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DOE/NV--1537

Corrective Action Decision Document for Corrective Action Unit 568: Area 3 Plutonium Dispersion Sites Nevada National Security Site, Nevada

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/s/ Joseph P. Johnston 08/03/2015
Joseph P. Johnston, Navarro CO Date

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CORRECTIVE ACTION DECISION DOCUMENT FOR CORRECTIVE ACTION UNIT 568: AREA 3 PLUTONIUM DISPERSION SITES NEVADA NATIONAL SECURITY SITE, NEVADA

U.S. Department of Energy, National Nuclear Security Administration
Nevada Field Office
Las Vegas, Nevada

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**CORRECTIVE ACTION DECISION DOCUMENT
FOR CORRECTIVE ACTION UNIT 568:
AREA 3 PLUTONIUM DISPERSION SITES
NEVADA NATIONAL SECURITY SITE, NEVADA**

Approved by: /s/ Tiffany A. Lantow Date: 08/05/2015

Tiffany A. Lantow
Soils Activity Lead

Approved by: /s/ Robert F. Boehlecke Date: 08/05/2015

Robert F. Boehlecke
Environmental Management Operations Manager

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List of Acronyms and Abbreviations

Ac	Actinium
ALM	Adult Lead Methodology
Am	Americium
ASTM	ASTM International
bgs	Below ground surface
BMP	Best management practice
BOL	Bill of Lading
CA	Contamination area
CAA	Corrective action alternative
CAB	Corrective action boundary
CADD	Corrective action decision document
CAI	Corrective action investigation
CAIP	Corrective action investigation plan
CAS	Corrective action site
CAU	Corrective action unit
CFR	*Code of Federal Regulations*
Cm	Curium
cm	Centimeter
cm^3	Cubic centimeter
Co	Cobalt
COC	Contaminant of concern
COPC	Contaminant of potential concern
cpm	Counts per minute
cps	Counts per second
Cs	Cesium
CSM	Conceptual site model

List of Acronyms and Abbreviations *(Continued)*

CV	Coefficient of variation
day/yr	Days per year
DCB	Default contamination boundary
DOE	U.S. Department of Energy
dpm	Disintegration per minute
DQA	Data quality assessment
DQI	Data quality indicator
DQO	Data quality objective
DRO	Diesel-range organics
EPA	U.S. Environmental Protection Agency
Eu	Europium
FAL	Final action level
FD	Field duplicate
FFACO	*Federal Facility Agreement and Consent Order*
FIDLER	Field instrument for the detection of low-energy radiation
FSL	Field-screening level
FSR	Field-screening result
ft	Foot
ft^2	Square foot
ft^3	Cubic foot
g	Gram
gal	Gallon
g/day	Grams per day
GIS	Geographic Information Systems
GPS	Global Positioning System
GRO	Gasoline-range organics

List of Acronyms and Abbreviations *(Continued)*

GZ	Ground zero
HAE	Height above ellipsoid
HCA	High contamination area
hr/day	Hours per day
hr/yr	Hours per year
IA	Industrial area
in.	Inch
K	Potassium
kg/1,000 cm^3	Kilograms per 1,000 cubic centimeters
kt	Kiloton
LCL	Lower confidence limit
LLW	Low-level waste
LVF	Load Verification Form
m	Meter
m^2	Square meter
MDC	Minimum detectable concentration
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MLLW	Mixed low-level waste
M&O	Management and operating
mrem/IA-yr	Millirem per Industrial Area year
mrem/OU-yr	Millirem per Occasional Use Area year
mrem/RW-yr	Millirem per Remote Work Area year
mrem/yr	Millirem per year
N/A	Not applicable
NAC	*Nevada Administrative Code*

List of Acronyms and Abbreviations (Continued)

NAD	North American Datum
NDEP	Nevada Division of Environmental Protection
NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
NNSS	Nevada National Security Site
NSTec	National Security Technologies, LLC
OU	Occasional use
PAH	Polyaromatic hydrocarbon
PAL	Preliminary action level
Pb	Lead
PCB	Polychlorinated biphenyl
pCi/g	Picocuries per gram
POC	Performance objective criteria
PPE	Personal protective equipment
PRG	Preliminary Remediation Goal
PSM	Potential source material
Pu	Plutonium
QA	Quality assurance
QAP	Quality Assurance Plan
QC	Quality control
r^2	Coefficient of determination
RadCon	Radiological control
RBCA	Risk-based corrective action
RCRA	*Resource Conservation and Recovery Act*
ROM	Rough order of magnitude
RRMG	Residual radioactive material guideline
RSL	Regional screening level

List of Acronyms and Abbreviations *(Continued)*

RWMC	Radioactive waste management complex
SCL	Sample collection log
SCO	Surface contaminated object
SD	Standard deviation
SE	Safety experiment
Sr	Strontium
SVOC	Semivolatile organic compound
Tc	Technetium
TCLP	Toxicity Characteristic Leaching Procedure
TED	Total effective dose
TLD	Thermoluminescent dosimeter
TMMC	Toxco Materials Management Center
TPH	Total petroleum hydrocarbons
TRS	Terrestrial radiological survey
TRU	Transuranic
TSCA	*Toxic Substances Control Act*
U	Uranium
UCL	Upper confidence limit
UR	Use restriction
US/UK	United States/United Kingdom
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
yd^2	Square yard
yd^3	Cubic yard

Executive Summary

This Corrective Action Decision Document has been prepared for Corrective Action Unit (CAU) 568, Area 3 Plutonium Dispersion Sites, in Area 3 of the Nevada National Security Site, Nevada. This complies with the requirements of the *Federal Facility Agreement and Consent Order* (FFACO) that was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management; U.S. Department of Defense; and DOE, Legacy Management. CAU 568 comprises the 14 corrective action sites (CASs) listed in Table ES-1.

Table ES-1
CAU 568 FFACO CASs

FFACO CAS Number	FFACO CAS Description
03-08-04	Soil and Debris Piles
03-23-17	S-3I Contamination Area
03-23-19	T-3U Contamination Area
03-23-20	Otero Contamination Area
03-23-22	Platypus Contamination Area
03-23-23	San Juan Contamination Area
03-23-26	Shrew/Wolverine Contamination Area
03-23-30	HCA Soil Pile
03-23-31	U-3d Contamination Area
03-23-32	U-3j Test Release
03-23-33	U-3r Contamination Area
03-23-34	U-3ay Contamination Area
03-26-04	Test-Related Debris
03-45-01	Test Surface Releases

The purpose of this Corrective Action Decision Document is to identify and provide the rationale for the recommendation of corrective action alternatives (CAAs) for the 14 CASs within CAU 568.

Corrective action investigation (CAI) activities were performed from April 2014 through May 2015, as set forth in the *Corrective Action Investigation Plan for Corrective Action Unit 568: Area 3 Plutonium Dispersion Sites, Nevada National Security Site, Nevada*; and in accordance with the *Soils*

Activity Quality Assurance Plan, which establishes requirements, technical planning, and general quality practices.

The approach for the CAI was to investigate and make data quality objective (DQO) decisions based on the types of releases present. To facilitate site investigation and DQO decisions, all identified releases (i.e., CAS components) were organized into study groups. The reporting of investigation results and the evaluation of DQO decisions are at the release level. The CAAs were evaluated at the FFACO CAS level.

The purpose of the CAI was to fulfill data needs as defined during the DQO process. The CAU 568 dataset of investigation results was evaluated based on a data quality assessment. This assessment demonstrated that the dataset is complete and acceptable for use in fulfilling the DQO data needs.

Investigation results were evaluated against final action levels (FALs) established in this document. A radiological dose FAL of 25 millirem per year was established based on the Occasional Use Area exposure scenario (80 hours of annual exposure). Chemical contamination FALs were established for individual constituents. Removable radioactive contamination levels that meet the definition criteria for a high contamination area (HCA) are assumed to require corrective action, even though the area may not present a potential radiation dose to a receptor that exceeds the FAL.

Table ES-2 presents a summary of CAI results and required corrective actions for each CAU 568 release.

Based on the evaluation of analytical data from the CAI, review of future and current operations at the 14 CASs, and the detailed and comparative analysis of the potential CAAs, the following corrective actions are recommended for CAU 568:

- No further action is the preferred corrective action for CASs 03-23-17, 03-23-22, 03-23-26.
- Closure in place is the preferred corrective action for CAS 03-23-19; 03-45-01; the SE DCBs at CASs 03-23-20, 03-23-23, 03-23-31, 03-23-32, 03-23-33, and 03-23-34; and the Pascal-B HCA at CAS 03-23-31.
- Clean closure is the preferred corrective action for CASs 03-08-04, 03-23-30, and 03-26-04; and the four well head covers at CASs 03-23-20, 03-23-23, 03-23-31, and 03-23-33.

Table ES-2
Summary of Investigation Results at CAU 568
(Page 1 of 2)

Release	CAS Number	CAI Results	Corrective Action
Chavez SE surface release	03-23-17, 03-23-19	No COCs identified	None
Chavez HCA (DCB)	03-23-19	HCA conditions assumed to exceed FALs	Required
Otero, San Juan, and Pascal-C SEs surface release	03-23-20, 03-23-23	No COCs identified	None
Otero SE DCB	03-23-20	Assumed TED above FALs in SE DCB	Required
Otero well head cover (PSM)		Removable contamination meets CA conditions	Required
Platypus weapons-related test surface release	03-23-22	No COCs identified	None
San Juan SE DCB	03-23-23	Assumed TED above FALs in SE DCB	Required
San Juan well head cover (PSM)		HCA conditions assumed to exceed FALs	Required
Pascal-C SE DCB		Assumed TED above FALs in SE DCB	Required
Bernalillo SE surface release		No COCs identified	None
Former windrows		No COCs identified	None
Shrew weapons-related test surface release	03-23-26	No COCs identified	None
Wolverine weapons-related test surface release		No COCs identified	None
Drainage		No COCs identified	None
Pascal-B SE surface release	03-23-31	No COCs identified	None
Pascal-B HCA		HCA conditions assumed to exceed FALs	Required
Pascal-B SE DCB		Assumed TED above FALs in SE DCB	Required
Luna SE surface release		No COCs identified	None
Luna SE DCB		Assumed TED above FALs in SE DCB	Required
Luna well head cover (PSM)		HCA conditions assumed to exceed FALs	Required
Colfax SE surface release		No COCs identified	None
Colfax SE DCB		Assumed TED above FALs in SE DCB	Required
Pascal-A SE surface release	03-23-32	No COCs identified	None
Pascal-A SE DCB		Assumed TED above FALs in SE DCB	Required

Table ES-2
Summary of Investigation Results at CAU 568
(Page 2 of 2)

Release	CAS Number	CAI Results	Corrective Action
Valencia SE surface release	03-23-33	No COCs identified	None
Valencia SE DCB		Assumed TED above FALs in SE DCB	Required
Valencia well head cover (PSM)		HCA conditions assumed to exceed FALs	Required
Chipmunk SE surface release	03-23-34	No COCs identified	None
Chipmunk SE DCB		Assumed TED above FALs in SE DCB	Required
Mink weapons-related test surface release		No COCs identified	None
Funnel weapons-related test surface release		No COCs identified	None
Cognac, Chinchilla, Chinchilla II, Stoat, Armadillo, Haymaker, Solendon, and Tuna weapons-related surface releases; Tendrac joint US/UK test surface release	03-45-01	No COCs identified	None
Boomer weapons-related test surface release		Assumed TED above FALs in crater area	Required
Soil and debris piles (lead PSM present on piles; potential PSM within piles)	03-08-04	Assumed PSM within soil and debris piles; PSM removed from surface of piles	Required
HCA soil pile	03-23-30	HCA conditions assumed to exceed FALs	Required
PSM (lead bricks, lead-acid batteries, lead sheets, lead plates, transformer)	03-26-04	No COCs identified; PSM removed	Completed
Lead from broken lead-acid battery (Location C17)		Lead detected above FALs	Required
Lead from lead shot (Location C19)		PSM present	Required

COC = Contaminant of concern
DCB = Default contamination boundary
PSM = Potential source material
SE = Safety experiment
TED = Total effective dose
US/UK = United States/United Kingdom

The preferred CAAs were evaluated on technical merit focusing on performance, reliability, feasibility, safety, and cost. The alternatives were judged to meet all requirements for the technical components evaluated. The alternatives meet all applicable federal and state regulations for closure of the site and will reduce potential exposure pathways to the contaminated media to an acceptable level at CAU 568.

1.0 Introduction

This Corrective Action Decision Document (CADD) presents information supporting the selection of corrective action alternatives (CAAs) for Corrective Action Unit (CAU) 568, Area 3 Plutonium Dispersion Sites, located at the Nevada National Security Site (NNSS), Nevada. CAU 568 comprises 14 corrective action sites (CASs). In the Corrective Action Investigation Plan (CAIP), CAU 568 consisted of six CASs (NNSA/NFO, 2014a). However, in order to more efficiently and effectively characterize and close the releases at CAU 568, eight CASs were added during the corrective action investigation (CAI) to capture the multiple test releases and debris items present within the scope of CAU 568. These 14 CASs and their associated releases are shown on Figures 1-1 and 1-2 and listed in Table 1-1.

A detailed discussion of the history of this CAU is presented in the *Corrective Action Investigation Plan for Corrective Action Unit 568: Area 3 Plutonium Dispersion Sites, Nevada National Security Site, Nevada* (NNSA/NFO, 2014a).

To facilitate site investigation and the evaluation of data quality objective (DQO) decisions for different releases, the reporting of investigation results and the evaluation of DQO decisions for different releases were organized into study groups. In the CAIP, releases were assigned to study groups. Based on additional information generated during the CAI, some changes were made to study group assignments. The revised assignments are shown in Table 1-1 and the study groups are described below.

Study Group 1, Releases within a Defined Radiological Survey Signature: This release category is specific to the atmospheric deposition of radionuclide contamination from weapons-related tests and safety experiments (SEs). The release is composed mainly of fission and activated products from the weapons tests, and unfissioned nuclear material (from the scattering of nuclear material due to the detonation of chemical explosives) from SEs onto the soil surface. Atmospheric releases of radionuclides that have been distributed at the NNSS from nuclear testing have been found to be concentrated in the upper 5 centimeters (cm) of undisturbed soil (McArthur and Kordas, 1983 and 1985; Gilbert et al., 1977; Tamura, 1977). This study group also investigates radionuclide contamination that was initially deposited on the soil surface but has been subsequently displaced or

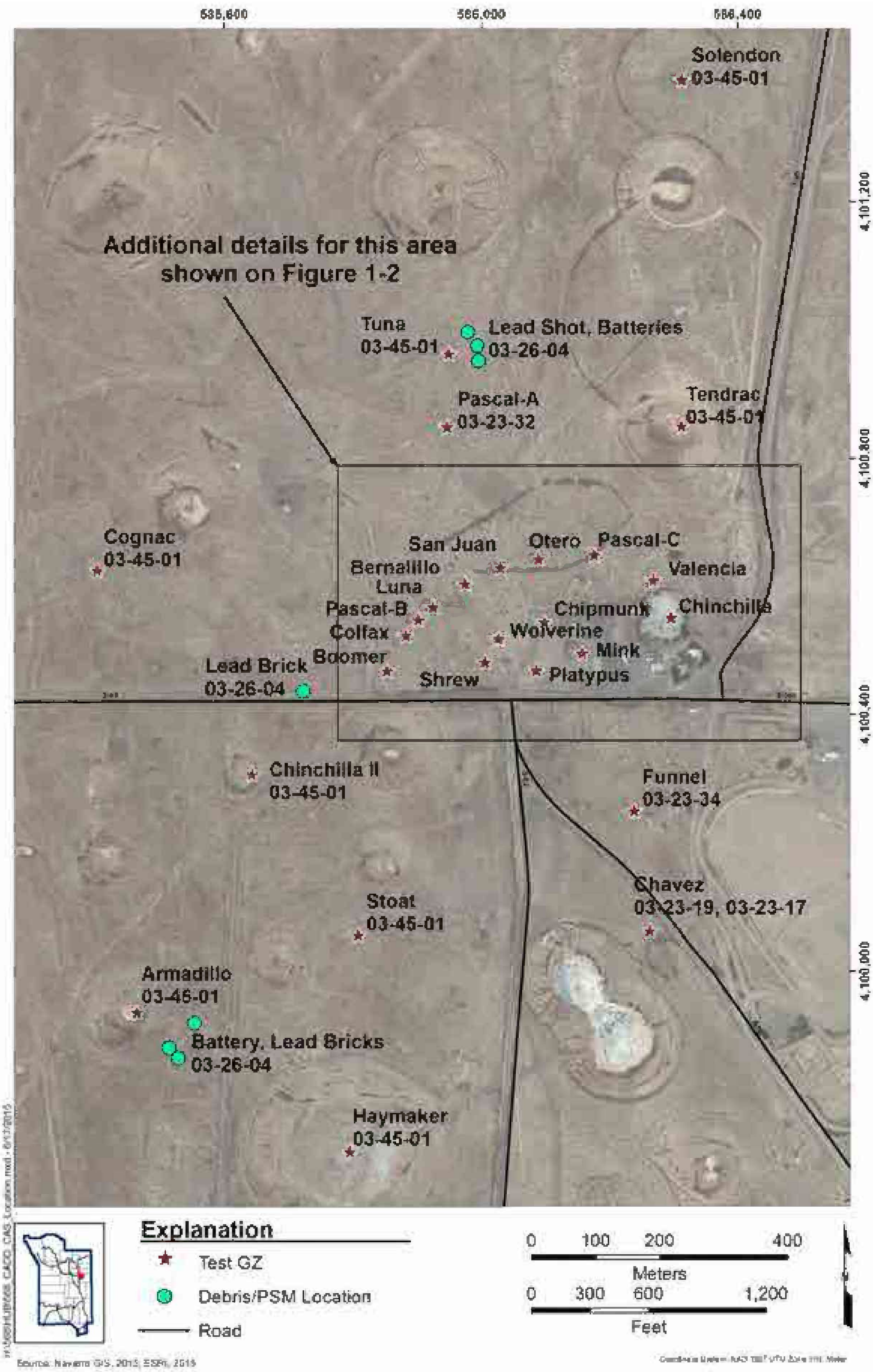

Figure 1-1
CAU 568 CAS Location Map

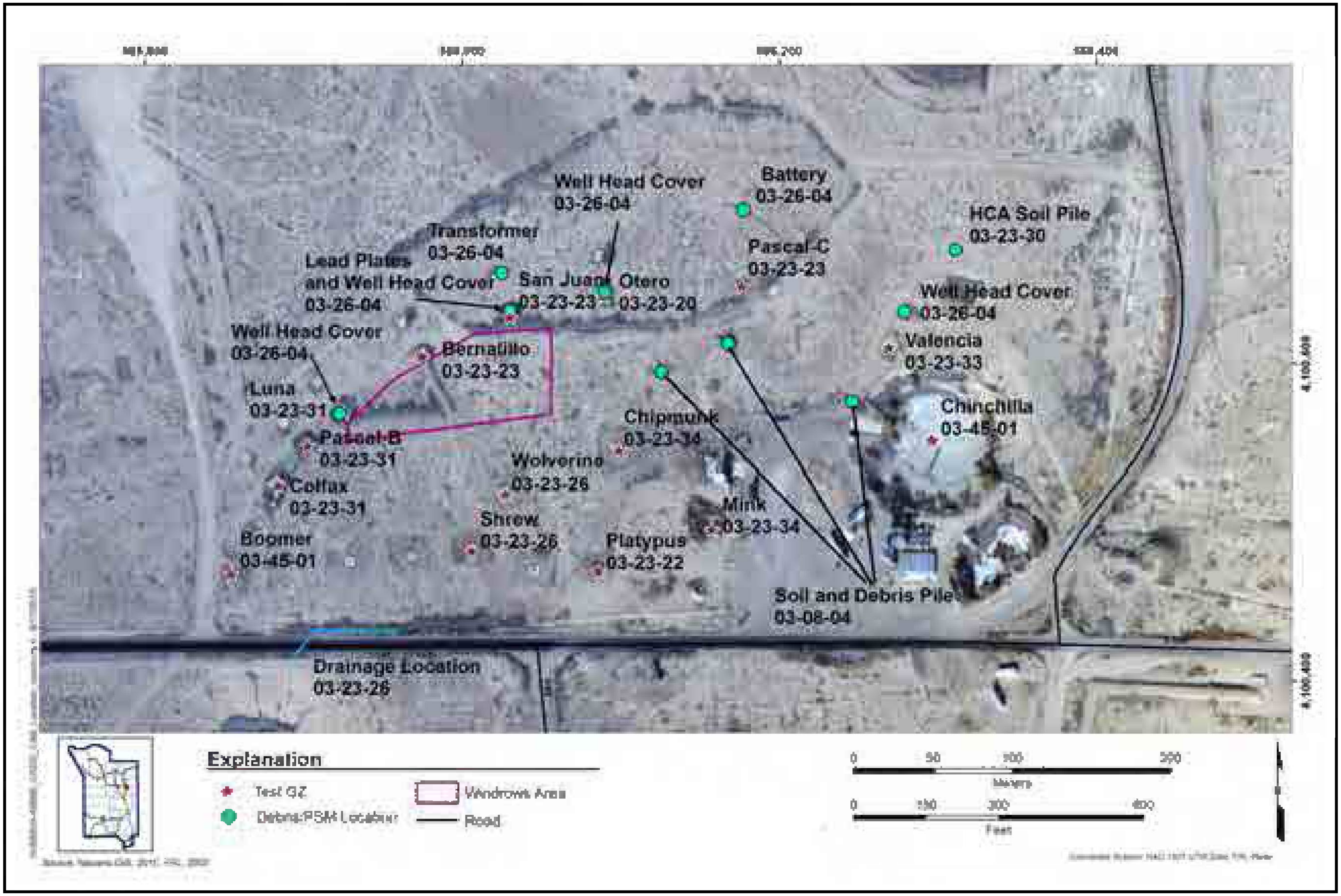

Figure 1-2
CAU 568 CAS Location Map (Zoom)

Table 1-1
CAU 568 Releases with Associated CASs and Study Groups
(Page 1 of 6)

Release	FFACO CAS Number	FFACO CAS Description	Study Group	Release Source
Chavez SE surface release	03-23-17, 03-23-19	S-3I Contamination Area[a], T-3U Contamination Area	1	Surface release of radionuclides from tower SE conducted on 10/27/1958 as part of Operation Hardtack II. Detonated atop a tower at a height of 52 ft, with a yield of 0.6 tons. A plume is present centered around the GZ area.
Chavez HCA (DCB)	03-23-19	T-3U Contamination Area		Contaminated surface soil assumed to meet HCA conditions. DCB is defined by the HCA boundary.
Otero, San Juan, and Pascal-C SEs surface release	03-23-20, 03-23-23	Otero Contamination Area, San Juan Contamination Area	1	Surface release of radionuclides from the Otero, San Juan, and Pascal-C underground safety experiments. Otero was conducted on 09/12/1958 as part of Operation Hardtack II, and was detonated at a depth of 480 ft bgs in an unstemmed hole, with a yield of 38 tons. San Juan was conducted on 10/20/1958 as part of Operation Hardtack II, and was detonated at a depth of 234 ft bgs in an unstemmed hole, with zero yield. Pascal-C was conducted on 12/06/1957 as part of Operation Project 58, and was detonated at a depth of 250 ft bgs in an unstemmed hole, with a yield of 38 tons. A plume is present over the area containing the three tests, and is centered north of the Otero GZ. Per a crater stability study (Olsen, 2013), access into the GZ area at Pascal-C is prohibited.
Otero SE DCB	03-23-20	Otero Contamination Area	1	Subsurface contamination within the test chimney of the Otero SE emplacement hole.
Otero well head cover (PSM)			4	Steel well head cover debris that was originally welded onto Otero emplacement hole. Now sits adjacent to the emplacement hole on soil surface. Removable contamination present on well head cover, which meets CA conditions.
Platypus weapons-related test surface release	03-23-22	Platypus Contamination Area	1	Surface release of radionuclides from underground weapons-related test conducted on 02/24/1962 as part of Operation Nougat. Detonated at a depth of 190 ft bgs, with a low yield.

Table 1-1
CAU 568 Releases with Associated CASs and Study Groups
(Page 2 of 6)

Release	FFACO CAS Number	FFACO CAS Description	Study Group	Release Source
San Juan SE DCB	03-23-23	San Juan Contamination Area	1	Subsurface contamination within the test chimney of the San Juan SE emplacement hole.
San Juan well head cover (PSM)			4	Steel well head cover debris that was originally welded onto San Juan emplacement hole. Now sits adjacent to the emplacement hole on the concrete emplacement pad. Removable contamination present on well head cover meets HCA conditions.
Pascal-C SE DCB			1	Subsurface contamination within the test chimney of the Pascal-C SE emplacement hole.
Bernalillo SE surface release				Surface release of radionuclides from underground safety experiment conducted on 09/17/1958 as part of Operation Hardtack II. Detonated at a depth of 456 ft bgs in an unstemmed hole, with a yield of 15 tons. A UR with engineering controls for contamination within the gas sampling line (CAU 547) is present from GZ, south to the Tejon (U-3cj) GZ (NNSA/NSO, 2012a).
Former Windrows				Surface and/or subsurface release of radionuclides and/or chemicals from scraped surface radiological contamination and road oil that was sprayed on the windrows.The area surrounding the tests conducted in 1957 and 1958 was bladed in 1959, and windrows were constructed. These windrows were sprayed with hot road oil. The windrows were subsequently removed from the site.
Shrew weapons-related test surface release	03-23-26	Shrew/Wolverine Contamination Area	3	Surface release of radionuclides from underground weapons-related test conducted on 09/16/1961 as part of Operation Nougat. Detonated at a depth of 322 ft bgs, with a low yield.
Wolverine weapons-related test surface release			1	Surface release of radionuclides from underground weapons-related test conducted on 10/12/1962 as part of Operation Storax. Detonated at a depth of 241 ft bgs, with a low yield.
Drainage			5	Surface water migration from a minor drainage identified at the northern edge of 3-03 Road, ending in a crater south of 3-03 Road.

Table 1-1
CAU 568 Releases with Associated CASs and Study Groups
(Page 3 of 6)

Release	FFACO CAS Number	FFACO CAS Description	Study Group	Release Source
Pascal-B SE surface release	03-23-31	U-3d Contamination Area	1	Surface release of radionuclides from underground safety experiment conducted on 08/27/1957 as part of Operation Plumbbob. Detonated at a depth of 500 ft bgs in an unstemmed hole, with a yield of 1 g. A plume is present centered over the GZ area.
Pascal-B HCA				Contaminated surface soil meeting HCA conditions, associated with the Pascal-B test release.
Pascal-B SE DCB				Subsurface contamination within the test chimney of the Pascal-B SE emplacement hole.
Luna SE surface release				Surface release of radionuclides from underground safety experiment conducted on 09/21/1958 as part of Operation Hardtack II. Detonated at a depth of 484 ft bgs in an unstemmed hole, with a yield of 1.5 tons.
Luna SE DCB				Subsurface contamination within the test chimney of the Luna SE emplacement hole.
Luna well head cover (PSM)			4	Steel well head cover debris that was originally welded onto Luna emplacement hole. Now sits on the edge of the concrete emplacement pad. Removable contamination present on well head cover meets HCA conditions.
Colfax SE surface release			1	Surface release of radionuclides from underground safety experiment conducted on 10/05/1958 as part of Operation Hardtack II. Detonated at a depth of 350 ft bgs in an unstemmed hole. with a yield of 5.5 tons.
Colfax SE DCB				Subsurface contamination within the test chimney of the Colfax SE emplacement hole.
Pascal-A SE surface release	03-23-32	U-3j Test Release	1	Surface release of radionuclides from underground safety experiment conducted on 07/26/1957 as part of Operation Plumbbob. Detonated at a depth of 500 ft bgs in an unstemmed hole, with a yield of 56 tons. A plume is present over the GZ area, trending northeast.
Pascal-A SE DCB				Subsurface contamination within the test chimney of the Pascal-A SE emplacement hole.

Table 1-1
CAU 568 Releases with Associated CASs and Study Groups
(Page 4 of 6)

Release	FFACO CAS Number	FFACO CAS Description	Study Group	Release Source
Valencia SE surface release	03-23-33	U-3r Contamination Area	1	Surface release of radionuclides from underground safety experiment conducted on 09/26/1958 as part of Operation Hardtack II. Detonated at a depth of 484 ft bgs in an unstemmed hole, with a yield of 2 tons.
Valencia SE DCB				Subsurface contamination within the test chimney of the Valencia SE emplacement hole.
Valencia well head cover (PSM)			4	Steel well head cover debris that was originally welded onto Valencia emplacement hole. Now sits north of the emplacement hole on the concrete hoist pad. Removable contamination present on well head cover, which meets HCA conditions.
Chipmunk SE surface release	03-23-34	U-3ay Contamination Area	3	Surface release of radionuclides from underground safety experiment conducted on 02/15/1963 as part of Operation Storax. Detonated at a depth of 195 ft bgs, with a low yield.
Chipmunk SE DCB				Subsurface contamination within the test chimney of the Chipmunk SE emplacement hole.
Mink weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 10/29/1961 as part of Operation Nougat. Detonated at a depth of 630 ft bgs, with a low yield.
Funnel weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 06/25/1968 as part of Operation Crosstie. Detonated at a depth of 389 ft bgs, with a yield of less than 20 kt.

Table 1-1
CAU 568 Releases with Associated CASs and Study Groups
(Page 5 of 6)

Release	FFACO CAS Number	FFACO CAS Description	Study Group	Release Source
Cognac weapons-related test surface release	03-45-01	Test Surface Releases	2	Surface release of radionuclides from underground weapons-related test conducted on 10/25/1967 as part of Operation Crosstie. Detonated at a depth of 789 ft bgs, with a yield of less than 20 kt.
Chinchilla weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 02/19/1962 as part of Operation Nougat. Detonated at a depth of 492 ft bgs, with a yield of 1.9 kt.
Chinchilla II weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 03/31/1962 as part of Operation Nougat. Detonated at a depth of 448 ft bgs, with a low yield.
Armadillo weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 02/09/1962 as part of Operation Nougat. Detonated at a depth of 786 ft bgs, with a yield of 7.1 kt.
Stoat weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 01/09/1962 as part of Operation Nougat. Detonated at a depth of 992 ft bgs, with a yield of 5.1 kt.
Haymaker weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 06/27/1962 as part of Operation Nougat. Detonated at a depth of 1,340 ft bgs, with a yield of 67 kt.
Solendon weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 02/12/1964 as part of Operation Niblick. Detonated at a depth of 493 ft bgs, with a yield of less than 20 kt. Area is posted with "Caution Contamination Area" signs.
Boomer weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 10/01/1961 as part of Operation Nougat. Detonated at a depth of 330 ft bgs, with a low yield. Per the crater stability study, access into the GZ area is prohibited.
Tuna weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 12/20/1963 as part of Operation Niblick. Detonated at a depth of 1,359 ft bgs, with a low yield.
Tendrac joint US/UK test surface release				Surface release of radionuclides from underground weapons-related test conducted on 12/07/1962 as part of Operation Storax. Detonated at a depth of 993 ft bgs, with a low yield.

Table 1-1
CAU 568 Releases with Associated CASs and Study Groups
(Page 6 of 6)

Release	FFACO CAS Number	FFACO CAS Description	Study Group	Release Source
Soil and debris piles (lead PSM present on piles; potential PSM within piles)	03-08-04	Soil and Debris Piles	4	Surface and/or subsurface releases of chemicals and/or radionuclides from debris. Three soil and debris piles are present in the area. These piles have an unknown origin and may not have originated from releases in the area. PSM (lead items) was identified on the surface of the piles. This PSM may have released contaminants to the soil in the piles. Additional PSM may be present within the piles.
HCA soil pile	03-23-30	HCA Soil Pile	4	Surface and/or subsurface releases of radionuclides and/or chemicals from debris. This pile has an unknown origin and may not have originated from releases in the area. Contaminated metallic debris is visible in the pile, which may have released contaminants to the soil. Additional PSM may be present within the pile. A plume is present over the pile area.
PSM (lead bricks, lead-acid batteries, lead sheets, lead plates, lead shot, transformer)	03-26-04	Test-Related Debris	4	Surface and/or subsurface releases of chemicals and/or radionuclides from debris. PSM items were identified scattered around the area containing CAU 568. This PSM may have released contaminants to the surrounding soil.

Source: Holmes & Narver, 1958; REECo, 1959; GE, 1979; NNSA/NSO, 2012a; Olsen,2013; NNSA/NFO, 2015

[a]The FFACO CAS description for CAS 03-23-17 refers to "S-3I." The location S-3I is identified as the Coulomb-C hole (NNSA/NFO, 2015). The location of Coulomb-C was investigated within the scope of CAU 569. For CAU 568, the release at CAS 03-23-17 is defined as being associated with the release from the Chavez test.

bgs = Below ground surface
CA = Contamination area
DCB = Default contamination boundary
FFACO = *Federal Facility Agreement and Consent Order*
ft = Foot
g = Gram
GZ = Ground zero
HCA = High contamination area
kt = Kiloton
PSM = Potential source material
UR = Use restriction
US/UK = United States/United Kingdom

covered through mechanical means (e.g., blading, windrow formation, reworking of soil for subsequent activities in the area). Also included within this study group is the subsurface contamination within the test chimneys associated with nine SEs conducted in the scope of CAU 568. These nine locations were established as DCBs in the CAIP (NNSA/NFO, 2014a).

Study Group 2, Releases Located within a Crater or Potential Crater Area That Cannot Be Entered: This group investigates subsidence craters where there has been a documented release of radioactivity to the surface from the associated underground test. Subsidence craters are considered to be the area above underground nuclear tests that have formed a surface crater or have the potential to form a surface crater. These areas have been determined to pose a significant physical safety hazard, and most are fenced and/or posted to keep workers from inadvertently being exposed to this hazard. These subsidence craters were evaluated using the subsidence crater strategy as presented in the *Soils Risk-Based Corrective Action* (RBCA) *Evaluation Process* (NNSA/NFO, 2014b). Contamination extending beyond the subsidence crater boundary was addressed in accordance with Study Group 1 sampling procedures.

Study Group 3, Releases with No Radiological Survey Signature: This group investigates documented releases of radioactivity from an underground test to the surface where there is no associated radiological survey signature. Documented releases that were identified at the time of the test were either short-lived radionuclides or released at low concentrations such that the remaining activities are insufficient to be detected by the aerial or terrestrial radiological survey (TRS) instruments.

Study Group 4, Spills and Debris: This group investigates any chemical or radiological contamination associated with features or items such as debris, spills, contaminated areas, and piles/mounds. The debris was evaluated for PSM as defined in the Soils RBCA document (NNSA/NFO, 2014b), and spills were evaluated based on analytical results of soil samples collected from locations containing the presence of biasing factors such as discoloration or elevated instrument readings.

Study Group 5, Drainages: This group investigates radionuclide contamination that was initially deposited onto the soil surface but has subsequently been displaced through erosion.

The release sources specific to CAU 568 are presented in Table 1-1.

Corrective actions are recommended in this document in accordance with the FFACO (1996, as amended) that was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management; U.S. Department of Defense; and DOE, Legacy Management.

1.1 Purpose

This CADD develops and evaluates potential CAAs and provides the rationale for the selection of recommended CAAs for the CASs in CAU 568.

1.2 Scope

The CAI for CAU 568 was completed by demonstrating through environmental soil and thermoluminescent dosimeter (TLD) sample analytical results the nature and extent of contaminants of concern (COCs) at the releases within any study group. For radiological releases, a COC is defined as the presence of radionuclides that jointly present a dose to a receptor exceeding a final action level (FAL) of 25 millirem per year (mrem/yr). A corrective action is also required for areas meeting HCA conditions because radiological dose is assumed to exceed the FAL within the HCAs. For chemical releases, a COC is defined as the presence of a contaminant above its corresponding FAL. The presence of a COC requires a corrective action. A corrective action is also required if a waste present within a release site contains a contaminant that, if released to soil, would cause the soil to contain a COC. Such a waste is considered to be PSM as defined in the Soils RBCA document (NNSA/NFO, 2014b).

The scope of the activities used to identify, evaluate, and recommend preferred CAAs for CAU 568 included the following:

- Performed visual surveys to identify biasing factors for selecting soil and PSM sample locations.
- Performed radiological surveys to identify biasing factors for selecting soil and PSM sample locations.
- Established sample plot and biased sample locations.
- Collected soil samples at sample plot and biased sampling locations.
- Submitted soil samples for analysis.
- Staged TLDs at soil sample and background locations.
- Collected and submitted TLDs for analysis.

- Collected Global Positioning System (GPS) coordinates of sample locations, TLD locations, and points of interest.
- Implemented interim corrective actions of soil and PSM removal.
- Conducted waste management activities (e.g., sampling, disposal).
- Evaluated corrective action objectives based on the results of the CAI and the CAA screening criteria.
- Recommended and justified preferred CAAs.

The CAI activities were completed in accordance with the CAIP (NNSA/NFO, 2014a) except as noted in Appendix A; and in accordance with the *Soils Activity Quality Assurance Plan* (QAP) (NNSA/NSO, 2012b), which establishes requirements, technical planning, and general quality practices. The evaluation of investigation results and the risk associated with site contamination was conducted in accordance with the Soils RBCA document (NNSA/NFO, 2014b).

In addition, a study was conducted to evaluate the variability in americium (Am)-241 results due to self-absorption from particle position. Results from this study are shown in Appendix G.

1.3 CADD Contents

This CADD is divided into the following sections and appendices:

- Section 1.0, "Introduction," summarizes the purpose, scope, and contents of this CADD.
- Section 2.0, "Corrective Action Investigation Summary," summarizes the investigation field activities, the results of the investigation, and the need for corrective action.
- Section 3.0, "Evaluation of Alternatives," describes, identifies, and evaluates the steps taken to determine preferred CAAs.
- Section 4.0, "Recommended Alternatives," presents the preferred CAAs for each CAS and the rationale based on the corrective action objectives and screening criteria.
- Section 5.0, "References," provides a list of all referenced documents used in the preparation of this CADD.

- Appendix A, *Corrective Action Investigation Results*, provides a description of the CAU 568 objectives, field investigation and sampling activities, investigation results, waste management, and quality assurance (QA).

- Appendix B, *Data Assessment*, provides a data quality assessment (DQA) that reconciles DQO assumptions and requirements to the investigation results.

- Appendix C, *Cost Estimates*, presents cost estimates for the construction, operation, and maintenance of the CAAs evaluated for each CAS.

- Appendix D, *Evaluation of Risk*, provides documentation of the chemical and radiological RBCA processes as applied to CAU 568.

- Appendix E, *Activity Organization*, identifies the DOE Soils Activity Lead and other appropriate personnel involved with the CAU 568 characterization and closure activities.

- Appendix F, *Sample Location Coordinates,* provides CAI sample locations coordinates.

- Appendix G, *Gamma Am-241 Replicate Study*, provides the results of a study conducted to evaluate self-attenuation associated with gamma spectroscopy.

- Appendix H, *Nevada Division of Environmental Protection* (NDEP) *Comments*, contains responses to NDEP comments on the draft version of this document.

1.4 Applicable Programmatic Plans and Documents

All investigation activities were performed in accordance with the following documents:

- CAIP for CAU 568, Area 3 Plutonium Dispersion Sites (NNSA/NFO, 2014a)
- Soils QAP (NNSA/NSO, 2012b)
- Soils RBCA document (NNSA/NFO, 2014b)
- FFACO (1996, as amended)

2.0 Corrective Action Investigation Summary

The following subsections summarize the CAI activities and investigation results, and identify the necessity for corrective action at CAU 568. Detailed CAI activities and results for individual CAU 568 study groups are presented in Appendix A of this document.

2.1 Investigation Activities

CAI activities were conducted from April 2014 through May 2015. The purpose of the CAI was to provide the additional information needed to resolve the following CAU 568-specific DQOs:

- Determine whether COCs are present in the soils associated with CAU 568.
- Determine the extent of identified COCs.
- Ensure that adequate data have been collected to evaluate closure alternatives under the FFACO.

The field investigation was completed as specified in the CAIP with minor deviations as described in Sections A.2.1 through A.2.4, which provide the general investigation and evaluation methodologies.

Data to calculate radiological dose were provided by the analytical results of TLD samples for external radiological dose and soil samples for the calculation of internal radiological dose. Data to evaluate chemical risk were provided by analytical results of soil samples.

The DQO Decision I (the presence of a COC) was resolved for any area where removable contamination is present at levels meeting the criteria for defining an HCA (HCA conditions) by assuming that COCs are present within the HCA. The DQO Decision I was also resolved for any area containing PSM. DQO Decision II (the extent of COC contamination) was resolved for areas containing HCA conditions by the currently established HCA boundaries and for the PSM by collecting soil samples adjacent to the PSM.

For DQO Decision I at other potential release sites, sample locations were established judgmentally based on the presence of biasing factors (e.g., lead bricks and highest radiation survey values). Using the contamination levels from the judgmental locations of highest potential contamination provides a conservative estimate of the contaminant exposure a receptor would receive from working at the release site. Where samples were collected in sample plots, an additional level of conservatism was added by evaluating the judgmental sample results probabilistically using the 95 percent upper confidence limit (UCL) of the average sample result to resolve DQO Decision I.

Sample locations for DQO Decision II (the extent of COC contamination) for radiological COCs were selected judgmentally at locations estimated to provide a range of dose values from the highest dose to a level below the FAL. The extent of radiological COC contamination was defined as a boundary that encompasses radiation survey isopleths with a value that corresponds to a total effective dose (TED) of 25 mrem/yr. To accomplish this, the relationship between TED (the sum of internal and external dose) and radiation survey values is estimated from a simple linear regression of paired calculated TED and radiation survey values for each sample location. Then the radiation survey value that corresponds to 25 mrem/yr is calculated from the regression equation. Confidence in estimating the extent of Decision II was provided by a more conservative estimate of the radiation survey value corresponding to 25 mrem/yr. This is accomplished using the uncertainty of how well the calculated relationship between TED and radiation survey values (i.e., the regression) represents the assumed true relationship. This uncertainty includes the uncertainty of how well the calculated TED represents true TED and the uncertainty of how well the radiation survey instrument readings represent the calculated TED. This combined uncertainty was estimated using an uncertainty interval as defined in the *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance* (EPA, 2009a). This process for using regression uncertainty in establishing a conservative estimate of the extent of COC contamination is presented in the Soils RBCA document (NNSA/NFO, 2014b).

Sample locations for DQO Decision II (the extent of COC contamination) for chemical COCs were selected judgmentally at locations surrounding the estimated extent of COC contamination.

The calculated TED for each sample location is an estimation of the true radiological dose (true TED). The TED is defined in 10 *Code of Federal Regulations* (CFR) Part 835 (CFR, 2015) as the sum of the effective dose (for external exposures) and the committed effective dose (for internal exposures).

As described in Appendix D, the TED to a receptor from site contamination is a function of the time the receptor is present at the site and exposed to the radioactively contaminated soil. Therefore, TED is reported in this document based on the following three exposure scenarios that address the potential exposure of workers to contaminants in soil:

- **Industrial Area.** Assumes continuous industrial use of a site. This scenario assumes that the site is the regular assigned work area for the worker who will be on the site for an entire career (8 hours per day [hr/day], 250 days per year [day/yr] for 25 years). The worker is assumed to spend 1/3 of the workday outdoors exposed to contaminated soil. The TED values calculated using this exposure scenario are the TED an industrial area worker receives during 2,000 hours of annual exposure to site radioactivity and are expressed in terms of millirem per Industrial Area year (mrem/IA-yr).

- **Remote Work Area.** Assumes non-continuous work activities at a site. This scenario assumes that the site is an area where the worker regularly visits but is not an assigned work area where the worker spends an entire workday. A site worker under this scenario is assumed to be on the site for an equivalent of 336 hours per year (hr/yr) (or 8 hr/day for 42 day/yr) for an entire career (25 years). The worker is assumed to spend 1/3 of the workday outdoors exposed to contaminated soil. The TED values calculated using this exposure scenario are the TED a remote area worker receives during 336 hours of annual exposure to site radioactivity and are expressed in terms of millirem per Remote Work Area year (mrem/RW-yr).

- **Occasional Use Area.** Assumes occasional work activities at a site. This scenario assumes that this is an area where the worker does not regularly visit but may occasionally use for short-term activities. A site worker under this scenario is assumed to be on the site for an equivalent of 80 hr/yr (or 8 hr/day for 10 day/yr) for 5 years. The TED values calculated using this exposure scenario are the TED an occasional use worker receives during 80 hours of annual exposure to site radioactivity and are expressed in terms of millirem per Occasional Use Area year (mrem/OU-yr).

In accordance with the graded approach described in the Soils QAP (NNSA/NSO, 2012b), the dataset quality will be determined by its intended use in decision making. Data used to define the presence of COCs are classified as decisional and will be used to make corrective action decisions. Survey data are classified as decision supporting and are not used, by themselves, to make corrective action decisions. As presented in Appendix D, the radiological FALs are based on the Occasional Use Area site-specific exposure scenario, and chemical FALs are based on the Industrial Area exposure scenario.

An assumption was made that corrective action is required within the areas meeting HCA conditions at San Juan, Chavez, and the HCA soil pile; and for subsurface contamination within the DCBs at nine underground SEs (San Juan, Otero, Pascal-A, Pascal-B, Pascal-C, Luna, Colfax, Valencia, and Chipmunk) that vented radioactivity to the soil surface. Methods used for calculating internal, external, and total dose are presented in the Soils RBCA document (NNSA/NFO, 2014b).

The following subsections describe specific investigation activities conducted at the releases within each study group. Additional information regarding the investigation is presented in Appendix A.

2.1.1 Study Group 1, Releases within a Defined Radiological Survey Signature

Investigation activities at Study Group 1 included performing visual inspections, conducting GPS-assisted TRSs, staging TLDs, and collecting surface and subsurface soil samples at areas with defined radiological survey signatures. During the visual inspections, concrete pads and radiological postings were identified. No other biasing factors were identified. The TRSs were conducted over the area associated with the plumes identified in the 2012 americium aerial survey (Stampahar, 2012) (outside the DCBs) to identify locations of elevated radiological readings to determine sample locations. A TRS was also conducted within the DCB at the Chavez HCA to determine locations of elevated radiological readings for grab soil sampling for informational purposes only. The results of the TRS confirmed that the fallout plume was positioned as expected, and showed some scattered levels of radiation within some of the plumes indicative of the soil disturbance from the historical blading of the area and creation of windrows. One 100-square-meter (m^2) sample plot was then established within each plume at the location containing the highest TRS readings (Locations A04, A11, A22, A24, A25, A28, A29, and A31) (see Figures A.2-1 and A.3-1).

Sample plots were also established along vectors within isopleths from the 2012 americium aerial survey (Stampahar, 2012) (Locations A01–A03, A05–A07, A08–A10, A12–A14, and A16–A21) (see Figure A.3-2). Subsurface screening and sample collection was conducted within vector sample plots A06 and A07 placed within the plume containing the San Juan, Otero, and Pascal-C releases, in the area historically identified as containing windrows. This subsurface investigation was conducted to determine whether buried chemical and/or radiological contamination is present. Additional sample plots were placed at other areas of elevated TRS readings (Locations A15, A23, and A32) (see Figure A.3-1). One sample plot was placed within an area of low radiological readings (A30) within the Pascal-B plume. Subsurface screening and sample collection was conducted within these sample plots to determine whether buried contamination is present, due to blading historically conducted in the area.

Biased grab samples were also collected from three release locations within Study Group 1 (Locations B01, B02, and A25a) (see Figure A.3-1). Locations B01 and B02 were established nearest to the GZs of two underground SEs (Luna and Colfax) at elevated radiological readings; and Location A25a was established southeast of the Platypus GZ within an area of elevated radiological readings. TLDs were installed at all sample locations discussed above within Study Group 1 to measure external radiological doses.

Two biased grab samples were collected from Locations A33 and A34 within the DCB at Chavez. These grab samples were collected only for informational purposes.

Sampling activities to determine internal dose at sample plots consisted of collecting composite surface soil samples from nine unbiased locations within each sample plot. See Section A.3.1 for additional information on investigation activities at Study Group 1. Results of the sampling effort are reported in Section 2.2.

The conceptual site model (CSM) and associated discussion for this study group are provided in the CAIP (NNSA/NFO, 2014a). The contamination pattern of the radionuclides at Study Group 1 is consistent with the CSM in that the radiological contamination is greatest at the release point and generally decreases with distance from the release point. Additionally, some areas of radiological readings are sporadic due to historical blading and windrow formation. Information gathered during the CAI supports and validates the CSM as presented in the CAIP. No modification to the CSM was needed.

2.1.2 Study Group 2, Releases Located within a Crater or Potential Crater Area That Cannot Be Entered

Investigation activities at the Study Group 2 releases included performing visual inspections, conducting GPS-assisted TRSs, staging TLDs, and collecting surface soil samples. During the visual inspections, fence lines and t-posts indicating the crater and potential crater boundaries were identified. No other biasing factors were identified. The TRSs were conducted in the areas surrounding the craters or potential crater areas to determine whether contamination released from the associated underground test extends beyond the crater boundary. The results of the TRS showed that elevated radiological readings were identified at the southern edge of the Boomer crater, attributed to the Boomer test release. A sample plot was established at this location of elevated radiological readings (see Figure A.4-1). Elevated radiological readings were also identified adjacent to the western edge of the Solendon potential crater area (northwest of the Tendrac crater area). These elevated radiological readings are believed to be associated with the release from the San Juan test, not with the Solendon or Tendrac tests. A sample plot was established at this location (Location A15) of elevated radiological readings (see Figure A.3-1).

TLDs were installed at both sample plot locations to measure external radiological doses. Sampling activities to determine internal dose at sample plots consisted of collecting composite surface soil samples from nine unbiased locations within each sample plot. See Section A.4.1 for additional information on investigation activities at the Study Group 2 releases. Results of the sampling effort are reported in Section 2.2.

The CSM and associated discussion for this study group are provided in the CAIP (NNSA/NFO, 2014a). The contamination pattern of the radionuclides at the Study Group 2 releases is consistent with the CSM in that the radiological contamination is greatest at the release point (GZ) and generally decreases with distance from the release point. Information gathered during the CAI supports and validates the CSM as presented in the CAIP. No modification to the CSM was needed.

2.1.3 Study Group 3, Releases with No Radiological Survey Signature

Investigation activities at the Study Group 3 releases included performing visual inspections, conducting GPS-assisted TRSs, staging TLDs, and collecting surface soil samples. During the visual inspections, emplacement holes and concrete emplacement hole pads were identified. The TRSs were conducted in the release areas near GZ at Shrew, Mink, Chipmunk, and Funnel to identify any locations of elevated radiological readings. The results of the TRS showed that no elevated radiological readings were identified in close proximity to the GZs. Sample locations were established nearest to the GZs at the Shrew, Mink, and Chipmunk because these GZs are located within an area where multiple other test releases occurred (see Figure A.5-1). A grab sample was not collected from the Funnel GZ area because no other tests around Funnel had surface releases of radioactivity.

TLDs were installed at the three sample locations (Shrew, Mink, Chipmunk) to measure external radiological doses (see Figure A.5-1). Sampling activities to determine internal dose at sample locations consisted of collecting surface grab soil samples. See Section A.5.1 for additional information on investigation activities at the Study Group 3 releases. Results of the sampling effort are reported in Section 2.2.

The CSM and associated discussion for this study group are provided in the CAIP (NNSA/NFO, 2014a). The contamination pattern of the radionuclides at the Study Group 3 releases is consistent with the CSM in that the releases at this study group have no radiological survey signatures. The radionuclides released from the Study Group 3 test releases were either short-lived radionuclides or released at low concentrations such that the remaining activities are insufficient to be detected by the aerial or TRS instruments. Information gathered during the CAI supports and validates the CSM as presented in the CAIP. No modification to the CSM was needed.

2.1.4 Study Group 4, Spills and Debris

Investigation activities at the Study Group 4 area included performing visual inspections, conducting GPS-assisted TRSs, staging TLDs, and collecting surface and subsurface soil samples. During the visual inspections at CAU 568, PSM was identified that included four well head covers, lead bricks, lead-acid batteries, lead plates, lead shot, lead sheets, a transformer, an HCA soil pile, and soil and debris piles with lead items on their surfaces (see Figure A.6-1). During interim corrective actions, lead items (including four broken lead-acid batteries, one intact lead-acid battery, 15 lead bricks, two lead sheets, and 28 lead plates) and a transformer were removed from the site. The area of lead shot, any PSM within the soil and debris piles, and the well head covers were not removed.

Grab samples were collected from the stained soil area beneath the transformer for environmental and waste management purposes. Grab samples were also collected from beneath lead items, including lead plates near the San Juan GZ and lead items on the soil and debris piles. Composite plot samples were collected from beneath the lead bricks and lead batteries (see Table A.6-2 and Figure A.6-3).

TRSs were conducted in the area of the HCA soil pile and the three soil and debris piles to identify any locations of elevated radiological readings and to determine the extent of elevated readings associated with the piles. The results of the TRS showed that elevated radiological readings were identified around the toes of the three soil and debris piles, within the HCA soil pile (DCB), and adjacent to the southern edge of the posted HCA. Based on the TRSs, sample locations were established within the HCA soil pile and adjacent to the southern edge of the HCA soil pile (see Figure A.6-1). TLDs were installed at these sample locations to measure external radiological doses. Sampling activities to determine internal dose at sample locations consisted of collecting composite surface soil samples from nine unbiased locations within each sample plot. Sample locations were also established on and around the soil and debris piles for waste management purposes.

See Section A.6.1 for additional information on investigation activities at Study Group 4. Results of the sampling effort are reported in Section 2.2.

The CSM and associated discussion for this study group are provided in the CAIP (NNSA/NFO, 2014a). The contamination pattern of the radionuclides at the Study Group 4 releases is consistent with the CSM in that the released contaminants are greatest beneath and surrounding the PSM. Information gathered during the CAI supports and validates the CSM as presented in the CAIP. No modification to the CSM was needed.

