cases, the reported concentration is less than the MDL or less than the MDL plus measurement error (laboratory qualifier code “U”).

4.2.1 Northern Testing Area

All of the radionuclide (^3H) analyses performed in 2018 as part of the post-closure monitoring program for the Northern Testing Area wells (ER-5-3_p2, ER-5-3-2, ER-5-5, and ER-11-2) have results below the analytical MDL (Table 4-2). These results are consistent with prior years of post-closure sampling (see Appendix A, Table A-2).

Table 4-2
 ^3H , ^{14}C , ^{36}Cl , ^{99}Tc , and ^{129}I Analytical Results

Well	Date	Type ^a	^3H	^3H , Low Level	^{14}C	^{36}Cl	^{99}Tc	^{129}I		
MCL (pCi/L) ^b				20,000	2,000	700	900	1		
			Results (pCi/L)							
ER-5-3_p2	01/31/2018	R	--	<2.91	--	--	--	--		
ER-5-3-2	01/30/2018	R	--	<3.14	--	--	--	--		
		FD	--	<2.83	--	--	--	--		
ER-5-5	01/24/2018	R	--	<2.66	--	--	--	--		
		FD	--	<2.97	--	--	--	--		
ER-11-2	02/05/2018	R	--	<3.06	--	--	--	--		
		FD	--	<2.47	--	--	--	--		
RNM-2S	01/22/2018	R	82,000	--	<380	<3.2	<7.3	<0.81		
		FD	80,000	--	U 380	<2.9	<7.7	<0.86		
UE-5n	01/18/2018	R	123,000	--	<380	<2.7	<7.5	<0.82		

^a R = Regular sample; FD = Field duplicate sample.

^b The COCs are regulated as beta emitters in the SDWA (CFR, 2018), and limited to an MCL for all beta and photon emitters combined of 4 mrem/yr, meaning the combined dose from all beta and photon radionuclides present must be equal to or less than 4 mrem/yr. The MCL presented here is the concentration of each single radionuclide, which equates to a 4-mrem/yr dose as if it were the only radionuclide present.

mrem/yr = Millirem per year

U = Compound analyzed but not detected; value less than MDC plus 2 sigma error

-- = Not analyzed

4.2.2 Central Testing Area

Both monitoring wells in the Central Testing Area contain ^3H at concentrations in excess of the SDWA standard (Table 4-2) (CFR, 2018). The ^3H in both wells is the result of the long-term

radionuclide migration experiment, with RNM-2S pumping and drawing contaminated water from the CAMBRIC underground nuclear test, and UE-5n affected by the infiltration below the discharge ditch. The pumping and discharge occurred from October 1975 to August 1991, with two additional short periods in October 1999 and April to July 2003. The ${}^3\text{H}$ concentration measured in the RNM-2S sample from 2018 is 4,000 to 5,000 pCi/L lower than that measured in 2017, a decrease of about 5 percent (see [Appendix A, Table A-2](#)). This is consistent with the overall pattern in concentration at RNM-2S over the last decade of a slowly decreasing trend subsequent to the peak breakthrough in 1980 ([Figure 4-2](#)). The ${}^3\text{H}$ concentration in UE-5n also exhibits a trend of decreasing concentration—in this case, subsequent to 2009 ([Figure 4-3](#)). The 2018 measurement for UE-5n is 9,000 pCi/L lower than that measured in 2017 (see [Appendix A, Table A-2](#)).

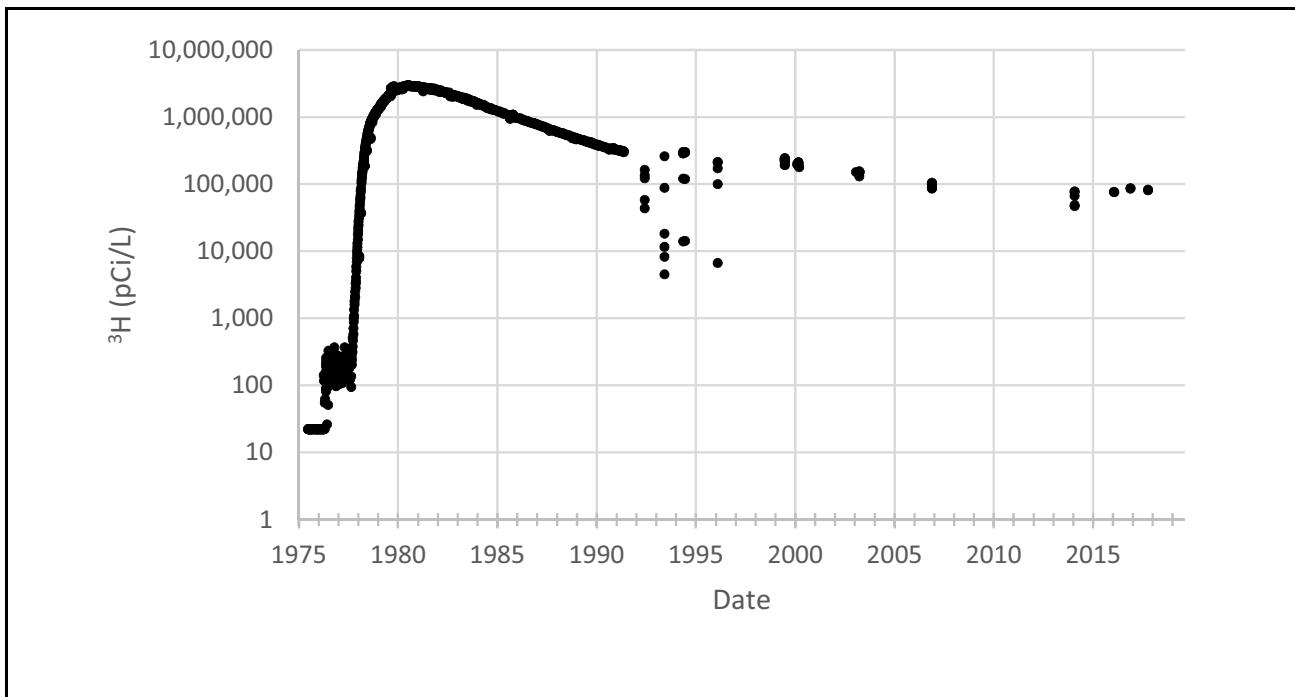


Figure 4-2
Trend in ${}^3\text{H}$ Concentration Measured in Samples from RNM-2S

The other radionuclides (${}^{14}\text{C}$, ${}^{36}\text{Cl}$, ${}^{99}\text{Tc}$, and ${}^{129}\text{I}$) measured in the RNM-2S and UE-5n samples are at concentrations below the analytical MDL or the MDL plus error ([Table 4-2](#)).

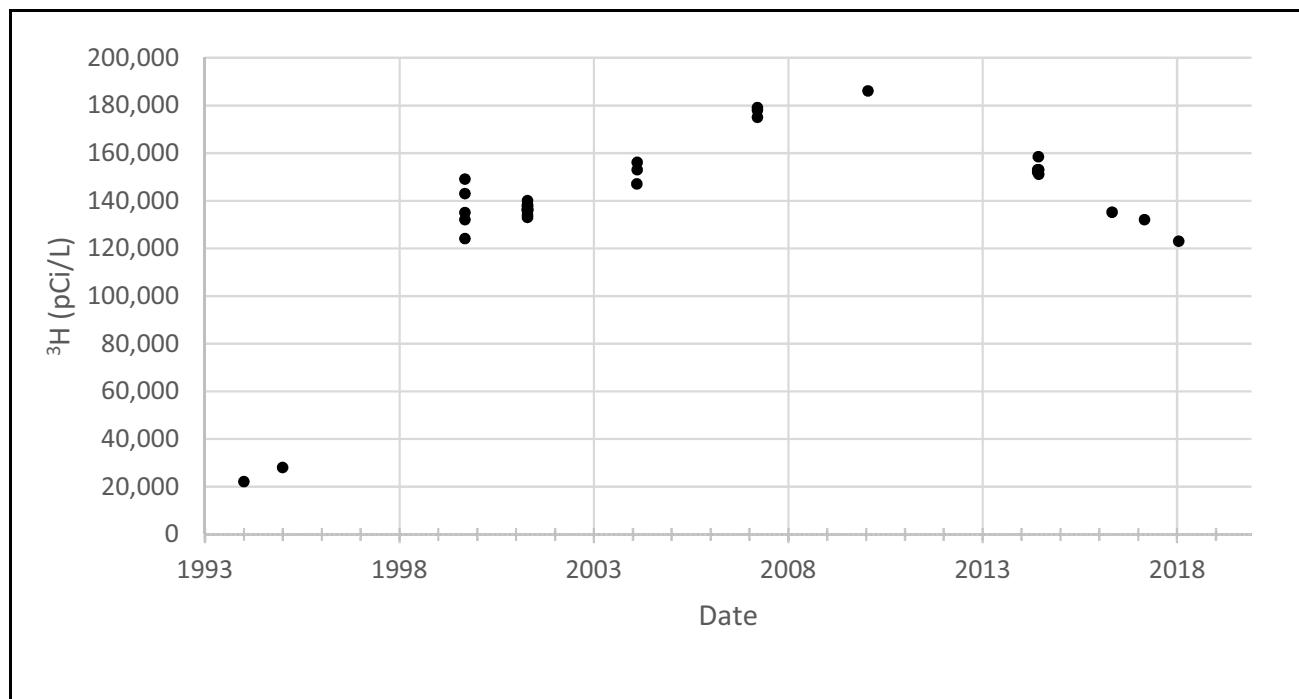


Figure 4-3
Trend in ³H Concentration Measured in Samples from UE-5n

4.3 Water-Level Monitoring

The objective of long-term FFACO monitoring of water levels is to identify whether changes have occurred in the hydrologic system that could impact closure decisions and CB forecasts. Long-term FFACO water-level monitoring wells can be divided into two groups (Navarro, 2016).

The *contaminant-boundary scale wells* are those influential for determining local gradient and local contaminant migration. The *CAU flow-model scale wells* are those influential for monitoring boundary conditions controlling contaminant migration beyond the local scale.

Sixteen wells are specified for the post-closure water-level network (Table 4-3; Figure 4-4).

An important global purpose for monitoring water levels in the Northern and Central Testing Area wells is to provide data on possible impacts from pumping in southern Frenchman Flat. Groundwater in southern Frenchman Flat has been pumped to supply water for NNSS operations for decades, and the associated water-level declines have the potential to affect groundwater flow throughout the basin (Elliott and Fenelon, 2010).

Table 4-3
Wells Used for Monitoring Water Levels Important to the CAU 98 Closure

Well Name	Latitude (NAD 27)	Longitude (NAD 27)	Aquifer	Category ^a
ER-5-3 deep piezometer	36.873091	-115.937985	Alluvial/Volcanic	Local
ER-5-3 main (upper zone)	36.873091	-115.937985	Alluvial	Local
ER-5-3-2	36.873115	-115.938328	Lower Carbonate	Boundary Conditions
ER-5-3-3	36.873339	-115.938130	Alluvial	Local
ER-5-4 main	36.824271	-115.963453	Alluvial/Volcanic	Local
ER-5-4 piezometer	36.824271	-115.963453	Alluvial	Local
ER-5-4-2	36.823996	-115.963457	Volcanic	Boundary Conditions
ER-5-5 m1 ^b	36.870096	-115.930288	Alluvial	Local
ER-11-2	36.887315	-115.938664	Volcanic	Local and Boundary Conditions
RNM-1	36.824488	-115.966819	Alluvial	Local
RNM-2S	36.822561	-115.966916	Alluvial	Local
UE-5n	36.820720	-115.961447	Alluvial	Local
WW-4	36.904952	-116.024001	Volcanic	Boundary Conditions
WW-4A	36.903195	-116.027433	Volcanic	Boundary Conditions
WW-5A	36.776477	-115.958100	Alluvial	Boundary Conditions
WW-5B	36.801257	-115.968977	Alluvial	Boundary Conditions

^a Local = Wells influential for determining local gradient and plume migration; Boundary Condition = Wells influential for determining boundary conditions controlling contaminant migration.

^b ER-5-5 has a separate main well (m1) and piezometer (p1) that are completed at nearly the same depth interval. Previously, a query of ER-5-5 water levels from the USGS National Water Information System provided data collected from both m1 and p1; in 2018, data collected from m1 and p1 were separated and reported individually. The CR is silent in regard to interval. As the piezometer is now unavailable due to the presence of a transducer, the water level in ER-5-5 m1 is reported here.

The specific purpose for monitoring the water level in each well is provided below:

- **ER-5-3 deep piezometer:** Monitors the deep alluvial/volcanic system in the Northern Testing Area. Provides local gradient data.
- **ER-5-3 main (upper zone):** Monitors the alluvial system in the Northern Testing Area. Provides local gradient data.
- **ER-5-3-2:** Monitors the regional carbonate in the Northern Testing Area. Provides regional hydraulic gradient data. Monitors impacts from pumping the carbonate aquifer.

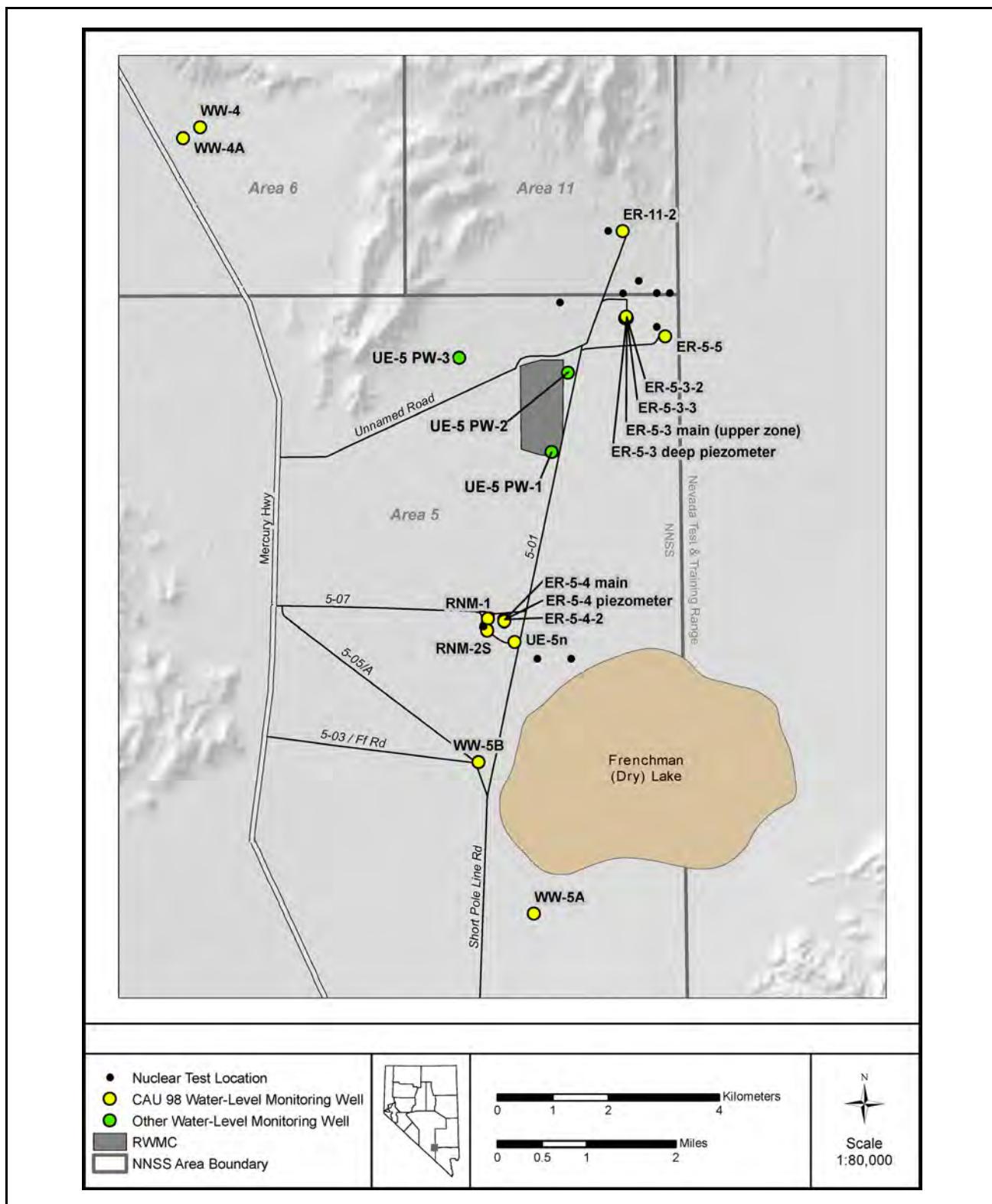


Figure 4-4
Location of Water-Level Monitoring Wells in Frenchman Flat
Measured for the Closure Monitoring Program

