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

Corrective Action Unit (CAU) Number: 375
CAU Description: Area 30 Buggy Unit Craters
CAU Owner: Soils - Environmental Restoration (ER)

ROTC No. DOE/NV--1458-ROTC 1 **Page** 1 of 18

Document Type Corrective Action Decision Document/Closure Report (CADD/CR) **Date** 05/08/2025

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

Jaclyn Petrello
Requestor Name

Long-Term Monitoring Activity Lead
Requestor Title

Description of Change:	**Justification:**
1. This ROTC replaces the Use Restriction (UR) information listed in the documentation for CAU 375. UR forms have been updated to list all UR requirements, including but not limited to: post-closure site controls (signs, fencing, etc.), inspection and maintenance requirements, and Geographic Information Systems (GIS) coordinate information. The UR requirements and form(s) included in this ROTC represent the current corrective action requirements for each Corrective Action Site (CAS) in this CAU and supersede information concerning corrective action and post-closure requirements in existing documentation.	1. Some changes in the UR requirements from those found in closure documents have been subsequently modified in letters, memos, and inspection reports. This has resulted in difficulty in determining current post-closure requirements. A review of the post-closure requirements for this CAU has been conducted to ensure that all requirements have been identified and documented on the new UR form. The new UR form was developed to be inclusive of all requirements for long-term monitoring and standardize information contained in the URs consistent with current protocols.
2. The UR boundary coordinate values changed due to conversion from North American Datum (NAD) 1927 to NAD 1983.	2. UR boundary coordinates need to be in one standardized coordinate system.
3. The UR boundary for CAS 25-23-22 was extended in the northeast.	3. The boundary change corresponds with radiologic boundary

FEDERAL FACILITY AGREEMENT AND CONSENT ORDER (FFACO)
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ROTC No. DOE/NV--1458-ROTC 1 **Page** 2 of 18

Document Type Corrective Action Decision Document/Closure Report (CADD/CR) **Date** 05/08/2025

Description of Change:	**Justification:** extension recommended by Radiological Control.

Schedule Impacts:
No impacts to schedule.

ROTC applies to the following document(s):

- U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2011. Corrective Action Decision Document/Closure Report for Corrective Action Unit 375: Area 30 Buggy Unit Craters, Nevada National Security Site, Nevada, Rev. 0, DOE/NV--1458. Las Vegas, NV.

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

Corrective Action Unit (CAU) Number: 375
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ROTC No. DOE/NV--1458-ROTC 1 **Page** 3 of 18

Document Type Corrective Action Decision Document/Closure Report (CADD/CR) **Date** 05/08/2025

Approvals:

JACLYN PETRELLO Digitally signed by JACLYN PETRELLO Date: 2025.05.08 07:23:54 -07'00' Date ______

Jaclyn Petrello
Activity Lead
Environmental Management (EM) Nevada Program

TIFFANY GAMERO Digitally signed by TIFFANY GAMERO Date: 2025.05.08 06:32:56 -07'00' Date ______

Tiffany Gamero
FFACO Agreement Coordinator
Environmental Management (EM) Nevada Program

Christine Andres Digitally signed by Christine Andres Date: 2025.05.08 15:16:03 -07'00' Date ______

Christine Andres
Chief, Bureau of Federal Facilities
Nevada Division of Environmental Protection (NDEP)

U.S. Department of Energy, Environmental Management Nevada Program
Use Restriction Information

General Information

Use Restriction (UR) Type(s):	FFACO Only
Corrective Action Unit (CAU) Number & Description:	375 - Area 30 Buggy Unit Craters
Corrective Action Site (CAS) Number & Description:	25-23-22 - Contaminated Soils Site
CAU/CAS Owner:	Soils - ER
Note:	N/A

Section I. *Federal Facility Agreement and Consent Order* (FFACO) UR

Basis for FFACO UR

Summary Statement: This FFACO UR is established to protect workers from inadvertent exposure to Radiological contaminants that were released at this site. Radiological contaminants are present that exceed final action levels.

FFACO UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
FFACO Boundary	1	566,169	4,076,084
	2	566,130	4,076,100
	3	566,030	4,076,116
	4	565,954	4,076,176
	5	565,895	4,076,175
	6	565,886	4,076,182
	7	565,886	4,076,213
	8	565,899	4,076,226
	9	565,946	4,076,226
	10	565,995	4,076,286
	11	566,053	4,076,278
	12	566,056	4,076,282
	13	566,129	4,076,279
	14	566,142	4,076,298
	15	566,163	4,076,281
	16	566,224	4,076,310
	17	566,303	4,076,240
	18	566,291	4,076,170
	19	566,299	4,076,162
	20	566,289	4,076,142
	21	566,169	4,076,084

[1] UR Points are listed clockwise beginning at the southernmost point. If multiple points share the southernmost Northing coordinate, the easternmost point is listed as Point 1.

[2] UR coordinate values presented herein were transformed from the North American Datum of 1927, and rounded to the nearest meter; resultant coordinates may not reflect the original precision of values contained within the source GIS data set.

Boundary Applies to: Both Surface and Subsurface

Depth is unknown.

Survey Source: GIS

FFACO UR Requirements

Site Controls:

This FFACO UR is recorded as described in **Section IV. Recordation Requirements** to restrict activities within the area by the coordinates listed above and depicted in the attached figure without prior notification of NDEP unless the activities are conducted under the provisions of 10 CFR, Part 835, Occupational Radiation Protection and 10 CFR, Part 851, Worker Safety and Health Program.

Control	Criteria
Signage	Present and legible.

Inspection Frequency: Annual

Additional Considerations:

Consideration	Criteria
None	None

Requirements Comments:

Section II. Administrative UR

An Administrative UR is not identified for this site.

Section III. Supporting Documentation

UR Source Document(s)

ROTC 1 for CAU 375 CADD/CR (DOE/NV--1458), dated **05/08/2025**.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2011. Corrective Action Decision Document/Closure Report for Corrective Action Unit 375: Area 30 Buggy Unit Craters, Nevada National Security Site, Nevada, Rev. 0, DOE/NV--1458. Las Vegas, NV.

Attachments

- UR Boundary Map (UTM, Zone 11, NAD 83 meters)

Section IV. Recordation Requirements

Recordation:

The above UR(s) are recorded in the:

- FFACO Database
- NNSA M&O Contractor GIS
- EM Nevada Program CAU/CAS Files

Section V. EM Nevada Program Approval

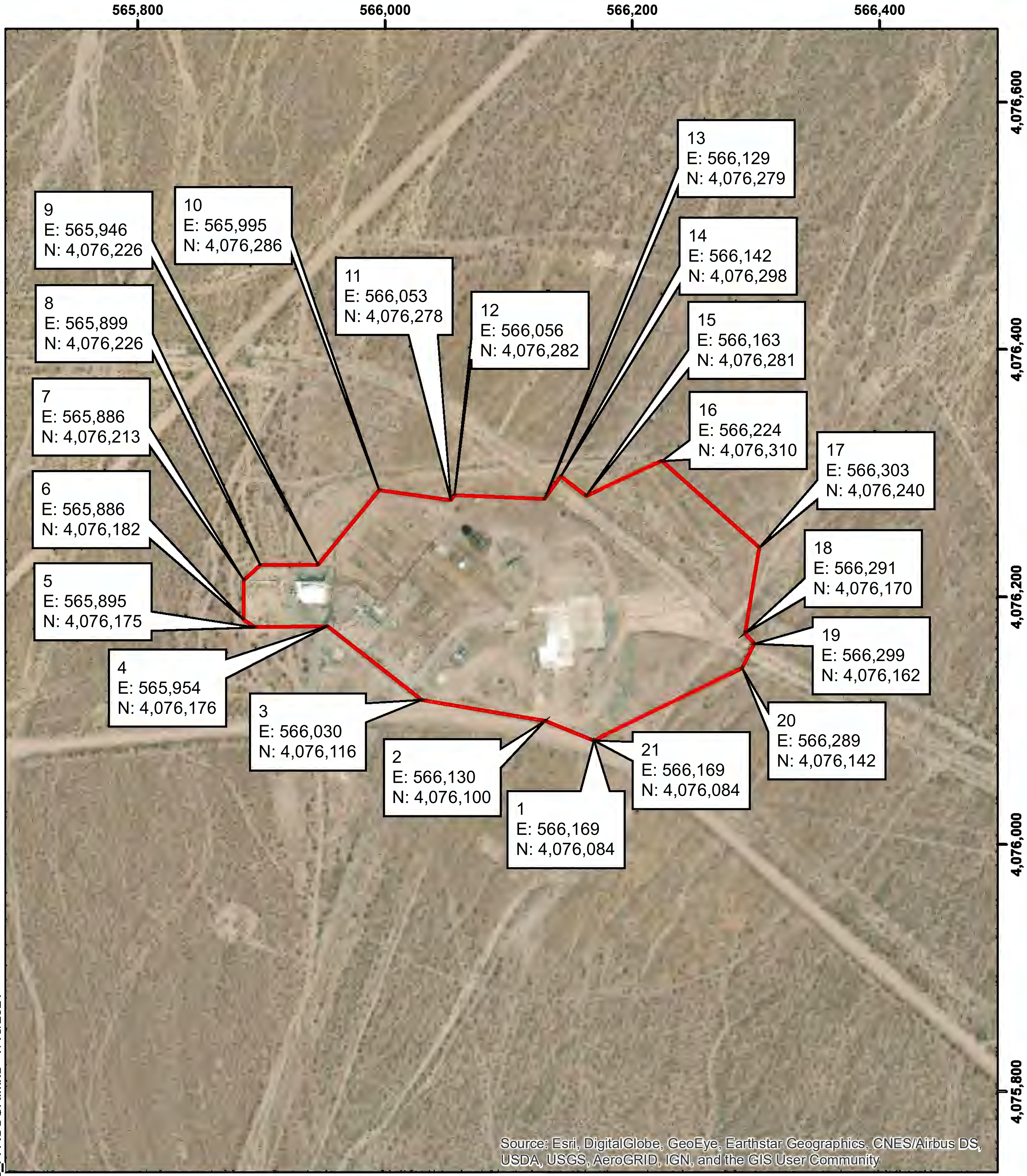
JACLYN PETRELLO Digitally signed by JACLYN PETRELLO Date: 2025.05.08 07:24:23 -07'00'

Date: ______________________

Jaclyn Petrello

Activity Lead

EM Nevada Program



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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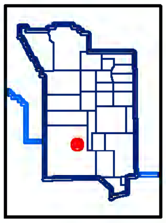


CAU 375, CAS 25-23-22
Contaminated Soils Site
FFACO UR Boundary

Explanation

🟥 FFACO UR

Source: Navarro GIS, 2021

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Supplemental Information Figure

Additional supplemental information on site features was not present in previous iterations of this Use Restriction (UR), therefore a supplemental information figure is not attached. If additional information on site features is required for this site, please contact the *Federal Facility Agreement and Consent Order* (FFACO) Database Administrator.

U.S. Department of Energy, Environmental Management Nevada Program
Use Restriction Information

General Information

Use Restriction (UR) Type(s):	Both FFACO and Administrative
Corrective Action Unit (CAU) Number & Description:	375 - Area 30 Buggy Unit Craters
Corrective Action Site (CAS) Number & Description:	30-45-01 - U-30a, b, c, d, e Craters
CAU/CAS Owner:	Soils - ER
Note:	N/A

Section I. *Federal Facility Agreement and Consent Order* (FFACO) UR

Basis for FFACO UR

Summary Statement: This FFACO UR is established to protect workers from inadvertent exposure to Radiological contaminants that were released at this site. Radiological contaminants are assumed to be present that exceed final action levels.

U.S. Department of Energy, Environmental Management Nevada Program
Use Restriction Information

FFACO UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
FFACO Boundary	1	555,910	4,095,749
	2	555,848	4,095,761
	3	555,803	4,095,755
	4	555,781	4,095,772
	5	555,773	4,095,804
	6	555,723	4,095,842
	7	555,709	4,095,894
	8	555,700	4,096,009
	9	555,741	4,096,035
	10	555,789	4,096,047
	11	555,816	4,096,086
	12	555,858	4,096,093
	13	555,997	4,096,035
	14	556,062	4,095,971
	15	556,070	4,095,926
	16	556,045	4,095,808
	17	555,989	4,095,757
	18	555,910	4,095,749

[1] UR Points are listed clockwise beginning at the southernmost point. If multiple points share the southernmost Northing coordinate, the easternmost point is listed as Point 1.

[2] UR coordinate values presented herein were transformed from the North American Datum of 1927, and rounded to the nearest meter; resultant coordinates may not reflect the original precision of values contained within the source GIS data set.

Boundary Applies to: Both Surface and Subsurface

Depth is unknown.

Survey Source: GIS

FFACO UR Requirements

Site Controls:

This FFACO UR is recorded as described in **Section IV. Recordation Requirements** to restrict activities within the area by the coordinates listed above and depicted in the attached figure without prior notification of NDEP unless the activities are conducted under the provisions of 10 CFR, Part 835, Occupational Radiation Protection and 10 CFR, Part 851, Worker Safety and Health Program.

Control	Criteria
Signage	Present and legible.

Inspection Frequency: Annual

Additional Considerations:

Consideration	Criteria
None	None

Requirements Comments:

Section II. Administrative UR

Basis for Administrative UR

Summary Statement: This Administrative UR is established to protect workers should future land use result in increased exposure to site contaminants. Radiological contaminants are present that exceed action levels under the Industrial Area (2,000 hours per year) exposure scenario.

U.S. Department of Energy, Environmental Management Nevada Program
Use Restriction Information

Administrative UR Physical Description

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

UR Boundary	UR Point[1]	Easting[2]	Northing[2]
Admin Boundary	1	555,950	4,095,638
	2	555,834	4,095,662
	3	555,642	4,095,781
	4	555,563	4,095,872
	5	555,552	4,095,954
	6	555,570	4,096,077
	7	555,599	4,096,120
	8	555,976	4,096,196
	9	556,119	4,096,138
	10	556,222	4,095,954
	11	556,230	4,095,913
	12	556,207	4,095,836
	13	556,140	4,095,747
	14	556,040	4,095,670
	15	555,950	4,095,638

[1] UR Points are listed clockwise beginning at the southernmost point. If multiple points share the southernmost Northing coordinate, the easternmost point is listed as Point 1.

[2] UR coordinate values presented herein were transformed from the North American Datum of 1927, and rounded to the nearest meter; resultant coordinates may not reflect the original precision of values contained within the source GIS data set.

Boundary Applies to: Surface

Starting Depth: 0

Ending Depth: 5

Depth Unit: Centimeters

Survey Source: GIS

Administrative UR Requirements

Administrative URs do not require onsite postings or other physical barriers, and they do not require periodic inspections or maintenance.

Site Controls:

This Administrative UR is recorded as described in **Section IV. Recordation Requirements** to restrict activities within the area defined by the coordinates listed above and depicted in the attached figure without prior notification of NDEP unless the activities are conducted under the provisions of 10 CFR, Part 835, Occupational Radiation Protection and 10 CFR, Part 851, Worker Safety and Health Program.

Section III. Supporting Documentation

UR Source Document(s)

ROTC 1 for CAU 375 CADD/CR (DOE/NV--1458), dated **05/08/2025**.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2011. Corrective Action Decision Document/Closure Report for Corrective Action Unit 375: Area 30 Buggy Unit Craters, Nevada National Security Site, Nevada, Rev. 0, DOE/NV--1458. Las Vegas, NV.

Attachments

- UR Boundary Maps (UTM, Zone 11, NAD 83 meters)

Section IV. Recordation Requirements

Recordation:

The above UR(s) are recorded in the:

- FFACO Database
- NNSA M&O Contractor GIS
- EM Nevada Program CAU/CAS Files

Section V. EM Nevada Program Approval

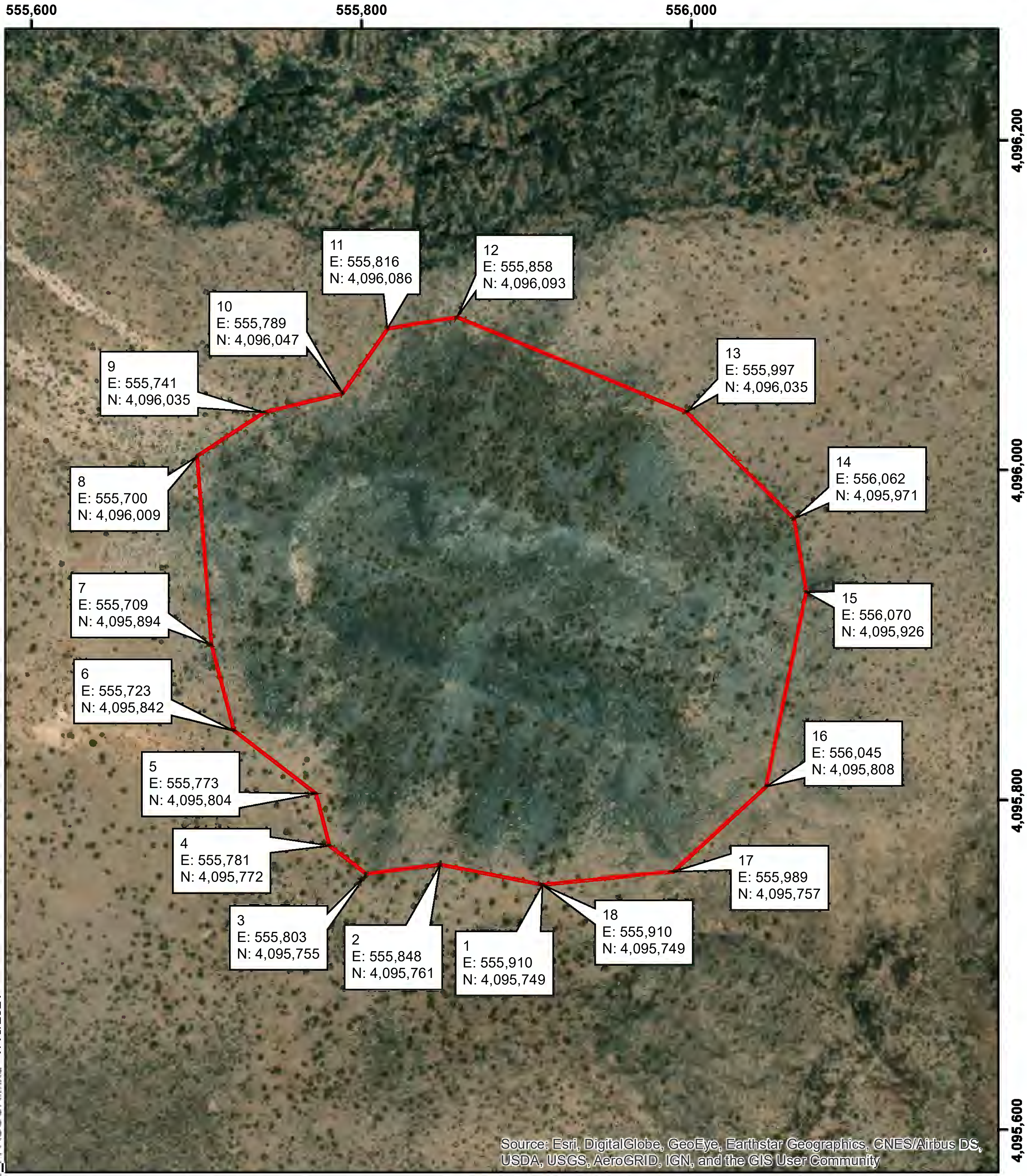
JACLYN PETRELLO Digitally signed by JACLYN PETRELLO Date: 2025.05.08 07:24:56 -07'00'

Date: ____________________

Jaclyn Petrello

Activity Lead

EM Nevada Program



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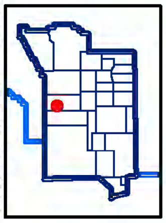
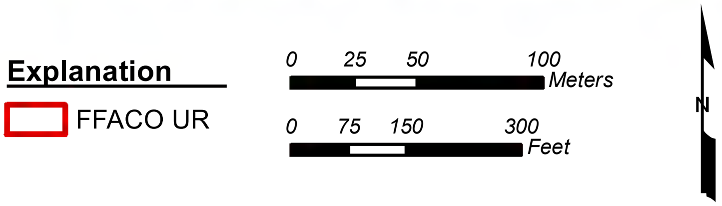
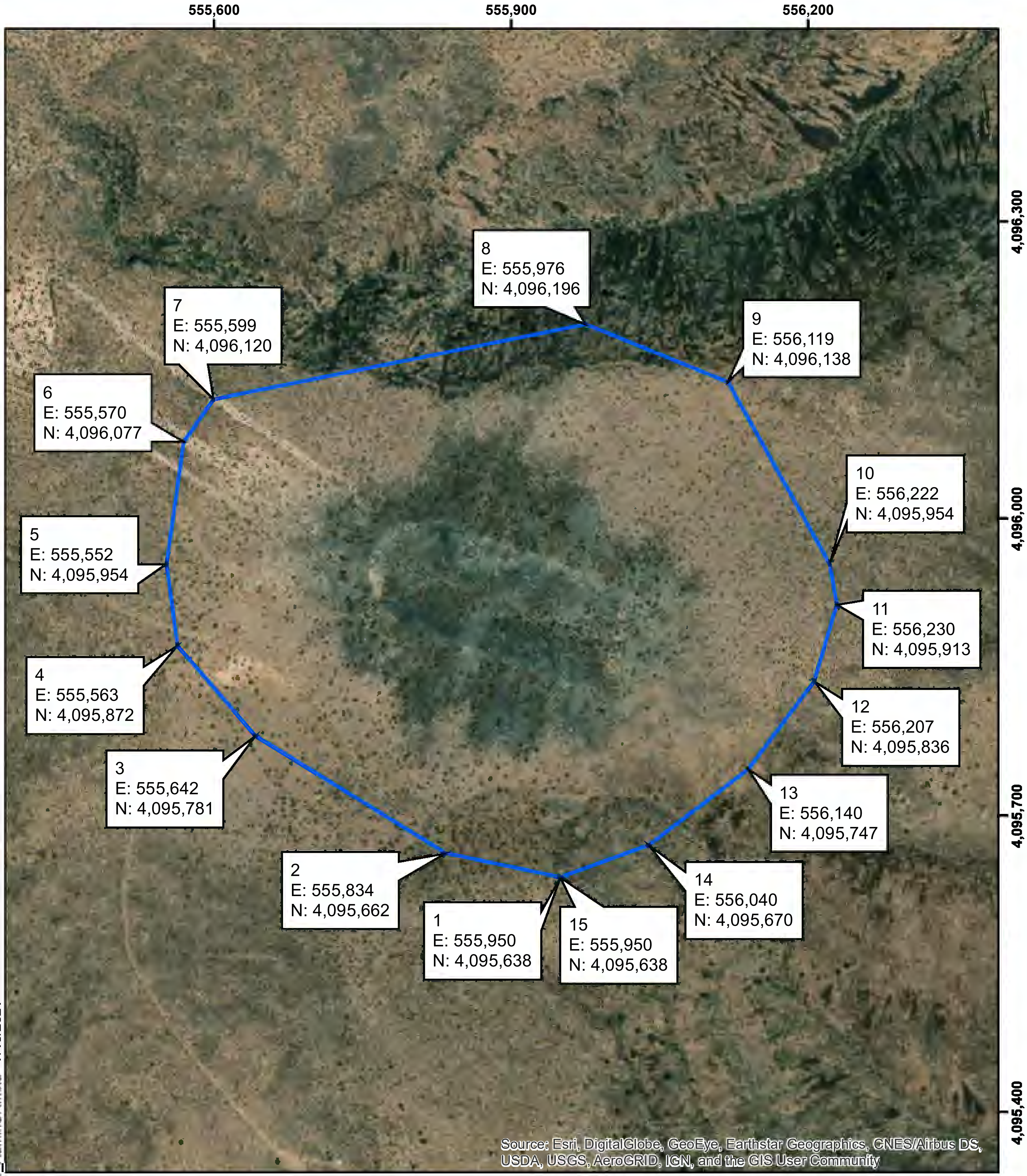


CAU 375, CAS 30-45-01
U-30a, b, c, d, e Craters
FFACO UR Boundary



Source: Navarro GIS, 2021

Coordinate System: NAD 1983 UTM Zone 11N, Meter



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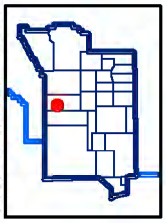

CAU 375, CAS 30-45-01
U-30a, b, c, d, e Craters
Administrative UR Boundary

Explanation

▭ Admin UR

Source: Navarro GIS, 2021

Coordinate System: NAD 1983 UTM Zone 11N, Meter

Supplemental Information Figure

Additional supplemental information on site features was not present in previous iterations of this Use Restriction (UR), therefore a supplemental information figure is not attached. If additional information on site features is required for this site, please contact the *Federal Facility Agreement and Consent Order* (FFACO) Database Administrator.

Nevada
Environmental
Restoration
Project

DOE/NV--1458

National Nuclear Security Administration

Corrective Action Decision Document/ Closure Report for Corrective Action Unit 375: Area 30 Buggy Unit Craters Nevada National Security Site, Nevada

Controlled Copy No.: UNCONTROLLED
Revision No.: 0

August 2011

Approved for public release; further dissemination unlimited.

Environmental Restoration
Project

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

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DOE/NV--1458

CORRECTIVE ACTION DECISION DOCUMENT/ CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 375: AREA 30 BUGGY UNIT CRATERS NEVADA NATIONAL SECURITY SITE, NEVADA

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

Controlled Copy No.: UNCONTROLLED

Revision No.: 0

August 2011

Reviewed and determined to be UNCLASSIFIED
Derivative Classifier: Joseph P. Johnston/N-I CO
(Name/personal ~~identifier~~ and position title)
Signature: /s/ Joseph P. Johnston
Date: 8/9/2011

CORRECTIVE ACTION DECISION DOCUMENT/CLOSURE REPORT FOR
CORRECTIVE ACTION UNIT 375:
AREA 30 BUGGY UNIT CRATERS
NEVADA NATIONAL SECURITY SITE, NEVADA

Approved by: /S/ Kevin Cabble Date: 8-9-11

Kevin J. Cabble
Federal Sub-Project Director
Soils Sub-Project

Approved by: /S/ Robert F. Boehlecke Date: 8/9/11

Robert F. Boehlecke
Federal Project Director
Environmental Restoration Project

Table of Contents

Appendix A - Corrective Action Investigation Results

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Table of Contents *(Continued)*

Appendix B - Data Assessment

Appendix C - Risk Assessment

Attachment C-1 - Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit (CAU) 375 Area 30 Buggy Unit Craters Nevada National Security Site, Nevada

Table of Contents *(Continued)*

List of Figures

List of Tables

List of Tables (Continued)

List of Tables *(Continued)*

List of Acronyms and Abbreviations

Ac	Actinium
Ag	Silver
Am	Americium
ANPR	Advance Notice of Proposed Rulemaking
ASTM	ASTM International
bgs	Below ground surface
BMP	Best management practice
BOL	Bill of Lading
CA	Contamination area
CAA	Corrective action alternative
CADD	Corrective action decision document
CAI	Corrective action investigation
CAIP	Corrective action investigation plan
CAS	Corrective action site
CAU	Corrective action unit
CD	Certificate of Disposal
CED	Committed effective dose
CFR	*Code of Federal Regulations*
CLP	Contract Laboratory Program
cm	Centimeter
Cm	Curium
Co	Cobalt
COC	Contaminant of concern
COPC	Contaminant of potential concern
CR	Closure report
Cs	Cesium

List of Acronyms and Abbreviations *(Continued)*

CSM	Conceptual site model
CZ	Contamination zone
day/yr	Days per year
DEM	Digital Elevation Model
DOE	U.S. Department of Energy
DQA	Data quality assessment
DQI	Data quality indicator
DQO	Data quality objective
EML	Environmental Measurements Laboratory
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 Lower Energy Radiation
FSR	Field-screening result
ft	Foot
ft^2	Square foot
g/yr	Grams per year
GPS	Global Positioning System
GWS	Gamma walkover survey
GZ	Ground zero
HASL	Health and Safety Laboratory
hr/day	Hours per day
hr/yr	Hours per year
ICRP	International Commission on Radiological Protection

List of Acronyms and Abbreviations *(Continued)*

ID	Identification
IDW	Investigation-derived waste
in.	Inch
lb	Pound
LCS	Laboratory control sample
LLW	Low-level waste
m	Meter
m^2	Square meter
m^3	Cubic meter
m/yr	Meters per year
MDC	Minimum detectable concentration
mg/day	Milligrams per day
mg/kg	Milligrams per kilogram
M&O	Management and operating
mrem	Millirem
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*
NAD	North American Datum
Nb	Niobium
NDEP	Nevada Division of Environmental Protection
N-I	Navarro-Intera, LLC
NIOSH	National Institute for Occupational Safety and Health

List of Acronyms and Abbreviations *(Continued)*

NIST	National Institute of Standards and Technology
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NNSS	Nevada National Security Site
NRDS	Nuclear Rocket Development Station
NTS	Nevada Test Site
PAL	Preliminary action level
Pb	Lead
PCB	Polychlorinated biphenyl
pCi/g	Picocuries per gram
PPE	Personal protective equipment
PRG	Preliminary Remediation Goal
PSDR	Package Storage and Disposal Request
PSM	Potential source material
Pu	Plutonium
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RBCA	Risk-based corrective action
RBSL	Risk-based screening level
RCRA	*Resource Conservation and Recovery Act*
RESRAD	Residual Radioactive
RIDP	Radionuclide Inventory and Distribution Program
R-MAD	Reactor Maintenance, Assembly, and Disassembly
RPD	Relative percent difference
RRMG	Residual radioactive material guideline
RWMS	Radioactive Waste Management Site

List of Acronyms and Abbreviations *(Continued)*

SCL	Sample collection log
Sr	Strontium
SSTL	Site-specific target level
SVOC	Semivolatile organic compound
TCA	Test Cell A
TED	Total effective dose
Th	Thorium
Tl	Thallium
TLD	Thermoluminescent dosimeter
U	Uranium
UCL	Upper confidence limit
UR	Use restriction
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
VSP	Visual Sample Plan
μR/hr	Microroentgens per hour

Executive Summary

This Corrective Action Decision Document (CADD)/Closure Report (CR) has been prepared for Corrective Action Unit (CAU) 375, Area 30 Buggy Unit Craters, located within Areas 25 and 30 at the Nevada National Security Site, Nevada, in accordance with the *Federal Facility Agreement and Consent Order* (FFACO). Corrective Action Unit 375 comprises three corrective action sites (CASs):

- 25-23-22, Contaminated Soils Site
- 25-34-06, Test Cell A Bunker
- 30-45-01, U-30a, b, c, d, e Craters

The purpose of this CADD/CR is to provide justification and documentation supporting the recommendation that no further corrective action is needed for CAU 375 based on the implementation of corrective action of closure in place with administrative controls at CAS 25-23-22, no further action at CAS 25-34-06, and closure in place with administrative controls and removal of potential source material (PSM) at CAS 30-45-01. Corrective action investigation (CAI) activities were performed from July 28, 2010, through April 4, 2011, as set forth in the *Corrective Action Investigation Plan for Corrective Action Unit 375: Area 30 Buggy Unit Craters.*

The approach for the CAI was divided into two facets: investigation of the primary release of radionuclides, and investigation of other releases (migration in washes and chemical releases). The purpose of the CAI was to fulfill data needs as defined during the data quality objective (DQO) process. The CAU 375 dataset of investigation results was evaluated based on the data quality assessment. This assessment demonstrated the dataset is 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 Remote Work Area exposure scenario (336 hours of annual exposure). Radiological doses exceeding the FAL were assumed to be present within the default contamination boundaries at CASs 25-23-22 and 30-45-01. No contaminants were identified at CAS 25-34-06, and no corrective action is necessary. Potential source material in the form of lead plate, lead-acid batteries, and oil within an abandoned transformer were identified at CAS 30-45-01, and corrective actions were undertaken that consisted of removing

the PSM. Use restrictions and warning signs were implemented for the remaining radiological contamination at CASs 25-23-22 and 30-45-01. These use restrictions were recorded in the FFACO database; the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) Facility Information Management System; and the NNSA/NSO CAU/CAS files.

Therefore, NNSA/NSO provides the following recommendations:

- No further corrective actions are necessary for CAU 375.
- A Notice of Completion to NNSA/NSO is requested from the Nevada Division of Environmental Protection for closure of CAU 375.
- Move CAU 375 from Appendix III to Appendix IV of the FFACO.