2.1.5 Study Group 5, Drainages

Investigation activities at the Study Group 5 area included performing visual inspections, conducting GPS-assisted TRSs, staging TLDs, and collecting surface soil samples. During the visual inspections, sedimentation areas were identified. The TRSs were conducted within the small drainage at the northern edge of 3-03 Road, across 3-03 Road, and to the edge of the Agouti test crater to identify locations of elevated radiological readings in order to bias locations for grab soil sampling. No locations of elevated radiological readings were identified during the TRS. Instead, two sample locations were chosen based on visual sedimentation areas (see Figure A.7-1).

TLDs were installed at both sample locations to measure external radiological doses. Sampling activities to determine internal dose at sample locations consisted of collecting surface grab samples. See Section A.7.1 for additional information on investigation activities at Study Group 5. Results of the sampling effort are reported in Section 2.2.

The CSM and associated discussion for this study group are provided in the CAIP (NNSA/NFO, 2014a). The contamination pattern of the radionuclides at Study Group 5 is consistent with the CSM. Information gathered during the CAI supports and validates the CSM as presented in the CAIP. No modification to the CSM was needed.

2.2 Results

The summary of data from the CAI provided in Section 2.2.1 defines the areas within CAU 568 where the contaminants of potential concern (COPCs) exceeded the FALs and extent of all identified COCs. Section 2.2.2 summarizes the assessment made in Appendix B, which demonstrates that the CAI results satisfy the DQO data requirements.

The preliminary action levels (PALs) and FALs for radioactivity are based on an annual dose limit of 25 mrem/yr. This dose limit is specific to the annual dose a receptor could potentially receive from a CAU 568 release. As such, it is dependent upon the cumulative annual hours of exposure to site contamination. The PALs for radioactivity were established in the CAIP (NNSA/NFO, 2014a) based on a dose limit of 25 mrem/yr over an annual exposure time of 2,000 hours (i.e., the Industrial Area exposure scenario that a site worker would be exposed to site contamination 8 hr/day for 250 day/yr). The FALs for radioactivity were established in Appendix D based on a dose limit of 25 mrem/yr over an annual exposure time of 80 hours (i.e., the Occasional Use Area exposure scenario defines that a site worker would be exposed to site contamination 8 hr/day for 10 day/yr). To be comparable to these action levels, the CAU 568 investigation results are presented in terms of the dose a receptor would receive from site contamination under the Industrial Area (mrem/IA-yr) and Occasional Use Area (mrem/OU-yr) exposure scenarios.

The chemical PALs are based on the U.S. Environmental Protection Agency (EPA) Region 9 Regional Screening Levels (RSLs) for chemical contaminants in industrial soils (EPA, 2015) except where natural background concentrations of *Resource Conservation and Recovery Act* (RCRA) metal exceed the screening level (e.g., arsenic on the NNSS). With the exception of lead and arsenic, the chemical FALs were established in Appendix C at the PAL concentrations.

The FALs for removable contamination are based on the criteria defined in Section 8.4 of the Soils RBCA document (NNSA/NFO, 2014b). This conservatively assumes that removable contamination meeting HCA criteria is defined as a COC and requires corrective action.

2.2.1 Summary of Analytical Data

The following subsections present a summary of the analytical and computational results for soil and TLD samples at collected from the releases within Study Groups 1 through 5. All sampling and analyses were conducted as specified in the CAIP (NNSA/NFO, 2014a). Results that are equal to or greater than the FAL are identified by bold text in the data tables presented in the Investigation Results sections of Sections A.3.0 through A.7.0.

Chemical results are reported as individual analytical results compared to their individual FALs. PSM samples are evaluated against the PSM criteria and assumptions defined in Section A.2.4 to determine whether a release of the waste to the surrounding environmental media could cause the presence of a COC in the environmental media. Radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr as established in Appendix D. Calculation of the TED for each sample was accomplished through summation of internal and external dose as described in Sections A.3.3.3, A.4.3.3, A.5.3.3, A.6.3.3, and A.7.3.3.

Judgmental sample results are reported as individual analytical results and as multiple contaminant analyses where the combined effect of contaminants are compared to FALs. Probabilistic sample results are reported as the average and the 95 percent UCL of the average results.

2.2.1.1 Study Group 1, Releases within a Defined Radiological Survey Signature

Soil and TLD samples were collected from 30 sample plots and five grab sample locations within the releases at Study Group 1 (see Figure A.3-1). Based on the results of TLD, surface soil samples (0 to 5 cm bgs), and subsurface soil samples (15 to 20 cm bgs and 20 to 25 cm bgs) collected at Study Group 1, radiological contamination does not exceed the FAL (25 mrem/OU-yr) at any sampled location. Removable contamination meets HCA conditions within the HCA (DCB) at Chavez, and the HCA at Pascal-B. It is assumed that a dose above FALs is present within the eight DCBs for subsurface contamination associated with the underground SEs in Study Group 1. The corrective action boundaries for these DCBs and HCA areas are shown on Figure A.3-3. The average and the 95 percent UCL TED values for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios for all sample locations in Study Group 1 are presented in Table A.3-8.

2.2.1.2 Study Group 2, Releases Located within a Crater or Potential Crater Area That Cannot Be Entered

Soil and TLD samples were collected from the Boomer release outside the crater area (see Figure A.4-1). Based on the results of TLD and surface soil samples (0 to 5 cm bgs) collected at Study Group 2, radiological contamination does not exceed the FAL for the radiological dose (25 mrem/OU-yr) at the sampled location. However, according to Section 4.2.2.2 of the CAIP (NNSA/NFO, 2014a) and Section 8.5.2 of the RBCA document, if there is radioactivity above background (as detected during the TRS) originating from the test release within the crater area, the entire crater area will be included in a corrective action boundary (CAB) (NNSA/NFO, 2014b). This area is shown on Figure A.4-2. The average and the 95 percent UCL TED values for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios for the sampled location in Study Group 2 are presented in Table A.4-4.

There were no elevated TRS values detected around the remaining test releases in Study Group 2 that would indicate the potential presence of COCs originating from any of these release sites. Therefore, no sampling was conducted at those releases.

2.2.1.3 Study Group 3, Releases with No Radiological Survey Signature

Soil and TLD samples were collected from the Chipmunk, Mink, and Shrew GZ areas. Based on the results of TLD and surface soil samples (0 to 5 cm bgs) collected at Study Group 3, radiological contamination does not exceed the FAL for the radiological dose (25 mrem/OU-yr) at any sampled location. It is assumed a dose above FALs is present within the DCB for subsurface contamination associated with the Chipmunk underground SE. This area is shown on Figure A.5-2. The average and the 95 percent UCL TED values for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios for all sample locations in Study Group 3 are presented in Table A.5-5.

2.2.1.4 Study Group 4, Spills and Debris

PSM items consisting of lead-acid batteries, lead bricks, lead plates, lead sheets, lead shot, and a transformer were identified at the site, including on the surfaces of the soil and debris piles (see Figure A.6-1). All visible lead-acid batteries, lead bricks, lead plates, lead sheets, and the transformer were removed from the site. Verification samples were collected from the soil beneath the PSM (see Figure A.6-3). The FAL for lead was exceeded at broken battery Location C17. Chemical contamination in the remaining soil at all other sampled PSM locations was below FALs. The lead shot PSM (Location C19) was not removed from the site. Additionally, based on the presence of surface lead debris on the three soil and debris piles, there is the potential for additional lead items to be present within the piles.

Based on the results of TLD and soil samples collected from the HCA soil pile (see Figure A.6-2), radiological contamination does not exceed the FAL for the radiological dose (25 mrem/OU-yr). However, removable contamination meets HCA conditions for the debris within the HCA soil pile (established as a DCB in the CAIP [NNSA/NFO, 2014a]). Removable contamination also meets HCA conditions for the well head covers at San Juan (DCB), Luna, and Valencia. These HCAs are assumed to exceed the FAL of 25 mrem/OU-yr. These locations are shown on Figure A.6-5.

The average and the 95 percent UCL TED values for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios for all radiological sample locations in Study Group 4 are presented in Table A.6-6. The analytical results of soil samples collected after corrective actions were completed are presented in Tables A.6-7, A.6-8, A.6-9, and A.6-10.

2.2.1.5 Study Group 5, Drainages

Soil and TLD samples were collected from within two locations in the identified drainage (see Figure A.7-1). Based on the results of TLD and surface soil samples (0 to 5 cm bgs) collected at Study Group 5, radiological contamination does not exceed the FAL for the radiological dose (25 mrem/OU-yr) at any sampled location. The average and the 95 percent UCL TED values for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios for all sample locations in Study Group 5 are presented in Table A.7-5.

2.2.2 Data Assessment Summary

The DQA is presented in Appendix B and includes an evaluation of the data quality indicators (DQIs) to determine the degree of acceptability and usability of the reported data in the decision-making process. The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps to ensure that DQO decisions are sound and defensible.

The DQA process as presented in Appendix B is composed of the following five steps:

1. Review DQOs and Sampling Design.
2. Conduct a Preliminary Data Review.
3. Select the Test.
4. Verify the Assumptions.
5. Draw Conclusions from the Data.

The results of the DQI evaluation show that some of the data were identified as having quality issues associated with precision, accuracy, completeness, and sensitivity. However, as explained in Appendix B, these deficiencies do not affect the decision-making process.

The results of the DQI evaluation in Appendix B show that all DQI criteria were met and that the CAU 568 dataset support their intended use in the decision-making process. Based on the results of the DQA, the nature and extent of COCs at CAU 568 have been adequately identified to develop and evaluate CAAs. The DQA also determined that information generated during the investigation supports the CSM assumptions, and the data collected met the DQOs.

2.3 Need for Corrective Action

Analytes detected during the CAI were evaluated against FALs to identify COCs. Table A.10-1 lists the COCs identified at the CAU 568 CASs. The presence of a COC requires a corrective action. A corrective action is also required for DCBs or areas meeting HCA conditions because radiological dose is assumed to exceed the FAL within these areas. A corrective action may also be required if a waste is present containing contamination that, if released, could cause the surrounding environmental media to contain a COC (PSM). An evaluation of possible remedial alternatives is required for all releases that require a corrective action (presented in Section 3.0). The CAAs are identified in Section 3.0 and evaluated for their ability to ensure protection of the public and the environment in accordance with *Nevada Administrative Code* (NAC) 445A (NAC, 2014a), feasibility, and cost-effectiveness. CAAs are not evaluated for releases that do not contain COCs or PSM (following corrective actions completed during the CAI).

The impacted volume and characteristics are provided in each CAS-specific subsection below. Volume calculations for contaminated material to be removed from each area are shown in Appendix C. Site-specific characteristics that might constrain remediation at each of the CASs are the presence of subsidence craters within which access is prohibited, or underground and/or overhead utilities and facility structures.

2.3.1 Study Group 1, Releases within a Defined Radiological Survey Signature

Based on analytical results of environmental samples collected from 30 sample plots and five grab sample locations within the releases at Study Group 1, no COCs were identified. However, HCA conditions exist within the Chavez and Pascal-B HCAs, and it is assumed that radiological contamination within these areas exceeds the FAL of 25 mrem/OU-yr. These areas require corrective action. The extent of the area requiring corrective action is bounded by the physical boundary of each HCA to a depth of 1 ft bgs. The estimated volume for the Chavez and Pascal-B HCAs are 1,220 cubic yards (yd^3) and 240 yd^3, respectively.

DCBs are associated with eight underground SEs at Study Group 1. These areas require corrective action. For the SE DCBs, the extent of the areas requiring corrective action is bounded by the emplacement hole concrete pads (except for Otero and Pascal-C, which have no visible concrete pad), down to a depth of 25 ft bgs. The estimated volume for each of the SE DCBs is 22,500 cubic feet (ft^3) (834 yd^3) of soil and debris.

2.3.2 Study Group 2, Releases Located within a Crater or Potential Crater Area That Cannot Be Entered

Based on analytical results of environmental samples collected from the Boomer release at this study group, no COCs were identified. However, it is assumed that radiological contamination at levels exceeding the FAL of 25 mrem/OU-yr is present within the Boomer crater area, based on the presence of radiological readings above background adjacent to the Boomer crater area (Location A26). This area requires corrective action. The extent of the area requiring corrective action is bounded by the visible crater area to a depth of 25 ft bgs. The estimated volume for the Boomer crater area is 10,000 ft^3 (370 yd^3).

2.3.3 Study Group 3, Releases with No Radiological Survey Signature

Based on analytical results of environmental samples collected from the Chipmunk, Mink, and Shrew GZ areas at this study group, no COCs were identified. However, it is assumed that radiological contamination at levels exceeding the FAL is present within the DCB associated with the Chipmunk underground SE. This area requires corrective action. The extent of the area requiring corrective action is bounded by the emplacement hole concrete pad, down to a depth of 25 ft bgs. The estimated volume for the SE DCB is 22,500 ft^3 (834 yd^3) of soil and debris.

2.3.4 Study Group 4, Spills and Debris

PSM was identified at the site (Section 2.1.4). All visible PSM, except for the well head covers and lead shot, was removed as an interim corrective action. After the PSM was removed and verification soil samples were collected (see Section A.6.1), no further corrective action is required at any PSM location except for the lead-contaminated soil underneath battery Location C17. Because lead was detected above FALs within the soil at this location, the soil requires corrective action. The extent of the lead COC contamination at Location C17 is limited to 1 ft bgs and comprises approximately 1.7 yd^3.

At Location C19, the lead shot requires corrective action. The extent of PSM at lead shot Location C19 is limited to 1 ft bgs and comprises approximately 75 yd^3 of potentially affected soil and lead shot.

It is assumed that PSM may be present within the three soil and debris piles; therefore, these locations require corrective action. The extent of COC contamination is limited to the physical extent of the soil and debris piles. The estimated volumes of the three soil and debris piles are 288 yd^3, 78 yd^3, and 141 yd^3.

HCA conditions exist within San Juan, Valencia, and Luna, based on the removable contamination associated with the well head covers, and it is assumed that radiological contamination levels exceeds the FAL of 25 mrem/OU-yr. These areas require corrective action. The extent of the area requiring corrective action is bounded by each physical well head cover. Although the Otero well head cover does not meet HCA conditions (it only meets CA conditions), it is recommended it be included in the chosen corrective action because the Otero well head cover is similar to the other three identified well head covers. The estimated volume for the San Juan, Valencia, Luna, and Otero well head covers is 1 yd^3 for each location.

HCA conditions are present within the HCA soil pile, and it is assumed that radiological contamination levels exceed the FAL of 25 mrem/OU-yr. This area is assumed to exceed the FAL of 25 mrem/OU-yr and requires corrective action. There is also the potential for PSM to be present within the HCA soil pile. The extent of the area requiring corrective action is bounded by the physical pile. The estimated volume of the HCA soil pile is 28 yd^3.

2.3.5 Study Group 5, Drainages

Based on analytical results of environmental samples collected from the drainage at this study group, no COCs were identified. Therefore, no corrective action is required for the drainage at CAS 03-23-26.

3.0 Evaluation of Alternatives

The purpose of this section is to present the corrective action objectives for CAU 568, describe the general standards and decision factors used to screen the various CAAs, and develop and evaluate a set of selected CAAs that will meet the corrective action objectives. This CAA evaluation is intended for use in making corrective action decisions for CAU 568 conditions at the conclusion of the CAI (after the completion of any interim corrective actions). As no further corrective action is required for sites where corrective actions were completed during the CAI, those sites will not be included in the evaluation of CAAs.

3.1 Corrective Action Objectives

The RBCA process used to establish FALs is described in the Soils RBCA document (NNSA/NFO, 2014b). This process conforms with NAC 445A.227, which lists the requirements for sites with soil contamination (NAC, 2014b). For the evaluation of corrective actions, NAC 445A.22705 (NAC, 2014c) requires the use of ASTM International (ASTM) Method E1739 (ASTM, 1995) to "conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary." For the evaluation of corrective actions, the FALs are established as the necessary remedial standard.

This RBCA process defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses. These tiers are defined in Appendix D.

A Tier 1 evaluation was conducted for all detected contaminants to determine whether contaminant levels satisfy the criteria for a quick regulatory closure or warrant a more site-specific assessment. For chemical contaminants, this was accomplished by comparing individual source area contaminant concentration results to the Tier 1 action levels (the PALs established in the CAIP [NNSA/NFO, 2014a]). For radiological contaminants, this was accomplished by comparing the radiological PAL of 25 mrem/IA-yr to the TED at each sample location calculated using the Industrial Area exposure scenario.

The contaminants detected in samples collected at CAU 568 that exceeded Tier 1 action levels were lead at Study Group 4 and radiological dose at Study Groups 1 and 4.

The concentrations of all other sampled contaminants were below Tier 1 action levels. The FALs for all non-radiological contaminants were established as the Tier 1 action levels. The FALs for radiological contaminants were passed on to a Tier 2 evaluation.

The Tier 2 evaluation was conducted in accordance with the Soils RBCA document (NNSA/NFO, 2014b). This evaluation (presented in Appendix D) was based on risk to receptors. The risk to receptors from contaminants at CAU 568 is due to chronic exposure to contaminants (e.g., receiving a dose over time). Therefore, the risk to a receptor is directly related to the amount of time a receptor is exposed to the contaminants. A review of the current and projected use of CAU 568 sites determined that workers may be present at these sites for only a limited number of hours per year, and it is not reasonable to assume that any worker would be present at this site on a full-time basis (NNSA, 2014).

Based on current site usage, it was determined in the CAU 568 DQOs that the Occasional Use Area exposure scenario is appropriate in calculating receptor exposure time. In order to quantify the maximum number of hours a site worker may be present at CAU 568, current and anticipated future site activities were evaluated in Appendix D. This evaluation concluded that the most exposed worker under current land usage is an inspection and maintenance worker, who has the potential to be present at the site for up to 10 hr/yr at each FFACO UR. As a result, it was determined that the most exposed worker could not be exposed to site contamination for more time than is assumed under the Occasional Use exposure scenario (80 hr/yr). Therefore, the TEDs at each location were calculated using a more conservative exposure time of 80 hr/yr, and the 95 percent UCL of the TED measured at each location was used to compare to the FAL. Additional details of the Tier 2 evaluation for radionuclides are provided in Appendix D.

The Tier 2 evaluation for lead compared the analytical results to the Tier 2 action levels. The Tier 2 action level was calculated using EPA's Adult Lead Methodology (ALM) to estimate the concentration of lead in the blood of pregnant women and their developing fetuses who might be exposed to lead-contaminated soils (EPA, 2009b). This calculation used a site-specific soil ingestion rate (of 0.0667 grams/day [g/day]) and an exposure frequency of 44 day/yr. The FAL for lead established in Appendix D using this methodology is 5,739 milligrams per kilogram (mg/kg).

The FALs for all CAU 568 COPCs are shown in Table 3-1.

Table 3-1
Definition of PALs and FALs for CAU 568 COPCs

COPCs	Tier 1 Based FALs	Tier 2 Based FALs	Tier 3 Based FALs
VOCs	EPA Region 9 RSLs	None	N/A
SVOCs	EPA Region 9 RSLs	None	N/A
PCBs	EPA Region 9 RSLs	None	N/A
RCRA Metals (other than lead)	EPA Region 9 RSLs	None	N/A
Lead	800 mg/kg	5,739 mg/kg	N/A
Radionuclides	25 mrem/IA-yr	25 mrem/OU-yr	N/A

N/A = Not applicable
PCB = Polychlorinated biphenyl
SVOC = Semivolatile organic compound
VOC = Volatile organic compound

The RBCA dose evaluation does not address the potential for removable contamination to be transported to other areas. A discussion on the risks associated with removable radioactive contamination is presented in the Soils RBCA document (NNSA/NFO, 2014b). This requires corrective action for areas containing HCA conditions even though the area may not present a potential radiation dose to a receptor that exceeds the FAL. Therefore, it is assumed that areas of HCA conditions require corrective action.

A corrective action may also be required if a waste present within a CAS contains contaminants that, if released, could cause the surrounding environmental media to contain a COC. Such a waste would be considered PSM. To evaluate wastes for the potential to result in the introduction of a COC to the surrounding environmental media, the conservative assumption is made that any physical waste containment will fail at some point and the contaminants will be released to the surrounding media. The criteria to be used for determining whether a waste is PSM are defined in the Soils RBCA document (NNSA/NFO, 2014b).

3.2 Screening Criteria

The screening criteria used to evaluate and select the preferred CAAs are identified in the EPA *Guidance on RCRA Corrective Action Decision Documents* (EPA, 1991) and the *Final RCRA Corrective Action Plan* (EPA, 1994).

CAAs are evaluated based on four general corrective action standards and five remedy selection decision factors. All CAAs must meet the four general standards to be selected for evaluation using the remedy selection decision factors.

The general corrective action standards are as follows:

- Protection of human health and the environment
- Compliance with media cleanup standards
- Control the source(s) of the release
- Comply with applicable federal, state, and local standards for waste management

The remedy selection decision factors are as follows:

- Short-term reliability and effectiveness
- Reduction of toxicity, mobility, and/or volume
- Long-term reliability and effectiveness
- Feasibility
- Cost

3.2.1 Corrective Action Standards

The following text describes the corrective action standards used to evaluate the CAAs.

Protection of Human Health and the Environment

Protection of human health and the environment is a general mandate of the RCRA statute (EPA, 1994). This mandate requires that the corrective action include any necessary protective measures. These measures may or may not be directly related to media cleanup, source control, or management of wastes. The CAAs are evaluated for the ability to be protective of human health and the environment through an evaluation of risk as presented in Appendix D.

Compliance with Media Cleanup Standards

The CAAs are evaluated for the ability to meet the proposed media cleanup standards. The media cleanup standards are the FALs defined in Appendix D.

Control the Source(s) of the Release

The CAAs are evaluated for the ability to stop further environmental degradation by controlling or eliminating additional releases that may pose a threat to human health and the environment. Unless source control measures are taken, efforts to clean up releases may be ineffective or, at best, will essentially involve a perpetual cleanup. Therefore, each CAA must provide effective source control to ensure the long-term effectiveness and protectiveness of the corrective action.

Comply with Applicable Federal, State, and Local Standards for Waste Management

The CAAs are evaluated for the ability to be conducted in accordance with applicable federal and state regulations (e.g., 40 CFR 260 to 282, "Hazardous Waste Management" [CFR, 2014a]; 40 CFR 761 "Polychlorinated Biphenyls," [CFR, 2014b]; and NAC 444.842 to 444.980, "Facilities for Management of Hazardous Waste" [NAC, 2012]).

3.2.2 Remedy Selection Decision Factors

The following text describes the remedy selection decision factors used to evaluate the CAAs.

Short-Term Reliability and Effectiveness

Each CAA must be evaluated with respect to its effects on human health and the environment during implementation of the selected corrective action. The following factors will be addressed for each alternative:

- Protection of the community from potential risks associated with implementation, such as fugitive dusts, transportation of hazardous materials, and explosion
- Protection of workers during implementation
- Environmental impacts that may result from implementation
- The amount of time until the corrective action objectives are achieved

Reduction of Toxicity, Mobility, and/or Volume

Each CAA must be evaluated for its ability to reduce the toxicity, mobility, and/or volume of the contaminated media. Reduction in toxicity, mobility, and/or volume refers to changes in one or more characteristics of the contaminated media by the use of corrective measures that decrease the inherent threats associated with that media.

Long-Term Reliability and Effectiveness

Each CAA must be evaluated in terms of risk remaining at the CAU after the CAA has been implemented. The primary focus of this evaluation is on the extent and effectiveness of the control that may be required to manage the risk posed by treatment of residuals and/or untreated wastes.

Feasibility

The feasibility criterion addresses the technical and administrative feasibility of implementing a CAA and the availability of services and materials needed during implementation. Each CAA must be evaluated for the following criteria:

- **Construction and operation.** Refers to the feasibility of implementing a CAA given the existing set of waste and site-specific conditions.
- **Administrative feasibility.** Refers to the administrative activities needed to implement the CAA (e.g., permits, URs, public acceptance, rights of way, offsite approval).
- **Availability of services and materials.** Refers to the availability of adequate offsite and onsite treatment, storage capacity, disposal services, necessary technical services and materials, and prospective technologies for each CAA.

Cost

Costs for each alternative are estimated for comparison purposes only. The cost estimate for each CAA includes both capital, and operation and maintenance costs, as applicable, and are provided in Appendix C. The following is a brief description of each component:

- **Capital costs.** These include direct costs that may consist of materials, labor, construction materials, equipment purchase and rental, excavation and backfilling, sampling and analysis, waste disposal, demobilization, and health and safety measures. Indirect costs are separate and not included in the estimates.

- **Operation and maintenance costs.** These costs are separate and include labor, training, sampling and analysis, maintenance materials, utilities, and health and safety measures. These costs are not included in the estimates.

3.3 Development of CAAs

This section identifies and briefly describes the viable corrective action technologies and the CAAs considered for each CAU 568 CAS. The CAAs are based on the current nature of contamination at CAU 568, which does not include contamination removed as part of the corrective actions completed during the CAI (Section 2.2.1). Based on the review of existing data, future use, and current operations at the NNSS, the following alternatives have been developed for consideration at CAU 568:

- **Alternative 1.** No further action
- **Alternative 2.** Clean closure
- **Alternative 3.** Closure in place with administrative controls

3.3.1 Alternative 1 – No Further Action

Under the no further action alternative, no CAI activities will be implemented. This alternative is a baseline case with which to compare and assess the other CAAs and their ability to meet the corrective action standards.

3.3.2 Alternative 2 – Clean Closure

Alternative 2 includes excavating and disposing of PSM and impacted soil at all areas that require corrective action. A visual inspection will be conducted to ensure that PSM has been removed before the corrective action is completed. Verification samples will be collected and analyzed for the presence of a COC after the contaminated soil is removed.

Contaminated materials removed will be disposed of at an appropriate disposal facility. Excavated areas will be returned to surface conditions compatible with the intended future use of the site.

3.3.3 Alternative 3 – Closure in Place with Administrative Controls

Alternative 3 includes the implementation of a UR at all areas that require corrective action. This UR will restrict inadvertent contact with contaminated media by prohibiting any activity that would cause a site worker to be exposed to COCs exceeding the risk evaluation basis as presented in Appendix D. This alternative also includes engineering controls to cover contamination at the surface within the SE DCBs and the Boomer GZ area.

3.4 Evaluation and Comparison of Alternatives

The evaluation of CAAs does not include corrective actions that were completed during the CAI. The corrective actions that were completed during the CAU 568 field investigation were as follows:

- *Removal of lead items included in CASs 03-08-04 and 03-26-04.* This corrective action involved the removal of lead-acid batteries, lead plates, lead sheets, and lead bricks. No soil was removed from the immediate area of the lead. Confirmation samples were collected and analyzed. Only the soil underneath lead-acid battery Location C17 exceeded the FAL for lead and requires corrective action. Lead shot (Location C19) was not removed from the site as an interim corrective action. This lead shot PSM requires corrective action.

- *Removal of a transformer included in CAS 03-26-04.* Soil samples were collected from the stained soil beneath the transformer and analyzed. This soil was not removed from the site. The analytical results did not exceed the FALs.

Verification of the completion of these corrective actions are documented in this report. A summary of CAI results and required corrective actions are presented in Table 3-2 for each CAU 568 release.

Each CAA presented in Section 3.3 was evaluated by stakeholders in the CAA meeting conducted on June 11, 2015, for the CASs that require corrective action based on the general corrective action standards listed in Section 3.2. This evaluation is presented in Table 3-3 along with the preferred alternative. The CAAs of clean closure and closure in place with UR met the general corrective action standards.

Table 3-2
Summary of Investigation Results at CAU 568
(Page 1 of 2)

Release	CAS Number	CAI Results	Corrective Action
Chavez SE surface release	03-23-17, 03-23-19	No COCs identified	None
Chavez HCA (DCB)	03-23-19	HCA conditions assumed to exceed FALs	Required
Otero, San Juan, and Pascal-C SEs surface release	03-23-20, 03-23-23	No COCs identified	None
Otero SE DCB	03-23-20	Assumed TED above FALs in SE DCB	Required
Otero well head cover (PSM)		Removable contamination meets CA conditions	Required
Platypus weapons-related test surface release	03-23-22	No COCs identified	None
San Juan SE DCB	03-23-23	Assumed TED above FALs in SE DCB	Required
San Juan well head cover (PSM)		HCA conditions assumed to exceed FALs	Required
Pascal-C SE DCB		Assumed TED above FALs in SE DCB	Required
Bernalillo SE surface release		No COCs identified	None
Former windrows		No COCs identified	None
Shrew weapons-related test surface release	03-23-26	No COCs identified	None
Wolverine weapons-related test surface release		No COCs identified	None
Drainage		No COCs identified	None
Pascal-B SE surface release	03-23-31	No COCs identified	None
Pascal-B HCA		HCA conditions assumed to exceed FALs	Required
Pascal-B SE DCB		Assumed TED above FALs in SE DCB	Required
Luna SE surface release		No COCs identified	None
Luna SE DCB		Assumed TED above FALs in SE DCB	Required
Luna well head cover (PSM)		HCA conditions assumed to exceed FALs	Required
Colfax SE surface release		No COCs identified	None
Colfax SE DCB		Assumed TED above FALs in SE DCB	Required
Pascal-A SE surface release	03-23-32	No COCs identified	None
Pascal-A SE DCB		Assumed TED above FALs in SE DCB	Required

Table 3-2
Summary of Investigation Results at CAU 568
(Page 2 of 2)

Release	CAS Number	CAI Results	Corrective Action
Valencia SE surface release	03-23-33	No COCs identified	None
Valencia SE DCB		Assumed TED above FALs in SE DCB	Required
Valencia well head cover (PSM)		HCA conditions assumed to exceed FALs	Required
Chipmunk SE surface release	03-23-34	No COCs identified	None
Chipmunk SE DCB		Assumed TED above FALs in SE DCB	Required
Mink weapons-related test surface release		No COCs identified	None
Funnel weapons-related test surface release		No COCs identified	None
Cognac, Chinchilla, Chinchilla II, Stoat, Armadillo, Haymaker, Solendon, and Tuna weapons-related surface releases; Tendrac joint US/UK test surface release	03-45-01	No COCs identified	None
Boomer weapons-related test surface release		Assumed TED above FALs in crater area	Required
Soil and debris piles (lead PSM present on piles; potential PSM within piles)	03-08-04	Assumed PSM within soil and debris piles; PSM removed from surface of piles	Required
HCA soil pile	03-23-30	HCA conditions assumed to exceed FALs	Required
PSM (lead bricks, lead-acid batteries, lead sheets, lead plates, transformer)	03-26-04	No COCs identified; PSM removed	Completed
Lead from broken lead-acid battery (Location C17)		Lead detected above FALs	Required
Lead from lead shot (Location C19)		PSM present	Required

Table 3-3
Evaluation of General Corrective Action Standards

STANDARD #1: PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	
Clean Closure	**Closure in Place with UR**
The clean closure alternative is more protective as the contamination is removed, preventing future exposure. Less potential dose/contamination to future generations. Future monitoring not required. The clean closure alternative increases the potential for short-term environmental damage during cleanup activities.	Considering the remoteness of the site, proximity to the public, and depth to groundwater, the closure in place alternative is protective as it establishes URs, and provides for periodic inspections and long-term maintenance to prevent future exposure. Minimizes exposure to workers.
STANDARD #2: COMPLIANCE WITH ENVIRONMENTAL CLEAN-UP STANDARDS **STANDARD #3: COMPLIANCE WITH APPLICABLE FEDERAL, STATE, AND LOCAL STANDARDS FOR WASTE MANAGEMENT**	
Clean Closure	**Closure in Place with UR**
The clean closure alternative complies with cleanup standards established with NDEP through the FFACO process.	The closure in place alternative complies with closure in place standards established in the FFACO process.
STANDARD #4: CONTROL THE SOURCE(S) OF THE RELEASE	
Clean Closure	**Closure in Place with UR**
The clean closure alternative is more protective as the source of the release(s) is removed. Minimizes risk to future generations.	The closure in place alternative controls exposure by administrative controls and barriers, but does not remove hazard.

The two CAAs that met the general corrective action standards were further evaluated based on the remedy selection decision factors described in Section 3.2. This evaluation is presented in Tables 3-4 through 3-8. The stakeholders determined a preferred CAA for each remedy selection decision factor.

Table 3-4 includes the DCBs associated with eight underground SEs (San Juan, Otero, Pascal-A, Pascal-B, Pascal-C, Luna, Colfax, and Valencia) that were evaluated under Study Group 1; the DCB associated with the underground SE (Chipmunk) that was evaluated under Study Group 3; and the Boomer GZ crater area evaluated under Study Group 2. The extent of the areas requiring corrective action includes the emplacement hole areas (inclusive of the concrete emplacement pads) down to a depth of 25 ft bgs. The SE emplacement holes and Boomer GZ area are assumed to have contamination above FALs. Clean closure of the nine SE DCBs and Boomer would consist of excavating soil and debris (e.g., steel casings, concrete pads) to a depth of 25 ft bgs. The remaining

Table 3-4
Evaluation of Remedy Selection Decision Factors for SE DCBs and Boomer
(Page 1 of 3)

DECISION FACTOR #1: LONG-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure - PREFERRED	**Closure in Place with UR and Engineering Controls**
The clean closure alternative is reliable and effective at protecting human health and the environment in the long term because removal of the contaminated media eliminates the future exposure of site workers and the environment. Note: Clean closure would only include contamination to 25 ft bgs.	The closure in place alternative is protective as it covers the surface access to the contamination, establishes URs, and provides for periodic inspections and long-term maintenance to prevent future exposure of site workers and the public. Contamination would be prevented from airborne and surface migration.
DECISION FACTOR #2: REDUCTION OF TOXITY, MOBILITY, AND/OR VOLUME	
Clean Closure	**Closure in Place with UR and Engineering Controls - PREFERRED**
Short term: The clean closure alternative increases the mobility due to cutting the emplacement hole casings and exposing site workers to contamination. Long term: The clean closure alternative reduces the mobility, toxicity, and volume of the contamination because the contaminated media is removed to a depth of 25 ft bgs. Contamination would remain below 25 ft bgs.	The closure in place alternative provides no reduction in the toxicity, mobility, or volume of the contamination. However, it would provide a reduction in the surface mobility of contamination. PSM remains in place below the cap and could be released to the soil. The site workers would not be exposed to the site contamination, because the emplacement hole pipes would not be severed.
DECISION FACTOR #3: SHORT-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure	**Closure in Place with UR and Engineering Controls - PREFERRED**
The clean closure alternative would present risk to site workers in the short term during implementation of the corrective action. This risk is based on the cutting of emplacement hole casings that contain the contamination, use of heavy equipment, exposure to contaminated soil and debris, and travel to/from the site. Short-term risks to worker due to exposure to dust and similar items and safety/occupational risks during clean closure of site. The clean closure alternative introduces short-term risks during waste management activities required for clean closure (large volumes of contaminated soil and debris being removed).	The closure in place alternative would present minimal risk to site workers in the short term during travel to/from the site, and installation/maintenance of UR signs and engineering barriers. During implementation of closure in place, the emplacement hole casings are not cut open, minimizing the short-term risk to site workers.

Table 3-4
Evaluation of Remedy Selection Decision Factors for SE DCBs and Boomer
(Page 2 of 3)

DECISION FACTOR #4: FEASIBILITY	
Clean Closure	**Closure in Place with UR and Engineering Controls - PREFERRED**
The clean closure alternative would potentially expose site workers to high levels of removable contamination. The clean closure alternative would require extensive radiological controls and heavy equipment, as soil and emplacement holes would be removed to a depth of 25 ft bgs. Holes would be filled below 25 ft bgs. The emplacement holes are located within CAs or HCAs. Access to the crater areas at Pascal-C and Boomer is prohibited; therefore, the clean closure alternative may not be feasible for these two releases.	The closure in place alternative is feasible. This alternative is the most easily and quickly implemented, and involved establishing the URs and placing engineering controls over the emplacement holes. There are limitations to accessing the potential crater areas at Boomer and Pascal-C. However, the areas are small, and methods should be available for placing engineering controls without entering these areas.
DECISION FACTOR #5: COST	
Clean Closure	**Closure in Place with UR and Engineering Controls - PREFERRED**
Cost to implement clean closure: $8,000,000 rough order of magnitude (ROM) (see Attachment C-1 for cost estimates) - Large volume of waste generated (834 yd^3 [22,500 ft^3] for each hole), may not be able to dispose of at the Area 5 Radioactive Waste Management Complex (RWMC). - Large disposal costs (assumes disposal off NNSS of transuranic [TRU] waste). - Labor intensive. - No maintenance costs.	Cost to implement closure in place: $1,500,000 ROM (see Attachment C-1 for cost estimates) Maintenance cost: $500/yr (per CAS) - No waste, no disposal costs. - Labor intensive. The closure in place alternative would require long-term monitoring-radiological/demarcation and posting, and upkeep of engineering controls. The estimated annual costs for post-closure monitoring do not include potential future costs for additional radiological surveys or road maintenance that may be required under the DOE Radiation Control program.

Table 3-4
Evaluation of Remedy Selection Decision Factors for SE DCBs and Boomer
(Page 3 of 3)

DECISION FACTOR #6: OTHER CONSIDERATIONS (e.g., environmental setting, radiological status of site, proximity to other releases, site-specific considerations)	
Clean closure may have a greater ecological impact vs. closure in place because of the use of heavy equipment to excavate soil. Worker safety concerns for clean closure, potential subsidence, exposure to plutonium contamination. Clean closure would consolidate the waste in a contained area with long-term environmental controls.	Worker safety concerns for closure in place due to potential crater subsidence as discussed in Decision Factor #4.

emplacement hole casings would be filled, and the excavation would be backfilled with clean fill to ground surface. Closure in place of the SE DCBs and Boomer would consist of performing engineering controls to cover the surface contamination at each release location and establishing FFACO URs.

Table 3-5 includes the well head cover debris sitting on the ground surface or on a concrete pad associated with the San Juan, Luna, Valencia, and Otero emplacement holes that were evaluated under Study Group 4. The extent of the area requiring corrective action includes each physical well head cover. Three of the well head covers have removable contamination meeting HCA criteria; however, because the Otero well head cover meets CA criteria and is similar in nature to the other three well head covers, it is recommended that it be included in the chosen corrective action for the three well head covers. Clean closure of the four well head covers would consist of removing, packaging, and disposing of each well head cover. Closure in place of the well head covers would consist of establishing FFACO URs at each release location.

Table 3-6 includes the Pascal-B HCA and Chavez HCA (DCB) that were evaluated under Study Group 1. The extent of the area requiring corrective action includes boundary of the posted HCA at each location. The HCAs are assumed to have contamination above FALs. Clean closure of the Pascal-B HCA and Chavez HCA would consist of removing and disposing of contaminated surface soil to below FALs to a depth of 1 ft bgs. Closure in place of the HCAs would consist of establishing FFACO URs at each release location.

Table 3-5
Evaluation of Remedy Selection Decision Factors for Well Head Covers
(Page 1 of 2)

DECISION FACTOR #1: LONG-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure - PREFERRED	**Closure in Place with UR**
The clean closure alternative is reliable and effective at protecting human health and the environment in the long term because removal of the contaminated media eliminates the future exposure of site workers and the environment. Clean closure (removal) ensures no potential migration of contamination.	The closure in place alternative is protective as it establishes URs, and provides for periodic inspections and long-term maintenance to prevent future exposure of site workers and the public. Contamination would not be prevented from airborne and surface migration.
DECISION FACTOR #2: REDUCTION OF TOXITY, MOBILITY, AND/OR VOLUME	
Clean Closure - PREFERRED	**Closure in Place with UR**
The clean closure alternative reduces the mobility, toxicity, and volume of the contamination because the contaminated media is removed.	The closure in place alternative provides no reduction in the toxicity, mobility, or volume of the contamination. PSM remains in place and may be released to the soil.
DECISION FACTOR #3: SHORT-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure	**Closure in Place with UR - PREFERRED**
The clean closure alternative would present risk to site workers in the short term during implementation of the corrective action. This risk is based on the use of heavy equipment, exposure to contaminated debris, and travel to/from the site. The clean closure alternative introduces short-term risks during waste management activities required for clean closure (contaminated debris being removed).	The closure in place alternative would present minimal risk to site workers during installation of UR signs and maintenance of fencing, as required. This risk is based upon use of equipment and travel to/from the site.
DECISION FACTOR #4: FEASIBILITY	
Clean Closure - EQUAL	**Closure in Place with UR - EQUAL**
The clean closure alternative would potentially expose site workers to high levels of removable contamination. This alternative would require the most planning, resources, and time to implement, considering labor, equipment, transportation, waste management, and disposal. The clean closure alternative would require extensive radiological controls.	The closure in place alternative is feasible. This alternative is the most easily and quickly implemented, due to the limited actions involved (establishing the URs).

Table 3-5
Evaluation of Remedy Selection Decision Factors for Well Head Covers
(Page 2 of 2)

DECISION FACTOR #5: COST	
Clean Closure	**Closure in Place with UR - PREFERRED**
Cost to implement clean closure: $200,000 ROM (see Attachment C-1 for cost estimates) - Volume of waste generated (4 yd^3). - Disposal costs assume disposal of Surface Contaminated Objects (SCO) II on the NNSS. - Labor intensive. - No maintenance costs.	Cost to implement closure in place: $53,000 ROM (see Attachment C-1 for cost estimates) Maintenance cost: $500/yr per CAS - No waste, no disposal costs, not labor intensive. - Requires long-term maintenance costs (UR only). The estimated annual costs for post-closure monitoring do not include potential future costs for additional radiological surveys or road maintenance that may be required under the DOE Radiation Control program. The closure in place alternative would require long-term monitoring-radiological/demarcation and posting. If the well head covers are moved closure to the GZ emplacement holes to be closed in place with the emplacement hole DCBs, the cost for closure in place will increase.
DECISION FACTOR #6: OTHER CONSIDERATIONS (e.g., environmental setting, radiological status of site, proximity to other releases, site-specific considerations)	
Clean closure of the site may require historical assessment of the site before remediation. Clean closure may have a greater ecological impact vs. closure in place because of the use of heavy equipment to remove the well head covers. Clean closure would consolidate the waste in a contained area with long-term environmental controls.	High levels of contamination are present on the well head covers, which present a health and safety hazard. If the SE DCB (emplacement holes) were to be closed in place, and the well head covers were to be moved to be closer to the emplacement holes, the cost to move the well head covers would be similar to that of clean closure.

Table 3-7 includes the three soil and debris piles and the HCA soil pile that were evaluated under Study Group 4. The extent of the areas requiring corrective action includes the physical piles on the ground surface. There is the possibility that the soil and debris piles contain PSM. The HCA soil pile is assumed to have contamination above FALs. Clean closure of the HCA soil pile and three soil and debris piles would consist of removing and disposing of each physical pile. Any PSM present within the piles would be segregated and disposed of appropriately. Verification samples would be collected after soil and PSM removal. Closure in place of the piles would consist of establishing FFACO URs at each release location.

Table 3-6
Evaluation of Remedy Selection Decision Factors for Pascal-B HCA and Chavez HCA
(Page 1 of 3)

DECISION FACTOR #1: LONG-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure - PREFERRED	**Closure in Place with UR**
The clean closure alternative is reliable and effective at protecting human health and the environment in the long term because removal of the contaminated media eliminates the future exposure of site workers and the environment. Clean closure ensures no potential migration of contamination. Clean closure does not eliminate the need for future institutional controls of contiguous areas (e.g., other CAU 568 releases [SE DCBs]).	The closure in place alternative is protective as it establishes URs, and provides for periodic inspections and long-term maintenance to prevent future exposure of site workers and the public. Contamination would not be prevented from airborne and surface migration.
DECISION FACTOR #2: REDUCTION OF TOXITY, MOBILITY, AND/OR VOLUME	
Clean Closure - PREFERRED	**Closure in Place with UR**
Short term: The clean closure alternative increases the mobility due to removal of contaminated soil and exposing site workers to contamination. Long term: The clean closure alternative reduces the mobility, toxicity, and volume of the contamination because the contaminated media is removed.	The closure in place alternative provides no reduction in the toxicity, mobility, or volume of the contamination. Contaminated soil and debris remains in place.
DECISION FACTOR #3: SHORT-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure	**Closure in Place with UR - PREFERRED**
The clean closure alternative would present risk to site workers in the short term during implementation of the corrective action. This risk is based on the use of heavy equipment, exposure to contaminated soil, and travel to/from the site. The clean closure alternative introduces short-term risks during waste management activities required for clean closure (large volumes of contaminated soil being removed).	The closure in place alternative would present minimal risk to site workers during installation of UR signs and maintenance of fencing, as required. This risk is based upon exposure to contaminated soil, and travel to/from the site.

Table 3-6
Evaluation of Remedy Selection Decision Factors for Pascal-B HCA and Chavez HCA
(Page 2 of 3)

DECISION FACTOR #4: FEASIBILITY	
Clean Closure	**Closure in Place with UR - PREFERRED**
The clean closure alternative would potentially expose site workers to high levels of removable contamination and would require the most planning, resources, and time to implement, considering labor, equipment, transportation, waste management, and disposal. The clean closure alternative would require extensive radiological controls. The clean closure alternative would not include the Pascal-B SE DCB, located within the HCA. The HCA is located within a larger CA.	The closure in place alternative is the most easily and quickly implemented, due to the limited actions involved (establishing the URs).
DECISION FACTOR #5: COST	
Clean Closure	**Closure in Place with UR - PREFERRED**
Cost to implement clean closure: Pascal-B: $350,000 ROM Chavez: $1,300,000 ROM (see Attachment C-1 for cost estimates) - Pascal B: Large volume of waste generated (240 yd^3). - Chavez: Large volume of waste generated (1,220 yd^3), may not be able to dispose of at the Area 5 RWMC. - Disposal costs assume disposal on NNSS of low-level waste (LLW). - Labor intensive. - No maintenance costs.	Cost to implement closure in place: Pascal-B: $64,000 ROM Chavez: $80,000 ROM (see Attachment C-1 for cost estimates) Maintenance cost:$500/yr per CAS - No waste, no disposal costs, not labor intensive. - Requires long-term maintenance costs (UR only). The estimated annual costs for post-closure monitoring do not include potential future costs for additional radiological surveys or road maintenance that may be required under the DOE Radiation Control program. The closure in place alternative would require long-term monitoring-radiological/demarcation and posting. - The closure in place alternative assumes that potential migration of contaminated soil will not affect the UR boundary.

Table 3-6
Evaluation of Remedy Selection Decision Factors for Pascal-B HCA and Chavez HCA
(Page 3 of 3)

DECISION FACTOR #6: OTHER CONSIDERATIONS (e.g., environmental setting, radiological status of site, proximity to other releases, site-specific considerations)	
Clean closure may have a greater ecological impact vs. closure in place because of the use of heavy equipment to excavate soil.	For Chavez, a well-constructed chain-link fence exists around the area meeting HCA conditions. For Pascal-B, there is a physical t-post/fence barrier which could be utilized for posting URs. For Pascal-B, the adjacent SE DCB (emplacement hole) is to be closed in place; therefore, the cost for closure in place of the area meeting HCA conditions would be much less.

Table 3-7
Evaluation of Remedy Selection Decision Factors for 4 Soil and Debris Piles
(Page 1 of 3)

DECISION FACTOR #1: LONG-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure - PREFERRED	**Closure in Place with UR**
The clean closure alternative is reliable and effective at protecting human health and the environment in the long term because removal of the contaminated media eliminates the future exposure of site workers and the environment.	The closure in place alternative is protective as it establishes URs, and provides for periodic inspections and long-term maintenance to prevent future exposure of site workers and the public. Contamination would not be prevented from airborne and surface migration.
DECISION FACTOR #2: REDUCTION OF TOXITY, MOBILITY, AND/OR VOLUME	
Clean Closure - PREFERRED	**Closure in Place with UR**
Short term: The clean closure alternative increases the mobility due to removal of contaminated soil and debris and exposing site workers to contamination. Long term: The clean closure alternative reduces the mobility, toxicity, and volume of the contamination because the contaminated media is removed.	The closure in place alternative provides no reduction in the toxicity, mobility, or volume of the contamination. PSM remains in place and is released to the soil.

Table 3-7
Evaluation of Remedy Selection Decision Factors for 4 Soil and Debris Piles
(Page 2 of 3)

DECISION FACTOR #3: SHORT-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure	**Closure in Place with UR - PREFERRED**
The clean closure alternative would present risk to site workers in the short term during implementation of the corrective action. This risk is based on the use of heavy equipment, exposure to contaminated soil and debris, and travel to/from the site. The clean closure alternative introduces short-term risks during waste management activities required for clean closure (large volumes of contaminated soil and debris being removed).	The closure in place alternative would present minimal risk to site workers during installation of UR signs and maintenance of fencing, as required. This risk is based upon exposure to contaminated soil and debris, and travel to/from the site.
DECISION FACTOR #4: FEASIBILITY	
Clean Closure - EQUAL	**Closure in Place with UR - EQUAL**
The clean closure alternative would potentially expose site workers to high levels of removable contamination and PSM. This alternative would require the most planning, resources, and time to implement, considering labor, equipment, transportation, waste management, and disposal. The clean closure alternative would require extensive radiological controls.	The closure in place alternative is the most easily and quickly implemented, due to the limited actions involved (establishing the URs).

Table 3-7
Evaluation of Remedy Selection Decision Factors for 4 Soil and Debris Piles
(Page 3 of 3)

DECISION FACTOR #5: COST	
Clean Closure	**Closure in Place with UR - PREFERRED**
Cost to implement clean closure: $118,000 ROM for HCA soil pile $475,000 ROM for 3 soil and debris piles (see Attachment C-1 for cost estimates) - Volume of waste generated: 28 yd^3 for HCA soil pile 507 yd^3 for 3 soil and debris piles - Disposal costs for HCA pile assume disposal on NNSS of LLW. - Disposal costs for the 3 soil and debris piles assume disposal of limited hazardous waste off the NNSS and disposal of solid waste on the NNSS. - Labor intensive. - No maintenance costs.	Cost to implement closure in place: $45,000 ROM for HCA soil pile $45,000 ROM for 3 soil and debris piles (see Attachment C-1 for cost estimates) Maintenance cost: $500/yr per CAS - No waste, no disposal costs, not labor intensive. - Requires long-term maintenance costs (UR only). - The estimated annual costs for post-closure monitoring do not include potential future costs for additional radiological surveys or road maintenance that may be required under the DOE Radiation Control program. - The closure in place alternative would require long-term monitoring-radiological/demarcation and posting. - The closure in place alternative assumes that potential migration of contaminated soil will not affect the UR boundary.
DECISION FACTOR #6: OTHER CONSIDERATIONS (e.g., environmental setting, radiological status of site, proximity to other releases, site-specific considerations)	
Clean closure of the site may require historical assessment of the site before remediation. Clean closure may have a greater ecological impact vs. closure in place because of the use of heavy equipment to excavate soil. Clean closure would remove debris from the area making the area more aesthetic. Clean closure would consolidate the waste in a contained area with long-term environmental controls.	

Table 3-8 includes the lead shot area and the soil underneath the broken lead-acid battery that were evaluated under Study Group 4. The extent of the areas requiring corrective action includes the physical area of the lead shot and the physical extent of the broken battery on the ground surface. The lead shot extends into the ground surface approximately 3 inches (in.). The presence of lead shot PSM requires corrective action. The soil under the broken lead-acid battery exceeds the FAL for lead. Clean closure of the lead shot area and lead-acid battery soil area would consist of removing and disposing of lead PSM and soil to a depth of approximately 3 to 6 in. bgs. Verification samples would

Table 3-8
Evaluation of Remedy Selection Decision Factors for Lead Shot Area and Lead-Acid Battery Soil
(Page 1 of 2)

DECISION FACTOR #1: LONG-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure - PREFERRED	**Closure in Place with UR**
The clean closure alternative is reliable and effective at protecting human health and the environment in the long term because removal of the contaminated media eliminates the future exposure of site workers and the environment.	The closure in place alternative is protective as it establishes URs, and provides for periodic inspections and long-term maintenance to prevent future exposure of site workers and the public. Contamination would not be prevented from surface migration.
DECISION FACTOR #2: REDUCTION OF TOXITY, MOBILITY, AND/OR VOLUME	
Clean Closure - PREFERRED	**Closure in Place with UR**
The clean closure alternative reduces the mobility, toxicity, and volume of the contamination because the contaminated media is removed.	The closure in place alternative provides no reduction in the toxicity, mobility, or volume of the contamination. PSM remains in place and is released to the soil.
DECISION FACTOR #3: SHORT-TERM RELIABILITY AND EFFECTIVENESS	
Clean Closure	**Closure in Place with UR - PREFERRED**
The clean closure alternative would present risk to site workers in the short term during implementation of the corrective action. This risk is based on the use of heavy equipment, exposure to contaminated soil and debris, and travel to/from the site.	The closure in place alternative would present minimal risk to site workers during installation of UR signs and maintenance of fencing, as required. This risk is based upon exposure to contaminated soil and debris, and travel to/from the site.
DECISION FACTOR #4: FEASIBILITY	
Clean Closure - EQUAL	**Closure in Place with UR - EQUAL**
The clean closure alternative would require the most planning, resources, and time to implement, considering labor, equipment, transportation, waste management, and disposal. Note: While the logistics of implementing clean closure are more extensive than those for closure in place with a UR, clean closure can be accomplished with existing experience and capabilities.	The closure in place alternative is the most easily and quickly implemented, due to the limited actions involved (establishing the URs).

Table 3-8
Evaluation of Remedy Selection Decision Factors for Lead Shot Area and Lead-Acid Battery Soil
(Page 2 of 2)

DECISION FACTOR #5: COST	
Clean Closure	**Closure in Place with UR - PREFERRED**
Cost to implement clean closure: $90,000 ROM for lead-acid battery soil $160,000 ROM for lead shot (see Attachment C-1 for cost estimates) - Volume of waste generated: 1.7 yd^3 for lead-acid battery soil 75 yd^3 for lead shot - Disposal costs assume disposal off the NNSS of hazardous waste. - Labor intensive. - No maintenance costs.	Cost to implement closure in place: $45,000 ROM for lead-acid battery soil $45,000 ROM for lead shot (see Attachment C-1 for cost estimates) Maintenance cost: $500/yr per CAS - No waste, no disposal costs, not labor intensive. - Requires long-term maintenance costs (UR only). - The closure in place alternative would require long-term monitoring and posting. - The closure in place alternative assumes that potential migration of contaminated soil will not affect the UR boundary.
DECISION FACTOR #6: OTHER CONSIDERATIONS (e.g., environmental setting, radiological status of site, proximity to other releases, site-specific considerations)	
Clean closure of the site may require historical assessment of the site before remediation. Clean closure may have a greater ecological impact vs. closure in place because of the use of heavy equipment to excavate soil. Similar sites have been clean closed in the past. Clean closure would consolidate the waste in a contained area with long-term environmental controls.	If closed in place, will require Tuna potential crater area to be use restricted.

be collected after soil and PSM removal. Closure in place of the lead areas would consist of establishing FFACO URs at each release location.