- **ER-5-3-3:** Monitors the alluvial system in the Northern Testing Area. Provides local gradient data.
- **ER-5-4 main:** Monitors the alluvial/volcanic system in the Central Testing Area. Provides local gradient data near CAMBRIC.
- **ER-5-4 piezometer:** Monitors the alluvial system in the Central Testing Area. Provides local gradient data near CAMBRIC.
- **ER-5-4-2:** Monitors the deep volcanic confining unit in the Central Testing Area. Provides data confirming an upward vertical gradient and no vertical pathway for contaminants to enter the carbonate aquifer.
- **ER-5-5 m1:** Monitors the alluvial system in the Northern Testing Area. Provides local gradient data near MILKSHAKE.
- **ER-11-2:** Monitors the volcanic confining unit in the Northern Testing Area. Provides local gradient data near PIN STRIPE and boundary conditions on the northern edge of Frenchman Flat.
- **RNM-1:** Monitors the alluvial system in the Central Testing Area. Provides local gradient data near CAMBRIC.
- **RNM-2S:** Monitors the alluvial system in the Central Testing Area. Provides local gradient data near CAMBRIC.
- **UE-5n:** Monitors alluvial system in Central Testing Area. Provides local gradient data near the Cambric Ditch.
- **WW-4:** Monitors impacts from pumping the volcanic aquifer in the CP sub-basin portion of northwestern Frenchman Flat.
- **WW-4A:** Monitors impacts from pumping the volcanic aquifer in the CP sub-basin portion of northwestern Frenchman Flat.
- **WW-5A:** Monitors impacts from pumping of the alluvial aquifer in southern Frenchman Flat.
- **WW-5B:** Monitors impacts from pumping of the alluvial aquifer in southern Frenchman Flat.

Water-level measurements in 2018 were conducted by the U.S. Geological Survey (USGS) according to their procedure USGS-WL-COLLECT-01, “Procedure for Manually Measuring Depth-to-Water with Steel Tapes, Electric Tapes, and Wirelines for the U.S. Department of Energy, National Nuclear Security Administration” (USGS, 2014). Water levels are measured quarterly and within a narrow

time frame to allow for synoptic analysis. The time frame is coordinated with measurements performed by the NNSS management and operating (M&O) contractor at the Area 5 RWMC pilot water-table wells (UE-5 PW-1, UE-5 PW-2, and UE-5 PW-3) to facilitate data comparison. In 2018, the Frenchman Flat water levels were measured on March 5, June 4, August 13, and October 22 (Table 4-4), with the exception of the three RWMC wells, which were measured on October 25, 2018, rather than October 22 because of mechanical problems with equipment.

Table 4-4
Water-Level Data for 2018 ^a (Page 1 of 2)

Name	03/05/2018		06/04/2018		08/13/2018		10/22/2018	
	Depth (ft bgs)	Elevation (m)						
ER-5-3 deep piezometer	928.72	733.46	928.47	733.54	928.51	733.53	928.39	733.57
ER-5-3 main (upper zone)	927.97 Z	733.69	927.74	733.76	927.75	733.76	927.72	733.77
ER-5-3-2	961.56 R	723.48	961.33	723.55	961.40	723.53	961.32	723.55
ER-5-3-3	927.97	733.71	927.71	733.78	927.72	733.78	927.62	733.81
ER-5-4 main	726.13	733.22	725.94	733.28	725.98	733.26	725.97	733.27
ER-5-4 piezometer	725.56	733.39	725.68	733.35	725.55	733.39	725.54	733.40
ER-5-4-2	649.93	756.46	649.61	756.56	649.69	756.54	649.77	756.51
ER-5-5 m1	930.64 Z	733.54	930.36	733.63	930.36	733.63	930.27	733.65
ER-11-2	1,154.05 Z	737.36	1,153.84	737.43	1,153.91	737.41	1,153.98	737.38
RNM-1	730.38	732.98	730.11	733.06	730.14	733.05	730.09	733.07
RNM-2S	724.36 R	733.31	724.07	733.39	724.09	733.39	724.08	733.39
UE-5n	706.91 R	733.39	706.58	733.49	706.60	733.48	706.54	733.50
UE-5 PW-1	772.39	733.35	772.17	733.42	772.18	733.41	772.16	733.42 ^b
UE-5 PW-2	839.58	733.51	839.47	733.54	839.38	733.57	839.46	733.55 ^b
UE-5 PW-3	888.81	733.60	888.55	733.68	888.66	733.64	888.74	733.62 ^b
WW-4	839.80	841.77	839.61	841.82	840.05	841.69	840.07	841.68
WW-4A	840.26	842.90	840.08	842.95	840.53	842.81	840.53	842.81

Table 4-4
Water-Level Data for 2018 ^a (Page 2 of 2)

Name	03/05/2018		06/04/2018		08/13/2018		10/22/2018	
	Depth (ft bgs)	Elevation (m)						
WW-5A	703.96	728.06	703.63	728.16	703.50	728.20	703.50	728.20
WW-5B	689.19	732.42	688.95	732.49	689.42	732.35	689.25	732.40

^a Groundwater depth is reported in feet below ground surface, consistent with the measurement units. Groundwater elevation is in meters, relative to National Geodetic Vertical Datum (NGVD) of 1929, consistent with the CAU model units.

^b Measured on October 25, 2018.

R = Site had been pumped recently.

Z = Other conditions existed that would affect the measurement. For ER-5-3 main (upper zone) and ER-11-2, these wells had been bailed recently, but no water-level response was noted. For ER-5-5 main, it had been pumped recently but already recovered.

4.4 Water-Level Results

Water-level data are maintained by USGS in the National Water Information System (NWIS), accessible at <https://waterdata.usgs.gov/nv/nwis/nwis> (USGS, 2019). Analysis of water levels and trends for Frenchman Flat wells has been performed by Bright et al. (2001) for the period 1954 to 1998; by Stoller-Navarro Joint Venture (SNJV) (2004) for measurements before 2004; by SNJV (2006) with particular attention to revised land elevation measurements; by Fenelon et al. (2010) for data through 2009; and by Navarro-Intera, LLC (N-I) (2014) for data through 2013 with an emphasis on uncertainty analysis. Ongoing water-level data analysis is provided in Elliott and Fenelon (revised annually).

The 2018 monitoring data are considered in the context of water levels collected from 2004 forward because the majority of wells have complete records through this period, and measurements in this time frame are coincident (synoptic) with those at the Area 5 RWMC wells (UE-5 PW-1, UE-5 PW-2, and UE-5 PW-3). The 2018 water-level measurements are consistent with prior measurements at the monitoring wells. The majority of monitoring wells completed in the upper portion of the saturated zone of Frenchman Flat have a long-term trend of gradually declining water level (Figure 4-5). In the short term, water levels at the end of 2018 were slightly higher in these wells than at the end of 2017, but the increase is small compared to the overall declining trend. Water levels in wells completed deeper in the hydrogeologic system, in deep alluvium and volcanic rocks (ER-5-3 deep piezometer, ER-5-4-2, ER-11-2), exhibit either stable or rising water levels. The water levels in the water supply Wells WW-4, WW-4a, and WW-5b are somewhat more erratic than those of other wells as a result

of their pumping for water production, and the water level continues to rise in former supply Well WW-5A.

The water level in ER-5-3-2 (completed in the carbonate aquifer) remains well below the pre-2016 level. All measurements subsequent to pumping for sample collection in May 2016 have been about 16.6 ft below the pre-2016 non-pumping level. The cause of the water-level decline subsequent to the sampling event remains unknown.

4.5 Institutional Control Monitoring

Institutional controls are an important and inherent part of the corrective action chosen for CAU 98. The objective of institutional controls is to limit access to potentially contaminated groundwater, and thereby prevent exposure of the public, workers, and the environment to COCs from the Frenchman Flat underground nuclear tests.

The Frenchman Flat hydrographic basin covers most of the southeastern portion of the NNSS and a portion of the adjacent Nevada Test and Training Range (NTTR) ([Figure 4-6](#)). The NNSS and the NTTR are located on land that has been withdrawn from public use for the purpose of military activities. The first withdrawal occurred in October 1940 as part of a rapid expansion of U.S. military operations associated with World War II. The expansion included the acquisition of large amounts of real estate for ground and air reservations (Fine and Remington, 1989). More than 3.5 million acres of federal land southeast of Tonopah, Nevada, were withdrawn through Executive Order No. 8578 to create an aerial bombing and gunnery range (DOE/NV, 1996).

The NNSS, formerly the Nevada Test Site, was formed through four Public Land Orders (PLO 805, 1662, 2568, and 3759) issued by the Bureau of Land Management (BLM, 1952, 1958, 1961, and 1965). After several revocations and expansions, the NNSS now covers an area of 870,400 acres; and the NTTR, operated by the U.S. Air Force (USAF), encompasses nearly 2.9 million acres.

The most recent withdrawal related to the NTTR occurred in October 1999 under Title XXX of Public Law 106-65, the “National Defense Authorization Act for Fiscal Year 2000” (Statutes at Large, 2000). This authorization expires November 6, 2021. USAF has filed an application requesting an extension of the existing land withdrawal, plus the withdrawal of additional acreage (BLM, 2016).

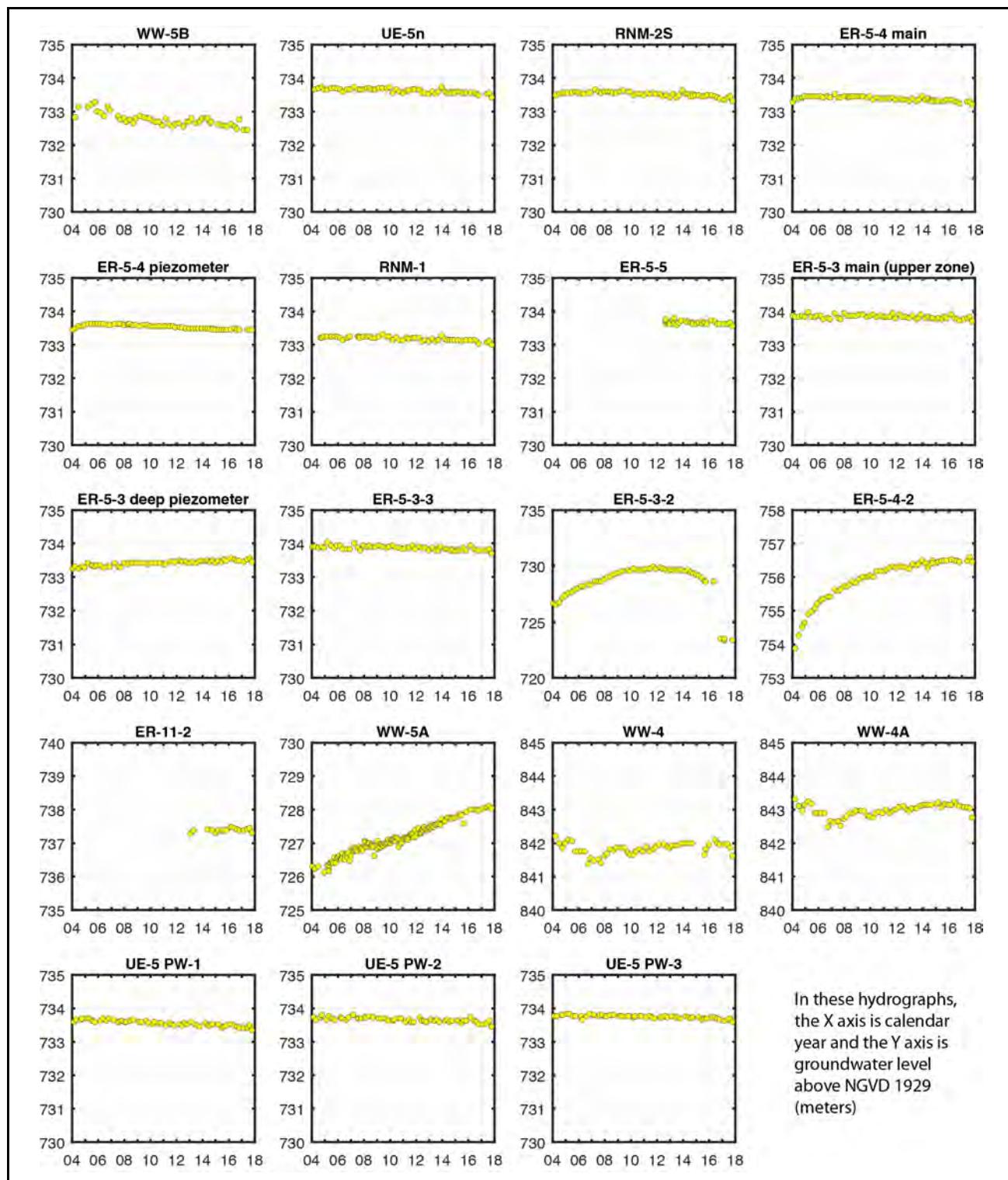


Figure 4-5
Hydrographs of Groundwater Levels That Are Considered To Represent Static Conditions

Note: Water levels indicated by USGS (2019) as being affected by pumping, well construction, or other factors, are considered non-static and are not included in these hydrographs.