1.0 Introduction

This Corrective Action Decision Document (CADD)/Closure Report (CR) presents information supporting closure of Corrective Action Unit (CAU) 375, Area 30 Buggy Unit Craters, located at the Nevada National Security Site (NNSS), Nevada. The corrective actions described in this document were implemented in accordance with the *Federal Facility Agreement and Consent Order* (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. The NNSS is located approximately 65 miles northwest of Las Vegas, Nevada.

Corrective Action Unit 375 comprises the three corrective action sites (CASs) shown on Figure 1-1 and listed below:

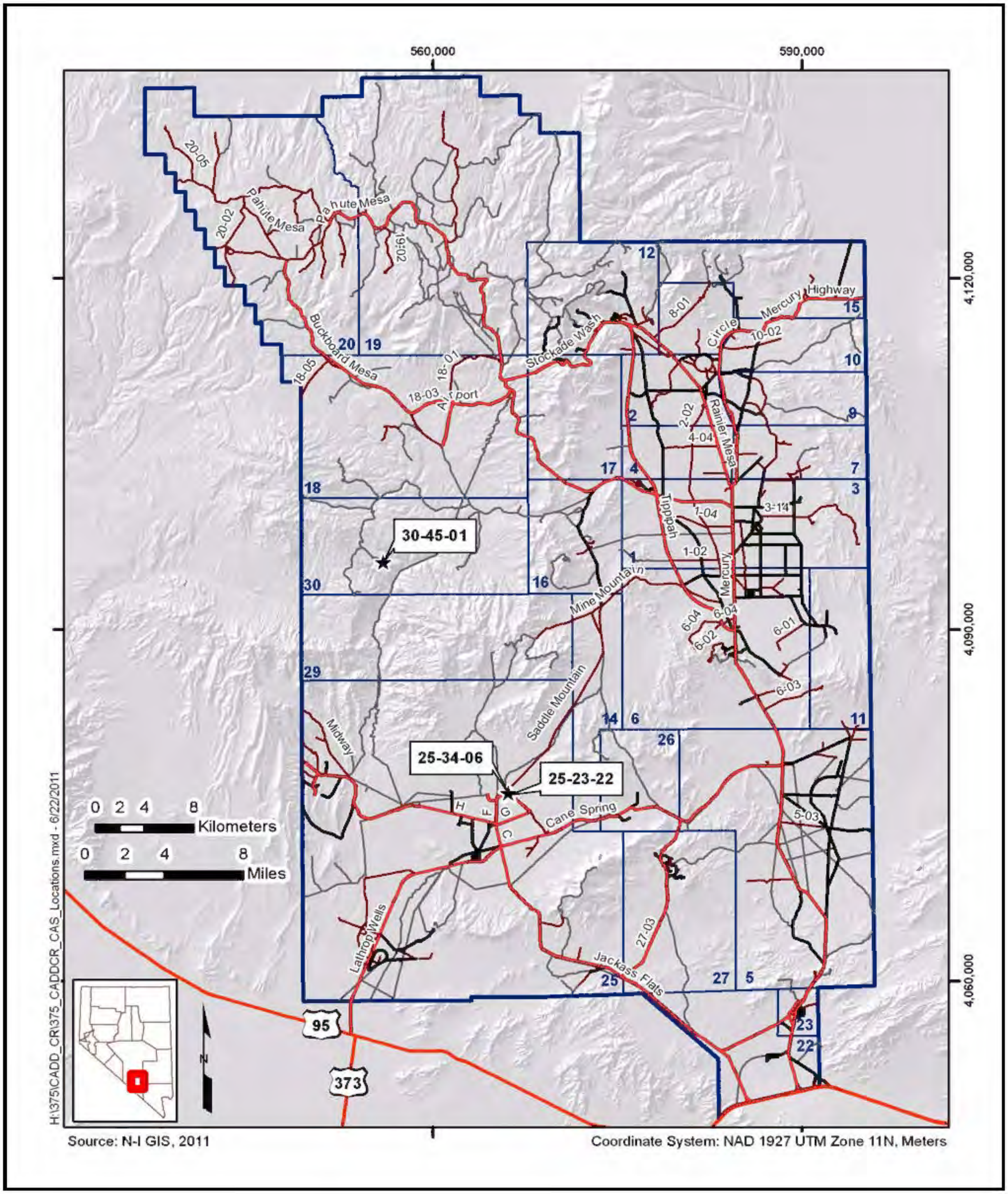
- 25-23-22, Contaminated Soils Site
- 25-34-06, Test Cell A Bunker
- 30-45-01, U-30a, b, c, d, e Craters

A detailed discussion of the history of this CAU is presented in the *Corrective Action Investigation Plan* (CAIP) *for Corrective Action Unit 375: Area 30 Buggy Unit Craters* (NNSA/NSO, 2010).

1.1 Purpose

This report provides documentation and justification for the closure of CAU 375. This includes a description of investigation activities and evaluation of the data, and a description of corrective actions that were performed. The investigative activities were conducted in accordance with the CAIP except as noted herein. The corrective actions include removing potential source materials (PSMs) and implementing use restrictions (URs) for remaining contamination that exceeds the final action levels (FALs). Based on the implementation of these corrective actions, no further corrective actions are necessary at CAU 375. The CAIP provides information relating to site history as well as the scope and planning of the investigation. Therefore, this information will not be repeated in this document.

Corrective Action Unit 375 consists of three inactive sites at the NNSS. Corrective Action Site 25-23-22 (referred to as Test Cell A [TCA] in this document) is located in Area 25 and consists of a



Source: N-I GIS, 2011

Coordinate System: NAD 1927 UTM Zone 11N, Meters

Figure 1-1
CAU 375, CAS Location Map

release of radioactive material from the testing of nuclear rocket motors that exhausted directly to the atmosphere and resulted in surface soil contamination.

Corrective Action Site 25-34-06 (referred to as the TCA Bunker in this document) is located in Area 25 within the fenced area at TCA and consists of the potential release of contamination associated with material that was stored in the TCA Bunker.

Corrective Action Site 30-45-01 (referred to as Buggy in this document) is located in Area 30 and consists of a release of radionuclides to the surrounding soil from the Buggy test (consisting of five devices) conducted as part of the Plowshare program. Because this test was conducted underground, radioactive contamination at this site also includes the prompt injection of radioactive material from the test detonation that remains within the oblong crater and ejecta mounds surrounding the crater.

1.2 Scope

The corrective action investigation (CAI) for CAU 375 was completed by demonstrating through environmental soil and thermoluminescent dosimeter (TLD) sample analytical results the nature and extent of contaminants of concern (COCs) at all CASs. (Note: For radiological releases, a COC is defined as the presence of radionuclides that jointly present a dose to a receptor exceeding 25 millirem per year [mrem/yr] based on the appropriate exposure scenario).

The collection of samples was not feasible at some locations. Therefore, the following assumptions were necessary:

- A dose greater than the FAL may exist anywhere within the fenced area at TCA.
- A dose greater than the FAL may exist within the crater and ejecta field at Buggy.

The scope of the investigation activities at CAU 375 included performing visual surveys, collecting environmental and quality control (QC) samples, and placing TLDs. The scope of the corrective action activities included evaluating corrective action alternatives (CAAs), removing PSMs, establishing and posting URs, and documenting closure activities.

1.3 CADD/CR Contents

This document is divided into the following sections and appendices:

Section 1.0, "Introduction," summarizes the document purpose, scope, and contents.

Section 2.0, "Corrective Action Investigation Summary," summarizes the investigation field activities and the results of the investigation, and justifies that no further corrective action is needed.

Section 3.0, "Recommendation," provides the basis for requesting that the CAU be moved from Appendix III to Appendix IV of the FFACO.

Section 4.0, "References," provides a list of all referenced documents used in the preparation of this CADD/CR.

Appendix A, *Corrective Action Investigation Results*, provides a description of the project objectives, field investigation and sampling activities, investigation results, waste management, and quality assurance (QA). Sections A.3.0 through A.5.0 provide specific information regarding field activities, sampling methods, and laboratory analytical results from the investigation.

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

Appendix C, *Risk Assessment*, presents an evaluation of risk associated with the establishment of FALs.

Appendix D, *Closure Activity Summary*, provides details on the completed closure activities, and includes the required verification activities and supporting documentation.

Appendix E, *Evaluation of Corrective Action Alternatives*, provides a discussion of the results of the CAI, the alternatives considered, and the rationale for the recommended alternative.

Appendix F, *Data Tables*, provides tabular compilations of validated analytical results that provide a basis for the internal radiological dose estimates and the tabular compilations of TLD sample data that provide a basis for the external radiological dose estimates.

Appendix G, *Sample Location Coordinates*, presents the northing and easting coordinates for each sample plot, the biased sample locations, and other points of interest.

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

1.3.1 Applicable Programmatic Plans and Documents

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

- CAIP for CAU 375, Area 30 Buggy Unit Craters (NNSA/NSO, 2010)
- *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002)
- FFACO (1996, as amended)

1.3.2 Data Quality Assessment Summary

The DQO process as agreed to by stakeholders and as presented in the CAIP (NNSA/NSO, 2010) ensures that the right type, quality, and quantity of data will be available to support the resolution of DQO decisions with an appropriate level of confidence. A DQA as summarized in Section 2.2.2 and presented in Appendix B evaluates the degree of acceptability and usability of the reported data in the decision-making process. Using both the DQO and DQA processes help to ensure that DQO decisions are sound and defensible.

Based on this evaluation the nature and extent of COCs at CAU 375 have been adequately identified to implement the corrective actions. Information generated during the investigation supports the conceptual site model (CSM) assumptions, and the data collected met the DQOs and support their intended use in the decision-making process.

2.0 Corrective Action Investigation Summary

The following sections summarize the investigation activities and investigation results, and justify why no further corrective action is required at CAU 375. Detailed investigation activities and results for individual CAU 375 CASs are presented in Appendix A of this document.

2.1 Investigation Activities

Corrective action investigation activities were conducted as set forth in the CAU 375 CAIP (NNSA/NSO, 2010) from July 28, 2010, through April 4, 2011. The purpose of the CAU 375 CAI was to provide the additional information needed to resolve the following project-specific DQOs:

- Determining whether COCs are present in the soils associated with CAU 375.
- Determining the extent of identified COCs.
- Ensuring adequate data have been collected to evaluate closure alternatives under the FFACO.

The scope of the CAI included the following activities:

- Performing visual surveys
- Performing radiological surveys
- Collecting environmental samples for laboratory analyses
- Collecting QC samples for laboratory analyses
- Placing, collecting, and analyzing TLDs

To facilitate site investigation and the evaluation of DQO decisions for different CSM components, the releases at each CAS were classified into one of the following two categories:

- **Primary releases** (referred to as “test releases” in the CAIP [NNSA/NSO, 2010]) – This release category is specific to the atmospheric deposition of radionuclide contamination onto the soil surface that has not been displaced through excavation or migration in the case of TCA and Buggy, and to the potential contaminants associated with items stored in the TCA Bunker. The contamination associated with the primary releases is limited to the top 5 centimeters (cm) of undisturbed soil. Sampling surface soils to a depth of 5 cm is appropriate for areas that have not been disturbed, as numerous studies of soils contaminated by atmospheric deposition following nuclear testing at the NNSS have shown that more than 90 percent of the radioactivity in undisturbed soil is contained within the top 5 cm of soil (McArthur and Kordas, 1983 and 1985; Gilbert et al., 1977; Tamura, 1977). Therefore, for the purposes of this CADD/CR, surface is defined as the upper 5 cm of soil for the TCA and Buggy CASs.

- **Other releases** (referred to as "non-test releases" in the CAIP) – This release category includes any radionuclide contamination from test activities that is not limited to the top 5 cm of surface soil for TCA and Buggy CASs as well as judgmental bias identified on the concrete floor of the TCA Bunker. The TCA Bunker has a concrete floor and has accumulated dirt and dust along with evidence of small animal habitation. Therefore, for the purposes of this CADD/CR, the TCA Bunker surface is defined as the dirt, dust, and gravel located on top of the concrete floor and at the entrance to the bunker. For TCA and Buggy, this includes radionuclide contaminants that were initially deposited onto the soil surface (as in the primary release category), but have subsequently been displaced through excavation or migration. This category also includes radionuclides that were deposited under mechanisms other than atmospheric deposition. This includes the injection of radionuclides into native material from the nuclear detonation (such as in the Buggy crater from the Buggy Plowshare test), the deposition of ejecta piles around the Buggy crater, and any other chemical or radiological contamination discovered during the investigation through the identification of biasing factors that are not a part of a previously identified release. The depth of radiological contamination from other releases is dependent upon the nature of the release or subsequent movement through excavation or migration. Investigation of other releases was accomplished through measurements of soil radioactivity using a judgmental sampling scheme at depths dependent upon the nature of the release, or by conservative assumptions that radioactivity is present at depth based on process knowledge.

For the primary release at CASs 25-23-22 and 30-45-01, sample plots were established judgmentally based on aerial radiation surveys (BN, 1999a and b) and the results of the gamma walkover surveys (GWSs). Within each sample plot, probabilistic sample locations were established based on a randomized grid. For other releases at CASs 25-23-22 and 30-45-01 and the primary release at CAS 25-34-06, judgmental sample locations were determined based on biasing criteria such as elevated radiological readings, sediment accumulation areas, PSM, and stained soil.

Confidence in judgmental sampling scheme decisions was established qualitatively through validation of the CSM and verification that the selected plot locations meet the DQO criteria. Samples within the sample plots were collected and evaluated based on a probabilistic sample scheme. Confidence in probabilistic sampling scheme decisions was established by validating the CSM, justifying that sampling locations are representative of the plot area, and demonstrating that a sufficient number of samples were collected to justify statistical inferences (e.g., averages and 95 percent upper confidence limits [UCLs]).

The potential external dose at each TLD location was determined from the results of a TLD placed at a height of 1 meter (m) above the soil surface. The net external dose (the gross TLD dose reading minus the background dose) was then divided by the number of hours the TLD was exposed to site contamination resulting in an hourly dose rate. That hourly dose rate was then multiplied by the number of hours per year (hr/yr) that a site worker would be present at the site (i.e., the annual exposure duration) to establish the maximum potential annual external dose a site worker could receive. The appropriate annual exposure duration, in hours, is based on the exposure scenario used (as defined in this section).

The potential internal dose at each soil sample location was determined based on the laboratory analytical results of soil samples and residual radioactivity material guidelines (RRMGs) that were calculated using the Residual Radioactive (RESRAD) computer code (Yu et al., 2001) (see Appendix C, Attachment C-1). The RRMGs are the activity concentrations of individual radionuclides in surface soil that would cause a receptor to receive an internal dose equal to the radiological FAL. The internal doses from each of the radionuclides are then summed to produce the total potential internal dose.

The potential internal dose at each TLD location where soil samples were not collected was conservatively estimated using the calculated net external dose from the TLD and the ratio of internal dose to external dose from the plot with the maximum internal dose. This was done under the conservative assumption that the internal dose at any CAU 375 location would constitute the same percentage of the total dose as at the plot where the maximum internal dose was observed. Therefore, the ratio of the internal to external dose was determined at the plot with the highest internal dose by dividing the internal dose by the external dose. This CAS-specific ratio was then multiplied by the external dose measured at each TLD location where soil samples were not collected to estimate the internal dose at these locations.

The calculated total effective dose (TED) (the sum of internal and external dose) 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, 2010) as the sum of the effective dose (for external exposures) and the committed effective dose (for internal exposures).

Because a measured TED is an estimate of the true (unknown) TED, it is uncertain how well the calculated TED represents the true TED. If the measured TED were significantly different than the true TED, a decision based on the measured TED could result in a decision error. To reduce the probability of making a false negative decision error at probabilistic sample locations, a conservative estimate of the true TED is used to compare to the FAL instead of the measured TED. This conservative estimate (overestimation) of the true TED was calculated as the 95 percent UCL of the average TED measurements. By definition, there will be a 95 percent probability that the true TED is less than the 95 percent UCL of the measured TED.

As described in Appendix C, 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:

- **Industrial Area –** Assumes continuous industrial use of a site. This scenario addresses exposure to industrial workers exposed daily to contaminants in soil during an average workday. This scenario assumes that this is the regular assigned work area for the worker who will be on the site for an entire career (225 days per year [day/yr], 10 hours per day [hr/day] for 25 years). The TED values calculated using this exposure scenario are the TED an industrial worker receives during 2,250 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 addresses exposure to industrial workers exposed to contaminants in soil during a portion of an average workday. This scenario assumes that this 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 hr/yr (or 8 hr/day for 42 day/yr) for an entire career (25 years). 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 addresses exposure to industrial workers who are not assigned to the area as a regular worksite but may occasionally use the 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).

The following sections describe specific investigation activities conducted at each CAS. Additional information regarding the investigation is presented in Appendix A.

2.1.1 TCA

Investigation activities at TCA included performing visual inspections, conducting Global Positioning System (GPS)-assisted GWSs, staging TLDs, and collecting surface soil samples. During the visual inspections, identified biasing factors included soil mounds outside the fence line and sedimentation areas located in washes outside the fence line (across F Road from TCA). The GWSs were conducted over the area outside the TCA fence line to identify areas of elevated radiological readings that would indicate the location of maximum radioactivity.

For the primary release at TCA, one sample plot (AA) was established judgmentally at the location of highest radioactivity outside TCA based on the results of GWSs. For other releases at TCA, judgmental samples were collected from areas where visual bias was present (soil pile). Judgmental samples were also collected from two areas of sedimentation within each of two washes at TCA downgradient of the testing pad. Sample locations are shown in Figure A.3-2.

Thermoluminescent dosimeters were installed at locations outside the fence line at TCA where the radiological readings were the greatest to measure external radiological doses. One 100-square-meter sample plot was then established at the location containing the highest reading as detected during the GWSs (see Figure A.3-1). Composite surface soil samples were collected from the sample plot to determine internal dose. See Section A.3.1 for additional information on investigation activities at TCA. Results of the sampling effort are reported in Section 2.2.

The CSM and associated discussion for this CAS are provided in the CAIP (NNSA/NSO, 2010). The contamination pattern of the radionuclides at TCA is consistent with the CSM in that the radiological contamination is greatest at the release point (test pad), generally decreases with distance from the release point, and is biased in the northerly direction. 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 TCA Bunker

Investigation activities at the TCA Bunker included performing visual inspections and collecting a surface soil sample. During the visual inspection, the biasing factor was accumulated soil present on the concrete floor and at the entrance to the bunker.

For the primary release at the TCA Bunker, one soil sample location was established judgmentally based on visual bias. The sample location is shown in Figure A.4-1. See Section A.4.1 for additional information on investigation activities at the TCA Bunker. Results of the sampling effort are reported in Section 2.2.

The CSM and associated reference to the TCA Bunker are provided in the CAIP (NNSA/NSO, 2010). No modification to the CSM was needed.

2.1.3 Buggy

Investigation activities at Buggy included performing visual inspections, conducting GPS-assisted GWSs, placing TLDs, and collecting surface soil samples. During visual inspections, identified biasing factors included a lead box, a transformer, an unlined sediment pond, sedimentation areas located in washes, vehicle batteries, and compressed gas cylinders. Gamma walkover surveys were performed around the crater and to the north to identify the spatial distribution of elevated radiological readings and verify the location of maximum radioactivity. The TLDs were installed at locations throughout the Buggy site to measure external doses and determine background. One sample plot was established at the area containing the highest reading as detected from the Field Instrument of the Detection of Lower Energy Radiation (FIDLER) surveys (see Figure A.5-3) to determine internal dose. Seven biased samples and four sedimentation samples (two samples from each of two washes leading away from the crater) were also collected. See Section A.5.1 for additional information on investigation activities conducted at Buggy. Results of the sampling effort are reported in Section 2.2.

For the primary release at Buggy, a single sample plot (BA) was established at a judgmental sample location determined to present the maximum internal dose. The location was identified by the maximum FIDLER survey reading. The TLDs were judgmentally located throughout the area surrounding the existing crater and ejecta area. For other releases at Buggy, judgmental soil samples were collected from areas where visual bias was present (lead box, transformer, bermed area). Judgmental soil samples were also collected from two areas of sedimentation within each of two major washes at Buggy downgradient of the crater area. Sample locations are shown in Figure A.5-5.

The CSM and associated discussion for this CAS are provided in the CAIP (NNSA/NSO, 2010). The contamination pattern of the radionuclides at Buggy is consistent with the CSM in that the radiological contamination generally decreases with distance from ground zero (GZ) and is biased in the northerly (downwind) direction. 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 data summary provided in Section 2.2.1 defines the COCs identified at CAU 375. Section 2.2.2 summarizes the assessment made in Appendix B, which demonstrates that the investigation 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 375 release. As such, it is dependent upon the cumulative annual hours of exposure to site contamination. The PALs were established in the CAIP (NNSA/NSO, 2010) based on a dose limit of 25 mrem/yr over an annual exposure time of 2,250 hours (i.e., the Industrial Area exposure scenario that a site worker would be exposed to site contamination for 225 day/yr and 10 hr/day). The FALs were established in Appendix C based on an Industrial Site scenario for TCA and a dose limit of 25 mrem/yr over an annual exposure time of 336 hours (i.e., the Remote Work Area exposure scenario defines that a site worker would be exposed to site contamination for 42 day/yr and 8 hr/day) for Buggy. To be comparable to these action levels, the CAU 375 investigation results are presented in terms of the dose a receptor would receive from site contamination under the Industrial Area (mrem/IA-yr), Remote Work Area (mrem/RW-yr), and Occasional Use Area (mrem/OU-yr) exposure scenarios.

The chemical PALs are based on the *Region 9: Superfund, Regional Screening Table (Formerly PRGs), Screening Levels for Chemical Contaminants* in industrial soils (EPA, 2009) except where natural background concentrations of *Resource Conservation and Recovery Act* (RCRA) metal exceed the screening level (e.g., arsenic on the NNSS). The chemical FALs were established in Appendix C at the PAL concentrations.

2.2.1 Summary of Analytical Data

Results for both the primary releases and other releases are presented in the following subsections. For radioactivity, results of probabilistic samples are reported as TED based on the remote work area exposure scenario comparable to the radiological FAL as established in Appendix C. Calculation of the TED for each sample was accomplished through summation of internal and external dose as described in Sections A.3.2.1.3 and A.5.2.3. Judgmental sample results are reported as individual analytical results and as multiple constituent analyses where the combined effect of contaminants are compared to FALs. The FALs as established in Appendix C are based on an annual exposure duration of the Industrial Area and Remote Work Area exposure scenarios (2,250 hr/yr and 336 hr/yr respectively).

2.2.1.1 TCA

Discussions of the results for samples collected at TCA are grouped by sampling approach.

Probabilistic Samples

The average TED and 95 percent UCL TED values for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table 2-1.

Soil samples were collected from a single soil sample plot and analyzed for contaminant concentrations to estimate internal dose. These analytical results were combined with the measured TLD results (external dose) to estimate average and 95 percent UCL TED at that single location. The ratio of internal dose to TED from the sample plot were then applied to the other TLDs to estimate average and 95 percent UCL TED at the other TLD locations. (See Section 2.1 for further explanation.)

The TEDs for surface soils exceeded the FAL of 25 mrem/IA-yr at four TCA sample locations. Due to the amount of excavation and demolition that has taken place, it is assumed that contamination is present within the TCA fence line that exceeds the FAL (see Section D.1.1).

Judgmental Samples

Samples were collected from two sedimentation areas within each of the two primary washes potentially collecting runoff from TCA. In addition, a sample (375A01) was collected from soil piles

Table 2-1
TCA TED at Sample Location (mrem/yr)

TLD Location (Sample Plot)	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
AT01 (AA)	**34.2**	**40.2**	5.1	6.0	1.2	1.4
AT02	**28.2**	**33.1**	4.2	4.9	1.0	1.2
AT03	23.8	**28.7**	3.6	4.3	0.8	1.0
AT04	18.3	19.8	2.7	3.0	0.6	0.7
AT05	**30.9**	**36.6**	4.6	5.5	1.1	1.3
AT06	16.4	20.4	2.4	3.0	0.6	0.7
AT07	16.7	21.8	2.5	3.3	0.6	0.8
AT08	16.6	21.7	2.5	3.2	0.6	0.8
AT09	10.3	17.0	1.5	2.5	0.4	0.6
AT10	13.7	18.1	2.0	2.7	0.5	0.6
AT12	3.3	7.6	0.5	1.1	0.1	0.3
AT13	2.3	5.7	0.3	0.8	0.1	0.2
AT14	0[a]	2.4	0[a]	0.4	0[a]	0.1
AT15	2.2	5.2	0.3	0.8	0.1	0.2

[a]Where the reading was less than zero, a value of zero was used.

Bold indicates the values exceeding 25 mrem/yr.

located outside the TCA fence line based on a visual walkover survey. All judgmental samples were collected at the depth of 0 to 5 cm below ground surface (bgs). Although subsurface samples were collected from a depth of 5 to 10 cm in the sedimentation areas, field-screening results (FSRs) were greatest at the surface, and only the surface samples were sent for analysis. The analytical results indicate that no contaminants are present in concentrations exceeding FALs. The maximum detected sample results for other releases are listed in Table 2-2.

Summary of Investigation Results at TCA

Based on the analytical results for surface soil samples collected at TCA, no COCs were identified at this CAS. However, it is assumed that COCs are present within the TCA fence line (the default contamination area), which was identified in the CAIP (NNSA/NSO, 2010). Therefore, a corrective

Table 2-2
Maximum Detected Sample Results of Other Releases for CAS 25-23-22, Contaminated Soils Site

Contaminant	Sample Number	Depth (cm bgs)	Sample Location	Maximum Result	PAL	Units
Ac-228	375A002	0 - 5	AT15	2.09	5	pCi/g
Cs-137	375A003	0 - 5	AT12	0.679	12.2	pCi/g
Eu-152	375A003	0 - 5	AT12	1.31 (J)	5.68	pCi/g
Pb-212	375A002	0 - 5	AT15	2.48 (J)	N/A[a]	pCi/g
Pb-214	375A006	0 - 5	A01	1.19 (J)	N/A[a]	pCi/g
Tl-208	375A002	0 - 5	AT15	0.697	N/A[b]	pCi/g
U-234	375A001	0 - 5	A14	0.934	19,600	pCi/g
U-235/236	375A001	0 - 5	AT14	0.12	20,890	pCi/g
U-238	375A001	0 - 5	A14	0.793	21,200	pCi/g

[a] Pb is in the U decay chain.
[b] Tl is in the Ac decay chain.

Ac = Actinium
Cs = Cesium
Eu = Europium
N/A = Not applicable

Pb = Lead
pCi/g = Picocuries per gram
Tl = Thallium
U = Uranium

J= Estimated value

action is required. The selected corrective action (based on the corrective action evaluation presented in Appendix E) for the subsurface contamination is closure in place with a UR. A UR was established that encompasses the area within the fence line (the default contamination area) as well as the contaminated area outside the fence line as shown in Figure A.3-2.

2.2.1.2 TCA Bunker

The maximum detected sample results are listed in Table 2-3.

Summary of Investigation Results at TCA Bunker

Based on the analytical results for surface soil samples collected at the TCA Bunker, no COCs were associated with this CAS. The selected corrective action (based on the corrective action evaluation presented in Appendix E) for the TCA Bunker is no further action.

Table 2-3
Maximum Detected Sample Results of Primary Release for CAS 25-34-06, Test Cell A Bunker

Contaminant	Sample Number	Depth (cm bgs)	Sample Location	Maximum Result	FAL	Units
Arsenic	375A008	0 - 5	A02	1.74	23	mg/kg
Barium	375A007	0 - 5	A02	179 (J+)	190,000	mg/kg
Chromium	375A008	0 - 5	A02	7.71	39.2	mg/kg
Fluoranthene	375A008	0 - 5	A02	0.0179 (J)	22,000	mg/kg
Lead	375A008	0 - 5	A02	9.99 (J)	800	mg/kg
Mercury	375A007	0 - 5	A02	0.0159	43	mg/kg
Selenium	375A008	0 - 5	A02	0.547 (J)	5,100	mg/kg
Silver	375A007	0 - 5	A02	0.236 (J)	5,100	mg/kg
U-234	375A007	0 - 5	A02	1.15	137,900	pCi/g
U-235	375A007	0 - 5	A02	0.089	149,600	pCi/g
U-238	375A008	0 - 5	A02	1.27	155,400	pCi/g

mg/kg = Milligrams per kilogram

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

2.2.1.3 Buggy

Discussions of the results for samples collected at Buggy are grouped by sampling approach.

Probabilistic Samples

As presented in the CAIP (NNSA/NSO, 2010), it was determined that a single soil sample plot be identified that had the greatest potential for contribution to internal dose. The ratio of internal dose to external dose from that location would be applied to all of the TLDs located at the site to conservatively estimate internal dose at each TLD location (see Section 4.2.2.1 of the CAIP for further discussion).

The average TED values and the 95 percent UCL values for the TED for Industrial Area, Remote Work Area, and Occasional Use Area exposure scenario are presented in Table 2-4.

The TEDs for surface soils did not exceed the FAL of 25 mrem/RW-yr at any location.

Table 2-4
Buggy External Dose Estimates at Sample Location (mrem/yr)
(Page 1 of 2)

TLD Location	**Industrial Area**		**Remote Work Area**		**Occasional Use Area**	
	Avg.	**95% UCL**	**Avg.**	**95% UCL**	**Avg.**	**95% UCL**
B00	12.1	13.7	1.8	2.0	0.4	0.5
B01	10.0	13.4	1.5	2.0	0.4	0.5
B02	11.2	13.8	1.7	2.1	0.4	0.5
B03	24.2	**28.9**	3.6	4.3	0.9	1.0
B04	**88.2**	**94.7**	13.2	14.1	3.1	3.4
B05	**51.0**	**60.8**	7.6	9.1	1.8	2.2
B06	12.5	15.0	1.9	2.2	0.4	0.5
B07	14.2	18.5	2.1	2.8	0.5	0.7
B08	**36.2**	**40.7**	5.4	6.1	1.3	1.4
B09	13.5	18.9	2.0	2.8	0.5	0.7
B10	12.5	16.4	1.9	2.5	0.4	0.6
B11	4.6	7.4	0.7	1.1	0.2	0.3
B12	8.7	11.4	1.3	1.7	0.3	0.4
B13	**93.0**	**97.5**	13.9	14.6	3.3	3.5
B14	**41.7**	**47.5**	6.2	7.1	1.5	1.7
B15	20.6	23.9	3.1	3.6	0.7	0.8
B16	7.8	11.6	1.2	1.7	0.3	0.4
B17	4.2	7.6	0.6	1.1	0.2	0.3
B18	**44.9**	**53.1**	6.7	7.9	1.6	1.9
B19	8.5	9.1	1.3	1.4	0.3	0.3
B20	**41.8**	**44.1**	6.2	6.6	1.5	1.6
B21	8.9	12.7	1.3	1.9	0.3	0.5
B22	**49.2**	**55.4**	7.4	8.3	1.8	2.0
B23	16.1	19.7	2.4	2.9	0.6	0.7
B24	13.6	16.0	2.0	2.4	0.5	0.6
B25	22.0	**25.7**	3.3	3.8	0.8	0.9
B26	**37.9**	**46.4**	5.7	6.9	1.3	1.7
B27	**49.9**	**59.2**	7.4	8.8	1.8	2.1

Table 2-4
Buggy External Dose Estimates at Sample Location (mrem/yr)
(Page 2 of 2)

TLD Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Avg.	**95% UCL**	**Avg.**	**95% UCL**	**Avg.**	**95% UCL**
B28	11.6	15.7	1.7	2.3	0.4	0.6
B29	4.0	4.9	0.6	0.7	0.1	0.2
B31	16.1	21.9	2.4	3.3	0.6	0.8
B32	**32.7**	**41.2**	4.9	6.2	1.2	1.5

Bold indicates the values exceeding 25 mrem/yr.

Judgmental Samples

Samples were collected at Buggy from two sedimentation areas within each of the two primary washes leading away from the crater, from beneath a transformer, from a bermed area, and from the nearest soil location downgradient from a lead box. Samples from each sedimentation area were collected at the surface (0 to 5 cm bgs) and at the shallow subsurface (5 to 10 cm bgs). The sample collected from beneath the transformer was collected from a depth of 0 to 5 cm bgs. The sample collected from the bermed area was collected from a depth of 0 to 5 cm bgs. The samples collected from the soil downgradient of the concrete pad that secured the lead box were collected from depths of 0 to 30 cm. The analytical results did not identify any contaminants in concentrations exceeding FALs. The maximum detected sample results for other releases are listed in Table 2-5.