4.0 Recommended Alternatives

The CAAs for the sites that require additional corrective actions (Table 3-2) were evaluated based on technical merits focusing on reduction of toxicity, mobility and/or volume; reliability; short- and long-term feasibility; cost; and other considerations. The corrective action recommendations by the stakeholders for CAU 568 are based on the assumption that activities on the NNSS will be limited to those that are industrial in nature and that the NNSS will maintain controlled access (i.e., restrict public access and residential use). Should the future land use of the NNSS change such that these assumptions are no longer are valid, additional evaluation may be necessary.

The CAA of clean closure was selected by the stakeholders in the CAA meeting conducted on June 11, 2015, as the recommended correction action for the four well head covers (CASs 03-23-20, 03-23-23, 03-23-31, and 03-23-33); HCA soil pile (CAS 03-23-30); the three soil and debris piles (CAS 03-08-04); the lead-acid battery soil (CAS 03-26-04); and the lead shot area (CAS 03-26-04).

The CAA of closure in place with engineering and administrative controls was selected by the stakeholders in the CAA meeting as the preferred correction action for the nine SE DCBs (CASs 03-23-20, 03-23-23, 03-23-31, 03-23-32, 03-23-33, and 03-23-34) and the Boomer crater area (CAS 03-45-01). The CAA of closure in place with an FFACO UR was the selected by the stakeholders as the preferred corrective action for the Chavez HCA (CAS 03-23-19) and Pascal-B HCA (CAS 03-23-31). Working in areas of high removable contamination (such as removing soil under a corrective action of clean closure) requires extensive radiological controls to protect workers from inhaling or ingesting airborne radioactive particles. A corrective action of clean closure at the SE DCBs would require extensive excavations (the corrective action areas and volumes at each CAS are presented in Table 4-1) of up to 25 ft in depth. These corrective actions selected were based on the extent of the corrective action boundaries and the infeasibility of removing large quantities of soil containing high levels of removable contamination.

Table 4-1
Estimated Corrective Action Boundary Areas and Volumes at CAU 568 CASs

CAS	Release	Area (yd^2)	Volume (yd^3)
03-23-19	HCA (DCB)	1,835	1,220
03-23-20	SE DCB Otero	100	834
	Otero Well Head Cover	100	1
03-23-23	SE DCB San Juan	100	834
	San Juan Well Head Cover (HCA, DCB)	100	1
	SE DCB Pascal-C	100	834
03-23-31	SE DCB Pascal-B	100	834
	SE DCB Luna	100	834
	SE DCB Colfax	100	834
	Pascal-B HCA	717	240
	Luna Well Head Cover (HCA)	100	1
03-23-33	SE DCB Valencia	100	834
	Valencia Well Head Cover (HCA)	100	1
03-23-34	SE DCB Chipmunk	100	834
03-08-04	Potential PSM in Soil and Debris Piles	300	507
03-23-30	HCA (HCA Soil Pile)	42	28
03-23-32	SE DCB Pascal-A	100	834
03-26-04	Lead-Acid Battery Soil	4	1.7
	Lead Shot	224	75
03-45-01	Boomer	44	370

yd^2 = Square yard

In addition to the corrective actions identified above, the following actions will be implemented as a best management practice (BMP):

In accordance with the Soils RBCA document (NNSA/NFO, 2014b) and Section 3.3 of the CAIP (NNSA/NFO, 2014a), an administrative UR will be identified as a BMP for areas where a future site worker could receive an annual dose exceeding 25 mrem/yr if the land use were to change and a more intensive use of the area (up to a full-time industrial use). This conservative assumption is that a worker would be exposed to site contamination for a period of 2,000 hr/yr. This administrative UR (implemented as a BMP) is not part of any FFACO corrective action. To determine the extent of this area, a correlation of radiation survey values to Industrial Area TED values was conducted as discussed in Section A.2.5 for each area where dose is present at a level exceeding 25 mrem/IA-yr (as is the case at San Juan [CAS 03-23-23], Chavez [CAS 03-23-19], Valencia [CAS 03-23-33], Platypus [CAS 03-23-22], and the HCA soil pile [CAS 03-23-30]). The radiation survey with the best correlation was the field instrument for the detection of low-energy radiation (FIDLER) TRS. The administrative boundary at each of these sites was identified to encompass the FIDLER TRS isopleth corresponding to a dose of 25 mrem/IA-yr.

In the case of the areas where an industrial land use of the area (2,000 hr/yr) could cause a future site worker to receive a dose exceeding 25 mrem/yr at Valencia and Platypus, it is recommended that the surface soil in those areas exhibiting a dose above PALs (25 mrem/IA-yr) be removed, so no administrative boundary will be required. The Valencia area where a dose above PALs is present measures approximately 72 yd^2, and the Platypus area measures approximately 4 yd^2.

In the area adjacent to the HCA soil pile (includes Location A27), an industrial land use of the area (2,000 hr/yr) could cause a future site worker to receive a dose exceeding 25 mrem/IA-yr. In order to eliminate the need for an administrative boundary in this area, the CAB for the HCA soil pile was extended to include this area with a dose above 25 mrem/IA-yr, and this surface soil adjacent to the HCA soil pile (approximately 73 yd^2) is also recommended for removal.

An administrative UR may also be established based on the presence of removable contamination that meets CA criteria (see Section A.2.6). There are two areas in CAU 568 that meet CA criteria (San Juan CA and Chavez CA). The recommended administrative boundaries are presented Figure A.3-4 and will be implemented in the closure report. Administrative URs will be recorded and controlled in the same manner as the FFACO URs, but will not require posting or inspections.

All URs will be recorded in the FFACO database; Management and Operating (M&O) Contractor Geographic Information Systems (GIS); and the U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office (NNSA/NFO) CAU/CAS files. The development of URs for CAU 568 are based on current land use. Any proposed activity within a use restricted area that would result in higher risk to the most exposed site worker than that presented in the risk evaluation (see Appendix C) would require NDEP approval.

5.0 References

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Appendix A

Corrective Action Investigation Results

A.1.0 Introduction

This appendix presents the CAI activities and analytical results for CAU 568. CAU 568 consists of the releases associated with the 14 CASs listed in Table A.1-1 located in Area 3 of the NNSS (Figures A.1-1 and A.1-2). Eight CASs were added to the original six CASs during the CAI in order to more efficiently and effectively characterize and close the releases at CAU 568. To facilitate site investigation and the evaluation of DQO decisions for different releases, the reporting of investigation results and the evaluation of DQO decisions for different releases were organized into study groups. In the CAIP, releases were assigned to study groups. Based on additional information generated during the CAI, some changes were made to study group assignments. The assignments are shown in Table A.1-1 and the study groups are described in Section 1.0.

The release sources specific to CAU 568 are presented in Table A.1-1.

Table A.1-1
CAU 568 Releases with Associated CASs and Study Groups
(Page 1 of 6)

Release	FFACO CAS Number	FFACO CAS Description	Study Group	Release Source
Chavez SE surface release	03-23-17, 03-23-19	S-3I Contamination Area[a], T-3U Contamination Area	1	Surface release of radionuclides from tower SE conducted on 10/27/1958 as part of Operation Hardtack II. Detonated atop a tower at a height of 52 ft, with a yield of 0.6 tons. A plume is present centered around the GZ area.
Chavez HCA (DCB)	03-23-19	T-3U Contamination Area	1	Contaminated surface soil assumed to meet HCA conditions. DCB is defined by the HCA boundary.
Otero, San Juan, and Pascal-C SEs surface release	03-23-20, 03-23-23	Otero Contamination Area, San Juan Contamination Area	1	Surface release of radionuclides from the Otero, San Juan, and Pascal-C underground safety experiments. Otero was conducted on 09/12/1958 as part of Operation Hardtack II, and was detonated at a depth of 480 ft bgs in an unstemmed hole, with a yield of 38 tons. San Juan was conducted on 10/20/1958 as part of Operation Hardtack II, and was detonated at a depth of 234 ft bgs in an unstemmed hole, with zero yield. Pascal-C was conducted on 12/06/1957 as part of Operation Project 58, and was detonated at a depth of 250 ft bgs in an unstemmed hole, with a yield of 38 tons. A plume is present over the area containing the three tests, and is centered north of the Otero GZ. Per a crater stability study (Olsen, 2013), access into the GZ area at Pascal-C is prohibited.

Table A.1-1
CAU 568 Releases with Associated CASs and Study Groups
(Page 2 of 6)

Release	FFACO CAS Number	FFACO CAS Description	Study Group	Release Source
Otero SE DCB	03-23-20	Otero Contamination Area	1	Subsurface contamination within the test chimney of the Otero SE emplacement hole.
Otero well head cover (PSM)			4	Steel well head cover debris that was originally welded onto Otero emplacement hole. Now sits adjacent to the emplacement hole on soil surface. Removable contamination present on well head cover, which meets CA conditions.
Platypus weapons-related test surface release	03-23-22	Platypus Contamination Area	1	Surface release of radionuclides from underground weapons-related test conducted on 02/24/1962 as part of Operation Nougat. Detonated at a depth of 190 ft bgs, with a low yield.
San Juan SE DCB	03-23-23	San Juan Contamination Area	1	Subsurface contamination within the test chimney of the San Juan SE emplacement hole.
San Juan well head cover (PSM)			4	Steel well head cover debris that was originally welded onto San Juan emplacement hole. Now sits adjacent to the emplacement hole on the concrete emplacement pad. Removable contamination present on well head cover meets HCA conditions.
Pascal-C SE DCB			1	Subsurface contamination within the test chimney of the Pascal-C SE emplacement hole.
Bernalillo SE surface release				Surface release of radionuclides from underground safety experiment conducted on 09/17/1958 as part of Operation Hardtack II. Detonated at a depth of 456 ft bgs in an unstemmed hole, with a yield of 15 tons. A UR with engineering controls for contamination within the gas sampling line (CAU 547) is present from GZ, south to the Tejon (U-3cj) GZ (NNSA/NSO, 2012a).
Former Windrows				Surface and/or subsurface release of radionuclides and/or chemicals from scraped surface radiological contamination and road oil that was sprayed on the windrows.The area surrounding the tests conducted in 1957 and 1958 was bladed in 1959, and windrows were constructed. These windrows were sprayed with hot road oil. The windrows were subsequently removed from the site.

Table A.1-1
CAU 568 Releases with Associated CASs and Study Groups
(Page 3 of 6)

Release	FFACO CAS Number	FFACO CAS Description	Study Group	Release Source
Shrew weapons-related test surface release	03-23-26	Shrew/Wolverine Contamination Area	3	Surface release of radionuclides from underground weapons-related test conducted on 09/16/1961 as part of Operation Nougat. Detonated at a depth of 322 ft bgs, with a low yield.
Wolverine weapons-related test surface release			1	Surface release of radionuclides from underground weapons-related test conducted on 10/12/1962 as part of Operation Storax. Detonated at a depth of 241 ft bgs, with a low yield.
Drainage			5	Surface water migration from a minor drainage identified at the southern edge of the Shrew/Wolverine CA on the north side of 3-03 Road, ending in a crater south of 3-03 Road.
Pascal-B SE surface release	03-23-31	U-3d Contamination Area	1	Surface release of radionuclides from underground safety experiment conducted on 08/27/1957 as part of Operation Plumbbob. Detonated at a depth of 500 ft bgs in an unstemmed hole, with a yield of 1 g. A plume is present centered over the GZ area.
Pascal-B HCA				Contaminated surface soil meeting HCA conditions, associated with the Pascal-B test release.
Pascal-B SE DCB				Subsurface contamination within the test chimney of the Pascal-B SE emplacement hole.
Luna SE surface release				Surface release of radionuclides from underground safety experiment conducted on 09/21/1958 as part of Operation Hardtack II. Detonated at a depth of 484 ft bgs in an unstemmed hole, with a yield of 1.5 tons.
Luna SE DCB				Subsurface contamination within the test chimney of the Luna SE emplacement hole.
Luna well head cover (PSM)			4	Steel well head cover debris that was originally welded onto Luna emplacement hole. Now sits on the edge of the concrete emplacement pad. Removable contamination present on well head cover meets HCA conditions.
Colfax SE surface release			1	Surface release of radionuclides from underground safety experiment conducted on 10/05/1958 as part of Operation Hardtack II. Detonated at a depth of 350 ft bgs in an unstemmed hole. with a yield of 5.5 tons.
Colfax SE DCB				Subsurface contamination within the test chimney of the Colfax SE emplacement hole.

Table A.1-1
CAU 568 Releases with Associated CASs and Study Groups
(Page 4 of 6)

Release	FFACO CAS Number	FFACO CAS Description	Study Group	Release Source
Pascal-A SE surface release	03-23-32	U-3j Test Release	1	Surface release of radionuclides from underground safety experiment conducted on 07/26/1957 as part of Operation Plumbbob. Detonated at a depth of 500 ft bgs in an unstemmed hole, with a yield of 56 tons. A plume is present over the GZ area, trending northeast.
Pascal-A SE DCB				Subsurface contamination within the test chimney of the Pascal-A SE emplacement hole.
Valencia SE surface release	03-23-33	U-3r Contamination Area	1	Surface release of radionuclides from underground safety experiment conducted on 09/26/1958 as part of Operation Hardtack II. Detonated at a depth of 484 ft bgs in an unstemmed hole, with a yield of 2 tons.
Valencia SE DCB				Subsurface contamination within the test chimney of the Valencia SE emplacement hole.
Valencia well head cover (PSM)			4	Steel well head cover debris that was originally welded onto Valencia emplacement hole. Now sits north of the emplacement hole on the concrete hoist pad. Removable contamination present on well head cover, which meets HCA conditions.
Chipmunk SE surface release	03-23-34	U-3ay Contamination Area	3	Surface release of radionuclides from underground safety experiment conducted on 02/15/1963 as part of Operation Storax. Detonated at a depth of 195 ft bgs, with a low yield.
Chipmunk SE DCB				Subsurface contamination within the test chimney of the Chipmunk SE emplacement hole.
Mink weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 10/29/1961 as part of Operation Nougat. Detonated at a depth of 630 ft bgs, with a low yield.
Funnel weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 06/25/1968 as part of Operation Crosstie. Detonated at a depth of 389 ft bgs, with a yield of less than 20 kt.

Table A.1-1
CAU 568 Releases with Associated CASs and Study Groups
(Page 5 of 6)

Release	FFACO CAS Number	FFACO CAS Description	Study Group	Release Source
Cognac weapons-related test surface release	03-45-01	Test Surface Releases	2	Surface release of radionuclides from underground weapons-related test conducted on 10/25/1967 as part of Operation Crosstie. Detonated at a depth of 789 ft bgs, with a yield of less than 20 kt.
Chinchilla weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 02/19/1962 as part of Operation Nougat. Detonated at a depth of 492 ft bgs, with a yield of 1.9 kt.
Chinchilla II weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 03/31/1962 as part of Operation Nougat. Detonated at a depth of 448 ft bgs, with a low yield.
Armadillo weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 02/09/1962 as part of Operation Nougat. Detonated at a depth of 786 ft bgs, with a yield of 7.1 kt.
Stoat weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 01/09/1962 as part of Operation Nougat. Detonated at a depth of 992 ft bgs, with a yield of 5.1 kt.
Haymaker weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 06/27/1962 as part of Operation Nougat. Detonated at a depth of 1,340 ft bgs, with a yield of 67 kt.
Solendon weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 02/12/1964 as part of Operation Niblick. Detonated at a depth of 493 ft bgs, with a yield of less than 20 kt. Area is posted with “Caution Contamination Area” signs.
Boomer weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 10/01/1961 as part of Operation Nougat. Detonated at a depth of 330 ft bgs, with a low yield. Per the crater stability study, access into the GZ area is prohibited.
Tuna weapons-related test surface release				Surface release of radionuclides from underground weapons-related test conducted on 12/20/1963 as part of Operation Niblick. Detonated at a depth of 1,359 ft bgs, with a low yield.
Tendrac joint US/UK test surface release				Surface release of radionuclides from underground weapons-related test conducted on 12/07/1962 as part of Operation Storax. Detonated at a depth of 993 ft bgs, with a low yield.

Table A.1-1
CAU 568 Releases with Associated CASs and Study Groups
(Page 6 of 6)

Release	FFACO CAS Number	FFACO CAS Description	Study Group	Release Source
Soil and debris piles (lead PSM present on piles; potential PSM within piles)	03-08-04	Soil and Debris Piles	4	Surface and/or subsurface releases of chemicals and/or radionuclides from debris. Three soil and debris piles are present in the area. These piles have an unknown origin and may not have originated from releases in the area. PSM (lead items) was identified on the surface of the piles. This PSM may have released contaminants to the soil in the piles. Additional PSM may be present within the piles.
HCA soil pile	03-23-30	HCA Soil Pile	4	Surface and/or subsurface releases of radionuclides and/or chemicals from debris. This pile has an unknown origin and may not have originated from releases in the area. Contaminated metallic debris is visible in the pile, which may have released contaminants to the soil. Additional PSM may be present within the pile. A plume is present over the pile area.
PSM (lead bricks, lead-acid batteries, lead sheets, lead plates, lead shot, transformer)	03-26-04	Test-Related Debris	4	Surface and/or subsurface releases of chemicals and/or radionuclides from debris. PSM items were identified scattered around the area containing CAU 568. This PSM may have released contaminants to the surrounding soil.

Source: Holmes & Narver, 1958; REECo, 1959; GE, 1979; NNSA/NSO, 2012a; Olsen, 2013; NNSA/NFO, 2015b

[a]The FFACO CAS description for CAS 03-23-17 refers to “S-3I.” The location S-3I is identified as the Coulomb-C hole (NNSA/NFO, 2015b). The location of Coulomb-C was investigated within the scope of CAU 569. For CAU 568, the CA at CAS 03-23-17 is defined as being associated with the release from the Chavez test.

Additional information regarding the history of each site, planning, and the scope of the investigation is presented in the CAU 568 CAIP (NNSA/NFO, 2014a).

A.1.1 Investigation Objectives

The objective of the investigation was to provide sufficient information to evaluate and select CAAs to support the closure of each CAS in CAU 568. This objective was achieved by identifying the nature and extent of COCs, identifying potential corrective action wastes, and implementing interim corrective actions.

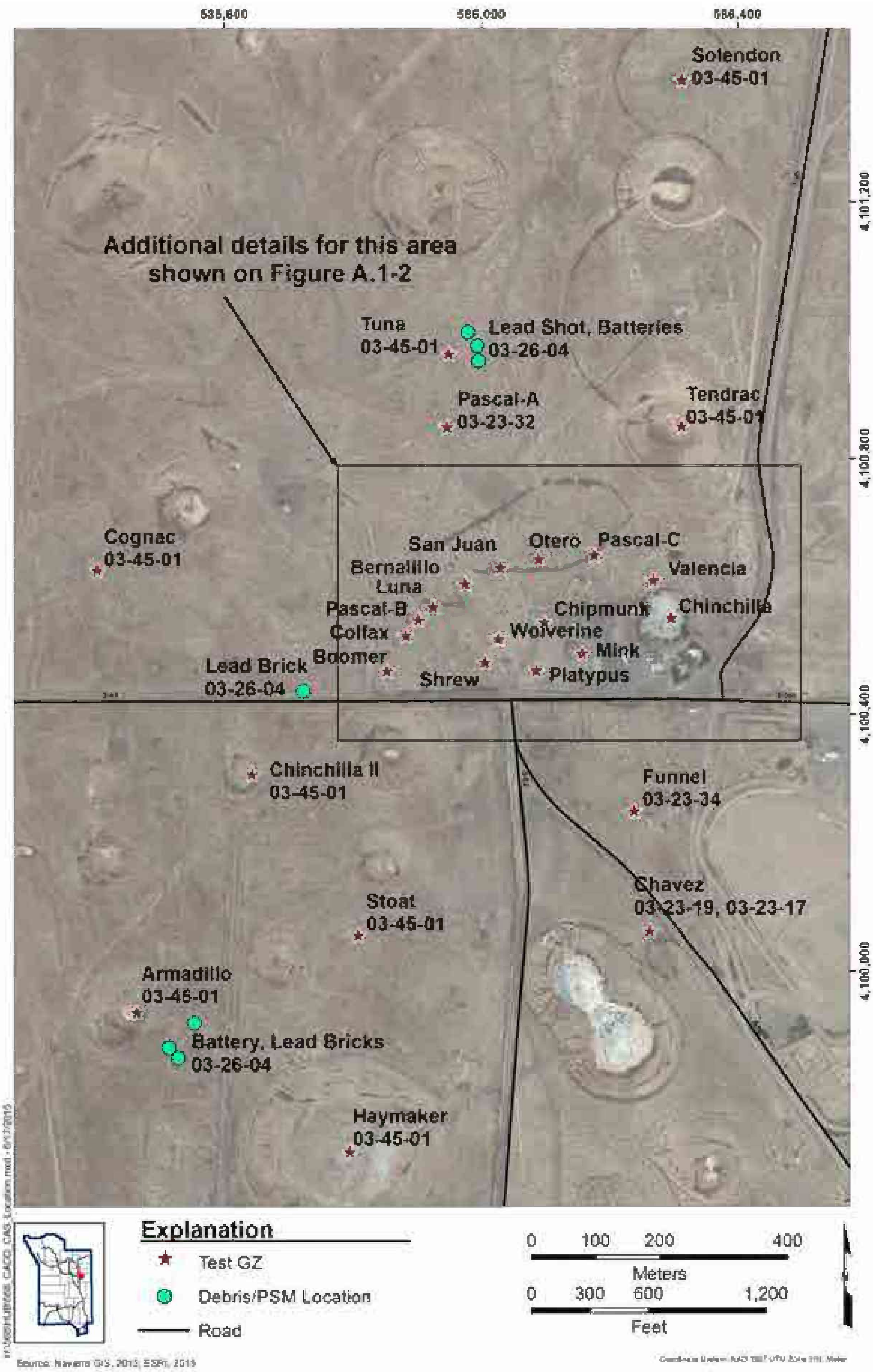

Figure A.1-1
CAU 568 CAS Location Map

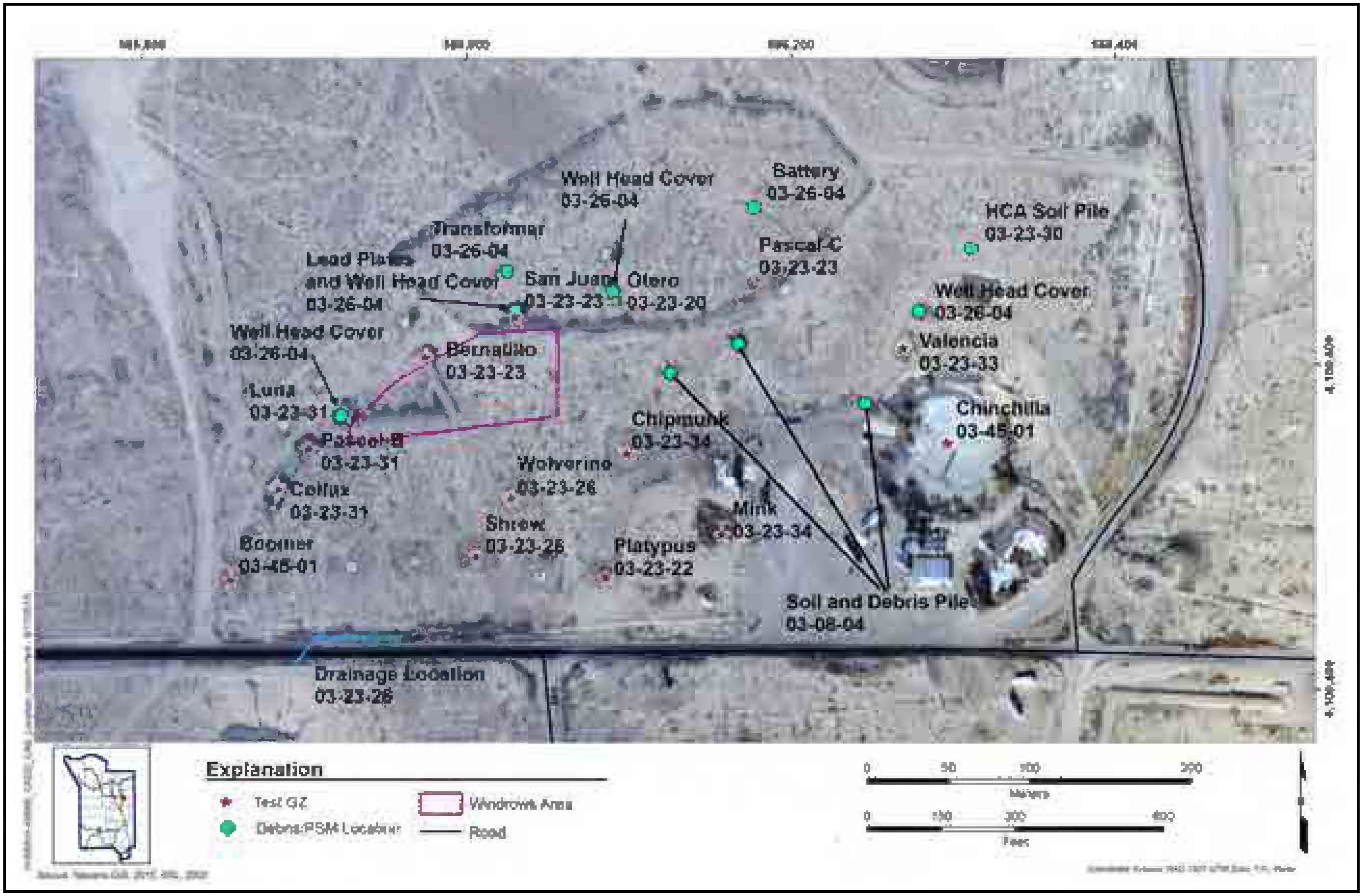

Figure A.1-2
CAU 568 CAS Location Map (Zoom)

For radiological contamination, a COC is defined as the presence of radionuclides that jointly present a dose to a receptor exceeding the FAL of 25 mrem/yr. For other types of contamination, a COC is defined as the presence of a contaminant at a concentration exceeding its corresponding FAL concentration (see Section A.2.4).

A.1.2 Contents

This appendix describes the investigation and presents the results. The contents of this appendix are as follows:

- Section A.1.0 describes the investigation background, objectives, and the contents of this document.
- Section A.2.0 provides an investigation overview.
- Sections A.3.0 through A.7.0 provide study-group-specific (see Section A.2.0) information regarding the field activities, sampling methods, and laboratory analytical results from investigation sampling.
- Section A.8.0 summarizes waste management activities.
- Section A.9.0 discusses the QA and quality control (QC) processes followed and the results of QA/QC activities.
- Section A.10.0 provides a summary of the investigation results.
- Section A.11.0 lists the cited references.

The complete field documentation and laboratory data—including field activity daily logs, sample collection logs (SCLs), analysis request/chain-of-custody forms, laboratory certificates of analyses, and analytical results—are retained in CAU 568 files as hard copy documents or electronic media.

A.2.0 Investigation Overview

Field investigation and sampling activities for the CAU 568 CAI were conducted between April 2014 and May 2015. The following CAI activities were conducted:

- Inspected and verified CAS features identified in the CAIP (NNSA/NFO, 2014a).
- Performed visual inspections.
- Performed utility surveys.
- Conducted TRSs.
- Established sample locations, collected soil samples, and submitted soil samples for offsite laboratory analysis from sample plots and grab sample locations.
- Staged, collected, and submitted TLDs for analysis from soil sample locations and background locations.
- Collected GPS coordinates of sample locations, TLD locations, and points of interest.
- Conducted interim corrective actions (i.e., limited PSM removal).
- Conducted waste management activities (e.g., sampling, debris disposal).

The investigation and sampling program adhered to the requirements set forth in the CAIP (NNSA/NFO, 2014a) (except any deviations described herein) and in accordance with the Soils QAP (NNSA/NSO, 2012), which establishes requirements, technical planning, and general quality practices. The evaluation of investigation results and the risk associated with site contamination was conducted in accordance with the Soils RBCA document (NNSA/NFO, 2014b).

In accordance with the graded approach described in the Soils QAP (NNSA/NSO, 2012), the quality required of a dataset will be determined by its intended use in decision making. Data used to define the presence of COCs are classified as decisional and will be used to make corrective action decisions. Survey data are classified as decision supporting and are not used, by themselves, to make corrective action decisions. The radiological and chemical FALs are presented in Appendix D.

The study groups were investigated by collecting TLD samples for external radiological dose calculations and collecting soil samples for the calculation of internal radiological dose, where appropriate. The field investigation was completed as specified in the CAIP (NNSA/NFO, 2014a) with minor deviations as described in Sections A.2.1 through A.2.5, which provide the general investigation and evaluation methodologies.

A.2.1 Sample Locations

All sample locations for CAU 568 were selected judgmentally, using biasing factors such as radiological survey results and/or the presence of debris. At locations where soil sample plots were established, soil samples were collected following a probabilistic approach. One or more composite samples were collected within each sample plot, and TLDs were located at the center of each sample plot. The subsample aliquot locations for each sample were identified using a predetermined random-start, triangular grid pattern.

All sample locations and points of interest were surveyed with a GPS instrument. Appendix F presents these GPS data in a tabular format. Additional information on the selection of sample locations is found in the CAIP and the study-group-specific sections (Sections A.3.0 through A.7.0).

A.2.2 Investigation Activities

The investigation activities as listed in Section A.2.0 performed at CAU 568 were consistent with the field investigation activities specified in the CAIP (NNSA/NFO, 2014a). The investigation strategy provided the necessary information to establish the nature and extent of contamination associated with each study group release. The following subsections describe the specific investigation activities that took place at CAU 568.

A.2.2.1 Radiological Surveys

Aerial surveys and TRSs were conducted at the CAU 568 CASs. Aerial radiological surveys were performed at the site in 1994 at an altitude of 200 ft with 500-ft flight-line spacing (BN, 1999a). Another aerial survey was conducted at the site in 2012 at an altitude of 15 meters (m) with 23-m flight line spacings (Stampahar, 2012) to provide better resolution of the distribution of site radioactivity.

TRSs were performed to identify specific locations for sample plots and biased sample locations. Count-rate data were collected with a TSA Systems PRM-470 model plastic scintillator. Count-rate and position data were collected and recorded at 1-second intervals, via a Trimble Systems GeoXT GPS unit. The travel speed was approximately 1 to 2 meters per second with the radiation detector held at a height of approximately 18 in. above the ground surface. Count rates for the PRM-470 and FIDLER are recorded in units of counts per second (cps) and counts per minute (cpm), respectively. As background radiation levels change over time, these measurement units were converted to multiples of background. This provides additional comparability of results that were collected at different times. The radiation surveys generated discrete measurement points (point data). The point data results are presented as continuous spatial distributions (i.e., interpolated surfaces). These were estimated from the point data using an inverse distance weighted interpolation technique. Figure A.2-1 presents a graphic representation of the data from the TRS.

A.2.2.2 Radiological Field Screening

The study-group-specific sections of this document identify the locations where radiological field screening was conducted and how the field-screening levels (FSLs) were used to aid in the selection of samples submitted for analysis. Field-screening results (FSRs) are recorded on SCLs that are retained in project files.

Site-specific FSLs were determined each day before investigational soil sampling began. A location was selected in the vicinity of the site with a minimal probability of being impacted from releases or site operations. Ten or more surface soil aliquots, from the top 5 cm of soil, were collected at random locations within the selected area. The aliquots were then mixed, and 10 one-minute static counts were obtained for both alpha and beta/gamma measurements. The FSLs for both alpha and beta/gamma were calculated by multiplying the sample standard deviation by 2 and adding that value to the sample average.

Radiological field screening was used at CAU 568 to evaluate the presence of buried contamination within disturbed areas, and to aid in the selection of biased samples for laboratory analyses within these areas. Radiological field screening was limited to radiological parameters and was conducted using an NE Electra instrument. Within disturbed areas, soil was removed at the sample location and screened for radioactivity in 5- to 10-cm-depth increments to a total depth of 30 cm bgs (or until

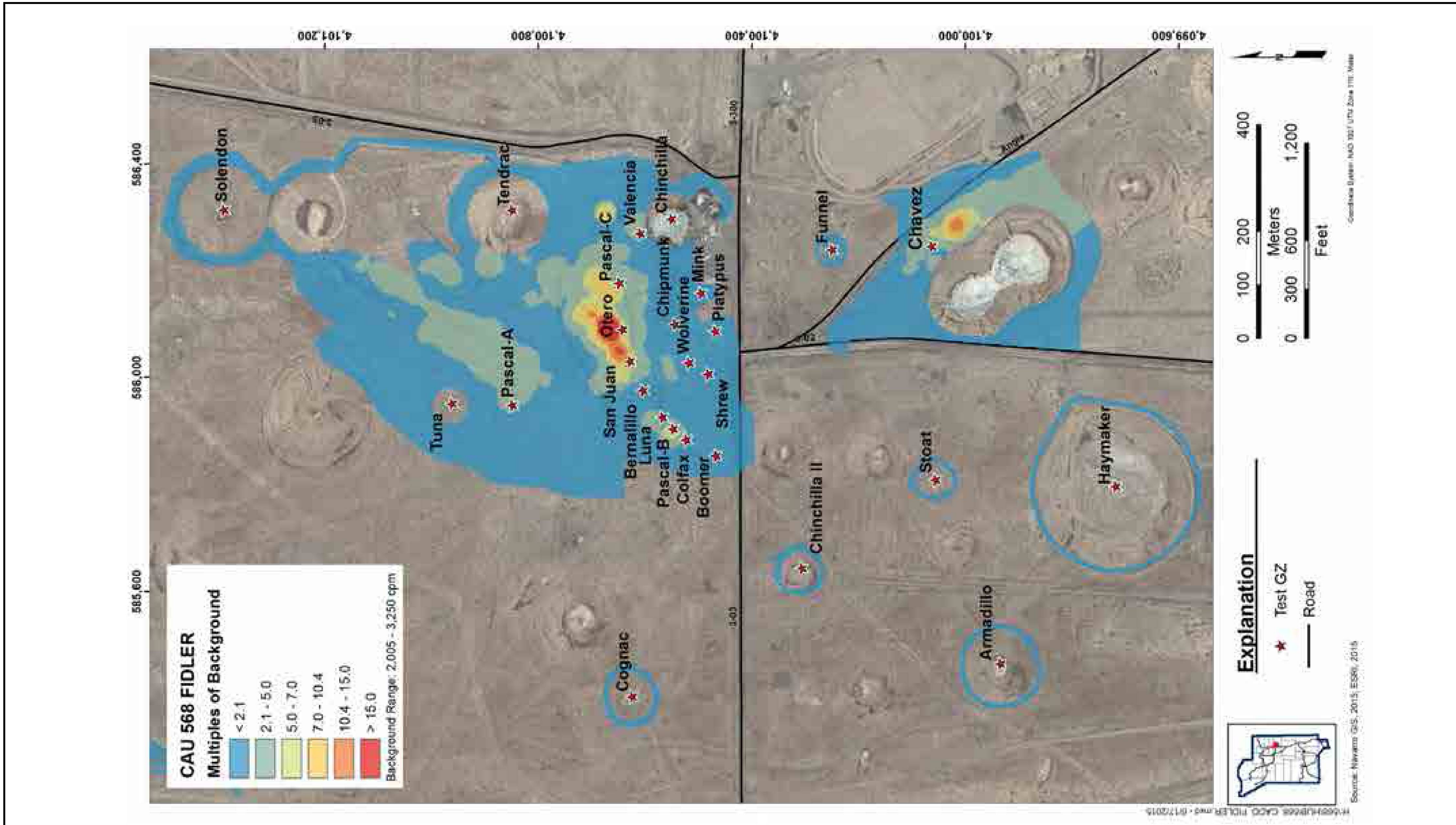

Figure A.2-1
TRSs Conducted at CAU 568

material was encountered). These FSRs were used to determine whether a subsurface contamination layer(s) could be distinguished from surface contamination. Buried contamination was considered to be present only if the depth interval reading exceeded the FSL, and there was a greater than 20 percent difference between the depth interval reading and the surface soil reading. For locations where it was determined that buried contamination was present, the subsurface depth interval with the highest reading was sent for offsite laboratory analyses.

A.2.2.3 TLD Sampling

TLDs (Panasonic UD-814) were staged at CAU 568, within sample plots and at grab sample locations, with the objective of collecting *in situ* measurements to determine the external radiological dose (Figure A.3-1).

TLDs were also placed at three background locations outside the influence of any identified release to measure background radiation. The background TLDs measure dose from natural sources in areas unaffected by the CAU-related releases during field deployment. The locations for the three background TLDs were selected using a background isopleth map generated from the 1994 gamma aerial radiation survey (BN, 1999a), as shown on Figure A.2-2. It was determined that the background TLD locations are representative of the general area and can be used as a good estimate of true average background dose for all of the environmental TLDs. Therefore, the background TLD results were used in the calculation of radiological dose at all study groups in CAU 568. See Section A.2.3.2 for a discussion of the external dose calculation for the background TLD locations.

Each TLD was placed at a height of 1 m above the ground surface, which is consistent with TLD placement in the NNSS routine environmental monitoring program and with site characterization at other Soils Activity FFACO CAUs. Once retrieved from the field locations, the TLDs were analyzed by automated TLD readers that are calibrated and maintained by the NNSS M&O contractor.

This approach allowed for the use of existing QC procedures for TLD processing. Details of the environmental monitoring TLD program and TLD QC are presented in Section A.9.0. All readings conformed to the approved QC program and are considered representative of the external radiological dose at each location.

A.2.2.4 Soil Sampling

Soil sampling at CAU 568 included collecting surface soil samples within sample plot and grab sample locations. Within each sample plot, except for Location A25 (see Section A.3.1.4.2), four composite samples were collected. Each composite sample was composed of nine randomly located aliquots, resulting in a total of 36 aliquots collected from each plot. Each aliquot was collected using a "vertical-slice cylinder and bottom-trowel" method. This required the insertion of the 3.5-in. inside diameter cylinder to a depth of 5 cm, excavation of the outside soil along one side of the cylinder (to permit trowel placement), and horizontal insertion of a trowel along the bottom of the cylinder. This method captured a cylindrical-shaped section of the soil from 0 to 5 cm bgs. At Location A25 (Platypus) and at lead item locations where plot samples were collected, only one composite sample was collected.

After collection, each aliquot was carefully placed atop a sieve (#4 mesh) fitted into a bottom pan with a plastic bag liner. Oversized material that did not pass through the sieve was returned to the original sample location.

At disturbed locations, subsurface samples were collected as described in Section A.2.2.2 to determine whether buried contamination exists. At each of these locations, the samples were field screened for radioactivity levels. The surface sample and the surface sample interval with the highest FSRs meeting the requirements in Section A.2.2.2 were sent to the laboratory for analysis.

A.2.3 Dose Calculations

Soil and TLD data are used to calculate a TED that could potentially be received by a human receptor at the site. The following subsections discuss the process for evaluating the soil and TLD data in terms of dose, so the data may be compared directly to the dose-based radiological FAL.

A.2.3.1 Internal Dose Calculations

Internal dose was calculated using the radionuclide analytical results from soil samples and the corresponding residual radioactive material guideline (RRMG) (NNSA/NFO, 2014b). The internal dose RRMG concentration for a particular radionuclide is that concentration in surface soil that would cause an internal dose to a receptor of 25 mrem/yr (under the appropriate exposure scenario) independent of any other radionuclide (assuming that no other radionuclides contribute dose). The internal dose RRMG for each detected radionuclide (in picocuries per gram [pCi/g] of soil) was derived using RESRAD computer code (Yu et al., 2001) under the appropriate exposure scenario (NNSA/NFO, 2014b).

The total internal dose corresponding to each surface soil sample was calculated by adding the dose contribution from each radionuclide. For each sample, the radionuclide-specific analytical result was divided by its corresponding internal RRMG (NNSA/NFO, 2014b) to yield a fraction of the 25-mrem/yr dose and then multiplied by 25 to yield an internal dose estimate (in mrem/yr) at that sample location. Soil concentrations of Pu isotopes are inferred from gamma spectroscopy results as described in the representativeness discussion of Section B.1.1.1.1. The internal doses for all radionuclides detected in a soil sample were then summed to yield an internal dose for that sample. For probabilistic samples, a 95 percent UCL was calculated for the internal dose in each sample plot using the results of all soil samples collected in that plot (NNSA/NFO, 2014a). For judgmental sample locations where only one sample was collected, statistical inferences could not be calculated, and the single analytical result was used to calculate the internal dose.

For TLD locations where soil samples were not collected, the internal dose was estimated using the external dose measurement from the TLD and the internal to external dose ratio from the sample plot with the maximum internal dose within the corresponding release. The internal dose for each of these locations was calculated by multiplying this ratio by the external dose value specific to each location using the following formula:

$$Internal\ dose_{est} = External\ dose_{est} \times [Internal\ dose / External\ dose]_{max}$$

where

est = location for the estimate of internal dose
max = location of maximum internal dose

Use of this method to estimate internal dose will overestimate the internal dose (and therefore TED) as the internal to external dose ratio generally decreases with decreasing TED values.

A.2.3.2 External Dose Calculations

External dose was calculated using TLDs. The TLDs used at CAU 568 contain four individual elements. External dose at each TLD location is determined using the readings from TLD elements 2, 3, and 4. Each of these elements is considered to be a separate independent measurement of external dose. A 95 percent UCL of the average of these measurements was calculated for each TLD location. Element 1 is designed to measure dose to the skin and is not relevant to the determination of the external dose for the purpose of this investigation.

For subsurface sample locations where external dose measurements were not available, a TLD-equivalent external dose was calculated using the subsurface sample results. This was accomplished by establishing an average ratio between RESRAD-calculated external dose from surface samples and the corresponding TLD readings. The RESRAD-calculated external dose from the subsurface samples was then adjusted to TLD-equivalent values using the following formula:

$$Equivalent\ Subsurface_{TLD} = Subsurface_{RR} \times (Surface_{TLD} / Surface_{RR})_{ave}$$

where

TLD = external dose based on TLD readings
RR = external dose based on RESRAD calculation from analytical soil concentrations

Estimates of external dose at the CAU 568 sites are presented as net values (i.e., background radiation dose has been subtracted from the raw result). The background dose at CAU 568 was determined to be the average of the background TLD results from two of the three background locations (F01, F02, and F03) (29.6 mrem/IA-yr) as shown in Table A.2-1 and Figure A.2-2. The external dose for Location F01 was not used in the calculation of background dose because at the time of collection, the dosimeter case was found to be broken and the dosimeter was lying on a bush below the case. Therefore, it was determined that the result from the TLD may not be representative of the location.

A.2.3.3 Total Effective Dose

The calculated TED represents the sum of the internal dose and the external dose for each sample location. For locations where a TLD was not placed, TED was calculated directly from the soil sample analytical results. This was accomplished using the method described in Section A.2.3.1 for internal dose, except the RRMGs for TED were used instead of the RRMGs for internal dose.

Table A.2-1
Background TLD Samples

TLD Location	TLD Number	Date Placed	Date Removed	Purpose
F01[a]	4449	06/25/2014	10/14/2014	Background
F02	6211			
F03	3549			

[a] The TLD at Location F01 was not used in the calculation of background dose because at the time of collection, the dosimeter case was damaged and the dosimeter was lying on a bush below the case.

The calculated TED is an estimate of the true (unknown) TED. It is uncertain how well the calculated TED represents the true TED. If a calculated TED were directly compared to the FAL, any significant difference between the true TED and the calculated TED could lead to decision errors.

To reduce the probability of a false-negative decision error for probabilistic sampling results, a conservative estimate of the true TED (i.e., the 95 percent UCL) is used to compare to the FAL. By definition, there will be a 95 percent probability that the true TED is less than the 95 percent UCL of the calculated TED. The probabilistic sampling design as described in the CAIP (NNSA/NFO, 2014a) conservatively prescribes using the 95 percent UCL of the TED for DQO decisions. The 95 percent UCL of the TED is also used for determining the presence or absence of COCs (DQO Decision I). For sample locations where a TLD and multiple soil samples are collected (i.e., sample plots), this is calculated as the sum of the 95 percent UCLs of the internal and external doses. For grab sample locations where a TLD sample was collected, this is calculated as the sum of the 95 percent UCL of the external dose and the single internal dose estimate.

A minimum number of samples is required to assure sufficient confidence in dose statistics for probabilistic sampling such as the average and 95 percent UCL (EPA, 2006). As stated in the CAIP, if the minimum sample size criterion cannot be met, it must be assumed that contamination exceeds the FAL. The calculation of the minimum sample size is described in Section B.1.1.1.1.

To reduce the probability of a false-negative decision error for judgmental sampling results, samples were biased to locations of higher radioactivity. Samples from these locations will produce TED results that are higher than from adjacent locations of lower radioactivity (within the exposure area

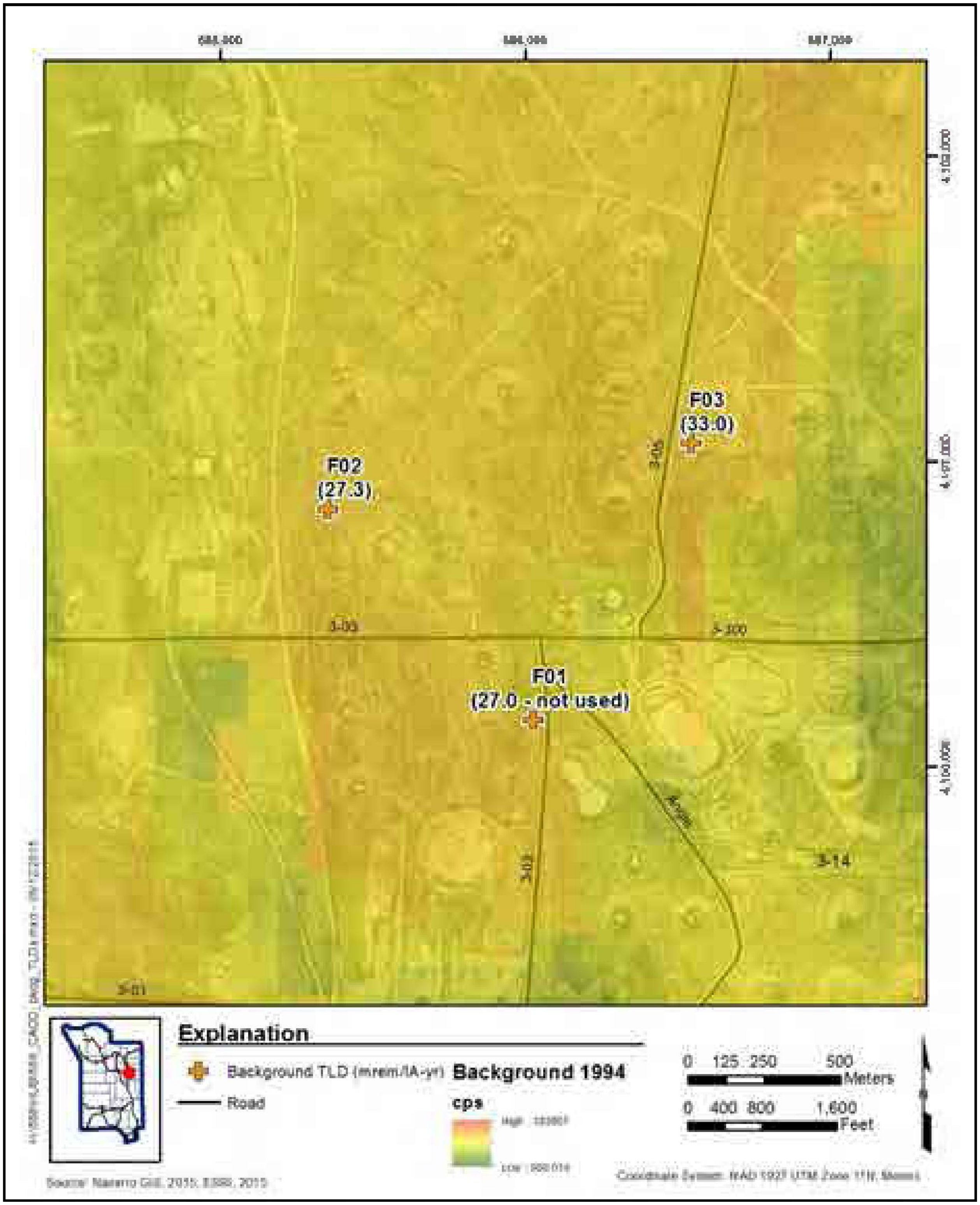

Figure A.2-2
CAU 568 Background TLD Locations

that is being characterized for dose). This will conservatively overestimate the true TED of the exposure area and protect against false-negative decision errors.

A.2.4 Comparison to Action Levels

The radiological PALs and FALs are based on an annual dose limit of 25 mrem/yr. This dose limit is specific to the annual dose a receptor could potentially receive from a CAU 568 release. As such, it is dependent upon the cumulative annual hours of exposure to site contamination. The PALs were established in the CAIP (NNSA/NFO, 2014a) based on a dose limit of 25 mrem/yr over an annual exposure time of 2,000 hours (i.e., the Industrial Area exposure scenario in which a site worker is exposed to site contamination for 8 hr/day and 250 day/yr). The FALs were established in Appendix D based on a dose limit of 25 mrem/yr over an annual exposure time of 80 hours (i.e., the Occasional Use Area exposure scenario in which a site worker is exposed to site contamination for 8 hr/day and 10 day/yr).

Results for each of the study group releases are presented in Sections A.3.0 through A.7.0. Radiological results are reported as doses that are comparable to the dose-based FAL as established in Appendix D. Chemical results are reported as individual concentrations that are comparable to the individual chemical FALs as established in Appendix D. Results that are equal to or greater than FALs are identified by bold text in the study-group-specific results tables (see Sections A.3.0 through A.7.0).

A COC is defined as any contaminant present in environmental media exceeding a FAL. A COC may also be defined as a contaminant that, in combination with other like contaminants, is determined to jointly pose an unacceptable risk based on a multiple constituent analysis (NNSA/NFO, 2014a). If COCs are present, corrective action must be considered for the study group release.

A corrective action may also be required if a waste present within a study group release contains contaminants that, if released, could cause the surrounding environmental media to contain a COC. Such a waste would be considered PSM. To evaluate wastes for the potential to result in the introduction of a COC to the surrounding environmental media, the conservative assumption was made that any physical waste containment would fail at some point and release the contaminants to the surrounding media. The following were used as the criteria for determining whether a waste is PSM:

- A waste, regardless of concentration or configuration, may be assumed to be PSM and handled under a corrective action.

- Based on process knowledge and/or professional judgment, some waste may be assumed to not be PSM if it is clear that it could not result in soil contamination exceeding a FAL.

- If assumptions about the waste cannot be made, then the waste material will be sampled, and the results will be compared to FALs based on the following criteria:

  - For non-liquid wastes, the concentration of any chemical contaminant in soil (following degradation of any physical containment and release of contaminants into soil) would be equal to the mass of the contaminant divided by the mass of the potentially contaminated soil. If the resulting soil concentration exceeds the FAL, then the waste would be considered to be PSM.

  - For non-liquid wastes, the dose resulting from radioactive contaminants in soil (following degradation of any physical containment and release of contaminants into soil) would be calculated using the activity of the contaminant in the waste divided by the mass of the potentially contaminated soil (for each radioactive contaminant) and calculating the combined resulting dose using the RRMGs for TED as described in Section A.2.3.3. If the dose exceeds the FAL, then the waste would be considered to be PSM.

  - For liquid wastes, the concentration of any chemical contaminant in soil (following degradation of any physical containment and release of contaminants into soil) will be calculated using the following equation based on the concentration of contaminants in the waste, the soil water holding capacity of the soil (field capacity), and the soil bulk density. If the resulting soil concentration exceeds the FAL, then the liquid waste would be considered to be PSM.

$$C_s = \frac{C_l \times FC_s}{P_b}$$

where

C_s = estimated constituent concentration in soil (mg/kg)
C_l = constituent concentration in liquid PSM (mg/L)
FC_s = soil field capacity (0.2 kg/1,000 cm^3)
P_b = soil bulk density (1.5 kg/1,000 cm^3)

A.2.5 Correlation of Dose to Radiation Survey Isopleths

A boundary for a corrective action or an administrative UR for a particular release site may be established by using radiation survey isopleths if it can be shown that a sufficient correlation exists between TED and radiation survey values. A continuous spatial distribution (i.e., interpolated surface) was estimated from each of the listed radiation surveys using an inverse distance weighted interpolation technique. The average Industrial Area TED value for each study site was then matched with a radiation survey value from the interpolated surface at the corresponding geographic location. A correlation was then calculated between these data pairs for each radiation survey. Correlation statistics are used to establish the relationship between the paired values as well as an indicator of the strength of the relationship (i.e., the coefficient of determination, or r^2). The minimum strength of the relationship for a valid correlation was defined in the DQOs as an r^2 of 0.8.

The TED values used in the correlation were the average TED for probabilistic samples or the calculated TED for judgmental samples from biased sample locations. To protect against a Decision II false-negative decision error (the potential for a receptor to receive a dose exceeding the 25-mrem/yr FAL outside the defined boundary), the Soils Activity uses a conservative estimate of the radiation survey value corresponding to 25 mrem/yr. This is accomplished using the uncertainty of how well the calculated relationship between TED and emitted radiation (i.e., the regression) represents the assumed true relationship. This uncertainty includes the uncertainty of how well the calculated TED represents true TED and the uncertainty of how well the radiation survey instrument readings represent emitted radioactivity. These uncertainties were used to conservatively establish corrective action boundaries and administrative UR boundaries by using the 95 percent lower confidence limit (LCL) of the regression correlation as described in the Soils RBCA document (NNSA/NFO, 2014b).