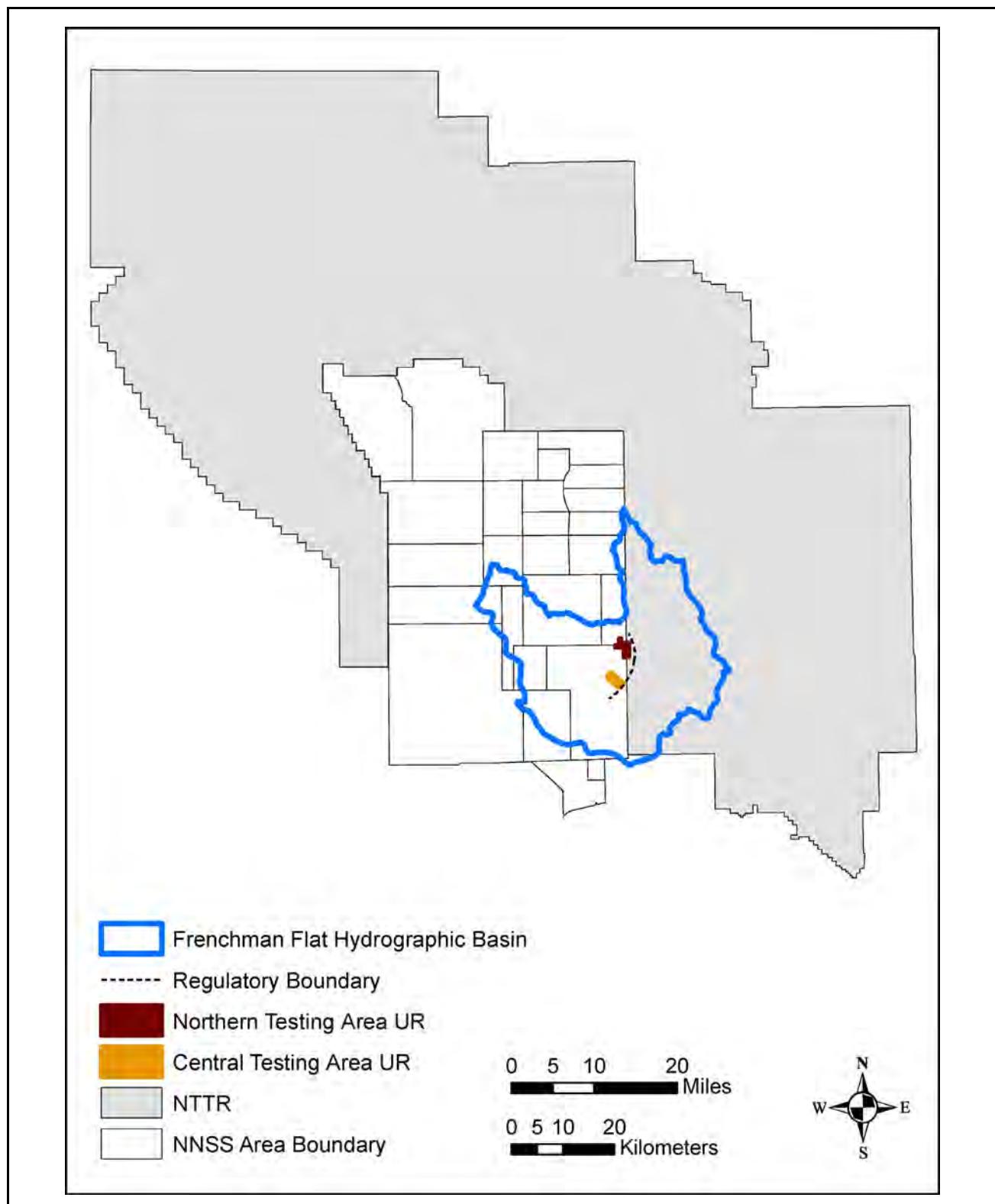


Figure 4-6
URs for CAU 98 in Relation to the NNSS, NTTR, and the Frenchman Flat Hydrographic Basin Boundary

The institutional controls established through the CR (NNSA/NFO, 2016a and b) are restrictions that apply within the UR areas and upgradient of the regulatory boundary negotiated between EM Nevada Program and NDEP. Two UR areas were identified: one for the Northern Testing Area and one for the Central Testing Area. The perimeter of each UR area encompasses all of the CBs within that area (Figure 4-6). Because the UR areas are within the NNSS and the NTTR boundaries, and because the restrictions apply to groundwater that is more than 500 ft bgs, the URs do not require onsite postings or physical barriers.

The following restrictions apply to activities within the UR areas:

1. **Land-use and real property controls, notifications, and restrictions:** All subsurface activities—including drilling, pumping, and testing of wells—must be communicated to the EM Nevada Program UGTA Federal Activity Lead before field activities begin. These controls are administered through NFO orders establishing requirements for use of and operations on the NNSS. The current order, NFO Order 410.X1, describes the screening and siting process and Real Estate/Operations Permit (REOP) processes (NNSA/NFO, 2013).
2. **Groundwater control:** Groundwater used for human consumption, irrigating crops, and any industrial use (such as dust control) must be preceded by laboratory analysis for COCs, and must meet SDWA standards (CFR, 2018). In addition, effects of pumping on contaminant migration will be evaluated to verify UR boundaries are protective.

The Frenchman Flat Central UR area is located completely within Area 5 of the NNSS. The Frenchman Flat Northern UR covers portions of Areas 5 and 11, as well as continuing eastward by about 430 m onto NTTR land.

The institutional controls are monitored by confirming the registration and visibility of the URs in land management systems operated by National Nuclear Security Administration Nevada Field Office (NNSA/NFO) M&O and USAF. The additional groundwater control of evaluating the effects of pumping on contaminant migration is monitored by considering changes and potential changes in groundwater use in the broader area around the UR areas.

4.6 Institutional Control Monitoring Results

The institutional controls in place to limit access to areas of potentially contaminated groundwater at CAU 98 include government ownership, access control, federal oversight, and a State of Nevada water-use application process. These controls are monitored annually to verify performance.

The NNSS and NTTR remain federally controlled, secure sites. Both sites retain access control through active and passive means, prohibiting entry except for approved personnel for approved purposes. NNSA/NFO and the EM Nevada Program continue to manage federal oversight of activities on the NNSS. USAF continues oversight of activities on the NTTR. The Nevada Department of Water Resources (NDWR) continues to maintain responsibility for managing water use in the state.

4.6.1 UR Verification

The URs must be verified annually. The initial registration of the UR boundaries in the M&O Geographic Information Systems (GIS) was confirmed by letter from Morris to Dinsman dated September 22, 2016 (Morris, 2016a), and amended October 18, 2016 (Morris, 2016b). It is additionally documented in a UR report, recording the addition of the restriction information to the GIS (see [Appendix C](#)). The continued registration and visibility of the URs in the land management system operated by EM Nevada Program was confirmed on January 29, 2019, by viewing the Subsurface URs within the Integrated Planning Map maintained by the M&O contractor. The two UR areas were observed, with accompanying descriptions and links to original documentation.

The initial USAF registry of the URs was asserted by letter from Kan to Dinsman dated January 25, 2017 (Kan, 2017). The continued presence of the restrictions was confirmed by email from the USAF (Kan, 2019).

In addition, the following three items require annual documentation:

1. Have there been encroachments due to drilling or new uses for the groundwater within and adjacent to the UR boundary that could conceivably impact the CB or be a potential threat to human health or the environment within one year of the inspection?

Verification: NDWR did not grant any new applications for water use in the Frenchman Flat basin (Basin 160) during 2018. No REOPs were submitted during 2018 that included drilling, excavating, or impacting the subsurface at a depth of 50 ft or greater below the surface of the Frenchman Flat hydrographic basin (question 9I of the REOP risk hazard questionnaire). There were also no activities included within REOPs that included a requirement for an increase in use of groundwater resources, whether from an existing well or installation of a new well, within Frenchman Flat (REOP risk hazard questionnaire question 9H). Water usage associated with operations and construction at the Area 5

RWMC returned to a typical level in 2018, after an increase in water use during the 2017 construction of a new disposal cell (Ortego, 2019).

USAF has drilled no wells nor has plans to drill wells in the Frenchman Flat basin, and has no facilities or activities on the planning horizon that would increase groundwater use in the area (Kan, 2019).

- Are there any changes to or new REOPs that affect the UR?

Verification: Two new primary REOPs and two new secondary REOPs were established within Area 5 of Frenchman Flat during 2018. Two primary REOPs and one secondary REOP were retired during the year. There are currently a total of 24 primary REOPs in Area 5 (and subset Area 5A, which comprises the RWMC) and 17 secondary REOPs (see [Table 4-5](#) and [Appendix C](#)). These were inspected in the Facility Data Warehouse on January 30, 2019. A larger number of REOPs underwent technical changes in 2018 as compared to the previous two years, presumably as the process of transitioning the REOPs from the previous to new M&O contractor offered an opportunity to update locations, activities, and identified risks. None of the activities associated with the new REOPs, nor changes to existing REOPs, have the potential to affect the URs or substantively increase groundwater use in the area.

Table 4-5
REOP Activity for Area 5 ^a

	2018	2017	2016 ^b
Total Primary REOPs	24	24	22
New	2	4	NA
Retired	2	2	NA
Total Secondary REOPs	17	16	18
New	2	4	NA
Retired	1	6	NA

^a Includes subset Area 5A, which comprises the RWMC.

^b 2016 is the baseline year.

NA = Not available

- Do monitoring data suggest that the URs should be modified?

Verification: Monitoring data do not suggest any need to modify the URs.

4.6.2 Identification of New Land Use Impacts

Processes are in place to ensure that the Frenchman Flat URs prohibit drilling in the region of possible groundwater contamination. The REOP process for the NNSS screens activities for potential conflict with URs; and there are specific questions pertaining to groundwater use and drilling within the REOP risk hazard questionnaire. Construction activities on the NTTR require a USAF Form 813, which triggers an environmental impact review and leads to consultation with the GIS database housing the URs.

As recognized in the CR (NNSA/NFO, 2016b), activities outside the URs have the potential to affect groundwater flow that could alter the CB forecasts. Although the groundwater-level monitoring is a direct sentinel of any such impact on CAU 98, it is paired with monitoring of regional groundwater extraction activities, as described below. This allows for early identification of the potential for system changes so that response actions, such as increased monitoring, can be initiated.

The closest wells to CAU 98 that are used for water supply are those operated by NNSA/NFO for NNSS activities. Pumping data are reported by the M&O contractor and are available through USGS (USGS and DOE, 2019). In the Frenchman Flat area, six wells have produced water from the alluvium, two from volcanic units, and three from the LCA ([Figure 4-7](#); SNJV, 2004). During 2018, three of these wells were in production (WW-4, WW-4A, and WW-5B), with minor water withdrawals from another (WW-5C pumped 38,400 gallons [gal] in 2018). The production from each of the three current major production wells is presented in the context of its production history in [Figure 4-8](#). WW-4 and WW-4A pump groundwater from volcanic units and are in the CP sub-basin, separated from the underground testing areas in Frenchman Flat by a hydrologic barrier associated with the Cane Spring fault. In combination, pumping from the two wells slightly decreased (about 1 percent) in 2018 as compared to 2017, after the significant 2017 increase associated with construction at the Area 5 RWMC.

Pumping from the alluvial aquifer in the main Frenchman Flat basin is of most importance for the CBs. The production from WW-5B (completed in alluvium) in 2018 totaled 43.3 million gal, a decline of approximately 10 percent from 2017 withdrawals. Compared to pumping recorded since 1951 ([Figure 4-9](#)), current pumping of groundwater from alluvium in Frenchman Flat is much less

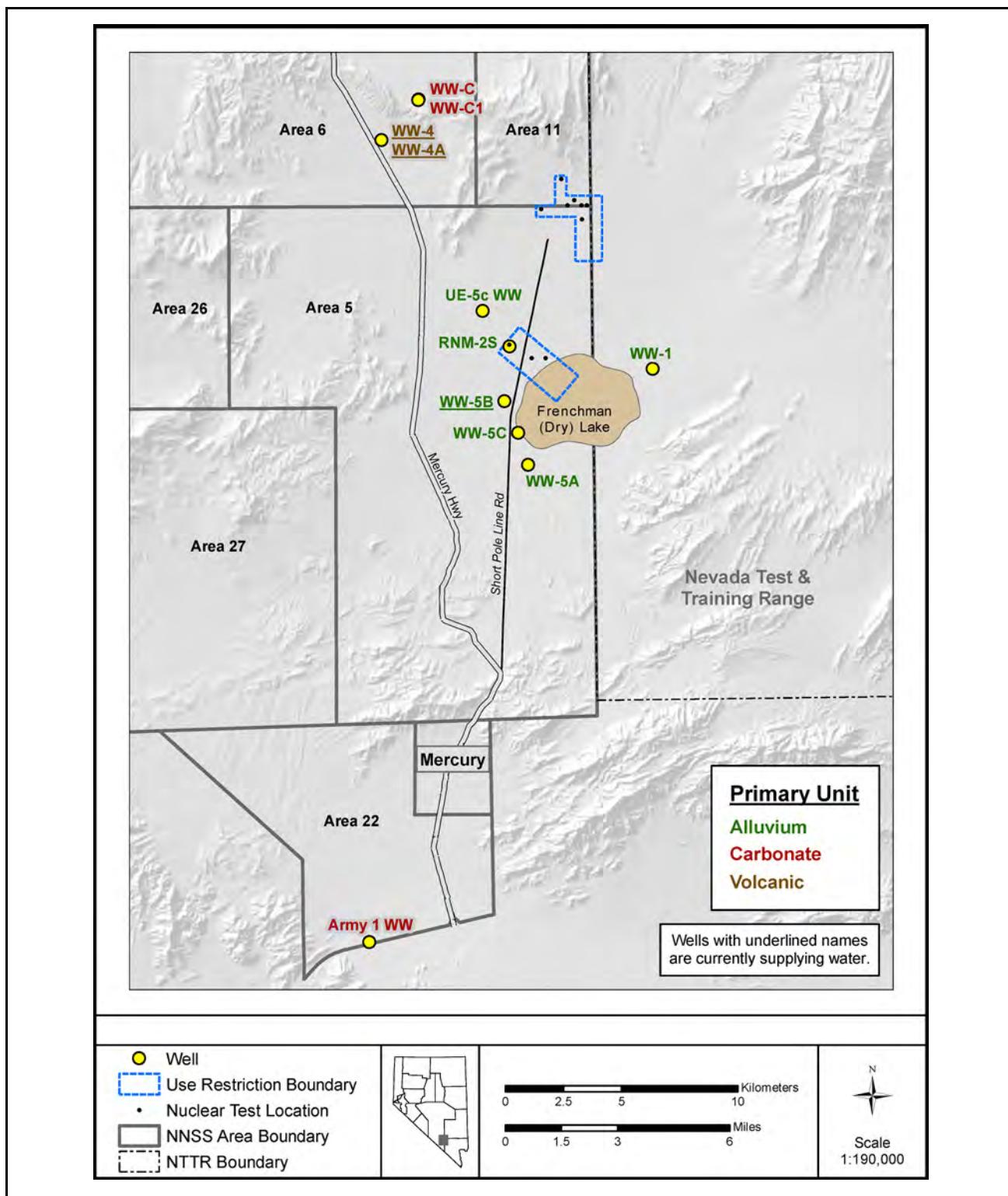


Figure 4-7
Past and Present Groundwater Production Wells in the Frenchman Flat Area

Note: Well RNM-2S was pumped for a radionuclide migration experiment, whereas the others were used for supply.