Summary of Investigation Results at Buggy

Based on the analytical results, no COCs were identified at this CAS. However, it is assumed that COCs are present in the default contamination area (includes the crater and ejecta field) that exceed the FAL due to direct injection of radionuclides into the subsurface soil from the nuclear test. Oil within the transformer and the lead box are assumed to be PSM. Therefore, the default contamination boundary, the transformer, and the lead box require corrective action. The selected corrective action (based on the corrective action evaluation presented in Appendix E) for the default contamination boundary is closure in place with a UR. An FFACO UR was established that encompasses the default contamination boundary as shown in Figure A.5-7.

Table 2-5
Maximum Detected Sample Results for Other Releases at Buggy

Contaminant	Sample Number	Depth (cm bgs)	Location	Maximum Result	FAL	Units
Arsenic	375BX07	0-5	B36	6.98	23	mg/kg
Barium	375BX05	0-5	B34	209 (J)	190,000	mg/kg
Cadmium	375BX05	0-5	B34	0.175 (J)	800	mg/kg
Chromium	375BX08	0-5	B37	10.4	39.2	mg/kg
Lead	375BX05	0-5	B34	291	800	mg/kg
Mercury	375BX05	0-5	B34	0.0244	43	mg/kg
Selenium	375BX05	0-5	B34	0.56 (J)	5,100	mg/kg
Silver	375BX05	0-5	B34	0.113 (J)	5,100	mg/kg
Aroclor-1254	375BX04	0-5	B39	0.0041 (J)	0.74	mg/kg
Aroclor-1260	375BX04	0-5	B39	0.0021 (J)	0.74	mg/kg

J = Estimated value

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 are available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes help to ensure that DQO decisions are sound and defensible.

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

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

The DQA results support DQO decisions on the presence and/or extent of contamination at each CAS. Based on the results of the DQA presented in Appendix B, the DQO requirements have been met. The DQA also determined that information generated during the investigation support the CSM assumptions, and the data collected support their intended use in the decision-making process.

The results of the DQI evaluation show that precision and accuracy did not meet the associated criterion. As presented in Appendix B, the failure of precision is due to high variability, suggesting discrete particle contamination; therefore, there is a negligible potential for this precision deficiency to cause a false negative decision error. Also, the samples causing accuracy to fail are extremely small when compared to the FAL; therefore, the results can be used confidently. All other DQI criteria were met. The DQA determined that information generated during the investigation support the CSM assumptions, and the data collected support their intended use in the decision-making process. Based on the results of the DQA presented in Appendix B, the DQO requirements have been met.

2.3 Justification for No Further Action

No further corrective action is needed for the three CASs within CAU 375 based on implementation of corrective actions. The corrective actions implemented at the CAU 375 CASs were closure in place with URs at TCA and Buggy, and no further action at the TCA Bunker. These corrective actions were selected to ensure protection of the public and the environment in accordance with *Nevada Administrative Code* (NAC) 445A (NAC, 2008) based on an evaluation of risk, feasibility, and cost effectiveness (the evaluation of CAAs is presented in Appendix E).

2.3.1 Final Action Levels

The establishment of the FALs (presented in Appendix C) was based on risk to receptors. The radiological risk to receptors from contaminants at CAU 375 is due to chronic exposure to radionuclides (i.e., 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 the TCA, TCA Bunker, and Buggy sites determined that workers may only be present at these sites for a limited number of hours per year, and it is not reasonable to assume that any worker would be present at these sites on a full-time basis (DOE/NV, 1996). In order to quantify the maximum number of hours a site worker may be present at CAU 375, current and anticipated future site activities were evaluated as part of the CAI (see Appendix C, Section C.1.9). This evaluation concluded that the most exposed worker under current land usage is a maintenance worker or military personnel participating in exercises who has the potential to be present at the site for up to 80 hr/yr.

In the CAU 375 DQOs, it was conservatively determined that the Occasional Use Area exposure scenario (as listed in Section 3.1.1 of the CAIP [NNSA/NSO, 2010]) would be appropriate in calculating receptor exposure time based on current land use at all CAU 375 CASs. 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 are assumed to be on the site for an equivalent of 80 hr/yr.

Using the 95 percent UCL of the average maximum dose measured at CAU 375, a receptor would have to be exposed to the location of maximum dose for 510 hours to receive a dose of 25 millirem (mrem). Thus, a receptor at the site for 336 hr/yr over 25 years (Remote Work scenario) would not exceed the 25-mrem/yr dose limit. As the most exposed worker under current land usage will not be exposed to site contamination for more than the time assumed for the Remote Work Area scenario (336 hr/yr), it was decided to base the FALs on the Remote Work Area use scenario for Buggy (see Appendix C); however, because of its location in an industrial area, it was decided to base the FALs for TCA on the Industrial Area use scenario (2,250 mrem/yr).

3.0 Recommendation

Corrective action decisions for all three CASs were based on the risk assessment presented in Appendix C and the corrective action evaluation presented in Appendix E. In the risk assessment, it was determined to use the Industrial Area at TCA with its exposure scenario (with an exposure duration of 2,250 hr/yr of site worker exposure) as the radiological FAL for DQO decisions and the Remote Work Area at Buggy with its exposure scenario (with an exposure duration of 336 hr/yr of site worker exposure) as the radiological FAL for DQO decisions.

At TCA, the TED from surface soils exceeded a dose of 25 mrem under the Industrial Area scenario (25 mrem/IA-yr) at plot AA and at TLD locations AT01, AT02, AT03, and AT05 (see Table A.3-6). The selected corrective action (based on the corrective action evaluation presented in Appendix E) is closure in place with a UR. The FFACO UR boundary was established to encompass the existing fence line and the TLD locations where the TED value was greater than 25-mrem/IA-yr (see Section A.3.3 and Figure A.3-3). The FFACO UR is presented in Attachment D-1.

At the TCA Bunker, chemical contamination does not exceed any FAL; therefore, the corrective action is no further action.

At Buggy, chemical contamination does not exceed the FALs. However, chemical PSMs are present and require corrective action. The selected corrective action for the chemical PSMs is removal. Although radiological contamination at Buggy does not exceed the FAL of 25 mrem/RW-yr at any location outside the crater, it is assumed that radioactivity within the crater exceeds FALs and requires corrective action. The selected corrective action (based on the corrective action evaluation presented in Appendix E) is closure in place with a UR. The FFACO UR was established to encompass the default contamination, which included the crater and the crater ejecta field (see Section A.5.3).

No further corrective action is required at CAU 375 based upon implementation of corrective actions at the CAU 375 CASs. These corrective actions are evaluated in Appendix E based on technical merits focusing on reduction of toxicity, mobility and/or volume; reliability; short- and long-term feasibility; and cost. The FFACO URs implemented at each CAS will protect site workers from inadvertent exposure. These FFACO URs require annual inspections to certify that postings are in place, intact, and readable. Maintenance or replacement of postings may be conducted without prior NDEP approval. The corrective actions for CAU 375 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 valid, additional evaluation may be necessary.

In accordance with PAL-FAL (NNSA/NSO, 2006), an administrative UR was implemented at Buggy as a best management practice (BMP) for any area where an industrial land use of the area could cause a future site worker to receive a dose exceeding 25 mrem/yr (assuming the worker would be exposed to site contamination for a period of 2,250 hr/yr). To determine the extent of this area, a correlation of radiation survey values to the 95 percent UCL of Industrial Area Scenario TED values was conducted for each radiation survey (1994 and 1999 aerial radiation surveys [BN, 1999a and b] and the site-specific GWS). The aerial surveys reflected what was demonstrated in the investigation, so the administrative UR boundary was established to encompass the aerial survey isopleth corresponding to a dose of approximately 25-mrem/IA-yr. This will restrict any future industrial land use activities that would result in a site worker exceeding the exposure time assumed under the current land use scenario (Remote Work Area scenario of 336 hr/yr). The TED from surface soils exceeded a dose of 25 mrem under the Industrial Area scenario (25 mrem/IA-yr) at plot BA and at TLD locations B03, B04, B05, B08, B13, B14, B15, B18, B20, B22, B25, B26, B27, and B32 (see Table A.5-6). The administrative UR boundary was established to encompass the aerial isopleth corresponding to 25-mrem/IA-yr (see Section A.5.3 and Figure A.5-8). The administrative UR is presented in Attachment D-1.

The URs are recorded in the FFACO database; the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) Facility Information Management System; and the NNSA/NSO CAU/CAS files.

The NNSA/NSO requests that NDEP issue a Notice of Completion for this CAU and approve transferring CAU 375 from Appendix III to Appendix IV of the FFACO.

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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 375. Corrective Action Unit 375 consists of the following three CASs located in Areas 25 and 30 of the NNSS (Figure A.1-1):

- 25-23-22, Contaminated Soils Site
- 25-34-06, Test Cell A Bunker
- 30-45-01, U-30a, b, c, d, e Craters

Corrective Action Site 25-23-22 (referred to as TCA in this document) is located in Area 25 of the NNSS on F Road, approximately halfway between the Reactor Maintenance, Assembly, and Disassembly (R-MAD) site and the Test Cell C site. The TCA site consists of a release of surface and near-surface radioactive contamination from nuclear rocket testing.

Corrective Action Site 25-34-06 (referred to as the TCA Bunker in this document) is located within the fence line at TCA. The TCA Bunker consists of a potential release of contamination from materials that were stored within the bunker.

Corrective Action Site 30-45-01 (referred to as Buggy in this document) is located in Area 30 of the NNSS. Buggy consists of the deposition of radioactive contamination as a result of the Buggy (U-30a, b, c, d, e) Plowshare test.

Additional information regarding the history of each site, planning, and the scope of the investigation is presented in the CAU 375 CAIP (NNSA/NSO, 2010).

A.1.1 Project Objectives

The objective of the investigation was to provide sufficient information to complete corrective actions and support the recommendation for closure of each CAS in CAU 375. This objective was achieved by identifying the nature and extent of COCs; and by evaluating, selecting, and implementing acceptable CAAs.

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

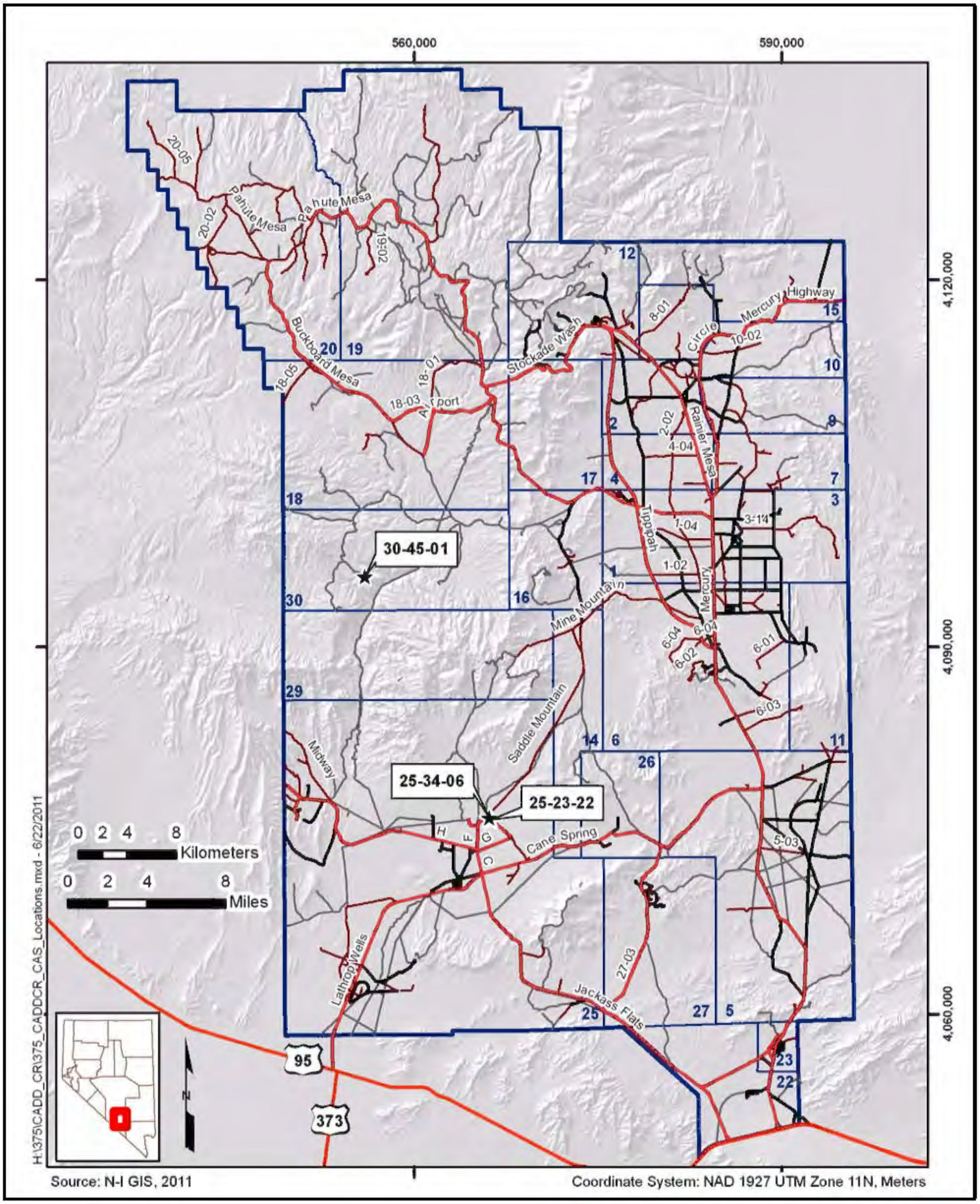


Figure A.1-1
CAU 375, CAS Location Map

defined as the presence of a contaminant at a concentration exceeding its corresponding FAL concentration (see Section A.2.5).

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 contents.
- Section A.2.0 provides an investigation overview.
- Sections A.3.0 through A.5.0 provide CAS-specific information regarding the field activities, sampling methods, and laboratory analytical results from investigation sampling.
- Section A.6.0 summarizes waste management activities.
- Section A.7.0 discusses the QA and QC processes followed and the results of QA/QC activities.
- Section A.8.0 provides a summary of the investigation results.
- Section A.9.0 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, soil sample descriptions, laboratory certificates of analyses, and analytical results—are retained in project files as hard copy files or electronic media.

A.2.0 Investigation Overview

The following CAU 375 CAI activities were conducted from July 28, 2010, through April 4, 2011:

- Inspected and verified the CAS components identified in the CAIP (NNSA/NSO, 2010).
- Performed site walkovers to identify biased sampling locations.
- Conducted radiological surveys.
- Established sample plots and composite sample aliquot locations.
- Staged TLDs at soil sample plots, background locations, and additional locations of interest.
- Collected and submitted TLDs for analysis.
- Collected soil samples at sample plots and at biased sampling locations.
- Submitted soil samples for offsite laboratory analysis.
- Collected GPS coordinates of sample locations, TLD locations, and points of interest.

The investigation and sampling program adhered to the requirements set forth in the CAIP (NNSA/NSO, 2010). Samples were collected, documented, and analyzed as prescribed in the CAIP. Quality control samples (e.g., duplicate samples) were collected as required by the Industrial Sites QAPP (NNSA/NV, 2002a) and the CAU 375 CAIP.

To facilitate site investigation and the evaluation of DQO decisions for different CSM components, the releases at each CAS were classified into one of the following two categories:

- **Primary releases** (referred to as “test releases” in the CAIP [NNSA/NSO, 2010]) – This release category is specific to the atmospheric deposition of radionuclide contamination onto the soil surface that has not been displaced through excavation or migration. The contamination associated with the primary releases is limited to the top 5 cm of undisturbed soil. Sampling surface soils to a depth of 5 cm is appropriate for areas that have not been disturbed, as numerous studies of soils contaminated by atmospheric deposition following nuclear testing at the NNSS have shown that more than 90 percent of the radioactivity in undisturbed soil is contained within the top 5 cm of soil (McArthur and Kordas, 1983 and 1985; Gilbert et al., 1977; Tamura, 1977). Therefore, for the purposes of this CADD/CR, surface is defined as the upper 5 cm of soil.

- **Other releases** (referred to as “non-test releases” in the CAIP) – This release category includes any radionuclide contamination from test activities that is not limited to the upper 5 cm of soil. This includes radionuclide contaminants that were initially deposited onto the soil surface (as in the primary release category) but have subsequently been displaced through excavation or migration. This category also includes radionuclides that were deposited under mechanisms other than atmospheric deposition. This includes the injection of radionuclides into native material from the nuclear detonation (such as in the Buggy crater), the deposition of ejecta piles around the Buggy crater, and any other chemical or radiological contamination discovered during the investigation through the identification of biasing factors that are not a part of a previously identified release. The depth of radiological contamination from other releases is dependent upon the nature of the release or subsequent movement through excavation or migration. Investigation of other releases was accomplished through measurements of soil contamination using a judgmental sampling scheme at depths dependent upon the nature of the release, or by conservative assumptions that contamination is present at depth based on process knowledge.

The CASs were investigated by collecting TLD samples for external radiological dose measurements and collecting soil samples for the calculation of internal radiological dose. The field investigation was completed as specified in the CAIP with minor deviations described in the Corrective Action Investigation Activities subsections of each CAS section.

Sections A.2.1 through A.2.5 provide the general investigation and evaluation methodologies used at all CASs.

A.2.1 Sample Locations

Investigation locations selected for sample plots were based on interpretation of site-specific GWSs and historical investigations (1994 aerial radiological survey [BN, 1999a], 1999 aerial radiological survey [BN, 1999b], and Radionuclide Inventory and Distribution Program (RIDP) data [McArthur and Kordas, 1985; Gray et al., 2007]); information obtained during site visits; and site conditions as provided in the CAIP (NNSA/NSO, 2010). Soil sampling for the primary releases at CAU 375 consisted of the collection of surface soil samples (as defined in Section A.2.0) within sample plots. Four composite samples were collected within each sample plot, and TLDs were located at the center of each sample plot. The randomly located aliquot locations were identified using a predetermined random-start, triangular grid pattern. The random sample location coordinates were generated in Visual Sample Plan (VSP) software (PNNL, 2007).

Sample locations for other releases were selected based on biasing factors such as visual identification of sedimentation areas in drainages, elevated radiological readings, and soil staining. The center of each sample plot, judgmental sample locations, and CAS points of interest were surveyed with a GPS instrument. Appendix G presents these data in a tabular format. The environmental sample plot locations (Tables A.3-1, A.4-1, and A.5-1) for the CAU 375 CASs TCA, TCA Bunker, and Buggy are shown on Figures A.3-2, A.4-1, and A.5-4, respectively.

A.2.2 Investigation Activities

The investigation activities as listed in Section A.2.0 performed at CAU 375 were consistent with the field investigation activities stipulated in the CAIP (NNSA/NSO, 2010). The investigation strategy provided the necessary information to establish the nature and extent of contamination associated with each CAS. The following sections describe the specific investigation activities that took place at CAU 375.

A.2.2.1 Radiological Surveys

Aerial and ground-level radiological surveys were conducted at the CAU 375 CASs. Aerial radiological surveys were performed at the sites in 1994 at an altitude of 200 feet (ft) with 500-ft flight-line spacing (BN, 1999a). Aerial radiological surveys were again performed at Area 25 sites in 1999 at an altitude of 50 ft with 75-ft flight-line spacing (BN, 1999b).

Ground-level GWS 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 and at the Buggy site, a field instrument for the detection of low-energy radiation (FIDLER) was also used. Count-rate and position data were collected and recorded at 1-second intervals, via a Trimble Systems GeoXT GPS unit. The walkover speed was approximately 1 to 2 meters per second with the radiation detector held at a height of approximately 18 inches (in.) above the ground surface.

A.2.2.2 Soil Sampling

Soil sampling for the primary releases at CAU 375 CASs consisted of the collection of surface soil samples (as defined in Section A.2.0) within sample plots. Within each sample plot, four composite samples were collected. Each composite sample was composed of nine randomly located aliquots, resulting in a total of 36 randomly located aliquots collected from each plot. Each aliquot was collected using a “vertical-slice cylinder and bottom-trowel” method. This required the insertion of a 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.

After each aliquot was collected, it was carefully placed atop a sieve (#4 mesh) fitted into a bottom pan (with a plastic bag lining the pan, which limited dust generation during transfer to a sample container [metal can]). Each aliquot was slowly sieved, and oversized material that did not pass through the sieve was returned to the original sample location. After each sample was field screened, it was transferred to an empty metal can. Each metal can was then sealed with a lid and a locking ring, and shaken using a paint shaker for three minutes to homogenize the soil.

At other release locations, the drainage samples were collected at 5-cm intervals vertically from the surface to a maximum depth of 10 cm or at refusal. These samples were radiologically field screened, and the surface sample and the interval with the highest FSRs were sent to the laboratory for analysis.

A.2.2.3 Internal Dose Estimates

Internal dose was estimated using the radionuclide analytical results from soil samples and the corresponding RRMG (see Attachment C-1). 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 (assumes that no other radionuclides contribute dose). The internal dose RRMG for each detected radionuclide (in pCi/g of soil) was derived using RESRAD computer code (Yu et al., 2001) under the appropriate exposure scenario (see Attachment C-1).

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 (see Attachment C-1) to yield a fraction of the 25-mrem/yr dose. The fractions for all radionuclides detected in a soil sample were summed to yield a total fraction for that sample. The sum of the fractions was then multiplied by 25 to yield an internal dose estimate (in mrem/yr) at that sample location. For the primary release samples, a 95 percent UCL was calculated for the internal dose in a sample plot using the results of all soil samples collected in that plot (see Attachment C-1). For other release samples 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 by establishing a ratio between the external dose measurement from TLD location AT01 and plot AA, and then multiplying this ratio by the external dose value specific to each location.

A.2.2.4 External Dose Measurements

Thermoluminescent dosimeters (Panasonic UD-814) were placed at each CAS in CAU 375 with the objective of collecting *in situ* measurements to determine the external radiological dose. The TLDs were placed in locations beyond the expected plume influences around each site; at the approximate center of each sample plot; and at biased sample locations within selected drainages. All TLDs were placed at a height of approximately 1 m to be consistent with the NNSS environmental monitoring program. Once retrieved from the field locations, the TLDs were submitted to the Environmental Technical Services group for analysis. The TLD results are discussed in Sections A.3.2.1 and A.5.2.1.

The TLDs were analyzed using automated TLD readers that are calibrated and maintained by the NNSS management and operating (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.7.0. All readings conformed to the approved QC program and are considered representative of the external radiological dose at each location.

Each TLD used in this CAI contains four individual elements. External dose at each TLD location is determined using the readings from TLD elements 2, 3, and 4 from each of the TLDs at a specific location, and each of the elements is considered a single sample in the statistical calculation of external dose. 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 and, therefore, was not included in the external dose calculation. A 95 percent UCL was then calculated for each TLD location using the results from the other three TLD elements contained within each TLD.

Estimates of external dose, in mrem/IA-yr, at the CAU 375 sites are presented as net values (e.g., the dose from control TLDs and from the natural or "field" background has been subtracted from the raw result). The control or "rack" background TLDs measured the amount of dose received by the TLDs before being deployed in the field. The "field" background TLDs measured the amount of dose received by TLDs in areas unaffected by the CASs. Background TLD results are not included in the TED tables, but their analytical results are displayed in Appendix F.

A.2.3 Total Effective Dose

The TED represents the sum of the internal dose (calculated from soil sample results) and the external dose (calculated from TLD measurements) for each sample location. The average TED calculated from sample results is an estimate of the true (unknown) TED. It is uncertain how well the average TED represents the true TED. If an average TED were directly compared to the FAL, any significant difference between the true TED and the sample TED could lead to decision errors. To reduce the probability of a false negative decision error, 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. Therefore, the probabilistic sampling design as described in the CAIP (NNSA/NSO, 2010) specifies using the 95 percent UCL of the TED for DQO decisions. The 95 percent UCL of the TED at each sample location was calculated as the sum of the 95 percent UCLs of the internal and external doses.

A.2.4 Laboratory Analytical Information

Radiological analyses of the collected soil samples were performed by GEL Laboratories LLC, of Charleston, South Carolina. The analytical suites and laboratory analytical methods used to analyze investigation samples are listed in Table A.2-1. Analytical results are reported in this appendix if they were detected above the minimum detectable concentrations (MDCs). The complete laboratory data packages are available in the project files.

Validated analytical data for CAU 375 investigation samples have been compiled and evaluated to determine the presence of COCs and to define the extent of COC contamination if present. The validated results of the radiochemical analyses were evaluated for only those radionuclides that

Table A.2-1
Laboratory Analyses and Methods, CAU 375 Investigation Samples[a]

Analysis	Analytical Method[b]
Isotopic U	Aqueous/Non-aqueous - DOE EML HASL-300[c] U-02-RC
Isotopic Pu	Aqueous - DOE EML HASL-300[c] Pu-10-RC Non-aqueous - DOE EML HASL-300[c] Pu-02-RC
Isotopic Am	Aqueous - DOE EML HASL-300[c] Am-03-RC Non-aqueous - DOE EML HASL-300[d] Am-01-RC
Gamma Spectroscopy	Aqueous - EPA 901.1[d] Non-aqueous - DOE EML HASL-300[c] Ga-01-R
Sr-90	Aqueous - EPA 905.0[d] Non-aqueous - DOE EML HASL-300[c] Sr-02-RC
RCRA Metals	EPA SW-846 6010[e]

[a] Investigation samples include both environmental and associated QC samples.
[b] The most current EPA, DOE, ASTM, NIOSH, or equivalent accepted analytical method may be used, including approved Laboratory Standard Operating Procedures (NNES, 2009).
[c] *The Procedures Manual of the Environmental Measurements Laboratory* (DOE, 1997).
[d] *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA, 1980).
[e] *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 3rd edition,* Parts 1-4, SW-846 CD-ROM (EPA, 1996).

Am = Americium
ASTM = ASTM International
EML = Environmental Measurements Laboratory
EPA = U.S. Environmental Protection Agency
HASL = Health and Safety Laboratory
NIOSH = National Institute for Occupational Safety and Health
Pu = Plutonium
Sr = Strontium

contribute to an internal dose (see Appendix C). The analytical results for each CAS are presented in Sections A.3.0, A.4.0, and A.5.0.

The analytical parameters were selected through the application of site process knowledge as described in the CAIP (NNSA/NSO, 2010).

A.2.5 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 375 release. As such, it is dependent upon the cumulative annual hours of exposure to site contamination. The PALs were established in the CAIP (NNSA/NSO, 2010) based on a dose limit of 25 mrem/yr over an annual exposure time of 2,250 hours (i.e., the Industrial Area exposure scenario that a site worker would be exposed to site contamination for 225 day/yr and 10 hr/day). The FALs were established in Appendix C based on a dose limit of 25 mrem/yr over an annual exposure time of 336 hours (i.e., the Remote Work Area exposure scenario that a site worker would be exposed to site contamination for 42 day/yr and 8 hr/day).

Results for both the primary releases and other releases are presented in Sections A.3.2, A.4.2, and A.5.2. Radiological results are reported as doses that are comparable to the dose-based FAL as established in Appendix C. Chemical results are reported as individual concentrations that are comparable to the individual chemical action levels as established in Appendix C. Results that are equal to or greater than FALs are identified by bold text in the CAS-specific results tables (see Sections A.3.0, A.4.0, and A.5.0).

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/NSO, 2006). If COCs are present, corrective action must be considered for the CAS.

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 was made that any physical waste containment would fail at some point and the contaminants would be released to the surrounding media. The following will be 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 the waste and release of contaminants into soil) would be equal to the mass of the contaminant in the waste divided by the mass of the waste. 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 the waste and release of contaminants into soil) would be calculated using the activity of the contaminant in the waste divided by the mass of the waste (for each radioactive contaminant) and calculating the combined resulting dose using the RESRAD code (Murphy, 2004). If the resulting soil concentration exceeds the FAL, then the waste would be considered to be PSM.

- For liquid wastes, the resulting concentration of contaminants in the surrounding soil will be calculated based on the concentration of contaminants in the waste and the liquid holding capacity of the soil. If the resulting soil concentration exceeds the FAL, then the liquid waste would be considered to be PSM.

A.3.0 CAS 25-23-22, Contaminated Soils Site

Corrective Action Site 25-23-22 is located at Test Cell A in the north-central portion of Area 25 of the NNSS, on Road F between the R-MAD site and Test Cell C. Corrective Action Site 25-23-22 consists of a release of radioactive contamination to the soil surface as a result of discharge from nuclear rocket motor testing. Additional detail on the history of TCA is provided in the CAIP (NNSA/NSO, 2010).

A.3.1 Corrective Action Investigation Activities

A total of four environmental samples from one sample plot, five samples from runoff sedimentation areas (four environmental samples and one field duplicate), and one environmental sample from the berm around the area were collected during investigation activities at TCA. All environmental samples were analyzed for gamma spectroscopy; isotopic Am, Pu, U; and Sr-90. The environmental sample collected from the berm was also analyzed for semivolatile organic compounds (SVOCs) and RCRA metals. The sample identifications (IDs), locations, and types are listed in Table A.3-1. A total of 16 TLDs (2 background locations and 14 CAS locations) were collected during investigation activities at TCA to measure external dose to site workers. The TLD IDs, locations, and types are listed in Table A.3-2. The specific CAI activities conducted to satisfy the CAIP requirements at this CAS (NNSA/NSO, 2010) are described in the following sections.

A.3.1.1 Visual Inspections

Visual inspections of TCA were conducted over the course of the field investigation including site walks, sampling efforts, and radiological surveys. The presence of scattered debris (e.g., tools, papers, PPE) was identified. The only biasing factor located outside the fence line was the presence of earthen berms. A single soil sample (location A01) was collected from one of the berms. No other samples were collected as a result of the visual inspection.

A.3.1.2 Radiological Surveys

Global Positioning System-assisted GWSs were performed at TCA during the CAI. The GWSs were conducted outside the fence surrounding TCA and along washes leading away from TCA to identify

Table A.3-1
Soil Samples Collected at TCA

Sample Plot or Location	Sample Number	Depth (cm bgs)	Matrix	Purpose
AT01	375AA01	0 - 5	Soil	Environmental
	375AA02	0 - 5	Soil	Environmental
	375AA03	0 - 5	Soil	Environmental
	375AA04	0 - 5	Soil	Environmental
AT14	375A001	0 - 5	Soil	Environmental
AT15	375A002	0 - 5	Soil	Environmental
AT12	375A003	0 - 5	Soil	Environmental
AT13	375A004	0 - 5	Soil	Environmental
AT13	375A005	0 - 5	Soil	FD of #375A004
A01	375A006	0 - 15	Soil	Environmental

the locations of the highest radiological readings and to confirm the location of the fallout plume. The results of the GWS show that the highest gamma radiation readings are present in the area directly outside the fence to the north of TCA and confirm that the fallout plume is positioned similar to the 1994 aerial survey (BN, 1999a). Figure A.3-1 presents a graphic representation of the data from the GWS. One sample plot (AA) was established within the area containing the highest anomalous reading outside the fence line as detected during the GWSs.

A.3.1.3 Sample Collection

A.3.1.3.1 TLD Samples

The TLDs were installed at 16 locations (AT01 through AT16) around TCA to measure external doses (Figure A.3-2). Two of these TLDs (AT11 and AT16) were placed at locations believed to be beyond the influence of the releases associated with the CAS at TCA to measure "field" background. A sample plot was placed at one TLD location (AT01). Other TLDs were placed at locations AT02 through AT10 within the area impacted by the plume to the north of the test pad beyond the TCA fence. Four other TLDs (AT12 through AT15) were located at sediment areas. All TLDs were included in the routine quarterly read of the NNSS environmental monitoring TLDs. Details of the

Table A.3-2
TLD Samples at TCA

TLD Location	TLD No.	Date Placed	Date Removed	Purpose
AT01	5156	09/28/2010	01/11/2011	Sample plot/TLD
AT02	4433	09/28/2010	01/11/2011	TLD only
AT03	5036	09/28/2010	01/11/2011	TLD only
AT04	4805	9/28/2010	01/11/2011	TLD only
AT05	4447	09/28/2010	01/11/2011	TLD only
AT06	4331	09/28/2010	01/11/2011	TLD only
AT07	4963	09/28/2010	01/11/2011	TLD only
AT08	5161	09/28/2010	01/11/2011	TLD only
AT09	4952	09/28/2010	01/11/2011	TLD only
AT10	5017	09/28/2010	01/11/2011	TLD only
AT11	4686	09/28/2010	01/11/2011	TLD only
AT12	4572	09/28/2010	01/11/2011	Sediment/TLD
AT13	4756	09/28/2010	01/11/2011	Sediment/TLD
AT14	4697	09/28/2010	01/11/2011	Sediment/TLD
AT15	4481	09/28/2010	01/11/2011	Sediment/TLD
AT16	5065	09/28/2010	01/11/2011	TLD only

environmental monitoring TLD program and TLD QC are presented in Section A.7.0. See Figure A.3-2 for TLD locations.