A.2.6 Best Management Practices

As a BMP, an administrative UR will be established to include any area where an industrial land use of the area (2,000 hr/yr) could cause a future site worker to receive a dose exceeding 25 mrem/yr. To determine the extent of the area where TED exceeds the PAL (Industrial Area scenario), a correlation of radiation survey values to the average Industrial Area TED values was conducted for the following radiation surveys as described in Section A.2.5:

- 1996 Am-241 aerial radiation survey (BN, 1999b)
- 1996 man-made aerial radiation survey (BN, 1999b)
- 2012 Am-241 aerial radiation survey (Stampahar, 2012)
- 2012 man-made aerial radiation survey (Stampahar, 2012)
- Site-specific TRS (FIDLER survey)

The quality of these correlations is indicated by the r^2. The radiation survey that exhibits the best r^2 and exceeds the minimum criteria of 0.80 as set in the Soils RBCA document (NNSA/NFO, 2014b) will be used for the LCL of this correlation (as described in Section A.2.5). Based on the LCL of the chosen survey correlation, the radiation survey value that corresponds to the 25-mrem/IA-yr PAL in multiples of background will be identified.

The second criterion for an administrative UR is the presence of removable contamination that meets CA criteria. CA criteria is defined as greater than 20 disintegrations per minute (dpm) but less than or equal to 2,000 dpm removable alpha contamination (NNSA/NSO, 2012a).

A.3.0 Study Group 1, Releases within a Defined Radiological Survey Signature

Study Group 1, Releases within a Defined Radiological Survey Signature, is located in the western portion of Area 3 of the NNSS, near the Area 3 RWMC and former Mud Plant. The study group consists of the atmospheric deposition of radionuclide contamination from weapons-related tests and SEs. Additional detail on the history of Study Group 1 is provided in the CAIP (NNSA/NFO, 2014a).

A.3.1 CAI Activities

The specific CAI activities conducted to satisfy the CAIP requirements at this study group are described in the following subsections.

A.3.1.1 Visual Surveys

During visual surveys, the GZ locations of the test releases in Study Group 1 were identified. Additionally, the former windrow area was investigated. No indication of windrows was observed; however, three disturbed areas (Locations A23, A30, and A32) were identified (Figure A.3-1). These areas were investigated for the potential presence of buried contamination. No other features or potential releases associated with Study Group 1 were identified during visual surveys.

A.3.1.2 Radiological Screening

A former windrow area and disturbed areas within the Pascal-B plume are present within the scope of Study Group 1. At sample locations within these areas, surface and subsurface samples were field screened for radioactivity levels as described in Section A.2.2.2 to determine whether buried contamination exists. Based on the screening results, subsurface samples were collected from one location within the former windrow area (Location A07) and one disturbed location within the Pascal-B plume (Location A32) (Figure A.3-1).

A.3.1.3 Radiological Surveys

Aerial surveys and TRSs were performed at Study Group 1. The aerial surveys are described in Section A.2.2.1. The TRSs were conducted at the site to identify the spatial distribution of

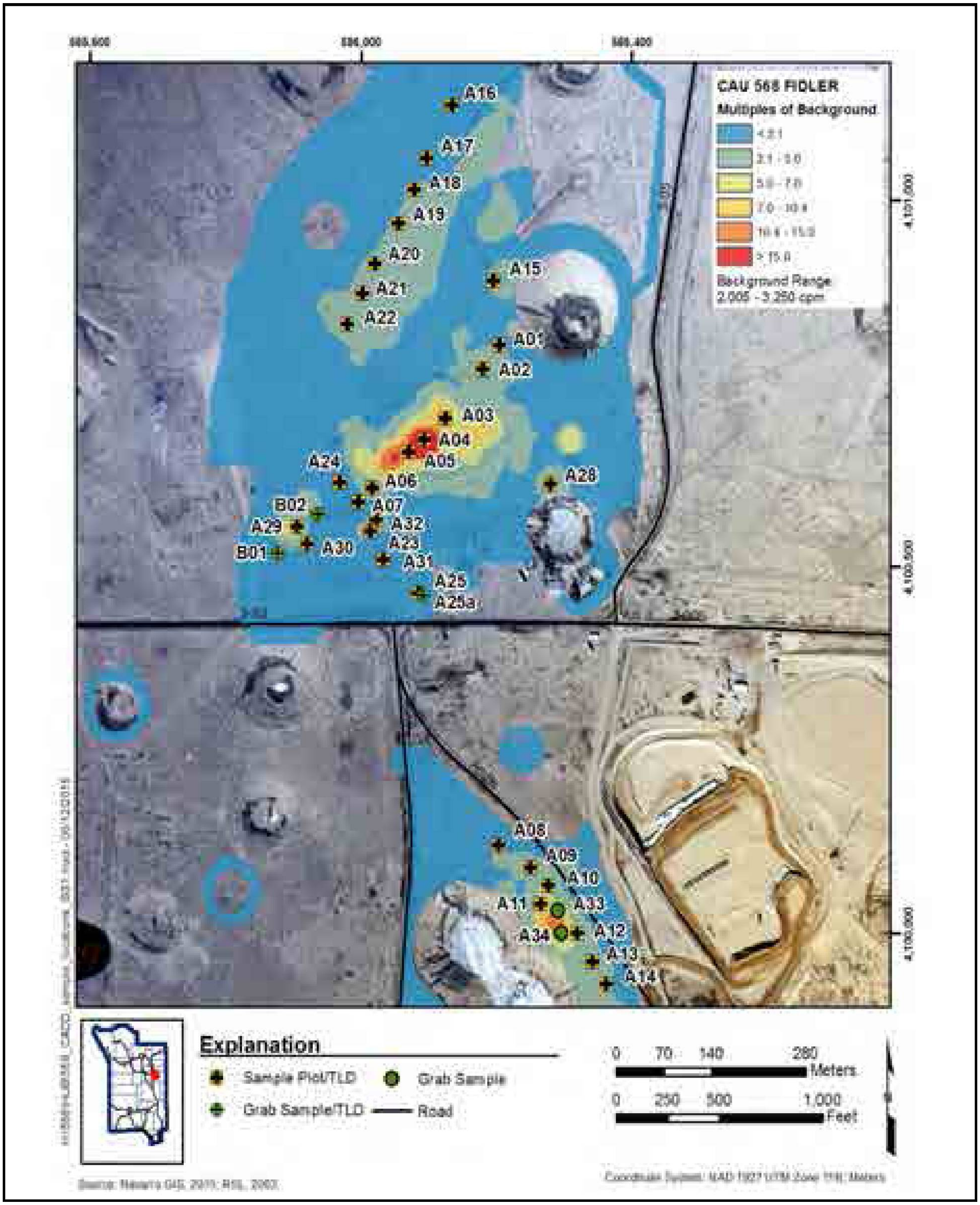

Figure A.3-1
Study Group 1 Sample Locations

radiological readings and to identify the locations of the highest radiological readings. For Study Group 1, seven distinct areas each with a defined radiological survey signature (plume) were identified. The test releases within each plume area and the locations of highest radiological readings in each plume are listed in Table A.3-1. Sample plots were established at the location of highest radiological readings within each of these plumes (Figure A.3-1). See Figure A.2-1 for a graphic representation of the TRSs conducted at Study Group 1.

Table A.3-1
Study Group 1 TRS Results

Test Releases in Each Plume	Location of Highest Radiological Readings
San Juan, Otero, Pascal-C	North of the Otero GZ
Bernalillo	North of GZ
Pascal-B	Adjacent to the northern edge of GZ emplacement pad
Colfax	Adjacent to southern edge of GZ emplacement pad
Luna	Adjacent to northern edge of GZ emplacement pad
Pascal-A	Southeast of GZ
Valencia	East of GZ
Platypus	South of GZ
Wolverine	Adjacent to the southern edge of the GZ emplacement pad
Chavez	Adjacent to GZ

In addition to the TRSs, the 2012 aerial radiological survey (Stampahar, 2012) was used to determine the locations of the vector soil sample plots within the Otero, San Juan, and Pascal-C plume; and the Pascal-A plume. Vector sample locations were selected along these two plumes to be used, if necessary, to determine the extent of surface soil contamination. Vector plots were not placed within the other five Study Group 1 plumes. The aerial radiological survey covered the extent of detectable radiation plumes emanating from Study Group 1 releases (Figure A.3-1).

A.3.1.4 Sample Collection

Soil samples and TLD samples were collected to satisfy the CAIP requirements (NNSA/NFO, 2014a) at Study Group 1. The specific CAI activities conducted this study group are described in the following subsections.

A.3.1.4.1 TLD Samples

Table A.3-2 shows the number of TLD samples collected by type (plot and grab). The TLDs were installed at 33 locations (A01–A25, A25a, A28–A32, B01, and B02) at Study Group 1 to calculate external doses. At all sample plots except for A15, A29, A31, and A32, one TLD was placed in the center of each sample plot. At Locations A15, A29, A31, and A32, radiological readings were not evenly distributed. Therefore, one TLD was placed in each of four quadrants. One TLD was placed at each grab sample location within Study Group 1 except for Locations A33 and A34 within the Chavez HCA. The Chavez HCA is a DCB, and these grab samples were collected only for informational purposes. TLDs placed at Study Group 1 are listed in Table A.3-3. All TLDs were measured by the NNSS environmental TLD monitoring program. See Figure A.3-1 for TLD locations.

Table A.3-2
Study Group 1 TLD Sample Summary

Location Type	Number of Locations	Number of TLDs[a]	Analyses (Method)
Grab	3	3	See Section A.9.5
Plot	30	42	
Total	33	45	

[a] Number of TLDs is greater than the number of locations for some sample types because some locations had more than one TLD.

A.3.1.4.2 Soil Samples

Soil sampling for Study Group 1 consisted of collecting sample plot samples and surface soil grab samples, and performing subsurface screening and grab sampling at disturbed areas. There were 117 surface soil composite samples collected from 30 plots to determine internal dose. For Location A25, only one composite sample was collected from the sample plot instead of the typical four composite samples because the plot was located on the gravel-covered concrete emplacement pad at the Platypus GZ and there was not enough soil from which to collect multiple samples.

One surface grab sample was collected from Locations A25a, B01, and B02 to determine internal dose. A field duplicate (FD) sample was collected from Location B01. For Location A25a, a grab sample was collected because the area of elevated radiological readings was smaller than the size of a

Table A.3-3
TLDs at Study Group 1
(Page 1 of 2)

Release	Location	TLD No.	Date Placed	Date Removed	Purpose
San Juan, Otero, Pascal-C	A01	6031	06/24/2014	10/14/2014	Sample plot
	A02	4832	06/24/2014	10/14/2014	Sample plot
	A03	4327	06/25/2014	10/14/2014	Sample plot
	A04	6149	06/25/2014	10/14/2014	Sample plot
	A05	6340	06/25/2014	10/14/2014	Sample plot
	A06	6235	06/24/2014	10/14/2014	Sample plot
	A07	6032	06/24/2014	10/14/2014	Sample plot
	A15	6325	06/24/2014	10/14/2014	Sample plot
		6261	06/24/2014	10/14/2014	Sample plot
		6039	06/24/2014	10/14/2014	Sample plot
		6040	06/24/2014	10/14/2014	Sample plot
Bernalillo	A24	6057	06/24/2014	10/14/2014	Sample plot
Pascal-B	A29	4347	06/25/2014	10/14/2014	Sample plot
		6380	06/25/2014	10/14/2014	Sample plot
		6104	06/25/2014	10/14/2014	Sample plot
		4186	06/25/2014	10/14/2014	Sample plot
	A30	5132	06/25/2014	10/14/2014	Sample plot
	A23	6481	06/24/2014	10/14/2014	Sample plot
	A32	6095	06/25/2014	10/14/2014	Sample plot
		6172	06/25/2014	10/14/2014	Sample plot
		6493	06/25/2014	10/14/2014	Sample plot
		6170	06/25/2014	10/14/2014	Sample plot
Colfax	B01	6485	06/25/2014	10/14/2014	Grab Sample
Luna	B02	6231	06/24/2014	10/14/2014	Grab Sample

Table A.3-3
TLDs at Study Group 1
(Page 2 of 2)

Release	Location	TLD No.	Date Placed	Date Removed	Purpose
Pascal-A	A16	6166	06/24/2014	10/14/2014	Sample plot
	A17	6292	06/24/2014	10/14/2014	Sample plot
	A18	6491	06/24/2014	10/14/2014	Sample plot
	A19	6042	06/24/2014	10/14/2014	Sample plot
	A20	6484	06/24/2014	10/14/2014	Sample plot
	A21	6381	06/24/2014	10/14/2014	Sample plot
	A22	4417	06/24/2014	10/14/2014	Sample plot
Valencia	A28	4419	06/25/2014	10/15/2014	Sample plot
Platypus	A25	6131	08/06/2014	11/13/2014	Sample plot
	A25a	6382	06/24/2014	10/14/2014	Grab Sample
Wolverine	A31	6317	06/25/2014	10/14/2014	Sample plot
		6482	06/25/2014	10/14/2014	Sample plot
		6134	06/25/2014	10/14/2014	Sample plot
		4860	06/25/2014	10/14/2014	Sample plot
Chavez	A08	6272	06/26/2014	10/15/2014	Sample plot
	A09	6120	06/26/2014	10/15/2014	Sample plot
	A10	6426	06/26/2014	10/15/2014	Sample plot
	A11	4918	06/26/2014	10/15/2014	Sample plot
	A12	4134	06/26/2014	10/15/2014	Sample plot
	A13	6155	06/26/2014	10/15/2014	Sample plot
	A14	4568	06/26/2014	10/15/2014	Sample plot

sample plot. For Locations B01 and B02 (collected near the Colfax and Luna GZ, respectively), grab samples were collected in accordance with the CAIP (NNSA/NFO, 2014a).

Within the Chavez HCA (DCB), grab samples were collected from Locations A33 and A34 to gather additional information about elevated radiological readings within the Chavez HCA and are not used for DQO decisions.

Samples collected for the determination of internal dose were submitted for gamma spectroscopy; plutonium (Pu)-241; and isotopic uranium (U), Pu, and Am analyses. A select few (nine samples) were submitted for additional strontium (Sr)-90 and technetium (Tc)-99 analyses, based on the expected locations of the highest cesium (Cs)-137 results per Section A.2.2.2 of the CAIP (NNSA/NFO, 2014a).

Grab samples collected from within the former windrow area at Locations A06 and A07, and disturbed areas at Locations A23 and A32 were screened to determine whether buried horizons of radioactivity exists, as discussed in Section A.3.1.2. Grab samples collected from the surface and subsurface at these locations were submitted for gamma spectroscopy; Pu-241; and isotopic U, Pu, and Am analyses. Samples from Locations A06 and A07 with the highest FSRs were also submitted for VOC, SVOC, and PCB analysis, because there is the potential for oil to have been sprayed on the former windrows. A summary including the number, depth, and purpose for each sample is provided in Table A.3-4. Sample locations are shown on Figure A.3-1.

Table A.3-4
Samples Collected at Study Group 1
(Page 1 of 6)

Release	Location	Sample Number	Depth (cm bgs)	Purpose
San Juan, Otero, Pascal-C	A01	A673	0.0 - 5.0	Plot Composite
		A674	0.0 - 5.0	Plot Composite
		A675	0.0 - 5.0	Plot Composite
		A676	0.0 - 5.0	Plot Composite
	A02	A677	0.0 - 5.0	Plot Composite
		A678	0.0 - 5.0	Plot Composite
		A679	0.0 - 5.0	Plot Composite
		A680	0.0 - 5.0	Plot Composite
	A03	A601	0.0 - 5.0	Plot Composite
		A602	0.0 - 5.0	Plot Composite
		A603	0.0 - 5.0	Plot Composite
		A604	0.0 - 5.0	Plot Composite

Table A.3-4
Samples Collected at Study Group 1
(Page 2 of 6)

Release	Location	Sample Number	Depth (cm bgs)	Purpose
San Juan, Otero, Pascal-C	A04	A605	0.0 - 5.0	Plot Composite
		A606	0.0 - 5.0	Plot Composite
		A607	0.0 - 5.0	Plot Composite
		A608	0.0 - 5.0	Plot Composite
	A05	A609	0.0 - 5.0	Plot Composite
		A610	0.0 - 5.0	Plot Composite
		A611	0.0 - 5.0	Plot Composite
		A612	0.0 - 5.0	Plot Composite
	A06	A705	0.0 - 5.0	Plot Composite
		A706	0.0 - 5.0	Plot Composite
		A707	0.0 - 5.0	Plot Composite
		A708	0.0 - 5.0	Plot Composite
		A003	0.0 - 5.0	Grab (Rad) - Windrows
		A007	0.0 - 5.0	Grab (Chem) - Windrows
	A07	A709	0.0 - 5.0	Plot Composite
		A710	0.0 - 5.0	Plot Composite
		A711	0.0 - 5.0	Plot Composite
		A712	0.0 - 5.0	Plot Composite
		A004	0.0 - 5.0	Grab (Rad) - Windrows
	A07a	A005	15.0 - 20.0	Grab (Rad) - Windrows
	A07b	A006	20.0 - 25.0	Grab (Rad) - Windrows
	A07a	A008	15.0 - 20.0	Grab (Chem)- Windrows
	A07a	A009	15.0 - 20.0	Grab (Chem) - FD of A008
	A15	A689	0.0 - 5.0	Plot Composite
		A690	0.0 - 5.0	Plot Composite
		A691	0.0 - 5.0	Plot Composite
		A692	0.0 - 5.0	Plot Composite

Table A.3-4
Samples Collected at Study Group 1
(Page 3 of 6)

Release	Location	Sample Number	Depth (cm bgs)	Purpose
Bernalillo	A24	A697	0.0 - 5.0	Plot Composite
		A698	0.0 - 5.0	Plot Composite
		A699	0.0 - 5.0	Plot Composite
		A700	0.0 - 5.0	Plot Composite
Pascal-B	A29	A681	0.0 - 5.0	Plot Composite
		A682	0.0 - 5.0	Plot Composite
		A683	0.0 - 5.0	Plot Composite
		A684	0.0 - 5.0	Plot Composite
	A30	A721	0.0 - 5.0	Plot Composite
		A722	0.0 - 5.0	Plot Composite
		A723	0.0 - 5.0	Plot Composite
		A724	0.0 - 5.0	Plot Composite
	A23	A002	0.0 - 5.0	Grab
		A701	0.0 - 5.0	Plot Composite
		A702	0.0 - 5.0	Plot Composite
		A703	0.0 - 5.0	Plot Composite
		A704	0.0 - 5.0	Plot Composite
	A32a	A010	15.0 - 20.0	Grab
	A32	A713	0.0 - 5.0	Plot Composite
		A714	0.0 - 5.0	Plot Composite
		A715	0.0 - 5.0	Plot Composite
		A716	0.0 - 5.0	Plot Composite
Colfax	B01	B003	0.0 - 5.0	Grab
		B004	0.0 - 5.0	Grab - FD of B003
Luna	B02	B005	0.0 - 5.0	Grab

Table A.3-4
Samples Collected at Study Group 1
(Page 4 of 6)

Release	Location	Sample Number	Depth (cm bgs)	Purpose
Pascal-A	A16	A617	0.0 - 5.0	Plot Composite
		A618	0.0 - 5.0	Plot Composite
		A619	0.0 - 5.0	Plot Composite
		A620	0.0 - 5.0	Plot Composite
	A17	A621	0.0 - 5.0	Plot Composite
		A622	0.0 - 5.0	Plot Composite
		A623	0.0 - 5.0	Plot Composite
		A624	0.0 - 5.0	Plot Composite
	A18	A625	0.0 - 5.0	Plot Composite
		A626	0.0 - 5.0	Plot Composite
		A627	0.0 - 5.0	Plot Composite
		A628	0.0 - 5.0	Plot Composite
	A19	A629	0.0 - 5.0	Plot Composite
		A630	0.0 - 5.0	Plot Composite
		A631	0.0 - 5.0	Plot Composite
		A632	0.0 - 5.0	Plot Composite
	A20	A633	0.0 - 5.0	Plot Composite
		A634	0.0 - 5.0	Plot Composite
		A635	0.0 - 5.0	Plot Composite
		A636	0.0 - 5.0	Plot Composite
	A21	A637	0.0 - 5.0	Plot Composite
		A638	0.0 - 5.0	Plot Composite
		A639	0.0 - 5.0	Plot Composite
		A640	0.0 - 5.0	Plot Composite
	A22	A641	0.0 - 5.0	Plot Composite
		A642	0.0 - 5.0	Plot Composite
		A643	0.0 - 5.0	Plot Composite
		A644	0.0 - 5.0	Plot Composite

Table A.3-4
Samples Collected at Study Group 1
(Page 5 of 6)

Release	Location	Sample Number	Depth (cm bgs)	Purpose
Valencia	A28	A613	0.0 - 5.0	Plot Composite
		A614	0.0 - 5.0	Plot Composite
		A615	0.0 - 5.0	Plot Composite
		A616	0.0 - 5.0	Plot Composite
Platypus	A25	A011	0.0 - 5.0	Plot Composite
	A25a	A001	0.0 - 5.0	Grab
Wolverine	A31	A717	0.0 - 5.0	Plot Composite
		A718	0.0 - 5.0	Plot Composite
		A719	0.0 - 5.0	Plot Composite
		A720	0.0 - 5.0	Plot Composite
Chavez	A08	A645	0.0 - 5.0	Plot Composite
		A646	0.0 - 5.0	Plot Composite
		A647	0.0 - 5.0	Plot Composite
		A648	0.0 - 5.0	Plot Composite
	A09	A649	0.0 - 5.0	Plot Composite
		A650	0.0 - 5.0	Plot Composite
		A651	0.0 - 5.0	Plot Composite
		A652	0.0 - 5.0	Plot Composite
	A10	A653	0.0 - 5.0	Plot Composite
		A645	0.0 - 5.0	Plot Composite
		A655	0.0 - 5.0	Plot Composite
		A656	0.0 - 5.0	Plot Composite
	A11	A657	0.0 - 5.0	Plot Composite
		A658	0.0 - 5.0	Plot Composite
		A659	0.0 - 5.0	Plot Composite
		A660	0.0 - 5.0	Plot Composite

Table A.3-4
Samples Collected at Study Group 1
(Page 6 of 6)

Release	Location	Sample Number	Depth (cm bgs)	Purpose
Chavez	A12	A661	0.0 - 5.0	Plot Composite
		A662	0.0 - 5.0	Plot Composite
		A663	0.0 - 5.0	Plot Composite
		A664	0.0 - 5.0	Plot Composite
	A13	A665	0.0 - 5.0	Plot Composite
		A666	0.0 - 5.0	Plot Composite
		A667	0.0 - 5.0	Plot Composite
		A668	0.0 - 5.0	Plot Composite
	A14	A669	0.0 - 5.0	Plot Composite
		A670	0.0 - 5.0	Plot Composite
		A671	0.0 - 5.0	Plot Composite
		A672	0.0 - 5.0	Plot Composite
	A33	A012	0.0 - 5.0	Grab
	A34	A013	0.0 - 5.0	Grab

A.3.1.4.3 Gamma Am-241 Replicate Variability

A relatively large sample size (~1,600 g) within a Marinelli container is used for the gamma spectroscopy analysis. While this greatly reduces the impact of heterogeneously distributed discrete particles and provides results that are more representative of true contaminant activities at the release site, this method has the potential to provide less accurate results due to the haphazard location of contaminant particles within the Marinelli container at the time of measurement. The distance of particles from the detector would result in some differential self-absorption of the emissions from radioactive particles. As the magnitude of this problem was not previously understood, a study was conducted to evaluate the variability in Am-241 results due to self-absorption from particle position. Results from this study are shown in Appendix G and demonstrate that this effect provides minimal variability in replicate Am-241 measurements.

A.3.2 Deviations/Revised Conceptual Site Model

All sampling was completed in accordance with the requirements of the CAIP, and all CAI results support the CSM described in the CAIP except as noted in this section. According to the CAIP (NNSA/NFO, 2014a), for Decision II sampling, "three Decision II sample plots will be established judgmentally along each of two vectors that are approximately normal to the radiation survey isopleths..." The plume at Pascal-A trends northeast from the GZ area. Therefore, for Decision II sampling within the Pascal-A plume, sample plots were only placed along one vector, due to the direction of the plume in relation to GZ.

The CAIP requirements (NNSA/NFO, 2014a) were met at this study group. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

A.3.3 Investigation Results

The following subsections present the analytical and computational results for soil and TLD samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NFO, 2014a). The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr. For chemical contaminants, the results are reported as individual concentrations that are comparable to their corresponding FALs. Results that are equal to or greater than FALs are identified by bold text in the results tables.

The internal dose calculated from soil sample results, and the external dose calculated from TLD measurements were combined to determine TED at each sample location. External doses for TLD locations are summarized in Section A.3.3.1. Internal doses for each sample location are summarized in Section A.3.3.2. The TEDs for each sampled location are summarized in Section A.3.3.3. Chemical contaminant results for Study Group 1 are summarized in Section A.3.3.4.

A.3.3.1 External Radiological Dose Calculations

Estimates for the external dose that a receptor would receive at each Study Group 1 TLD sample location (Figure A.3-1) were determined as described in Section A.2.3.2. External dose was calculated for the Industrial Area exposure scenario and then scaled (based on exposure duration) to the Remote Work Area and Occasional Use Area exposure scenarios for each TLD location. The SD, number of elements, minimum sample size, and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.3-5. The minimum sample size criterion was met for all sample locations in Study Group 1.

Table A.3-5
Study Group 1, 95% UCL External Dose for Each Exposure Scenario
(Page 1 of 2)

Release	Location	SD	Number of Elements	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
San Juan, Otero, Pascal-C	A01	0.0	3	3	2.6	0.4	0.1
	A02	0.0	3	3	4.3	0.7	0.2
	A03	0.0	3	3	12.7	2.1	0.6
	A04	0.7	3	3	**81.9**	13.8	4.1
	A05	0.2	3	3	17.3	2.9	0.9
	A06	0.1	3	3	5.1	0.9	0.3
	A07	0.1	3	3	4.1	0.7	0.2
	A07a	N/A[a]	N/A[a]	N/A[a]	0.2	0.0	0.0
	A07b	N/A[a]	N/A[a]	N/A[a]	0.2	0.0	0.0
	A15	0.1	12	3	2.6	0.4	0.1
Bernalillo	A24	0.1	3	3	2.9	0.5	0.1
Pascal-B	A29	0.1	12	3	2.4	0.4	0.1
	A30	0.0	3	3	0.7	0.1	0.0
	A23	0.1	3	3	5.9	1.0	0.3
	A32	0.1	12	3	3.0	0.5	0.2
	A32a	N/A[a]	N/A[a]	N/A[a]	2.6	0.4	0.1
Colfax	B01	0.0	3	3	0.8	0.1	0.0
Luna	B02	0.1	3	3	3.6	0.6	0.2

Table A.3-5
Study Group 1, 95% UCL External Dose for Each Exposure Scenario
(Page 2 of 2)

Release	Location	SD	Number of Elements	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Pascal-A	A16	0.1	3	3	3.5	0.6	0.2
	A17	0.1	3	3	4.4	0.7	0.2
	A18	0.1	3	3	7.2	1.2	0.4
	A19	0.1	3	3	2.7	0.4	0.1
	A20	0.0	3	3	3.9	0.7	0.2
	A21	0.1	3	3	3.4	0.6	0.2
	A22	0.1	3	3	9.0	1.5	0.4
Valencia	A28	0.1	3	3	3.9	0.7	0.2
Platypus	A25	0.0	3	3	1.4	0.2	0.1
	A25a	0.1	3	3	2.2	0.4	0.1
Wolverine	A31	0.1	12	3	0.8	0.1	0.0
Chavez	A08	0.0	3	3	1.6	0.3	0.1
	A09	0.1	3	3	4.0	0.7	0.2
	A10	0.1	3	3	6.3	1.1	0.3
	A11	0.1	3	3	3.3	0.6	0.2
	A12	0.1	3	3	6.3	1.1	0.3
	A13	0.1	3	3	6.0	1.0	0.3
	A14	0.1	3	3	3.8	0.6	0.2
	A33	N/A[a]	N/A[a]	N/A[a]	**79.3**	13.4	4.0
	A34	N/A[a]	N/A[a]	N/A[a]	**102.8**	17.3	5.1

[a]No TLD was placed at this location. External dose was calculated using the external RESRAD values.

OU = Occasional use

Bold indicates the values exceeding 25 mrem/yr.

A.3.3.2 Internal Radiological Dose Calculations

Estimates for the internal dose that a receptor would receive at each Study Group 1 sample location (Figure A.3-1) were determined as described in Section A.2.3.1. The SD, number of samples, minimum sample size, and 95 percent UCL of the internal dose at the sample plots for each exposure scenario are presented in Table A.3-6. The number of samples and internal dose at the grab sample locations for each exposure scenario are presented in Table A.3-7. As shown in Table A.3-6, the minimum sample size criterion was met for all plot sample locations in Study Group 1.

Table A.3-6
Study Group 1, 95% UCL Internal Dose at Sample Plots for Each Exposure Scenario
(Page 1 of 2)

Release	Location	SD	Number of Samples	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
San Juan, Otero, Pascal-C	A01	0.0	4	3	1.0	0.2	0.1
	A02	0.0	4	3	3.5	0.6	0.2
	A03	0.1	4	3	13.6	2.3	0.8
	A04	2.4	4	3	**133.2**	22.4	8.0
	A05	0.5	4	3	23.6	4.0	1.4
	A06	0.2	5	3	10.3	1.7	0.6
	A07	0.0	5	3	0.9	0.2	0.1
	A15	0.0	4	3	3.1	0.5	0.2
Bernalillo	A24	0.0	4	3	1.7	0.3	0.1
Pascal-B	A29	0.1	4	3	4.9	0.8	0.3
	A30	0.0	4	3	0.5	0.1	0.0
	A23	0.3	5	3	9.3	1.6	0.6
	A32	0.1	4	3	2.7	0.5	0.2
Pascal-A	A16	0.0	4	3	0.3	0.1	0.0
	A17	0.0	4	3	0.7	0.1	0.0
	A18	0.0	4	3	1.8	0.3	0.1
	A19	0.0	4	3	2.5	0.4	0.2
	A20	0.0	4	3	2.1	0.3	0.1
	A21	0.0	4	3	2.8	0.5	0.2
	A22	0.1	4	3	5.3	0.9	0.3
Valencia	A28	1.4	4	3	**42.4**	7.1	2.5

Table A.3-6
Study Group 1, 95% UCL Internal Dose at Sample Plots for Each Exposure Scenario
(Page 2 of 2)

Release	Location	SD	Number of Samples	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Wolverine	A31	0.0	4	3	0.8	0.1	0.1
Chavez	A08	0.0	4	3	0.4	0.1	0.0
	A09	0.2	4	3	7.5	1.3	0.5
	A10	0.1	4	3	6.6	1.1	0.4
	A11	0.0	4	3	3.9	0.7	0.2
	A12	0.1	4	3	5.1	0.9	0.3
	A13	0.1	4	3	2.9	0.5	0.2
	A14	0.0	4	3	0.8	0.1	0.0

Bold indicates the values exceeding 25 mrem/yr.

Table A.3-7
Study Group 1 Internal Dose at Grab Sample Locations for Each Exposure Scenario

Release	Location	Number of Samples	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
San Juan, Otero, Pascal-C	A07a	1	0.0	0.0	0.0
	A07b	1	0.0	0.0	0.0
Pascal-B	A32a	1	4.7	0.8	0.3
Colfax	B01	2	0.6	0.1	0.0
Luna	B02	1	0.8	0.1	0.0
Platypus	A25	1	0.4	0.1	0.0
	A25a	1	**51.5**	8.7	3.1
Chavez	A33	1	**181.2**	**30.5**	10.9
	A34	1	**229.3**	**38.6**	13.8

Bold indicates the values exceeding 25 mrem/yr.

The contribution of internal (5.2 mrem/OU-yr) and external dose (2.9 mrem/OU-yr) to TED (8.1 mrem/OU-yr) at sample Location A04 demonstrates that internal dose at Study Group 1 comprises a large percentage of TED (64 percent) within the San Juan plume.

A.3.3.3 Total Effective Dose

The TED for each sample location was calculated by adding the external dose values and the internal dose values. Values for both the average TED and the 95 percent UCL of the TED for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table A.3-8.

Table A.3-8
Study Group 1 TED at Sample Locations (mrem/yr)
(Page 1 of 2)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
San Juan, Otero, Pascal-C	A01	3.0	3.6	0.5	0.6	0.2	0.2
	A02	6.7	7.8	1.1	1.3	0.4	0.4
	A03	22.7	**26.3**	3.8	4.4	1.2	1.5
	A04	**145.1**	**215.0**	24.4	**36.2**	8.1	12.1
	A05	27.1	41.0	4.6	6.9	1.5	2.3
	A06	8.6	15.4	1.5	2.6	0.5	0.9
	A07	2.7	5.1	0.5	0.9	0.1	0.3
	A07a	0.1	0.2	0.0	0.0	0.0	0.0
	A07b	0.2	0.2	0.0	0.0	0.0	0.0
	A15	4.7	5.8	0.8	1.0	0.3	0.3
Bernalillo	A24	2.2	4.6	0.4	0.8	0.1	0.2
Pascal-B	A29	4.8	7.3	0.8	1.2	0.3	0.4
	A30	0.4	1.2	0.1	0.2	0.0	0.1
	A23	7.1	15.2	1.2	2.6	0.4	0.9
	A32	3.7	5.8	0.6	1.0	0.2	0.3
	A32a	6.6	7.3	1.1	1.2	0.4	0.4
Colfax	B01	0.6	1.4	0.1	0.2	0.0	0.1
Luna	B02	2.0	4.4	0.3	0.7	0.1	0.2

Table A.3-8
Study Group 1 TED at Sample Locations (mrem/yr)
(Page 2 of 2)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Pascal-A	A16	1.6	3.8	0.3	0.6	0.1	0.2
	A17	1.8	5.1	0.3	0.9	0.1	0.3
	A18	3.8	9.0	0.6	1.5	0.2	0.5
	A19	2.1	5.2	0.4	0.9	0.1	0.3
	A20	4.2	6.0	0.7	1.0	0.2	0.3
	A21	2.9	6.2	0.5	1.0	0.2	0.3
	A22	7.3	14.3	1.2	2.4	0.4	0.8
Valencia	A28	15.2	**46.3**	2.6	7.8	0.9	2.7
Platypus	A25	0.4	1.8	0.1	0.3	0.0	0.1
	A25a	**51.5**	**53.7**	8.7	9.0	3.1	3.2
Wolverine	A31	0.5	1.6	0.1	0.3	0.0	0.1
Chavez	A08	0.3	2.0	0.1	0.3	0.0	0.1
	A09	5.9	11.5	1.0	1.9	0.3	0.7
	A10	9.0	12.8	1.5	2.2	0.5	0.7
	A11	3.7	7.3	0.6	1.2	0.2	0.4
	A12	6.9	11.4	1.2	1.9	0.4	0.6
	A13	5.6	8.9	0.9	1.5	0.3	0.5
	A14	1.8	4.6	0.3	0.8	0.1	0.2
	A33	**239.9**	**260.5**	**40.4**	**43.9**	13.8	14.9
	A34	**305.5**	**332.1**	**51.4**	**55.9**	17.6	18.9

Bold indicates the values exceeding 25 mrem/yr.

The 95 percent UCL of the average TED did not exceed the FAL (25 mrem/OU-yr) at any sample location within Study Group 1 (Figure A.3-2). However, radiological dose is assumed to exceed the FAL within the DCBs and HCAs.

DCBs were established for subsurface contamination associated with eight underground SEs that vented radioactivity to the soil surface in Study Group 1. The DCB associated with the Chipmunk SE is discussed in Section A.5.4. Although it can be verified whether contamination on the surface poses

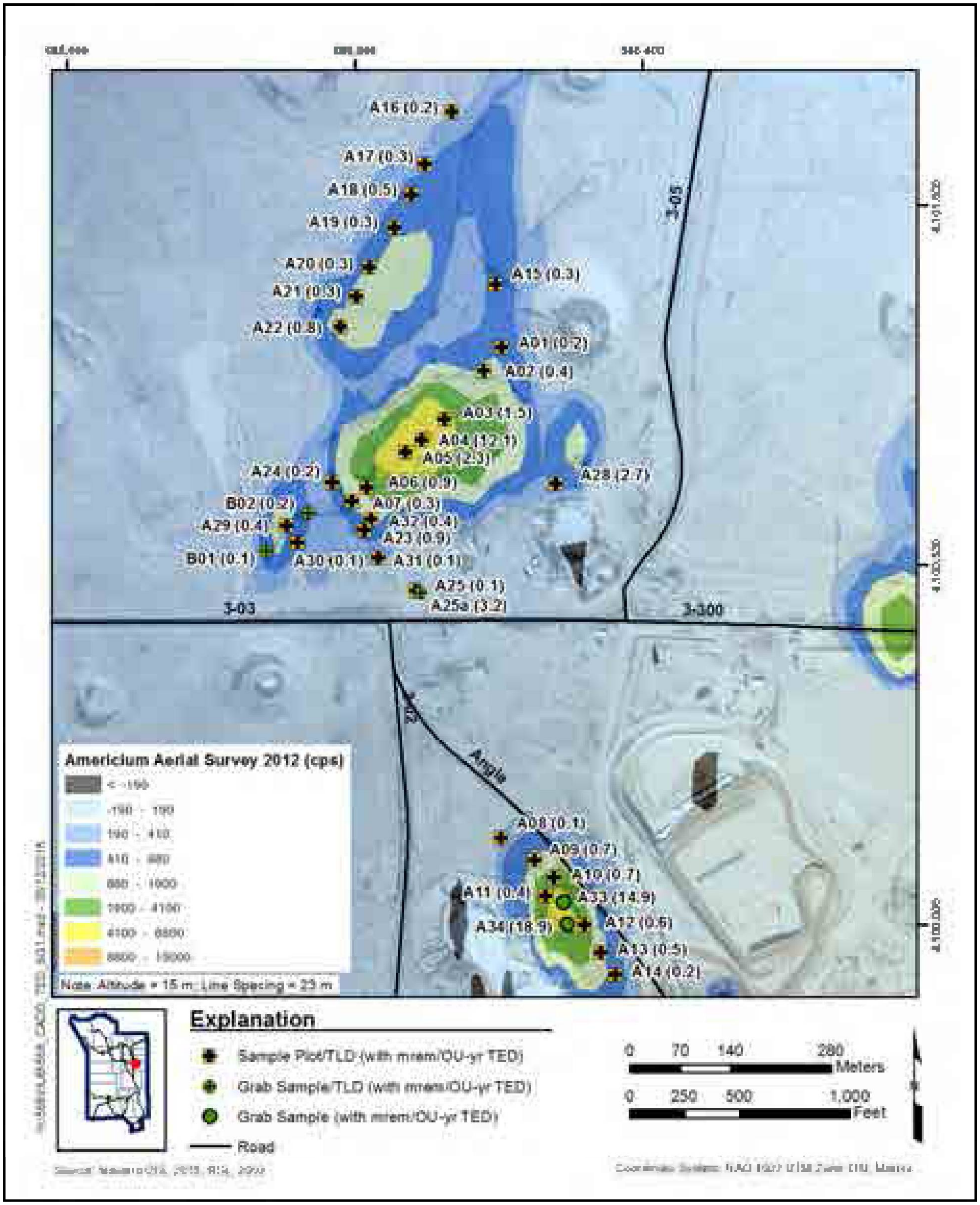

Figure A.3-2
95% UCL of the TED at Study Group 1

a risk to site workers, it is not feasible to verify whether subsurface contamination along the venting flow path is present and poses a risk to site workers. Therefore, by establishing DCBs at these sites, workers will be protected from inadvertent exposure to contaminants if the subsurface soil contamination were exposed.

A.3.3.4 Chemical Contaminants

Samples collected from the former windrow area (Locations A06 and A07) (Figure A.3-1) were analyzed for SVOCs, VOCs, and PCBs. There were no analytical results exceeding minimum detectable concentrations (MDCs) from the samples collected at the former windrow area, and therefore the results are not presented.

A.3.4 Nature and Extent of COCs

As presented in Section A.3.3.3, it is assumed that contamination is present that exceeds the FAL of 25 mrem/OU-yr where DCBs were established in the CAIP (NNSA/NFO, 2014a) or where HCA conditions are present. The releases requiring corrective action at Study Group 1 and the estimated affected volumes of contaminated material at each location are presented in Table A.3-9. The release areas and volumes were estimated based on the physical extent of the concrete pads or areas inside the HCA fence. The corrective action boundaries (CABs) at Study Group 1 are shown on Figure A.3-3.

A.3.5 Best Management Practices

As a BMP, an administrative UR will be established to include any area where an industrial land use of the area (2,000 hr/yr) could cause a future site worker to receive a dose exceeding 25 mrem/yr. To determine the extent of the area where TED exceeds the PAL (Industrial Area scenario), a correlation of radiation survey values to the average Industrial Area TED values was conducted for the following radiation surveys as described in Section A.2.5:

- 1996 Am-241 aerial radiation survey (BN, 1999b)
- 1996 man-made aerial radiation survey (BN, 1999b)
- 2012 Am-241 aerial radiation survey (Stampahar, 2012)
- 2012 man-made aerial radiation survey (Stampahar, 2012)
- Site-specific TRS (FIDLER survey)

Table A.3-9
Study Group 1 Locations Requiring Corrective Action

CAS	Release	Area (yd^2)	Volume (yd^3)
03-23-19	HCA (DCB)	1,835	1,220
03-23-20	SE DCB Otero	100	834
03-23-23	SE DCB San Juan	100	834
	SE DCB Pascal-C	100	834
03-23-31	SE DCB Pascal-B	100	834
	SE DCB Luna	100	834
	SE DCB Colfax	100	834
	Pascal-B HCA	717	240
03-23-33	SE DCB Valencia	100	834
03-23-32	SE DCB Pascal-A	100	834

The quality of these correlations is indicated by the coefficients of determination (r^2) as shown in Table A.3-10. The radiation survey that exhibited the best r^2 at all sites is the FIDLER TRS with an r^2 of 0.90, which exceeds the minimum criteria of 0.80 as set in the Soils RBCA document (NNSA/NFO, 2014b). The inset chart in Figure A.3-4 shows the LCL of this correlation (as described in Section A.2.5). Based on the LCL of the FIDLER TRS correlation, the radiation survey value that corresponds to the 25-mrem/IA-yr PAL is 10.4 multiples of background. The second criterion for an administrative UR is the presence of removable contamination that meets CA criteria. There are two areas in Study Group 1 that exceed CA criteria (San Juan CA and Chavez CA). These areas were included in the administrative boundaries. The administrative boundaries are shown on Figure A.3-4.

In the case of the areas where an industrial land use of the area (2,000 hr/yr) could cause a future site worker to receive a dose exceeding 25 mrem/yr at Valencia and Platypus, it is recommended that the soil in those areas exhibiting a dose above PALs (25 mrem/IA-yr) be removed, so no administrative UR will be required. The Valencia area where a dose above PALs is present measures approximately 72 yd^2, and the Platypus area measures approximately 4 yd^2. Those areas are shown on Figure A.3-4 as “Small Soil Areas >95% UCL IA TED.”

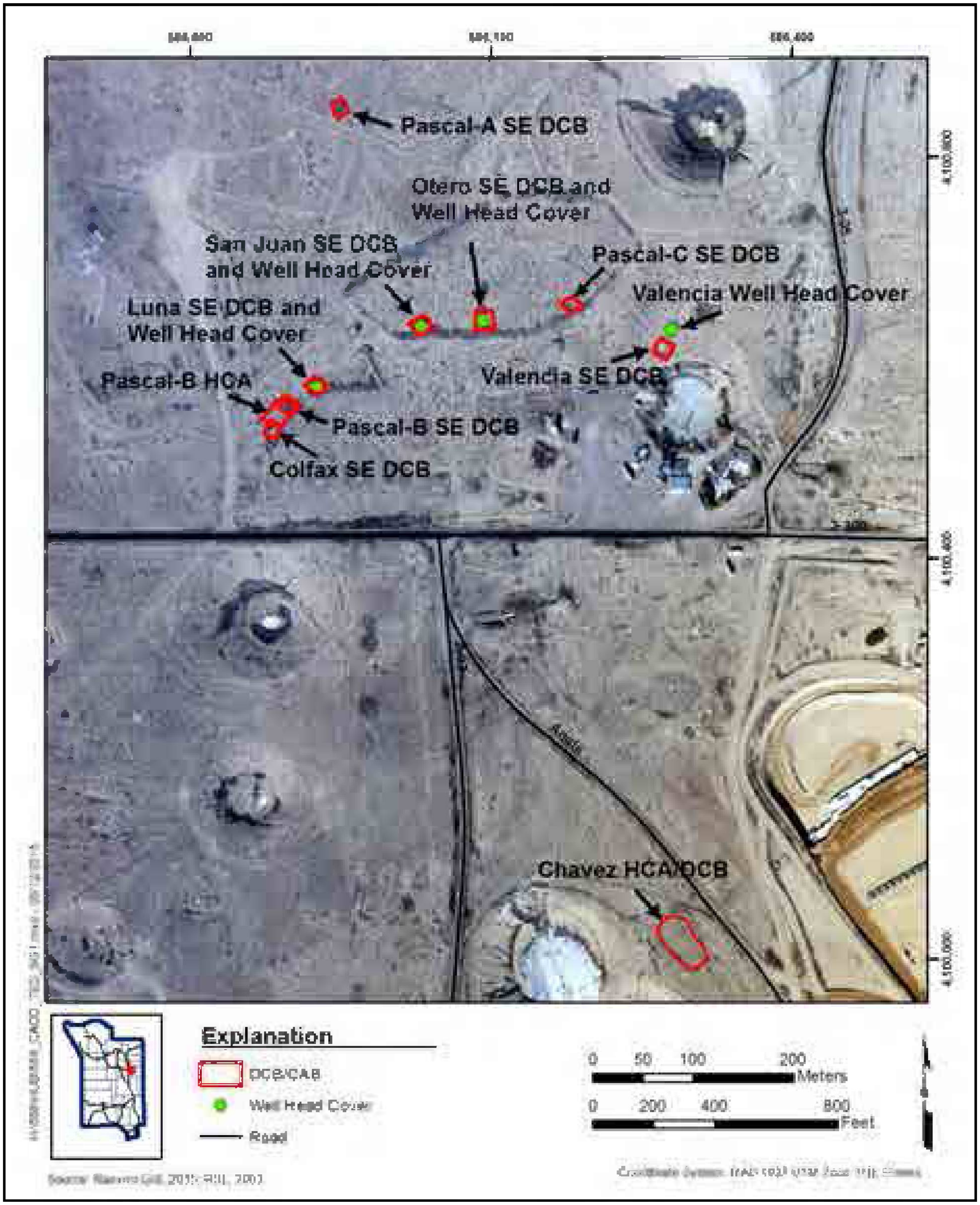

Figure A.3-3
Corrective Action Boundaries for Study Group 1

Table A.3-10
Study Group 1 Coefficients of Determination of IA TED with Radiological Surveys

Dataset	Coefficient of Determination (r^2)
1996 Americium Aerial Radiation Survey	0.46
1996 Man-made Aerial Radiation Survey	0.60
2012 Americium Aerial Radiation Survey	0.62
2012 Man-made Aerial Radiation Survey	0.59
N-I FIDLER TRS	0.90

IA = Industrial area

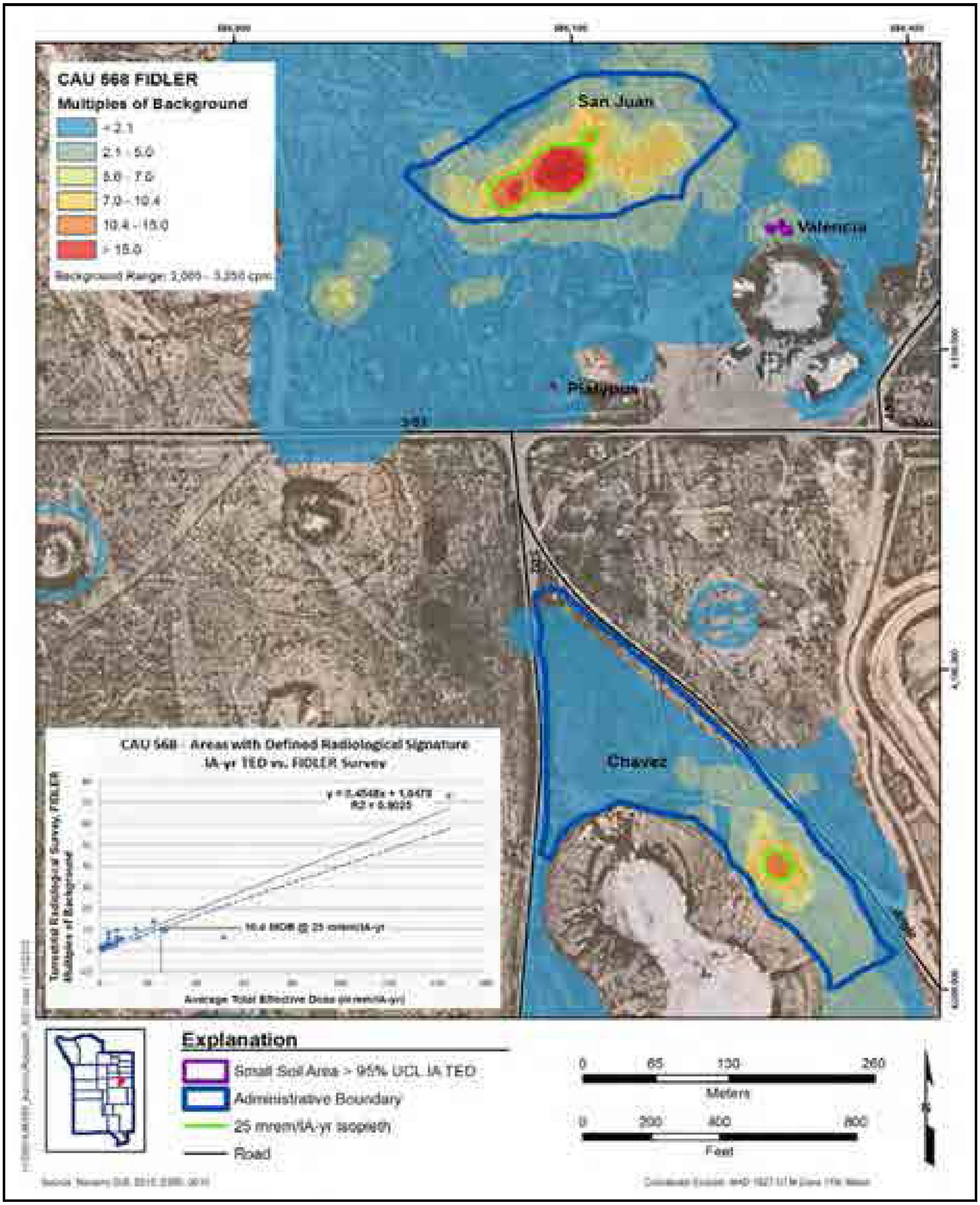

Figure A.3-4
Administrative Boundaries for Study Group 1

A.4.0 Study Group 2, Releases Located within a Crater or Potential Crater Area That Cannot Be Entered

Study Group 2, Releases Located within a Crater or Potential Crater Area That Cannot Be Entered, is located in the western portion of Area 3 of the NNSS, near the Area 3 RWMC and former Mud Plant. The study group consists of subsidence craters where there has been a documented release of radioactivity to the surface from the associated underground test. Additional detail on the history of Study Group 2 is provided in the CAIP (NNSA/NFO, 2014a).

A.4.1 CAI Activities

The specific CAI activities conducted to satisfy the CAIP requirements at this study group are described in the following subsections.

A.4.1.1 Visual Surveys

Visual surveys of the Study Group 2 release areas were conducted. During the surveys, fenced craters or potential crater areas with signs reading, "Potential Crater Area Keep Out" were observed. No other features or potential releases associated with Study Group 2 were identified during visual surveys. The test releases associated with Study Group 2 are shown on Figure A.1-1.

A.4.1.2 Radiological Surveys

Aerial surveys and TRSs were performed at Study Group 2. The aerial surveys are described in Section A.2.2.1. The TRSs were conducted at the site to determine whether areas that cannot be sampled must be assumed to require corrective action based on the subsidence crater corrective action strategy as presented in the Soils RBCA document (NNSA/NFO, 2014b). For Study Group 2, 10 crater areas each with a documented release were identified. They are Cognac (U-3fm), Chinchilla (U-3ag), Chinchilla II (U-3as), Stoat (U-3ap), Armadillo (U-3ar), Haymaker (U-3auS), Solendon (U-3cz), Boomer (U-3aa), Tuna (U-3de), and Tendrac (U-3ba). Elevated radiological readings were identified during the FIDLER TRS at the southern edge of the Boomer crater. Elevated radiological readings were also identified during the FIDLER TRS at the western edge of the CA fence associated with the Solendon test (northwest of the RMA fence associated Tendrac). These elevated radiological readings are believed to be associated with the release from the San Juan and Pascal-A tests; not with the Solendon or Tendrac tests. A sample plot was established at the location of elevated readings associated with Boomer (Figure A.4-1) and at the Solendon CA fence line. Results from the sample plot placed adjacent to the Solendon CA fence line are presented in Study Group 1 (Section A.3.3). See Figure A.2-1 for a graphic representation of the TRSs conducted at Study Group 2.

A.4.1.3 Sample Collection

Soil samples and TLD samples were collected to adjacent to the Boomer crater area to satisfy the CAIP requirements (NNSA/NFO, 2014a) at Study Group 2. The specific CAI activities conducted this study group are described in the following subsections.

A.4.1.3.1 TLD Samples

Because the radiological readings were not evenly distributed through the sample plot established at Boomer (Location A26), one TLD was placed within each of four quadrants within the sample plot. The TLDs were installed to calculate external doses. The TLDs placed at Study Group 2 are listed in Table A.4-1. All TLDs were measured by the NNSS environmental TLD monitoring program. See Figure A.4-1 for TLD locations.

A.4.1.3.2 Soil Samples

Soil sampling for Study Group 2 consisted of collecting composite soil plot samples at an area of elevated radiological readings at the southern edge of the Boomer crater. Composite soil samples A693–A696 were collected from 0.0 to 5.0 cm bgs within the sample plot at Boomer (Location A26). All soil samples were submitted for gamma spectroscopy; Pu-241; and isotopic U, Pu, and Am analyses. Sample Location A26 is shown on Figure A.4-1.