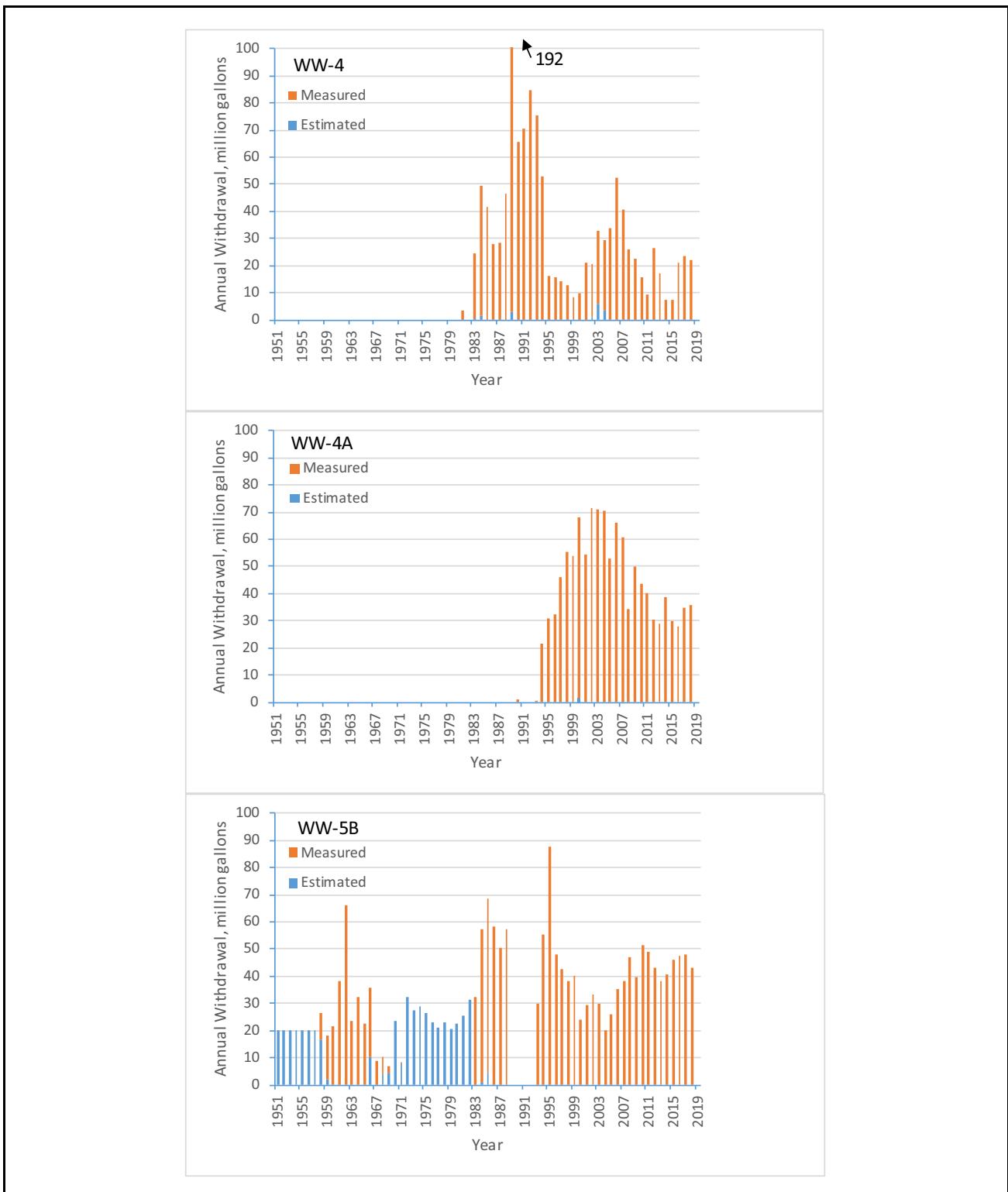


Figure 4-8
Annual Water Production from Wells WW-4, WW-4A, and WW-5B

Note: Data are provisional and from USGS (USGS and DOE, 2019).

than it was during the peak between 1977 and 1991, when RNM-2S was in production for the radionuclide migration experiment (USGS and DOE, 2019).

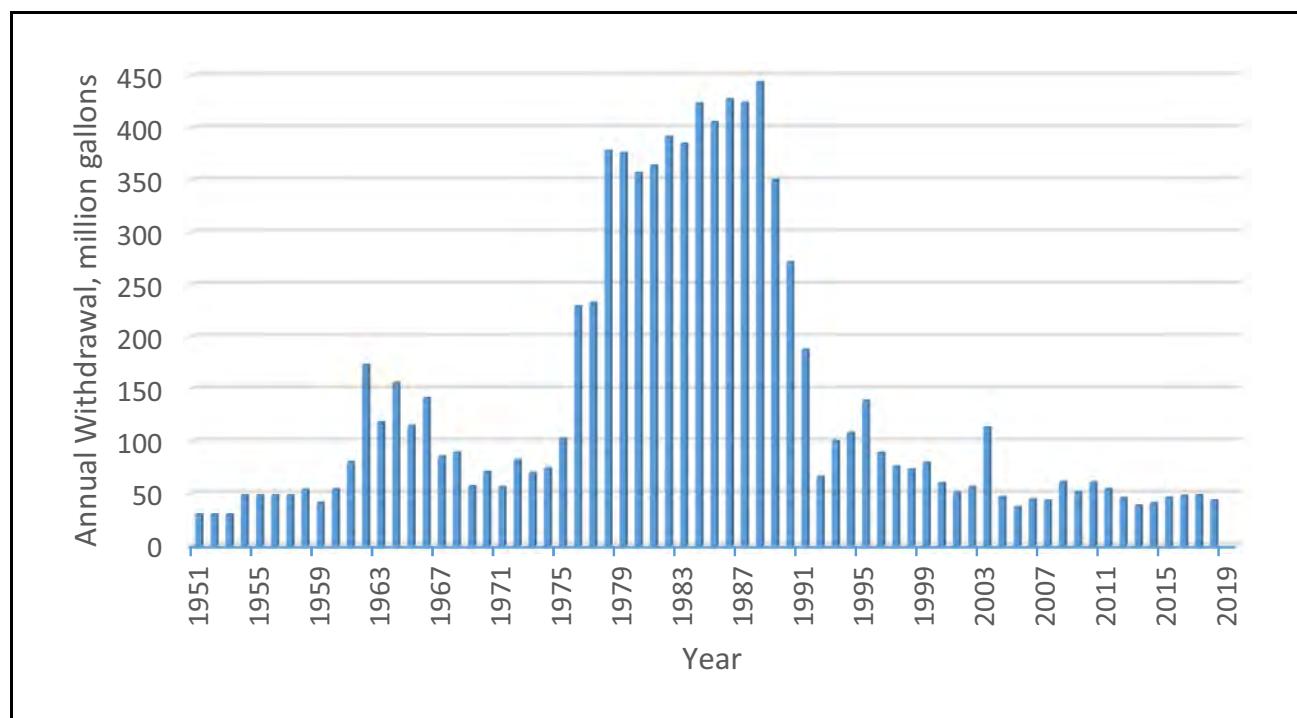


Figure 4-9
Total Annual Withdrawals for Wells Completed in the Alluvial Aquifer of Frenchman Flat

Note: The wells included are WW-1, WW-5A, WW-5B, WW-5C, UE-5C WW, and RNM-2S. Data are provisional and from USGS (USGS and DOE, 2019).

Regionally, groundwater usage is monitored through data reported by NDWR. Actual usage is reported for the two most actively pumped basins in the region: Indian Springs Valley (Basin 161) and the Amargosa Desert (Basin 230) (Figure 4-10). Pumpage by USAF is included in the Indian Springs Valley data. “Active annual duty” is recorded for all basins and represents the amount of groundwater that can potentially be used, as represented by permits and other legal means. Although the active annual duty does not necessarily coincide with actual groundwater use, changes in the active annual duty reflect interest in a basin’s groundwater resources.

The active annual duty for the Frenchman Flat hydrographic basin and eight nearby basins is evaluated each year. A summary of the active annual duty for the eight nearby basins and the actual groundwater use for Basins 161 and 230 is shown in Table 4-6, with the geographic

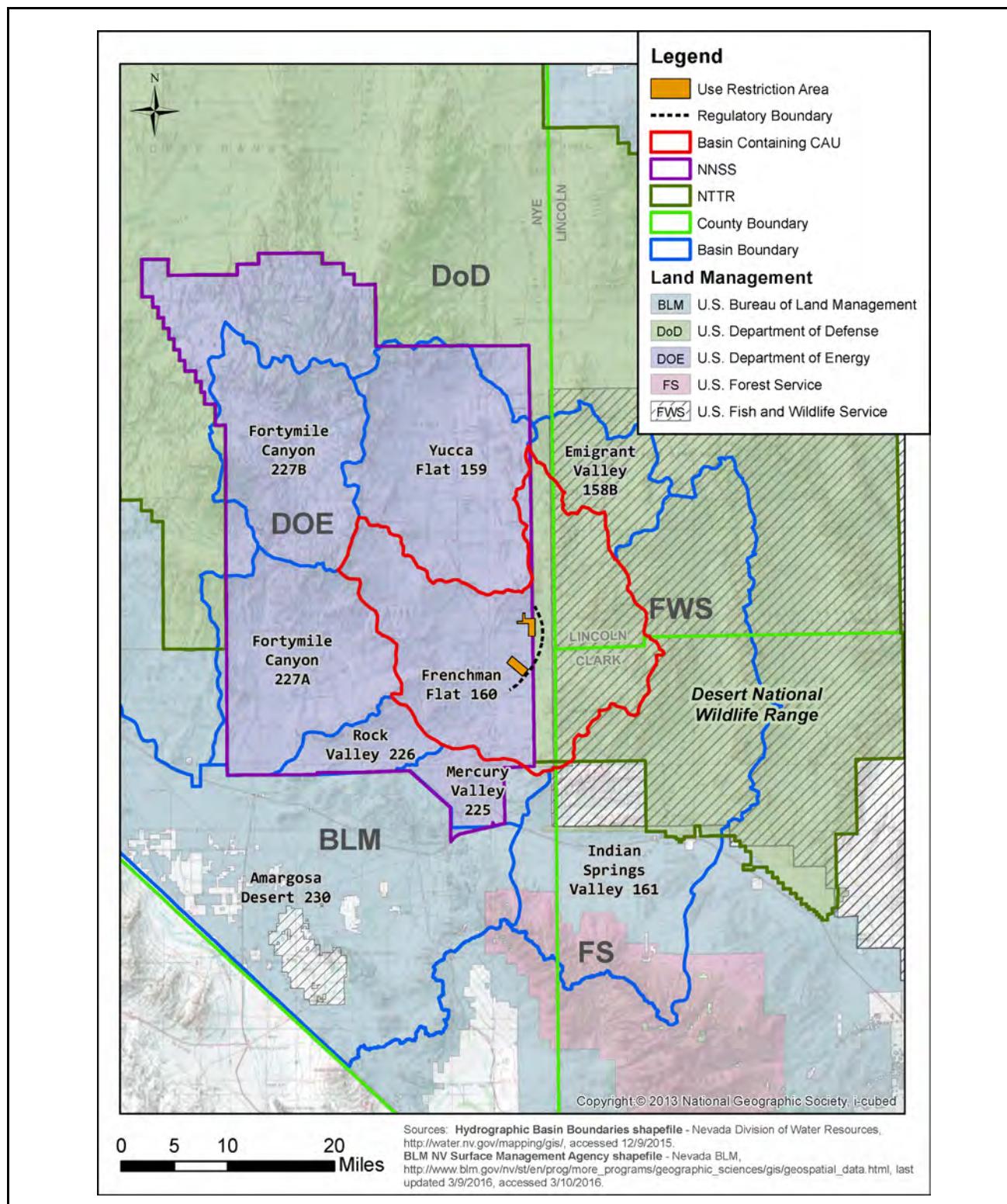


Figure 4-10
Hydrographic Basin Locations, Names, and Numbers in the Vicinity of Frenchman Flat

relationship of the basins shown in [Figure 4-10](#). New permit applications in 2018 occurred in Basins 161 and 230. Basin 161, Indian Springs Valley, received two permit applications in 2018. One of these is ready for action, and the other was permitted during the year. The permitted duty is 13.43 ac-ft/yr, and the pending application is for 4 ac-ft/yr. Basin 230, Amargosa Desert, had 16 applications filed in 2018 for underground water sources. Two of these were permitted during the year for a total of 417.24 ac-ft/yr. Another 10 are ready for action, and one is in the initial application process, together for a total of 1,269.94 ac-ft/yr. Three applications were withdrawn ([Table 4-7](#)).

Direct queries were made in July 2018 and January 2019 to the NDWR specialists responsible for the basins of interest to inquire whether they are aware of any upcoming large-scale projects or other changes that could involve significant increases or decreases in groundwater pumping in the region, but that have not yet reached the application phase (Sullivan, 2018 and 2019, Appendix C). The answer was negative for the reporting periods. NDWR previously noted the lack of timetable for pending applications by the Southern Nevada Water Authority in Basin 161, Indian Springs Valley (and in adjoining Basin 211, Three Lakes Valley).

Table 4-6
Active Annual Duty in 2018 and Actual Groundwater Pumpage in 2017 for
Hydrographic Basins near Frenchman Flat

Basin	2018 Active Annual Duty (acre-ft/yr)	2017 Groundwater Pumpage Inventory (acre-ft/yr)
158B - Emigrant Valley	0.00	NA
159 - Yucca Flat	0.00	NA
160 - Frenchman Flat	0.00	NA
161 - Indian Springs Valley	1,389.97	619
225 - Mercury Valley	0.00	NA
226 - Rock Valley	0.00	NA
227A - Fortymile Canyon (South)	17.22	NA
227B - Fortymile Canyon (North)	0.00	NA
230 - Amargosa Desert	27,286.48	16,920
Total	28,693.67	17,539

Source: NDWR, 2019a and b

acre-ft/yr = Acre-foot per year

Table 4-7
Applications to NDWR for Permits for Underground Water

	Basin 230			Basin 161		
	2018	2017	2016	2018	2017	2016
Permit Applications	16	5	16	2	0	0
Ready for Action	10	3	11	1	0	0
Permitted	2	0	4	1	0	0
Denied, Withdrawn, or Canceled	3	2	1	0	0	0
Application Stage	1	0	0	0	0	0
Prior Applications Permitted	8	4	3	0	0	0

5.0 Site Inspection and Verification of Well Functionality and Effectiveness

The 16 wells in the post-closure water-level monitoring network are inspected quarterly, coincident with the water-level measurement process. This inspection verifies that the well is locked and properly marked; the survey point is marked and undamaged; the well pad is clear and in good condition; and the area around the well pad is not damaged or eroded. Any damage to the well or pad is noted. In 2018, these quarterly inspections were performed by USGS and recorded on their field form USGS-WL-COLLECT-frm-01, Rev. No. 5. A summary of those inspections is included in [Appendix D](#). No adverse conditions were noted for the 16 well locations in 2018 (see [Appendix D](#)).

The same inspection items discussed above are checked before groundwater sampling of the six wells used for water-quality monitoring. Additionally, the conditions of the wells, sumps, discharge areas, and areas surrounding the wells are inspected for damage before groundwater sampling and are assessed to determine whether the infiltration area remains viable, whether any new roads or facilities have been constructed, and whether there have been changes to the drainage pattern or area. Navarro conducted the presampling inspections in 2018 and found no adverse conditions.

6.0 Summary

The regulatory closure of CAU 98 requires annual monitoring for the first five years. This report presents the results of monitoring conducted for water quality, water levels, and institutional controls in CY 2018. COCs of significant levels were identified only in source/plume wells located within known areas of contamination. Water-level measurements in 2018 were generally consistent with previous measurements in the monitoring wells, with a long-term trend of water-level decline in most of the monitoring wells; rising water levels in three wells (ER-5-3 deep piezometer, ER-5-4-2, and WW-5A); variable water levels in the producing supply wells (WW-4, WW-4A, and WW-5B); and a continued unexplained lowered water level in ER-5-3-2.

The URs were verified as being in place to limit activities near the underground tests. NNSA/NFO, EM Nevada Program, and NTTR managers report no activities during 2018 or activities on the planning horizon that would significantly impact withdrawal of groundwater within Frenchman Flat. Regionally, water-rights records indicate no large increases in groundwater use in basins adjoining Frenchman Flat, and NDWR personnel report no knowledge of pending activities that have yet to reach the formal application stage.

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U.S. Geological Survey and U.S. Department of Energy. 2019. “USGS/U.S. Department of Energy Cooperative Studies in Nevada” web page. As accessed at http://nevada.usgs.gov/doe_nv in February 2019.