A.3.1.3.2 Soil Samples

Sampling activities at TCA for the determination of internal dose at the sample plot consisted of the collection of four primary release composite surface soil (defined in Section A.2.0) samples at a single plot (AA), sample location AT01. The plot location was established at the area of the highest radiological readings as detected during the GWSs conducted at the site. Soil samples were also collected from the sedimentation locations (AT12 through AT15) to determine internal dose. A soil sample was collected from the berm (A01) to determine existing chemical contamination. Final sample locations (Table A.3-1) are shown on Figure A.3-2.

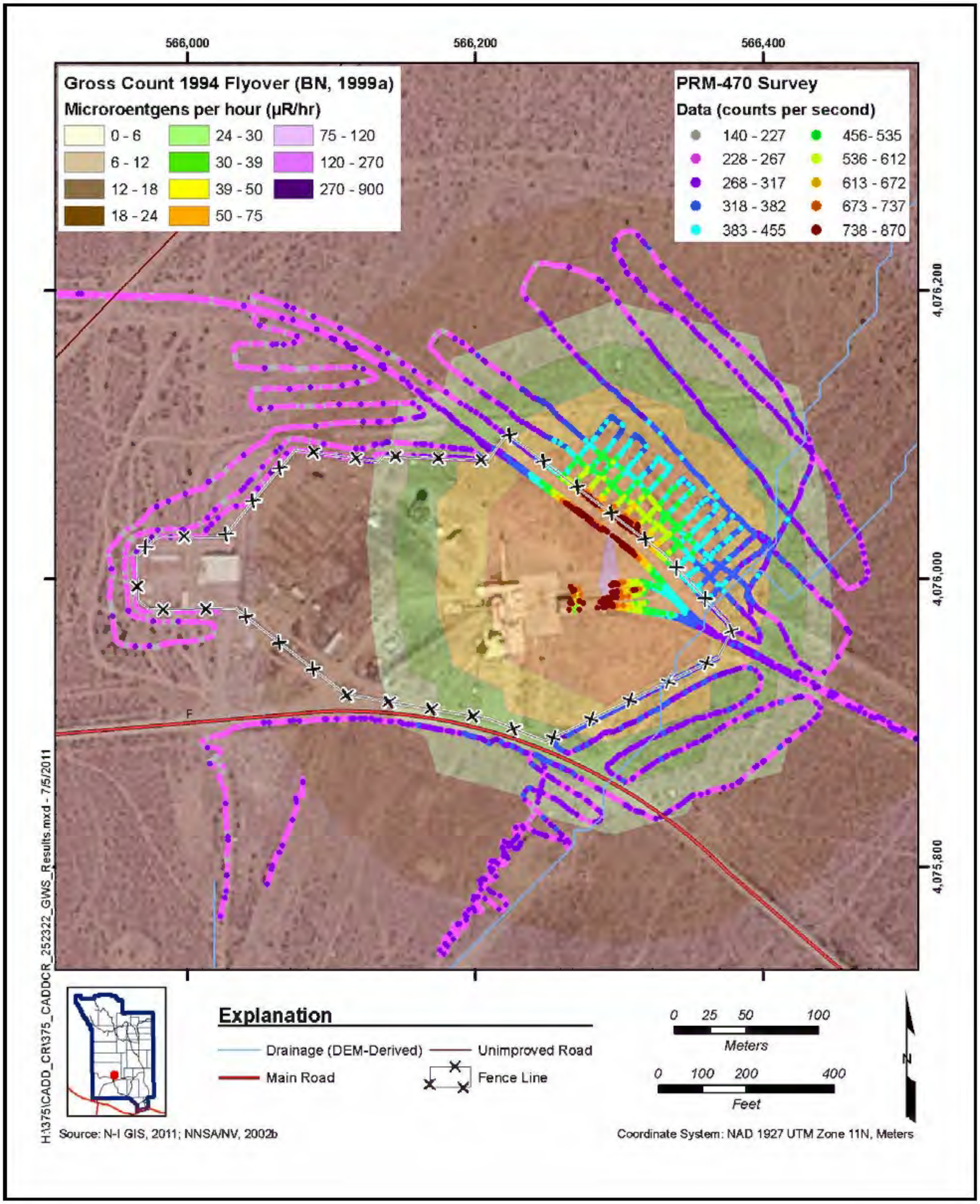


Figure A.3-1
Gamma Walkover Surveys of Selected Locations at TCA

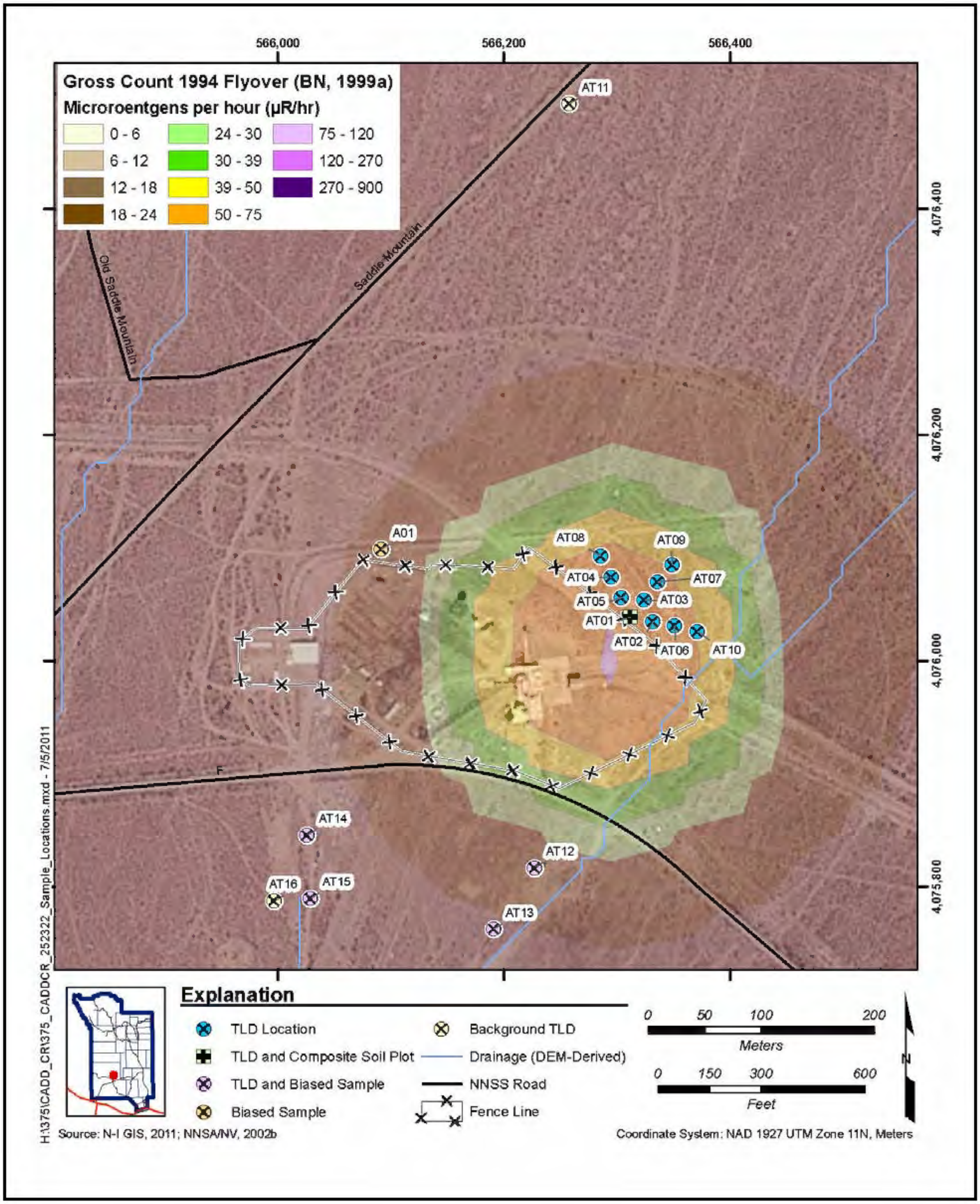


Figure A.3-2
TCA Sample and TLD Locations

A.3.1.4 Deviations

No deviations to the CAIP (NNSA/NSO, 2010) were noted.

A.3.2 Investigation Results

The following sections present the analytical and computational results for soil and TLD samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NSO, 2010). The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/IA-yr (the dose associated with an exposure period of 2,250 hr/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 analytical parameters and laboratory methods used during this investigation were discussed in Section A.2.0 and are listed in Table A.2-1.

A minimum number of samples is required to assure sufficient confidence in dose statistics 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.

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.3.2.1. Internal dose for the sample plot is summarized in Section A.3.2.1.2. The TEDs for each sampled location are summarized in Section A.3.2.1.3. Radiological results for the other release samples are summarized in Section A.3.2.2.

A.3.2.1 Radiological Dose Results

A.3.2.1.1 External Radiological Dose Measurements

Measurements for the external dose were 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 as shown in Table A.3-3.

Table A.3-3
TCA External Dose Estimate at Sample Location (mrem/yr)

Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Avg.	**95% UCL**	**Avg.**	**95% UCL**	**Avg.**	**95% UCL**
AT01	**34.2**	**40.2**	5.1	6.0	1.2	1.4
AT02	**28.2**	**33.1**	4.2	4.9	1.0	1.2
AT03	23.8	**28.7**	3.6	4.3	0.8	1.0
AT04	18.3	19.8	2.7	3.0	0.6	0.7
AT05	**30.9**	**36.6**	4.6	5.5	1.1	1.3
AT06	16.4	20.4	2.4	3.0	0.6	0.7
AT07	16.7	21.8	2.5	3.3	0.6	0.8
AT08	16.6	21.7	2.5	3.2	0.6	0.8
AT09	10.3	17.0	1.5	2.5	0.4	0.6
AT10	13.7	18.1	2.0	2.7	0.5	0.6
AT12	3.3	7.6	0.5	1.1	0.1	0.3
AT13	2.3	5.7	0.3	0.8	0.1	0.2
AT14	0[a]	2.4	0[a]	0.4	0.0	0.1
AT15	2.2	5.2	0.3	0.8	0.1	0.2

[a] Where the reading was less than zero, a value of zero was used.

Bold indicates the values exceeding 25 mrem/yr.

A.3.2.1.2 Internal Radiological Dose Estimations

Estimates for the internal dose that a receptor would receive at the sample plot at TCA were determined as described in Section A.2.2.3. Table A.3-4 presents a comparison of the internal and external doses at the sample plot and shows that the contribution to TED from internal dose is not significant. The average internal dose and 95 percent UCL for each exposure scenario is presented in Table A.3-5. The analytical results for the individual radionuclides in each composite sample are presented in Appendix F.

A.3.2.1.3 Total Effective Dose

The TED for each sample location (plot or TLD) was calculated by adding the internal and external dose values. Values for both the average TED and the 95 percent UCL of the TED for the Industrial

Table A.3-4
TCA Ratio of Calculated Internal Dose to External Dose at Sample Plot AA (mrem/IA-yr)

Location	Average Internal Dose	Average External Dose	Average Total Dose	Internal to External Dose Ratio
AT01	0.13	34.2	34.3	0.004

Table A.3-5
TCA Internal Dose Estimate at Sample Location (mrem/yr)

Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Avg.	95% UCL	Avg.	95% UCL	Avg.	95% UCL
AT01	0.13	0.3	0.02	0.0	0.0	0.0
AT02	0.11	0.3	0.01	0.0	0.0	0.0
AT03	0.09	0.2	0.01	0.0	0.0	0.0
AT04	0.07	0.2	0.01	0.0	0.0	0.0
AT05	0.12	0.3	0.01	0.0	0.0	0.0
AT06	0.06	0.2	0.01	0.0	0.0	0.0
AT07	0.07	0.2	0.01	0.0	0.0	0.0
AT08	0.07	0.2	0.01	0.0	0.0	0.0
AT09	0.04	0.1	0.0	0.0	0.0	0.0
AT10	0.05	0.1	0.01	0.0	0.0	0.0
AT12	0.02	0.0	0.0	0.0	0.0	0.0
AT13	0.02	0.0	0.0	0.0	0.0	0.0
AT14	0.02	0.0	0.0	0.0	0.0	0.0
AT15	0.03	0.0	0.0	0.0	0.0	0.0

Area, Remote Work Area, and Occasional Use Area exposure scenarios were determined and are presented in Table A.3-6.

The TED exceeded the FAL (the 95 percent UCL of the average TED) of 25-mrem/IA-yr at four sample locations (Figure A.3-3).

Table A.3-6
TCA TED at Primary Release Sample Location (mrem/yr)

TLD Location (Sample Plot)	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**
AT01 (AA)	**34.2**	**40.2**	5.1	6.0	1.2	1.4
AT02	**28.2**	**33.1**	4.2	4.9	1.0	1.2
AT03	23.8	**28.7**	3.6	4.3	0.8	1.0
AT04	18.3	19.8	2.7	3.0	0.6	0.7
AT05	**30.9**	**36.6**	4.6	5.5	1.1	1.3
AT06	16.4	20.4	2.4	3.0	0.6	0.7
AT07	16.7	21.8	2.5	3.3	0.6	0.8
AT08	16.6	21.7	2.5	3.2	0.6	0.8
AT09	10.3	17.0	1.5	2.5	0.4	0.6
AT10	13.7	18.1	2.0	2.7	0.5	0.6
AT12	3.3	7.6	0.5	1.1	0.1	0.3
AT13	2.3	5.7	0.3	0.8	0.1	0.2
AT14	0[a]	2.4	0[a]	0.4	0.0	0.1
AT15	2.2	5.2	0.3	0.8	0.1	0.2

[a] Where the reading was less than zero, a value of zero was used.

Bold indicates the values exceeding 25 mrem/yr.

A.3.2.2 Chemical Results

Analytical results exceeding MDCs from the sample collected from the berm at the depth of 0 to 15 cm bgs at TCA are presented in the following sections.

A.3.2.2.1 Radionuclides

The results from the testing for gamma-emitting and isotopic radionuclides are displayed in Table A.3-7. No radionuclides were found in concentrations that exceeded their respective PALs.

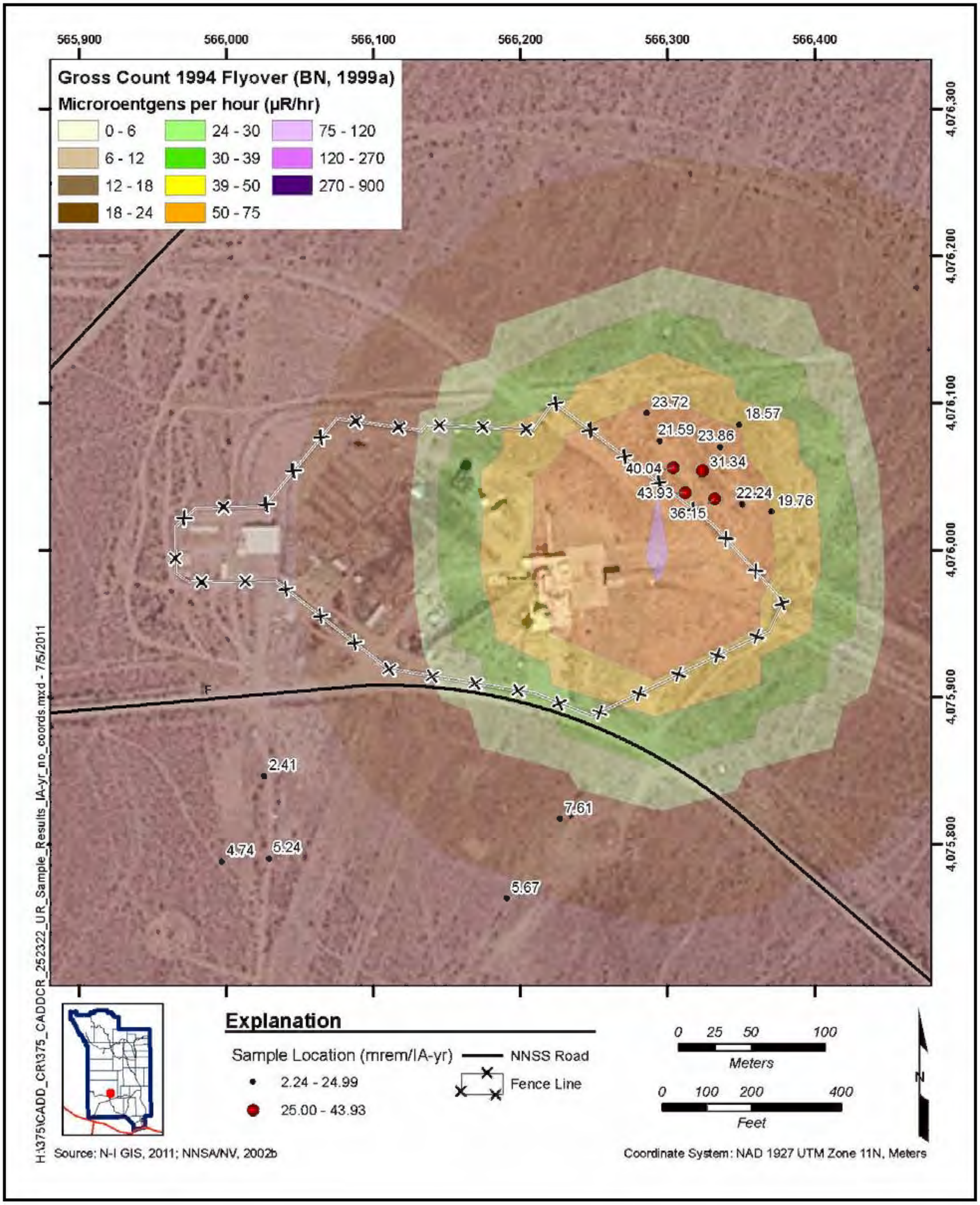


Figure A.3-3
TCA TED Results

Table A.3-7
Sample Results for Radionuclides at TCA

Sample Location	Sample Number	Depth (cm bgs)	COPCs (pCi/g)										
			Ac-228	Am-241	Co-60	Cs-137	Eu-152	Nb-94	Pu-239/240	Sr-90	U-234	U-235	U-238
FAL			**3292**	**9239**	**122.5**	**487.4**	**255.7**	**645.2**	**12690**	**55220**	**131400**	**1709**	**9572**
A01	375A006	0 - 15	1.96	--	--	0.199	0.547 (J)	--	--	--	0.78	0.0715	0.804

Co = Cobalt
COPC = Contaminant of potential concern
Nb = Niobium

J= Estimated value
-- = Not detected above MDCs.

A.3.2.2.2 RCRA Metals

Analytical results for RCRA metals in the environmental samples collected at the biased locations at the dirt mound that surrounds TCA that were detected above MDCs are presented in Table A.3-8. No metals were found in concentrations that exceeded their respective PALs.

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

Sample Location	Sample Number	Depth (cm bgs)	COPCs (mg/kg)				
			Arsenic	Barium	Chromium	Lead	Mercury
FAL			**23**	**190,000**	**39.2**	**800**	**43**
A01	375A006	0 - 15	0.959 (J)	95.7 (J+)	4.71	13.9 (J)	0.0178

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

A.3.2.2.3 SVOCs

Analytical results for SVOCs in the environmental sample collected at the biased location revealed no contaminant concentrations above MDCs.

A.3.3 Nature and Extent of Contamination

Based on the analytical results for samples collected outside the fence line at TCA, a UR was established to include any area where an industrial land use of the area (2,250 hr/yr) could cause a future site worker to receive a net effective dose increase of 25 mrem/yr above naturally occurring background levels. The calculated net TED values for TCA were compared to the PAL of 25 mrem/IA-yr. As indicated in Figure A.3-3 and Table A.3-6, the PAL is exceeded at four sample locations. To determine the extent of this area, a correlation of the 95 percent UCL for the Industrial Area scenario was plotted against each of the following datasets:

- Ground-based large area transect radiological surveys obtained in 2011 (Figure A.3-4)
- Aerial radiological surveys (gross count) obtained in 1994 (Figure A.3-5)
- Aerial radiological surveys (man-made) obtained in 1994 (Figure A.3-6)

Each of the datasets was converted from point data into a continuous dataset (surface) by using an inverse distance weighted interpolation method. The relationship between the surface value and the measured TED values at each of the sample locations was determined by statistical correlation. The correlation coefficient (R^2 value) indicates the strength of the correlation. The R^2 values for the correlations were 0.938, 0.889, and 0.626, respectively. The ground-based radiological survey data provided the best correlation to measured TED. Based on this correlation, the ground-based radiological survey value that corresponds to the 95 percent UCL of a 25-mrem/IA-yr TED is 2.001 multiples of background. The 2.001 isopleth from the interpolated surface of the GWS was used to define the 25-mrem/IA-yr boundary beyond the default contamination area (i.e., the TCA fence line). The FFACO UR boundary was conservatively defined as the combined area of the 2.001 GWS isopleth and the default contamination area (Figure A.3-7). The UR boundary is presented in Attachment D-1.

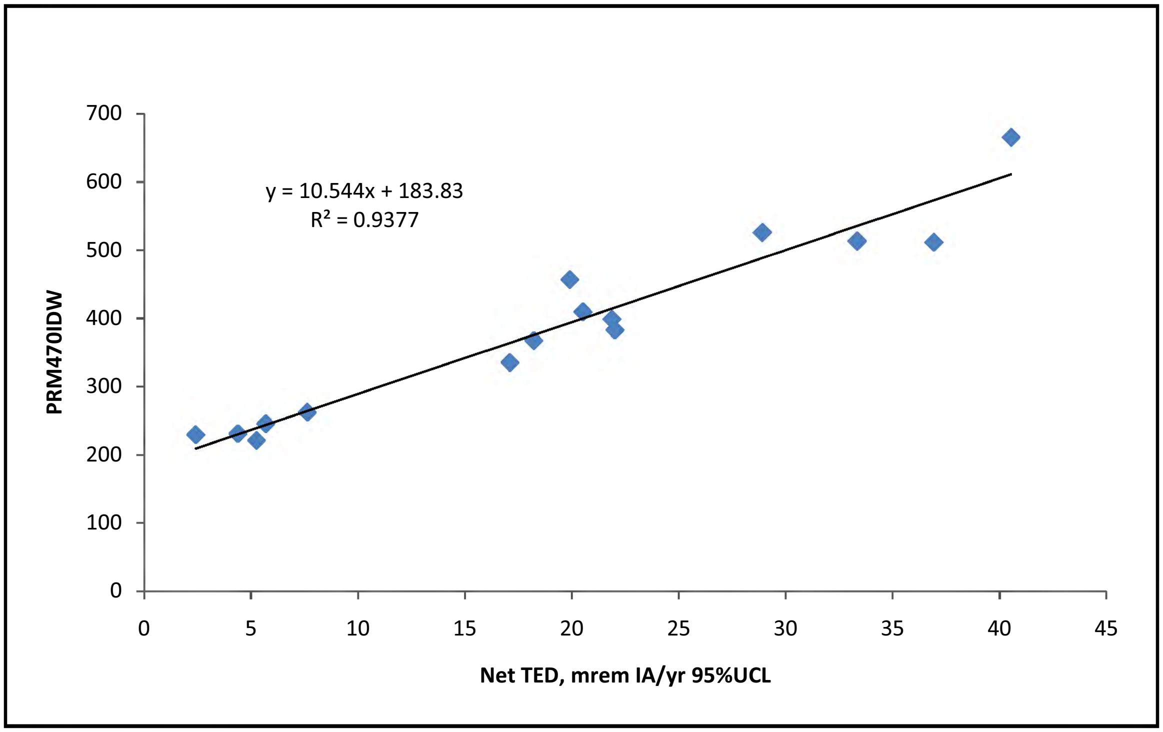


Figure A.3-4
Gamma Walkover Survey vs. Net TED (mrem IA/yr @ 95% UCL)

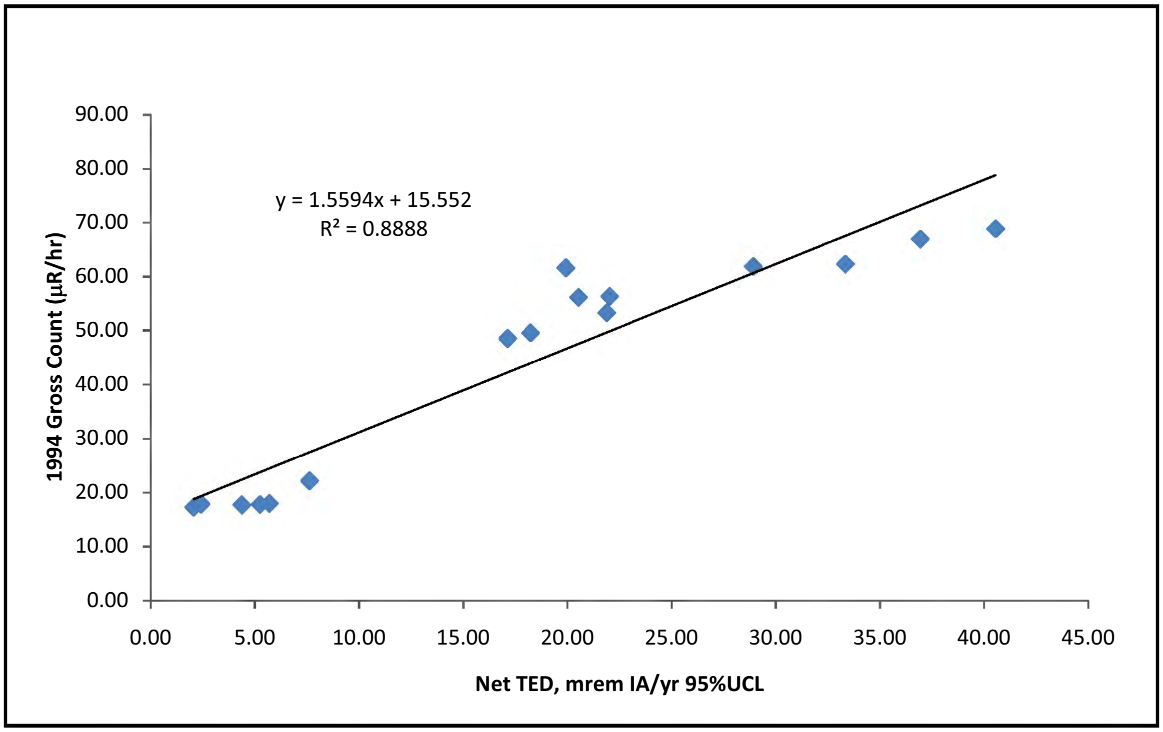


Figure A.3-5
1994 Gross Count vs. Net TED (mrem IA/yr @ 95% UCL)

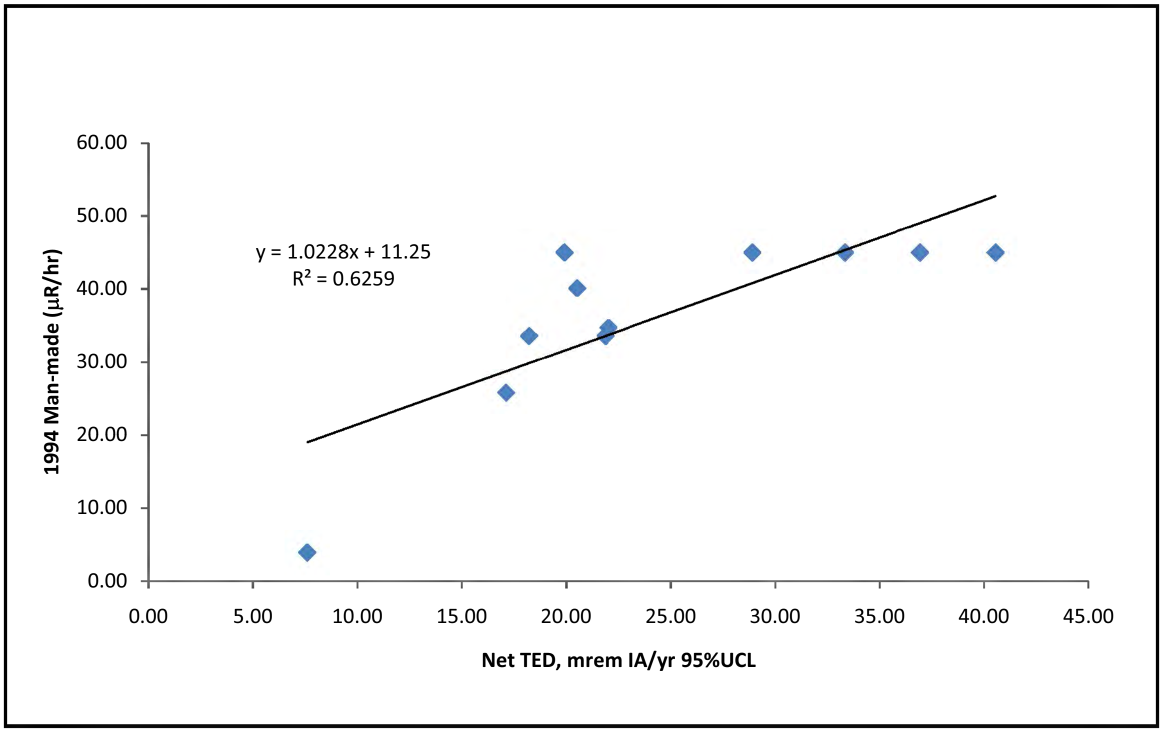
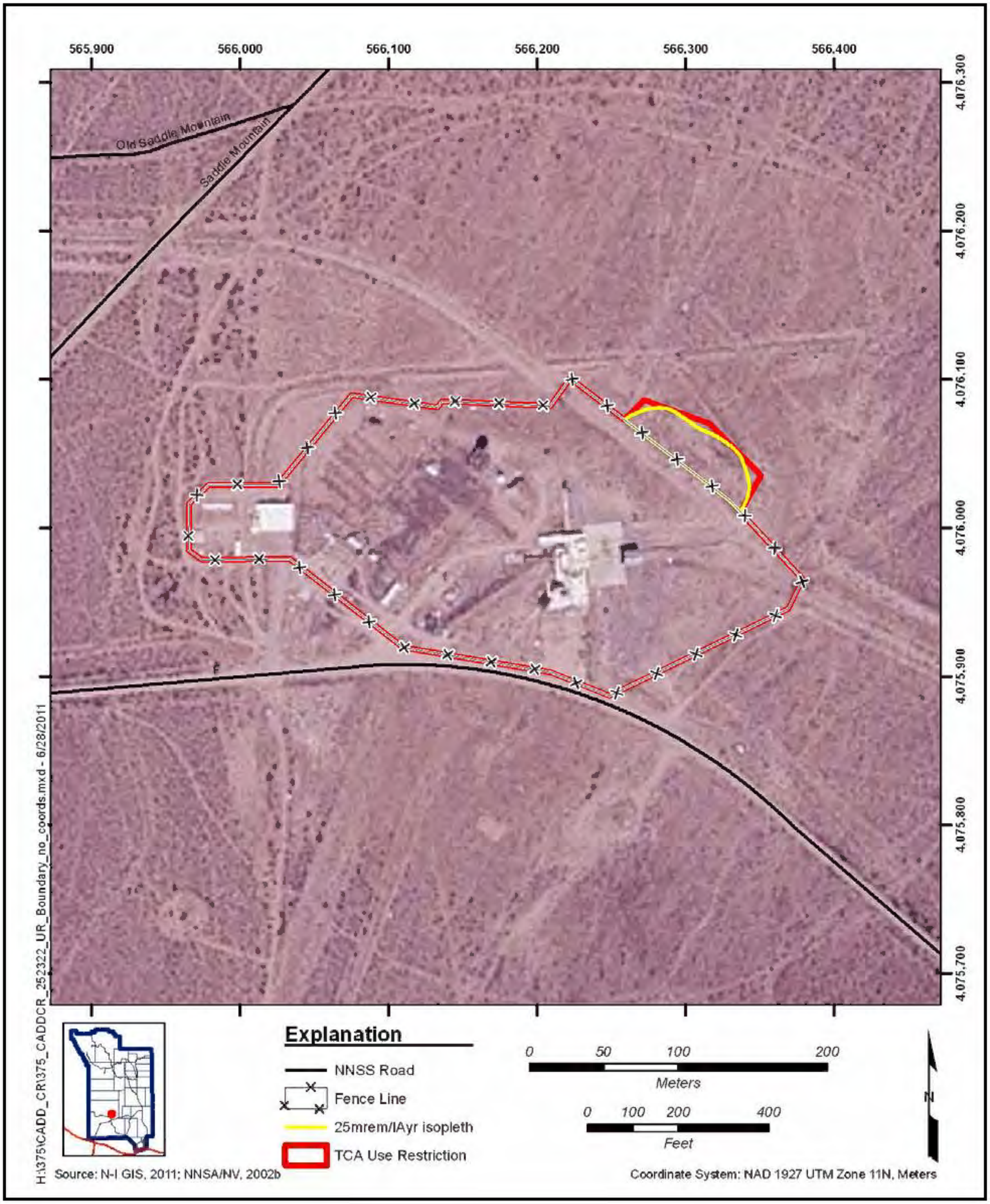


Figure A.3-6
1994 Man-made vs. Net TED (mrem IA/yr @ 95% UCL)

A.3.4 Revised Conceptual Site Model

The CAIP requirements (NNSA/NSO, 2010) were met at this CAS. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions to the CSM were necessary.