A.4.2 Deviations/Revised Conceptual Site Model

No deviations to the CAIP (NNSA/NFO, 2014a) were noted for this study group.

The CAIP requirements were met at this study group. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

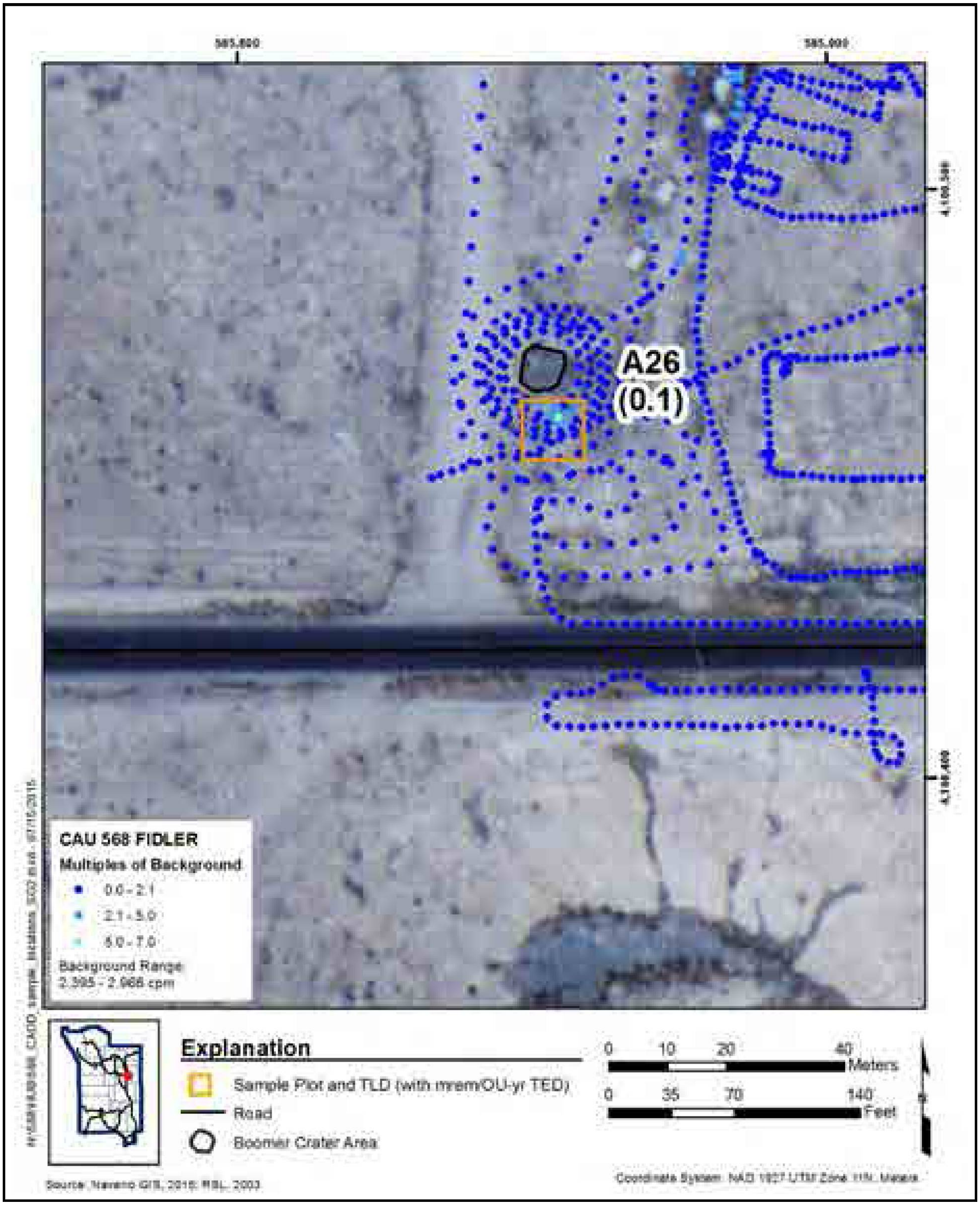

Figure A.4-1
Study Group 2 Sample Locations and 95% UCL of the TED

Table A.4-1
TLDs at Study Group 2

Release	Location	TLD No.	Date Placed	Date Removed	Purpose
Boomer	A26	6429	06/24/2014	10/14/2014	Sample plot
		4547	06/24/2014	10/14/2014	Sample plot
		6066	06/24/2014	10/14/2014	Sample plot
		6029	06/24/2014	10/14/2014	Sample plot

A.4.3 Investigation Results

The following subsections present the analytical and computational results for soil and TLD samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NFO, 2014a). The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr. No chemical samples were collected for this study group.

The internal dose calculated from soil sample results, and the external dose calculated from TLD measurements were combined to determine TED at the sample location. The external dose for TLD Location A26 is summarized in Section A.4.3.1. The internal dose for Location A26 is summarized in Section A.4.3.2. The TED for Location A26 is summarized in Section A.4.3.3.

A.4.3.1 External Radiological Dose Calculations

Estimates for the external dose that a receptor would receive at the Study Group 2 TLD sample location (Figure A.4-1) were determined as described in Section A.2.3.2. External dose was calculated for the Industrial Area exposure scenario and then scaled (based on exposure duration) to the Remote Work Area and Occasional Use Area exposure scenarios for the TLD location. The SD, number of elements, minimum sample size, and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.4-2. The minimum sample size criterion was met for the sampled location in Study Group 2.

Table A.4-2
Study Group 2, 95% UCL External Dose for Each Exposure Scenario

Release	Location	SD	Number of Elements	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Boomer	A26	0.0	12	3	0.4	0.1	0.0

A.4.3.2 Internal Radiological Dose Calculations

Estimates for the internal dose that a receptor would receive at the Study Group 2 sample location (Figure A.4-1) were determined as described in Section A.2.3.1. The SD, number of samples, minimum sample size, and 95 percent UCL of the internal dose for each exposure scenario are presented in Table A.4-3. As shown in Table A.4-3, the minimum sample size criterion was met for sample Location A26.

Table A.4-3
Study Group 2, 95% UCL Internal Dose for Each Exposure Scenario

Release	Location	SD	Number of Samples	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Boomer	A26	0.0	4	3	1.7	0.3	0.1

A.4.3.3 Total Effective Dose

The TED for the sample plot was calculated by adding the external dose values and the internal dose values. Values for both the average TED and the 95 percent UCL of the TED for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table A.4-4.

Table A.4-4
Study Group 2 TED at Sample Location (mrem/yr)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Boomer	A26	1.0	2.1	0.2	0.4	0.1	0.1

The 95 percent UCL of the average TED did not exceed the FAL (25 mrem/OU-yr) at sample Location A26 (Figure A.4-1). Although no dose above FALs was identified at sample Location A26, the Boomer area is a crater area that is posted as a CA and had a release that was detected outside the posted CA (sampled location). According to Figure 8-1 in the Soils RBCA document (NNSA/NFO, 2014b), if there is a documented release associated with the crater test, a perimeter radiation survey was performed, and detectable contamination is detected originating from the crater, then the entire crater must be included in a CAB. Therefore, it is assumed that a dose above the FAL of 25 mrem/OU-yr exists within the crater at Boomer, and corrective action is required. For the remainder of the crater releases in this study group, no detectable contamination was identified during the radiation surveys performed, originating from these crater releases. According to Figure 8-1 in the Soils RBCA document (NNSA/NFO, 2014b), if a perimeter radiation survey is performed and detectable contamination is not identified originating from the crater, then no corrective action is needed for the crater area. Therefore, no other crater areas within Study Group 2 require corrective action.

A.4.4 Nature and Extent of COCs

The area requiring corrective action at Boomer measures approximately 400 square feet (ft^2) (44 yd^2). The estimated volume for the Boomer crater area is 10,000 ft^3 (370 yd^3). The area and volume of the Boomer crater area was estimated based on the physical extent of the area inside the CA fence. The area requiring corrective action is shown on Figure A.4-2.

A.4.5 Best Management Practices

No BMPs were implemented or are proposed for the releases within Study Group 2.

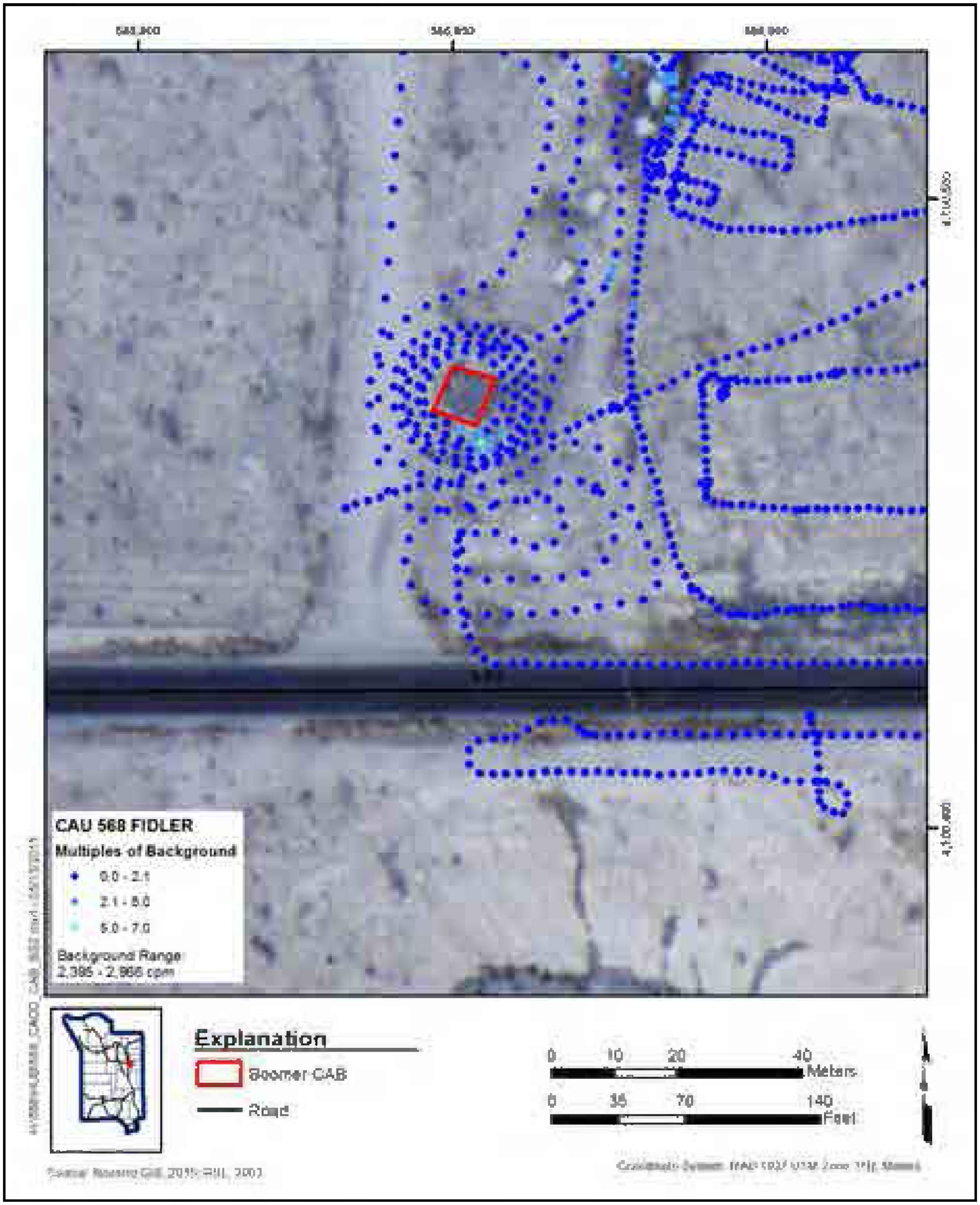

Figure A.4-2
Corrective Action Boundary for Study Group 2

A.5.0 Study Group 3, Releases with No Radiological Survey Signature That Can Be Entered

Study Group 3, Releases with No Radiological Survey Signature That Can Be Entered, is located in the western portion of Area 3 of the NNSS, near the Area 3 RWMC and former Mud Plant. The study group consists of underground tests with documented releases of radioactivity to the surface; however, there is no radiological survey signature present. Additional detail on the history of Study Group 3 is provided in the CAIP (NNSA/NFO, 2014a).

A.5.1 CAI Activities

The specific CAI activities conducted to satisfy the CAIP requirements at this study group are described in the following subsections.

A.5.1.1 Visual Surveys

Visual surveys of the Study Group 3 areas were conducted. During the surveys, the GZ areas associated with Shrew, Mink, Chipmunk, and Funnel were identified. “Caution Contamination Area” signs are posted around the GZ area at Chipmunk. “Caution Contamination Area” signs are also present surrounding the Shrew GZ area and other GZs in the vicinity of Shrew. An area marked with “Caution Underground Radioactive Material” surrounds the Funnel GZ and other GZs in the vicinity of Funnel. No radiological postings were present at the Mink GZ area. Concrete/asphalt pads surround the Chipmunk and Shrew GZs. No other features, or potential releases associated with Study Group 3 were identified. The areas for TRSs and sample collection at Study Group 3 were selected based on visible GZ locations.

A.5.1.2 Radiological Screening

No radiological screening for sample selection was conducted at this study group.

A.5.1.3 Radiological Surveys

Aerial surveys and TRSs were performed at Study Group 3. The aerial surveys are described in Section A.2.2.1. The TRSs were conducted at the Shrew, Mink, Chipmunk, and Funnel test areas to identify any elevated radiological readings to assist in the determination of grab sample locations. For all four locations, no elevated radiological readings were detected, and no sample locations were selected based on the TRSs. See Figure A.2-1 for a graphic representation of the TRSs conducted at Study Group 3.

A.5.1.4 Sample Collection

Soil samples and TLD samples were collected to satisfy the CAIP requirements (NNSA/NFO, 2014a) at Study Group 3. The specific CAI activities conducted this study group are described in the following subsections.

A.5.1.4.1 TLD Samples

One TLD was installed at each of three grab sample locations (B03–B05) at Study Group 3 to calculate external doses (Figure A.5-1). The TLDs placed at Study Group 3 are listed in Table A.5-1. All TLDs were measured by the NNSS environmental TLD monitoring program. See Figure A.5-1 for TLD locations.

A.5.1.4.2 Soil Samples

One grab soil sample was collected from each of three locations (B03–B05). Grab samples were collected at the nearest feasible location to each of the Shrew, Mink, and Chipmunk GZs. For Chipmunk (Location B03) and Shrew (Location B04), the sample was collected at the edge of the concrete/asphalt emplacement pad. For Mink, no emplacement pad was identified, so the sample was collected adjacent to GZ. All soil samples were submitted for gamma spectroscopy; Pu-241; and isotopic U, Pu, and Am analyses. Additional information including depth and purpose for each soil sample collected for Study Group 3 is provided in Table A.5-2. Sample locations are shown on Figure A.5-1.

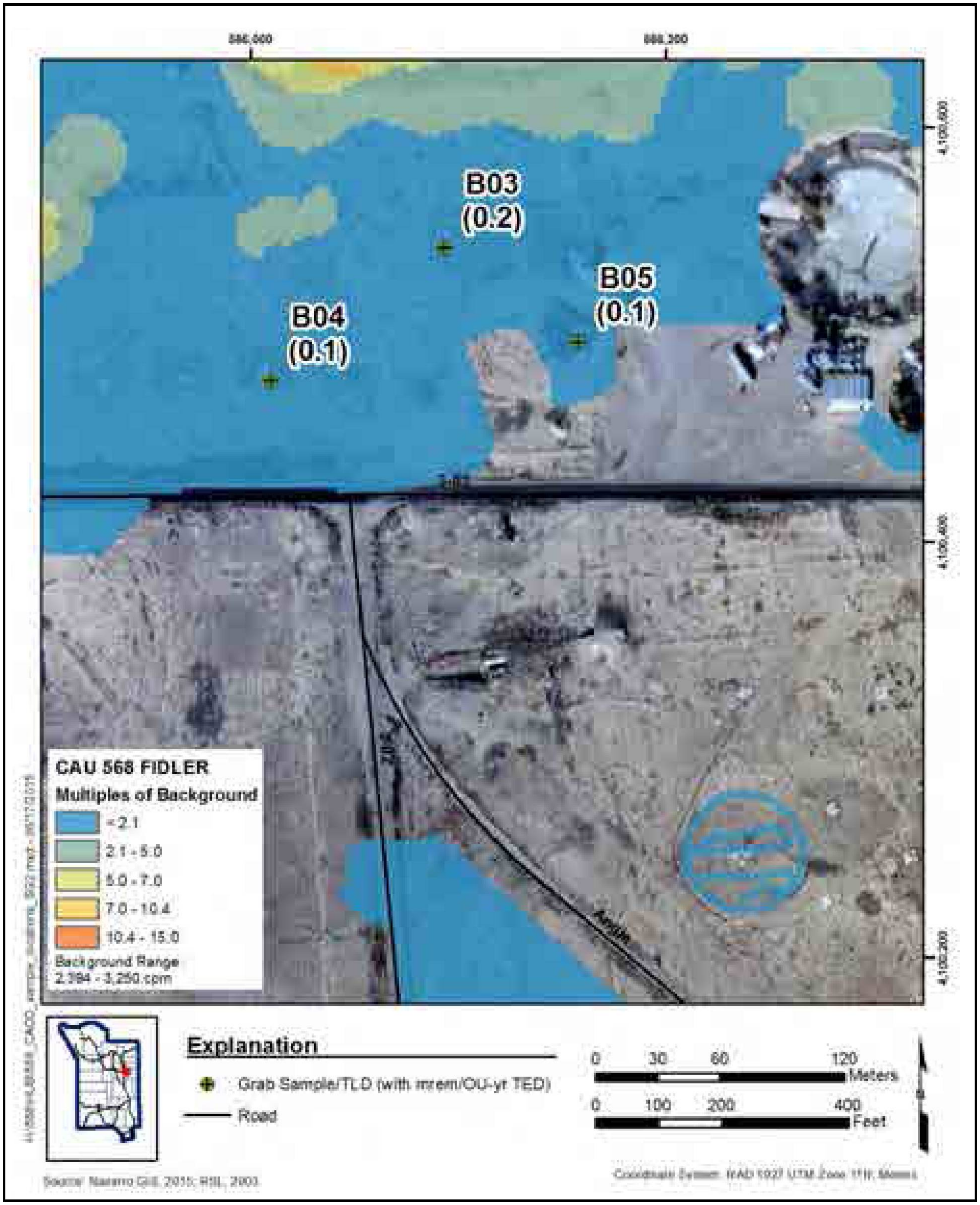

Figure A.5-1
Study Group 3 Sample Locations and 95% UCL of the TED

Table A.5-1
TLDs at Study Group 3

Release	Location	TLD No.	Date Placed	Date Removed	Purpose
Chipmunk	B03	6047	06/24/2014	10/14/2014	Grab sample
Shrew	B04	6081	06/25/2014	10/14/2014	Grab sample
Mink	B05	6498	06/25/2014	10/14/2014	Grab sample

Table A.5-2
Samples Collected at Study Group 3

Release	Location	Sample Number	Depth (cm bgs)	Purpose
Chipmunk	B03	B002	0.0 - 5.0	Grab
Shrew	B04	B006	0.0 - 5.0	Grab
Mink	B05	B001	0.0 - 5.0	Grab

Because the Shrew, Mink, and Chipmunk GZs are located in an area where multiple tests had surface releases of radioactivity identified during the TRSs and aerial radiological surveys, and because there may be some influence of contamination from test releases in close proximity, confirmational grab samples were collected at the nearest feasible location to each of the Shrew, Mink, and Chipmunk GZs. Because no elevated radiological readings were detected during the TRS at Funnel, and because no tests in close proximity to Funnel had documented surface releases of radioactivity detected during aerial radiological surveys, it was decided that no sample was needed for the Funnel release.

A.5.2 Deviations/Revised Conceptual Site Model

All sampling was completed in accordance with the requirements of the CAIP, and all CAI results support the CSM described in the CAIP except as noted in this section. According to the CAIP (NNSA/NFO, 2014a), Study Group 3 Decision I sampling consists of collecting a grab sample within each release with no radiological survey signature. However, because no elevated radiological readings were detected during the TRS or on aerial radiological surveys in the Funnel area, and because no tests in close proximity to Funnel had documented or measured (during aerial radiological surveys) surface releases of radioactivity, no confirmatory sample was collected for the Funnel release. Sample results from other test locations in this study group are well below FALs. No other deviations were noted for this study group.

The CAIP requirements were met at this study group. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

A.5.3 Investigation Results

The following subsections present the analytical and computational results for soil and TLD samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NFO, 2014a). The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr. Results that are equal to or greater than FALs are identified by bold text in the results tables.

The internal dose calculated from soil sample results, and the external dose calculated from TLD measurements were combined to determine TED at each sample location. External doses for TLD locations are summarized in Section A.5.3.1. Internal doses for each sample location are summarized in Section A.5.3.2. The TEDs for each sampled location are summarized in Section A.5.3.3.

A.5.3.1 External Radiological Dose Calculations

Estimates for the external dose that a receptor would receive at each Study Group 3 TLD sample location (Figure A.5-1) were determined as described in Section A.2.3.2. External dose was calculated for the Industrial Area exposure scenario and then scaled (based on exposure duration) to the Remote Work Area and Occasional Use Area exposure scenarios for each TLD location. The SD, number of elements, minimum sample size, and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.5-3. The minimum sample size criterion was met for all sample locations in Study Group 3.

Table A.5-3
Study Group 3, 95% UCL External Dose for Each Exposure Scenario

Release	Location	SD	Number of Elements	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Chipmunk	B03	0.1	3	3	3.2	0.5	0.2
Shrew	B04	0.0	3	3	1.3	0.2	0.1
Mink	B05	0.0	3	3	1.4	0.2	0.1

A.5.3.2 Internal Radiological Dose Calculations

Estimates for the internal dose that a receptor would receive at each Study Group 3 grab sample location (Figure A.5-1) were determined as described in Section A.2.3.1. The number of samples and internal dose for each exposure scenario are presented in Table A.5-4.

Table A.5-4
Study Group 3 Internal Dose for Each Exposure Scenario

Release	Location	Number of Samples	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Chipmunk	B03	1	0.3	0.1	0.0
Shrew	B04	1	0.7	0.1	0.0
Mink	B05	1	0.0	0.0	0.0

A.5.3.3 Total Effective Dose

The TED for each grab sample location was calculated by adding the external dose values and the internal dose values. Values for both the average TED and the 95 percent UCL of the TED for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table A.5-5.

Table A.5-5
Study Group 3 TED at Sample Locations (mrem/yr)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Chipmunk	B03	0.3	3.5	0.1	0.6	0.0	0.2
Shrew	B04	0.7	2.0	0.1	0.3	0.0	0.1
Mink	B05	0.0	1.5	0.0	0.2	0.0	0.1

The 95 percent UCL of the average TED did not exceed the FAL (25 mrem/OU-yr) at any sample location within Study Group 3 (Figure A.5-1). However, radiological dose is assumed to exceed the FAL within the Chipmunk SE DCB. A DCB was established for subsurface contamination associated with the Chipmunk underground SE that vented radioactivity to the soil surface. Although it can be verified whether contamination on the surface poses a risk to site workers, it is not feasible to verify whether subsurface contamination along the venting flow path is present and poses a risk to site workers. Therefore, by establishing a DCB at this site, workers will be protected from inadvertent exposure to contaminants if the subsurface soil contamination were exposed.

A.5.3.4 Chemical Contaminants

No chemical samples were collected from Study Group 3.

A.5.4 Nature and Extent of COCs

As presented in Section A.5.3.3, it is assumed that contamination is present that exceeds the FAL of 25 mrem/OU-yr where DCBs were established in the CAIP (NNSA/NFO, 2014a). The subsurface contamination associated with the Chipmunk SE DCB to a depth of 25 ft bgs is assumed to exceed the FAL of 25 mrem/OU-yr and requires corrective action. The affected volume of contaminated material is estimated to be 22,500 ft^3 (834 yd^3). The volume of the release was estimated based on the physical extent of the concrete emplacement hole pad. The area requiring corrective action is shown on Figure A.5-2.

A.5.5 Best Management Practices

No BMPs were implemented or are proposed for this study group.

Figure A.5-2
Corrective Action Boundary for Study Group 3

A.6.0 Study Group 4, Spills and Debris

Study Group 4, Spills and Debris, is located in the western portion of Area 3 of the NNSS, scattered throughout the area encompassing CAU 568. The study group consists of the release of chemical or radiological contamination associated with features or items such as debris, spills, contaminated areas, and piles/mounds. Additional detail on the history of Study Group 4 is provided in the CAIP (NNSA/NFO, 2014a).

A.6.1 CAI Activities

The specific CAI activities conducted to satisfy the CAIP requirements at this study group are described in the following subsections.

A.6.1.1 Visual Surveys

Visual surveys of CAU 568 were conducted. During the surveys, PSM was identified that included steel well head covers, lead bricks, lead-acid batteries, lead plates, lead sheets, lead shot, a transformer, an HCA soil pile, and soil and debris piles with lead items on their surfaces. Stained soil was visible beneath the transformer. One steel well head cover was identified near each emplacement hole at San Juan, Otero, Luna, and Valencia. The locations of the PSM associated with Study Group 4 are shown on Figure A.6-1.

A.6.1.2 Radiological Screening

No radiological screening for sample selection was conducted at this study group.

A.6.1.3 Radiological Surveys

A FIDLER TRS was conducted at the HCA soil pile. During the detailed TRS, an area of elevated radiological readings was identified adjacent to the HCA fence in addition to elevated radiological readings within the HCA. Samples were biased to locations within and adjacent to the HCA based on elevated readings as shown on Figure A.6-2.

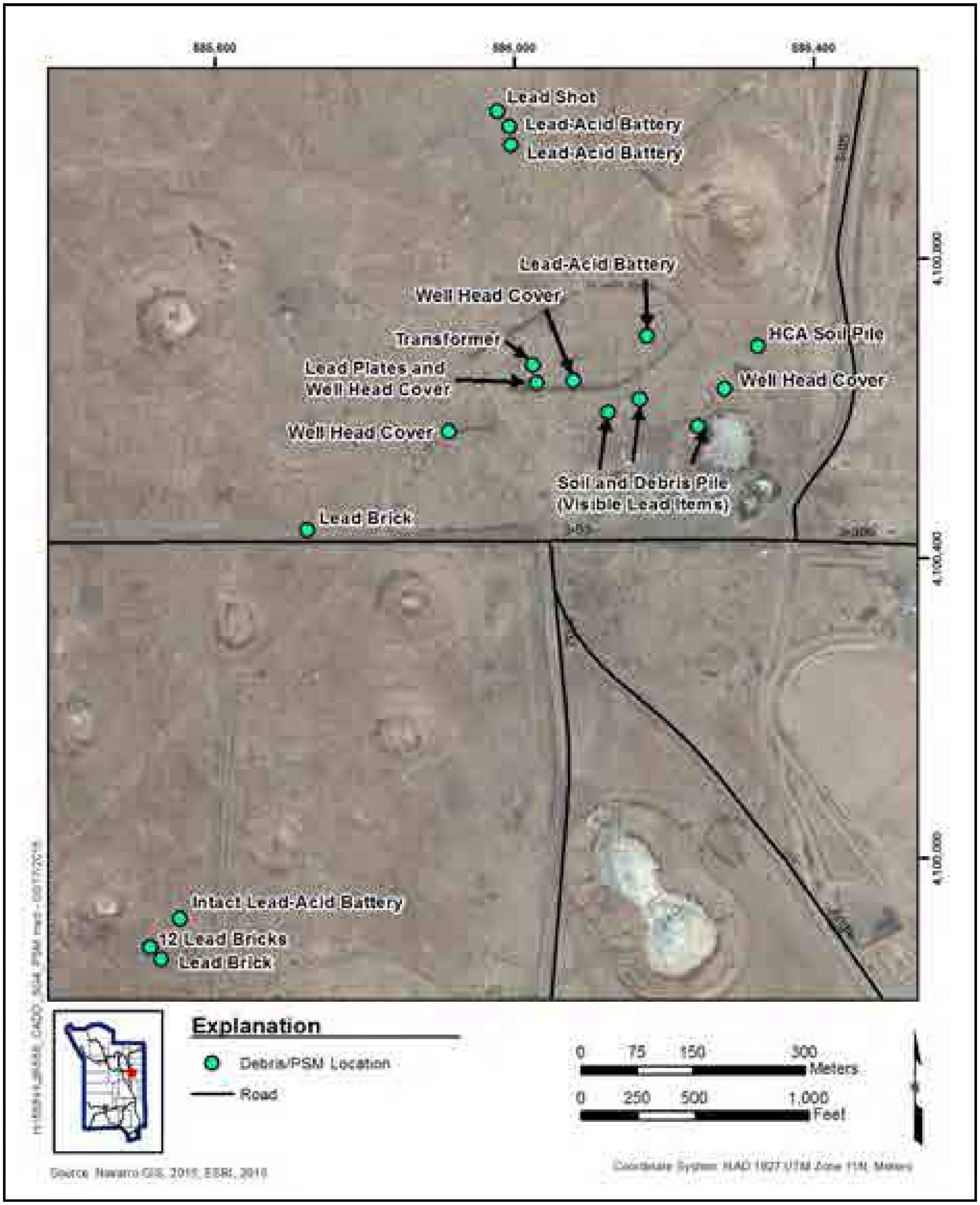

Figure A.6-1
Study Group 4 PSM Locations

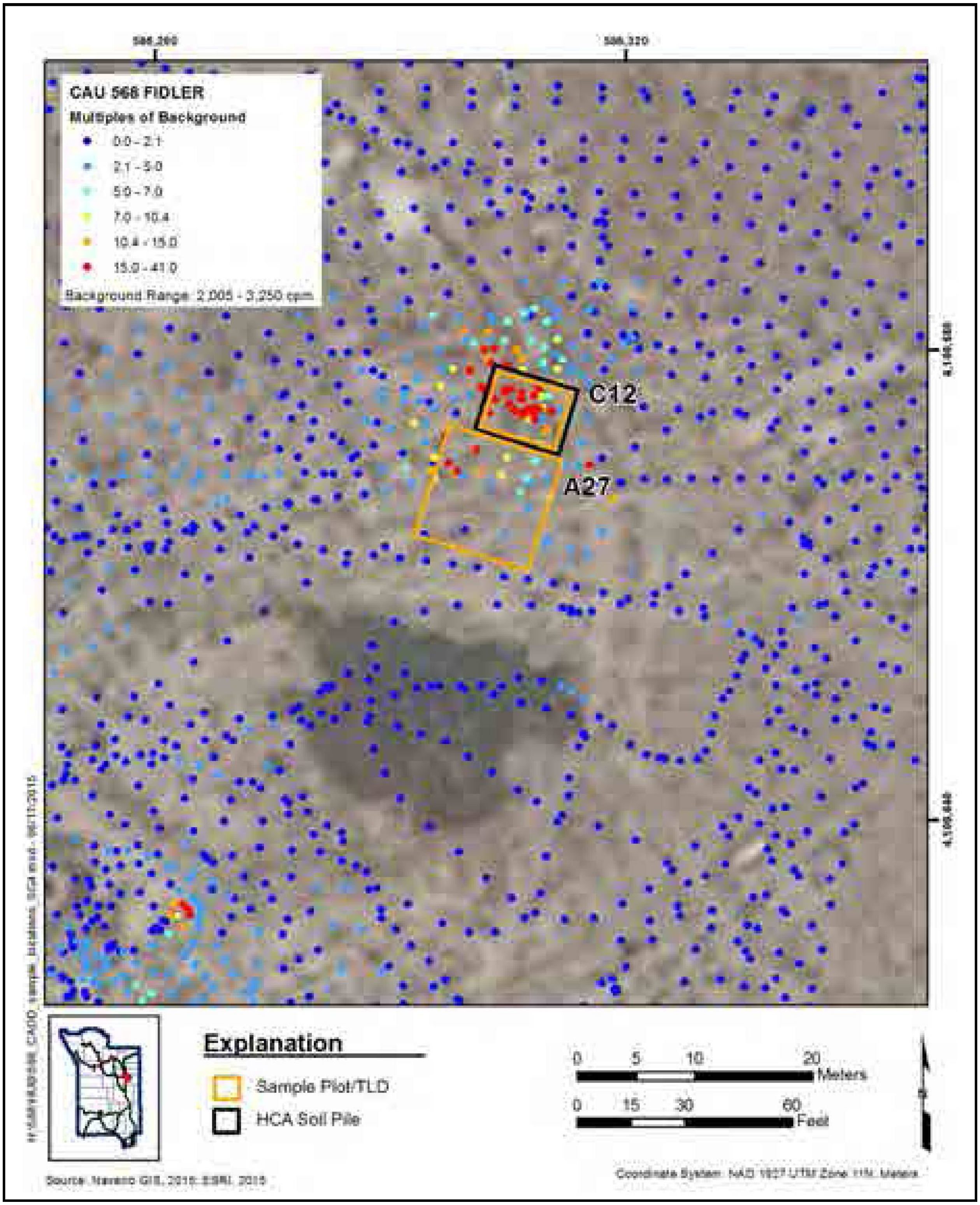

Figure A.6-2
Study Group 4 HCA Soil Pile Sample Locations

A.6.1.4 Sample Collection

Soil samples and TLD samples were collected to satisfy the CAIP requirements (NNSA/NFO, 2014a) at Study Group 4. The specific CAI activities conducted this study group are described in the following subsections.

A.6.1.4.1 TLD Samples

To calculate external doses, one TLD was installed within sample plot Location C12 at the center of the HCA soil pile. At a location of elevated radiological readings adjacent to the HCA fence, four TLDs were installed (one in each quadrant of the sample plot) at Location A27 (Figure A.6-3). TLDs were installed in four locations at A27 because radiological readings were not evenly distributed throughout the sample plot. The TLDs placed at Study Group 4 are listed in Table A.6-1. All TLDs were measured by the NNSS environmental TLD monitoring program.

A.6.1.4.2 Soil Samples

One composite soil sample consisting of nine aliquots was collected from a 6-by-6-m sample plot spread across the HCA soil pile (Location C12). At the location of elevated radiological readings adjacent to the HCA (detected in the TRS), four composite soil samples were collected from the sample plot (Location A27). All samples from the HCA soil pile area were analyzed for gamma spectroscopy; Pu-241; and isotopic U, Pu, and Am analyses.

Environmental grab soil samples were collected from the soil under lead items (Locations C04–C06, C11, and C13–C20). One FD (Sample C007) was collected from the soil under a broken lead-acid battery (Location C13). All soil samples under the lead items were submitted for RCRA metals analysis. Samples were collected from the most likely locations to have lead contamination, based on the visible presence of lead.

Environmental grab samples were collected from the stained soil under one transformer (Location C01), biased to the heaviest staining. Per the CAIP (NNSA/NFO, 2014a), sample D001 (Location C01) was sampled and submitted for SVOCs, VOCs, and PCBs. Additional analyses were requested for sample D001 based on the location of the transformer within a radiological plume and for waste management purposes, if the soil were to be removed from the site. Those additional

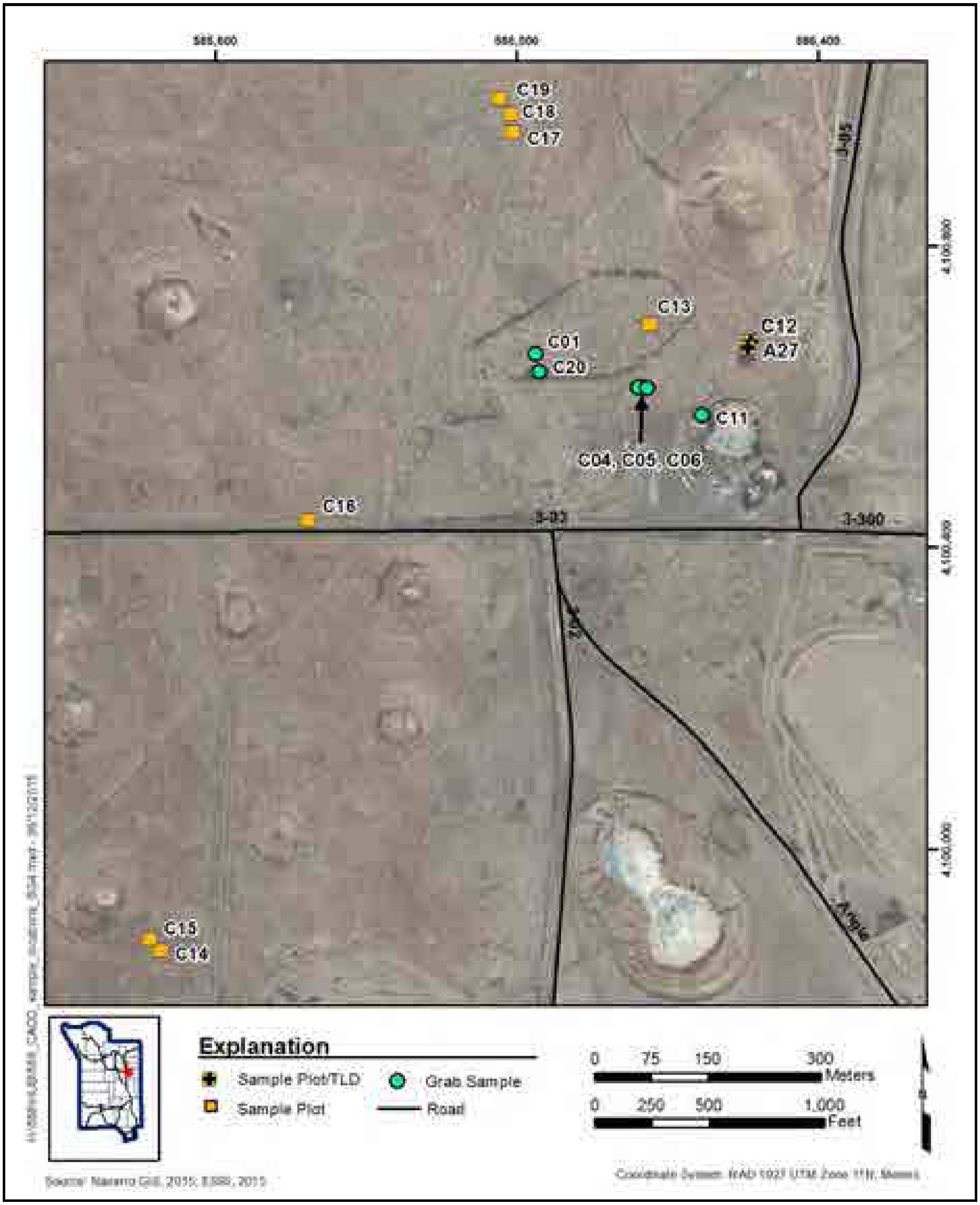

Figure A.6-3
Study Group 4 Sample Locations

Table A.6-1
TLDs at Study Group 4

Release	Location	TLD No.	Date Placed	Date Removed	Purpose
HCA soil pile	C12	6156	06/25/2014	10/14/2014	Grab sample
Elevated readings adjacent to HCA soil pile	A27	6274	06/25/2014	10/14/2014	Sample Plot
		4184	06/25/2014	10/14/2014	Sample Plot
		6295	06/25/2014	10/14/2014	Sample Plot
		4270	06/25/2014	10/14/2014	Sample Plot

analyses were for RCRA metals, total petroleum hydrocarbons (TPH)-diesel-range organics (DRO), TPH-gasoline-range organics (GRO), and gamma spectroscopy analysis (see Section A.8.2 for waste management sample results). Samples C021 and C022 from Location C01 were sampled only for polyaromatic hydrocarbon (PAH) SVOCs to replace the original PAH results from sample D001 that were rejected. Information including depth and purpose for each environmental soil sample collected for Study Group 4 is provided in Table A.6-2. Sample locations are shown on Figure A.6-3.

Table A.6-2
Samples Collected at Study Group 4
(Page 1 of 2)

Release	Location	Sample Number	Depth (cm bgs)	Purpose
Transformer	C01	D001	0.0 - 5.0	Grab
		C021	0.0 - 5.0	Grab
		C022	25.0 - 30.0	Grab
Lead plate	C04	C003	0.0 - 5.0	Grab
Lead-acid battery	C05	C002	0.0 - 5.0	Grab
Lead brick	C06	C004	0.0 - 5.0	Grab
Lead sheet	C11	C005	0.0 - 5.0	Grab
HCA soil pile	C12	C507	0.0 - 5.0	Plot composite
Elevated readings adjacent to HCA soil pile	A27	A685	0.0 - 5.0	Plot composite
		A686	0.0 - 5.0	Plot composite
		A687	0.0 - 5.0	Plot composite
		A688	0.0 - 5.0	Plot composite

Table A.6-2
Samples Collected at Study Group 4
(Page 2 of 2)

Release	Location	Sample Number	Depth (cm bgs)	Purpose
Lead-acid battery	C13	C006	0.0 - 5.0	Plot composite
		C007	0.0 - 5.0	Plot composite (FD of C006)
Lead brick	C14	C008	0.0 - 5.0	Plot composite
Lead bricks	C15	C009	0.0 - 5.0	Plot composite
Lead brick	C16	C010	0.0 - 5.0	Plot composite
Lead-acid battery	C17	C011	0.0 - 5.0	Plot composite
Lead-acid battery	C18	C012	0.0 - 5.0	Plot composite
Lead shot	C19	C013	5.0 - 10.0	Plot composite
Lead plates	C20	C014	0.0 - 10.0	Grab composite

A.6.2 Deviations/Revised Conceptual Site Model

No deviations to the CAIP (NNSA/NFO, 2014a) were noted for this study group.

The CAIP requirements were met at this study group. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

A.6.3 Investigation Results

The following subsections present the analytical and computational results for soil and TLD samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NFO, 2014a). The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr. The chemical results are reported as individual concentrations that are comparable to their corresponding FALs. Results that are equal to or greater than FALs are identified by bold text in the results tables.

For the HCA soil pile (Location C12) and area of elevated readings adjacent to the HCA soil pile fence (Location A27), the internal dose calculated from soil sample results and the external dose calculated from TLD measurements were combined to determine TED at each sample location.

External doses for TLD locations are summarized in Section A.6.3.1. Internal doses for each sample location are summarized in Section A.6.3.2. The TEDs for each sampled location are summarized in Section A.6.3.3. Chemical contaminant results for Study Group 4 are summarized in Section A.6.3.4.

A.6.3.1 External Radiological Dose Calculations

Estimates for the external dose that a receptor would receive at each Study Group 4 TLD sample location (Figure A.6-2) were determined as described in Section A.2.3.2. External dose was calculated for the Industrial Area exposure scenario and then scaled (based on exposure duration) to the Remote Work Area and Occasional Use Area exposure scenarios for each TLD location. The SD, number of elements, minimum sample size, and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.6-3. The minimum sample size criterion was met for all sample locations in Study Group 4.

Table A.6-3
Study Group 4, 95% UCL External Dose for Each Exposure Scenario

Release	Location	SD	Number of Elements	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
HCA soil pile	C12	0.7	3	3	**70.5**	11.8	3.5
Elevated readings adjacent to HCA soil pile	A27	0.2	3	3	9.5	1.6	0.5

Bold indicates the values exceeding 25 mrem/yr.

A.6.3.2 Internal Radiological Dose Calculations

Estimates for the internal dose that a receptor would receive at each Study Group 4 sample location (Figure A.6-2) were determined as described in Section A.2.3.1. The SD, number of samples, minimum sample size, and 95 percent UCL of the internal dose at the sample plot for each exposure scenario are presented in Table A.6-4. The number of samples and internal dose at the grab sample location for each exposure scenario are presented in Table A.6-5. As shown in Table A.6-4, the minimum sample size criterion was met for the plot sample location in Study Group 4.

Table A.6-4
Study Group 4, 95% UCL Internal Dose at Sample Plot for Each Exposure Scenario

Release	Location	SD	Number of Samples	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Elevated readings adjacent to HCA soil pile	A27	0.3	4	3	15.6	2.6	0.9

Table A.6-5
Study Group 4 Internal Dose at Grab Sample Locations for Each Exposure Scenario

Release	Location	Number of Samples	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
HCA soil pile	C12	1	**97.7**	16.4	5.9

Bold indicates the values exceeding 25 mrem/yr.

The contribution of internal (5.9 mrem/OU-yr) and external dose (2.3 mrem/OU-yr) to TED (8.2 mrem/OU-yr) at sample Location C12 demonstrates that internal dose at Study Group 4 comprises a large percentage of TED (72 percent).

A.6.3.3 Total Effective Dose

The TED for each sample location was calculated by adding the external dose values and the internal values. Values for both the average TED and the 95 percent UCL of the TED for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table A.6-6.

The TED did not exceed the FAL (the 95 percent UCL of the average TED exceeding 25 mrem/OU-yr) at sample location within Study Group 4 (Figure A.6-4). However, radiological dose is assumed to exceed the FAL within the HCA soil pile area (DCB).

Table A.6-6
Study Group 4 TED at Sample Locations (mrem/yr)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
HCA soil pile	C12	**143.5**	**168.1**	24.1	**28.3**	8.2	9.4
Elevated readings adjacent to HCA soil pile	A27	16.0	**25.1**	2.7	4.2	0.9	1.4

Bold indicates the values exceeding 25 mrem/yr.

A.6.3.4 Chemical Contaminants

PSM items including four broken lead-acid batteries, one intact lead-acid battery, 15 lead bricks, two lead sheets, 28 lead plates, and an area of lead shot were identified at CAU 568 (Figure A.6-1). These PSM items require corrective action. All lead PSM items were removed from the site as an interim corrective action except for the lead shot, which remains at Location C19. After the PSM was removed, verification soil samples were collected from lead Locations C04–C06, C11, and C13–C20 (Figure A.6-3). All lead results were below FALs except for sample C011 (Location C17) collected from below a broken lead-acid battery.

During interim corrective actions, lead shot was not removed from Location A19. Therefore, corrective action is required for the PSM at Location C19. Additionally, based on the presence of lead debris on the surfaces of the three soil and debris piles, there is the potential for additional PSM to be present within the piles. Therefore, a corrective action is required for the three soil and debris piles.

Samples were also collected from the transformer soil (Location C01) (Figure A.6-3). Sample D001 had rejected results for PAHs; therefore, a surface soil sample (0 to 5 cm bgs) and a sample from 25 to 30 cm bgs were collected and analyzed for PAH SVOCs. This set of samples returned valid results for PAHs. The analytical results exceeding MDCs from the environmental samples collected in Study Group 4 are presented in Tables A.6-7, A.6-8, A.6-9, and A.6-10.

Figure A.6-4
95% UCL of the TED at Study Group 4

Table A.6-7
Study Group 4 Sample Results for Metals Detected above MDCs

Sample Location	Sample Number	Depth (cm bgs)	COPCs (mg/kg)						
			Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium
FALs			**23**	**190,000**	**9,300**	**33.6**	**5,739**	**43**	**5,100**
C05	C002	0 - 5	4.2	900	0.56 (J)	6.8	200 (J)	0.042	--
C04	C003	0 - 5	4.5	290	--	5	29 (J)	0.03 (J-)	--
C06	C004	0 - 5	4.6	620	0.6 (J)	6.1	180 (J)	0.03 (J-)	--
C11	C005	0 - 5	4.1	510	0.77 (J)	5.5	410 (J)	0.2	--
C13	C006	0 - 5	3.8	270	--	5	26	--	0.46 (J+)
	C007	0 - 5	3.3	260	--	11	20	--	1
C14	C008	0 - 5	3.9	180	0.29 (J-)	7	27	--	0.81
C15	C009	0 - 5	3.8	160	0.23 (J-)	6.3	33	--	1.2
C16	C010	0 - 5	3.9	150	0.2 (J-)	5.8	51	0.039	0.57
C17	C011	0 - 5	**28**	150	0.62	6.5	**6,600**	--	--
C18	C012	0 - 5	4.4	140	0.21 (J-)	7.7	160	--	0.93
C19	C013	5 - 10	4.7	160	0.15 (J-)	7.6	34	--	0.55
C20	C014	0 - 10	3.2	180 (J)	1.6	5.1	530	--	0.91

J = Estimated value.
J+ = The result is an estimated quantity, but the result may be biased high.
J- = The result is an estimated quantity, but the result may be biased low.

-- = Not detected above MDCs.

Bold indicates the values exceeding the FAL.

A.6.4 Nature and Extent of COCs

As presented in Section A.6.3.3, it is assumed that contamination is present that exceeds the FAL of 25 mrem/OU-yr where DCBs were established in the CAIP (NNSA/NFO, 2014a) or where HCA conditions are present. The area of the HCA soil pile (DCB) measures approximately 35 m^2 (42 yd^2), based on the area inside the HCA fence. The radiologically impacted soil and debris within the HCA soil pile is a pile is approximately 1 ft high and is assumed to have been dumped on the soil surface. HCA conditions are present on three of the four well head casings, and the volume of the four steel well head covers is approximately 4 yd^3, collectively. This estimated volume is based on the physical extent of the steel well head covers.

Table A.6-8
Study Group 4 Sample Results for VOCs Detected above MDCs

Sample Location	Sample Number	Depth (cm bgs)	COPCs (mg/kg)								
			1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Ethyl benzene	Isopropyl benzene	n-Propyl benzene	p-isopropyl toluene	sec-Butyl benzene	Toluene	Total Xylenes
FALs			**260**	**10,000**	**27**	**11,000**	**21,000**	**11,000**	**45,400**	**45,000**	**2,700**
C01	D001	0 - 6	0.028 (J)	0.014 (J)	0.012 (J)	0.0049 (J)	0.011 (J)	0.0045 (J)	0.0052 (J)	0.43	0.09 (J)

J = Estimated value.

Table A.6-9
Study Group 4 Sample Results for SVOCs Detected above MDCs

Sample Location	Sample Number	Depth (cm bgs)	COPCs (mg/kg)		
			1-Methylnaphthalene	2-Methylnaphthalene	Phenanthrene
FALs			**71**	**2,200**	**170,000**
C01	C021	0 - 5	0.53	0.52	1.4
	C022	25 - 30	0.047 (J)	0.038 (J)	--
	D001	0 - 6	--	1.8 (J)	2.6 (J)

J = Estimated value.

Table A.6-10
Study Group 4 Sample Results for PCB Detected above MDC

Sample Location	Sample Number	Depth (cm bgs)	COPCs (mg/kg)
			Aroclor 1260
FALs			**0.74**
C01	D001	0 - 6	0.17

As presented in Section A.6.3.4, sample C011 (Location C17) exceeded the FAL for lead, and corrective action is required for the soil under the lead-acid battery. The estimated extent of the lead COC contamination at Location C17 is limited to 1 ft bgs and comprises approximately 1.7 yd^3, based on the physical extent of the broken lead-acid battery.

After interim corrective actions, the only PSM remaining at CAU 568 is lead shot (Location C19) and potential lead contained within the three soil and debris piles. Therefore, these locations require corrective action. The estimated extent of the PSM at lead shot Location C19 is limited to 1 ft bgs and comprises approximately 75 yd^3, based on the physical extent of the lead shot. The extent of COC contamination at the three soil and debris piles is limited to the physical extent of the soil and debris piles. The estimated volumes of the three soil and debris piles are 288 yd^3, 78 yd^3, and 141 yd^3.

The areas requiring corrective action are shown on Figure A.6-5.

A.6.5 Best Management Practices

The area adjacent to the HCA soil pile (includes Location A27) where an industrial land use of the area (2,000 hr/yr) could cause a future site worker to receive a dose exceeding 25 mrem/IA-yr. In order to eliminate the need for an administrative UR in this area, the CAB for the HCA soil pile has been extended to include this area with a dose above 25 mrem/IA-yr (Figure A.6-5). The area where a dose above PALs is present measures approximately 73 yd^2.

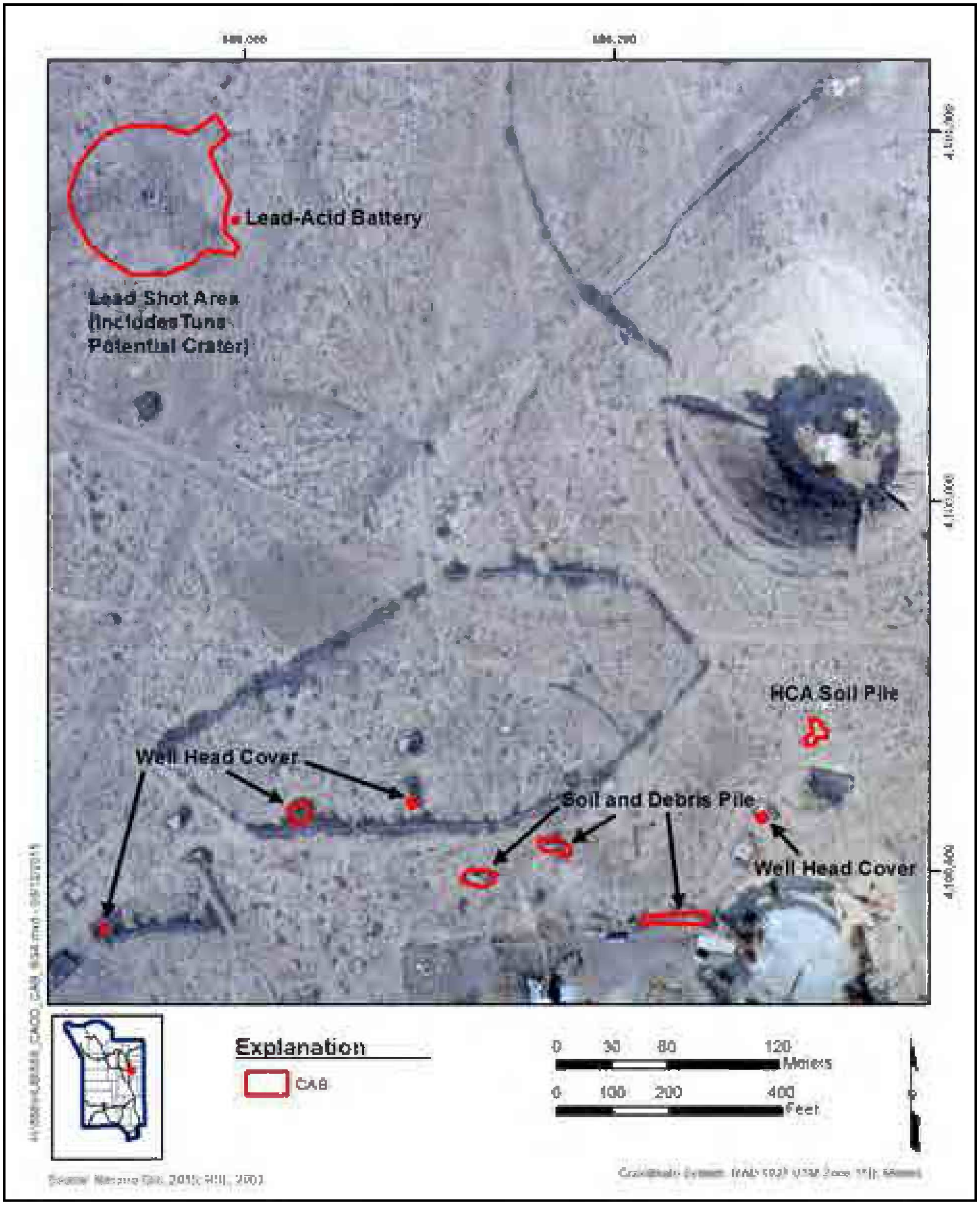

Figure A.6-5
Corrective Action Boundaries for Study Group 4

A.7.0 Study Group 5, Drainages

Study Group 5, Drainages, is located in the western portion of Area 3 of the NNSS, within the area encompassing CAU 568. The study group consists of radionuclide contamination that was initially deposited onto the soil surface but has subsequently been displaced through erosion. Additional detail on the history of Study Group 5 is provided in the CAIP (NNSA/NFO, 2014a).