Appendix A

2018 Additional Water-Sample Analytical Data

A.1.0 Additional Water-Sample Analytical Data

The CR (NNSA/NFO, 2016) identified some of the water-quality monitoring wells in Frenchman Flat as characterization locations (Table 4-1), meaning they require baseline geochemical conditions to be established by a minimum of three sample sets. One well, ER-5-3_p2, remains in this category, and samples from the well in 2018 were subject to a more extensive suite of analyses than required for radiological monitoring. These additional analytes are used for system characterization, model evaluation, and baseline determination. The analytical suite is reduced for samples collected using a bailer, as was the case for sampling at Well ER-5-3_p2. These analyses are performed by a commercial laboratory that is certified by the NDEP Bureau of Safe Drinking Water, and the results for these analyses are presented in Table A-1.

Table A-1
Additional Commercial Laboratory Analytical Results for 2018 Water Samples
(Page 1 of 2)

Well	ER-5-3_p2
Sample Date	01/31/2018
Sample Number	201-013118-1 ^a
Water Properties	
pH (SU)	J- 7.6
Specific Conductance (μ S/cm)	380
Major and Minor Constituents (mg/L)	
Alkalinity as CaCO_3	160
CO_3	<12
HCO_3	195.04
Br	0.3
Cl	J 17
F	1.3
SO_4	5
Ca	13
K	8.3
Mg	2.9
Na	53
Al	<0.015
Fe	2.2
SiO_2	21.39

Table A-1
Additional Commercial Laboratory Analytical Results for 2018 Water Samples
(Page 2 of 2)

Well	ER-5-3_p2
Sample Date	01/31/2018
Sample Number	201-013118-1 ^a
Trace Constituents (µg/L)	
Ag	<1.1
As	J 9.7
Ba	J 9.5
Cd	<0.33
Cr	<0.51
Li	J 23
Mn	290
Pb	3.5
Se	11
Sr	55
²³⁸ U	0.15

^a This sample was collected using a bailer. The required analyte suite is therefore limited to alkalinity, anions, total metals, and ³H (NNSA/NFO, 2016, Table 4-2).

mg/kg = Milligrams per kilogram
SU = Standard unit

µg/L = Micrograms per liter
µS/cm = Microsiemens per centimeter

J = Result is estimated.
J- = Result is estimated and is biased low.

Table A-2 summarizes radioisotope sampling results for samples collected since inception of post-closure monitoring. Results for the radionuclides that contributed to the CBs (i.e., COCs) are presented.

Table A-2
Radioisotope Sampling Results from Inception of Post-closure Monitoring

Monitoring Location	Date	³ H	³ H Low Level	¹⁴ C	³⁶ Cl	⁹⁹ Tc	¹²⁹ I
ER-5-3_p2	06/07/2016	<360	<3.73	<420	--	--	--
	04/06/2017	--	<2.67	--	--	--	--
	01/31/2018	--	<2.91	--	--	--	--
ER-5-3-2	05/19/2016	<340	<3.71	J <400	<3.1	<7.4	<0.93
	03/14/2017	<247	<2.82	<334	<22.7	<8.48	<0.749
	01/30/2018	--	<3.14	--	--	--	--
	01/30/2018 ^a	--	<2.83	--	--	--	--
ER-5-5	05/16/2016	<350	<3.65	J <410	<2.8	<7	<0.76
	05/16/2016 ^a	<350	--	J <410	<2.6	<7.2	<0.75
	05/16/2016 ^b	<249	--	<166	<3.54	<5.93	<0.836
	03/08/2017	<246	<2.81	<334	<21.9	<8.27	<1.15
	03/08/2017 ^b	<248	<2.77	<335	<24.4	<9.07	<0.243
	01/24/2018	--	<2.66	--	--	--	--
	01/24/2018 ^a	--	<2.97	--	--	--	--
ER-11-2	04/19/2016	--	J 17.48	--	--	--	--
	06/29/2016	--	<2.99	--	--	--	--
	04/11/2017	--	<3.03	--	--	--	--
	04/11/2017 ^a	--	U 3.46	--	--	--	--
	02/05/2018	--	<3.06	--	--	--	--
	02/05/2018 ^a	--	<2.47	--	--	--	--
RNM-2S	05/10/2016	76,000	--	J <400	<3.3	<6.9	<0.69
	05/10/2016 ^a	75,000	--	J <410	<3.2	<6.8	<0.69
	03/06/2017	86,000	--	<410	<3.6	<7.8	<0.74
	03/06/2017 ^a	85,000	--	<400	<2.9	<8	<0.71
	01/22/2018	82,000	--	<380	<3.2	<7.3	<0.81
	01/22/2018 ^a	80,000	--	U 380	<2.9	<7.7	<0.86
UE-5n	05/05/2016	135,000	--	J <420	<2.6	<7	<0.73
	03/01/2017	132,000	--	<400	<2.8	<7.4	<0.69
	01/18/2018	123,000	--	<380	<2.7	<7.5	<0.82

^a Duplicate sample

^b Regular sample analyzed by a different laboratory

J = Result is estimated.

U = Result was above the MDL but below the MDL plus error.

-- = Not analyzed

A.2.0 References

NNSA/NFO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2016. *Underground Test Area (UGTA) Closure Report for Corrective Action Unit 98: Frenchman Flat Nevada National Security Site, Nevada*, Rev. 1, DOE/NV--1538-Rev. 1. Las Vegas, NV.

Appendix B

Hydrographs

B.1.0 Hydrographs

The following plots (Figures B-1 through B-6) show hydrographs from the testing areas in Frenchman Flat to illustrate relationships between water levels within these areas. The plots include water levels flagged by the USGS as “Site was being pumped,” “Site had been pumped recently,” and “Other conditions existed that would affect the measured water level (explain in remarks)” as identified in the NWIS by status codes P, R, and Z, respectively. Note that the NWIS does not include a remarks field for these wells.

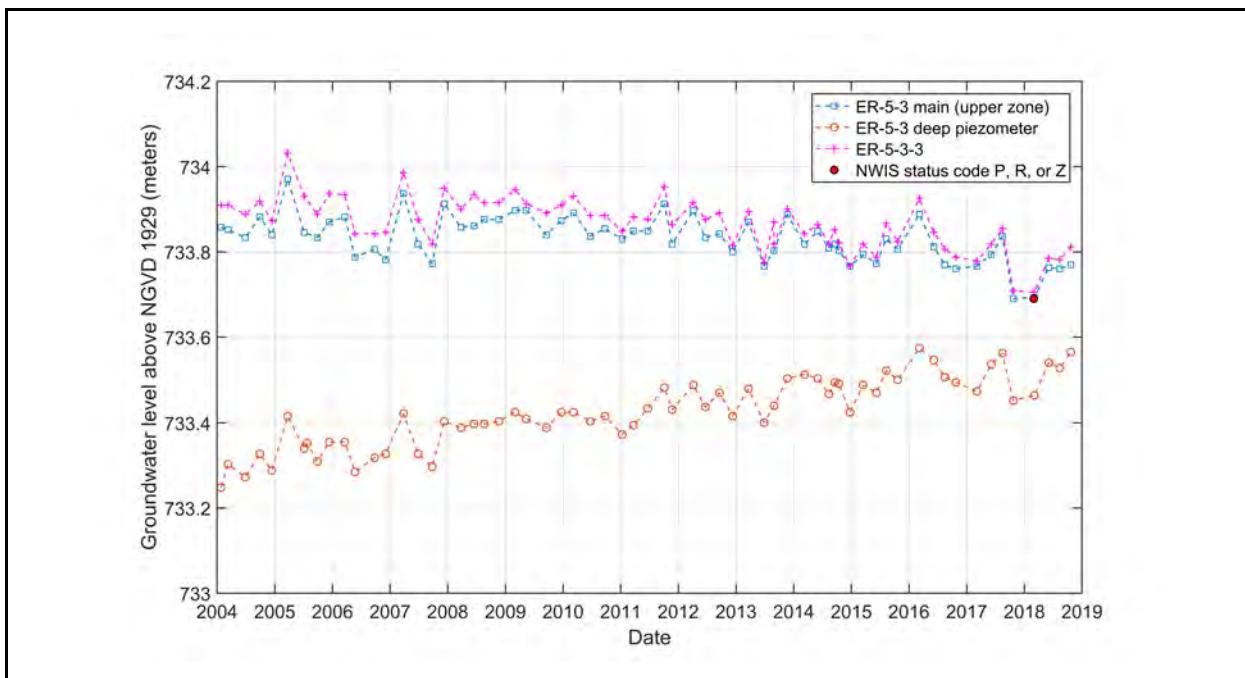


Figure B-1
Water Levels in Northern Testing Area Wells ER-5-3 main (upper zone),
ER-5-3 Deep Piezometer, and ER-5-3-3

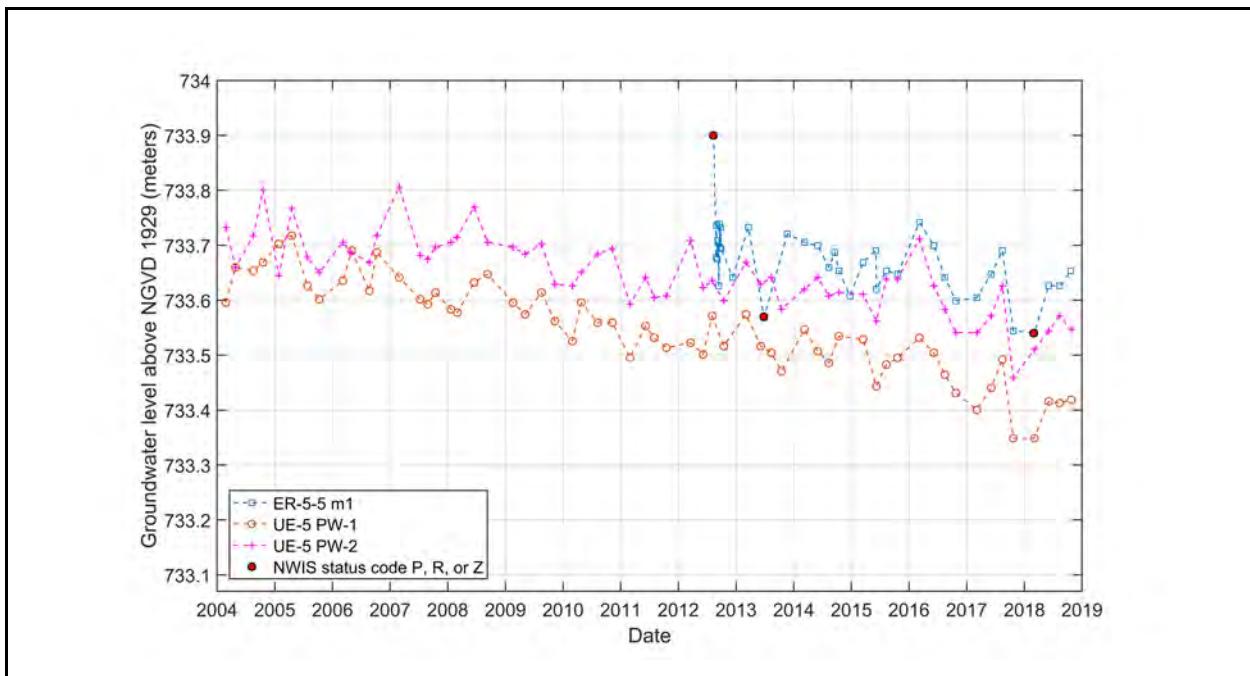


Figure B-2
Water Levels in Northern Frenchman Flat Wells ER-5-5, UE-5 PW-1, and UE-5 PW-2

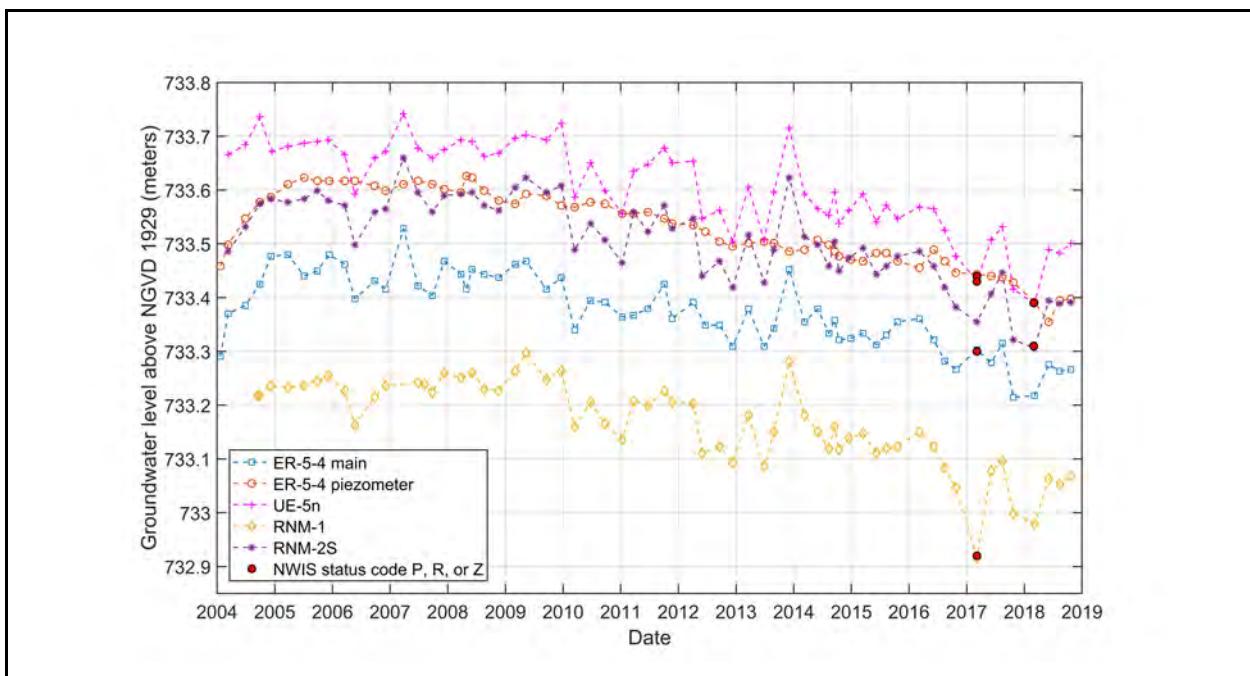


Figure B-3
Water Levels in Central Testing Area Wells ER-5-4 main, ER-5-4 piezometer, UE-5n, RNM-1, and RNM-2S