Source: N-I GIS, 2011; NNSA/NV, 2002b

Coordinate System: NAD 1927 UTM Zone 11N, Meters

Figure A.3-7
TCA UR Boundary

A.4.0 CAS 25-34-06, Test Cell A Bunker

Corrective Action Site 25-34-06 is located at Test Cell A in the north-central portion of Area 25 of the NNSS, on Road F between the R-MAD site and Test Cell C. Corrective Action Site 25-34-06 consists of the potential release of contamination from material stored in a bunker located within the TCA fence line.

A.4.1 Corrective Action Investigation Activities

Two environmental samples (one primary release sample and one duplicate) were collected during investigation activities at the TCA Bunker. Both samples were analyzed for gamma spectroscopy, isotopic Am, isotopic Pu, isotopic U, and isotopic Sr-90; total volatile organic compounds (VOCs), and total RCRA metals. The sample IDs, location, and type are listed in Table A.4-1. The specific CAI activities conducted to satisfy the CAIP requirements (NNSA/NSO, 2010) are described in the following sections.

Table A.4-1
Soil Samples Collected at TCA Bunker

Sample Plot or Location	Sample Number	Depth (cm bgs)	Matrix	Purpose
A02	375A007	0 - 5	Soil	Environmental
	375A008	0 - 5	Soil	FD of #375A007

A.4.1.1 Visual Inspections

Visual inspections of the bunker were conducted over the course of the field investigation including site walks and sampling efforts. A single soil sample and a duplicate were collected from immediately inside the entrance of the TCA Bunker located within the TCA fence line. No other biasing factors were identified.

A.4.1.2 Sample Collection

A.4.1.2.1 Soil Samples

Sampling activities at the TCA Bunker consisted of the collection of one primary release surface soil (defined in Section A.2.0) sample and one duplicate at sample location A02. The final sample location (Table A.4-1) is shown on Figure A.4-1.

A.4.1.3 Deviations

No deviations to the CAIP (NNSA/NSO, 2010) were noted.

A.4.2 Investigation Results

The following sections present the analytical results for the soil samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NSO, 2010). Results that are equal to or greater than FALs are identified by bold text in the results tables. The analytical parameters and laboratory methods used during this investigation were discussed in Section A.2.0 and are listed in Table A.2-1.

A.4.2.1 Results for Primary Release at TCA Bunker

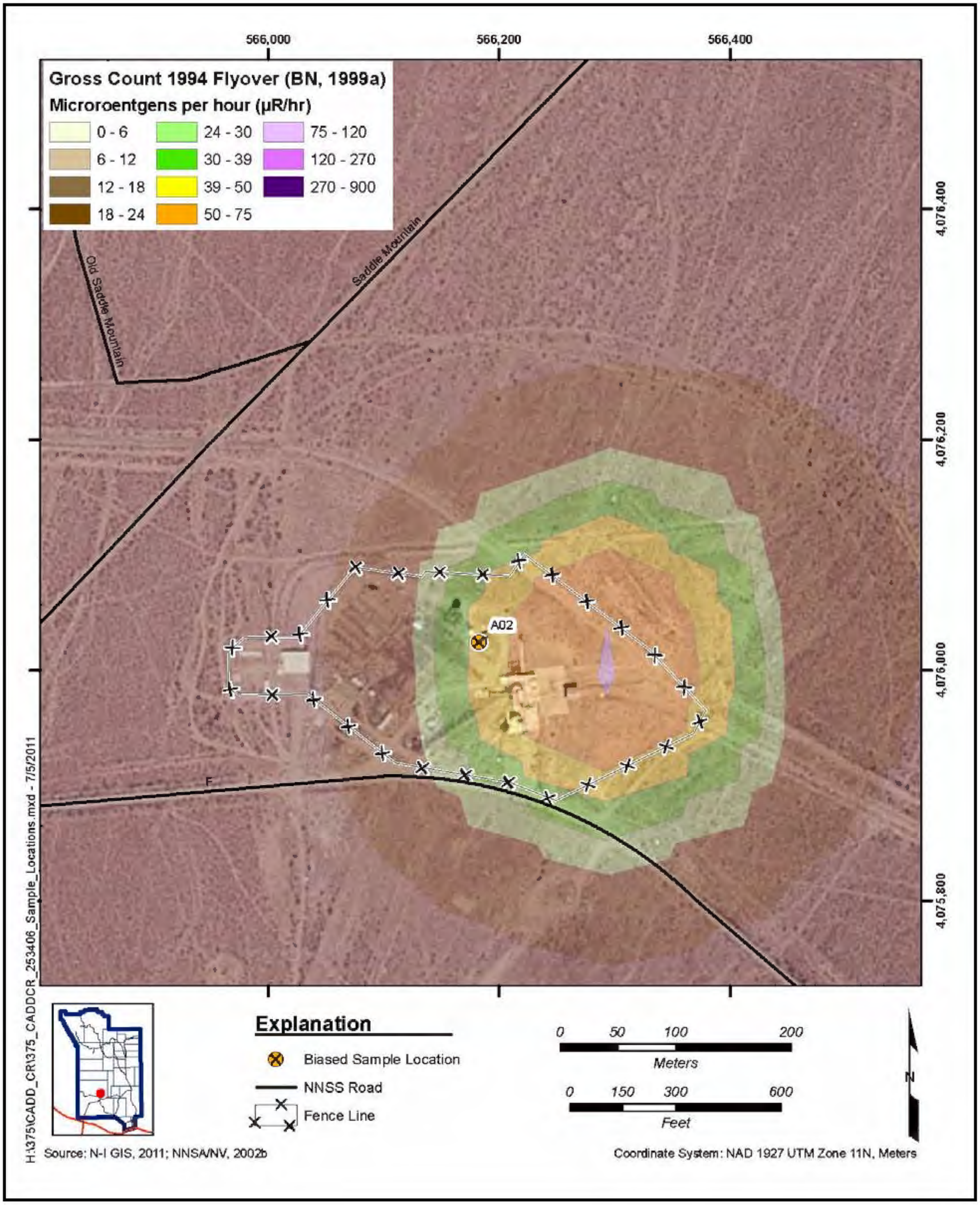
Analytical results exceeding MDCs from the samples collected at the depth of 0 to 5 cm bgs at the TCA Bunker are presented in the following sections.

A.4.2.1.1 Gamma-Emitting Radionuclides

Analytical results for gamma-emitting radionuclides in the environmental sample collected at biased location that were detected above MDCs are presented in Table A.4-2. No gamma-emitting radionuclide results exceeded their respective FALs.

A.4.2.1.2 Isotopic Radionuclides

Analytical results detected above MDCs for isotopic radionuclides in the environmental samples collected at biased locations are presented in Table A.4-3. No isotopic radionuclide results exceeded their respective FALs.



H:\375\CADD_CR\375_CADDCR_253406_Sample_Locations.mxd - 7/5/2011

Source: N-I GIS, 2011; NNSA/NV, 2002b

Coordinate System: NAD 1927 UTM Zone 11N, Meters

Figure A.4-1
TCA Bunker Sample Location

Table A.4-2
Sample Results of Gamma-Emitting Radionuclides above MDCs at TCA Bunker

Sample Location	Sample Number	Depth (cm bgs)	COPCs (pCi/g)	
			Ac-228	**Eu-152**
FALs			**3,292**	**255.7**
A02	375A007	0 - 5	1.49	0.34 (J)
A02	375A008	0 - 5	1.65	0.32 (J)

J = Estimated value

Table A.4-3
Sample Results of Isotopic Radionuclides above MDCs at TCA Bunker

Sample Location	Sample Number	Depth (cm bgs)	COPCs (pCi/g)		
			U-234	**U-235/236**	**U-238**
FALs			**131,400**	**1,709**	**9,572**
A02	375A007	0 - 5	1.15	0.09	1.02
A02	375A008	0 - 5	1.11	0.08	1.27

A.4.2.1.3 RCRA Metals

Analytical results for RCRA metals in the environmental samples collected at the biased location at the entrance to the TCA Bunker that were detected above MDCs are presented in Table A.4-4. No metals were found in concentrations that exceeded their respective FALs.

A.4.2.1.4 SVOCs

Analytical results for SVOCs in the environmental samples collected at the biased location that were detected above MDCs are presented in Table A.4-5. No SVOCs were found in concentrations that exceeded their respective FALs.

A.4.3 Nature and Extent of Contamination

Based on the analytical results for soil samples collected at the entrance to the TCA Bunker, no surface COCs were identified at this CAS.

Table A.4-4
Sample Results for Metals Detected above MDCs at TCA Bunker

Sample Location	Sample Number	Depth (cm bgs)	COPCs (mg/kg)						
			Arsenic	**Barium**	**Chromium**	**Lead**	**Mercury**	**Selenium**	**Silver**
FAL			**23**	**190,000**	**39.5**	**800**	**43**	**5,100**	**5,100**
A02	375A007	0 - 5	1.3	179 (J+)	7.58	8.27 (J)	0.0159	--	0.236 (J)
A02	375A008	0 - 5	1.74	114 (J+)	7.71	9.99 (J)	0.0117	0.547 (J)	0.185 (J)

J= Estimated value
J+ = Result is an estimated quantity, but may be biased high.
-- = Not detected above MDCs.

Table A.4-5
Sample Results for SVOCs Detected above MDCs at TCA Bunker

Sample Location	Sample Number	Depth (cm bgs)	COPCs (mg/kg)
			Fluoranthene
FAL			**22,000**
A02	375A008	0 - 5	0.0179 (J)

J = Estimated value

A.4.4 Revised Conceptual Site Model

The CAIP requirements (NNSA/NSO, 2010) were met at this CAS. The information gathered during the CAI supports the CSM as presented in the CAIP for CAU 375. Therefore, no revisions to the CSM were necessary.

A.5.0 CAS 30-45-01, U-30a, b, c, d, e Craters

Corrective Action Site 30-45-01 is located in the south-central portion of Area 30 of the NNSS, on Chukar Mesa overlooking a section of Fortymile Canyon. The CAS consists of an atmospheric deposition of radioactive material to the soil surface as well as prompt injection of materials into the soils forming the crater that resulted from the Buggy test. Additional detail is provided in the CAIP (NNSA/NSO, 2010).

A.5.1 Corrective Action Investigation Activities

A total of 17 characterization samples (4 primary release samples from 1 plot and 13 other release samples from sedimentation and biased locations [including 1 FD]) were collected during investigation activities at Buggy. Primary release and other release sedimentation samples were analyzed for gamma spectroscopy; Sr-90; and isotopic U, Pu, and Am. The non-sedimentation other release samples were analyzed for RCRA metals, SVOCs, or polychlorinated biphenyls (PCBs). The sample IDs, locations, and types are listed in Table A.5-1. A total of 45 TLDs (7 “field” background locations and 32 CAS locations with 3 TLD locations with 3 TLDs each) were placed and collected during investigation activities at Buggy to measure external dose. All TLDs were analyzed for total external dose. The TLD IDs, locations, and types are listed in Table A.5-2. The specific CAI activities conducted to satisfy the CAIP requirements at this CAS (NNSA/NSO, 2010) are described in the following sections.

A.5.1.1 Visual Inspections

Visual inspections of Buggy were conducted over the course of the field investigation and included site walks, sampling efforts, and radiological surveys. During the surveys, the following debris and equipment were identified: three lead-acid batteries, two compressed gas cylinders, one lead box, an asbestos tile located in the lead box, and one electrical transformer (Figure A.5-1). No biasing factors (e.g., stains or odors) were noted on or adjacent to any of the objects, but swipe samples of the gas bottles and soil samples from around the lead box and transformer were collected. The locations of these physical features are shown on Figure A.5-2.

Table A.5-1
Soil Samples Collected at Buggy

Sample Location (Plot)	Sample Number	Depth (cm bgs)	Matrix	Purpose
B04 (BA)	375BA01	0 - 5	Soil	Environmental
	375BA02	0 - 5	Soil	Environmental
	375BA03	0 - 5	Soil	Environmental
	375BA04	0 - 5	Soil	Environmental
B12	375BX11	0 - 5	Soil	Environmental
	375BX12	5 - 10	Soil	Environmental
B28	375BX09	0 - 5	Soil	Environmental
	375BX10	5 - 10	Soil	Environmental
B31	375BX01	0 - 5	Soil	Environmental
B32	375BX02	0 - 5	Soil	Environmental
	375BX03	0 - 5	Soil	FD of #375BX02
B39	375BX04	0 - 5	Soil	Environmental
B34	375BX05	0 - 30	Soil	Environmental
B35	375BX06	0 - 30	Soil	Environmental
B36	375BX07	0 - 30	Soil	Environmental
B37	375BX08	0 - 30	Soil	Environmental
B38	375BX13	0 - 5	Soil	Environmental

Table A.5-2
TLD Samples at Buggy
(Page 1 of 3)

Location	TLD No.	Date Placed	Date Removed	Purpose
B00	2010	07/28/2010	11/08/2010	TLD only
B01	3816	07/28/2010	11/08/2010	TLD only
B02	3812	07/28/2010	11/08/2010	TLD only
B03	3713	07/28/2010	11/08/2010	TLD only
B04	1693	07/28/2010	11/08/2010	Sample plot
B04	6293	12/28/2010	04/04/2011	Sample Plot
B04	6295	12/28/2010	04/04/2011	Sample Plot

Table A.5-2
TLD Samples at Buggy
(Page 2 of 3)

Location	TLD No.	Date Placed	Date Removed	Purpose
B05	3286	08/02/2010	11/08/2010	TLD only
B06	1804	08/03/2010	11/08/2010	TLD only
B07	3731	08/03/2010	11/08/2010	TLD only
B08	3426	08/02/2010	11/08/2010	TLD only
B09	4257	08/02/2010	11/08/2010	TLD only
B10	1213	08/02/2010	11/08/2010	TLD only
B11	4284	08/02/2010	11/08/2010	TLD only
B12	3609	08/03/2010	11/08/2010	Sediment/TLD
B13	4177	08/02/2010	11/08/2010	TLD only
B13	6288	12/28/2010	04/04/2011	TLD only
B13	6289	12/28/2010	04/04/2011	TLD only
B14	3763	08/02/2010	11/08/2010	TLD only
B15	3825	08/02/2010	11/08/2010	TLD only
B16	3362	08/02/2010	11/08/2010	TLD only
B17	3348	08/02/2010	11/08/2010	TLD only
B18	1016	08/02/2010	11/08/2010	TLD only
B19	3524	08/02/2010	11/08/2010	TLD only
B20	3991	8/02/20100	11/08/2010	TLD only
B20	6287	12/28/2010	04/04/2011	TLD only
B20	6297	12/28/2010	04/04/2011	TLD only
B21	3596	08/02/2010	11/08/2010	TLD only
B22	3798	08/02/2010	11/08/2010	TLD only
B23	4248	08/02/2010	11/08/2010	TLD only
B24	1606	08/02/2010	11/08/2010	TLD only
B25	3928	08/02/2010	11/08/2010	TLD only
B26	3294	08/02/2010	11/08/2010	TLD only
B27	3396	08/02/2010	11/08/2010	TLD only
B28	3854	08/03/2010	11/08/2010	Sediment/TLD
B29	4047	08/02/2010	11/08/2010	TLD only

Table A.5-2
TLD Samples at Buggy
(Page 3 of 3)

Location	TLD No.	Date Placed	Date Removed	Purpose
B30	3691	08/03/2010	11/08/2010	Background TLD location
B31	4295	08/02/2010	11/08/2010	Sediment/TLD
B32	3801	08/02/2010	11/08/2010	Sediment/TLD
B33	3624	08/03/2010	11/08/2010	Background TLD location
B40	6294	12/28/2010	04/04/2011	Background TLD location
B41	6279	12/28/2010	04/04/2011	Background TLD location
B42	6285	12/28/2010	04/04/2011	Background TLD location
B43	6292	12/28/2010	04/04/2011	Background TLD location
B44	6291	12/28/2010	04/04/2011	TLD location

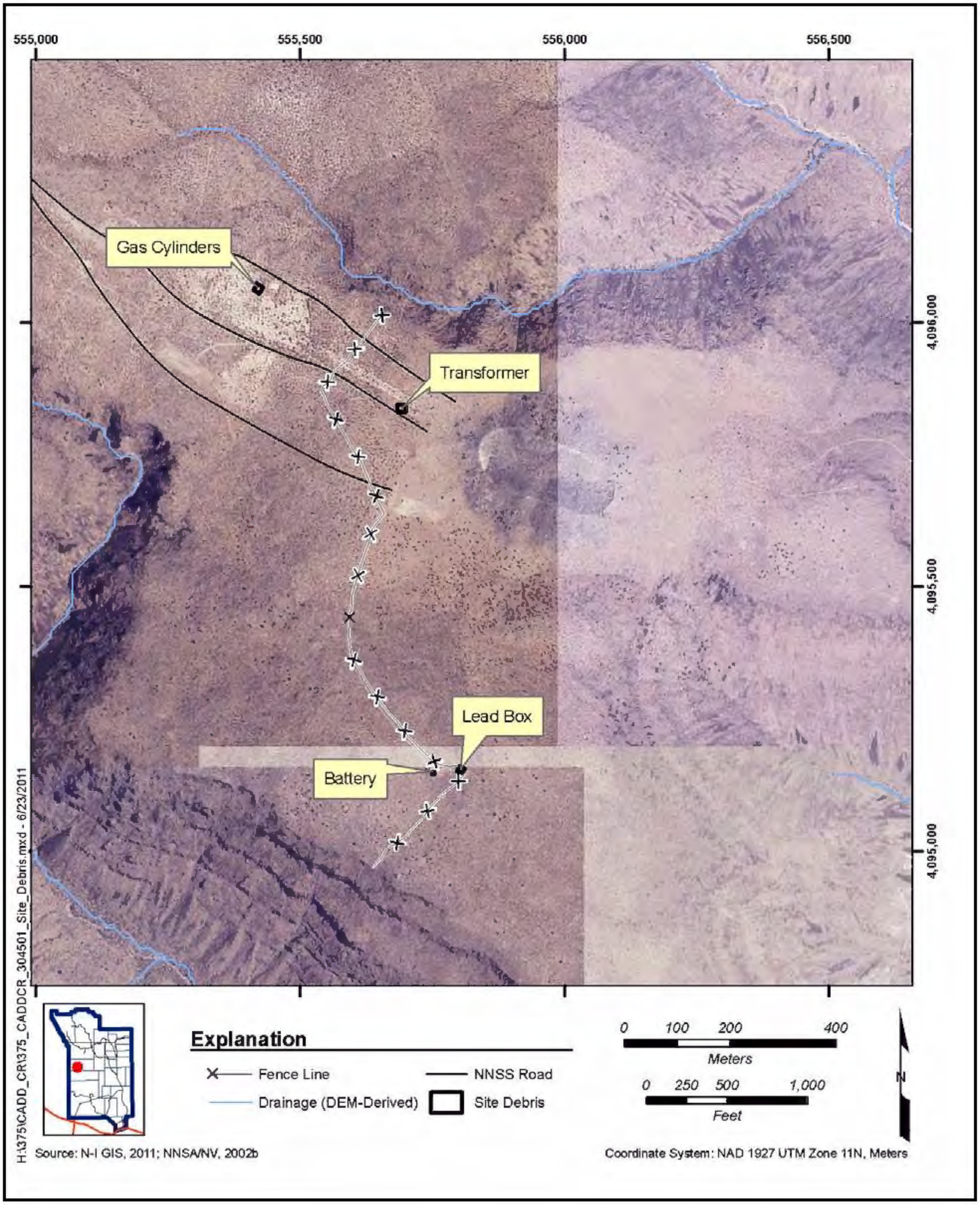
In addition to the notable physical features, drainages are present that pass through and downgradient of the site, and were identified as potential routes for migration of contaminated sediments. The major drainages exiting the Buggy site were visually inspected, and biased samples of the two closest sedimentation areas downgradient of GZ were collected. A bermed area located near the compressed gas cylinders was also noted. No stains or odors were present. A single soil sample was collected from the sediment located at a low point within the bermed area. No additional biasing factors were noted at the CAS based on visual inspections.

A.5.1.2 Radiological Surveys

Ground-based radiological surveys were conducted at Buggy. These surveys were performed to examine the distribution of radiological contamination across the site, which was used as input into the location and placement of the soil sampling plot.

Global Positioning System-assisted GWSs were conducted by walking around the Buggy crater as well as walking transects across the site to verify the location of the plume as depicted in the 1994 aerial radiological survey (BN, 1999a). Count-rate data were collected with a TSA Systems PRM-470 model plastic scintillator and FIDLER. Data were logged and position data collected at 1-second intervals, via a Trimble Systems GeoXT GPS unit. The walkover speed was approximately

Figure A.5-1
Debris Items Identified during Visual Inspection of Buggy



Source: N-I GIS, 2011; NNSA/NV, 2002b

Coordinate System: NAD 1927 UTM Zone 11N, Meters

Figure A.5-2
Buggy Physical Features Locations

1 to 2 meters per second with the radiation detector held at a height of about 18 in. above the ground surface. Data were post-processed, loaded into a geographical information system, color-coded, and displayed on a map of the CAS. Figure A.5-3 provides a graphical representation of the results of the GWS surveys.

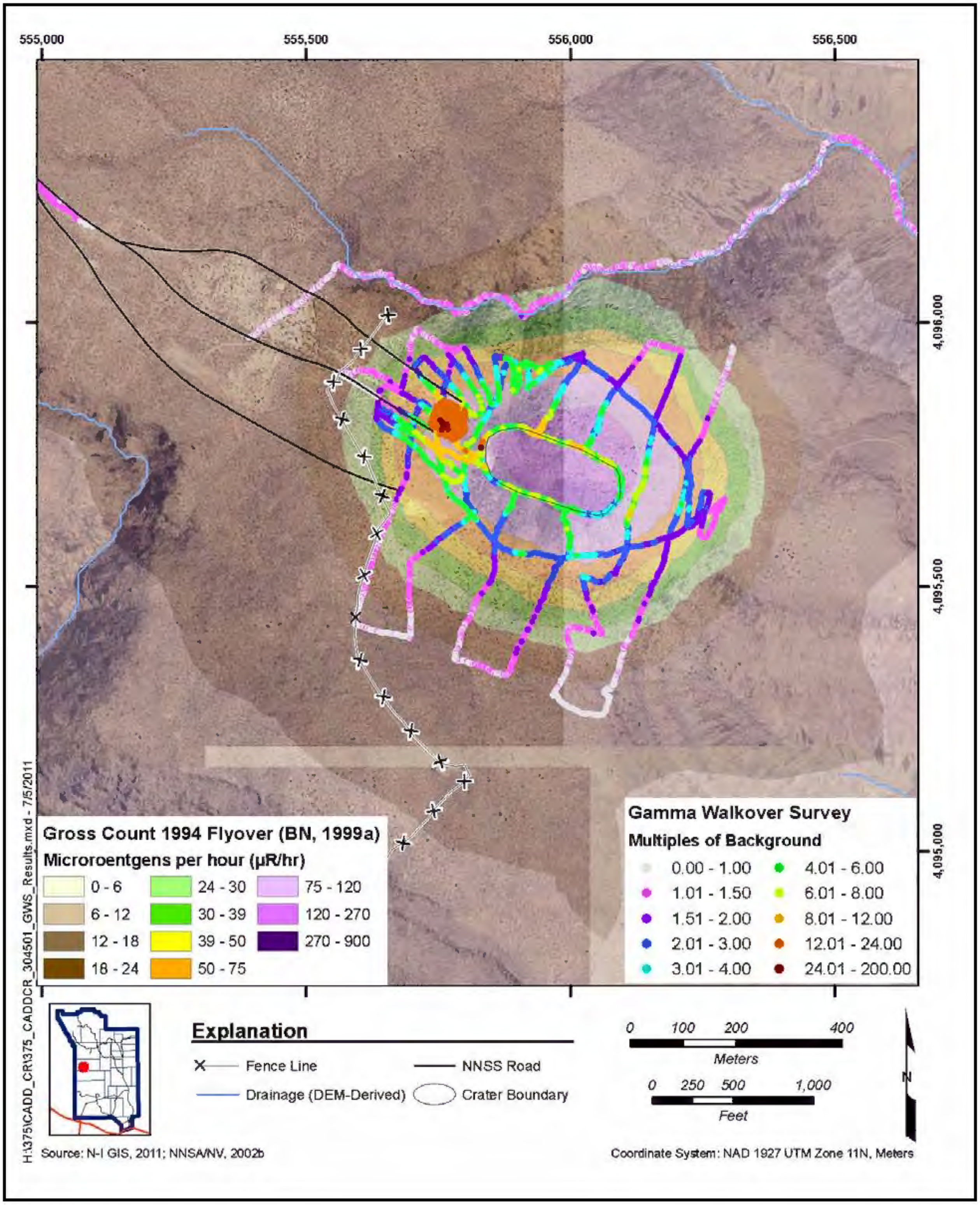
The results of the GWS were used in the determination of the location of the soil sample plot as described in Section A.5.1.4 and TLD sample vectors as described in Section A.5.1.3.

A.5.1.3 TLD Measurements

The TLDs listed in Table A.5-2 were used at the Buggy site to measure external doses. Figure A.5-4 shows TLD locations. A total of seven TLDs (B30, B33, and B40 through B44) were placed at locations believed to be beyond the influence of the releases associated with the CAS at Buggy. One TLD (B44) was removed from consideration as a background TLD because it was unintentionally placed within the contamination plume. To aid in the determination of the proper background dose to use in TED calculation, a background isopleth map generated from the 1994 aerial radiation survey (BN, 1999a) was used to verify that background TLDs represent the background dose estimate at the Buggy site. Upon investigation of the isopleths, it was determined that the TLD location B30 was located in a different geologic formation that presented readings approximately 20 percent greater than the readings within the geologic formation where the Buggy crater is located. The TLD located in this formation was removed as a background TLD. Four TLDs (B12, B28, B31, and B32) were placed at sediment locations to measure the external dose along migration pathways. The remainder of the TLDs (B00 through B11, B13 through B27, and B29) were placed in different isopleths along vectors extending away from the crater.

A.5.1.4 Sample Collection

For the primary release at Buggy, sampling activities for the determination of internal dose consisted of the collection of four primary release composite surface soil samples from one sample plot within Buggy (B04). As explained in the CAIP (NNSA/NSO, 2010) the internal exposure results from the single sample plot was used as a percentage of TED to determine the contribution to TED at the other TLD locations by using the same conservative percentage. The plot sample location along with all other TLD locations are shown on Figure A.5-4.



Source: N-I GIS, 2011; NNSA/NV, 2002b

Coordinate System: NAD 1927 UTM Zone 11N, Meters

Figure A.5-3
Gamma Walkover Surveys of Selected Locations at Buggy

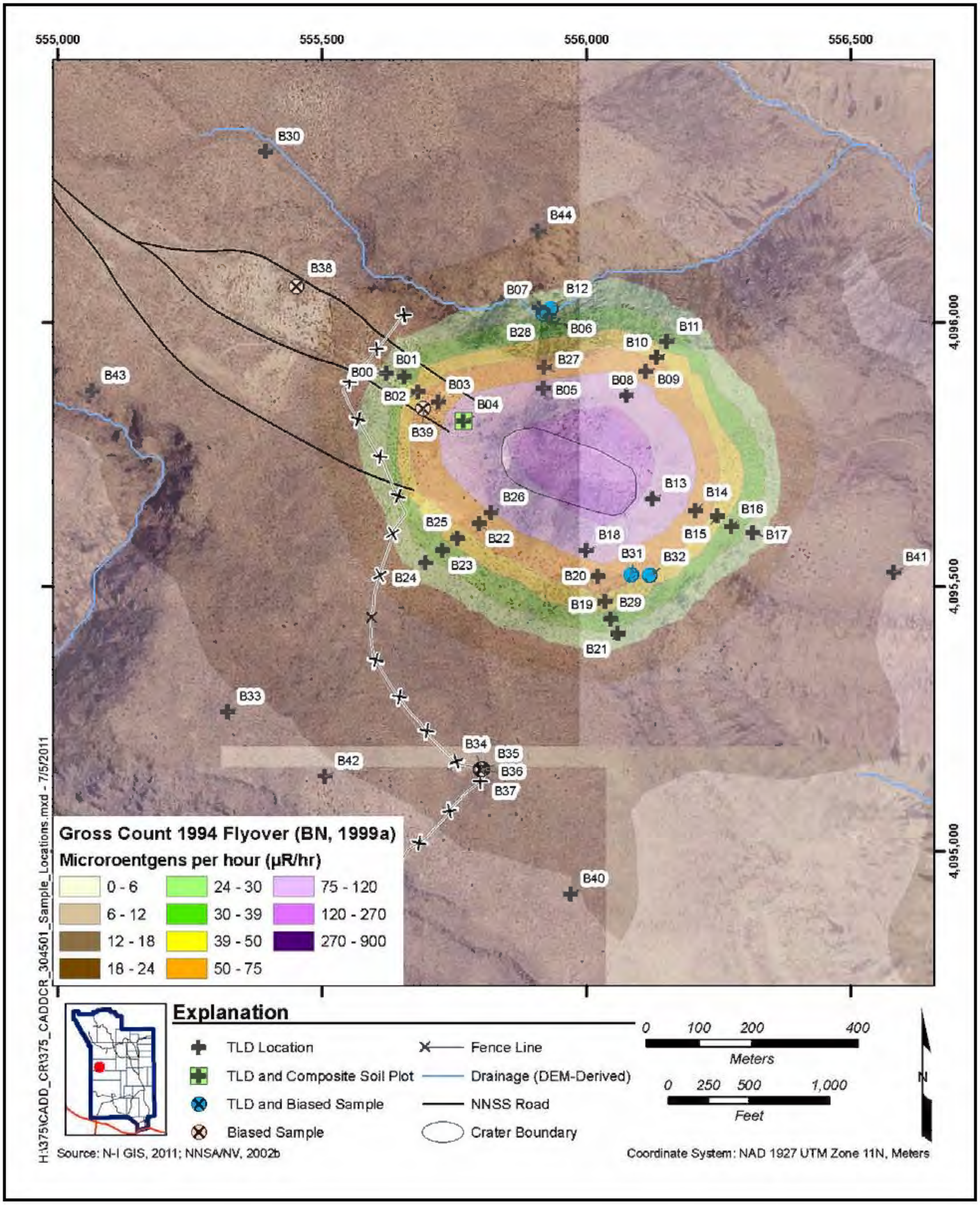


Figure A.5-4
Buggy Sample and TLD Locations

For the other releases at Buggy, one sample (0 to 5 cm bgs) was collected from each of two sedimentation areas (locations B31 and B32) within the wash southwest of the crater area, and two samples (0 to 5 cm and 5 to 10 cm) were collected from each of two sedimentation areas (locations B12 and B28) within the wash northeast of the crater area. In all four sedimentation locations, refusal made deeper samples impractical to obtain. These samples were collected to determine whether migration away from the test area had occurred. Other release samples were collected from a low spot in the bermed retention basin (B38), from beneath a transformer located within the contamination area (CA) (B39), and from the soil downgradient from the lead box (B34 through B37). Biased sample locations are shown on Figure A.5-5.

A.5.1.5 Deviations

No deviations to the CAIP (NNSA/NSO, 2010) were noted.

A.5.2 Investigation Results

The following sections provide the analytical and computational results for soil and TLD samples. All sampling was conducted and analyses performed as specified in the CAIP (NNSA/NSO, 2010). The radiological results are reported as doses that are comparable to the dose-based FALs as established in Appendix C. Results that are equal to or greater than FALs are identified by bold text in the results tables.