A.7.1 CAI Activities

The specific CAI activities conducted to satisfy the CAIP requirements at this study group are described in the following subsections.

A.7.1.1 Visual Surveys

During visual surveys of CAU 568, one minor drainage was identified exiting the Wolverine/Shrew CA and traveling across 3-03 Road. The drainage terminates in a crater on the south side of 3-03 Road. No other obvious drainages were identified exiting the area. The nearest two sediment accumulation areas to the Wolverine/Shrew CA were selected for grab sample locations. The sample locations for Study Group 5 are shown on Figure A.7-1.

A.7.1.2 Radiological Screening

At sediment accumulation sample locations within the drainage, surface samples (0 to 10 cm bgs) were field screened for radioactivity levels. No subsurface samples were collected because native material was reached at 10 cm bgs.

A.7.1.3 Radiological Surveys

Aerial surveys and TRSs were performed at Study Group 5. The aerial surveys are described in Section A.2.2.1. The TRSs were conducted within the drainage to identify any elevated radiological readings to assist in the determination of grab sample locations. No areas of elevated radiological readings were detected. See Figure A.2-1 for a graphic representation of the TRSs conducted at Study Group 5.

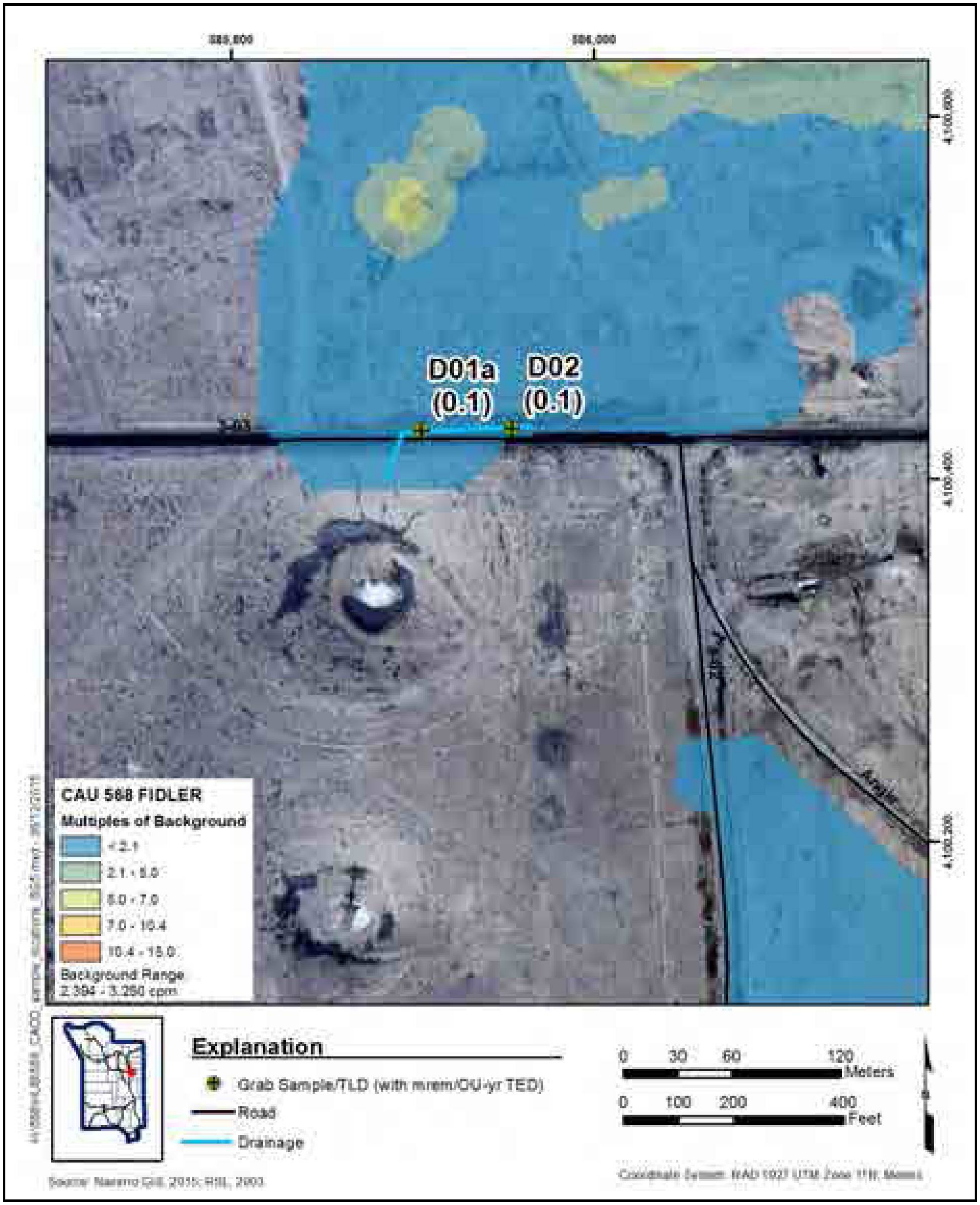

Figure A.7-1
Study Group 5 Sample Locations and 95% UCL of the TED

A.7.1.4 Sample Collection

Soil samples and TLD samples were collected to satisfy the CAIP requirements (NNSA/NFO, 2014a) at Study Group 5. Samples locations were selected as stated in Section A.7.1.1. The specific CAI activities conducted this study group are described in the following subsections.

A.7.1.4.1 TLD Samples

One TLD was installed at each of two grab sample locations (D01a and D02) at Study Group 5 to calculate external doses (Figure A.7-1). The TLDs placed at Study Group 5 are listed in Table A.7-1 All TLDs were measured by the NNSS environmental TLD monitoring program. See Figure A.7-1 for TLD locations.

Table A.7-1
TLDs at Study Group 5

Release	Location	TLD No.	Date Placed	Date Removed	Purpose
Drainage	D01a	6379	06/24/2014	10/14/2014	Grab sample
	D02	6055	06/24/2014	10/14/2014	Grab sample

A.7.1.4.2 Soil Samples

One grab soil sample was collected from each of two locations (D01a and D02) per Section A.7.1.1. No subsurface samples were collected because the FSRs were not exceeded per Section A.2.2.2. All soil samples were submitted for gamma spectroscopy; Pu-241; and isotopic U, Pu, and Am analyses. Additional information including depth and type for each soil sample collected for Study Group 5 is provided in Table A.7-2. Sample locations are shown on Figure A.7-1.

Table A.7-2
Samples Collected at Study Group 5

Release	Location	Sample Number	Depth (cm bgs)	Purpose
Drainage	D01a	D001a	0.0 - 10.0	Grab
	D02	D002	0.0 - 10.0	Grab

A.7.2 Deviations/Revised Conceptual Site Model

No deviations were noted for this study group.

The CAIP requirements (NNSA/NFO, 2014a) were met at this study group. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

A.7.3 Investigation Results

The following subsections present the analytical and computational results for soil and TLD samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NFO, 2014a). The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr. Results that are equal to or greater than FALs are identified by bold text in the results tables.

The internal dose calculated from soil sample results, and the external dose calculated from TLD measurements were combined to determine TED at each sample location. External doses for TLD locations are summarized in Section A.7.3.1. Internal doses for each sample location are summarized in Section A.7.3.2. The TEDs for each sampled location are summarized in Section A.7.3.3.

A.7.3.1 External Radiological Dose Calculations

Estimates for the external dose that a receptor would receive at each Study Group 5 TLD sample location (Figure A.7-1) were determined as described in Section A.2.3.2. External dose was calculated for the Industrial Area exposure scenario and then scaled (based on exposure duration) to the Remote Work Area and Occasional Use Area exposure scenarios for each TLD location. The SD, number of elements, minimum sample size, and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.7-3. The minimum sample size criterion was met for all sample locations in Study Group 5.

Table A.7-3
Study Group 5, 95% UCL External Dose for Each Exposure Scenario

Release	Location	SD	Number of Elements	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Drainage	D01a	0.0	3	3	1.2	0.2	0.1
	D02	0.1	3	3	1.8	0.3	0.1

A.7.3.2 Internal Radiological Dose Calculations

Estimates for the internal dose that a receptor would receive at each Study Group 5 grab sample location (Figure A.7-1) were determined as described in Section A.2.3.1. The number of samples and internal dose for each exposure scenario are presented in Table A.7-4.

Table A.7-4
Study Group 5 Internal Dose for Each Exposure Scenario

Release	Location	Number of Samples	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Drainage	D01a	1	0.1	0.0	0.0
	D02	1	0.4	0.1	0.0

A.7.3.3 Total Effective Dose

The TED for each grab sample location was calculated by adding the external dose values and the internal dose values. Values for both the average TED and the 95 percent UCL of the TED for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table A.7-5.

Table A.7-5
Study Group 5 TED at Sample Locations (mrem/yr)

Release	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Drainage	D01a	0.1	1.3	0.0	0.2	0.0	0.1
	D02	0.4	2.2	0.1	0.4	0.0	0.1

The 95 percent UCL of the average TED did not exceed the FAL (25 mrem/OU-yr) at any sample location within Study Group 5 (Figure A.7-1).

A.7.3.4 Chemical Contaminants

No chemical samples were collected from Study Group 5.

A.7.4 Nature and Extent of COCs

No radiological contamination associated with Study Group 5 was identified that exceeded the FAL of 25 mrem/OU-yr. Therefore, no further corrective action is required for Study Group 5.

A.7.5 Best Management Practices

No BMPs were implemented or proposed for this study group.

A.8.0 Waste Management

This section addresses the characterization and management of investigation and remediation wastes. Waste management activities were conducted as specified in the CAIP (NNSA/NFO, 2014a).

A.8.1 Generated Wastes

The wastes listed in Table A.8-1 were generated during the field investigation activities of CAU 568. Wastes were segregated to the greatest extent possible, and waste minimization techniques were integrated into the field activities to reduce the amount of waste generated. Controls were in place to minimize the use of hazardous materials and the unnecessary generation of hazardous and/or mixed waste. Decontamination activities were planned and executed to minimize the volume of rinsate generated.

Table A.8-1
Waste Summary Table

Container Number	Waste Description	Waste Characterization	Waste Disposition			
			Disposal Facility	Waste Volume	Disposal Date	Disposal Doc[a]
568A02–568A08; 568A10	Debris - PPE	Low-Level Radioactive Waste	Area 5 RWMC	64 ft^3	Pending	Pending
15M002	Elemental Lead Debris	Mixed Low-Level Radioactive Waste	Area 5 RWMC	20.4 ft^3	06/23/2015	Onsite Waste Manifests (2)
568A01	Elemental Lead (brick, sheet)	Recycle Material	TMMC	8 ft^3	09/17/2013	Certificate of Recycle and BOL
568T01	Debris - transformer carcass	Solid Industrial Waste	Area 9, U10c Industrial Landfill	13 ft^3	05/05/2015	LVF
N/A	Debris - PPE outside Rad Area	Solid Industrial Waste	Area 9, U10c Industrial Landfill	29.7 ft^3	03/26/2015	LVF

BOL = Bill of Lading
LVF = Load Verification Form
PPE = Personal protective equipment
TMMC = Toxco Materials Management Center

The amount, type, and source of waste placed into each container were recorded in waste management logbooks that are maintained in the CAU 568 file.

Wastes generated during the CAI were segregated into the following waste streams:

- LLW (disposable PPE and sampling equipment)
- Mixed low-level waste (MLLW) debris
- Solid industrial waste debris (e.g., empty transformer debris)
- Recyclable waste (i.e., lead debris)

A.8.2 Waste Characterization and Disposal

All waste characterization and disposal were based on process knowledge, radiological surveys, and analytical results of site samples. Waste characterization and disposition was determined based on a review of analytical results and compared to federal and state regulations, permit requirements, and disposal or recycle facility acceptance criteria. Analytical results and comparisons to regulatory criteria are presented in Tables A.8-2, A.8-3, A.8-4, A.8-5, and A.8-6. Samples C501–C511 were soil samples collected to support potential waste disposal. Analyses added to Sample C01 were also analyzed to support potential waste disposal. However, as no waste was generated in association with these samples, the data were not used but are reported in Tables A.8-2, A.8-3, A.8-4, A.8-5, and A.8-6 for completeness.

Table A.8-2
TCLP Results Detected above MDCs at CAU 568
(Page 1 of 2)

Sample Location	Sample Number	Matrix	Parameter	Result	Criteria (TCLP Limits[a])	Units
C01	C511	Soil	Barium	0.22 (J-)	100	mg/L
			Cadmium	0.0063 (J-)	1	
			Lead	0.016	5	
C03	C502	Soil	Barium	1	100	mg/L
			Lead	2	5	
C12	C507	Soil	Lead	0.05	5	mg/L
			Selenium	0.092	1	
C19	C508	Soil	Barium	0.27 (J-)	100	mg/L
			Lead	0.33	5	
			Selenium	0.039 (J-)	1	

Table A.8-2
TCLP Results Detected above MDCs at CAU 568
(Page 2 of 2)

Sample Location	Sample Number	Matrix	Parameter	Result	Criteria (TCLP Limits[a])	Units
C20	C509	Soil	Barium	0.49 (J-)	100	mg/L
			Lead	2	5	
			Selenium	0.046	1	

[a] TCLP Limit (CFR, 2015)

TCLP = Toxicity Characteristic Leaching Procedure

J- = The result is an estimated quantity but the result may be biased low.

Table A.8-3
Sample Results for Metals Detected above MDCs

Sample Location	Sample Number	Depth (cm bgs)	COPCs (mg/kg)							
			Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
FALs			**23**	**190,000**	**9,300**	**33.6**	**5,739**	**43**	**5,100**	**5,100**
C01	D001	0 - 6	2.4	180	0.7	6.5	21 (J)	--	0.43 (J-)	0.45

J = Estimated value.
J- = The result is an estimated quantity, but the result may be biased low.

-- = Not detected above MDCs.

Table A.8-4
Sample Results for Motor Oil, TPH-DRO, and TPH-GRO Detected above MDCs

Sample Location	Sample Number	Depth (cm bgs)	COPCs (mg/kg)		
			Motor Oil	TPH-DRO	TPH-GRO
FALs			**--**	**100**	**100**
C03	C502	0 - 5	--	7.8	--
C08	C504	0 - 5	--	49	--
C10	C506	0 - 5	--	5	--
C01	D001	0 - 6	17,000 (J)	**51,000** (J)	2.6 (J)

J = Estimated value.

-- = Not detected above MDCs.

Table A.8-5
Sample Results for Isotopes Detected above MDCs

Sample Location	Sample Number	Depth (cm bgs)	COPCs (pCi/g)							
			Am-241	Am-243	Pu-238	Pu-239/240	Pu-241	U-234	U-235	U-238
C02	C501	0 - 5	31 (J)	--	2.43	186 (J)	74	1.26	--	0.81
C03	C502	0 - 5	10.3 (J)	--	0.86	61.4 (J)	--	1.04	--	0.83
C07	C503	0 - 5	5.64 (J)	0.13 (J+)	0.43	34.3 (J)	--	0.72	0.056	0.82
C08	C504	0 - 5	2.97 (J)	--	--	12.9 (J)	--	0.86	--	0.65
C09	C505	0 - 5	2.07 (J)	--	0.274	12.5 (J)	--	0.96	--	0.87
C10	C506	0 - 5	0.95 (J)	--	0.186	4.8 (J)	--	0.99	--	1.01
C12	C507	0 - 5	1,440	19.6 (J+)	94	8,900	2,620	11.6	--	--
C19	C510	0 - 5	4.54	0.053 (J+)	2.37	25.5	--	0.87	0.063	0.88
C20	C509	0 - 10	600	--	68	4,070	--	--	--	--

J = Estimated value.
J+ = The result is an estimated quantity, but the result may be biased high.

-- = Not detected above MDCs.

Table A.8-6
Samples Results for Gamma-Emitting Radionuclides Detected above MDCs

Sample Location	Sample Number	Depth (cm bgs)	COPCs (pCi/g)				
			Ac-228	Am-241	Cm-243	Cs-137	Eu-155
C02	C501	0 - 5	1.57	84 (J)	--	4.28	--
C03	C502	0 - 5	1.46	39 (J)	--	2.21	--
C07	C503	0 - 5	1.51	12.1 (J)	--	1.23	--
C08	C504	0 - 5	1.39	9.3 (J)	--	1.71	--
C09	C505	0 - 5	1.6	5.1 (J)	--	0.64	--
C10	C506	0 - 5	1.49	--	--	0.245	--
C12	C507	0 - 5	1.5	2,480 (J)	12.3 (J)	9.5	--
C19	C510	0 - 5	1.47	9.3 (J+)	--	1.04	--
C20	C509	0 - 10	1.75	17,300 (J)	--	2.47	4.9 (J)
C01	D001	0 - 6	1.22	89 (J)	--	4.3	--

Ac = Actinium
Cm = Curium
Cs = Cesium
Eu = Europium

J = Estimated value.
J+ = The result is an estimated quantity, but the result may be biased high.

-- = Not detected above MDCs.

The generated waste streams were characterized as Solid Industrial Waste, LLW, MLLW, and Recyclable Materials. The executed waste shipping and disposal documentation for CAU 568 are available in Attachment D-1.

A.8.2.1 Industrial Solid Waste

One solid waste item in the form of a transformer carcass (Container 568T01) was generated and characterized as hydrocarbon-impacted waste that meets the chemical and radiological waste acceptance criteria of the Area 9 U10c solid waste landfill. The transformer carcass was overpacked into an 85-gallon (gal) steel drum (13 ft^3) and shipped for disposal on May 5, 2015. Approximately 30 ft^3 of PPE and disposable sampling equipment was generated during the CAI. These materials were field screened to meet the unrestricted release of materials screening limits of Table 4-2 of the *Nevada National Security Site Radiological Control* (RadCon) *Manual* (NNSA/NSO, 2012a). This waste was characterized as industrial solid waste that meets the chemical and radiological waste acceptance criteria of the Area 9, U10c solid waste landfill (NNSA/NFO, 2015a). The solid waste was bagged, marked, and placed in a roll-off container located at Building 23-310 of which the contents have been subsequently disposed at the Area 9 U10c landfill on March 26, 2015.

A.8.2.2 LLW

Eight 55-gal drums (Containers 568A02–568A08 and 568A10) were generated during the CAU 568 CAI. The drums contained PPE and disposable sampling equipment generated during sampling activities within a posted radiological CA and/or HCA and were characterized as LLW. The waste in containers 568A02–568A08 and 568A10 meet the NNSS Waste Acceptance Criteria for disposal at the Area 5 RWMC (NNSA/NFO, 2015a).

A.8.2.3 MLLW

Approximately 20.4 ft^3 containing radiologically impacted elemental lead debris items was generated and packaged into one macro-encapsulation container (Container 15M002). The only source of chemical contamination was elemental lead in the form of plates, bricks, and other debris; therefore, the waste is characterized as RCRA regulated. These lead items were radiologically field screened during generation, and results exceeded the unrestricted release of materials screening limits of Table 4.2 of the NNSS RadCon Manual (NNSA/NSO, 2012a); therefore, the debris is characterized as MLLW. The waste was transferred to National Security Technologies, LLC (NSTec), Waste Generator Services for treatment and disposal at the Area 5 RWMC on June 23, 2015.

A.8.2.4 Recyclable Materials

Recyclable materials generated during the CAI at CAU 568 included elemental lead debris items comprising a lead brick, lead plates, and lead sheets that were packaged into container 568A01. The lead materials were radiologically field screened as generated to meet the acceptance criteria of TMMC. The lead materials in container 568A01 were determined to be radioactive material but meet the TMMC recycle material acceptance criteria. All recyclable lead materials were transferred offsite to TMMC for recycling on September 6, 2013.

A.9.0 Quality Assurance

This section contains a summary of QA/QC measures implemented during the sampling and analysis activities conducted in support of the CAU 568 CAI. The following subsections discuss the data validation process, QC samples, and nonconformances. A detailed evaluation of the DQIs is presented in Appendix B.

Laboratory analyses were conducted for samples used in the decision-making process to provide a quantitative measurement of any COPCs present. Rigorous QA/QC was implemented for all laboratory sample data, including documentation, verification and validation of analytical results, and affirmation of DQI requirements related to laboratory analysis. Detailed information regarding the QA program is contained in the Soils QAP (NNSA/NSO, 2012).

A.9.1 Data Validation

Data validation was performed in accordance with the Soils QAP (NNSA/NSO, 2012) and approved protocols and procedures. All laboratory data from samples collected and analyzed for CAU 568 were evaluated for data quality in a tiered process. Data were reviewed to ensure that samples were appropriately processed and analyzed, and the results were evaluated using validation criteria. Documentation of the data qualifications resulting from these reviews is retained in CAU 568 files as a hard copy and electronic media.

All laboratory data were subjected to a Tier 1 evaluation, while a Tier 2 evaluation was performed on a subset of reported data for all samples. A Tier 3 evaluation was performed on the analytical results for samples that represent 5 percent of the samples collected for site characterization.

Laboratory data packages were reviewed for completeness. The analytical data contained within the packages were evaluated for correctness, compliance, precision, and accuracy. Where issues were encountered within the data, validation-qualifiers were assigned with descriptions.

Am-243 results were estimated for potential high bias because the Am-241 spectral peaks and peak tailing are in the same region of interest in the alpha spectrometer. Cadmium, selenium, and mercury results were estimated with low bias because the instrument readings for the QC blanks returned negative values. Sample results estimated for matrix spikes and internal standards failures, had matrix interferences issues. Matrix spike failures were seen in metals QC samples while internal standards failures were seen in SVOC and VOC results; the matrix interference resulted in the inability to distinguish peaks in the chromatograms. When there are interferences inherent to the matrix of these samples, the results are said to be less accurate and therefore estimated. All Am-241, lead (Pb)-212, and Pb-214 results analyzed by gamma spectroscopy were biased high because the soil density was significantly less than the associated calibration standards density. For discussion on data qualified as rejected, see Appendix B.

An independent examination of the data packages was performed on 5 percent of the sample data. This review was performed by TLI Solutions, Inc., in Golden, Colorado.

A.9.2 QC Samples

During the CAI, three FDs were also sent as blind samples to the laboratory to be analyzed for the investigation parameters listed in the CAIP (NNSA/NFO, 2014a). Precision was evaluated and found to be reasonable (less 20 relative percent difference) with the exception of the isotopic results for Am-241, Pu-238, Pu-241, and Pu-239/240. High variability in the sample matrix suggests that discrete particles of contamination are present within the samples. Therefore, mixing will not produce homogeneity. This variability does not mean the precision of the measurement is poor, but that activities are variable within the samples. This is commonly observed in samples containing these radionuclides because single particles of these isotopes within a sample can result in detectable activity attributed to the entire sample. The isotopic analyses of Am-241, Pu-238, Pu-241, and Pu-239/240 were used only to estimate plutonium-to-americium ratios and were not used to calculate internal dose. As the precision rates for all other constituents meet the acceptance criteria for precision, the dataset is determined to be acceptable.

Laboratory QC samples used to measure accuracy and precision were analyzed by the laboratory with each batch of samples submitted for analysis. When QC criteria were exceeded, qualifying flags were added to sample results, along with the reason for estimation or rejection. Documentation of data qualifications is retained in the Analytical Services database and in the data packages located in Navarro Central Files.

A.9.3 Field Nonconformances

There were no field nonconformances identified for the CAI.

A.9.4 Laboratory Nonconformances

Laboratory nonconformances are generally due to fluctuations in analytical instrumentation operations, sample preparations, missed holding times, spectral interferences, high or low chemical yields/matrix spikes, precision, and the like. All laboratory nonconformances were reviewed for relevance and where appropriate, data were qualified.

A.9.5 TLD Data Validation

The data from the TLD measurements met rigorous data quality requirements. TLDs were obtained from, and measured by, the Environmental Technical Services group at the NNSS. This group is responsible for a routine environmental monitoring program at the NNSS. TLDs were submitted to the Environmental Technical Services group for analysis using automated TLD readers that are calibrated and maintained by the NSTec Radiological Control Department in accordance with existing QC procedures for TLD processing. A summary of the routine environmental monitoring TLD QC program can be found in the *Nevada Test Site Routine Radiological Environmental Monitoring Plan* (BN, 2003). Certification is maintained through the DOE Laboratory Accreditation Program for dosimetry.

The determination of the external dose component of the TED by TLDs was determined to be the most accurate method because of the following factors:

1. *TLDs are exposed at the sample plots for an extended time period that approximates the 2,000 hours of exposure time used for the Industrial Area exposure scenario.* This eliminates errors in reading dose-rate meter scale graduations and needle fluctuations that would be magnified when as-read meter values are multiplied from units of “per-hour” to 2,000 hours.

2. *The use of a TLD to determine an individual’s external dose is the standard in radiation safety and serves as the “legal dose of record” when other measurements are available.* Specifically, 10 CFR Part 835.402 (CFR, 2015) indicates that personal dosimeters must be provided to monitor individual exposures and that the monitoring program that uses the dosimeters must be accredited in accordance with a DOE Laboratory Accreditation Program.

A.10.0 Summary

Radionuclide and chemical contaminants detected in environmental samples during the CAI were evaluated against FALs to determine the presence and extent of COCs for CAU 568. No radionuclides were detected above FALs in soil samples collected from CAU 568. Radionuclide COCs were assumed to be present within DCBs and HCAs and require corrective action. Chemical COCs (lead and PAHs) were detected above FALs in soil samples collected and require corrective action. PSM (lead bricks, lead-acid batteries, lead sheets, lead plates, lead shot, and a transformer) is present at the site and requires corrective action. The following subsections summarize the results for each study group in CAU 568.

A.10.1 Study Group 1, Releases within a Defined Radiological Survey Signature

No radionuclides were detected above FALs in soil samples collected from Study Group 1. Therefore, no further action is required for CAS 03-23-17 or the test surface releases in Study Group 1 associated with CASs 03-23-20, 03-23-22, 03-23-23, 03-23-26, 03-23-31, 03-23-32, or 03-23-33.

Radionuclides exceeding the FAL are assumed to be present where HCA conditions are present within the Chavez (DCB) (CAS 03-23-19) and Pascal-B (CAS 03-23-31) HCAs. These areas of HCA conditions require corrective action. The alternatives of clean closure and closure in place with administrative controls were evaluated for these two areas meeting HCA conditions in Section 3.0. Closure in place with an FFACO UR is recommended for the Chavez HCA (DCB) at CAS 03-23-19 and the Pascal-B HCA at CAS 03-23-31.

It is also assumed that a dose above FALs is present within the DCBs for subsurface contamination associated with the eight underground SEs in Study Group 1. These areas require corrective action. The alternatives of clean closure and closure in place with engineering and administrative controls were evaluated for these DCBs at CASs 03-23-20, 03-23-23, 03-23-31, 03-23-32, and 03-23-33 in Section 3.0. Closure in place with engineering controls and an FFACO UR is recommended for the eight SE DCBs at CASs 03-23-20, 03-23-23, 03-23-31, 03-23-32, and 03-23-33.

A.10.2 Study Group 2, Releases Located within a Crater or Potential Crater Area That Cannot Be Entered

No radionuclides were detected above FALs in soil samples collected from Study Group 2. Radiological contamination associated with Boomer was identified adjacent to the Boomer crater area. Therefore, according to Figure 8-1 in the Soils RBCA document (NNSA/NFO, 2014b), the Boomer crater area requires corrective action. The alternatives of clean closure and closure in place with engineering and administrative controls were evaluated for this area in Section 3.0. Closure in place with engineering controls and an FFACO UR is the recommended corrective action for the Boomer release at CAS 03-45-01. No further corrective action is required for the other test surface releases associated with Study Group 2.

A.10.3 Study Group 3, Releases with No Radiological Survey Signature

No radionuclides were detected above FALs in soil samples collected from Study Group 3; therefore, no further corrective action is required for the Shrew test surface release at CAS 03-23-26, the Funnel test surface release at CAS 03-23-34, or the Mink test surface release at CAS 03-23-34. However, it is assumed a dose above FALs is present within the DCB for subsurface contamination associated with the Chipmunk underground SE (CAS 03-23-34). This area requires a corrective action. The alternatives of clean closure and closure in place with engineering and administrative controls were evaluated for this DCB in Section 3.0. The CAA of closure in place with engineering controls and an FFACO UR is the recommended corrective action for this DCB.

A.10.4 Study Group 4, Spills and Debris

No radionuclides were detected above FALs in soil samples collected from Study Group 4; however, it is assumed that a dose above FALs is present within the HCA soil pile (DCB) (CAS 03-23-30). This area requires corrective action. The alternatives of clean closure and closure in place with administrative controls were evaluated for this area in Section 3.0. The CAA of clean closure is recommended for the HCA soil pile (CAS 03-23-30). The CAB for CAS 03-23-30 was increased to include the area that exceeds 25 mrem/IA-yr, thereby eliminating the need for an administrative boundary at CAS 03-23-30.

Radionuclides exceeding the FAL are also assumed to be present where HCA conditions are present at the well head covers at San Juan (DCB), Luna, and Valencia. These PSM meeting HCA conditions require corrective action. Although the Otero well head cover does not meet HCA conditions (it only meets CA conditions), it is recommended that it be included in their chosen corrective action of clean closure because the Otero well head cover is similar to the other three identified well head covers.

PSM items including four broken lead-acid batteries, one intact lead-acid battery, 15 lead bricks, two lead sheets, 28 lead plates, an area of lead shot, and a transformer was identified at CAU 568. These PSM require corrective action. All lead PSM items and the transformer were removed from the site as an interim corrective action except for the lead shot, which remains at Location C19. Therefore, corrective action is required for the PSM at Location C19. After the PSM was removed, verification soil samples were collected. All results were below FALs except for sample C011 (Location C17) collected from below a broken lead-acid battery. Therefore, corrective action is required for the lead-contaminated soil at Location C17. The alternatives of clean closure and closure in place with administrative controls were evaluated for the lead shot area (Location C19) and lead-contaminated soil (Location C17) at CAS 03-26-04 in Section 3.0. The CAA of clean closure is the recommended corrective action for both areas.

Additionally, based on the presence of lead debris on the surfaces of the three soil and debris piles (CAS 03-08-04), there is the potential for additional PSM to be present within the piles. Therefore, a corrective action is required for the three soil and debris piles. The alternatives of clean closure and closure in place with administrative controls were evaluated for the soil and debris piles in Section 3.0. The CAA of clean closure is the recommended corrective action for soil and debris piles at CAS 03-08-04.

A.10.5 Study Group 5, Drainages

No contaminants were identified at levels exceeding FALs in Study Group 5. Therefore, no further corrective action is required for the drainage release at CAS 03-23-26.

A.10.6 Best Management Practices

As a BMP, it is recommended that an administrative UR be placed to encompass areas where an industrial land use of the area could cause a future site worker to receive a dose exceeding 25 mrem/IA-yr and at areas where removable contamination is present at levels meeting CA criteria. Because the area of San Juan/Otero (CASs 03-23-20 and 03-23-23) that meets CA criteria encompasses the area that exceeds 25 mrem/IA-yr, an administrative boundary for CASs 03-23-20 and 03-23-23 within the fenced area is recommended. For Chavez (CAS 03-23-19), because the area at Chavez that meets CA criteria encompasses the area that exceeds 25 mrem/IA-yr, an administrative UR boundary for CAS 03-23-19 within the fenced area is recommended. For the area that exceeds 25 mrem/IA-yr at Valencia (CAS 03-23-33) and Platypus (CAS 03-23-22), it is recommended that the soil be removed, so that no administrative boundary be necessary for those areas.

A summary of CAI results and actions implemented is presented in Table A.10-1 for each CAU 568 release.

Table A.10-1
Summary of Investigation Results at CAU 568
(Page 1 of 4)

CAS Number	Name	Study Group	Release	COC	CAA	BMP
03-23-17	S-3I Contamination Area	1	Chavez SE Surface Release	None	No Further Action	Administrative UR at CA Fence
03-23-19	T-3U Contamination Area	1	Chavez HCA (DCB)	HCA conditions assumed to exceed FALs	Closure in Place	None
03-23-20; 03-23-23	Otero Contamination Area; San Juan Contamination Area	1	San Juan, Otero, Pascal-C SE Surface Release	None	No Further Action	Administrative UR at CA Fence
03-23-20	Otero Contamination Area	1	Subsurface Contamination within Otero SE DCB	Assumed TED above FALs in SE DCB	Closure in Place	None
		4	Otero Well Head Cover	Removable contamination meets CA conditions	Clean Closure	None

Table A.10-1
Summary of Investigation Results at CAU 568
(Page 2 of 4)

CAS Number	Name	Study Group	Release	COC	CAA	BMP
03-23-22	Platypus Contamination Area	1	Platypus Test Surface Release	None	No Further Action	Remove Soil above 25 mrem/IA-yr outside CA Fence
03-23-23	San Juan Contamination Area	1	Windrows	None	No Further Action	None
		4	San Juan Well Head Cover	HCA conditions assumed to exceed FALs	Clean Closure	None
		1	Subsurface Contamination within San Juan SE DCB	Assumed TED above FALs in SE DCB	Closure in Place	None
		1	Subsurface Contamination within Pascal-C SE DCB	Assumed TED above FALs in SE DCB	Closure in Place	None
		1	Bernalillo Test Surface Release	None	No Further Action	None
03-23-26	Shrew/Wolverine Contamination Area	3	Shrew Test Surface Release	None	No Further Action	None
		1	Wolverine Test Surface Release	None	No Further Action	None
		5	Drainage	None	No Further Action	None
03-23-30	HCA Soil Pile	4	Release from Debris	HCA conditions assumed to exceed FALs	Clean Closure (Includes Soil above 25 mrem/IA-yr outside HCA Fence)	None

Table A.10-1
Summary of Investigation Results at CAU 568
(Page 3 of 4)

CAS Number	Name	Study Group	Release	COC	CAA	BMP
03-23-31	U-3d Contamination Area	1	Pascal-B SE Surface Release	None	No Further Action	None
		1	Pascal-B HCA	HCA conditions assumed to exceed FALs	Closure in Place	None
		1	Subsurface Contamination within Pascal-B SE DCB	Assumed TED above FALs in SE DCB	Closure in Place	None
		1	Luna SE Surface Release	None	No Further Action	None
		4	Luna Well Head Cover	HCA conditions assumed to exceed FALs	Clean Closure	None
		1	Subsurface Contamination within Luna SE DCB	Assumed TED above FALs in SE DCB	Closure In Place	None
		1	Colfax SE Surface Release	None	No Further Action	None
		3	Subsurface Contamination within Colfax SE DCB	Assumed TED above FALs in SE DCB	Closure in Place	None
03-23-32	U-3j Test Release	1	Pascal-A SE Surface Release	None	No Further Action	None
		1	Subsurface Contamination within Pascal-A SE DCB	Assumed TED above FALs in SE DCB	Closure in Place	None
03-23-33	U-3r Contamination Area	1	Valencia SE Surface Release	None	No Further Action	Remove Soil above 25 mrem/IA-yr
		4	Valencia Well Head Cover	HCA conditions assumed to exceed FALs	Clean Closure	None
		1	Subsurface Contamination within Valencia SE DCB	Assumed TED above FALs in SE DCB	Closure in Place	None

Table A.10-1
Summary of Investigation Results at CAU 568
(Page 4 of 4)

CAS Number	Name	Study Group	Release	COC	CAA	BMP
03-23-34	U-3ay Contamination Area	3	Chipmunk SE Surface Release	None	No Further Action	None
		3	Subsurface Contamination within Chipmunk SE DCB	Assumed TED above FALs in SE DCB	Closure in Place	None
		3	Mink Test Surface Release	None	No Further Action	None
		3	Funnel Test Surface Release	None	No Further Action	None
03-08-04	Soil and Debris Piles	4	PSM within Soil and Debris Pile	Assumed PSM within soil and debris piles; PSM removed from surface of piles	Clean Closure	None
03-26-04	Test-Related Debris	4	PSM Including Lead Items (Bricks, Sheets, Plates, Batteries) and Transformer	None	No Further Action - Corrective Action Completed	None
			Lead from Broken Lead-Acid Battery	Lead	Clean Closure	None
			Lead from Lead Shot	Lead	Clean Closure	None
03-45-01	Test Surface Releases	2	Cognac, Chinchilla, Chinchilla II, Stoat, Armadillo, Haymaker, Solendon, Tuna, and Tendrac Test Surface Releases	None	No Further Action	None
			Boomer Test Surface Release	Assumed TED above FALs in crater area	Closure in Place	None

A.11.0 References

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Appendix B

Data Assessment

B.1.0 Data Assessment

The DQA process is the scientific evaluation of the actual CAI results to determine whether the DQO criteria established in the CAU 568 CAIP (NNSA/NFO, 2014a) were met and whether DQO decisions can be resolved at the desired level of confidence. The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps to ensure that DQO decisions are sound and defensible.

The DQA involves five steps that begin with a review of the DQOs and end with an answer to the DQO decisions. These steps are briefly summarized as follows:

1. *Review DQOs and Sampling Design.* Review the DQO process to provide context for analyzing the data. State the primary statistical hypotheses; confirm the limits on decision errors for committing false-negative (Type I) or false-positive (Type II) decision errors; and review any special features, potential problems, or deviations to the sampling design.

2. *Conduct a Preliminary Data Review.* Perform a preliminary data review by reviewing QA reports and inspecting the data both numerically and graphically, validating and verifying the data to ensure that the measurement systems performed in accordance with the criteria specified, and using the validated dataset to determine whether the quality of the data is satisfactory.

3. *Select the Test.* Select the test based on the population of interest, population parameter, and hypotheses. Identify the key underlying assumptions that could cause a change in one of the DQO decisions.

4. *Verify the Assumptions.* Perform tests of assumptions. If data are missing or are censored, determine the impact on DQO decision error.

5. *Draw Conclusions from the Data.* Perform the calculations required for the test.

B.1.1 Review DQOs and Sampling Design

This section contains a review of the DQO process presented in Appendix A of the CAIP (NNSA/NFO, 2014a). The DQO decisions are presented with the DQO provisions to limit false-negative or false-positive decision errors. Special features, potential problems, or any deviations to the sampling design are also presented.

B.1.1.1 Decision I

The Decision I statement as presented in the CAIP is as follows: "Is any COC associated with the release present in environmental media?" (NNSA/NFO, 2014a). For judgmental sampling design, any analytical result for a COPC above the FAL will result in that COPC being designated as a COC. For probabilistic (unbiased) sampling design, any COPC that has a 95 percent UCL of the average concentration above the FAL will result in that COPC being designated as a COC. A COC may be assumed to be present based on the presence of wastes that have the potential to release COC concentrations in the future (i.e., PSM) or the presence of removable contamination at levels exceeding the criteria for defining an HCA. A COC may also be defined as a contaminant that, in combination with other like contaminants, is determined to jointly pose an unacceptable risk based on a multiple contaminant analysis (NNSA/NFO, 2014b).

Decision I Rules

- If the population parameter of any COPC in a target population exceeds the FAL for that COPC, then that COPC is identified as a COC.
- If a COC is detected, then the Decision II statement must be resolved.
- If COCs are not identified, then the CAI is complete.

B.1.1.1.1 DQO Provisions To Limit False-Negative Decision Error

A false-negative decision error (when it is concluded that contamination exceeding FALs is not present when it actually is) was controlled by meeting the following criteria:

1a) For Decision I, having a high degree of confidence that sample locations selected will identify COCs if present anywhere within the study group (judgmental sampling).

1b) Maintaining a false-negative decision error rate of 0.05 (probabilistic sampling).

2) Having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.

3) Having a high degree of confidence that the dataset is of sufficient quality and completeness.

Criteria 1b, 2, and 3 were assessed based on the entire dataset. Therefore, these assessments apply to both Decision I and Decision II.

Criterion 1a (Confidence Judgmental Sample Locations Identify COCs)

Decision I, as stipulated in the DQOs, was already resolved for the areas within the DCBs because those areas were already identified as requiring corrective action. Therefore, Decision I sampling only applied to those areas outside the DCBs. To resolve Decision I (determine whether a COC is present at a release), samples must be collected in areas most likely to contain a COC.

To satisfy the criteria that the samples must be collected in areas most likely to contain a COC (outside the DCBs), judgmental sample locations were selected at each study group as follows:

Study Group 1, Releases within a Defined Radiological Survey Signature

Grab and plot sample locations were selected within each release at Study Group 1 at the location of highest radiological readings as detected during the TRS. For the investigation of subsurface contamination within the former windrows, radiological screening was conducted and a subsurface sample was collected from Location A07, based on screening results.

Study Group 2, Releases Located within a Crater or Potential Crater Area That Cannot Be Entered

TRSs were conducted around crater or potential crater areas. Radioactivity was detected above background levels adjacent to the Boomer fence. This release was sampled in accordance with Study Group 1.

Study Group 3, Releases with No Radiological Survey Signature

Grab sample locations were selected within each release at Study Group 3 at the nearest feasible physical location to GZ, with the exception of Funnel. No areas of elevated radiological readings were detected during the Funnel TRS or on aerial radiological surveys, and other no tests in close proximity to Funnel had documented or measured (during aerial radiological surveys) surface releases of radioactivity. Therefore, no sample was collected for the Funnel release.

Study Group 4, Spills and Debris

Sample locations were selected at lead PSM locations based on the physical presence of PSM. Sample locations at the transformer location were biased to the location of heaviest staining on the soil.

Study Group 5, Drainages

Sample locations associated with the drainage were selected based on identified sedimentation accumulation areas. Subsurface screening was not conducted because native soil was encountered at 10 cm bgs.

Criterion 1b (Confidence in Probabilistic False-Negative Decision Error Rate)

Control of the false-negative decision error for the probabilistic samples was accomplished by ensuring the following:

- The samples are collected from unbiased locations.
- A sufficient sample size was collected.
- A false rejection rate of 0.05 was used in calculating the 95 percent UCLs and minimum sample size.

Selection of the sample aliquot locations within a sample plot was accomplished using a random start, systematic triangular grid pattern for sample placement. This permitted that all given locations within the boundaries of the sample plot would have an equal probability of being chosen. Although the TLD locations were not established at random locations (i.e., they were placed at the center of the sample plot), they provided three independent measurements of dose (per TLD) that integrate unbiased measurements from each sample location.

The minimum number of samples required for each probabilistic sample location was calculated for both the internal (soil samples) and external (TLD elements) dose samples. The minimum sample size (n) was calculated using the following EPA sample size formula (EPA, 2006):

$$n = \frac{s^2(z_{.95} + z_{.80})^2}{(\mu - C)^2} + \frac{z^2_{.95}}{2}$$

where

s = standard deviation
$z_{.95}$ = z score associated with the false-negative rate of 5 percent
$z_{.80}$ = z score associated with the false-positive rate of 20 percent
μ = dose level where false-positive decision is not acceptable (12.5 mrem/yr)
C = FAL (25 mrem/yr)

The use of this formula requires the input of basic statistical values associated with the sample data. Data from a minimum of three samples are required to calculate these statistical values and, as such, the least possible number of samples required to apply the formula is three. Therefore, in instances where the formula resulted in a value less than three, three is adopted as the minimum number of samples required. The results of the minimum sample size calculations and the number of samples collected are presented in Tables B.1-1 and B.1-2. As shown in these tables, the minimum number of soil and TLD samples within each plot was met or exceeded. The minimum sample size calculations were conducted for probabilistic sample locations as stipulated in the CAIP (NNSA/NFO, 2014a) based on the following parameters:

- A false rejection rate of 0.05
- A false acceptance rate of 0.20
- The maximum acceptable gray region set to one-half the FAL (12.5 mrem/yr)
- The calculated SD

Criterion 2 (Confidence in Detecting COCs Present in Samples)

The analytical methods were chosen during the DQO process as the analyses required to detect any of the COPCs listed in the CAIP that were defined as the contaminants that could reasonably be expected at the site that could contribute to a dose or risk exceeding FALs. The COPCs were identified based on operational histories, waste inventories, release information, investigative background, contaminant sources, release mechanisms, and migration pathways as presented in the

Table B.1-1
Input Values and Determined Minimum Number of Samples for Sample Plots
(Page 1 of 2)

Release	Plot	Standard Deviation (OU Scenario)	Samples Collected	Minimum Sample Size
San Juan, Otero, Pascal-C	A01	0.0	4	3
	A02	0.0	4	3
	A03	0.1	4	3
	A04	2.4	4	3
	A05	0.5	4	3
	A06	0.2	5	3
	A07	0.0	5	3
	A15	0.0	4	3
Bernalillo	A24	0.0	4	3
Pascal-B	A29	0.1	4	3
	A30	0.0	4	3
	A23	0.3	5	3
	A32	0.1	4	3
Pascal-A	A16	0.0	4	3
	A17	0.0	4	3
	A18	0.0	4	3
	A19	0.0	4	3
	A20	0.0	4	3
	A21	0.0	4	3
	A22	0.1	4	3
Valencia	A28	1.4	4	3
Wolverine	A31	0.0	4	3

Table B.1-1
Input Values and Determined Minimum Number of Samples for Sample Plots
(Page 2 of 2)

Release	Plot	Standard Deviation (OU Scenario)	Samples Collected	Minimum Sample Size
Chavez	A08	0.0	4	3
	A09	0.2	4	3
	A10	0.1	4	3
	A11	0.0	4	3
	A12	0.1	4	3
	A13	0.1	4	3
	A14	0.0	4	3
Boomer	A26	0.0	4	3

Note: The actual required minimum number of samples calculated by the one-sample t-test (EPA, 2006; PNNL, 2007) was less than 3. The minimum number of samples required to calculate statistics is 3.

Table B.1-2
Input Values and Determined Minimum Number of Samples for Sample Plot TLDs
(Page 1 of 2)

Release	TLD Location (Plot)	Standard Deviation (OU Scenario)	TLD Samples Collected	Minimum Sample Size
San Juan, Otero, Pascal-C	A01	0.0	3	3
	A02	0.0	3	3
	A03	0.1	3	3
	A04	0.7	3	3
	A05	0.2	3	3
	A06	0.1	3	3
	A07	0.1	3	3
	A15	0.1	12	3
Bernalillo	A24	0.1	3	3
Pascal-B	A29	0.1	12	3
	A30	0.0	3	3
	A23	0.1	3	3
	A32	0.1	3	3

Table B.1-2
Input Values and Determined Minimum Number of Samples for Sample Plot TLDs
(Page 2 of 2)

Release	TLD Location (Plot)	Standard Deviation (OU Scenario)	TLD Samples Collected	Minimum Sample Size
Pascal-A	A16	0.1	3	3
	A17	0.1	3	3
	A18	0.1	3	3
	A19	0.1	3	3
	A20	0.0	3	3
	A21	0.1	3	3
	A22	0.1	3	3
Valencia	A28	0.1	3	3
Wolverine	A31	0.1	12	3
Chavez	A08	0.0	3	3
	A09	0.1	3	3
	A10	0.1	3	3
	A11	0.1	3	3
	A12	0.1	3	3
	A13	0.1	3	3
	A14	0.1	3	3
Boomer	A26	0.0	12	3

Note: The actual required minimum number of samples calculated by the one-sample t-test (EPA, 2006; PNNL, 2007) was less than 3. The minimum number of samples required to calculate statistics is 3.

CAIP. This provides assurance that the analyses conducted for each sample has the capability of identifying any COPC present in the sample.

All samples were analyzed using the analytical methods listed in Table A.2-4 of the CAIP and for the chemical and radiological parameters listed in Section 3.2 of the CAIP (NNSA/NFO, 2014a) with the following exceptions:

In addition to the PCBs, SVOCs, and VOCs analyses, a sample collected from the surface soil at the stained transformer soil (Location C01) was also analyzed for RCRA metals, TPH-DRO, TPH-GRO, and gamma spectroscopy analysis for waste management purposes, in the event that the stained soil were removed from the site.

Because of the overlapping test releases within CAU 568, all samples associated with test releases submitted for radiological analyses were analyzed for gamma spectroscopy, and for isotopic U, Pu, and Am.

Instead of only one sample with the highest alpha FSR being analyzed for Pu-241 from each plutonium dispersal site, all samples submitted for a full radiological suite were also submitted for Pu-241 analysis.

Instead of only one sample from the expected location of the highest Cs-137 result being analyzed for Sr-90, nine samples were selected for Sr-90 analysis. Those samples were also analyzed for Tc-99.

Sample results were assessed against the acceptance criterion for the DQI of sensitivity as defined in the Soils QAP (NNSA/NSO, 2012). The sensitivity acceptance criterion is that analytical detection limits will be less than the corresponding FAL (NNSA/NFO, 2014a). For radionuclides, the criterion is that all detection limits are less than their corresponding Occasional Use Area internal dose RRMGs. All of the radiological analyses met this criterion, and no data were rejected due to sensitivity. This criterion was not achieved for the chemical analytes listed in Table B.1-3. Results not meeting the sensitivity acceptance criterion will not be used in making DQO decisions and will, therefore, be considered as rejected data. The impact on DQO decisions is addressed in the assessment of completeness.

Table B.1-3
Sensitivity Measurements

Parameter	Sample	Analyses	MDC (mg/kg)	Action Level (mg/kg)
Hexachlorobenzene	AA6D001	SVOCs	1.4	1.1
n-Nitroso di-n-propylamine	AA6D001	SVOCs	1.4	0.25
Pentachlorophenol	AA6D001	SVOCs	2.7	2.7
1,2-Dibromo-3-chloropropane	AA6D001	SVOCs	0.15	0.069

The parameters in Table B.1-3 failed the sensitivity criterion in one sample because the method detection limits exceeded the PAL. The sample that failed the sensitivity criterion contained soil stained with oil from the transformer, so the laboratory used reduced aliquots to avoid interferences and instrument contamination.

Criterion 3 (Confidence that Dataset is of Sufficient Quality and Complete)

To satisfy the third criterion, the dataset was assessed against the acceptance criteria for the DQIs of precision, accuracy, representativeness, comparability, and completeness, as defined in the Soils QAP (NNSA/NSO, 2012). The individual DQI results are presented in the following subsections.

Precision

Precision was evaluated as described in Section 4.2 of the Soils QAP (NNSA/NSO, 2012). Table B.1-4 provides the results for all constituents that were qualified for precision. The Soils QAP precision rate of 80 percent was met for all constituents.

Table B.1-4
Precision Measurements

Constituent	Analyses	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Am-243	Americium	4	142	97

Accuracy

Accuracy was evaluated as described in Section 4.2 of the Soils QAP (NNSA/NSO, 2012). No results qualified for accuracy exceeded one-half the FAL. Therefore, the criterion of 80 percent for accuracy was met for all contaminants. Table B.1-5 provides the results for all constituents that were qualified for accuracy.

Representativeness

The DQO process as identified in Appendix A of the CAIP (NNSA/NFO, 2014a) was used to address sampling and analytical requirements for CAU 568. During this process, appropriate locations were selected that enabled the samples collected to be representative of the population parameters identified in the DQO (the most likely locations to contain contamination [judgmental sampling] or

Table B.1-5
Accuracy Measurements

Constituent	Analyses	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Barium	Metals	1	14	92.9
Cadmium		3	14	78.6
Lead		1	14	92.9
Mercury		1	14	92.9
1,2,4-Trimethylbenzene	VOCs	1	4	75
1,3,5-Trimethylbenzene		1	4	75
4-Isopropyltoluene		1	4	75
Ethylbenzene		1	4	75
Isopropylbenzene		1	4	75
N-Propylbenzene		1	4	75
Sec-Butylbenzene		1	4	75
Total Xylenes		1	4	75
Trichloroethene		1	4	75

that represent contamination of the sample plot [probabilistic sampling] and locations that bound COCs) (Section A.2.1). The sampling locations identified in the Criterion 1a discussion meet this criterion.

Special consideration is needed for americium and plutonium isotope concentrations related to representativeness. This is due to the nature of these contaminants in soil. These isotopes may be present in soil in the form of small particles that may or may not be captured in a small soil sample of 1 to 2 g. As individual particles of these radionuclides can make a significant impact on analytical results, small soil samples taken from the same site can produce analytical results that are very different (i.e., poor accuracy). However, the americium and plutonium isotopes are co-located (e.g., Am-241 is a daughter product of Pu-241), and the relative concentrations between different samples from the same site (i.e., the ratio of americium to plutonium isotope concentrations) should be equal. Based on process knowledge and demonstrated by analytical results from previously sampled Soils sites, the ratios between americium and plutonium isotopes in soil contamination from any given source is expected to be the same throughout the contaminant plume at any given time. Therefore, if the ratios are known and one of these isotopic concentrations is known, the concentrations of the other isotopes can be estimated.