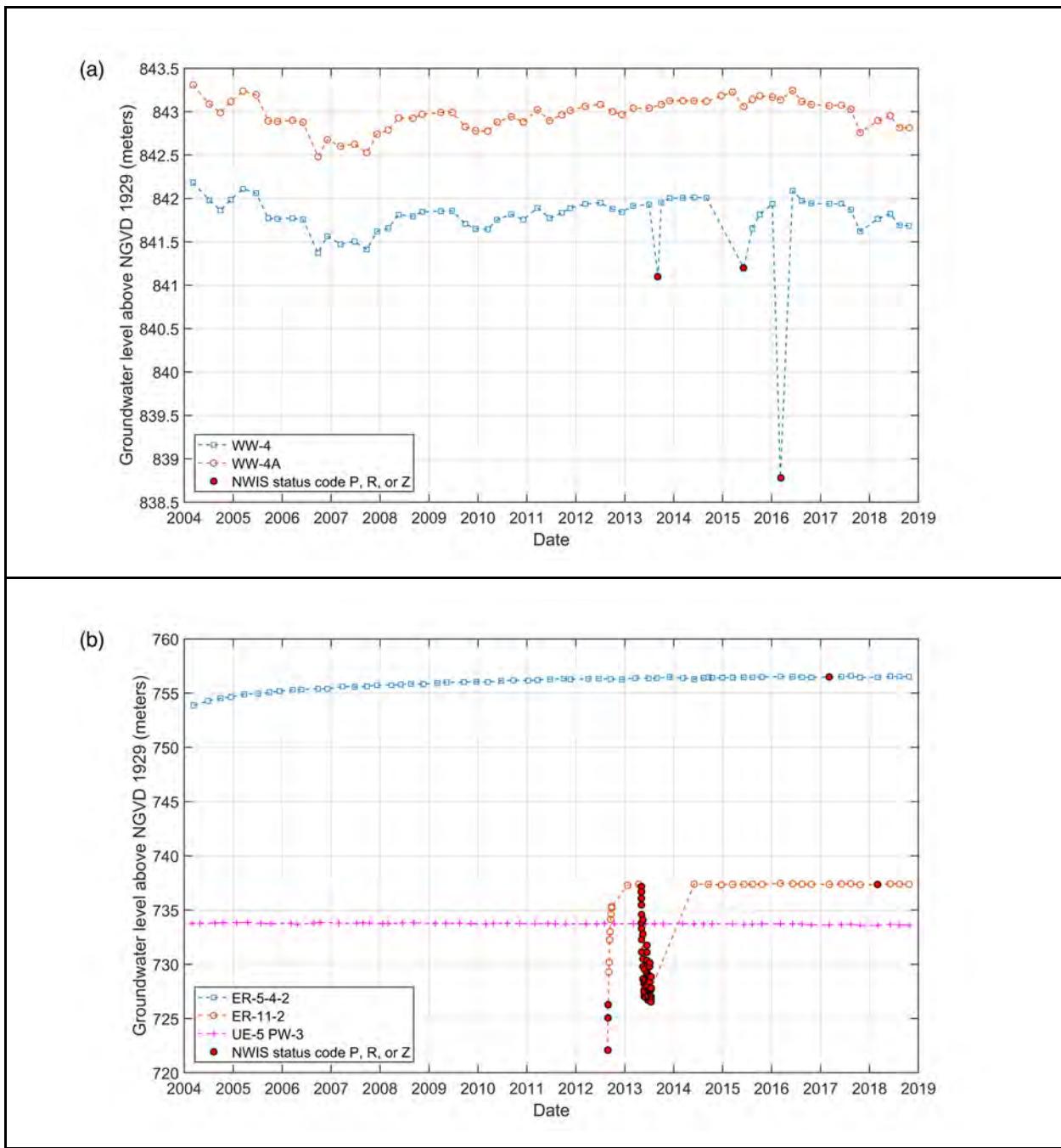


Figure B-4
Water Levels in Wells in the Volcanic Aquifer in Frenchman Flat (a) Northwestern Area (WW-4 and WW-4A), and (b) Central Area (ER-5-4-2) and Northern Area (ER-11-2 and UE-5 PW-3)

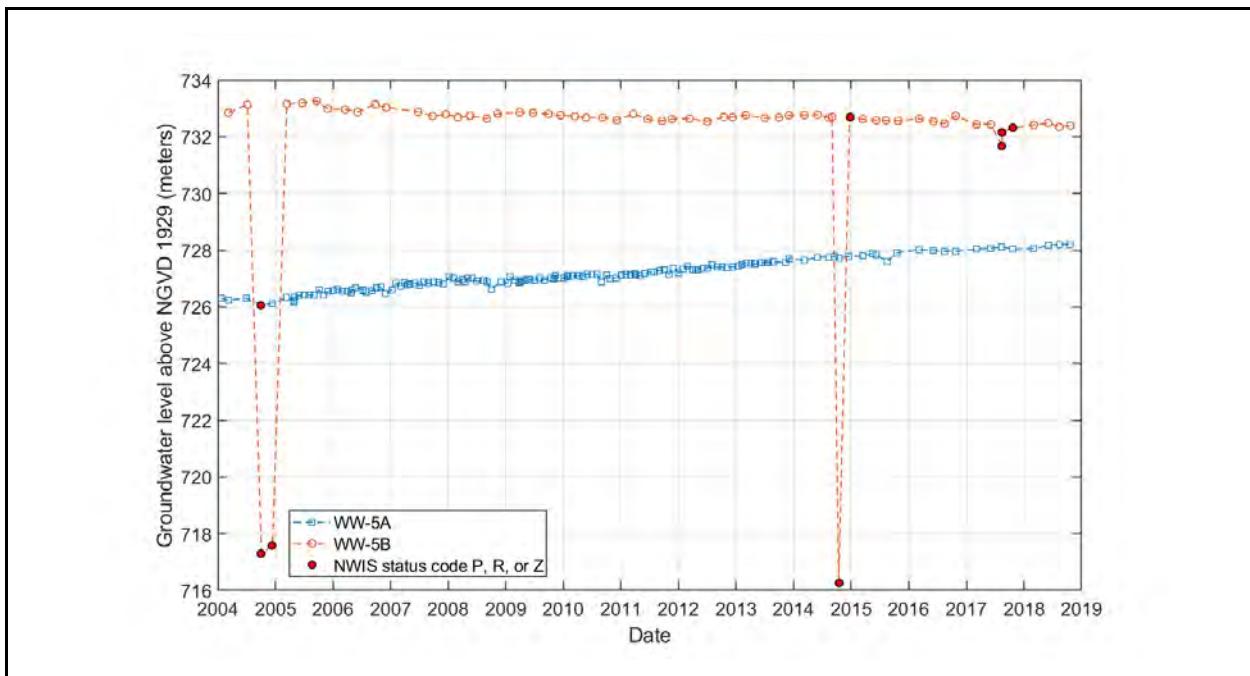


Figure B-5
Water Levels at Pumping Wells in the Alluvial Aquifer (WW-5A and WW-5B)

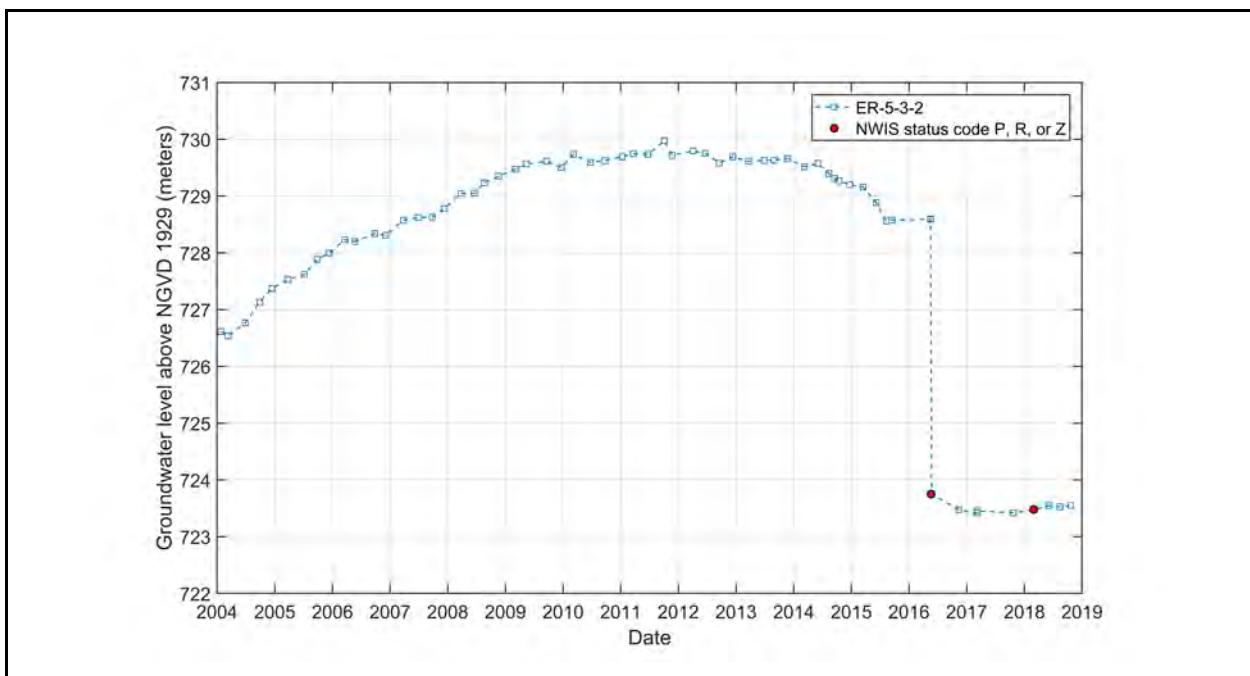


Figure B-6
Water Levels in ER-5-3-2 in the Carbonate Aquifer

Appendix C

UR and Institutional Control Information

C.1.0 UR and Institutional Control Information

Correspondence and information regarding the URs and institutional controls in place for CAU 98 are included in [Attachment C-1](#) for ready reference. The contents are as follows:

- Email from Kan to Chapman, dated January 16, 2019, describing USAF land control processes and activities pertinent to CAU 98
- Email from Ortego to Chapman, dated January 24, 2019, describing water withdrawal activities and responses to REOP Risk and Hazard Questionnaire questions 9h and 9i
- Emails from Sullivan to Collins, dated July 6, 2018 and January 29, 2019, responding to the question of whether or not the Nevada Division of Water Resources is aware of any upcoming large-scale projects or other changes that could involve significant increases/decreases in groundwater pumping activity in the region that have not yet reached the application phase
- List of REOPs (provided by email from Stringfellow to Chapman, dated January 23, 2019)
- UR Report from the NNSA/NFO M&O contractor's GIS system

Attachment C-1

UR and Institutional Control Information

(19 Pages)

From: KAN, MICHAEL K Maj USAF ACC NTTR/SE
To: [Jenny Chapman](#)
Cc: Robert.Boehlecke@emcbc.doe.gov; Bill.Wilborn@emcbc.doe.gov; [JENSEN, JAMES P GS-12 USAF ACC NTTR/XP](#); [CHRISTENSEN, ROGER D GS-12 USAF ACC NTTR/XP](#)
Subject: RE: Confirmation of FFACO use restrictions and groundwater conditions at CAU 98 Frenchman Flat
Date: Wednesday, January 16, 2019 11:22:06 AM

Ms. Chapman,

I just confirmed last year's responses with Mr. Christensen and they are still valid. See below for responses to request for information:

1. Either a verification report from the USAF GIS land management system indicating that the use restrictions for CAU 98 remain in the system, or your assertion of their presence in the system.
 - Per our GIS technicians, the following text describing land use restrictions: "Land-use/real property controls, notifications, and restrictions: All subsurface activities, including drilling, pumping, and testing of wells shall be communicated to the NNSA/NFQ UGTA Federal Activity Lead before field activities begin. These controls are administered through NNSA/NFO orders establishing requirements for use of and operations on the Nevada National Security Site (NNSS). The current order, NFO order 410.X1, describes the screening and siting process and Real Estate/Operations Permit (REOP) processes (NNSA/NSO, 2013 and 2009a). Groundwater control: Groundwater used for human consumption, irrigating crops and any industrial use (such as dust control) must be preceded by laboratory analysis for contaminants of concern (COCs) and must meet the Safe Drinking Water Act (SWDA) standards (CFR, 2015b). In addition, effects of pumping on contaminant migration will be evaluated to verify UR boundaries are protective."
2. During 2017, have any new water wells been drilled or are in the planning stages for Frenchman Flat? If so, please provide information regarding location, depth, and planned water production.
 - Per Roger Christensen, no new wells were drilled nor are planning on being drilled in Frenchman Flat
3. Are there any USAF activities or facilities proposed that could cause an increase in groundwater usage in the Frenchman Flat region ("region" being the Frenchman Flat, southern Emigrant Valley and Indian Springs Valley hydrographic basins)?
 - Per Roger Christensen, there are no plans for developments in the Frenchman Flat region that are expected to cause an increase in groundwater usage.

Please let me know if you have any questions.

Mike Kan, Maj, USAF, BSC
Range Radiation Safety Engineer
Nevada Test and Training Range (NTTR), Safety Directorate
Nellis Air Force Base
DSN: 312-348-5485

Comm: 702-653-5485

From: Jenny Chapman <Jenny.Chapman@dri.edu>
Sent: Tuesday, January 15, 2019 2:22 PM
To: KAN, MICHAEL K Maj USAF ACC NTTR/SE <michael.kan@us.af.mil>
Cc: Robert.Boehlecke@emcbc.doe.gov; Bill.Wilborn@emcbc.doe.gov
Subject: [Non-DoD Source] Confirmation of FFACO use restrictions and groundwater conditions at CAU 98 Frenchman Flat

Major Kan,

Attached please find a digital copy of a letter requesting information needed for the 2018 annual closure monitoring report for CAU 98, Frenchman Flat Underground Test Area. Thank you for your help, and for your assistance in the previous years.

Please let me know if there are any questions. Thanks, Jenny Chapman

Jenny Chapman
Program Manager for DOE/NNSA Nevada Field Office Contract Research Hydrogeologist
Division of Hydrologic Sciences Desert Research Institute
755 East Flamingo Road, Las Vegas, NV 89119 Phone: 702-862-5459
Fax: 702-862-5427
E-mail: jenny.chapman@dri.edu

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From: Ortego, Paul (CONTR)
To: [Jenny Chapman](#)
Subject: RE: [EXTERNAL] REOP risk hazard questions 9h and 9i regarding Frenchman Flat
Date: Thursday, January 24, 2019 9:15:35 AM

Hi Jenny,

I did review the answers to questions 9h and 9i to the REOP risk hazard questionnaire during CY 2018, both positive and negative. There were no positive answers in the Frenchman Flat hydrographic basin. Water usage associated with operations and construction at the Area 5 RWMC is considered typical during CY 2018.

Thus, there was nothing in the area during CY 2018 that would have any impact on the use restrictions.

Please call or email if you have any questions. Ken

From: Jenny Chapman <Jenny.Chapman@dri.edu>
Sent: Tuesday, January 15, 2019 2:41 PM
To: Ortego, Paul (CONTR) <ORTEGOPK@nv.doe.gov>
Subject: [EXTERNAL] REOP risk hazard questions 9h and 9i regarding Frenchman Flat Hi Ken,

You might recall participating in the Frenchman Flat Post-Closure Monitoring last year by providing information regarding planned and actual water use in the Frenchman Flat hydrographic basin. The monitoring is reported annually, so this request is the same as last year. It assumes that you remain the Subject Matter Expert reviewing positive answers to questions 9h and 9i on the REOP risk hazard questionnaire. These are the questions pertinent to groundwater extraction:

9H

Activities that will require an increase in use of groundwater resources, either through requiring additional volume from an existing well, or installation of a new water well.

9I

Activities that include drilling, excavating, or impacting the subsurface at a depth of 50 feet or greater below the surface. This includes any underground/tunnel activities.

Would you please respond to me as to whether or not any REOPs were reviewed in 2018 that indicated a possible increase in groundwater use or drilling that would affect the Frenchman Flat area in general (this would include activities elsewhere that might increase use of the water wells 4, 4A, and 5B)? We need to demonstrate cognizance of activities, so please respond with anything occurring in the area, whether or not you believe it could impact the use restrictions themselves.

Your email response will serve as documentation of the use restriction monitoring. Please give me a call if you have any questions. Thanks, Jenny

Jenny Chapman
Program Manager for DOE/NNSA Nevada Field Office Contract Research Hydrogeologist
Division of Hydrologic Sciences Desert Research Institute
755 East Flamingo Road, Las Vegas, NV 89119 Phone: 702-862-5459
Fax: 702-862-5427
E-mail: jenny.chapman@dri.edu

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From: [Adam Sullivan](#)
To: [Cheryl Collins](#); [Daniel Randles](#)
Subject: RE: Changes to groundwater pumping? - Frenchman Flat
Date: Friday, July 6, 2018 8:00:24 AM

Cheryl,

We are not aware of any large-scale projects planned within this area that would significantly increase or decrease groundwater pumping.