A minimum number of samples is required to assure sufficient confidence in the calculation of the 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 minimum sample size is described in Section B.1.1.1.1.

The internal dose calculated from the analytical results from the soil samples 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.5.2.1. Internal doses for each sampled location are summarized in Section A.5.2.2. The TEDs for each sampled location are summarized in Section A.5.2.3.

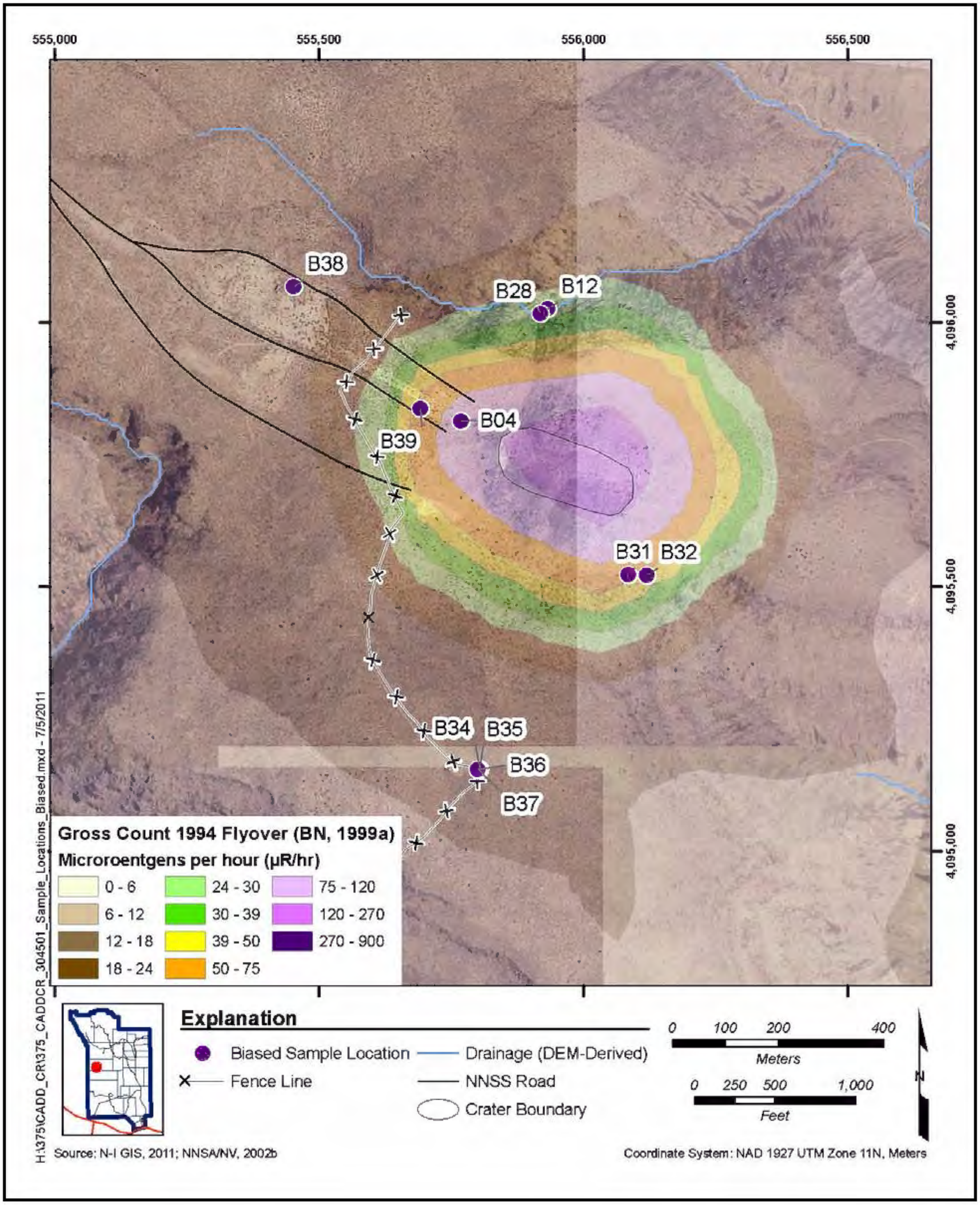


Figure A.5-5
Buggy Biased Sample Locations

A.5.2.1 External Radiological Dose Measurements

The external dose estimates at each sample location were derived from the TLDs. The external dose for each TLD location was calculated for the Industrial Area exposure scenario and then scaled, based on exposure duration, to the Remote Work Area and Occasional Use exposure scenarios. The 95 percent UCL and the average external dose for each exposure scenario are presented in Table A.5-3.

Table A.5-3
Buggy External Dose Estimates at Sample Location (mrem/yr)
(Page 1 of 2)

TLD Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Avg.	95% UCL	Avg.	95% UCL	Avg.	95% UCL
B00	12.1	13.7	1.8	2.0	0.4	0.5
B01	10.0	13.4	1.5	2.0	0.4	0.5
B02	11.2	13.8	1.7	2.1	0.4	0.5
B03	24.2	**28.9**	3.6	4.3	0.9	1.0
B04	**88.2**	**94.7**	13.2	14.1	3.1	3.4
B05	**51.0**	**60.8**	7.6	9.1	1.8	2.2
B06	12.5	15.0	1.9	2.2	0.4	0.5
B07	14.2	18.5	2.1	2.8	0.5	0.7
B08	**36.2**	**40.7**	5.4	6.1	1.3	1.4
B09	13.5	18.9	2.0	2.8	0.5	0.7
B10	12.5	16.4	1.9	2.5	0.4	0.6
B11	4.6	7.4	0.7	1.1	0.2	0.3
B12	8.7	11.4	1.3	1.7	0.3	0.4
B13	**93.0**	**97.5**	13.9	14.6	3.3	3.5
B14	**41.7**	**47.5**	6.2	7.1	1.5	1.7
B15	20.6	23.9	3.1	3.6	0.7	0.8
B16	7.8	11.6	1.2	1.7	0.3	0.4
B17	4.2	7.6	0.6	1.1	0.2	0.3
B18	**44.9**	**53.1**	6.7	7.9	1.6	1.9
B19	8.5	9.1	1.3	1.4	0.3	0.3
B20	**41.8**	**44.1**	6.2	6.6	1.5	1.6

Table A.5-3
Buggy External Dose Estimates at Sample Location (mrem/yr)
(Page 2 of 2)

TLD Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Avg.	**95% UCL**	**Avg.**	**95% UCL**	**Avg.**	**95% UCL**
B21	8.9	12.7	1.3	1.9	0.3	0.5
B22	**49.2**	**55.4**	7.4	8.3	1.8	2.0
B23	16.1	19.7	2.4	2.9	0.6	0.7
B24	13.6	16.0	2.0	2.4	0.5	0.6
B25	22.0	**25.7**	3.3	3.8	0.8	0.9
B26	**37.9**	**46.4**	5.7	6.9	1.3	1.7
B27	**49.9**	**59.2**	7.4	8.8	1.8	2.1
B28	11.6	15.7	1.7	2.3	0.4	0.6
B29	4.0	4.9	0.6	0.7	0.1	0.2
B31	16.1	21.9	2.4	3.3	0.6	0.8
B32	**32.7**	**41.2**	4.9	6.2	1.2	1.5

Bold indicates the values exceeding 25 mrem/yr.

A.5.2.2 Internal Radiological Dose Estimations

Estimates for the internal dose that a receptor would receive at each sample plot at Buggy were determined as described in Section A.2.2.3. Table A.5-4 presents a comparison of the internal and external doses at the sample plot and shows that the contribution to TED from internal dose is not significant. The average internal dose and 95 percent UCL for each exposure scenario is presented in Table A.5-5. The analytical results for the individual radionuclides in each composite sample and the corresponding calculated internal dose are presented in Appendix F.

Table A.5-4
Buggy Ratio of Calculated Internal Dose to External Dose (mrem/IA-yr)

Plot	Average Internal Dose	Average External Dose	Average TED	Internal to External Dose Ratio
Plot BA	11.6	88.2	99.8	0.13

Table A.5-5
Buggy Internal Dose Estimates at Sample Location (mrem/yr)
(Page 1 of 2)

TLD Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Avg.	95% UCL	Avg.	95% UCL	Avg.	95% UCL
B00	1.59	1.8	0.26	0.29	0.09	0.1
B01	1.32	1.76	0.21	0.28	0.07	0.1
B02	1.47	1.82	0.24	0.29	0.08	0.1
B03	3.18	3.79	0.51	0.61	0.18	0.22
B04	11.6	14.12	2.02	2.46	0.72	0.87
B05	6.7	7.99	1.08	1.29	0.38	0.45
B06	1.64	1.97	0.26	0.32	0.09	0.11
B07	1.86	2.43	0.30	0.39	0.11	0.14
B08	4.76	5.36	0.77	0.86	0.27	0.30
B09	1.77	2.48	0.29	0.40	0.10	0.14
B10	1.65	2.16	0.27	0.35	0.09	0.12
B11	0.60	0.97	0.10	0.16	0.03	0.06
B12	1.14	1.49	0.18	0.24	0.06	0.08
B13	12.2	12.8	1.97	2.06	0.70	0.73
B14	5.49	6.25	0.88	1.01	0.31	0.36
B15	2.70	3.14	0.43	0.51	0.15	0.18
B16	1.03	1.52	0.17	0.25	0.06	0.09
B17	0.56	1.00	0.09	0.16	0.03	0.06
B18	5.90	6.99	0.95	1.12	0.34	0.40
B19	1.12	1.20	0.18	0.19	0.06	0.07
B20	5.50	5.80	0.88	0.93	0.31	0.33
B21	1.17	1.67	0.19	0.27	0.07	0.10
B22	6.48	7.28	1.04	1.17	0.37	0.41
B23	2.12	2.59	0.34	0.42	0.12	0.15
B24	1.79	2.11	0.29	0.34	0.10	0.12
B25	2.89	3.38	0.47	0.54	0.16	0.19
B26	4.99	6.11	0.80	0.98	0.28	0.35
B27	6.56	7.79	1.05	1.25	0.37	0.44

Table A.5-5
Buggy Internal Dose Estimates at Sample Location (mrem/yr)
(Page 2 of 2)

TLD Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Avg.	95% UCL	Avg.	95% UCL	Avg.	95% UCL
B28	1.52	2.06	0.24	0.33	0.09	0.12
B29	0.56	0.65	0.08	0.10	0.03	0.04
B31	2.11	2.88	0.34	0.46	0.12	0.16
B32	4.31	5.42	0.69	0.87	0.25	0.31

Bold indicates the values exceeding 25 mrem/yr.

A.5.2.3 Total Effective Dose

The TED for the sample plot, each sediment sample location, or each TLD location was calculated by summing the external dose values and the internal dose values. Values for both the average TED and the 95 percent UCL of the TED for each exposure scenario are presented in Table A.5-6. The TED for sample locations does not exceed the FAL (the 95 percent UCL of the average TED exceeding 25 mrem/RW-yr) at any of the sampled locations (Figure A.5-6).

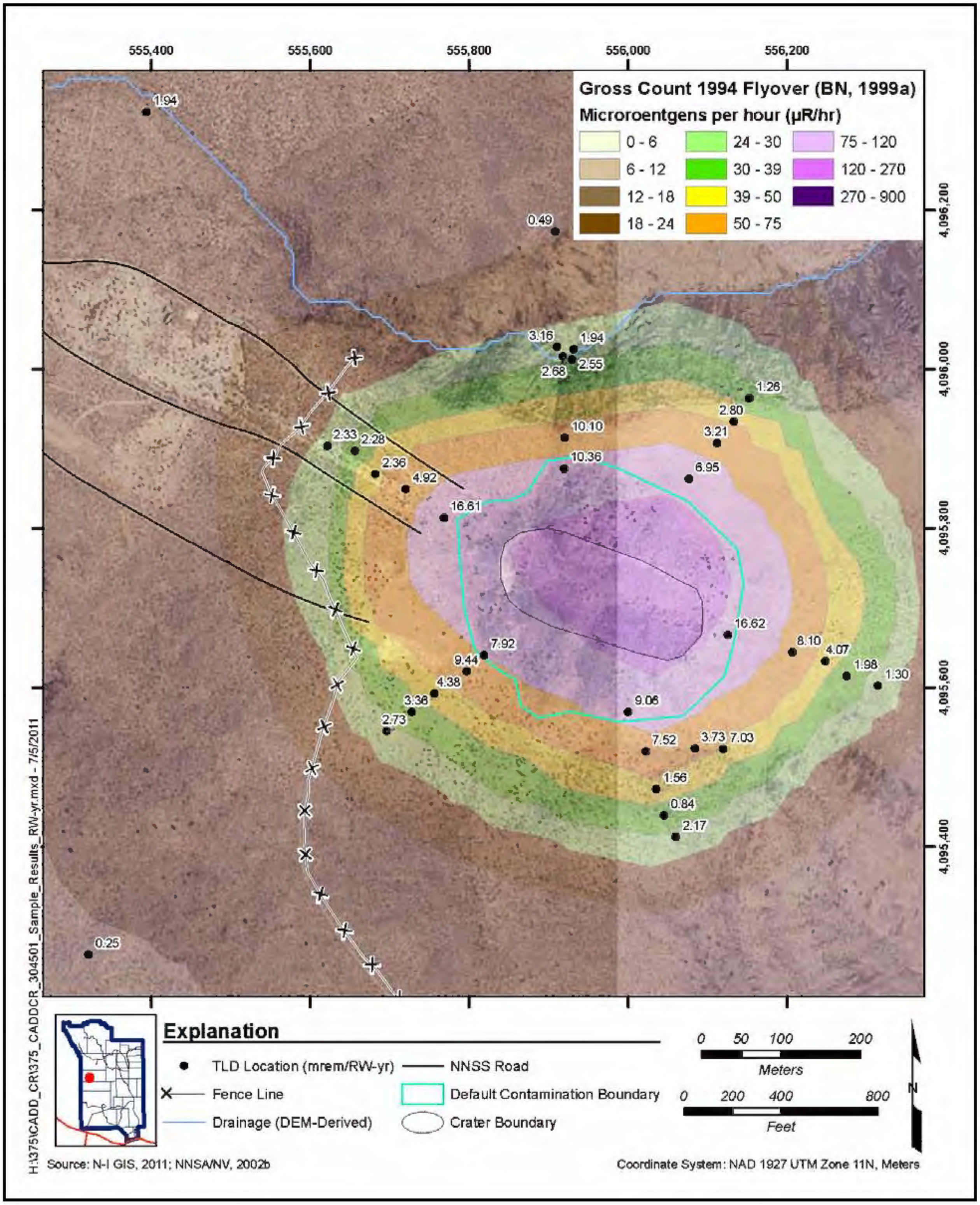
Table A.5-6
Buggy TED at TLD and Sample Locations (mrem/yr)
(Page 1 of 2)

TLD Locations (Plot)	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
B00	13.7	15.5	2.1	2.3	0.5	0.6
B01	11.3	15.1	1.7	2.3	0.4	0.6
B02	12.6	15.6	1.9	2.4	0.5	0.6
B03	**27.3**	**32.6**	4.1	4.9	1.0	1.2
B04 (Plot BA)	**99.8**	**108.8**	15.2	16.6	3.9	4.2
B05	**57.7**	**68.8**	8.7	10.4	2.2	2.6
B06	14.1	16.9	2.1	2.5	0.5	0.6
B07	16.0	20.9	2.4	3.2	0.6	0.8
B08	**41.0**	**46.1**	6.2	6.9	1.6	1.8

Table A.5-6
Buggy TED at TLD and Sample Locations (mrem/yr)
(Page 2 of 2)

TLD Locations (Plot)	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**
B09	15.3	21.3	2.3	3.2	0.6	0.8
B10	14.2	18.6	2.1	2.8	0.5	0.7
B11	5.2	8.4	0.8	1.3	0.2	0.3
B12	9.8	12.9	1.5	1.9	0.4	0.5
B13	**105.2**	**110.3**	15.9	16.6	4.0	4.2
B14	**47.2**	**53.8**	7.1	8.1	1.8	2.0
B15	23.3	**27.0**	3.5	4.1	0.9	1.0
B16	8.9	13.1	1.3	2.0	0.3	0.5
B17	4.8	8.6	0.7	1.3	0.2	0.3
B18	**50.8**	**60.1**	7.6	9.1	1.9	2.3
B19	9.6	10.3	1.4	1.6	0.4	0.4
B20	**47.3**	**49.9**	7.1	7.5	1.8	1.9
B21	10.1	14.4	1.5	2.2	0.4	0.5
B22	**55.7**	**62.7**	8.4	9.4	2.1	2.4
B23	18.2	22.3	2.7	3.4	0.7	0.8
B24	15.4	18.1	2.3	2.7	0.6	0.7
B25	24.9	**29.0**	3.8	4.4	0.9	1.1
B26	**42.9**	**52.6**	6.5	7.9	1.6	2.0
B27	**56.4**	**67.0**	8.5	10.1	2.1	2.5
B28	13.1	17.8	2.0	2.7	0.5	0.7
B29	4.5	5.6	0.7	0.8	0.2	0.2
B31	18.2	24.8	2.7	3.7	0.7	0.9
B32	**37.1**	**46.6**	5.6	7.0	1.4	1.8

Bold indicates the values exceeding 25 mrem/yr.



Source: N-I GIS, 2011; NNSA/NV, 2002b

Coordinate System: NAD 1927 UTM Zone 11N, Meters

Figure A.5-6
Values for the 95% UCL of the TED at Buggy

A.5.2.4 Results for Other Releases at Buggy

The following subsections present analytical results from the samples collected from each of two sedimentation areas within each major wash at Buggy, one soil sample collected from a bermed area, five soil samples collected from the soils downgradient from a lead box, and one soil sample collected from beneath a transformer. No samples were collected from beneath the batteries because the cases were still intact, or from around the cylinders because they remained secure although their valves were inspected and found to be opened to the atmosphere. The lead box, the batteries, and the transformer are assumed to be PSM and require corrective action.

A.5.2.4.1 RCRA Metals

Analytical results for RCRA metals in the environmental samples collected at the biased locations around the lead box that were detected above MDCs are presented in Table A.5-7. No metals were found in concentrations that exceeded their respective PALs.

Table A.5-7
Sample Results for Metals Detected above MDCs at Buggy

Sample Location	**Sample Number**	**Depth (cm bgs)**	**COPCs (mg/kg)**							
			Arsenic	**Barium**	**Cadmium**	**Chromium**	**Lead**	**Mercury**	**Selenium**	**Silver**
FAL			**23**	**190,000**	**800**	**39.2**	**800**	**43**	**5,100**	**5,100**
B34	375BX05	0 - 5	2.97	209	0.175 (J)	9.13	291	0.0244	--	--
B35	375BX06	0 - 5	1.18	173	0.166 (J)	8.23	27.4	0.0238	--	--
B36	375BX07	0 - 5	6.98	163	0.138 (J)	8.63	103	0.0208	0.56 (J)	--
B37	375BX08	0 - 5	2.38	161	0.163 (J)	10.4	137	0.0204	--	0.113 (J)

J= Estimated value
-- = Not detected above MDCs.

A.5.2.4.2 PCBs

Analytical results for PCBs in the environmental sample collected at the biased location beneath the transformer that were detected above MDCs are presented in Table A.5-8. No PCBs were found in concentrations that exceeded their respective PALs.

Table A.5-8
Sample Results for PCBs Detected above MDCs at Buggy

Sample Location	Sample Number	Depth (cm bgs)	COPCs (mg/kg)	
			Aroclor 1254	Aroclor 1260
FAL			**0.74**	**0.74**
B39	375BX04	0 - 5	0.0041 (J)	0.0021 (J)

J = Estimated value

A.5.2.4.3 SVOCs

Analytical results for SVOCs in the environmental sample collected at the biased location within the bermed retention basin revealed no contaminant concentrations above MDCs.

A.5.3 Nature and Extent of Contamination

Based on the data evaluation and the proposed scenario, no COCs were identified; however, COCs are assumed to be present within the default contamination boundary, within the transformer, the batteries, and the lead box. Therefore, a corrective action is required. Based on the corrective action evaluation presented in Appendix E, the selected corrective action for the default contamination boundary, which includes the Buggy crater and the associated ejecta area, is closure in place with a UR. The selected corrective action for the transformer, batteries, and lead box is clean closure. The boundary of the default contamination area was identified as the corrective action boundary for closure in place as shown in Figure A.5-7. An FFACO UR was established to encompass this area. The UR is presented in Attachment D-1.

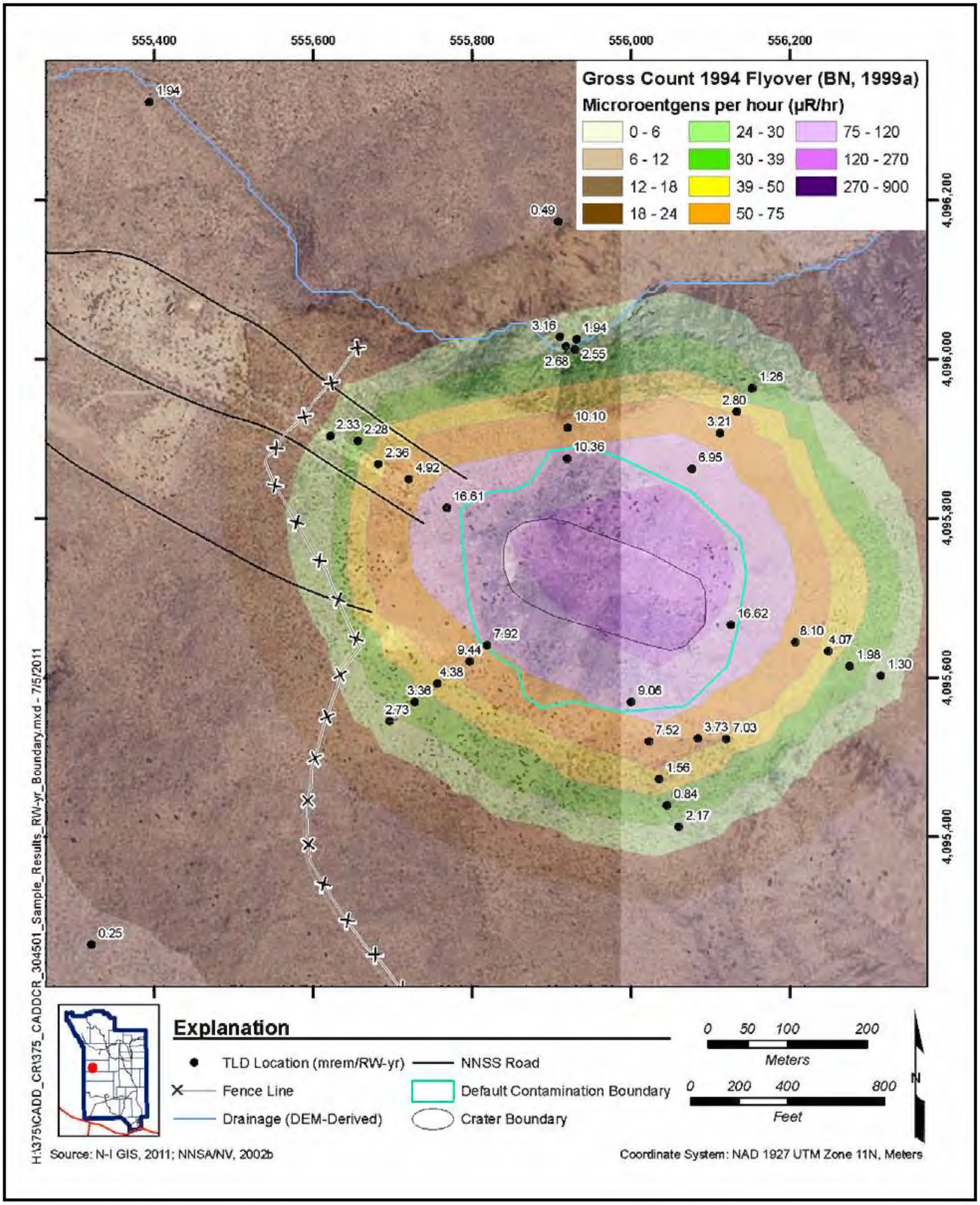


Figure A.5-7
Buggy Default Contamination Boundary/Corrective Action Area

As a BMP, an administrative UR was established to include any area where an industrial land use of the area (2,250 hr/yr) could cause a future site worker to receive a dose exceeding 25 mrem/yr. To determine the extent of the area where the Industrial Area TED exceeds the FAL (Industrial Area scenario), the dose values at each TLD location were compared to the isopleths generated during the 1994 aerial radiation surveys (BN, 1999a). The 1994 aerial radiation survey provides an acceptable boundary for the identification of the administrative UR boundary (Figure A.5-8). The administrative UR boundary established to encompass this area is presented in Attachment D-1.

A.5.4 Revised Conceptual Site Model

The CAIP requirements (NNSA/NSO, 2010) were met at this CAS. The information gathered during the CAI supports the CSM as presented in the CAIP for CAU 375. Therefore, no revisions were necessary to the CSM.

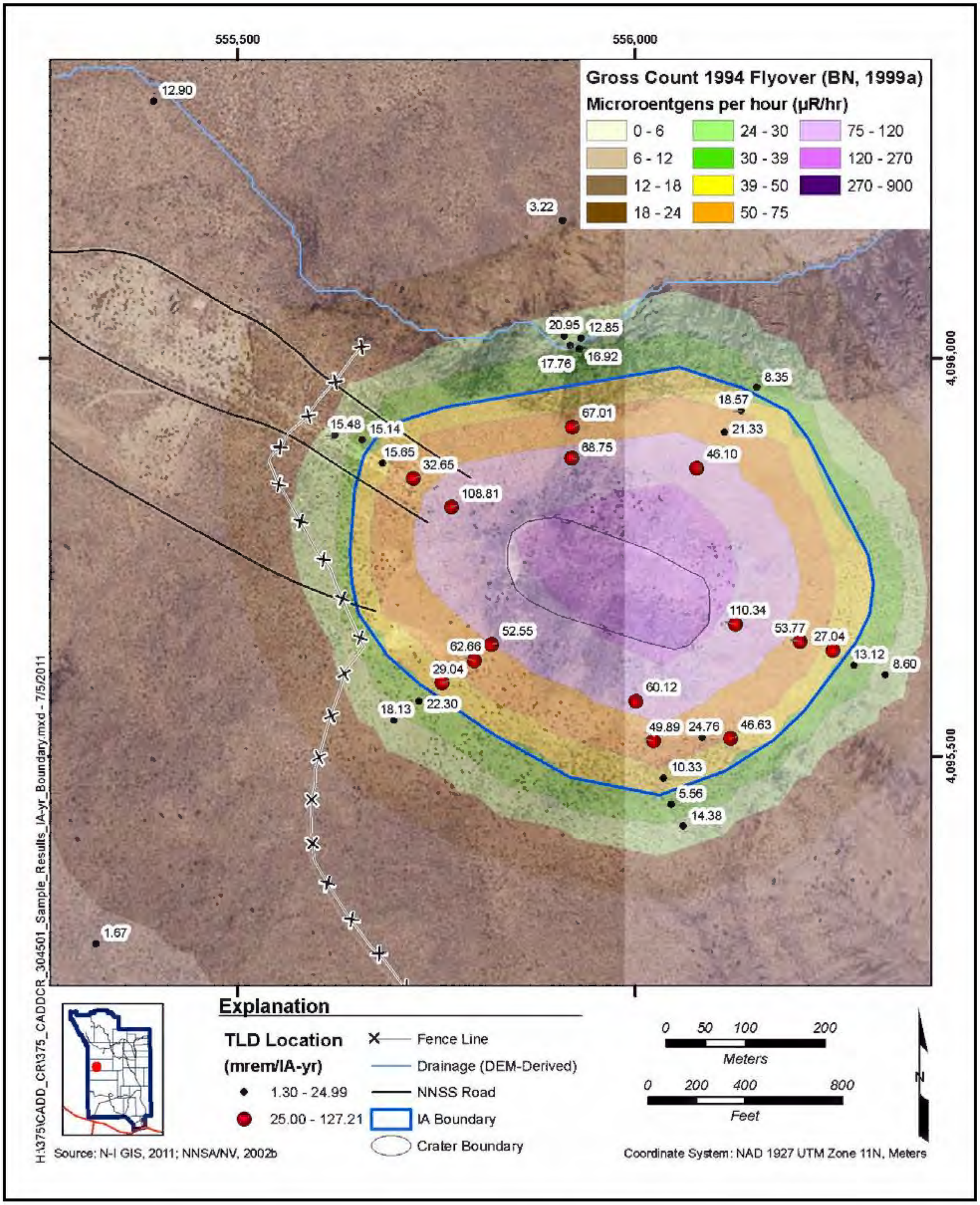


Figure A.5-8
Buggy Administrative UR Area

A.6.0 Waste Management

Waste management activities were conducted as specified in the CAIP (NNSA/NSO, 2010). Investigation-derived wastes (IDWs) generated during the CAI were characterized based on process knowledge and FSRs. Controls were in place to minimize the use of hazardous materials and the unnecessary generation of hazardous and/or mixed waste.

A.6.1 Waste Streams

The waste streams listed in Table A.6-1 were generated at CAU 375.

A.6.1.1 Investigation-Derived Waste

Investigation-derived waste generated during the field activities for CAU 375 included disposable personal protective equipment (PPE), disposable sampling equipment, and empty sample containers. The waste was bagged, labeled, and disposed of as low-level waste (LLW) at the Area 5 Radioactive Waste Management Site (RWMS).

A.6.1.2 Compressed Gas Cylinders

Two compressed gas cylinders were removed from the area outside the contamination area at Buggy and, as a BMP, were delivered to the NNSS M&O contractor to be recycled. The valves on top of both cylinders were inspected and found to be in the fully opened position (the contents had been previously exhausted). One of the cylinders was considered to be an old design and will be recycled as scrap metal, while the second cylinder was recycled for reuse.

A.6.1.3 Batteries

Three lead-acid batteries were removed from the area outside the contamination area at Buggy and are staged at Building 23-153 for recycling at TOXCO, Inc., of Oak Ridge, Tennessee. All of the batteries were dry (i.e., no longer contained the electrolyte fluid) and it is presumed that the liquid evaporated over time from exposure to the desert climate. The lead plates in these batteries are considered scrap metal and will be recycled. Under the scrap metal exemption of 40 CFR 261.4(a)(13), the lead plates are not considered hazardous waste when recycled (CFR, 2010b). These

Table A.6-1
Waste Summary Table

CAS	Waste Items	Waste Characterization				Waste Disposition			
		Hazardous	Hydrocarbon	PCBs	Radioactive	Disposal Facility	Waste Volume	Disposal Date	Disposal Doc[a]
30-45-01, 25-23-22	PPE	No	No	No	Yes (LLW)	Area 5 RWMS	1 55-gallon drum	07/28/2011	NTS Onsite Hazardous Material Transfer
30-45-01	Gas cylinders for recycle	No	No	No	No	Nevada Compressed Gas	2 cylinders	Pending	BOL
30-45-01	Lead-acid batteries for recycle	No	No	No	No	TOXCO, Inc.	3 batteries	Pending	Certificate of Recycle
30-45-01	Lead plate for recycle	No	No	No	No	TOXCO, Inc.	~2,400 lb	Pending	Certificate of Recycle
30-45-01	Transformer	Yes	Yes	No	Yes	Area 5 RWMS	4.65-m^3 macro box	06/23/2011	NTS Onsite Hazardous Material Transfer
30-45-01	Asbestos tile	No	No	No	Yes (LLW)	U10c	2 tiles	06/23/2011	NTS Landfill Load Verification
30-45-01	Wood debris	Yes	No	No	Yes (LLW)	Area 5 RWMS	4.65-m^3 macro box	06/23/2011	NTS Onsite Hazardous Material Transfer
30-45-01	Mercury switch	Yes	No	No	No	Rinchem Company	2 lb	06/28/2011	Uniform Hazardous Waste Manifest

[a] Copies of waste disposal documents are not available as of the date of this draft document but will be included in Appendix D.

BOL = Bill of Lading
CD = Certificate of Disposal
lb = Pound

m^3 = Cubic meter
NTS = Nevada Test Site
PSDR = Package Storage and Disposal Request

batteries will be shipped off site when enough recyclable material is accumulated to make offsite shipment economical. It is anticipated that this material will be shipped off site by the end of fiscal year 2011.