Am-241 is reported by the gamma spectrometry method as well as the isotopic americium method. As the gamma spectrometry measurement is based on a much larger soil sample (usually 1 liter), the particle distribution problem discussed above is greatly diminished and the probability of the result being representative of the sampled site is much improved. Therefore, the ratios between the americium and plutonium isotopes were established using the isotopic analytical results and these ratios were used to infer concentrations of plutonium isotopes using the gamma spectrometry results for Am-241. These inferred plutonium values are more representative of the sampled area than the isotopic results.

Based on the methodical selection of sample locations and the use of americium and plutonium concentrations that are more representative of the sampled area, the analytical data acquired during the CAU 568 CAI are considered to adequately represent contaminant concentrations of the sampled population.

Comparability

Field sampling, as described in the CAIP (NNSA/NFO, 2014a) was performed and documented in accordance with approved procedures that are comparable to standard industry practices. Approved analytical methods and procedures per DOE were used to analyze, report, and validate the data. These are comparable to other methods used not only in industry and government practices, but most importantly are comparable to other investigations conducted for the NNSS. Therefore, CAU 568 datasets are considered comparable to other datasets generated using these same standardized DOE procedures, thereby meeting DQO requirements.

Also, standard, approved field and analytical methods ensured that data were appropriate for comparison to the investigation action levels specified in the CAIP.

Completeness

The CAIP (NNSA/NFO, 2014a) defines acceptable criteria for completeness to be that the dataset is sufficiently complete to be able to make the DQO decisions. This is initially evaluated as 80 percent of release-specific analytes identified in the CAIP having valid results. Rejected data (either qualified as rejected or data that failed the criterion of sensitivity) are not used in the resolution of DQO decisions and are not counted toward meeting the completeness acceptance criterion. Table B.1-3 provides the failed sensitivity data for the site.

The completeness criteria was not met for Sample D001 collected from the stained soil at the transformer location. Matrix interference associated with high levels of oil in this sample resulted in the rejection of results for bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, and di-n-octyl phthalate. Although usable data for these parameters could not be obtained, these are not considered to be constituents of petroleum products, as discussed in Appendix F of the Soils RBCA document (NNSA/NFO, 2014b), and are not believed to be COPCs in the stained soil beneath the transformer. Therefore, the information needed to resolve DQO decisions for CAU 568 COPCs is considered to be complete.

B.1.1.1.2 DQO Provisions To Limit False-Positive Decision Error

The false-positive decision error was controlled by assessing the potential for false-positive analytical results. QA/QC samples such as method blanks were used to determine whether a false-positive analytical result may have occurred. This provision is evaluated during the data validation process and appropriate qualifications are applied to the data when applicable. There were no data qualifications that would indicate a potential false-positive analytical result.

Proper decontamination of sampling equipment also minimized the potential for cross contamination that could lead to a false-positive analytical result.

B.1.1.2 Decision II

Decision II as presented in the CAIP (NNSA/NFO, 2014a) is as follows: "Is sufficient information available to evaluate potential CAAs?" Sufficient information is defined to include the following:

- The lateral and vertical extent of COC contamination
- The information needed to predict potential remediation waste types and volumes
- The information needed to evaluate the feasibility of remediation alternatives

A corrective action will be determined for any release containing a COC or assumed to contain a COC. The evaluation of the need for corrective action will include the potential for wastes that are present at the site to contain contaminants that, if released, could cause the surrounding environmental media to contain COCs.

An interim corrective action of removal was completed for PSM items (lead items, lead-acid batteries, and a transformer) that were identified during the CAI for Study Group 4. See Section 2.3 for remaining releases needing corrective action and the resolution of Decision II.

The information needed to resolve the lateral and vertical extent of COC contamination (i.e., potential waste volumes) for the these areas is resolved based on the defined areas (i.e., boundaries) as presented in Section 2.3, and the resulting volumes are listed in Table 4-1.

The information needed to predict potential remediation waste types was provided by the analytical results from soil samples. This determined that the potential waste type for the lead-contaminated soil was hazardous waste, and the potential waste type for the soil and debris piles, DCBs, and HCAs was at least LLW with the potential to contain MLLW.

The information needed to evaluate the feasibility of remediation alternatives was provided by the potential waste volumes and the potential waste types.

B.1.1.3 Sampling Design

The CAIP (NNSA/NFO, 2014a) stipulated that the following sampling processes would be implemented:

- Sampling of sample plots will be conducted by a combination of judgmental and probabilistic sampling approaches.

  Result. The location of the plots were selected judgmentally, and sample aliquots were collected within each plot probabilistically as described in Section A.2.0.

- Judgmental sampling will be conducted at locations of potential contamination identified during the CAI.

  Result. Judgmental sampling was conducted within the windrows, at the drainage, and at grab sample locations for Study Group 3 as stipulated in the CAIP.

B.1.2 Conduct a Preliminary Data Review

A preliminary data review was conducted by reviewing QA reports and inspecting the data. The contract analytical laboratories generate a QA nonconformance report when data quality does not meet contractual requirements. All data received from the analytical laboratories met contractual requirements, and a QA nonconformance report was not generated. Data were validated and verified to ensure that the measurement systems performed in accordance with the criteria specified in the Soils QAP (NNSA/NSO, 2012). The validated dataset quality was found to be satisfactory.

B.1.3 Select the Test and Identify Key Assumptions

The test for making DQO decisions for radiological contamination was the comparison of the TED to the FAL of 25 mrem/OU-yr. For other types of contamination, the test for making DQO decisions was the comparison of the maximum analyte result from each release to the corresponding FAL. All radiological FALs were based on an exposure duration to a site worker using the Occasional Use Area exposure scenario. All chemical FALs, except for lead, were based on an exposure duration to a site worker using the Industrial Area exposure scenario. The FAL for lead was based on an exposure duration to a site worker using the Remote Work Area exposure scenario.

The key assumptions that could impact a DQO decision are listed in Table B.1-6.

Table B.1-6
Key Assumptions

Exposure Scenario	Occasional Use Area
Affected Media	Surface, shallow, and subsurface soil; drainage sediments
Location of Contamination/Release Points	Surface and shallow subsurface soil; drainage sediments
Transport Mechanisms	Percolation of precipitation through subsurface media serves as the major driving force for migration of contaminants. Surface water runoff may provide for the transportation of some contaminants within or outside the footprints of the study groups (i.e., drainages).
Preferential Pathways	Vertical transport is expected to dominate over lateral transport due to small surface gradients. However, the CASs are located on Yucca Flat, so there is some potential for lateral transport.
Lateral and Vertical Extent of Contamination	Contamination, if present, is expected to be contiguous to the release points. Concentrations are expected to decrease with distance and depth from the source. Lateral and vertical extent of contamination exceeding FALs is assumed to be within the spatial boundaries.
Groundwater Impacts	None
Future Land Use	Nuclear and High Explosive Test Zone
Other DQO Assumptions	Subsurface contamination may be present within the soil and debris piles, HCA soil pile, former windrow area, drainage, and the SE DCBs. Surface contamination is present within the area due to the extensive testing conducted. The CSM includes the potential for contamination associated with areas outside the HCAs, drainage, and PSM. The DQIs were satisfactorily met as discussed in Section B.1.1.1.1. The data collected during the CAI are considered to support the CSM and the DQO decision; therefore, no revisions to the CSM were necessary.

B.1.4 Verify the Assumptions

The results of the investigation support the key assumptions identified in the CAU 568 DQOs and Table B.1-6. All data collected during the CAI supported the CSM, and no revisions to the CSM were necessary.

B.1.4.1 Other DQO Commitments

The CAIP (NNSA/NFO, 2014a) made the following commitments:

1. ***Study Group 1, Releases within a Defined Radiological Survey Signature***

   Decision I will be evaluated by calculating TED in sample plots established within each release in Study Group 1. These sample plots will be established at the locations of highest results from the TRSs.

   Result: Decision I was resolved by placing TLDs and collecting environmental samples in sample plots collected at the locations of the highest radiation survey readings as required in the CAIP.

   For determination of buried contamination within the former windrow area, Decision I will be evaluated by investigating the two plots within the San Juan/Otero Plume for subsurface contamination.

   Result: Decision I was resolved by collecting environmental samples in the two sample plots as required in the CAIP.

2. ***Study Group 2, Releases Located within a Crater or Potential Crater Area That Cannot Be Entered***

   Decision I will be evaluated by conducting TRSs around each crater area fence line. If radioactivity above background is identified, it will be sampled in accordance with Study Group 1.

   Result: Decision I was resolved by placing TLDs and collecting environmental samples in one sample plot (Boomer) as required in the CAIP.

3. ***Study Group 3, Releases with No Radiological Survey Signature***

   Decision I will be evaluated by calculating TED from grab samples collected at each release. The locations will be selected based on the location of the highest radiological survey value or the nearest feasible location to GZ.

   Result: Decision I was resolved by placing TLDs and collecting environmental samples at sample locations as required in the CAIP, with the exception of Funnel. Unlike Shrew, Mink, and Chipmunk, which had some biasing factors based on potential influence of contamination from test releases in close proximity, Funnel had no biasing factors, and TRS results were at background levels. Therefore, no confirmatory sample was collected. Based on the results from other similar test releases in this study group, no COCs were detected, and it is assumed that Funnel has similar COPC concentrations.

4. ***Study Group 4, Spills and Debris***

Determine whether a potential release is present based on biasing factors such as elevated radiological readings, PSM, or stains.

Result. PSM were evaluated. Analyses and sample method (plot vs. grab) was determined based on the type of potential release. It was determined that one broken battery location contained COCs; PSM in the form of lead shot is present at the site; and it is assumed that PSM may be present within the soil and debris piles. Therefore, COCs above the FAL remain. Decision I was resolved as required by the CAIP.

5. ***Study Group 5, Drainages***

Decision I will be evaluated by calculating TED from samples collected in sediment accumulation areas present within the drainage.

Result: Decision I was resolved by placing TLDs and collecting environmental samples at two sample locations as required in the CAIP.

B.1.5 Draw Conclusions from the Data

This section resolves the two DQO decisions for each of the CAU 568 study groups.

B.1.5.1 Decision Rules for Both Decision I and II

Decision rule. If COC contamination is inconsistent with the CSM or extends beyond the spatial boundaries identified in Section A.5.2 of the CAIP (NNSA/NFO, 2014a), then work will be suspended and the investigation strategy will be reconsidered, else the decision will be to continue sampling.

- **Result.** The COC contamination was found to be consistent with the CSM and did not extend beyond the spatial boundaries.

B.1.5.2 Decision Rules for Decision I

Decision rule. If the population parameter of any COPC in the Decision I population of interest exceeds the corresponding FAL, then Decision II will be resolved and a corrective action will be determined, else no further action will be necessary for that COPC in that population.

- **Result.** COCs were found to be present within the soil at a lead battery location. COCs were also assumed to be present within the Boomer are, established DCBs, and HCAs. Therefore, corrective action and the resolution of Decision II is required.

Decision rule. If a waste is present that, if released, has the potential to cause future soil contamination at levels exceeding a FAL, then a corrective action will be determined, else no further action will be necessary.

- **Result.** Lead shot and other lead items were identified as PSM. An interim corrective action of PSM removal was completed for all visible lead items, except the lead shot. After the interim corrective action was completed, only lead shot PSM is present at CAU 568. Therefore, corrective actions and the resolution of Decision II are required based on the presence of PSM.

B.1.5.3 Decision Rules for Decision II

Decision rule. If the spatial extent of any COC has not been defined, then additional samples will be collected, else no further investigation will be necessary. If sufficient information is not available to determine potential remediation waste types and evaluate the feasibility of remediation alternatives, additional waste characterization samples will be collected, else no further investigation will be necessary.

- **Result.** Decision II was resolved for the lead shot area, lead battery soil, Boomer crater area, areas meeting HCA criteria, and DCBs. This was accomplished based on the defined areas (i.e., boundaries) and depth assumptions as presented in Sections A.3.4, A.4.4, A.5.4, and A.6.4; and based on the potential waste types described in Section 2.3 of the CAIP (NNSA/NFO, 2014a). Therefore, no additional information is needed to complete the Decision II evaluation.

B.2.0 References

EPA, see U.S. Environmental Protection Agency.

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

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Appendix C

Cost Estimates

C.1.0 Cost Estimates

Attachment C-1 contains the Cost Estimate Proposal Data Sheets for the corrective actions of clean closure and closure in place with administrative controls for the CAU 568 CASs.

Attachment C-1

Cost Estimate Proposal Data Sheets

(2 Pages)

Clean Closure and Closure in Place Estimates for CAU 568

The cost estimates for clean closure and closure in place for the releases requiring corrective action in CAU 568 are provided in the following table:

Release	CAS	Clean Closure Actions	Clean Closure ROM*	Closure in Place Actions	Closure in Place ROM*
Otero Safety Experiment DCB	03-23-20	Consists of excavating soil and debris (e.g., steel casings, concrete pads) to a depth of 25 ft bgs. The remaining emplacement hole casings would be filled, and the excavation would be backfilled with clean fill to ground surface.	$8,000,000 (based rough estimate of TRU waste disposal costs)	Consists of performing engineering controls to cover the surface contamination at each release location and establishing FFACO URs	$1,500,000
San Juan Safety Experiment DCB, Pascal-C Safety Experiment DCB	03-23-23				
Pascal-B Safety Experiment DCB, Luna Safety Experiment DCB, Colfax Safety Experiment DCB	03-23-31				
Pascal-A Safety Experiment DCB	03-23-32				
Valencia Safety Experiment DCB	03-23-33				
Chipmunk Safety Experiment DCB	03-23-34				
Boomer Weapons-Related Test	03-45-01				
Otero Well Head Cover	03-23-20	Consists of removing, packaging, and disposing of each well head cover	$200,000	Consists of establishing FFACO URs at each release location	$53,000
San Juan Well Head Cover	03-23-23				
Luna Well Head Cover	03-23-31				
Valencia Well Head Cover	03-23-33				
Pascal-B HCA	03-23-31	Consists of removing and disposing of contaminated surface soil to below FALs to a depth of 1 ft bgs	$350,000	Consists of establishing an FFACO UR at the release location	$64,000
Chavez HCA	03-23-19	Consists of removing and disposing of contaminated surface soil to below FALs to a depth of 1 ft bgs	$1,300,000	Consists of establishing an FFACO UR at the release location	$80,000

Release	CAS	Clean Closure Actions	Clean Closure ROM*	Closure in Place Actions	Closure in Place ROM*
3 Soil and Debris Piles	03-08-04	Consists of removing and disposing of the physical piles. Any PSM present within the piles would be segregated and disposed of appropriately. Verification samples would be collected after removal of the piles	$475,000	Consists of establishing FFACO URs at each release location	$45,000
HCA Soil Pile	03-23-30	Consists of removing and disposing of the physical pile. Any PSM present within the pile would be segregated and disposed of appropriately.	$118,000	Consists of establishing an FFACO UR at the release location	$45,000
Lead Shot Area	03-26-04	Consists of removing and disposing of lead PSM and soil to a depth of approximately 3 to 6 in. bgs. Verification samples would be collected after soil and PSM removal.	$160,000	Consists of establishing an FFACO UR at the release location	$45,000
Lead-Acid Battery Soil	03-26-04	Consists of removing and disposing of lead PSM and soil to a depth of approximately 3 to 6 in. bgs. Verification samples would be collected after soil and PSM removal.	$90,000	Consists of establishing an FFACO UR at the release location	$45,000

*ROM = Rough order of magnitude

ROM estimates are developed before the scope is fully defined. A ROM estimate will have an accuracy of about plus or minus 50 percent. These estimates are based on the NSTec Project Management system, which includes the estimating process, and is based on the principles of the Earned Value Management System as outlined in American National Standards Institute/Electronic Institute of America Standard ANSI/EIA-748-C, "Earned Value Management Systems," and in "A Guide to the Project Management Body of Knowledge," published by the Project Management Institute.

Refer to Section 3.4 for additional information on clean closure and closure in place alternatives.

Appendix D

Evaluation of Risk

D.1.0 Risk Assessment

The RBCA process used to establish FALs is described in the Soils RBCA document (NNSA/NFO, 2014b). This process conforms with NAC Section 445A.227, which lists the requirements for sites with soil contamination (NAC, 2014a). For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2014b) requires the use of ASTM Method E1739 (ASTM, 1995) to "conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary." For the evaluation of corrective actions, the FALs are established as the necessary remedial standard.

The ASTM Method E1739, "Standard Guide for Risk-Based Action Applied at Petroleum Release Sites," defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses:

- **Tier 1 evaluation.** Sample results from source areas (highest concentrations) are compared to Tier 1 action levels based on generic (non-site-specific) conditions (i.e., the PALs established in the CAU 568 CAIP [NNSA/NFO, 2014a]). The FALs may then be established as the Tier 1 action levels, or the FALs may be calculated using a Tier 2 evaluation.

- **Tier 2 evaluation.** Conducted by calculating Tier 2 action levels using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 action levels are then compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis.

- **Tier 3 evaluation.** Conducted by calculating Tier 3 action levels on the basis of more sophisticated risk analyses using methodologies described in Method E1739 that consider site-, pathway-, and receptor-specific parameters.

The RBCA decision process stipulated in the Soils RBCA document (NNSA/NFO, 2014b) is summarized in Figure D.1-1.

It is assumed that contamination exceeding the FAL is present and requires corrective action at the following locations:

- Subsurface contamination in nine SE emplacement holes (DCBs)
- Chavez HCA (DCB)
- Pascal-B HCA
- HCA Soil Pile (DCB)

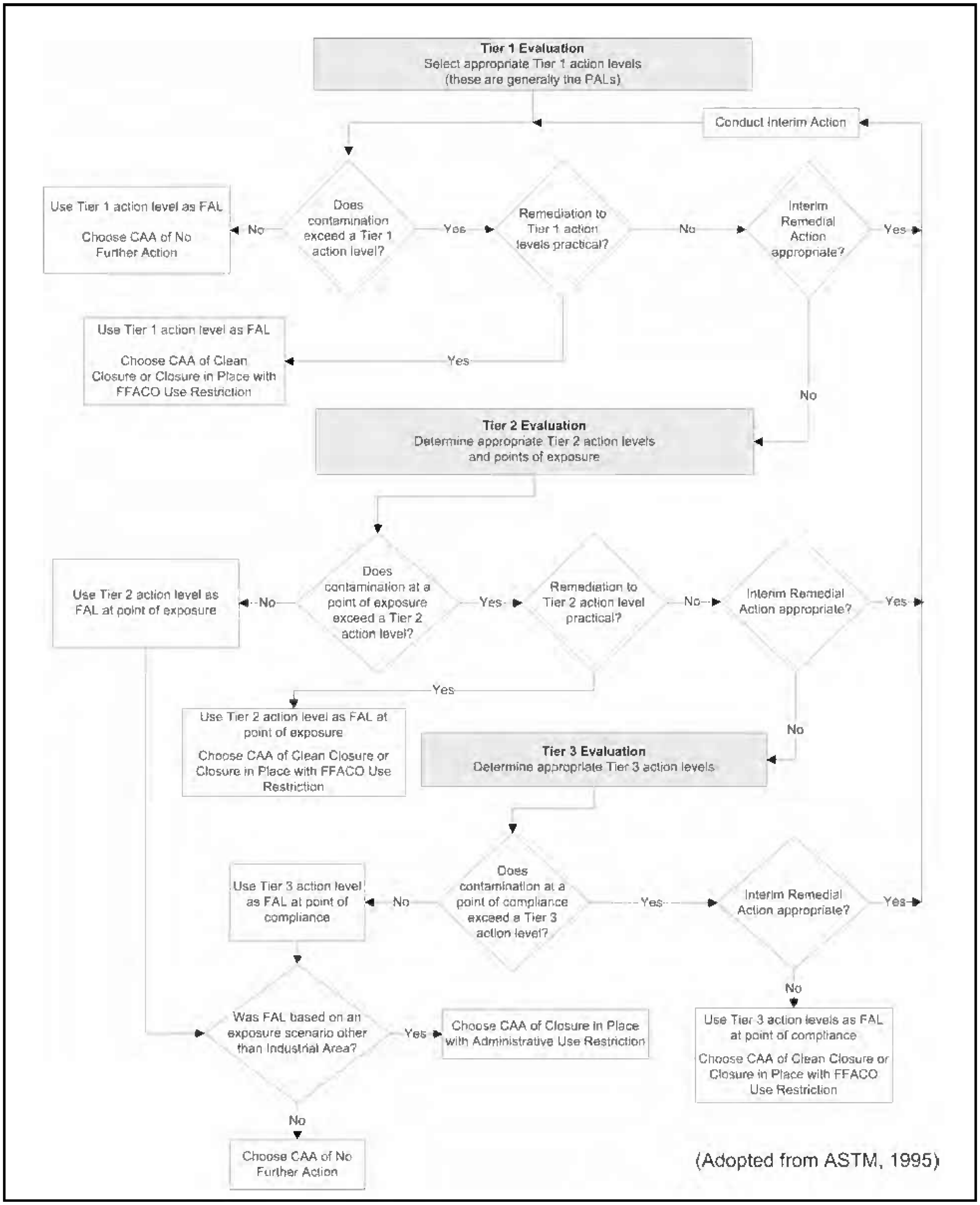

Figure D.1-1
RBCA Decision Process

- San Juan HCA (DCB) (well head cover)
- Luna HCA (well head cover)
- Valencia HCA (well head cover)
- Boomer crater area

The following PSM are assumed to contain sufficient quantities of hazardous chemicals to cause the underlying soil to exceed a FAL when the PSM is eventually released to the soil:

- Five lead-acid batteries
- 15 lead bricks
- Two lead sheets
- 28 lead plates
- One transformer
- Lead shot area
- Potential PSM within the soil and debris piles

The contamination associated with these releases is assumed to exceed FALs and require corrective action. Therefore, the need for corrective action will not be included in this risk evaluation. However, it will be included in the evaluation of corrective actions.

The transformer, lead bricks, lead sheets, lead plates, and lead-acid batteries were removed under an interim corrective action during the CAI. These will also not be considered in the evaluation of risk because this risk evaluation is intended for use in making corrective action decisions for CAU 568 conditions at the conclusion of the CAI (after the completion of any interim corrective actions).

D.1.1 Scenario

CAU 568, Area 3 Plutonium Dispersion Sites, comprises the following 14 CASs within Area 3 of the NNSS:

- 03-08-04, Soil and Debris Piles
- 03-23-17, S-3I Contamination Area
- 03-23-19, T-3U Contamination Area
- 03-23-20, Otero Contamination Area
- 03-23-22, Platypus Contamination Area
- 03-23-23, San Juan Contamination Area
- 03-23-26, Shrew/Wolverine Contamination Area
- 03-23-30, HCA Soil Pile
- 03-23-31, U-3d Contamination Area
- 03-23-32, U-3j Test Release

- 03-23-33, U-3r Contamination Area
- 03-23-34, U-3ay Contamination Area
- 03-26-04, Test-Related Debris
- 03-45-01, Test Surface Releases

CASs 03-23-17 and 03-23-19 consist of a surface release of radionuclides, primarily plutonium, from the Chavez tower SE, detonated atop a tower at a height of 52 ft (NNSA/NFO, 2015).

CASs 03-23-20, 03-23-23, 03-23-31, 03-23-32, and 03-23-33 consist of the surface releases of radionuclides, primarily plutonium, from the San Juan, Otero, Pascal-A, Pascal-B, Pascal-C, Luna, Colfax, and Valencia shaft SEs. These nine experiments were conducted in unstemmed holes in depths ranging from 234 to 500 ft bgs (NNSA/NFO, 2015). DCBs were established for the subsurface contamination assumed to be present above FALs within the emplacement holes. Included in CAS 03-23-23 is the location of former windrows, which were created from blading of surface radiological contamination in the area.

CAS 03-23-34 consists of the surface releases of radionuclides from the Chipmunk shaft SE, Mink weapons-related shaft test, and Funnel weapons-related shaft test. The tests were conducted at depths ranging from 195 to 630 ft bgs (NNSA/NFO, 2015). A DCB was established for the subsurface contamination assumed to be present above FALs within the Chipmunk emplacement hole.

CASs 03-23-22 and 03-23-26 consist of the surface releases of radionuclides from the Platypus, Shrew, and Wolverine weapons-related shaft tests, conducted at depths between 190 and 322 ft bgs (NNSA/NFO, 2015).

CAS 03-23-30 consists of a pile of soil and minimal metallic debris that contains removable contamination meeting HCA conditions. The origin of the pile is unknown; however, it appears to have been dumped at its current location and is believed to be associated with testing in the area.

CAS 03-08-04 consists of three piles of soil and testing-related debris that appear to have been dumped in their current locations. The origins of the piles are unknown; however, they are believed to be associated with testing in the area.

CAS 03-26-04 consists of lead items (lead plates, lead shot, lead bricks, lead sheets, lead-acid batteries) and a transformer, located within the scope of CAU 568. These items are believed to be associated with the testing in the area.

CAS 03-45-01 consists of the surface releases from the Cognac, Chinchilla, Chinchilla II, Stoat, Armadillo, Haymaker, Solendon, Boomer, and Tuna weapons-related shaft tests; and the Tendrac joint US/UK shaft test. The tests were conducted at depths ranging from 330 to 1,359 ft bgs (NNSA/NFO,2015).

D.1.2 Site Assessment

CAU 568 consists of the area affected by the surface releases of radioactivity associated with 25 shaft nuclear tests and one atmospheric nuclear test. Subsidence craters and potential crater areas are present at many of these test GZs. Scattered testing related debris is present throughout the area. Removable contamination meeting HCA conditions was identified on the well head covers near the San Juan, Luna, and Valencia GZs; within the HCA soil pile; and within the Pascal-B HCA. Staged TLDs and soil samples collected at various locations within this CAU were used to calculate TED to workers. See Section A.3.3.3 for details on the calculation of the TED. No TEDs from surface soil plots or grab samples exceeded the Occasional Use Area scenario based FAL established in this appendix (25 mrem/OU-yr). This scenario was conservatively used as it is more protective than the actual current and projected site use. The maximum calculated TED (based on the Occasional Use Area scenario) was 18.9 mrem/yr. However, it was shown that if site use were to change in the future to a continuous industrial work site, an industrial worker could potentially receive a TED in excess of 25 mrem/yr. The maximum calculated TED (based on the Industrial Area scenario) was 332.1 mrem/yr. Although the TED from soil samples did not exceed the FAL, subsurface contamination in the SE DCBs and contamination within the HCAs is assumed to exceed FALs.

Soil samples were also collected to determine the presence of chemical COCs. A soil sample collected from former lead-acid battery Location C17 exceeded the FAL for lead. PSM in the form of lead shot was identified at Location C19 (and was not removed from the site during the CAI). PSM in the form of lead items was identified on the surface of the three soil and debris piles within CAU 568. This visible PSM was removed from the piles. However, there is the potential for additional PSM to be present within the piles.

D.1.3 Site Classification and Initial Response Action

The four major site classifications listed in Table 3 of the ASTM Standard are (1) immediate threat to human health, safety, and the environment; (2) short-term (0 to 2 years) threat to human health, safety, and the environment; (3) long-term (greater than 2 years) threat to human health, safety, or the environment; and (4) no demonstrated long-term threats.

Based on the CAI and the completion of interim corrective actions, contamination is present within the DCBs, HCAs, soil and debris piles, and lead-acid battery soil that could pose a threat to human health, safety, and/or the environment. PSM is also present in the form of lead shot. Therefore, CAU 568 has been determined to be a Classification 2 site as defined by ASTM Method E1739 (ASTM, 1995).

D.1.4 Development of Tier 1 Action Level Lookup Table

Tier 1 action levels are defined as the PALs listed in the CAIP (NNSA/NFO, 2014a) as established during the DQO process. The PALs represent a very conservative estimate of risk, are preliminary in nature, and are generally used for site screening purposes. Although the PALs are not intended to be used as FALs, FALs may be defined as the Tier 1 action level (i.e., PAL) value if implementing a corrective action based on the Tier 1 action level is appropriate.

The PALs are based on the Industrial Area exposure scenario, which assumes that a full-time industrial worker is present at a particular location for his or her entire career (8 hr/day and 250 day/yr for a duration of 25 years). The 25-mrem/yr dose-based Tier 1 action level for radiological contaminants is determined by calculating the dose a site worker would receive if exposed to the site contaminants over an annual exposure period of 2,000 hours.

The Tier 1 action levels for chemical contaminants are the following PALs as defined in the CAIP:

- EPA Region 9 RSLs (EPA, 2015).
- Background concentrations for RCRA metals were evaluated when natural background exceeds the PAL, as is often the case with arsenic. Background is considered the mean plus two times the SD of the mean based on data published in Mineral and Energy Resource Assessment of the Nellis Air Force Range (NBMG, 1998; Moore, 1999).

- For COPCs without established RSLs, a protocol similar to EPA Region 9 was used to establish an action level; otherwise, an established value from another source may be chosen.

Although the PALs are based on an industrial scenario, no industrial activities are conducted at this site, and there are no assigned work stations in the surrounding area. Therefore, the use of an industrial scenario is overly conservative and is not representative of current land use.

D.1.5 Exposure Pathway Evaluation

For all releases, the DQOs stated that site workers could be exposed to COCs through oral ingestion, inhalation, or dermal contact (absorption) of soil or debris due to inadvertent disturbance of these materials or irradiation by radioactive materials. The potential exposure pathways would be through worker contact with the contaminated soil or various debris currently present at the site. The limited migration demonstrated by the analytical results, elapsed time since the releases, and depth to groundwater support the selection and evaluation of only surface and shallow subsurface contact as the complete exposure pathways. Ingestion of groundwater is not considered to be a significant exposure pathway.

D.1.6 Comparison of Site Conditions with Tier 1 Action Levels

An exposure time based on the Industrial Area scenario (2,000 hr/yr) was used to calculate the Tier 1 action levels (i.e., PALs). For radiological contaminants, dose values were calculated for comparison to the Tier 1 action level based on an exposure time of 2,000 hr/yr. Individual chemical analytical results were directly compared to chemical PALs.

All sampled locations at each CAU 568 release that exceed the radiological PAL are listed in Table D.1-1. Lead was also detected at sample locations that exceeded the Tier 1 action level. Based on the unrealistic but conservative assumption that a site worker would be exposed to the maximum dose calculated at any sampled location, this site worker would receive a 25-millirem dose at each of these release locations in the exposure times listed in Table D.1-2.

Table D.1-1
Locations Where TED Exceeds the Tier 1 Action Level at CAU 568 (mrem/IA-yr)

Release	Plot	Average TED	95% UCL TED
San Juan, Otero, Pascal-C	A03	22.7	**26.3**
	A04	**145.1**	**215.0**
	A05	**27.1**	**41.0**
Valencia	A28	15.2	**46.3**
Platypus	A25a	**51.5**	**53.7**
Chavez	A33	**239.9**	**260.5**
	A34	**305.5**	**332.1**
HCA Soil Pile	C12	**143.5**	**168.1**
	A27	16.0	**25.1**

Bold indicates the values exceeding 25 mrem/yr.

Table D.1-2
Minimum Exposure Time to Receive a 25-mrem/yr Dose

Release	Location of Maximum Dose	Maximum 95% UCL TED (mrem/OU-yr)	Minimum Exposure Time (hours)
San Juan, Otero, Pascal-C	A04	12.1	246
Valencia	A28	2.7	2,193
Platypus	A25a	3.2	646
Chavez	A34	18.9	114
HCA Soil Pile	C12	9.4	245

D.1.7 Evaluation of Tier 1 Results

Because the release sites listed in Section D.1.6 exceeded the Tier 1 action level and the Tier 1 action levels are based on exposures (i.e., a full-time industrial worker) that are not representative of current or future use of these sites, NNSA/NFO determined that remediation to the Tier 1 action level is not appropriate. The risk to receptors from contaminants at CAU 568 is directly related to the amount of time a receptor is exposed to the contaminants. A review of the current and projected use at all sites in CAU 568 determined that workers may be present at these sites for a maximum of 10 hr/yr (see Section D.1.10). As it is not reasonable to assume that any worker would be present at this site for 2,000 hr/yr (DOE/NV, 1996), it was determined to conduct a Tier 2 evaluation.

D.1.8 Tier 1 Remedial Action Evaluation

No remedial actions are proposed based on Tier 1 action levels.

D.1.9 Tier 2 Evaluation

No additional data were needed to complete a Tier 2 evaluation.

D.1.10 Development of Tier 2 Action Levels

The Tier 2 action levels are typically compared to contaminant values that are representative of areas at which an individual or population may come in contact with a COC originating from a CAS. This concept is illustrated in the EPA's Human Health Evaluation Manual (EPA, 1989). This document states that "the area over which the activity is expected to occur should be considered when averaging the monitoring data for a hot spot. For example, averaging soil data over an area the size of a residential backyard (e.g., an eighth of an acre) may be most appropriate for evaluating residential soil pathways." When evaluating industrial receptors, the area over which an industrial worker is exposed may be much larger than for residential receptors. For a site that is limited to industrial uses, the receptor would be a site worker, and patterns of employee activity would be used to estimate the area over which the receptor is exposed. This can be very complicated to calculate, as industrial workers may perform routine activities at many locations where only a portion of these locations may be contaminated. A more practical measure of integrated risk to radiological dose for an industrial worker is to calculate the portion of total work time that the worker is in proximity to elevated contaminant levels.

For the development of radiological Tier 2 action levels, the annual dose limit for a site worker is 25 mrem/yr (the same as was used for the Tier 1 evaluation). The Tier 2 evaluation is based on a receptor exposure time that is more specific to actual site conditions. The maximum potential exposure time for the most exposed worker at any CAU 568 release was determined based on an evaluation of current and reasonable future activities that may be conducted at the site.

Activities on the NNSS are strictly controlled through a formal work control process. This process requires facility managers to authorize all work activities that take place on the land or at the facilities within their purview. As such, these facility managers are aware of all activities conducted at the site. The facility managers responsible for the area of CAU 568 identified the general types of work activities that are currently conducted at the site, to include fencing/posting inspection and maintenance workers. Site activities that may occur in the future were identified by assessing tasks related to maintenance of existing infrastructure and long-term stewardship of the site (e.g., inspection and maintenance of UR signs, trespasser). In order to estimate the amount of time a site worker might spend conducting current or future activities, the NNSA/NFO and/or M&O contractor departments responsible for these activities were consulted. Under the current and projected land use at each of the CAU 568 releases, the following workers were identified as being potentially exposed to site contamination:

- **Inspection and Maintenance Worker.** This includes workers sent to conduct the annual inspection of the UR areas. The URs require a periodic inspection to ensure that any required access controls are intact and legible. This may require two people to spend up to 10 hr/yr each at each UR.
- **Trespasser.** This includes workers or individuals who do not have a specific work assignment at one of the CASs. Although the sites will be posted with warning signs, trespassers could potentially inadvertently enter these CAS areas and come in contact with site contamination. This is assumed to be an infrequent occurrence (i.e., once per year) that would result in a potential exposure of less than a day (8 hours).

Under the current land use at each of the CAU 568 releases, the most exposed worker would be the Inspection and Maintenance Worker, who could be exposed to site contamination for up to 10 hr/yr. An unrealistic but worst-case assumption that this most exposed worker were to remain at the location of the maximum dose for the entire maximum estimated time spent at the site (10 hr/yr), this worker could receive a maximum potential dose at each location as listed in Table D.1-3.

In the CAU 568 DQOs, it was conservatively determined that the Occasional Use Area exposure scenario (as listed in Section 3.1.1 of the CAIP [NNSA/NFO, 2014a]) would be appropriate in calculating receptor exposure time based on current land use at all CAU 568 releases. This exposure scenario assumes exposure to site workers who are not assigned to the area as a regular work site but may occasionally use the site for intermittent or short-term activities. Site workers under this scenario

Table D.1-3
Maximum Potential Dose to Most Exposed Worker at CAU 568 Releases

Location of Maximum Dose	Most Exposed Worker	Exposure Time	Maximum Potential Dose
A04	Inspection and Maintenance Worker	10 hr/yr	1.5 mrem/yr
A28	Inspection and Maintenance Worker	10 hr/yr	0.3 mrem/yr
A25a	Inspection and Maintenance Worker	10 hr/yr	0.4 mrem/yr
A34	Inspection and Maintenance Worker	10 hr/yr	2.4 mrem/yr
C12	Inspection and Maintenance Worker	10 hr/yr	1.2 mrem/yr

are assumed to be on the site for an equivalent of 80 hr/yr. As the use of this scenario provides a more conservative (longer) exposure to site contaminants than the most exposed worker (based on current and projected future land use), the development and evaluation of Tier 2 action levels were based on the Occasional Use Area exposure scenario.

The EPA's risk assessment tool for lead (the Adult Lead Methodology [ALM]) was used to calculate a Tier 2 action level for lead. This methodology is recommended by EPA because a reference dose value for lead is not available. In the commercial/industrial setting, the most sensitive receptor is the fetus of a worker who has a non-residential exposure to lead. Based on the available scientific data, a fetus is more sensitive to the adverse effects of lead than an adult (National Academy of Sciences, 1993). The EPA assumes that cleanup levels that are protective of a fetus will also afford protection for male or female adult workers. This Tier 2 action level estimates the concentration of lead in the blood of pregnant women and developing fetuses who might be exposed to lead-contaminated soils (EPA, 2009). The methodology for using the ALM to establish action levels for lead in soil is described in the Soils RBCA document. This document lists all the input parameters to be used in the ALM, including the EPA-established lead concentration limits in fetal blood.

Although the Tier 2 action levels for other contaminants were developed using the Occasional Use Area exposure scenario, the Tier 2 action level for lead was developed using the Remote Work Area exposure scenario. The Remote Work Area exposure scenario was used to calculate the Tier 2 action level for lead because EPA states that the minimum frequency of exposure of 1 day per week is recommended for short-term exposures. The recommended full-time exposure frequency of 219 day/yr equates to approximately 44 weeks per year. At 1 day per week, this minimum exposure frequency of 44 day/yr is equivalent to the Remote Work Area exposure scenario.

Therefore, the Remote Work Area exposure scenario soil ingestion rate (0.067 g/day) and the exposure frequency of 44 day/yr were used to calculate a Tier 2 action level for lead of 5,739 mg/kg.

D.1.11 Comparison of Site Conditions with Tier 2 Action Levels

The TEDs calculated using the Occasional Use Area exposure scenario were then compared to the 25-mrem/OU-yr Tier 2 action level. As shown in Table D.1-4, none of the 95 percent UCL TED values exceeded the 25-mrem/OU-yr Tier 2 action level.

Table D.1-4
Occasional Use Area Scenario TED (mrem/OU-yr)

Release	Location	Average TED	95% UCL TED
San Juan, Otero, Pascal-C	A04	8.1	12.1
Valencia	A28	0.9	2.7
Platypus	A25a	3.1	3.2
Chavez	A34	17.6	18.9
HCA Soil Pile	C12	8.2	9.4

The lead concentration (6,600 mg/kg) at Location C17 exceeded the Tier 2 action level (800 mg/kg).

D.1.12 Tier 2 Remedial Action Evaluation

Based on the Tier 2 evaluation, soil contamination at CAU 568 only lead is present at levels that exceed Tier 2 action levels. As corrective actions are practical for these releases, the Tier 2 action level is established as the FAL, and corrective actions are proposed.

As the FALs for all contaminants that were passed on to a Tier 2 evaluation were established as the Tier 2 action levels, a Tier 3 evaluation is not necessary.

D.2.0 Summary

The Tier 2 action levels are typically compared to results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis. Points of exposure are defined as those locations or areas at which an individual or population may come in contact with a COC originating from a release. However, for CAU 568, the Tier 2 action levels were conservatively compared to the maximum contaminant concentration from single point locations.

Of the releases considered in this risk assessment (Section D.1.0) only radiological dose and lead exceed their respective PALs. FALs were established for all other contaminants at the PAL (Tier 1) concentrations. The FALs for radiological dose and lead were established at the Tier 2 levels of 25 mrem/OU-yr and 5,739 mg/kg, respectively.

The corrective actions for CAU 568 are based on the assumption that activities on the NNSS will be limited to those that are industrial in nature and that the NNSS will maintain controlled access (i.e., restrict public access and residential use). The FALs were based on an exposure time of 80 hr/yr of site worker exposure to CAs surface soils. if the land use at these sites changed to a more intensive use, a site worker could be potentially exposed to site contamination for longer exposure times and receive an unacceptable level of risk. Should the future land use of the NNSS change such that these assumptions no longer are valid, additional evaluation may be necessary.

D.3.0 References

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Attachment D-1

Waste Disposal Documentation

(16 Pages)

The Certificate of Disposal for LLW is pending and will be provided in an addendum.

NSTec
Form
FRM-0266

04/04/13
Rev. 05

ONSITE WASTE TRANSPORT MANIFEST

Manifest Document No.: | 1 | 5 | N | 4 | 2 |

Page 1 of 1

Generation/Out-of-Service Date: 04-23-2015

1. Generator's Name, Organization, and Location: (Please Print)
Mark Heser, Navarro

Generator's Phone: (702) 295-2124

2. Receiving Facility, Organization, Location: (Please Print)
RWMC
Area 5, Bldg 24

Contact Phone: (702) 295-6811

3a. Transporter Name: (Please Print)
/s/ Signature on File

Transport Date: 6/23/2015

3b. Vehicle I.D. Number: G82-0428D

	HM	4. U.S. D.O.T. Description. Include: EPA Waste Code and Package Tracking Numbers.	5. Containers No.	5. Containers Type	6. Total Quantity	7. Unit Wt./Vol. (P or K)
a	X	UN2913, Waste, Radioactive Material, Surface Contaminated Objects (SCO-II), 7, Pu-238, Pu-240, Pu-241, Am-241, Cs-137, Co-60, Sr-90, Eu-152, solid, oxide 1.09E+07 Bq, Fissile Excepted, Exclusive Use Shipment, D008, D011	1	CM	5150	P
b						
c						
d						
e						
f						
g						

Use continuation pages for additional items, as necessary.

8. Special Handling Instructions/Additional Information: 24-Hour emergency contact: 702-295-0311 / Secondary: Mike McKinnon 5-1406 (Name & phone no.)

D004, D005, D006, D007, D009, D010 HAZTRAK tracking # DPM15T02, Package # 15N002, ERG # 162

8a. This is to certify that the above named materials are properly classified, described, packaged, marked, labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

Robert Zinn /s/ Signature on File — Printed Name / Signature
Date: 6/23/2015

9. Released by: Robert H Zinn (Printed Name) — /s/ Signature on File (Signature) — Date: 6/23/2015

10. Received for Transport by: Rick Hendricks (Printed Name) — /s/ Signature on File (Signature) — Date: 6-23-2015

11. Discrepancy Indication:

12. Disposal/Accumulation Site Signature: *(Acknowledges acceptance of waste)*
Stephen E Wolf (Printed Name) — /s/ Signature on File (Signature) — Date: 06/23/15

NTS On-Site HazMat Transfer - Published

Tracking No: DPM15702
Carrier: NSTEC ON BEHALF OF NNSA
Vehicle: G8204280 GV
Driver: RICHARD HENDRICKS

Depart: 23-JUN-2015 Arrival: 23-JUN-2015

From: ROBERT ZION
NSTEC
BASE CAMP
3-02 & 3-03 INTERSECTION
MERCURY, NV 89023
Area: 03
Bldg: CAU-[illegible]
Phone: 702/295-[illegible]
Mobile: 702/533-[illegible]

To: CHRISTOPHER CHALUPKA
NSTEC
BASE CAMP
TRU PAD
MERCURY, NV 89023
Area: 05
Bldg: 024
Phone: 702-295-[illegible]
Mobile:

Entered By: THERESA HALE
Modified By: THERESA HALE

Date Entered: 11-JUN-2015
Date Modified: 22-JUN-2015

Shipped Material(s)	Package(s)	Unit(s)	Guide No.
UN2913, RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-II) NON FISSILE OR FISSILE-EXCEPTED, 7 WASTE RADIONUCLIDES:PU-239, PU-240, PU-241, AM-241, CS-137, CO-60, SR-90, EU-152 PHYSICAL FORM:SOLID CHEMICAL FORM:OXIDE PACKAGE ACTIVITY:1.08E+07 BQ CATEGORY:FISSILE EXCEPTED, EXCLUSIVE USE SHIPMENT, PACKAGE # [illegible]	1 BOX, METAL	5,150 POUND(S) (GROSS)	162

Emergency Response Number
702-295-0311 Contact / Contract / ID: NNSS DUTY MANAGER

Secondary Emergency Response Contact And/Or Comments
MICHAEL MCKINNON 295-1406, CELL 702/417-0537

In the event of an emergency on the Nevada National Security Site, immediately contact the Operations Command Center (OCC) Duty Manager at 702/295-0311 for assistance.

EMERGENCY RESPONSE

By Phone
702-295-0311

By Radio
"MAYDAY - MAYDAY - MAYDAY"

In the event of an incident involving Hazardous Material:

1. Gather HazMat shipping papers and NAER Guidebook
2. Isolate the immediate area
3. Assess the situation:
   a. Fire, Spill, or Leak?
   b. People, Property, or the Environment at risk?
4. Contact On-site Emergency Response Personnel
5. Reference On-Site HazMat Transfer Tracking Number

This is to certify that the above-named materials are properly classified, described, packaged, marked, placarded, and labeled and are in proper condition for transportation according to the applicable regulations of the U.S. Department of Transportation. As a signatory I certify that I have been trained and tested to the requirements of 49 CFR, Part 172-700 and is compliant with the NTS OTSD.

Authorized Signature: /s/ Signature on File Date: 6/23/2015 Time: ____________

Received by: /s/ Signature on File Date: 6/23/15 Time: ____________

CERTFICATE OF RECYCLE

ISSUED TO: Navarro-Interra, LLC
COMPANY ADDRESS: Mercury NV 89023

Toxco Inc. certifies that the lead material noted in Contract No.NI13B0001A was received at the Toxco Material Management Center (TMMC) and title was assumed and the material will be reused as lead shielding within and in support of government or commercial nuclear industrial application as required by the Department of Energy Material Suspension.

Recycle and Disposition of Contaminated Lead from Navarro-Interra, LLC (N-I) c/o U.S. DOE NNSA/NFO Received in Shipment A13611.

/s/ Signature on File

Rick L. Low, TOXCO Materials Management Center Vice President/RSO 9/17/13

TOXCO, INC.
109 Flint Rd.
Oak Ridge TN 37830

STRAIGHT BILL OF LADING - SHORT FORM - ORIGINAL - Not Negotiable   SHIPPERS NUMBER NI13BO001A   DATE: 09/09/2013

Shipper (from)

NAVARRO-INTERA C/O US DOE
23-310 MERCURY HWY
MERCURY NV 89023-
TECHNICAL CONTACT: MARK HESER (702) 496-0150
JOB/WORK ORDER: NI13BO001A Task Order Rls 01
ROUTE: AVOID LAS VEGAS VALLEY & HOOVER DAM

Consignee (to)

TOXCO MATERIAL MANAGEMENT CENTER (TMMC)
109 FLINT ROAD
OAK RIDGE TN 37830-
CONTACT NAME: RICK LOW (423) 920-0070
REFERENCE #: NI13BO001A TO Rls 01

NI13B0001A   *LRGR*

No. Shipping Units	Type of Package	HM	Description of Articles, Special Marks, and Exceptions (Subject to Correction)	NMFC Item No.	Class	Rate	Weight (Subject to correction)
7	DRUM	X	UN2910, RADIOACTIVE MATERIAL, EXCEPTED PACKAGE-LIMITED QUANTITY OF MATERIAL, 7, CS137, PU239, SOLID, OXIDE, .0135526 MBq; CATEGORY: EXCEPTED FROM MARKING AND LABELING (EXCEPT FOR UN2910 AND RADIOACTIVE); FISSILE EXCEPTED; EXCLUSIVE USE DOT EMERGENCY RESPONSE GUIDE #161 ATTACHED		50		2,620 lb
4	PALLET		DOT-NON REGULATED MATERIAL, METAL PALLETS OF LEAD FOR RECYCLE,		50		5,035 lb
11	<<<Total Pieces		IN THE EVENT OF EMERGENCY, TELEPHONE 702-496-0150 - 24 HRS Contact or Registrant Name, or Contract Number DE-AC52-09NA28091	In the event of damage or loss of the material described in this Bill of Lading while in the possession of the carrier, the carrier agrees to notify the shipper/consignor within two hours.			7,655 lb 3,473 kg

FREIGHT CHARGES ARE:
- [ ] Prepaid
- [ ] Collect
- [x] 3rd Party

(see Remarks)

If this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement: The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

MERCURY, NV

This shipment is for the U.S. Department of Energy and the actual total transportation charges paid to the carrier(s) by the consignor or consignee are assignable to, and shall be reimbursed by, the U.S. Government and is subject to the terms and conditions set forth in the standard form of the U.S. Government Bill of Lading and to any available special rates or charges (41 CFR 109-40.50 and 41 CFR 109-40.3)

[x] Yes [ ] No

SECTION 13712/10721 RATES APPLY - TENDER NO.

Remarks:
EXCLUSIVE USE SHIPMENT - DEDICATED ROUTE MUST AVOID LAS VEGAS VALLEY AND HOOVER DAM.

Received, subject to individually determined rates or contracts that have been agreed upon in writing between the carrier and shipper, if applicable, otherwise to the rates, classifications and rules that have been established by the carrier and are available to the shipper, on request. The property described above, in apparent good order, except as noted (contents and conditions of contents of packages unknown) marked, consigned and destined as shown herein, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, unless otherwise specifically stated in individually determined rates and contracts that have been agreed upon in writing between the carrier and shipper, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at anytime interested in all or any of said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Uniform Freight Classification in effect on the date hereof, if this is a rail or rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment. Shipper hereby certifies they are familiar with all terms and conditions of the said bill of lading, set forth in the classification or tariff which governs the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for him/herself and their assigns.

This is to certify that the above named materials are properly classified, described, packaged, marked, labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation (Applicable for Hazardous Materials Only)

Shipper, Acting under contract DE-AC52-09NA28091 with the U.S. Department of Energy:

/s/ Signature on File

N-I C/O US DOE MERCURY, NV 89023

Per US DOE NNSA/NFO   Date 09/05/2013

Trailer Loaded by: [x] Shipper [x] Driver

Freight Counted by:
- [ ] Shipper
- [ ] Driver, Loose pieces
- [ ] Driver, pallet said to contain
- [ ] Driver, pallets containing

Vehicle/Car No:

Seal:

Placards Required: NONE

Label(s) applied: UN2910 Radioactive

Carrier LRGR / LANDSTAR RANGER

Per /s/ Signature on File   Date 9/9/13

TRANSPORTATION DEPARTMENT - PERMANENT POST OFFICE ADDRESS OF SHIPPER

Page 1 of 1

/s/ Signature on File 9/11/13

COPY

UNCONTROLLED When Printed

NNSS LANDFILL LOAD VERIFICATION

SWO USE (Select One) AREA ☐ 23 ☐ 6 ☒ 9/10C **LANDFILL**

For waste characterization, approval, and/or assistance, contact Solid Waste Operation (SWO) at 5-7898.

REQUIRED: WASTE GERERATOR INFORMATION
(This form is for rolloffs, dump trucks, and other onsite disposal of materials.)

Waste Generator: Mark Heser - Navarro WO (M/S - NSF 167)(Fax - 5-2025) Phone Number: 5-2124

Location / Origin: Area 3 - CAU 568 - 1 drum of HC waste - transformer Carcass. Container number 568T01

Waste Category: (check one) ☐ Commercial ☒ Industrial

Waste Type: (check one) ☐ NNSS ☐ Non-Putrescible ☐ Putrescible ☐ Asbestos Containing Material ☒ FFACO-onsite ☐ FFACO-offsite ☐ WAC Exception ☐ Historic DOE/NV

Pollution Prevention Category: (check one) ☒ Environmental management ☐ Defense Projects ☐ YMP

Pollution Prevention Category: (check one) ☒ Clean-Up ☐ Routine

Method of Characterization: (check one) ☒ Sampling & Analysis ☒ Process Knowledge ☒ Contents

Prohibited Waste at all three NNSS landfills: Radioactive waste; RCRA waste; Hazardous waste; Free liquids, PCBs above TSCA regulatory levels, and Medical wastes (needles, sharps, bloody clothing).

Additional Prohibited Waste at the Area 9 U10C Landfill: Sewage Sludge, Animal carcasses, and Wet garbage (food waste).

REQUIRED: WASTE CONTENTS ALLOWABLE WASTES
Check all allowable wastes that are contained within this load:

NOTE: Waste disposal at the Area 6 Hydrocarbon Landfill must have come into contact with petroleum hydrocarbons or coolants, such as: gasoline (no benzene, lead); jet fuel; diesel fuel; lubricants and hydraulics; kerosene; asphaltic petroleum hydrocarbon; and ethylene glycol.

Acceptable waste at any NNSS landfill: ☐ Paper ☐ Rocks / unaltered geologic materials ☐ Empty containers ☐ Asphalt ☐ Metal ☐ Wood ☐ Soil ☐ Rubber (excluding tires) ☐ Demolition debris ☐ Plastic ☐ Wire ☐ Cable ☐ Cloth ☐ Insulation (non-Asbestosform) ☐ Cement & concrete ☒ Manufactured items: (swamp coolers, furniture, rugs, carpet, electronic components, PPE, etc.)

Additional waste accepted at the Area 23 Mercury Landfill: ☐ Office Waste ☐ Food Waste ☐ Animal Carcasses ☐ Asbestos ☐ Friable ☐ Non-Friable (contact SWO if regulated load) Quantity: ______

Additional waste accepted at the Area 9 U10c Landfill:
☐ Non-friable asbestos ☐ Drained automobiles and military vehicles ☐ Solid fractions from sand/oil/water separators
☐ Friable asbestos ☐ Drained fuel filters (gas & diesel) ☐ Deconned Underground and Above Ground Tanks
☐ Light ballasts (contact SWO) ☒ Hydrocarbons (contact SWO) ☒ Other 1x85 gal drum - Non-PCB Transformer

Additional waste accepted at the Area 6 Hydrocarbon Landfill: ☐ ______
☐ Septic sludge ☐ Rags ☐ Drained fuel filters (gas & diesel) ☐ Crushed non-teme plated oil filters
☐ Plants ☐ Soil ☐ Sludge from sand/oil/water separators ☐ PCBs below 50 parts per million

REQUIRED: WASTE GENERATOR SIGNATURE

Initials: _____ (if initialed, no radiological clearance is necessary.)