Adam

Adam Sullivan, P.E.

Deputy State Engineer
Nevada Division of Water Resources
901 South Stewart Street, Suite 2002
Carson City, NV 89701
(775) 684-2867

From: Cheryl Collins <Cheryl.Collins@dri.edu>
Sent: Thursday, July 05, 2018 12:25 PM
To: Adam Sullivan <asullivan@water.nv.gov>; Daniel Randles <drandles@water.nv.gov>
Subject: Changes to groundwater pumping? - Frenchman Flat

Hi Adam,

On behalf of the U.S. Department of Energy Nevada Field Office, this is the semi-annual request for information regarding upcoming activities that could affect groundwater in the Frenchman Flat groundwater basin (Nevada hydrographic basin 160).

As a reminder, contaminants from nuclear testing are present in this basin, and a geographic contaminant boundary has been established in agreement with the Nevada Division of Environmental Protection, based on an extensive testing program. Should there be any significant changes to the current groundwater system, the boundary could be affected, and additional data collection and modeling may be necessary to evaluate potential boundary changes. Activities of significant magnitude to affect the groundwater system within Basin 160 are not expected, but the DOE is following this protocol to ensure its awareness of potential impacts.

In order to monitor groundwater usage in the area, we regularly carry out the following tasks:

- check information available on newly-filed applications on the <http://water.nv.gov/> web site and
- send this email to you to ask if you are aware of any upcoming large-scale projects or other changes that could involve significant increases/decreases in groundwater pumping activity in the region, but have not yet reached the application phase.

The nearest basins we believe are most likely to be locations of new activities are:

- 230 Amargosa Desert,
- 161 Indian Springs Valley, and
- 211 Three Lakes Valley.

In addition, significant changes to water pumping rates on the Nevada National Security Site or the Nevada Test and Training Range are also of interest. Please see the attached map for a visual representation of the region.

Thank you for your help with this program. If you have changes in staffing, please let us know who should receive this email. We would like to have two contacts in place with the Nevada Division of Water Resources to make certain at least one person receives this information request.

Additional information regarding DOE's investigations in Frenchman Flat and this monitoring of groundwater usage can be found in the report DOE/NV--1538, *Underground Test Area (UGTA) Closure Report for Corrective Action Unit 98: Frenchman Flat Nevada National Security Site, Nevada, 2015*.



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From: [Adam Sullivan](#)
To: [Cheryl Collins](#); [Daniel Randles](#)
Subject: RE: Changes to groundwater pumping? - Frenchman Flat area
Date: Tuesday, January 29, 2019 10:21:25 AM
Attachments: [image001.png](#)

Cheryl,

NDWR is not aware of any upcoming large-scale projects or other changes that could involve significant increases/decreases in groundwater pumping in your area of interest that have not reached the application phase.

Adam

Adam Sullivan
Deputy State Engineer
Nevada Division of Water Resources
Department of Conservation and Natural Resources
901 S. Stewart St., Suite 2002
Carson City, NV 89701
asullivan@water.nv.gov
(O) 775-684-2867 | (F) 775-684-2811

From: Cheryl Collins <Cheryl.Collins@dri.edu>
Sent: Monday, January 28, 2019 4:01 PM
To: Adam Sullivan <asullivan@water.nv.gov>; Daniel Randles <drandles@water.nv.gov>
Subject: FW: Changes to groundwater pumping? - Frenchman Flat area

Hello,

I apologize for being a nag about this. If I could get a very brief response, I'll enter it into my log and leave you guys along until July. Hope all is well with you there in NDWR land.

Cheryl

From: Cheryl Collins
Sent: Tuesday, January 15, 2019 12:47 PM
To: 'Adam Sullivan' <asullivan@water.nv.gov>; Daniel Randles <drandles@water.nv.gov>
Subject: Changes to groundwater pumping? - Frenchman Flat area

Hi Adam,

On behalf of the U.S. Department of Energy Nevada Field Office, this is the semi-annual request for information regarding upcoming activities that could affect groundwater in the Frenchman Flat groundwater basin (Nevada hydrographic basin 160).

As a reminder, contaminants from nuclear testing are present in this basin, and a geographic contaminant boundary has been established in agreement with the Nevada Division of Environmental Protection, based on an extensive testing program. Should there be any significant changes to the current groundwater system, the boundary could be affected, and additional data collection and modeling may be necessary to evaluate potential boundary changes. Activities of significant magnitude to affect the groundwater system within Basin 160 are not expected, but the DOE is following this protocol to ensure its awareness of potential impacts.

In order to monitor groundwater usage in the area, we regularly carry out the following tasks:

- check information available on newly-filed applications on the <http://water.nv.gov/> web site and
- send this email to you to ask if you are aware of any upcoming large-scale projects or other changes that could involve significant increases/decreases in groundwater pumping activity in the region, but have not yet reached the application phase.

The nearest basins we believe are most likely to be locations of new activities are:

230 Amargosa Desert,
161 Indian Springs Valley, and
211 Three Lakes Valley.

In addition, significant changes to water pumping rates on the Nevada National Security Site or the Nevada Test and Training Range are also of interest. Please see the attached map for a visual representation of the region.

Thank you for your help with this program. If you have changes in staffing, please let us know who should receive this email. We would like to have two contacts in place with the Nevada Division of Water Resources to make certain at least one person receives this information request.

Additional information regarding DOE's investigations in Frenchman Flat and this monitoring of groundwater usage can be found in the report DOE/NV--1538, *Underground Test Area (UGTA) Closure Report for Corrective Action Unit 98: Frenchman Flat Nevada National Security Site, Nevada*, 2015.



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Active REOPs at Area 5 (For Calendar Year 2018)
 (Page 1 of 7)

REOP Number	REOP Name	REOP Description	REOP Document
Primary REOPs			
DOE-0003	Greater Confinement Facility	Greater Confinement Facility	https://ntsweb.nv.doe.gov/docs/reops/doe/doe000300.pdf
DOE-0007	Legacy Sites	Vortex Site 1	https://ntsweb.nv.doe.gov/docs/reops/doe/doe000700.pdf
MSTS-0016	NNSS Water Systems	05W-ST-5N, Area 5 North Tank	https://ntsweb.nv.doe.gov/docs/reops/msts/msts001600.pdf
		05W-ST-5S, Area 5 South Tank	
		05-202762, Well 5B	
		05W-WW-5C, Well 5C	
		05-202181, Booster 5-A	
MSTS-0039	Fire and Rescue Stations	05-ML0102, Checkpoint Pass Training Area	https://ntsweb.nv.doe.gov/docs/reops/msts/msts003900.pdf
MSTS-0041	Radio Communications Infrastructure	05-14 and 05-15	https://ntsweb.nv.doe.gov/docs/reops/msts/msts004100.pdf
MSTS-0055	NNSS Power Distribution Infrastructure	05-S-7, Booster 5-A Substation	https://ntsweb.nv.doe.gov/docs/reops/msts/msts005500.pdf
		05P-S-FF, 138 kV Frenchman Flat	
MSTS-0075	NNSS Balance of Plant	90-ML0015, NNSS Balance of Plant	https://ntsweb.nv.doe.gov/docs/reops/msts/msts007500.pdf
MSTS-0086	Hazardous Waste Management Area	05-20	https://ntsweb.nv.doe.gov/docs/reops/msts/msts008600.pdf
MSTS-0096	Sewage Lagoons and Septic Systems	A05 RWMS Septic System	https://ntsweb.nv.doe.gov/docs/reops/msts/msts009600.pdf
		A05 RWMS Sewage Lagoon	

Active REOPs at Area 5 (For Calendar Year 2018)
 (Page 2 of 7)

REOP Number	REOP Name	REOP Description	REOP Document
MSTS-0121	Post-Closure Inspections and Maintenance (NNSS)	CAU 005 CAS 05-15-01 CAU 005 CAS 05-16-01 East CAU 005 CAS 05-16-01 West CAU 140 CAS 05-23-01 CAU 204 CAS 05-18-02 CAU 204 CAS 05-33-01 CAU 111 CAS 05-21-01 North Covers CAU 111 CAS 05-21-01 South Cover CAU 111 CAS 05-21-01 West Cover Greater Confinement Disposal Borehole - Test CAU 541 - Small Boy CAU 573, 05-23-02	https://ntsweb.nv.doe.gov/docs/reops/msts/msts012100.pdf
MSTS-0145	Underground Test Area Project	ER-5-2 ER-5-3, ER-5-3 #2, ER-5-3 #3 UE-5n ER-5-5 U-5a (N1 & N2) ER-5-4, ER-5-4 #2, RNM #1, RNM #2, RNM #2S	https://ntsweb.nv.doe.gov/docs/reops/msts/msts014500.pdf
MSTS-0212	Radioactive Waste Facilities	05A-ML0120, Area 5A RWMC Disposal Cells 05-ML0117, Area 5 North Pipeline	https://ntsweb.nv.doe.gov/docs/reops/msts/msts021200.pdf

Active REOPs at Area 5 (For Calendar Year 2018)
 (Page 3 of 7)

REOP Number	REOP Name	REOP Description	REOP Document
MSTS-0227	NNSS Public Sewer Collection System	90-INF8500, Waste Water Distribution	https://ntsweb.nv.doe.gov/docs/reops/msts/msts022700.pdf
MSTS-0239	NNSS Telecommunications Infrastructure	05-13	https://ntsweb.nv.doe.gov/docs/reops/msts/msts023900.pdf
		05-998653	
MSTS-0269	Base Ops	90-ML0147, Cane Springs Training Area	https://ntsweb.nv.doe.gov/docs/reops/msts/msts026900.pdf
MSTS-0279	NNSS Roads and Grounds	90-INF1700, Roads and Paved Parking	https://ntsweb.nv.doe.gov/docs/reops/msts/msts027900.pdf
MSTS-0292	Desert FACE Facility	05-ML0070, Nevada Desert Face Facility (NDFF)	https://ntsweb.nv.doe.gov/docs/reops/msts/msts029200.pdf
		05-ML0071, Mohave Global Change Facility (MGCF)	
MSTS-0433	Nonproliferation Test and Evaluation Complex (NPTEC)	05-ML0132, Southwest of NPTEC	https://ntsweb.nv.doe.gov/docs/reops/msts/msts043900.pdf
		90-ML0131, NPTEC Compound	
		05-ML0094, Area 5 Tank Farm	
MSTS-0439	Ecological & Environmental Monitoring	RWMS 5 Lagoons	https://ntsweb.nv.doe.gov/docs/reops/msts/msts043900.pdf
		DOD	
		Beatley 23, BECAMP FRF001 and FRF004	
		BECAMP FF66	
		BECAMP FRF002	
		BECAMP FRF003	
		BECAMP FRF007	
		BECAMP FRF006	

Active REOPs at Area 5 (For Calendar Year 2018)
 (Page 4 of 7)

REOP Number	REOP Name	REOP Description	REOP Document
MSTS-0439	Ecological & Environmental Monitoring	UCLAMHBORPIT	https://ntsweb.nv.doe.gov/docs/reops/msts/msts043900.pdf
		Beatley 20	
		Beatley 21	
		Beatley 22	
		Beatley 24	
		Beatley 25	
		Beatley 30	
		Beatley 31	
		Beatley 38	
MSTS-0452	Test Range South	90-ML0212, Test Range East	https://ntsweb.nv.doe.gov/docs/reops/msts/msts045200.pdf
NAV-0119	Yucca Mountain Permits and Monitoring	UE-5 TR-FF #1	https://ntsweb.nv.doe.gov/docs/reops/nav/nav011900.pdf
		UE-5 TR-FF #2	
NSTEC-0447	Outlying Areas	05-ML0027, Parcel 1 Land South of 200 Hill	https://ntsweb.nv.doe.gov/docs/reops/nstec/nstec044700.pdf
		05-ML0028, Parcel 2 Land North of 200 Hill	
SOC-0004	SOC Protective Force Training Complex	SOC Protective Force Training Complex	https://ntsweb.nv.doe.gov/docs/reops/soc/soc000400.pdf
SOC-0042	SOC Area 5 Munitions Storage Site	MSM Yankee Area 5	https://ntsweb.nv.doe.gov/docs/reops/soc/soc004200.pdf

Active REOPs at Area 5 (For Calendar Year 2018)
 (Page 5 of 7)

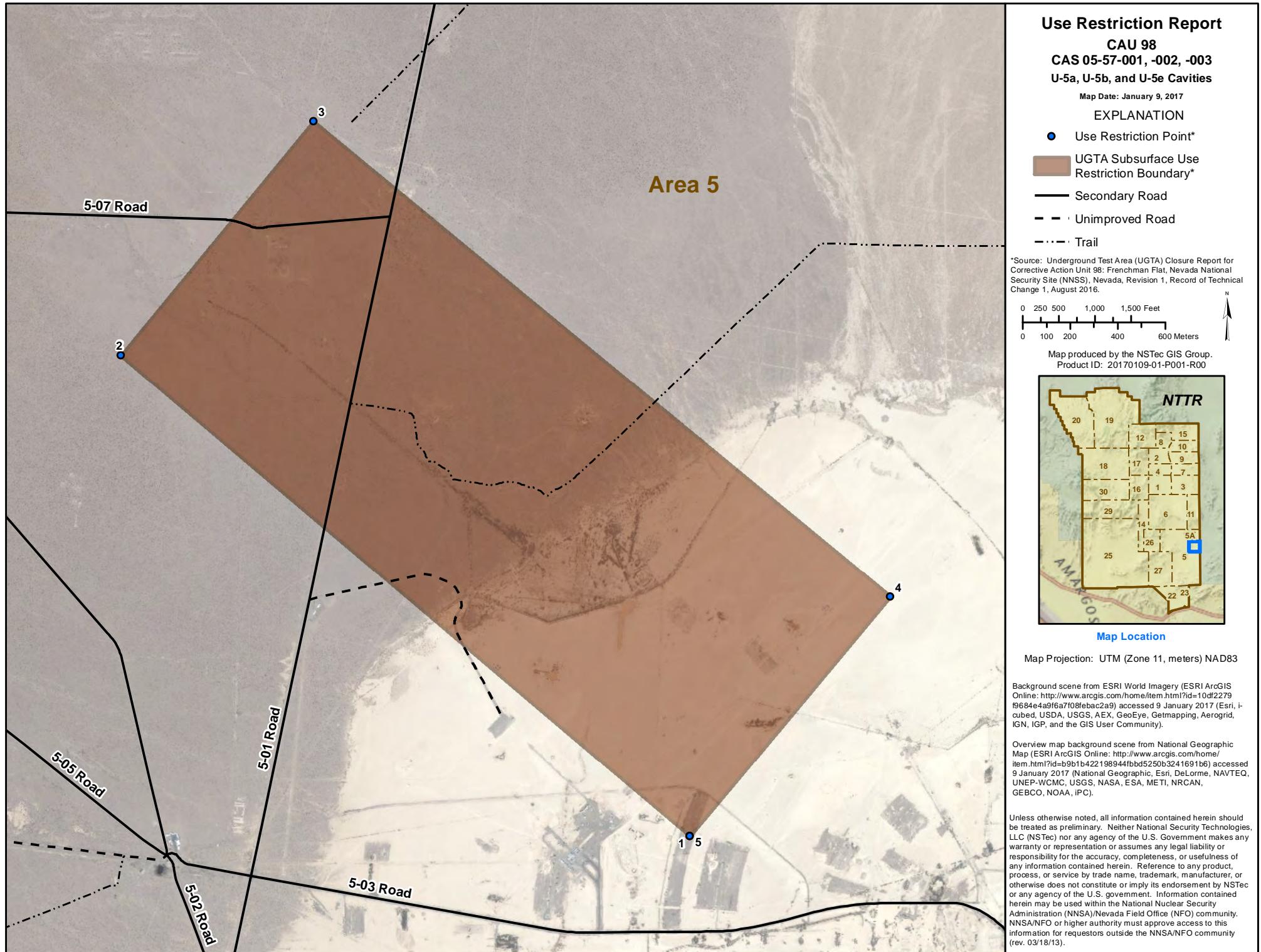
REOP Number	REOP Name	REOP Description	REOP Document
Secondary REOPs			
ARL/SORD-0001	Weather Support for the NNSS	A-05 VERT PRO HSC	https://ntsweb.nv.doe.gov/docs/reops/arsord/arsord000100.pdf
		A-05 MEDA 13	
		A-05 MEDA 5	
CNV-0028	DAF ESS Training	ESS Training Area	https://ntsweb.nv.doe.gov/docs/reops/cnv/cnv002800.pdf
CNV-0033	CNV-FOF Burma Road	05-ML0086	https://ntsweb.nv.doe.gov/docs/reops/cnv/cnv003300.pdf
DOD-0010	Base Operations	90-ML0147, Cane Springs Training Area	https://ntsweb.nv.doe.gov/docs/reops/dod/dod001000.pdf
DRI-0004	Nevada Desert Research Center (NDRC)	05-ML0071, Mojave Global Change Facility (MGCF)	https://ntsweb.nv.doe.gov/docs/reops/dri/dri000400.pdf
		05-ML0070, Nevada Desert FACE Facility (NDFF)	
DTRA-0062	Heavy Vehicle Testing	HB4	https://ntsweb.nv.doe.gov/docs/reops/dtra/dtra006200.pdf
MSTS/S-0004	NNSS Fire & Rescue Training	05-ML0102, Checkpoint Pass Training Area	https://ntsweb.nv.doe.gov/docs/reops/mstss/mstss000400.pdf
MSTS/S-0006	Ecological & Environmental Monitoring	BECAMP FRF005	https://ntsweb.nv.doe.gov/docs/reops/mstss/mstss000600.pdf
MSTS/S-0009	Dry Alluvium Geology Project	Point 4, South E	https://ntsweb.nv.doe.gov/docs/reops/mstss/mstss000900.pdf
		Point 7, RV 33.9 km	
		Point 1, South D	
		Point 2, South F	
MSTS/S-0023	NNSS Seismic Network	Rock Valley - RVFF	https://ntsweb.nv.doe.gov/docs/reops/mstss/mstss002300.pdf
		200 Hill Infrasound Sites	
		Geophone Sites - A-5	