A.6.1.4 Lead Plate

A wood box containing some sheets of lead and with lead plate bolted to the outside was removed from the area outside the contamination area at Buggy, and the lead is currently staged at Building 23-153 for future recycling at TOXCO, Inc. The lead is considered scrap metal and will be recycled. Under the scrap metal exemption of 40 CFR 261.4(a)(13), the lead is not considered hazardous waste when recycled (CFR, 2010b). The lead will be shipped off site when enough recyclable material is accumulated to make offsite shipment economical. It is anticipated that this material will be shipped off site by the end of September 2011.

A.6.1.5 Transformer

An oil-filled transformer was located within the contamination area at Buggy, and removed and disposed of by the NNSS M&O contractor. Because of the time frame when the Buggy test originally took place, the oil within the transformer is assumed to contain hydrocarbons and PCBs, and will be disposed of as mixed waste.

A.6.1.6 Asbestos Tile

An asbestos tile was located among the wood debris within the lead box outside the contamination area at Buggy, and was removed and disposed of by the NNSS M&O contractor. The tile will be disposed of as radioactive waste.

A.6.1.7 Wood Debris

The wood debris within the lead box outside the contamination area at Buggy was classified as a porous material, thus making it impossible to unquestionably determine radioactivity. Due to its direct contact with the lead, the wood debris was classified as mixed waste. The NNSS M&O contractor disposed of the wood in the Area 5 RWMS LLW landfill.

A.6.1.8 Mercury

A mercury switch was located among the wood debris within the lead box outside the contamination area at Buggy, and was removed and disposed of by the NNSS M&O contractor. The switch was disposed of as hazardous waste.

A.6.2 Waste Characterization

All waste dispositions were based on process knowledge, radiological surveys, site samples, and direct samples of the waste, when necessary. Waste characterization and disposition was based on federal and state regulations, permit limitations, and disposal facility acceptance criteria.

A.7.0 Quality Assurance

This section contains a summary of QA/QC measures implemented during the sampling and analysis activities conducted in support of the CAU 375 CAI. The following sections 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 samples, 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 Industrial Sites QAPP (NNSA/NV, 2002a).

A.7.1 Data Validation

Data validation was performed in accordance with the Industrial Sites QAPP (NNSA/NV, 2002a) and approved protocols and procedures. All laboratory data from samples collected and analyzed for CAU 375 were evaluated for data quality in a tiered process and are presented in Sections A.7.1.1 through A.7.1.3. 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 project files as a hard copy and electronic media.

All data analyzed as part of this investigation were subjected to Tier I and Tier II evaluations. A Tier III evaluation was performed on approximately 5 percent of the data analyzed.

A.7.1.1 Tier I Evaluation

Tier I evaluation for chemical and radiochemical analysis examines, but is not limited to, the following items:

- Sample count/type consistent with chain of custody.
- Analysis count/type consistent with chain of custody.
- Correct sample matrix.

- Significant problems and/or nonconformances stated in cover letter or case narrative.
- Completeness of certificates of analysis.
- Completeness of Contract Laboratory Program (CLP) or CLP-like packages.
- Completeness of signatures, dates, and times on chain of custody.
- Condition-upon-receipt variance form included.
- Requested analyses performed on all samples.
- Date received/analyzed given for each sample.
- Correct concentration units indicated.
- Electronic data transfer supplied.
- Results reported for field and laboratory QC samples.
- Whether or not the deliverable met the overall objectives of the project.

A.7.1.2 Tier II Evaluation

Tier II evaluation for radiochemical analysis examines, but is not limited to, the following items:

- Correct detection limits achieved.

- Blank contamination evaluated and, if significant, qualifiers are applied to sample results.

- Certificate of Analysis consistent with data package documentation.

- Quality control sample results (duplicates, laboratory control samples [LCSs], laboratory blanks) evaluated and used to determine laboratory result qualifiers.

- Sample results, uncertainty, and MDC evaluated.

- Detector system calibrated with National Institute of Standards and Technology (NIST)-traceable sources.

- Calibration sources preparation was documented, demonstrating proper preparation and appropriateness for sample matrix, emission energies, and concentrations.

- Detector system response to daily or weekly background and calibration checks for peak energy, peak centroid, peak full-width half-maximum, and peak efficiency, depending on the detection system.

- Tracers NIST-traceable, appropriate for the analysis performed, and recoveries that met QC requirements.

- Documentation of all QC sample preparation complete and properly performed.

- Spectra lines, photon emissions, particle energies, peak areas, and background peak areas support the identified radionuclide and its concentration.

A.7.1.3 Tier III Evaluation

The Tier III review is an independent examination of the Tier II evaluation. A Tier III review of 14 percent of the sample radiological data was performed by TLI Solutions, Inc., in Golden, Colorado. Tier II and Tier III results were compared and where differences are noted, data were reviewed and changes were made accordingly. This review included the following additional evaluations:

- Review
  - case narrative, chain of custody, and sample receipt forms,
  - lab qualifiers (applied appropriately),
  - method of analyses performed as dictated by the chain of custody,
  - raw data, including chromatograms, instrument printouts, preparation logs, and analytical logs,
  - manual integrations to determine whether the response is appropriate,
  - data package for completeness.
- Determine sample results qualifiers through the evaluation of (but not limited to)
  - tracers and QC sample results (e.g., duplicates, LCSs, blanks, matrix spikes) evaluated and used to determine sample results qualifiers,
  - sample preservation, sample preparation/extraction and run logs, sample storage, and holding time,
  - instrument and detector tuning,
  - initial and continuing calibrations,
  - calibration verification (initial, continuing, second source),
  - retention times,
  - second column and/or second detector confirmation,
  - mass spectra interpretation,

  - interference check samples and serial dilutions,
  - post-digestion spikes and method of standard additions,
  - breakdown evaluations.
- Perform calculation checks of
  - at least one analyte per QC sample and its recovery,
  - at least one analyte per initial calibration curve, continuing calibration verification, and second source recovery,
  - at least one analyte per sample that contains positive results (hits); radiochemical results only require calculation checks on activity concentrations (not error).
- Verify that target compound detects identified in the raw data are reported on the results form.
- Document any anomalies for the laboratory to clarify or rectify. The contractor should be notified of any anomalies.

A.7.2 Field QC Samples

Field QC samples consisted of two full laboratory QCs collected and submitted for analysis by the laboratory analytical methods shown in Table A.2-1. The QC samples were assigned individual sample numbers and sent to the laboratory "blind." Full laboratory QC samples are used to measure accuracy and precision associated with the matrix (see Appendix B for further discussion).

During the CAI, three FDs were also sent as blind samples to the laboratory to be analyzed for the investigation parameters listed in Table A.2-1. For these samples, the duplicate results' precision (i.e., relative percent differences [RPDs] between the environmental sample results and their corresponding FD sample results) were evaluated.

A.7.2.1 Laboratory QC Samples

Ten full laboratory QC samples were analyzed by the laboratory for the analytical methods shown in Table A.2-1. Full laboratory QC samples are used to measure accuracy and precision associated with the matrix (see Appendix B for further discussion).

A.7.3 Field Nonconformances

There were no field nonconformances identified for the CAI.

A.7.4 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, or precision. All laboratory nonconformances were reviewed for relevance and where appropriate, data were qualified.

A.7.5 TLD Data Validation

The use of a TLD to determine an individual’s external exposure is the standard in radiation safety and serves as the “legal dose of record” when other measurements are not available. Specifically, 10 CFR Part 835.402 (CFR, 2010a) indicates that personal dosimeters shall be provided to monitor individual exposures and that the monitoring program that uses the dosimeters shall be accredited in accordance with a DOE Laboratory Accreditation Program, as was the case for the TLDs used at CAU 375.

The TLDs were exposed at the CAU 375 sample locations for an exposure duration exceeding the 2,250 hours of the Industrial Area exposure scenario. The measured dose from each TLD was then scaled to the exposure durations defined for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios.

A.8.0 Summary

Radionuclide contaminants detected in environmental samples during the CAI were evaluated against FALs to determine the nature and extent of COCs for CAU 375. Assessment of the data generated from surface soil samples indicates that although surface radiological contamination at the site exceeds the PALs (based on the Industrial Area exposure scenario), it does not exceed the FALs (based on the Remote Work Area exposure scenario). However, surface and subsurface contamination is assumed to be present at both CASs that exceeds the FALs. Therefore, corrective action is required. The following summarizes the results for each CAS.

CAS 25-23-22, Contaminated Soils Site

Based on field observations and analytical results for surface soil (0 to 5 cm bgs) samples collected at this CAS, radiological contamination outside the default contamination boundary does exceed the FAL for the radiological dose (25 mrem/IA-yr). It is assumed that contamination is also present within the TCA fence line that also exceeds the FAL. Therefore, a corrective action is required. The selected corrective action (based on the corrective action evaluation presented in Appendix E) for the contamination both inside and outside the fence line is closure in place with a UR. A FFACO UR was established that encompasses the contaminated area and is presented in Attachment D-1.

CAS 25-34-06, Test Cell A Bunker

Based on field observations and analytical results for the surface soil (0 to 5 cm bgs) sample collected at this CAS, contamination at the site does not exceed any of the associated FALs. Therefore, no corrective action is required.

CAS 30-45-01, U-30a, b, c, d, e Craters

Based on field observations and analytical results for surface soil (0 to 5 cm bgs) samples collected at this CAS, the radiological contamination outside the default contamination boundary does not exceed the FAL for the radiological dose (25 mrem/RW-yr). However, it is assumed that contamination present in the crater and ejecta exceeds the FAL due to direct injection of radionuclides from the nuclear test conducted at the Buggy site. Therefore, a corrective action is required. The selected corrective action (based on the corrective action evaluation presented in Appendix E) for the contamination is closure in place with a UR. A FFACO UR was established that encompasses the area of the Buggy crater as well as the ejecta field surrounding the crater (Figure A.5-7). The FFACO UR is presented in Attachment D-1.

As a BMP, an administrative UR was established to include any area beyond the FFACO UR where an industrial land use of the area (2,250 hours of exposure per year) could cause a site worker to receive a dose exceeding 25 mrem/yr. Therefore, as a BMP, an administrative UR boundary was established around the area exceeding this value as shown on Figure A.5-8. The administrative UR is presented in Attachment D-1.

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Appendix B

Data Assessment

B.1.0 Data Assessment

The DQA process is the scientific evaluation of the actual investigation results to determine whether the DQO criteria established in the CAU 375 CAIP (NNSA/NSO, 2010) 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 help 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. The five steps are briefly summarized as follows:

Step 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.

Step 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.

Step 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.

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

Step 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 CAU 375 CAIP (NNSA/NSO, 2010). 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 (NNSA/NSO, 2010) for both primary and other releases is as follows: "Is radioactivity associated with the CAS present in environmental media that could result in a dose exceeding 25 mrem/yr? Any plot for which the 95 percent UCL of the mean TED exceeds 25 mrem/yr will be defined as containing a COC. If a COC is not present, the investigation for that release is complete." The Decision I statement for the other releases is as follows: "Is any COC associated with the CAS present in environmental media? Any analytical result for a COPC above a FAL will result in that COPC being designated as a COC." Contamination at levels exceeding FALs is assumed to be present within the crater at the Buggy CAS and within the fence line at the TCA CASs.

B.1.1.1.1 DQO Provisions To Limit False Negative Decision Error

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

1. For Decision I, having a high degree of confidence that sample locations selected will identify COCs if present anywhere within the CAS.
2. Maintenance of a false negative decision error rate of 0.05 (probabilistic sampling).
3. Having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.
4. 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

To resolve Decision I for the primary releases at CAU 375 (as stipulated in the DQOs), sample plot locations were chosen based on the highest GWS values outside the default contamination areas at the TCA and Buggy CASs.

The locations for sampling sedimentation areas at TCA and Buggy were selected based upon the criterion of visual field observations (visible sedimentation areas within a wash downgradient of GZ and/or elevated radiological readings from the GWSs) (Section A.2.1).

Criterion 1b

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 (Sections 4.1.1, A.8.2.1, and A.9.1 of the CAIP [NNSA/NSO, 2010]) was accomplished using the random start, systematic triangular grid pattern for sample placement. This permitted an unbiased, equal-weighted chance that any given location within the boundaries of the sample plot would be 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 an integrated, unbiased measurement of dose from the plot area.

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

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

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 sample plot and TLD samples was met or exceeded. The minimum sample size calculations were conducted as stipulated in the CAIP (NNSA/NSO, 2010) 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 standard deviation

Table B.1-1
Input Values and Determined Minimum Number of Samples for CAU 375, TCA

Soil Samples			
Plot	**Standard Deviation**	**Minimum Sample Size**	**Samples Collected**
AA	0.1521	1.4	4

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 CAU 375, Buggy

Soil Samples			
Plot	**Standard Deviation**	**Minimum Sample Size**	**Samples Collected**
BA	0.3744	1.4	4

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.

Criterion 2

All samples were analyzed using the analytical methods listed in Tables 3-2 and 3-3 of the CAIP (NNSA/NSO, 2010) and for the following radiological analytes as listed in Section 3.2 of the CAIP: gamma spectroscopy; Sr-90; and isotopic Am, U, and Pu.

Sample results were assessed against the acceptance criterion for the DQI of sensitivity as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The sensitivity acceptance criterion defined in the CAIP (NNSA/NSO, 2010) is that analytical detection limits will be less than the corresponding FAL. Therefore, the criterion is that all detection limits are less than their corresponding remote work area internal dose RRMGs. As all of the analytical result detection limits for every radionuclide were less than their corresponding RRMGs, the DQI for sensitivity has been met, and no data were rejected due to sensitivity.

Criterion 3

To satisfy the third criterion, the entire dataset, as well as individual sample results, were assessed against the acceptance criteria for the DQIs of precision, accuracy, comparability, completeness, and representativeness, as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The DQI acceptance criteria are presented in Table 6-1 of the CAIP (NNSA/NSO, 2010). As presented in the following subsections, these criteria were met for each of the DQIs with the exceptions of precision and accuracy.

Precision

Precision was evaluated as described in Section 6.2.3 of the CAIP (NNSA/NSO, 2010). Table B.1-3 provides the results for all constituents that were qualified for precision.

Table B.1-3
Precision Measurements

Parameter	Analyses	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Am-241	Iso-Am	3	23	86.9
U-234	Iso-U	3	23	86.9
Pu-238	Iso-Pu	7	23	69.5
Pu-239/240	Iso-Pu	7	23	69.5
Barium	Metals	3	7	57.1
Lead	Metals	3	7	57.1

As shown in Table B.1-3, the precision rate for the isotopes Pu-238 and Pu-239/240 as well as barium and lead did not meet the criteria of 80 percent specified in the CAIP (NNSA/NSO, 2010). The precision evaluations were based on differences in laboratory duplicate sample results (RPD). Variability in the sample matrix suggests that discrete particles of contamination are present within the samples, resulting in a nonhomogenous distribution throughout the soils. Nonhomogeneity does not mean the measurement is poor, but that contaminants are variable within the samples. Therefore, when a duplicate sample is analyzed, the results can be significantly different depending on how many discrete particles are contained in each sample. This is more likely to occur when contaminant levels approach instrument detection limits, as is the case with the samples failing the precision criteria. As shown in Table B.1-4, the potential for a false negative DQO decision error is negligible because the highest reported result for the contaminants that were qualified for precision are orders of magnitude less than the FALs. Therefore, the results that were qualified for precision can be confidently used to support the DQO decision. As the precision rates for all other constituents meet the acceptance criteria for precision, the dataset is determined to be acceptable for the DQI of precision.

Accuracy

Accuracy was evaluated as described in Section 6.2.4 of the CAIP (NNSA/NSO, 2010). As shown in Table B.1-5, the CAIP criterion of 80 percent accuracy was not met. The samples qualified for lead, barium, and selenium accuracy were estimated based on the matrix spike, matrix spike duplicate, and

Table B.1-4
Sample Results Failing Precision or Accuracy Criteria

Parameter	Analyses	Result	Fraction of FAL	FAL	Units
Pu-238	Iso-Pu	282	0.0203	13,900	pCi/g
	Iso-Pu	116	0.0083	13,900	pCi/g
	Iso-Pu	39.6	0.0028	13,900	pCi/g
	Iso-Pu	0.234	0.0000	13,900	pCi/g
	Iso-Pu	0.197	0.0000	13,900	pCi/g
	Iso-Pu	0.0492	0.0000	13,900	pCi/g
	Iso-Pu	0.0206	0.0000	13,900	pCi/g
Pu-239/240	Iso-Pu	128	0.0101	12,690	pCi/g
	Iso-Pu	89.4	0.0070	12,690	pCi/g
	Iso-Pu	104	0.0082	12,690	pCi/g
	Iso-Pu	1.28	0.0001	12,690	pCi/g
	Iso-Pu	2.42	0.0002	12,690	pCi/g
	Iso-Pu	0.451	0.0000	12,690	pCi/g
	Iso-Pu	0.0236	0.0000	12,690	pCi/g
Barium	Metals	95.7	0.0005	190,000	mg/kg
	Metals	179	0.0009	190,000	mg/kg
	Metals	114	0.0006	190,000	mg/kg
Lead	Metals	13.9	0.0174	800	mg/kg
	Metals	8.27	0.0103	800	mg/kg
	Metals	9.99	0.0125	800	mg/kg
Selenium	Metals	1.01	0.0002	5,100	mg/kg
	Metals	0.922	0.0002	5,100	mg/kg
	Metals	0.56	0.0001	5,100	mg/kg
	Metals	0.997	0.0002	5,100	mg/kg

serial dilution associated with these samples that failed laboratory criteria. This indicates the potential that the actual contaminant concentrations are greater or less than the reported result.

As shown in Table B.1-4, the potential for a false negative DQO decision error is negligible because the highest reported results for the COPCs that were qualified for accuracy are 50 to 5,000 times less than the FALs. Therefore, the results that were qualified for accuracy can be confidently used to

Table B.1-5
Accuracy Measurements

Parameter	Analyses	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Barium	Metals	3	7	57.1
Lead	Metals	3	7	57.1
Selenium	Metals	4	7	42.9

support the DQO decision. As the accuracy rates for all other constituents meet the acceptance criteria for accuracy, the database is determined to be acceptable for the DQI of accuracy.

Representativeness

The DQO process as identified in Appendix A of the CAIP (NNSA/NSO, 2010) was used to address sampling and analytical requirements for CAU 375. 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 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 1 discussion meet this criterion. Therefore, the analytical data acquired during the CAU 375 CAI are considered representative of the population parameters.

Comparability

Field sampling, as described in the CAIP (NNSA/NSO, 2010), 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, project 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/NSO, 2010) 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 CAS-specific non-critical analytes identified in the CAIP having valid results.

No parameters were rejected; therefore, the DQI completeness criterion of 80 percent has been met. No parameters failed the criterion for sensitivity in specific samples; therefore, all data for critical analytes were within the acceptable criteria.

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. Quality assurance/QC samples such as method blanks were used to determine whether a false positive analytical result may have occurred. No false positive analytical results were detected.

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/NSO, 2010) is as follows: “Is sufficient information available to evaluate appropriate corrective action alternatives?” Sufficient information is defined to include the following:

- Lateral and vertical extent of COC contamination
- Information needed to determine potential remediation waste types
- Information needed to evaluate the feasibility of remediation alternatives

Decision II extent of contamination was not needed at any of the CASs because TEDs above the 25 mrem/RW-yr FAL were not detected in surface soils outside the default contamination areas that were assumed to exceed the FAL.

B.1.1.3 Sampling Design

The CAIP (NNSA/NSO, 2010) made the following commitments for sampling:

1. Judgmental sampling will be conducted at other releases and at locations of potential contamination identified during the CAI.

   Result: Judgmental sampling was conducted at the entrance to the TCA Bunker, at the earthen berm that surrounds TCA, at the transformer at Buggy, at the soils downgradient from a lead box at Buggy, at an earthen bermed area at Buggy, and at two sedimentation areas within a wash downstream from GZ at both TCA and Buggy to determine whether migration from each site has occurred.

2. Sampling of primary releases will be conducted by a combination of judgmental and probabilistic sampling approaches.

   Result: The locations of the plots were selected judgmentally and samples were collected within each plot at both TCA and Buggy probabilistically as described in Section A.2.0.

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 warranted. Data were validated and verified to ensure that the measurement systems performed in accordance with the criteria specified. 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/RW-yr. For other types of contamination, the test for making DQO decisions was the comparison of the maximum analyte result from each CAS to the corresponding FAL. All FALs were 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	The potential for contamination exposure is limited to industrial and construction workers, and military personnel conducting training. These human receptors may be exposed to COPCs through oral ingestion or inhalation of soil and/or debris due to inadvertent disturbance of these materials or irradiation by radioactive materials.
Affected Media	Surface and shallow subsurface soil, debris such as metal and concrete.
Location of Contamination/Release Points	Surface soil (to 5 cm depth). See Section 2.1.
Transport Mechanisms	Surface water runoff may provide for the transportation of some contaminants within or outside the boundaries of the CASs. Percolation of precipitation through subsurface media serves as a minor driving force for vertical migration of contaminants.
Preferential Pathways	Drainages.
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. Groundwater contamination is not expected. Lateral and vertical extent of COC contamination is assumed to be within the spatial boundaries of each CAS.
Groundwater Impacts	None.
Future Land Use	Research, Test, and Experimental Zone (TCA); Reserved Zone (Buggy)
Other DQO Assumptions	Release at TCA is due to a venting of radioactive materials from an unshielded nuclear reactor during nuclear rocket testing. Subsurface contamination is present at TCA due to disturbance of the area due to excavation attributable to construction and demolition. Release at Buggy is due to atmospheric deposition during testing. Refractory plutonium is present as discrete particles. Subsurface contamination is present due to prompt injection of material in the crater. The DQIs were satisfactorily met as discussed in Section B.1.1.1.1. The data collected during the CAI are considered to accurately support the CSM and support 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 375 DQOs and Table B.1-6. All data collected during the CAI supported CSMs, and no revisions to the CSMs were necessary.

B.1.4.1 Other DQO Commitments

The CAIP (NNSA/NSO, 2010) made the following commitments for sampling:

1. For TCA, if the Decision I sample plot results yield a 95 percent UCL of the average TED exceeding the FAL, a Decision II sampling strategy would be presented and agreed upon by the stakeholders before collecting Decision II samples (Section 4.2.2 of the CAIP [NNSA/NSO, 2010]).

   Result: No sample plot surface results exceeded the FAL.

2. For Buggy, a single sample plot where the americium signature is determined to be the greatest by the 1994 flyover survey (BN, 1999) and/or the highest FIDLER radiation survey will be sampled, and then the ratio of internal dose to external dose will be applied to other sample locations. The minimum three sample plots along each of three vectors at Buggy would be placed so that the outermost sample plot on each vector would be located beyond the 25-mrem/yr dose boundary (Section 4.2.2 of the CAIP).

   Result: The locations of the sample plot met these requirements.

3. If a predetermined location cannot be feasibly sampled, the Site Supervisor will determine an alternate location (Section A.8.1.1 of the CAIP).

   Result: The modification of aliquot locations from planned positions was due to field conditions and observations (obstruction from a rock, vegetation, or animal burrows). The distances of the new aliquot locations from the planned locations ranged from approximately 4 in. to approximately 10 in. These changes in the planned locations did not impact the DQO decisions because the samples were collected from the nearest possible location to the original location and are, therefore, still considered to be randomly located.

B.1.5 Draw Conclusions from the Data

This section resolves the two DQO decisions for each of the CAU 375 CASs.

B.1.5.1 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 that COPC is identified as a COC, and Decision II samples will be collected, else no further investigation is needed for that release in that population.

Result: Although no COCs were identified at either CAS at sample plots, COCs were assumed to be present at all three CASs in subsurface soils based on process knowledge. Therefore, Decision II was resolved at all three CASs.

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/NSO, 2010), then work will be suspended and the investigation strategy will be reconsidered, else the decision will be to continue sampling to define the extent.

Result: The COC contamination was not found to be inconsistent with the CSM or extend beyond the spatial boundaries; therefore, work was not suspended.

Decision Rule: If a COC exists at any CAS, then a corrective action will be determined, else no further action will be necessary.

Result: Because COCs are assumed to exist at Buggy and TCA, corrective actions are required.

Decision Rule: If a waste is present that, if released, has the potential to cause the future contamination of site environmental media, then a corrective action will be identified, else no further action will be necessary.

Result: No wastes were identified at TCA that had the potential be cause a future release of COCs. At Buggy, a transformer was found within the CA and a lead box outside the CA. The lead box and the transformer have the potential to cause a future release of COCs and require corrective action.

B.1.5.2 Decision Rules for Decision 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/NSO, 2010), then work will be suspended and the investigation strategy will be reconsidered, else the decision will be to continue sampling to define the extent.

Result: The COC contamination was not found to be inconsistent with the CSM or extend beyond the spatial boundaries; therefore, there was no need to suspend work.

Decision Rule: If the population parameter (the observed concentration of any COC) in the Decision II population of interest exceeds the corresponding FAL in any bounding direction, or potential remediation waste types have not been adequately defined, then additional samples will be collected to complete the Decision II evaluation, else the extent of the COC contamination has been defined.

Result: Because no Decision I analytical results were above PALs, Decision II samples were not collected, and subsurface COCs were assumed to be limited to inside the fence line at TCA and within the crater and ejecta field at Buggy.

Decision Rule: If a radiation survey isopleth exists that bounds all locations determined to exceed the 95 percent UCL of the 25-mrem/yr TED, then the isopleth will be established as the corrective action boundary, else the radiation survey area will be increased until that boundary is defined.

Result: No investigation results exceeded FALs. Therefore, no Decision II samples were collected, and the default contamination boundary will serve as the corrective action boundary at both TCA and Buggy.

B.2.0 References

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Appendix C

Risk Assessment

C.1.0 Risk Assessment

The risk-based corrective action (RBCA) process used to establish FALs is described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). This process conforms with NAC Section 445A.227, which lists the requirements for sites with soil contamination (NAC, 2008a). For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2008b) 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 (i.e., FALs) or to establish that corrective action is not necessary."

The ASTM Method E1739 defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses:

- Tier 1 evaluation – Sample results from source areas (highest concentrations) are compared to risk-based screening levels (RBSLs) based on generic (non-site-specific) conditions (i.e., the PALs established in the CAU 375 CAIP [NNSA/NSO, 2010]). 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 Site-Specific Target Levels (SSTLs) using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 SSTLs 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. Total concentrations of total petroleum hydrocarbons will not be used for risk-based decisions under Tier 2 or Tier 3. Rather, the individual chemicals of concern will be compared to the SSTLs.

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

The risk-based corrective action decision process stipulated in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006) is summarized in Figure C.1-1.

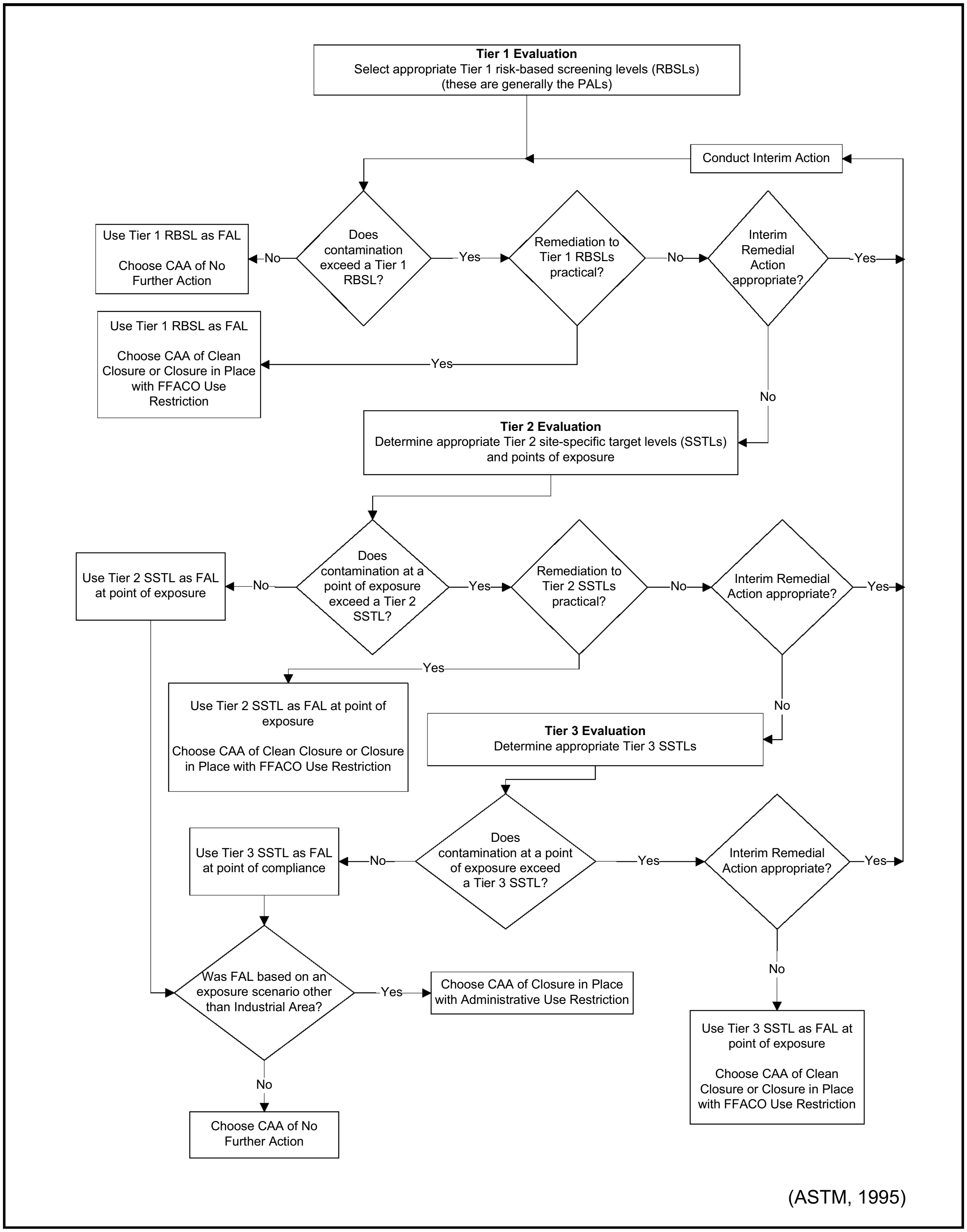

Figure C.1-1
Risk-Based Corrective Action Decision Process

C.1.1 A. Scenario

Corrective Action Unit 375, Area 30 Buggy Unit Craters, comprises the following three CASs within Areas 25 and 30 of the NNSS:

- 25-23-22, Contaminated Soils Site
- 25-34-06, Test Cell A Bunker
- 30-45-01, U-30a, b, c, d, e Craters

Corrective Action Site 25-23-22, Contaminated Soils Site (referred to as TCA in this document), is an inactive industrial site located in Area 25, in the southwest area of the NNSS. The TCA consists of a release of radioactive material to the soil surface as a result of the exhausting of radiological material during the testing of open-air nuclear reactors, nuclear engines, and nuclear furnaces. Testing was conducted periodically from 1959 through 1966.

Corrective Action Site 25-34-06, Test Cell A Bunker (referred to as the TCA Bunker in this document) is located within the fence line at TCA. The TCA Bunker consists of potential releases associated with items that were stored within the bunker.

Corrective Action Site 30-45-01, U-30a, b, c, d, e Craters (referred to as Buggy in this document), is an inactive site located in Area 30 of the NNSS. Buggy consists of a release of radioactive material to the soil surface from the Buggy (U-30a, b, c, d, e) Plowshares test. The Buggy test was conducted on March 12, 1968, at a depth of 140 ft (LRL, 1970). An oblong surface crater measuring 865 ft long by 254 ft wide and 70 ft deep resulted from this test (GE, 1979).

C.1.2 B. Site Assessment

Thermoluminescent dosimeter samples and soil samples collected at various locations outside the default contamination area at TCA were used to calculate TED to workers. The TEDs from four sample locations at TCA exceeded the Industrial Area Scenario based FAL established in this appendix (25 mrem/IA-yr). The maximum calculated TED (based on the Industrial Area Scenario) was 44.93 mrem/yr. Contamination is assumed to be present inside the TCA fence line that also exceeds the FALs.

A soil sample was collected from the entrance to the TCA Bunker to determine whether contaminants were present. The analytical results demonstrated that no contamination was present in concentrations that exceeded FALs.