The above mentioned waste was generated outside of a Controlled Waste Manageme[...] knowledge, does not contain radiological materials.

To the best of my knowledge, the waste described above contains only those materi[...] site. I have verified this through the waste characterization method identified above [...] prohibited and allowable waste items. I have contacted Property Management and h[...] is approved for disposal in the landfill.

> Radiological Survey Release for Waste Disposal
> RCT Initials
> N/A This container/load meets the criteria for no added man-made radioactive material
> Z This container/load meets the criteria for Radcon Manual Table 4.2 release limits.
> N/A This container/load is exempt from survey due to process knowledge and origin.
> SIGNATURE: /s/ Signature on File DATE: 4-1-15
> BN-0646 (10/05)

Print Name: Mark Heser

Signature: /s/ Signature on File Date: ~~4/2/2015~~ RE 5/5/15

Note: "Food waste, office trash and animal carcasses do not require a radiological clearance. Freon-containing appliances must have signed removal certification statement with Load Verification."

SWO USE ONLY

Load Weight (net from scale or estimate) 320 Certifier: /s/ Signature on File
Printed Name & Signature

NNSS LANDFILL LOAD VERIFICATION

2

SWO USE (Select One) AREA ☐ 23 ☐ 6 ☒ 9/10C **LANDFILL**

For waste characterization, approval, and/or assistance, contact Solid Waste Operation (SWO) at 5-7898.

REQUIRED: WASTE GENERATOR INFORMATION

(This form is for rolloffs, dump trucks, and other onsite disposal of materials.)

Waste Generator: Mark Hoser (Navarro- WO) Phone Number: 5-2124

Location / Origin: Building 23-310, 1x20 yd3 roll-off - containing debris for disposal ; tracking number 310R14

Waste Category: (check one) ☐ Commercial ☒ Industrial

Waste Type: (check one) ☐ NNSS ☐ Non-Putrescible ☐ Putrescible ☐ Asbestos Containing Material ☒ FFACO-onsite ☐ FFACO-offsite ☐ WAC Exception ☐ Historic DOE/NV

Pollution Prevention Category: (check one) ☒ Environmental management ☐ Defense Projects ☐ YMP

Pollution Prevention Category: (check one) ☒ Clean-Up ☐ Routine

Method of Characterization: (check one) ☒ Sampling & Analysis ☒ Process Knowledge ☒ Contents

Prohibited Waste at all three NNSS landfills: Radioactive waste; RCRA waste; Hazardous waste; Free liquids, PCBs above TSCA regulatory levels, and Medical wastes (needles, sharps, bloody clothing).

Additional Prohibited Waste at the Area 9 U10C Landfill: Sewage Sludge, Animal carcasses, Wet garbage (food waste); and Friable asbestos

REQUIRED: WASTE CONTENTS ALLOWABLE WASTES

Check all allowable wastes that are contained within this load:

NOTE: Waste disposal at the Area 6 Hydrocarbon Landfill must have come into contact with petroleum hydrocarbons or coolants, such as: gasoline (no benzene, lead); jet fuel; diesel fuel; lubricants and hydraulics; kerosene; asphaltic petroleum hydrocarbon; and ethylene glycol.

Acceptable waste at any NNSS landfill: ☐ Paper ☐ Rocks / unaltered geologic materials ☒ Empty containers
☐ Asphalt ☒ Metal ☒ Wood ☐ Soil ☐ Rubber (excluding tires) ☐ Demolition debris
☒ Plastic ☒ Wire ☒ Cable ☐ Cloth ☐ Insulation (non-Asbestosform) ☐ Cement & concrete
☒ Manufactured items: (swamp coolers, furniture, rugs, carpet, electronic components, PPE, etc.)

Additional waste accepted at the Area 23 Mercury Landfill: ☐ Office Waste ☐ Food Waste ☐ Animal Carcasses
☐ Asbestos ☐ Friable ☐ Non-Friable (contact SWO if regulated load) Quantity: ______

Additional waste accepted at the Area 9 U10c Landfill:
☐ Non-friable asbestos ☐ Drained automobiles and military vehicles ☐ Solid fractions from sand/oil/water separators
☐ Light ballasts (contact SWO) ☐ Drained fuel filters (gas & diesel) ☐ Deconned Underground and Above Ground Tanks
☐ Hydrocarbons (contact SWO) ☒ Other Empty containers

Additional waste accepted at the Area 6 Hydrocarbon Landfill: ☐ ______
☐ Septic sludge ☐ Rags ☐ Drained fuel filters (gas & diesel) ☐ Crushed non-terne plated oil filters
☐ Plants ☐ Soil ☐ Sludge from sand/oil/water separators ☐ PCBs below 50 parts per million

REQUIRED: WASTE GENERATOR SIGNATURE

Initials: ____ **(If initialed, no radiological clearance is necessary.)**

The above mentioned waste was generated outside of a Controlled Waste Managem[ent] ... knowledge, does not contain radiological materials.

To the best of my knowledge, the waste described above contains only those materi[als] ... site. I have verified this through the waste characterization method identified above ... prohibited and allowable waste items. I have contacted Property Management and h... is approved for disposal in the landfill.

Radiological Survey Release for Waste Disposal
RCT Initials
___ This container/load meets the criteria for no added man-made radioactive material
X This container/load meets the criteria for Radcon Manual Table 4-2 release limits.
___ This container/load is exempt from survey due to process knowledge and origin.
SIGNATURE: /s/ Signature on File DATE: 3/?/15

Print Name: Mark Hoser RC 3/26/15

Signature: /s/ Signature on File Date: ~~3/12/2015~~

Note: "Food waste, office trash and animal carcasses do not require a radiological clearance. Freon-containing appliances must have signed removal certification statement with Load Verification."

SWO USE ONLY

Load Weight (net from scale or estimate): 4,820 Certifier: /s/ Signature on File
Printed Name & Signature

INDUSTRIAL WASTE LOGBOOK for BUILDING 23-310 ROLL-OFF # 310R14
INDUSTRIAL and SANITARY WASTE and DISPOSAL at Area 9, U10c LANDFILL
(For waste items generated in accordance with [illegible] # EC-WG-1 and Radiological Release of Material)

Today's Date	CAU Number	CAS Number	Date on Bag	Number of Bags	Generator Initials	Notes Comments
9-30-13	Bldg 153	N/A	9-30-13	2	ELW	Secondary Containment Pallet trays
9-30-13	Bldg 153	↓	9-30-13	2	ELW	Mud mats (Steel 1.5'x10')
9-30-13	Bldg 153	↓	9-30-13	3	ELW	Electrical power cords
9-30-13	Bldg 153	↓	9-30-13	4	ELW	Wood blocks, miscel Debris
9-30-13	Bldg 153	↓	9-30-13	1	ELW	Plexiglass (1/4"x24"x24")
9-30-13	Bldg 153	↓	9-30-13	3	ELW	Storage boxes (black poly)
9-30-13	Bldg 153	↓	9-30-13	3	ELW	wood strips (1/2"x1-1/4"x8')
9-30-13	Bldg 153	↓	9-30-13	1	ELW	Skid plate (steel)
9-30-13	Bldg 153	↓	9-30-13	2	ELW	(1"x2'x10') Plexiglass
9-30-13	Bldg 153	↓	9-30-13	1	ELW	Storage box (yellow/Black poly)
10-3-13	ER-EC-15	N/A	10-3-13	1	[illegible]	PPE/Sampling Waste
10-7-13	Bldg 153	N/A	10-7-13	1	ELW	Debris (Equip Yard)
10-9-13	CAU 571	NA	10-9-13	1	LD	PPE + IDW
10-10-13	WM 366 165 104	NA	NA	NA	LD	4-Pallets, 3-10gl empty drums, 4-T-posts
10-16-13	Sample Room	NA	10-16-13	1	LD	Sample Room trash.
10-21-13	CAU-571	Study Group 3	10-21-2013	1	DH	Disposable sample Equip, PPE
10-21-13	Bldg 310	N/A	10-21-13	3	ELW	Empty Portable Eyewash
10-21-13	Bldg 310	N/A	10-21-13	1	ELW	plastic (black)
10-21-13	Bldg 310	N/A	10-21-13	1	ELW	Wood Pallet

Contact EC/WM Manager for questions and disposal of roll-off.

INDUSTRIAL WASTE LOGBOOK for BUILDING 23-310 ROLL-OFF # 310R14
INDUSTRIAL and SANITARY WASTE DISPOSAL at Area 9, U10c LANDFILL
(For waste items generated in accordance with S[illegible] # EC-WG-1 and Radiological Release of Material)

Today's Date	CAU Number	CAS Number	Date on Bag	Number of Bags	Generator Initials	Notes Comments
10-21-13	Bldg 310	N/A	10-21-13	9	ELW	Steel fence Post
10-21-13	Bldg 310	N/A	10-21-13	5	ELW	Empty STEEL drums 30gal (3) + 55gal (2)
10-22-13	Bldg 310	N/A	10-22-13	4	ELW	Light Stand
10-22-13	Bldg 153	N/A	10-22-13	1	ELW	Electric heater
10-22-13	Bldg 153	N/A	10-22-13	1	ELW	storage Box (plastic)
10-22-13	Bldg 153	N/A	10-22-13	2	ELW	Step stool
10-22-13	Bldg 153	N/A	10-22-13	1	ELW	plastic (roll)
10-23-13	Bldg 153	N/A	10-23-13	1	ELW	2 wheel cart (metal frame, wood) 7 pieces [RSR#130425-PI-51]
10-23-13	Bldg 153	N/A	10-23-13	1	ELW	Drum Dolly (Blue metal) [RSR#130402-PI-04]
10-23-13	Bldg 153	N/A	10-23-13	1	ELW	2 wheel cart (metal) [RSR#130425-PI-51]
10-23-13	Bldg 153	N/A	10-23-13	2	ELW	Sign Stand (metal)
10-23-13	Bldg 153	N/A	10-23-13	1	ELW	Scaffold PLANK panel (Aluminum) [RSR#130411-PI-23]
10-23-13	Bldg 153	N/A	10-23-13	1	ELW	Desk (metal)
10-23-13	Bldg 153	N/A	16-23-13	1	ELW	Sign Stand (metal)
10-23-13	Bldg 153	N/A	10-23-13	2	ELW	Wheel (metal)
10-23-13	Bldg 153	N/A	10-23-13	1	ELW	Storage Box (plastic)
10-23-13	Bldg 153	N/A	10-23-13	2	ELW	PPE (Clean)
10-26-13	ER-EC-15	N/A	10-26-13	1	JCR	lab waste and PPE
11-6-13	ER-EC-15	N/A	11-6-13	1	[illegible]	LAB WASTE + PPE

INDUSTRIAL WASTE LOGBOOK for BUILDING 23-310 ROLL-OFF # 310R14

INDUSTRIAL and SANITARY WASTE DISPOSAL at Area 9, U10c LANDFILL

(For waste items generated in accordance with S[illegible]S # EC-WG-1 and Radiological Release of Material)

Today's Date	CAU Number	CAS Number	Date on Bag	Number of Bags	Generator Initials	Notes Comments
12-3-13	UGTA →		12-3-13	1	[illegible]	Well ER-EC-1S Lab/PPE Waste
12-9-13	571	NA	12-9-13	1	DH	Sample Debris + PPE
12-10-13	571	NA	12-10-13	1	LD	Sample Debris + PPE
12-16-13	Bldg 6-909	N/A	12-16-13	1	ELW	Clean Waste (unused Protective Clothing)
12-18-13	571	NA	12-18-13	1	LD	Sample Debris + PPE
12-24-13	571	Study Group 5 NA	12-24-13	1	DH	PPE - Disposable Sample Equip.
1-2-2014	571	Study Group 5 NA	1-2-2014	1	DH	PPE - Disposable Sample Equip.
1-7-2014	Bldg 310	N/A	1-7-2014	2	ELW	Light Stand
1-10-14	UGTA	UGTA	1-10-14	1	[illegible]	ER-EC-1S LAB/PPE WASTE
1-~~17~~ 22-14	Bldg 310	N/A	1-22-14	2	ELW	Empty 55 gallon drum, traffic warning triangle
1-23-14	CS Piping	N/A	1-23-14	1	LD	PPE
1-23-14	Bldg 310	N/A	1-23-14	1	DH	LAB WASTE Swipes, Gloves, & Gauze
1-27-14	567	2023-08	1-27-14	1	DP	PPE
1-28-14	567	J-11 Site	1-28-14	1	DH	PPE & Disposable Sample Equip.
1-30-14	UGTA	UGTA	1-30-14	1	[illegible]	PPE LAB/WASTE ER-EC-1S
2-3-14	571	BAT 12	2-3-14	1	DH	PPE - Disposable Sample Equip.
2-4-14	567	05-23-07	2-4-14	1	DH	PPE / ISW
2-5-14	567	05-23-07	2-5-14	1	DH	PPE / ISW
2-6-14	567	05-23-07	2-6-14	1	DH	PPE / ISW

Contact EC/WM Manager for questions and disposal of roll-off.

INDUSTRIAL WASTE LOGBOOK for BU[illegible]DING 23-310 ROLL-OFF # 310 R14

INDUSTRIAL and SANITARY WASTE [illegible] DISPOSAL at Area 9, U10c LANDFILL

(For waste items generated in accordance with S[illegible] # EC-WG-1 and Radiological Release of Material)

UNCONTROLLED When Printed

Today's Date	CAU Number	CAS Number	Date on Bag	Number of Bags	Generator Initials	Notes Comments
2-10-2014	567	05-23-07	2-10-2014	1	DH + LD	PPE / IDW
2/10/2014	567	05-23-07	2-11-14	1	DH	PPE / IDW
2/12/2014	567	05-23-07	2-12-14	1	DH	PPE / IDW
2/13/2014	567	05-23-07	2-13-14	1	DH	PPE / IDW
2/13/2014	ER-EC-15	—	2-13-14	1	[illegible]	PPE/IDW
2-14-2014	ER-20-11	—	2-14-14	1	SM	PPE / Plastic containment
2-18-2014	567	05-23-07	2-18-2014	1	DH	PPE / IDW
2-18-2014	ER-EC-15	—	2-18-2014	1	[illegible]	PPE (Gloves, etc)
2-20-2014	567	05-23-07	2-20-14	1 eq 1	MH	Empty/punctured Aerosol paint cans.
2-20-2014	567	05-23-07	2-20-14	1	DH	PPE / IDW
2-24-2014	567	01-23-03	2-24-14	1	LD	PPE + IDW
2-25-2014	567	01-23-03	2-25-2014	1	DH	PPE + IDW
2-26-2014	567	01-23-03	2-26-2014	1	DH	PPE / IDW
2-27-2014	567	01-23-03	2-27-2014	1	DH	PPE / IDW
3-4-14	NA	NA	3-4-14	1	LD	PPE + IDW 23-153
3-4-14	NA	NA	3-4-14	2	LD	M/T Gemflors Sealant
3-4-14	NA	NA	3-4-14	1	LD	Comprimised spill Kit
3-4-14	NA	NA	NA	1	LD	Black Box
3-3-14	567	01-23-03	3-3-14	1	DH	PPE / IDW

Contact EC/WM Manager for questions and disposal of roll-off.

INDUSTRIAL WASTE LOGBOOK for BUILDING 23-310 ROLL-OFF # 310R14
INDUSTRIAL and SANITARY WASTE POSAL at Area 9, U10c LANDFILL
(For waste items generated in accordance with S -WG-1 and Radiological Release of Material)

UNCONTROLLED When Printed

Today's Date	CAU Number	CAS Number	Date on Bag	Number of Bags	Generator Initials	Notes Comments
3/5/2014	567	20-23-08	3/5/14	1	LD	PPE/Disposable Sample Equip.
3-6-2014	415	N/A	3/6/14	~~1~~ 2 ELW 4/3/14	ELW	Empty Containers from CAU 415 Sample Returns (1gallon ~~1 gallon~~) RSR 140306-SL-13 1-Broken Wooden Pallet ELW 4/3/14
3-10-2014	567	25-23-23	3/10/14	1	DH	PPE/Disposable Sample Equip.
3-17-14	415	N/A	3-17-14	1	LD	PPE+IDW From 415 Mockup Area 5 <disassembled>
3-18-14	Bldg 310	N/A	3-17-14	2	ELW	Metal/Wood Shelves (unit) 2'x4'x3'
3-18-14	Bldg 310	N/A	3-17-14	1	ELW	Debris
3/22/14	EREC14	UG14-420	3/21 - 3/22/14	2	RAZ	PPE/LABWASTE ER-EC-14
3/31/14	567	N/A	3-31-14	1	LD	PPE/IDW Colby URMA
4/6/14	415	NAFR-23-2	4-6-14	1	DH	PPE-Sample Equip. - IDW
4-7-14	415	NAFR-23-02	4-7-14	1	LD	vermiculite to transport samples
4/7/14	EREC14	NA	4/7/14	1	RZ	PPE/LABWASTE EREC-14
4-8-14	567	D	4-8-14	1	MH	RCRA MT cans - 5gal/1gallon paint can & PPE from Colby Site
4-8-14	567	D	4-8-14	1	MH	2x1 gallon Paint cans - RCRA empty from Colby Site
4-8-14	567	A	4-8-14	1	MH	PPE from CTOS Area
4-9-14	—	—	4-8-14	1	SH	Lab waste + PPE f/ Sampling at RNM-1.
4-10-14	567	Jull E	4-10-14	1	DH	PPE/Disposable Sample Equip.
4-10-14	Bldg 310	N/A	4-10-14	1	ELW	Lab bottle rack (plastic)
4-21-14	567	N/A	4-21-14	1	LD	PPE + IDW
4-28-14	EREC14	NA	4/24/14	1	JR	PPE + IDW

INDUSTRIAL WASTE LOGBOOK for BUILDING 23-310 ROLL-OFF # 310R14
INDUSTRIAL and SANITARY WASTE ?OSAL at Area 9, U10c LANDFILL
(For waste items generated in accordance with S… -WG-1 and Radiological Release of Material)

Today's Date	CAU Number	CAS Number	Date on Bag	Number of Bags	Generator Initials	Notes Comments
4-28-14	ER-EC-14	N/A	4/28/14	1	[illegible]	PPE & IDW
5-12-14	ER-EC-14	N/A	5-12-14	1	TF	PPE + Sampling waste
5-13-14	Bldg 23-310	N/A	5-13-14	1	JLW	PPE (training class materials)
5-13-14	CAU 567	05-23-07	5-13-14	1	LD	PPE + IDW
5-14-14	CAU 570	—	N/A	2 EA	MH	2 wooden Pallets from CAU 570 RMA
5-21-2014	CAU 567	05-23-23	5-21-14	1	DK	PPE & IDW
6-4-14	CAU 568	N/A	6-4-14	1	LD	PPE + IDW
6-5-14	Bldg 310	N/A	6-5-14	1	ELW	Clean Waste
6-12-14	UE-Sn	N/A	6-12-14	1	[illegible]	Lab waste (PPE)
6-17-14	CAU 568	N/A	6-17-14	1	LD	PPE + IDW
6-19-14	ER 6-2	NA	6-19-14	3	RZ	PPE/LAB WASTE
6-20-14	ER-7-2	N/A	6-20-14	1	[illegible]	PPE/Lab waste
6-26-14	UGTA	N/A	6/26/14	1	MH	1-Bag-Empty plastic Bottles.
6-30-14	Bldg 310	N/A	6/30/14	4	ELW	Empty Safety Fuel Cans (RSR# 140630-PI-70)
7-1-14	Bldg 310	N/A	7-1-14	1	ELW	Counter Top Vent (RSR# 140313-SL-22)
7-1-14	Bldg 310	N/A	7-1-14	1	ELW	FAN Filter Box (RSR# 140313-SL-22)
7-1-14	Bldg 310	N/A	7-1-14	1	ELW	PPE/Clean-Weather damaged
7-2-14	568	N/A	7-2-14	1	LD	PPE + IDW
7-8-14	568	N/A	7-8-14	1	DP	PPE + IDW

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INDUSTRIAL WASTE LOGBOOK for BUILDING 23-310 ROLL-OFF # 310R14

INDUSTRIAL and SANITARY WASTE [illegible] POSAL at Area 9, U10c LANDFILL

(For waste items generated in accordance with S[illegible] -WG-1 and Radiological Release of Material)

Today's Date	CAU Number	CAS Number	Date on Bag	Number of Bags	Generator Initials	Notes Comments
7/22/14	ER-EC-11	NA	7/22/14	1	RZ	PPE / LAB WASTE
7-25-14	ER-EC-11	N/A	7-25-14	2	[illegible]	PPE / Lab Waste
7-28-14	568	NA	7-28-14	1	LD	PPE + IDW.
7-29-14	6-909	N/A	7-29-14	1	[illegible]	PPE / LAB WASTE
7-31-14	B23-310	N/A	7/31/14	2	MH	Empty / Punctured aerosol cans - Air dusters (x2); Air horns (x4)
8-5-14	568	NA	8-5-14	1	DH	PPE + IDW
8-5-14	Bldg 310	N/A	8-5-14	2	ELW	clean waste (waste Lock???) 5 gallons
8-6-14	UGTA	N/A	8-6-14	1	JA	SAMPLE WASTE
8-6-14	Bldg 310	N/A	8-6-14	1	ELW	Debris (storage cargo container)
8-6-14	568 ~~586~~ MH	NA	8-6-14	1	LD	PPE + IDW
8-7-14	568 ~~586~~ MH	NA	8-7-14	1	LD	PPE + IDW
8-8-14	ER-EC-11	N/A	8-08-14	1	MPP	PPE Lab Waste
8-19-14	Bldg. 310	N/A	8-18-14	1	DH	UTV # 105585 oil change ~2 lbs oil-solidified
8-20-14	ER-EC-11	N/A	8-20-14	1	[illegible]	PPE LAB WASTE
8-25-14	ER-EC-11	N/A	8-20-14	1	[illegible]	PPE, Lab waste, filters/tubing.
9-3-14	Bldg 6-909	N/A	9-3-14	1	[illegible]	PPE, Lab waste
9-4-14	Bldg 310	N/A	9-4-14	2	ELW	folding chairs
9-4-14	Bldg 310	N/A	9-4-14	1	ELW	Hydrocarbon Stain pad (1) - Engine Hoist
9/11/14	ER20-8	—	9/11/14	1	RZ	PPE / LAB WASTE

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INDUSTRIAL WASTE LOGBOOK for BUILDING 23-310 ROLL-OFF # 310R14
INDUSTRIAL and SANITARY WASTE POSAL at Area 9, U10c LANDFILL
(For waste items generated in accordance with S -WG-1 and Radiological Release of Material)

Today's Date	CAU Number	CAS Number	Date on Bag	Number of Bags	Generator Initials	Notes Comments
9/17/14	ER20-8 #2	—	9/17/14	1	RZ	PPE / LAB WASTE
9-25-14	Bldg 310	N/A	9-25-14	1	ELW	Clean Waste from Rad Lab at Bldg 310.
9-29-14	568	NA	9-29-14	1	LD	PPE + IDW
9-30-14	568	NA	9-30-14	2	LD	PPE + IDW
10-2-14	Bldg 310	N/A	10-2-14	1	ELW	Clean Waste Lab Supplies at Bldg 310.
10-4-14	ER-20-8 #2	—	10-4-14	1	RZ	PPE / LAB WASTE
10-6-14	NA	—	10-6-14	1	LD	PPE
10/6/14	ER20-8-2	—	10/6/14	1	RZ	PPE / LAB WASTE
10/7/14	↓	—	10/7/14	1	RZ	" "
10-17-14	ER-20-8-2	—	10-17-14	2	[illegible]	" " "
10/16/14	"	—	10/16/14	1	SH	" " "
10-28-14	Bldg 310	N/A	10-28-14	7	ELW	Battery chargers, power cord
10-28-14	541	NA	10-28-14	1	LD	PPE
10-30-14	Bldg 310	N/A	10-30-14	1	ELW	PPE (unused - Age Limitation)
11-6-14	541	NA	11-6-14	1	LD	PPE + IDW
11-13-14	413	TTR clean slate II	11-13-14	1	DH	Disposable sample Equip / PPE
12-3-14	Bldg 310	N/A	12-3-14	2	ELW	Empty Safety fuel cans (RSR# 141119-PI-26)
12-4-14	TTR	NA	NA	NA	LD	canopy - Broken
12/8/14	CAU 541	NA	12/8/14	1	LD	PPE + IDW

UNCONTROLLED When Printed

Contact EC/WM Manager for questions and disposal of roll-off.

INDUSTRIAL WASTE LOGBOOK for BUILDING 23-310 ROLL-OFF # 310R14
INDUSTRIAL and SANITARY WASTE [illegible]POSAL at Area 9, U10c LANDFILL
(For waste items generated in accordance with S[illegible]-WG-1 and Radiological Release of Material)

Today's Date	CAU Number	CAS Number	Date on Bag	Number of Bags	Generator Initials	Notes Comments
11-17-14	541	NA	11-17-14	1	LD	PPE + IDW
11-18-14	541	NA	11-18-14	1	LD	PPE + IDW
11-19-14	Bldg 310	N/A	11-19-14	10	ELW	(9) T-Posts, (1) plastic bucket (metal Debris)
11-20-14	541	NA	11-20-14	1	LD	PPE + IDW
11-25-14	23-310	NA	NA	1	LD	Trailer Jack MG
12-11-14	541	NA	12-11-14	1	LD	PPE + IDW
12-22-14	575	15-64-01	N/A	N/A	[illegible]	3 metal collar - 6" diameter
1-11-15	ER-EC-6	NA	12-10-14	1	JCR	PPE + Lab waste
1-15-15	ER-EC-6	N/A	1-15-15	1	[illegible]	PPE and Lab waste
2-4-15	Bldg 23-310	N/A	2-4-15	1	MH	Empty / Punctured aerosol paint cans
2-4-15	Bldg 23-310	N/A	2-4-15	1	MH	4-empty bottles of Ultima Gold w/Absorbent
2-4-15	Bldg 23-310	N/A	2-4-15	1 x 5 gal Pail	MH	1 x 5 gallon bucket of Solidified Ultima Gold.

Last entry MHeaz 2/4/15

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Contact EC/WM Manager for questions and disposal of roll-off.

Appendix E

Activity Organization

E.1.0 Activity Organization

The NNSA/NFO Soils Activity Lead is Tiffany Lantow. She can be contacted at 702-295-7645.

The identification of the activity Health and Safety Officer and the Quality Assurance Officer can be found in the appropriate plan. However, personnel are subject to change, and it is suggested that the NNSA/NFO Soils Activity Lead be contacted for further information. The Task Manager will be identified in the FFACO Monthly Activity Report before the start of field activities.

Appendix F

Sample Location Coordinates

F.1.0 Sample Location Coordinates

Sample location coordinates were collected during the CAI using a GPS instrument. These coordinates identify the field sampling locations (e.g., latitude, longitude, elevation) at CAU 568.

Sample locations are shown on Figures A.3-1, A.4-1, A.5-1, A.6-3, and A.7-1. The corresponding coordinates for CAU 568 sample locations are listed in Table F.1-1.

Table F.1-1
Sample Location Coordinates for CAU 568
(Page 1 of 3)

Sample Location	Easting[a]	Northing[a]
Study Group 1		
A01	586204.1	4100803.5
A02	586179.5	4100770.7
A03	586124.9	4100702.6
A04	586093.2	4100675.0
A05	586070.8	4100657.2
A06	586016.8	4100607.9
A07	585996.5	4100588.9
A08	586202.9	4100121.2
A09	586249.7	4100090.4
A10	586276.6	4100066.2
A11	586265.5	4100040.7
A12	586320.0	4100000.8
A13	586341.5	4099962.3
A14	586362.6	4099931.6
A15	586199.7	4100890.5
A16	586135.4	4101129.9
A17	586097.5	4101057.8
A18	586079.0	4101015.3
A19	586055.0	4100969.4
A20	586021.1	4100913.8

Table F.1-1
Sample Location Coordinates for CAU 568
(Page 2 of 3)

Sample Location	Easting[a]	Northing[a]
A21	586002.9	4100873.1
A22	585980.3	4100831.8
A23	586023.0	4100564.4
A24	585968.8	4100615.1
A25	586084.8	4100464.6
A25a	586084.5	4100465.7
A28	586280.2	4100613.7
A29	585908.9	4100555.8
A30	585921.2	4100532.1
A31	586029.8	4100511.7
A32	586010.3	4100549.5
A33	586289.6	4100031.4
A34	586295.3	4100000.6
B01	585877.1	4100519.8
B02	585936.6	4100572.6
Study Group 2		
A26	585850.5	4100460.5
Study Group 3		
B03	586093.3	4100542.0
B04	586009.6	4100477.7
B05	586157.8	4100496.5
Study Group 4		
A27	586312.1	4100669.3
C12	586311.2	4100674.6
C02	586167.1	4100616.3
C03	586166.7	4100614.5
C04	586160.6	4100613.0
C05	586167.6	4100612.4
C06	586172.6	4100611.2

Table F.1-1
Sample Location Coordinates for CAU 568
(Page 3 of 3)

Sample Location	Easting[a]	Northing[a]
C07	586127.1	4100593.4
C08	586125.7	4100594.6
C09	586225.1	4100570.5
C10	586231.6	4100575.3
C11	586245.8	4100575.8
C13	586177.1	4100696.9
C14	585527.9	4099864.8
C15	585513.1	4099880.2
C16	585723.3	4100437.0
C17	585994.9	4100952.0
C18	585993.0	4100976.0
C19	585977.9	4100996.7
C20	586030.1	4100633.4
C01	586024.9	4100657.3
Study Group 5		
D01	585906.2	4100428.3
D02	585956.3	4100429.6
Background TLDs		
F01	586027.7	4100152.5
F02	585353.0	4100843.9
F03	586542.5	4101059.4

[a]UTM, NAD27, Zone 11N, Meters

HAE = Height above ellipsoid
NAD = North American Datum
UTM = Universal Transverse Mercator

Appendix G

Gamma Am-241 Replicate Study

G.1.0 Gamma Am-241 Replicate Study

The gamma Am-241 analysis provides a more representative estimate of site contamination activities as it reduces the effect of discrete contaminant particles through the use of a much larger sample volume (i.e., the gamma analysis uses 1,000 cubic centimeters [cm^3], while the isotopic analysis uses approximately 0.6 cm^3). The ability of this method to produce consistent results (i.e., method variability) was investigated due to the potential for differential self-absorption of the gamma emissions of radioactive particles based on their physical position within the Marinelli container. The variability of gamma Am-241 results caused by self-absorption within the container was examined by conducting 10 replicate gamma spectroscopy measurements on each of four soil samples from within the contaminant plume of a single nuclear test at the NNSS. The Marinelli containers were emptied, and the soil was mixed between each measurement to create different particle distributions within the Marinelli containers. The effect of these different distributions on gamma Am-241 results is shown in Table G.1-1 in units of picocuries per gram (pCi/g). The method used to describe variability in this table is the coefficient of variation (CV). This is an estimate of the amount of variability in the population based on the distribution of sample results relative to the average sample value. Because it is standardized to the average, the CV is unitless, and it can be used instead of the standard deviation (SD) to compare the spread of datasets that have different units or different means. The CV is calculated as the SD divided by the mean.

Table G.1-1
Gamma Spectroscopy Replicate Results (pCi/g)
(Page 1 of 3)

Sample Number	Isotope		
	K-40	Cs-137	Am-241
A602 Replicate 1	27.2	9.1	392
A602 Replicate 2	27.8	8.6	324
A602 Replicate 3	28.5	8.7	366
A602 Replicate 4	26.7	8.8	344
A602 Replicate 5	27.4	9	384
A602 Replicate 6	29.1	8.6	348
A602 Replicate 7	28.4	8.5	336

Sample Number	Isotope		
	K-40	Cs-137	Am-241
A605 Replicate 1	29.5	55.6	2,920
A605 Replicate 2	28.9	52.3	2,750
A605 Replicate 3	28.7	52.7	2,680
A605 Replicate 4	31	52.9	2,820
A605 Replicate 5	29.7	52	2,760
A605 Replicate 6	30.1	49.9	2,750
A605 Replicate 7	29.5	53.1	2,780

Table G.1-1
Gamma Spectroscopy Replicate Results (pCi/g)
(Page 2 of 3)

Sample Number	Isotope		
	K-40	Cs-137	Am-241
A602 Replicate 8	29	8.6	330
A602 Replicate 9	27.9	8.8	379
A602 Replicate 10	27.5	8.23	332
A602 Average	28.0	8.7	354
A602 SD	0.79	0.25	24.8
A602 95% LCL	27.4	8.5	339.1
A602 95% UCL	28.5	8.8	367.9
A602 CV	2.8%	2.9%	7.0%
A602 Unexplained	N/A	0.1%	4.2%

Sample Number	Isotope		
	K-40	Cs-137	Am-241
A605 Replicate 8	29.7	52.1	2,720
A605 Replicate 9	29.8	52.3	2,720
A605 Replicate 10	29.1	53.4	2,760
A605 Average	29.6	52.6	2,766
A605 SD	0.65	1.42	65.9
A605 95% LCL	29.2	51.8	2,728
A605 95% UCL	30.0	53.5	2,804
A605 CV	2.2%	2.7%	2.4%
A605 Unexplained	N/A	0.5%	0.2%

Sample Number	Isotope		
	K-40	Cs-137	Am-241
A658 Replicate 1	29.1	0.84	77
A658 Replicate 2	28.4	0.85	108
A658 Replicate 3	27.2	0.78	85
A658 Replicate 4	26.9	0.79	104
A658 Replicate 5	27.2	0.78	104
A658 Replicate 6	28	0.72	108
A658 Replicate 7	28	0.73	100
A658 Replicate 8	28.2	0.76	100
A658 Replicate 9	28.2	0.73	81.1
A658 Replicate 10	28.8	0.73	92

Sample Number	Isotope		
	K-40	Cs-137	Am-241
A662 Replicate 1	29.3	1.31	104
A662 Replicate 2	29.2	0.8	76.8
A662 Replicate 3	30.8	0.78	77.3
A662 Replicate 4	30.1	0.77	86
A662 Replicate 5	30.3	0.77	75
A662 Replicate 6	28.2	0.83	77.1
A662 Replicate 7	27.8	0.74	72.2
A662 Replicate 8	28.6	0.84	78.1
A662 Replicate 9	26.7	0.79	76.9
A662 Replicate 10	30.4	0.81	75.8

Table G.1-1
Gamma Spectroscopy Replicate Results (pCi/g)
(Page 3 of 3)

Sample Number	Isotope		
	K-40	Cs-137	Am-241
A658 Average	28.0	0.8	95.9
A658 SD	0.71	0.05	11.4
A658 95% LCL	27.6	0.7	89.3
A658 95% UCL	28.4	0.8	102.5
A658 CV	2.5%	6.0%	11.9%
A658 Unexplained	N/A	3.5%	9.3%

Sample Number	Isotope		
	K-40	Cs-137	Am-241
A662 Average	29.1	0.8	79.9
A662 SD	1.32	0.17	9.2
A662 95% LCL	28.4	0.7	74.6
A662 95% UCL	29.9	0.9	85.2
A662 CV	4.5%	19.7%	11.5%
A662 Unexplained	N/A	15.2%	6.9%

K = Potassium

Also shown in Table G.1-1 are gamma K-40 and Cs-137 results. The K-40 was included to estimate the variability that is associated with the measurement technique. This is based on the assumption that the K-40 is homogeneously distributed through the sample. Therefore, the variability of the K-40 is only attributable to the variability of the measurement system. This variability (when normalized to the average) can be subtracted from the total variabilities for Cs-137 and Am-241 results resulting in net unexplained variabilities. These net unexplained variabilities are believed to be associated with particle distributions and self-absorption within the Marinelli containers. The unexplained variabilities for each of the four samples are shown in Table G.1-1.

As shown in Figure G.1-1, the variabilities of both Cs-137 and Am-241 in replicate gamma spectroscopy results are dependent upon the magnitude of each radionuclide activity in the sample. This demonstrates that the variability associated with particle distributions on gamma spectroscopy results decreases with higher concentrations of Cs-137 and Am-241.

This study shows that gamma spectroscopy results are not sensitive to the potential effect of self-absorption within the Marinelli container.

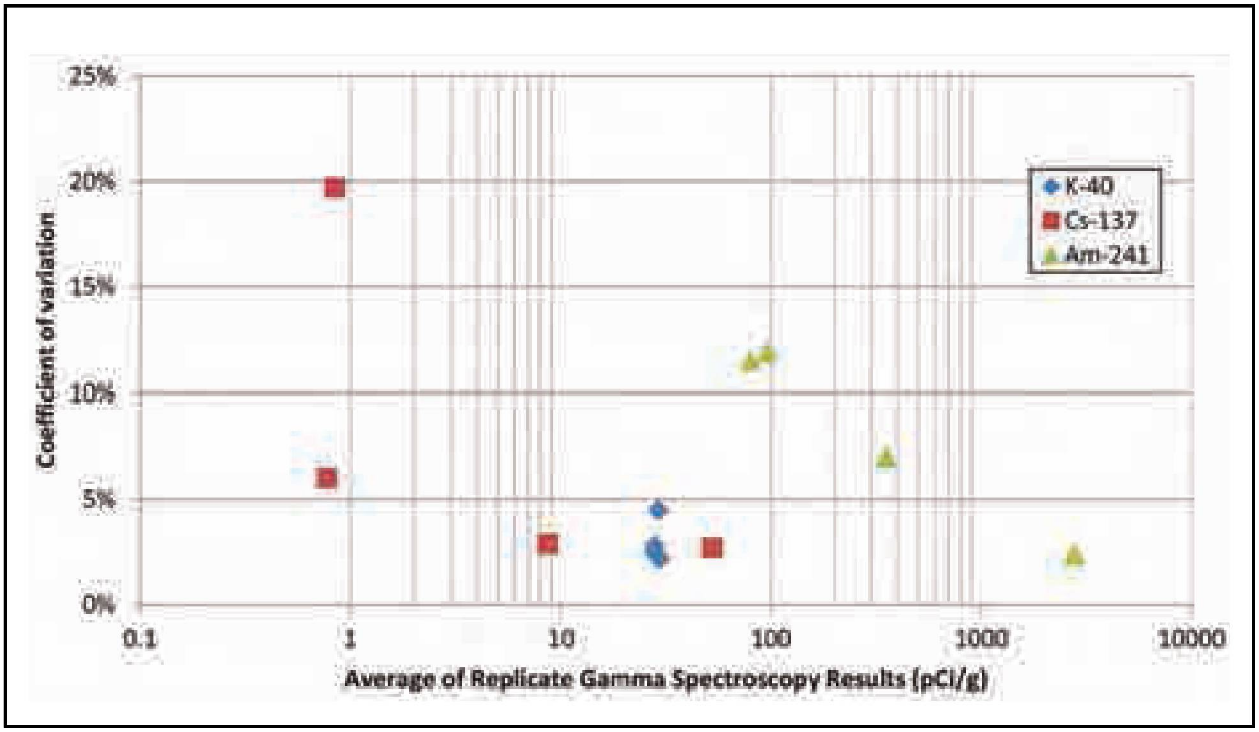

Figure G.1-1
Coefficient of Variation by Isotope Activity

Appendix H

Nevada Division of Environmental Protection Comments

(11 Pages)

Nevada Environmental Management Operations Activity
DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Corrective Action Decision Document for Corrective Action Unit 568: Area 3 Plutonium Dispersion Sites, Nevada National Security Site, Nevada	**2. Document Date:**	6/19/2015
3. Revision Number:	0	**4. Originator/Organization:**	Navarro
5. Responsible NNSA/NFO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Chris Andres and Scott Page, NDEP, (702) 486-2850 - ext. 232 and 237	**9. Reviewer's Signature:**	

10. Comment Number/Location	11. Type*	12. Comment	13. Comment Response	14. Accept
1.) Section 2.2.2, Page 26, 3rd Paragraph		Using "qualified" to describe data exhibiting "deficiencies" in the next sentence is unclear; suggest add brief explanation of how these terms apply with context of DQI, and what it means to qualify deficient data, and why decisions were not affected.	The paragraph was reworded to read, "The results of the DQI evaluation show that some of the data were identified as having quality issues associated with precision, accuracy, completeness, and sensitivity. However, as explained in Appendix B, these deficiencies do not affect the decision-making process."	
2.) Section 2.3.4, Page 28, 2nd Paragraph		3rd Sentence: clarify if estimate for lead shot PSM volume include the soil into which lead shot have been released; clarify if estimate includes lead shot extending into potential Tuna crater.	The paragraph was reworded to read, "At Location C19, the lead shot requires corrective action. The extent of PSM at lead shot Location C19 is limited to 1 ft bgs and comprises approximately 75 yd^3 of potentially affected soil and lead shot." Reference to the Tuna potential crater area was removed globally from the document, as it is not a concern. A stability study was conducted, and access into the Tuna potential crater area is permitted.	
3.) Section 3.4, Page 37, 5th Paragraph		2nd sentence, add the phrase, "along with the preferred alternative" after, "Table 3-3".	The requested phrase was added to the sentence.	
4.) Section 3.4, Page 40, Table 3-3		Standard 2, Clean Closure: • replace "regulator" with "NDEP"	The word was replaced as requested.	

Nevada Environmental Management Operations Activity
DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Corrective Action Decision Document for Corrective Action Unit 568: Area 3 Plutonium Dispersion Sites, Nevada National Security Site, Nevada	**2. Document Date:**	6/19/2015
3. Revision Number:	0	**4. Originator/Organization:**	Navarro
5. Responsible NNSA/NFO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Chris Andres and Scott Page, NDEP, (702) 486-2850 - ext. 232 and 237	**9. Reviewer's Signature:**	

10. Comment Number/Location	11. Type*	12. Comment	13. Comment Response	14. Accept
5.) Section 3.4, Page 42, Table 3-4		Decision Factor #4, Closure in Place: • an evaluation factor in the stakeholder CAA meeting of 6-11-15 included possible infeasibility of placing engineering controls at these GZs.	A sentence was added to Decision Factor #4, Closure In Place, which reads, "There are limitations to accessing the potential crater areas at Boomer and Pascal-C. However, the areas are small, and methods should be available for placing engineering controls without entering these areas."	
6.) Section 3.4, Page 43, Table 3-4		Decision Factor #6: • evaluation factors (including issues surrounding crater stability) discussed in stakeholder CAA meeting of 6-11-15 are not presented • the NOTES section should not appear if there are no notes to add, consistent with the other tables in the section	The following text was added to Decision Factor #6, Closure in Place: "Worker safety concerns for closure in place due to potential crater subsidence as discussed in Decision Factor #4." The notes section was deleted from Tables 3-4 through 3-8.	
7.) Section 3.4, Page 44, Table 3-5		Decision Factor #4 • NDEP records show that both alternatives were determined to be equally feasible, as discussed in stakeholder CAA meeting 6-11-15.	Agree. The word "EQUAL" has been added to the "Clean Closure" and "Closure in Place" columns of Decision Factor #4.	

Nevada Environmental Management Operations Activity
DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Corrective Action Decision Document for Corrective Action Unit 568: Area 3 Plutonium Dispersion Sites, Nevada National Security Site, Nevada	**2. Document Date:**	6/19/2015
3. Revision Number:	0	**4. Originator/Organization:**	Navarro
5. Responsible NNSA/NFO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	
7. Review Criteria:	Full		
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8.) Section 3.4, Page 44, Table 3-5		Decision Factor #5: • indicate where these estimates come from, i.e. a reference to Attach. C-1 • the CIP acronym is not defined on Page xii; either add to list, or remove since it is redundant with the table title	The phrase, "(see Attachment C-1 for cost estimates)" has been added globally to the Decision Factor tables following the cost estimates for Clean Closure and Closure in Place. Additionally, to be uniform between columns, "Cost to implement clean closure:" has been globally added to the beginning of the Clean Closure column in Decision Factor # 5, Cost. The CIP acronym has been removed.	
9.) Section 3.4, Page 45, Table 3-5		Decision Factor #6: • "NOTES" section: NDEP record taken during stakeholder CAA meeting of 6-11-15 indicates the Clean Closure alternative to be the preferred alternative. • in the "NOTES" section: describing both alternatives as "feasible" does not appear to be appropriate for "Other Considerations". • the phrase "in cost" used in sentence beginning with, "if the SE..." is redundant. • not obvious why clean closure could have greater ecological impact vs. closure in place (global comment).	Agree. Clean closure is the preferred alternative as stated in Section 4.0. The statement in the notes section about both alternatives being equally feasible referred to Decision Factor #4, Feasibility. The notes section has been removed, as it was confusing, and the word "EQUAL" has been added as stated in the response to Comment #7. The phrase "in cost" was removed as requested. For the well head covers, "because of the use of heavy equipment to remove the well head covers" was added to the end of the sentence discussing ecological impact. For the rest of the releases requiring corrective action in which ecological impact was mentioned, "because of the use of heavy equipment to excavate soil" was added to the end of the sentence discussing ecological impact.	

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10.) Section 3.4, Page 50, Table 3-7		Decision Factor #4: • NDEP record taken during stakeholder CAA meeting of 6-11-15 indicates Clean Closure and Closure in Place with URs to be equally feasible.	Agree. The word "EQUAL" has been added to the "Clean Closure" and "Closure in Place" columns of Decision Factor #4.	
11.) Section 3.4, Page 52, Table 3-8		Decision Factor #4: • NDEP record taken during stakeholder CAA meeting of 6-11-15 indicates removing lead shot from crater could be prevented if crater is determined to be inaccessible. • Suggest adding the following NOTE: "While the logistics of implementing clean closure are more extensive than those for closure in place wit URs, clean closure can be accomplished with existing experience and capabilities	For Decision Factor #4, the word "EQUAL" has been added to the "Clean Closure" and "Closure in Place" columns, because access to the Tuna crater is permitted, per a crater stability study conducted. The suggested note has been added to the Clean Closure column in Decision Factor #4, as edited: "Note: While the logistics of implementing clean closure are more extensive than those for closure in place with a UR, clean closure can be accomplished with existing experience and capabilities."	
12.) Section 3.4, Page 53, Table 3-8		Decision Factor #5: • Clean Closure: clarify if lead shot/soil would be managed as hazardous waste or mixed waste.	It is known that the lead shot/soil is hazardous waste. A determination will be made during remediation whether it will be hazardous waste or will be managed as mixed low-level waste. No change was made to the document.	
13.) Section 4.0, Page 54, 1st Paragraph		1st sentence: add the phrase, "and other considerations".	The phrase was added as requested.	
14.) Section 4.0, Page 54, 2nd Paragraph		Last sentence: add brief discussion of how designation of Tuna crater as inaccessible/unsafe could prevent removal of lead shot/soil that extends into crater.	In a recent crater stability study conducted, it was determined that access into the Tuna potential crater area is permitted. Therefore, no change was made.	

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15.) Section 4.0, Page 55, Table 4-1		Indicate the Area and Volume are approximations/estimates.	The word, "Estimated" was added to the title for Table 4-1.	
16.) Section A.1.0, Page A-2, Table A.1-1		Release Source column, Otero Well Head row: check spelling error.	The spelling error was corrected.	
17.) Section A.2.2.2, Page A-12, 3rd Paragraph		Are the sampling locations and/or results of this technique presented on any Figure?	This section is for general techniques applicable to all study groups. Investigations for the presence of buried contamination within specific study groups are discussed in Sections A.3.1.4.2 and A.7.1.4.2. The sample locations for all samples are shown on Figures A.3-1, A.4-1, A.5-1, A.6-3, and A.7-1.	
18.) Section A.2.2.3, Page A-14, 3rd Paragraph		1st sentence: clarify that 1-meter high placement is also consistent with site characterization at other FFACO CAUs.	The text, "and with site characterization at other Soils Activity FFACO CAUs" was added to the end of the sentence.	
19.) Section A.2.2.3, Page A-18, Table A.2-1		Add note explaining TLD F01 was not used in background calculation.	"The TLD at Location F01 was not used in the calculation of background dose because at the time of collection, the dosimeter case was damaged and the dosimeter was lying on a bush below the case." was added as a footnote in Table A.2-1.	

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20.) Section A.3.0, Page A-24, 1st and 2nd Paragraph		Ensure that an appropriate Fig. no. is given when sample locations are referenced.	Figure numbers were globally provided when sample locations were referenced. Additionally, the sample location designator "a" was removed globally in text for Sample Locations A07 and A32, because they only identify depth samples collected from a sample location. They are not different sample locations from A07 and A32.	

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21.) Section A.3.1.4.3, Page A-35, 1st Paragraph		Suggestion: move this discussion into an appendix and provide a table comparison of isotopic analysis for these sample locations, with a brief discussion of implications (if any) for the 25 mrem/OU-yr. Otherwise, these data do not appear to inform decision-making. Also, this method produces concentration-based instead of dose-based measurements, which currently is not applicable for FFACO CAU characterization, except as possibly decision-support data.	It is correct that this discussion does not inform decision-making as the data were already included and presented in the dose calculations. This discussion is presented as supplemental information that supports the use of gamma spectroscopy to characterize Am-241 activities in soil. Therefore, we agree that it is more appropriate to move this entire discussion to an appendix (Appendix G). The discussion in Section A.3.1.4.3 was moved to Appendix G. A paragraph was added to Section A.3.1.4.3 which reads,"A relatively large sample size (~1,600 g) within a Marinelli container is used for the gamma spectroscopy analysis. While this greatly reduces the impact of heterogeneously distributed discrete particles and provides results that are more representative of true contaminant activities at the release site, this method has the potential to provide less accurate results due to the haphazard location of contaminant particles within the Marinelli container at the time of measurement. The distance of particles from the detector would result in some differential self-absorption of the emissions from radioactive particles. As the magnitude of this problem was not previously understood, a study was conducted to evaluate the variability in Am-241 results due to self-absorption from particle position. Results from this study are shown in Appendix G and demonstrate that this effect provides minimal variability in replicate Am-241 measurements."	

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			Reference to Appendix G is provided at the end of Section 1.2, Scope, as follows: "In addition, a study was conducted to evaluate the variability in americium (Am)-241 results due to self-absorption from particle position. Results from this study are shown in Appendix G."	
22.) Section A.3.3.1, Page A-39, 1st Paragraph		1st sentence: insert, "Figure A.3-1" after "sample location"	The study group appropriate figure reference was added globally to the External Radiological Dose Calculations sections in Appendix A.	
23.) Section A.3.3.2, Page A-41, 1st Paragraph		1st sentence: insert, "Figure A.3-1" after "sample location"	The study group appropriate figure reference was added globally to the Internal Radiological Dose Calculations sections in Appendix A.	
24.) Section A.3.3.4, Page A-45, 1st Paragraph		1st sentence: at the end of the sentence insert the phrase, "and therefore the results are not presented".	The phrase was added as requested.	
25.) Section A.3.4, Page A-45, 1st Paragraph		2nd sentence: after the phrase, "Study Group 1 and the" add the word "estimated". Also, briefly discuss how the estimated volumes and areas were determined.	The word "estimated" was added as requested. A brief discussion was added globally to the Nature and Extent of COCs sections in Appendix A discussing how the estimated areas/volumes were determined.	
26.) Section A.3.5, Page A-49, 2nd Paragraph		Last sentence: after "Figure A.3-5", add the phrase, "as Small Soil Areas >95% UCL IA TED".	The phrase was added as requested.	

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27.) Section A.3.5, Page A-50, Figure A.3-5		The inset lower left is blurry and difficult to read.	The inset in the figure was corrected to be easier to read.	
28.) Section A.4.1.3.1, Page A-53, Figure A.4-1		Indicate location of the Boomer Crater on figure.	The Boomer crater area was labeled on the figure.	
29.) Section A.4.3.3, Page A-56, 1st Paragraph		2nd to last sentence: implies perimeter surveys were conducted at other craters in Study Group 2, which did not detect contamination originating from them (Fig A.2-1). Clarify.	The sentence was edited to read, "For the remainder of the crater releases in this study group, no detectable contamination was identified during the radiation surveys performed, originating from these crater releases. According to..."	
30.) Section A.5.4, Page A-65, Figure A.5-2		Indicate location of Chipmunk SE.	The location of the Chipmunk SE DCB has been included on the figure, similar to the labels in Figure A.3-4.	
31.) Section A.6.1.3, Page A-66, 1st Paragraph		1st sentence: should read, "HCA Soil Pile".	The spelling error has been corrected.	
32.) Section A.6.1.3, Page A-68, Figure A.6-2		Indicate location of HCA Soil Pile on figure.	The HCA soil pile has been labeled on the figure.	

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33.) Attachment C-1		This attachment would be more thorough by including the following: • Modify table to identify each release by CAS No. in accordance with similar table style in this document. • Add columns summarizing briefly the Clean Closure and CIP actions that result in stated costs. • Add working definition of "ROM", (i.e., prepared with little/no design information, etc.), and other basic assumptions. • State if these ROM estimates were prepared with reference to any industry standard guidance, i.e., DOE G 413.3-21, "Cost Estimating Guide"	The cost estimate table and text in Attachment C-1 has been modified as requested.	
34.) Section D.10, Page D-1, 1st Paragraph		3rd sentence: insert the full name of the referenced ASTM standard after "...E1739..."	The sentence has been edited to read, "The ASTM Method E1739, 'Standard Guide for Risk-Based Action Applied at Petroleum Release Sites,' defines..."	
35.) Section A.2.2.3, Page A-14, 2nd paragraph		Three TLDs were placed to record background radiation, but only two were used to establish background (see Figure A.2-2). Why was TLD F01 not used?	Discussion of the use of only two TLDs in the calculation of background external dose is presented in Section A.2.3.2. The following sentence was added to the end of the second paragraph in Section A.2.2.3: "See Section A.2.3.2 for a discussion of the external dose calculation for the background TLD locations."	Yes

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36.) General		Although not done in response to specific comments from NDEP, the following changes were made to the draft document: A table was added to the Executive Summary that consists of the FFACO CAS Number and FFACO CAS description for each of the 14 CASs in CAU 568. Table A.8-1 (Waste Summary Table) and Attachment D-1 were updated with the most recent waste disposal information for CAU 568. One waste stream (LLW PPE) has not been disposed of and an addendum will be issued once this waste stream has been disposed. In addition, minor editorial changes have been addressed throughout the document.		

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