Active REOPs at Area 5 (For Calendar Year 2018)
 (Page 6 of 7)

REOP Number	REOP Name	REOP Description	REOP Document
NAV-0026	Navarro UGTA Field Operations	ER-5-2	https://ntsweb.nv.doe.gov/docs/reops/nav/nav002600.pdf
		ER-5-3, ER-5-3 #2, ER-5-3 #3	
		ER-5-4, ER-5-4 #2, RNM #1, RNM #2, RNM #2S	
		ER-5-5	
		U-5a (N1 & N2)	
		UE-5n	
		WW-5A	
OGA-0004	Tarantula Test Series	90-ML0133, Port Gaston Compound	https://ntsweb.nv.doe.gov/docs/reops/oga/oga000400.pdf
SOC-0045	SOC MESH Network	SOC Trailers	https://ntsweb.nv.doe.gov/docs/reops/soc/soc004500.pdf
UNR-0003	UNR Field Tasks - Telemetry and Data Collection	RVFF	https://ntsweb.nv.doe.gov/docs/reops/unr/unr000300.pdf
USGS-0003	USGS Vegetation, Small Mammal and Reptile Studies	Beatley 23, BECAMP FRF001 and FRF004	https://ntsweb.nv.doe.gov/docs/reops/usgs/usgs000300.pdf
		BECAMP FF66	
		BECAMP FRF002	
		BECAMP FRF003	
		BECAMP FRF007	
		Beatley 20	
		Beatley 21	
		Beatley 22	
		Beatley 24	
		Beatley 25	

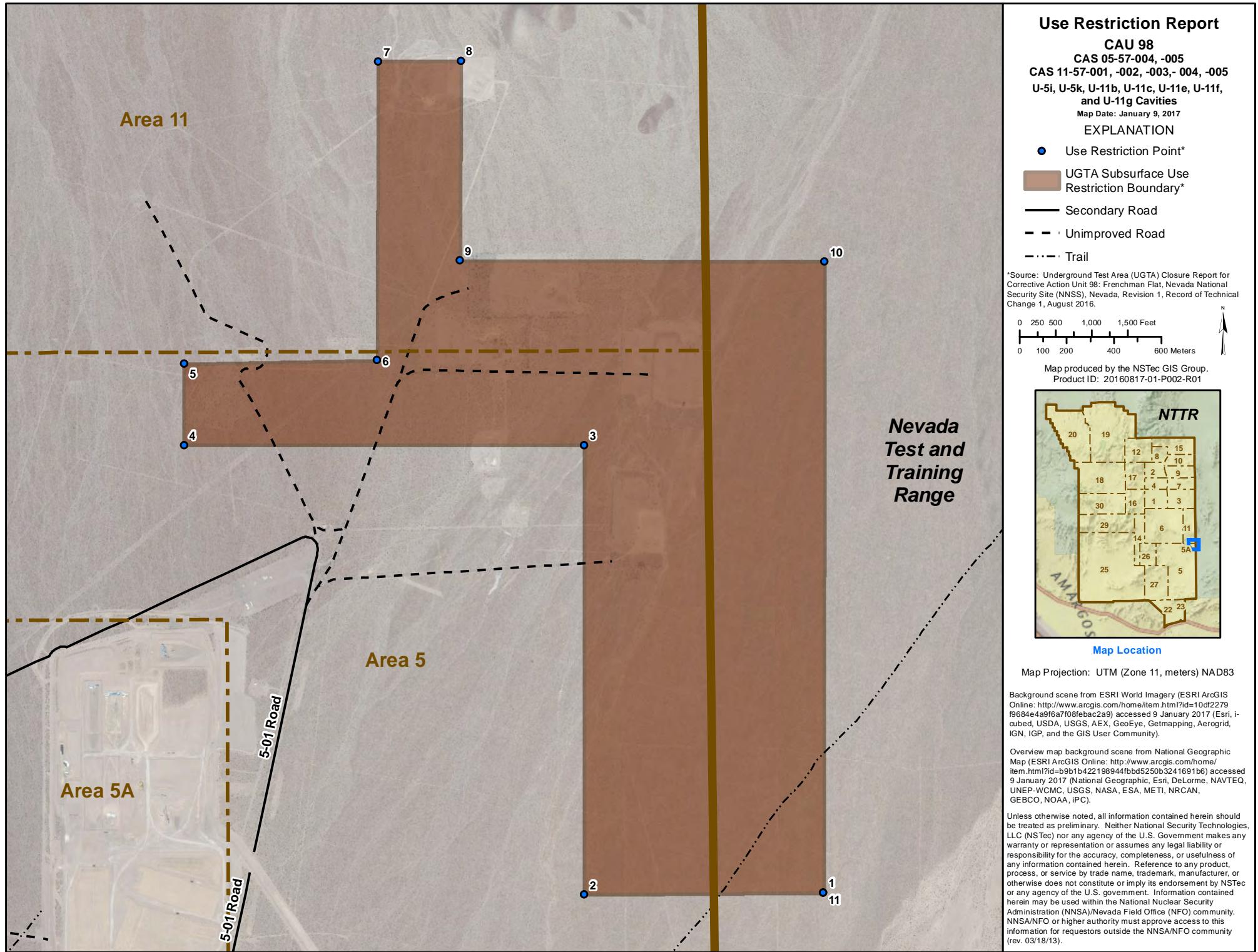
Active REOPs at Area 5 (For Calendar Year 2018)
 (Page 7 of 7)

REOP Number	REOP Name	REOP Description	REOP Document
USGS-0003	USGS Vegetation, Small Mammal and Reptile Studies	Beatley 30	https://ntsweb.nv.doe.gov/docs/reops/usgs/usgs000300.pdf
		Beatley 31	
		Beatley 38	
		BECAMP FRF005	
		BECAMP FRF006	
USGS-0005	Underground Test Area Activity (UGTA) and NNSS Well Data Collection	WW-5B	https://ntsweb.nv.doe.gov/docs/reops/usgs/usgs000500.pdf
		WW-5A	
		WW-5C	
		ER-5-5	
		ER-5-3, ER-5-3-2, and ER-5-3-3	
		ER-5-4, ER-5-4-2, RNM-1, RNM-2, and RNM-2S	
		UE-5n	
		UE-5m	
USGS-0009	Radio Tracking of Bighorn Sheep	Well 5C Trough	https://ntsweb.nv.doe.gov/docs/reops/usgs/usgs000900.pdf



UGTA UR Boundary Points

Description of Site	Point ID	Northing (UTM meters, NAD83)	Easting (UTM meters, NAD83)
U-5a, U-5b, U-5e Cavities	1	4073424	594092
U-5a, U-5b, U-5e Cavities	2	4075453	591693
U-5a, U-5b, U-5e Cavities	3	4076439	592504
U-5a, U-5b, U-5e Cavities	4	4074433	594937
U-5a, U-5b, U-5e Cavities	5	4073424	594092



UGTA UR Boundary Points

Description of Site	Point ID	Northing (UTM meters, NAD83)	Easting (UTM meters, NAD83)
U-5i,U-5k,U-11b,U-11c, U-11e,U-11f,U-11g Cavities	1	4079457	595991
U-5i,U-5k,U-11b,U-11c, U-11e,U-11f,U-11g Cavities	2	4079449	594981
U-5i,U-5k,U-11b,U-11c, U-11e,U-11f,U-11g Cavities	3	4081350	594981
U-5i,U-5k,U-11b,U-11c, U-11e,U-11f,U-11g Cavities	4	4081350	593287
U-5i,U-5k,U-11b,U-11c, U-11e,U-11f,U-11g Cavities	5	4081695	593289
U-5i,U-5k,U-11b,U-11c, U-11e,U-11f,U-11g Cavities	6	4081710	594104
U-5i,U-5k,U-11b,U-11c, U-11e,U-11f,U-11g Cavities	7	4082971	594109
U-5i,U-5k,U-11b,U-11c, U-11e,U-11f,U-11g Cavities	8	4082976	594458
U-5i,U-5k,U-11b,U-11c, U-11e,U-11f,U-11g Cavities	9	4082131	594453
U-5i,U-5k,U-11b,U-11c, U-11e,U-11f,U-11g Cavities	10	4082126	595997
U-5i,U-5k,U-11b,U-11c, U-11e,U-11f,U-11g Cavities	11	4079457	595991

Appendix D

Monitoring Network Inspections and Maintenance

D.1.0 Monitoring Network Inspections and Maintenance

No maintenance activities were conducted on the CAU 98 monitoring wells during 2018.

The water-quality monitoring wells were inspected during sampling activities in January and February 2018. The general road conditions, well pad conditions, infiltration areas, and surrounding areas were evaluated. Specific conditions are provided in [Table D-1](#).

Table D-1
Inspection Results in 2018 for Frenchman Flat Water-Quality Monitoring Wells

	ER-5-3_p2	ER-5-3-2	ER-5-5	ER-11-2	RNM-2S	UE-5n
Infiltration area viable?	Yes	Yes	Yes	Yes	Yes	Yes
New roads or facilities constructed?	No	No	No	No	No	No
Changes to drainage pattern or area?	No	No	No	No	No	Yes ^a

^a Minor erosion observed to well pad due to storm runoff, but changes not significant to integrity.

The water-level monitoring wells were inspected in 2018 on March 5, June 4, August 13, and October 22. These inspections considered the well condition (whether locked, marked, or damaged) and condition of the pad and survey point. No compromising conditions were found, as documented in [Table D-2](#).

Table D-2
Inspection Results for 2018 for Frenchman Flat Water-Level Monitoring Wells

Well	Well Locked?				Well Marked and Undamaged?				Survey Point Marked and Undamaged?				Well Pad in Good Condition (no erosion or standing water)?			
	Mar 5	Jun 4	Aug 13	Oct 22	Mar 5	Jun 4	Aug 13	Oct 22	Mar 5	Jun 4	Aug 13	Oct 22	Mar 5	Jun 4	Aug 13	Oct 22
ER-5-3 deep piez	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ER-5-3 main	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ER-5-3-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ER-5-3-3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ER-5-4 main	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	See note below			
ER-5-4 piez	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	See note below			
ER-5-4-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ER-5-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ER-11-2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
RNM-1	See note below				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
RNM-2S	See note below				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
UE-5n	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WW-4	See note below				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WW-4A	See note below				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WW-5A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WW-5B	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

piez = piezometer

Notes:

ER-5-4 main: Well pad is not clear. Collapsed sediment (2-ft hole) is located at the west side of the well casing. The collapsed sediment area does not appear to provide a flow path for surface water to enter the well.

ER-5-4 piez: Well pad is not clear. Collapsed sediment (2-ft hole) is located at the west side of the well casing. The collapsed sediment area does not appear to provide a flow path for surface water to enter the well.

RNM-1: The well cannot be locked. The well cap is always securely screwed onto the access tube when the field party arrives and is securely screwed onto the access tube before the field party leaves the well.

RNM-2S: The well cannot be locked. The well cap is always securely screwed onto the well when the field party arrives and is securely screwed onto the well before the field party leaves the well.

WW-4: The access tube cannot be locked. The well cap is always securely screwed onto the access tube when the field party arrives and is securely screwed onto the access tube before the field party leaves the well.

WW-4A: The access tube cannot be locked. The well cap is always securely screwed onto the access tube when the field party arrives and is securely screwed onto the access tube before the field party leaves the well.

Appendix E

Nevada Division of Environmental Protection Comments

(1 Page)

**NEVADA ENVIRONMENTAL MANAGEMENT OPERATIONS ACTIVITY
DOCUMENT REVIEW SHEET**

1. Document Title/Number: CY2018 Annual Closure Monitoring Report For Corrective Action Unit (CAU) 98: Frenchmen Flat, Underground Test Area, Nevada National Security Site, Nevada (January 2018 - December 2018)		2. Document Date: June 2019	
3. Revision Number: 0		4. Originator/Organization: Navarro	
5. Responsible EM Nevada Program Activity Lead: Tiffany Gamero		6. Date Comments Due: June 27, 2019	
7. Review Criteria:			
8. Reviewer/Organization Phone No.: Nevada Division of Environmental Protection		9. Reviewer's Signature:	
10. Comment Number/Location	11. Type ^a	12. Comment	13. Comment Response
1. Page 9, Section 4.0, First Paragraph, Last Sentence:		This sentence is confusing, please clarify.	Sentence was revised to read: "This evaluation will be performed at the conclusion of the five-year monitoring period."
2. Page 19, Table 4-4, Well WW-4A, Dates "08/13/2018" and "10/22/2018", "Depth" columns:		Both of these water level depths are exactly the same. Are both of these results accurate?	The data in the report are as reported by the USGS, and are indeed the same depth to water measurements on those two dates.
3. Page D-2 of D-2, First and Second Notes under Table D-2:		Are there any "preventative maintenance" plans for repair of the collapsed sediment areas around ER-5-4 main and piezometer although at this time it does not appear that there is a flow path for surface water to enter the well?	The settling of the rat hole will be backfilled with gravel and sand the week of 7/15/19. There is no flow path for surface water to enter the well.

^aComment Types: M = Mandatory, S = Suggested.

Return Document Review Sheets to Environmental Management Nevada Program Operations Activity, Attn: QAC, M/S NSF 505

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