The Buggy site contains test-related debris, and the area is posted as a contamination area. The test-related debris included PSM in the form of lead plate, batteries, and a transformer. Soil samples collected from beneath the lead plate and the transformer determined that no contamination was present in concentrations in excess of FALs. Thermoluminescent dosimeters were placed throughout the area to measure external dose, and soil samples were collected from the location of the maximum FIDLER survey readings to calculate internal dose. The analytical results from this soil sample plot were used to estimate internal dose. No TEDs from the surface soil plot and TLD locations at Buggy exceeded the Remote Work Area Scenario based FAL established in this appendix (25 mrem/RW-yr). The maximum calculated TED (based on the Remote Work Area Scenario) was 19.4 mrem/yr. However, subsurface contamination is assumed to be present in the Buggy crater and ejecta piles that exceeds FALs. 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 127.2 mrem/yr.

C.1.3 C. 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.

The TCA, TCA Bunker, and Buggy CASs do not present an immediate threat to human health, safety, or the environment; therefore, no interim response actions are necessary at these sites. However, corrective actions are required at TCA and Buggy due to the presence of potential contamination exceeding their respective FALs. At these CASs, contamination is assumed to be present that could pose a short-term threat to human health, safety, or the environment if any excavation was done in the crater or within the TCA fence line. Thus, both CASs have been determined to be Classification 2 sites and the TCA Bunker has been determined to be a Classification 4 site as defined by ASTM Method E1739.

C.1.4 D. Development of Tier 1 Lookup Table of RBSLs

Tier 1 RBSLs are defined as the PALs listed in the CAIP (NNSA/NSO, 2010) as established during the DQO process. The PALs represent a very conservative estimate of risk, are preliminary in nature, and are used for site screening purposes. Although the PALs are not intended to be used as FALs, FALs may be defined as the Tier 1 RBSL (i.e., PAL) value if implementing a corrective action based on the Tier 1 RBSL would be appropriate.

The PAL for radionuclides is based on a dose of 25 mrem/yr using the Industrial Area exposure scenario. The Industrial Area scenario assumes that a full-time industrial worker is present at a particular location for his entire career (225 day/yr, 10 hr/day for a duration of 25 years). The 25-mrem/yr dose-based Tier 1 RBSL for the primary release is implemented by calculating the dose a site worker would receive if exposed to the site contaminants over an annual exposure period of 2,250 hours.

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

- EPA Region 9 Risk-Based Preliminary Remediation Goals (PRGs) for Industrial Soils (EPA, 2009).
- Background concentrations for RCRA metals will be evaluated when natural background exceeds the PAL, as is often the case with arsenic. Background is considered the mean plus two times the standard deviation 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 PRGs, a protocol similar to EPA Region 9 will be used to establish an action level; otherwise, an established PRG from another EPA region may be chosen.

The PALs were developed based on an industrial scenario. Because the CAU 375 CASs in Areas 25 and 30 are not assigned work stations and are considered to be in remote or occasional use areas, the use of industrial scenario based PALs is conservative.

C.1.5 E. Exposure Pathway Evaluation

For all CASs, the DQOs stated that site workers would only 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 at the CASs. The potential exposure pathways would be through worker contact with the contaminated soil or various debris currently present within the site boundary. The limited migration demonstrated by the analytical results, elapsed time since the release, and depth to groundwater supports 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.

C.1.6 F. Comparison of Site Conditions with Tier 1 RBSLs

The fenced area at TCA and the crater/ejecta area at Buggy are assumed to contain significant contamination and require corrective action. Therefore, these areas are not included in the RBCA evaluations. Rather, these evaluations will be limited to the CAS areas outside the fence line and crater area. An exposure time based on the Industrial Area scenario (2,250 hr/yr) was used to calculate site radiological doses (TED). These values were compared to the Tier 1 RBSL (25-mrem/IA-yr dose) that is also based on an exposure time of 2,250 hr/yr.

The Industrial Area scenario based TED for all sampled locations at each CAU 375 CAS that exceed the Tier 1 RBSL (i.e., PAL) are listed in Table C.1-1. Based on the conservative assumption that a site worker would be exposed to the maximum dose measured at any sampled location outside the crater at Buggy or the fence line at TCA, this site worker would received 25 mrem dose at each of these CAS locations in the exposure times listed in Table C.1-2.

In addition, a transformer assumed to contain PCB oil and a lead box were present at Buggy. These waste items are considered to be PSM, as they are assumed to contain sufficient quantities of PCBs and lead respectively to cause the underlying soil to exceed the FAL for PCBs or lead when the contaminant is eventually released to the soil. Concentrations of all contaminants at the TCA Bunker are less than PALs.

C.1.7 G. Evaluation of Tier 1 Results

The risk to receptors from contaminants at CAU 375 is due to chronic exposure to radionuclides (i.e., 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. Because of ease of access and its location in an

Table C.1-1
Locations Where TED Exceeds the Tier 1 RBSL at CAU 375 (mrem/IA-yr)

CAS	TLD Locations (Plot)	Average TED	95% UCL TED
25-23-22 (TCA)	A01(AA)	**34.2**	**40.2**
	A02	**28.2**	**33.1**
	A03	23.8	**28.7**
	A05	**30.9**	**36.6**
30-45-01 (Buggy)	B03	**27.3**	**32.6**
	B04 (BA)	**99.8**	**108.8**
	B05	**57.7**	**68.8**
	B08	**41.0**	**46.1**
	B13	**105.2**	**110.3**
	B14	**47.2**	**53.8**
	B15	23.3	**27.0**
	B18	**50.8**	**60.1**
	B20	**47.3**	**49.9**
	B22	**55.7**	**62.7**
	B25	24.9	**29.0**
	B26	**42.9**	**52.6**
	B27	**56.4**	**67.0**
	B32	**37.1**	**46.6**

Bold indicates the values exceeding 25 mrem/yr.

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

CAS	Location of Maximum Dose	Maximum 95% UCL TED (mrem/IA-yr)	Minimum Exposure Time (hours)
TCA	Plot AA	43.9	1,280
Buggy	Location B13	110.3	510

industrial complex area at the NNSS, a Tier 1 remedial action evaluation was conducted for TCA. In a review of the current and projected use of Buggy and the conditions of the trails leading there, it was determined that workers may be present for only a few hours per year (see Section C.1.10), and it is not reasonable to assume that any worker would be present for 2,250 hr/yr (DOE/NV, 1996). Consequently, a Tier 2 remedial action evaluation was conducted for Buggy. The concentration of contaminants at the TCA Bunker were below PALs; therefore, it was decided to use Tier 1 as FALs. No Tier 2 evaluations on behalf of the TCA Bunker were necessary.

C.1.8 H. Tier 1 Remedial Action Evaluation

Based on the Tier 1 evaluation, the surface soils at TCA pose an unacceptable risk to human health and the environment. Therefore, further corrective action is necessary for the radiological contamination of surface soils within and beyond the default contamination area. It is also assumed that surface and subsurface contamination within the default contamination area and the area just north of the default contamination area (Figure A.3-4) exceed the Tier 1 RBSL of 25 mrem/IA-yr. A corrective action is practical for the identified contamination areas at this CAS; therefore, the Tier 1 RBSL is established as the FAL, and a corrective action is proposed. The corrective action of clean closure would require extensive excavation of a 560,000-square-foot (ft^2) area up to 25 ft in depth. The corrective action would not remove deeper contamination in the area, and a UR may still be required. Based on the extent of the corrective action boundaries and the infeasibility of removing the disturbed material at TCA, a corrective action of closure in place with URs is recommended. As this corrective action is practical for the contamination at TCA, the Tier 1 RBSL is established as the FAL for the primary releases, and the corrective action will be implemented.

As the radiological FAL for TCA was established at the Tier 1 RBSL, a Tier 2 evaluation for TCA is not necessary.

No further action is required at the TCA Bunker.

C.1.9 I. Tier 2 Evaluation

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

C.1.10 J. Development of Tier 2 Table of SSTLs

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 radioactivity—and, therefore, able to receive a dose. For example, site workers may have routine activities that require them to be exposed to a radioactive location for 225 hr/yr. If the worker's industrial work schedule was 10 hr/day for 225 day/yr—or 2,250 hr/yr (as is used for the Industrial Area exposure scenario)—the site worker would receive 10 percent of the potential annual dose that they would otherwise receive if exposed to the radioactive location for the entire work year.

For the development of radiological Tier 2 SSTLs, 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 Buggy 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 Buggy identified the general types of work activities that are currently conducted at the site, to include fencing/posting inspection and maintenance workers, and military trainees. 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/NSO and/or M&O contractor departments responsible for these activities were consulted. Under the current land use at Buggy, the following workers were identified as being potentially exposed to site contamination:

- **Inspection and Maintenance Worker–**Workers sent to conduct the annual inspection of the postings and fencing around the CASs. The UR requires a periodic inspection to ensure that the fencing is intact and the signs are legible. This will require two people to spend up to 10 hr/yr at each CAS.
- **Military Trainee–**Periodic military training activities conducted within Area 30. These workers typically spend one to two weeks per year training in the general area that includes Buggy. Although they are routinely advised to avoid areas containing radiological contamination and the sites will be posted with warning signs, there is a potential that they might inadvertently enter into these areas. It was conservatively assumed that this type of worker would spend up to one week per year (40 hours) at Buggy.
- **Trespasser–**This would include workers or individuals who do not have a specific work assignment at Buggy. Although the site will be posted with warning signs, there is a potential that they might inadvertently enter into an area 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 Buggy, the most exposed worker would be the Military Trainee, who would not be exposed to site contamination for more than 40 hr/yr. Based on the conservative assumption that the most exposed worker would be exposed to the maximum dose measured at any sampled location outside any fenced or crater area for the entire 40 hours, this worker would receive a maximum potential dose as listed in Table C.1-3.

Table C.1-3
Maximum Potential Dose to Most Exposed Worker at Buggy

CAS	Most Exposed Worker	Exposure Time	Maximum Potential Dose
Buggy	Military Trainee	40 hr/yr	2.0 mrem/yr

In the CAU 375 DQOs, it was conservatively determined that the Occasional Use Area exposure scenario (as listed in Section 3.1.1 of the CAIP [NNSA/NSO, 2010]) would be appropriate in calculating receptor exposure time based on current land use at all CAU 375 CASs. 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 are assumed to be on the site for an equivalent of 80 hours per year.

However, as the corrective action requirements at each of the CAU 375 CASs would not be significantly different if based on the Remote Work Area exposure scenario, it was conservatively determined to use the Industrial Work Area exposure scenario for TCA and the Remote Work Area exposure scenario for Buggy. Therefore, the radiological FAL determined under this exposure scenario was based on the assumption that a worker would be exposed to site contamination for 2,250 and 336 hr/yr, respectively.

C.1.11 K. Comparison of Site Conditions with Tier 2 Table SSTLs

The 25-mrem/yr dose-based Tier 2 SSTL for the primary releases based on the Remote Work Area exposure scenario was accomplished by calculating dose (i.e., TED) at the Buggy site over an exposure period of 336 hr/yr (8 hr/day, 42 day/yr). The TEDs calculated using the Remote Work Area exposure scenario were then compared to the 25-mrem/RW-yr Tier 2 SSTL. As shown in Table C.1-4, none of the 95 percent UCL TED values exceeded the 25-mrem/RW-yr Tier 2 SSTL. Therefore, no corrective actions will be required for surface contamination outside the default contamination areas at Buggy.

Table C.1-4
Remote Work Area Scenario Maximum TED (mrem/RW-yr)

CAS	Plot/Location	Average TED	95% UCL TED
Buggy	B13	15.2	16.6

C.1.12 L. Tier 2 Remedial Action Evaluation

Based on the Tier 2 evaluation, the surface soils at Buggy do not pose an unacceptable risk to human health and the environment. Therefore, no further corrective action is necessary for the radiological contamination of surface soils beyond the default contamination areas. However, it is assumed that surface and subsurface contamination exists at Buggy due to the direct injection of radioactivity into the Buggy crater and the dispersion of crater ejecta from the nuclear test. It is also assumed that this surface and subsurface contamination within the default contamination areas exceed the Tier 2 SSTL of 25 mrem/RW-yr. A corrective action is practical for the default contamination areas at these CASs; therefore, the Tier 2 SSTL is established as the FAL, and a corrective action will be proposed.

Based on the Tier 2 evaluation, the subsurface soils at the Buggy site pose an unacceptable risk to human health and the environment and require corrective action. The corrective actions will need to address the contamination within the crater area. A corrective action of clean closure at these CASs would require extensive excavations (the corrective action areas at each CAS are presented in Table C.1-5) of up to 25 ft in depth. This corrective action would not remove deeper contamination in the area of the craters at Buggy, and a UR may still be required. Based on the extent of the corrective action boundaries, the infeasibility of removing the disturbed material at TCA as well as the deep contamination in the Buggy crater, a corrective action of closure in place with URs is recommended for these areas. As this corrective action is practical for the contamination at these CASs, the Tier 1 RBSL is established as the FAL for the primary release at TCA, and the Tier 2 SSTL is established as the FAL for the primary release at Buggy.

Table C.1-5
Corrective Action Boundary Areas at CAU 375 CASs

CAS	Area (ft^2)
TCA	558,000
Buggy	985,000

As the radiological FAL was established as the Tier 2 SSTL, a Tier 3 evaluation was not necessary.

C.2.0 Recommendations

Because a number of TED values for surface soils at locations beyond the fence line at TCA are greater than the corresponding FAL (using the Industrial Area exposure scenario), it was determined that surface soil contamination at these locations warrant corrective actions. In addition, subsurface contamination is assumed to exist within the default contamination area that exceeds the FAL of 25 mrem/IA-yr. Therefore, a corrective action is also necessary for the contamination within the default contamination area at TCA.

Because all of the TED values for surface soils at the TCA Bunker and beyond the default contamination area at Buggy were less than the corresponding FALs at all locations (using the Remote Work Area exposure scenario), it was determined that surface soil contamination at these locations do not warrant corrective actions. However, subsurface contamination is assumed to exist at Buggy within the default contamination areas that exceeds the Remote Work Area exposure scenario based FAL of 25 mrem/RW-yr. Therefore, a corrective action is necessary for the contamination within the default contamination areas at both TCA and Buggy.

The FAL was based on an exposure time of 336 hr/yr of site worker exposure to CAS surface soils. To prevent future industrial land use activities conducted at the site that may cause a site worker to exceed this annual exposure time, administrative URs were implemented at Buggy as a BMP. The areas at Buggy that provide sufficient dose to potentially cause a full-time industrial worker to receive an annual dose exceeding 25 mrem was conservatively defined in Section D.1.2.

Additional corrective actions at Buggy include the removal and recycling of three lead-acid batteries and a lead box, and the removal and disposal of an oil-filled transformer.

The corrective actions for CAU 375 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 no longer are valid, additional evaluation may be necessary.

The FFACO and administrative URs for the TCA and Buggy CASs are recorded in the FFACO database, NNSA/NSO Facility Information Management System, and the NNSA/NSO CAU/CAS files. These URs are included in Appendix D.

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Attachment C-1

Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit (CAU) 375 Area 30 Buggy Unit Craters Nevada National Security Site, Nevada

(10 Pages)

Introduction

This appendix promulgates tables of Residual Radioactive Material Guidelines (RRMGs) for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios, for use in the evaluation of Soils Project sites. These exposure scenarios are described in the document *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). Two sets of RRMGs were calculated for each of the three exposure scenarios: one set using only the inhalation and ingestion pathways (e.g., internal dose), and one set that added the external gamma pathway (e.g., internal and external dose). The second set is needed to evaluate "other release" soil samples where thermoluminescent dosimeters (TLDs) were not emplaced to measure the external dose.

Background

The *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006), provides a Nevada Division of Environmental Protection (NDEP)-approved process for the derivation of soil sampling final action levels that are congruent with the risk-based corrective action process. This document is used by the Navarro-Intera, LLC, Soils Project as well.

The Residual Radioactive (RESRAD) computer code, version 6.5 (Yu et al., 2001), and the guidance provided in NNSA/NSO (2006) were used to derive RRMGs for use in the Soils Project. The RRMGs are radionuclide-specific values for radioactivity in surface soils, expressed in units of picocuries per gram (pCi/g). A soil sample with a radionuclide concentration that is equal to the RRMG value for that radionuclide would present a potential dose of 25 millirem per year (mrem/yr) to a receptor under the conditions described in the exposure scenario. When more than one radionuclide is present, the potential dose must be evaluated by summing the fractions for each radionuclide (i.e., the measured concentration divided by the RRMG for the radionuclide). The resultant sum of the fractions value is then multiplied by 25.0 to obtain an estimate of the dose.

The RRMGs are specific to a particular exposure scenario. The dose estimates obtained from the use of RRMGs are valid only when the assumptions provided in the exposure scenario for the intended land-use hold true. In most cases at the Nevada National Security Site (NNSS), the Industrial Area exposure scenario is quite conservative and is bounding for most anticipated future land uses.

A recent revision to 10 *Code of Federal Regulations* (CFR) Part 835 (CFR, 2011) had adopted new, more sophisticated, dosimetric models and new dosimetric terms. Internal dose is now to be expressed in terms of the Committed Effective Dose (CED), and International Commission on Radiological Protection (ICRP) 72 dose conversion factors are to be used.

Methods

Calculations were performed using the RESRAD code, version 6.5 (Yu et al., 2001). The ICRP 72 dose conversion factors were used. The RESRAD input parameters were verified and checkprinted.

The radionuclide niobium (Nb)-94 was previously added to the RRMGs to accommodate work in Area 25 that is related to the Nuclear Rocket Development Station (NRDS). The radionuclides silver (Ag)-108m, curium (Cm)-243, and Cm-244 were recently detected on one or more Soils Project sites, and RRMGs were calculated to demonstrate that their contribution to the total effective dose (TED) is negligible.

The RESRAD calculations have identified that for all radionuclides evaluated, with one exception: The maximum potential dose occurs at time-zero. The RRMGs provided in this memorandum do reflect those for time-zero. The exception previously mentioned is the radionuclide thorium (Th)-232, which has several daughters with short half-lives. Because the daughter activity "grows in," and because RRMGs include the contributions from daughters, the maximum potential dose for Th-232 actually occurs at 10.21 years. A RRMG for Th-232 at 10.21 years was not selected, and the RRMG for time-zero was used, for the following reasons:

- RESRAD suggests a set of RRMGs for use when the overall total dose is at its maximum. Considering the contributions from all radionuclide contaminants of potential concern (COPCs), this would be at time-zero.
- The additional dose from the in-growth of Th-232 daughters is offset by the radioactive decay of other radionuclides that would be present (e.g., cesium [Cs]-137).
- The additional dose from the in-growth of Th-232 daughters is very small when compared to the basic dose limit of 25 mrem/yr. For example, if Th-232 were found at a concentration of 100 pCi/g, the increase in potential dose from time-zero to 10.21 years would only be 0.52 millirem (mrem). To date, Th-232 has only been seen on Soils Project sites at environmental levels of about 1.5 to 3 pCi/g.

Assumptions and Default Parameters

Appendix B to DOE/NV--1107 (NNSA/NSO, 2006) lists the RESRAD code variables (i.e., input parameters) for the three exposure scenarios. These pre-determined values were used to calculate the RRMGs, with a few exceptions as described in Table 1.

Results

The RRMGs are presented in Tables 2 to 7. The abbreviation "RRMG" in each of the six tables includes a subscript to indicate the scenario and the exposure pathways that are activated. When referencing a set of RRMGs, the subscripts should be included to avoid confusion and a potential misapplication of the RRMGs.

Table 1: RESRAD Input Parameters

Item #	**RESRAD Parameter**	**Industrial Area**	**Remote Work Area**	**Occasional Use Area**	**Explanation**
1	Area of CZ (m^2)	1,000			Appendix B states "Site Specific." Previously, 100 m^2 was selected to conform to the maximum area of contamination limitation in DOE Order 5400.5 (DOE, 1993). Going forward, 1,000 m^2 has been selected to add conservativism and realism to the RRMGs. The 1,000 m^2 RRMGs will be applied to 100-m^2 evaluation areas.
2	Thickness of CZ (m)	0.05			Appendix B states "Site Specific." This depth encompasses the bulk of the potential contamination and includes the maximum concentration.
3	Cover Depth	0.00			Appendix B states "Site Specific." Cover depth only affects the time delay before contamination becomes available for erosion and airborne suspension. Increasing the cover depth, in some cases, may lead to lower dose estimates.
4	Precipitation (m/yr)	0.144			Appendix B states "Site Specific." The selected value is the average annual rainfall as recorded at Camp Desert Rock.
5	Indoor Time Fraction	**[0.1712]**	**[0.0256]**	0	The stated value was 0, conservatively assuming no time is spent indoors. The new value more accurately reflects the Industrial Area scenario in which 66% of the time is spent indoors. $\left(\frac{2250\ hrs\ on-site}{8760\ hrs\ in\ a\ year}\right) 0.6666\ indoors = 0.1712$ The same correction was made for the Remote Work Area scenario.
6	Soil Ingestion Rate (g/yr)	**[43.43]**	20.2	4.8	The stated value was 108, assuming that all time is spent outdoors under a 480-mg/day soil ingestion rate. The new value more accurately reflects the soil ingestion rate of 193 mg/day when both indoor and outdoor time fractions are considered. Refer to page 14 of DOE/NV--1107 (NNSA/NSO, 2006).
7	Indoor Dust Filtration Factor	**[0.4]**	**[0.4]**	1	This is the RESRAD default value and is appropriate as, under the Industrial Area and Remote Work Area scenarios, 66% of the time is spent indoors.
8	Shielding Factor External Gamma	**[0.7]**	**[0.7]**	1	This is the RESRAD default value and is appropriate as, under the Industrial Area and Remote Work Area scenarios, 66% of the time is spent indoors.
9	Pathway 1 – External Gamma	Suppressed	Suppressed	Suppressed	In general, external dose at Soils Projects will be evaluated via TLDs or direct measurement with a dose-rate meter. Soil samples and RRMGs are used to determine the internal dose component only. The pathway was activated for the second set of RRMGs for each scenario to allow the evaluation of biased sample locations where TLDs were not emplaced.

Note 1: Items 1–4 above are site-specific default values that were selected for the Soils Project.
Note 2: Table B.1-1 in Appendix B contains several errors. The bold and bracketed values are corrections to those values.

CZ = Contamination zone
g/yr = Grams per year
m = Meter
m^2 = Square meter
m/yr = Meters per year
mg/day = Milligrams per day

Table 2: Soils Project – Industrial Area Exposure Scenario – Internal Dose Only

Radionuclide	**RRMG$_{(IA-I)}$** (pCi/g)
Ag-108m	2.737E+06
Am-241	2.816E+03
Cm-243	3.852E+03
Cm-244	4.735E+03
Co-60	5.513E+05
Cs-137	1.409E+05
Eu-152	1.177E+06
Eu-154	8.469E+05
Eu-155	5.588E+06
Nb-94	3.499E+06
Pu-238	2.423E+03
Pu-239/240	2.215E+03
Sr-90	5.947E+04
Th-232	2.274E+03
U-234	1.960E+04
U-235	2.089E+04
U-238	2.120E+04

A soil sample at this RRMG value would present an internal dose potential of 25 mrem under the Industrial Area exposure scenario.

Table 3: Soils Project – Industrial Area Exposure Scenario – Internal & External Dose

Radionuclide	**RRMG$_{(IA-IE)}$** (pCi/g)
Ag-108m	9.281E+01
Am-241	1.503E+03
Cm-243	3.155E+02
Cm-244	4.713E+03
Co-60	1.833E+01
Cs-137	7.290E+01
Eu-152	3.826E+01
Eu-154	3.571E+01
Eu-155	9.583E+02
Nb-94	9.653E+01
Pu-238	2.416E+03
Pu-239/240	2.207E+03
Sr-90	7.714E+03
Th-232	5.067E+02
U-234	1.865E+04
U-235	2.555E+02
U-238	1.423E+03

A soil sample at this RRMG value would present a TED potential of 25 mrem under the Industrial Area exposure scenario.

Table 4: Soils Project – Remote Work Area Exposure Scenario – Internal Dose Only

Radionuclide	**RRMG$_{(RWA-I)}$** (pCi/g)
Ag-108m	3.389E+07
Am-241	1.612E+04
Cm-243	2.223E+04
Cm-244	2.716E+04
Co-60	7.229E+06
Cs-137	1.955E+06
Eu-152	1.324E+07
Eu-154	9.741E+06
Eu-155	6.645E+07
Nb-94	3.966E+07
Pu-238	1.388E+04
Pu-239/240	1.268E+04
Sr-90	8.075E+05
Th-232	1.341E+04
U-234	1.379E+05
U-235	1.496E+05
U-238	1.554E+05

A soil sample at this RRMG value would present an internal dose potential of 25 mrem under the Remote Work Area exposure scenario.

Table 5: Soils Project – Remote Work Area Exposure Scenario – Internal & External Dose

Radionuclide	**RRMG$_{(RWA\text{-}IE)}$** (pCi/g)
Ag-108m	6.204E+02
Am-241	9.239E+03
Cm-243	2.083E+03
Cm-244	2.715E+04
Co-60	1.225E+02
Cs-137	4.874E+02
Eu-152	2.557E+02
Eu-154	2.387E+02
Eu-155	6.406E+03
Nb-94	6.452E+02
Pu-238	1.390E+04
Pu-239/240	1.269E+04
Sr-90	5.522E+04
Th-232	3.292E+03
U-234	1.314E+05
U-235	1.709E+03
U-238	9.572E+03

A soil sample at this RRMG value would present a TED potential of 25 mrem under the Remote Work Area exposure scenario.

Table 6: Soils Project – Occasional Use Area Exposure Scenario – Internal Dose Only

Radionuclide	**RRMG$_{(OUA-I)}$** (pCi/g)
Ag-108m	2.762E+08
Am-241	4.555E+04
Cm-243	6.307E+04
Cm-244	7.68E+04
Co-60	7.421E+07
Cs-137	2.756E+07
Eu-152	8.174E+07
Eu-154	6.353E+07
Eu-155	4.751E+08
Nb-94	2.492E+08
Pu-238	3.922E+04
Pu-239/240	3.582E+04
Sr-90	9.949E+06
Th-232	3.852E+04
U-234	4.470E+05
U-235	4.922E+05
U-238	3.361E+05

A soil sample at this RRMG value would present an internal dose potential of 25 mrem under the Occasional Use Area exposure scenario.

Table 7: Soils Project – Occasional Use Area Exposure Scenario - Internal & External Dose

Radionuclide	**RRMG$_{(OUA-IE)}$** (pCi/g)
Ag-108m	2.087E+03
Am-241	2.797E+04
Cm-243	6.886E+03
Cm-244	7.653E+04
Co-60	4.122E+02
Cs-137	1.640E+03
Eu-152	8.604E+02
Eu-154	8.031E+02
Eu-155	2.156E+04
Nb-94	2.171E+03
Pu-238	3.915E+04
Pu-239/240	3.573E+04
Sr-90	1.955E+05
Th-232	1.062E+04
U-234	4.252E+05
U-235	5.749E+03
U-238	3.219E+04

A soil sample at this RRMG value would present a TED potential of 25 mrem under the Occasional Use Area exposure scenario.

References

CFR, see *Code of Federal Regulations*.

Code of Federal Regulations. 2011. Title 10 CFR Part 835, "Occupational Radiation Protection." Washington, DC: U.S. Government Printing Office.

DOE, see U.S. Department of Energy.

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

U.S. Department of Energy. 1993. *Radiation Protection of the Public and the Environment,* DOE Order 5400.5, Change 2. Washington, DC.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2006. *Industrial Sites Project Establishment of Final Action Levels*, Rev. 0, DOE/NV--1107. Las Vegas, NV.

Yu, C., A.J. Zielen, J.J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo III, W.A. Williams, and H. Peterson. 2001. *User's Manual for RESRAD Version 6*, ANL/EAD-4. Argonne, IL: Argonne National Laboratory, Environmental Assessment Division. (Version 6.5 released in October 2009.)

Appendix D

Closure Activity Summary
(Use Restriction)

D.1.0 Closure Activity Summary

The following sections document closure activities completed for CAU 375 at CASs 25-23-22, 25-34-06, and 30-45-01. Surface soil samples, TLD measurements, and GWS measurements were collected to characterize the presence and lateral extent of radiological contamination at these sites.

D.1.1 TCA Closure Activities

Based on the results of this investigation, a corrective action of closure in place with a UR was implemented for the default contamination area and encompasses the area assumed to exceed a dose of 25 mrem/IA-yr (Figure A.3-3). Because most of the area requiring the UR posting is encompassed by the TCA fence, the UR signs were installed on the TCA fence. Where the contamination area boundary extended beyond the existing fence line, a three-strand fence was constructed and signs affixed that encompassed the contamination area boundary. If the TCA fence line changes at any time in the future, the UR signs may be moved, as long as they encompass the use restricted area.

The established FFACO UR for TCA is defined by the coordinates listed in the FFACO UR form and as presented in Attachment D-1. The UR is recorded in the FFACO database, NNSA/NSO Facility Information Management System, and the NNSA/NSO CAU/CAS files. Any activities other than those listed in the FFACO UR for CAS 25-23-22 requires prior NDEP approval. Permission to conduct any activities that are restricted by the URs also requires prior NDEP approval.

D.1.2 Buggy Closure Activities

Based on the results of this investigation, a corrective action of closure in place with a UR was implemented only for the default contamination area and encompasses the area assumed to exceed a dose of 25 mrem/RW-yr (Figure A.5-7). Because the area requiring the UR posting is included in a posted CA, the UR signs were installed on the CA fence. If the CA fence line changes at any time in the future, the UR signs may be moved, as long as the use restricted area remains encompassed.

Although no surface soil COCs were identified at Buggy, it is assumed that subsurface contamination is present in the crater (due to direct injection of radionuclides into the subsurface soil from the nuclear test) that exceeds the FAL. Therefore, a corrective action of closure in place with a UR was implemented for the subsurface contamination. The UR encompasses the area of the Buggy crater as well as the ejecta mounds surrounding the crater (default contamination area).

The established FFACO UR for Buggy is defined by the coordinates listed in the FFACO UR form and as presented in Attachment D-1. Additionally, an administrative UR was established to prevent site workers from receiving a dose of 25 mrem/yr if there were more intensive use of the site in the future as presented in Attachment D-1. Both URs are recorded in the FFACO database, NNSA/NSO Facility Information Management System, and the NNSA/NSO CAU/CAS files. Any activities other than those listed in the FFACO UR for CAS 30-45-01 requires prior NDEP approval. Permission to conduct any activities that are restricted by the URs also requires prior NDEP approval.

Note: The CA boundary more than encompasses the administrative UR, but does not correlate with UR boundaries as the CA boundary is defined by removable radioactive contamination and the UR boundaries are defined by radiological dose (Figure A.5-7).

Attachment D-1

Use Restrictions

(7 Pages)

CAU Use Restriction Information

CAU Number/Description: CAU 375, Area 30 Buggy Unit Craters

Applicable CAS Number/Description: CAS 25-23-22, Contaminated Soils Site

Contact (Federal Sub-Project Director/Sub-Project): _____

FFACO Use Restriction Physical Description:

Surveyed Area (UTM, Zone 11, NAD 27, meters):

UR Points	Northing	Easting
Southeast point working	4,075,887.0	566,248.8
clockwise around use restriction	4,075,902.8	566,209.4
	4,075,919.6	566,109.8
	4,075,979.4	566,033.3
	4,075,978.5	565,974.4
	4,075,984.8	565,965.4
	4,076,016.5	565,965.8
	4,076,028.7	565.979.0
	4,076,029.2	566,025.6
	4,076,089.4	556,075.0
	4,076,081.2	566,132.9
	4,076,085.3	566,136.1
	4,076,082.1	566,209.0
	4,076,100.7	566,222.1
	4,076,073.7	566,258.6
	4,076,086.1	566,272.1
	4,076,070.6	566,316.1
	4,076,035.3	566,350.8
	4,076,010.4	566,336.0
	4,075,973.5	566,371.0
	4,075,965.3	566,378.7
	4,075,945.4	566,368.8

Depth: No depth limitations

Survey Method (GPS, GIS, etc): Heads-up digitizing

Basis for UR(s):

Summary Statement: This FFACO use restriction is to protect site workers from inadvertent exposure. The defined area is assumed to contain radioactive contamination in excess of the FAL of 25 mrem/yr. Additional site information is presented in the CADD/CR for CAU 375. Personnel are restricted from performing work in this area that would require personnel to be present for other than short term activities. The permissible short term activities include site visits, maintenance of the fence, radiological surveys, short duration radiological training, and retrieval of objects within the use-restricted area. Any activities to be conducted within this area that are not consistent with these defined short term activities requires the prior notification and approval of NDEP.

Contaminants Table:

Maximum Concentration of Contaminants for CAU 375 CAS 25-23-22, Contaminated Soils Site			
Constituent	**Maximum Concentration**	**Action Level**	**Units**
TED	>25	25	mrem/2,250 hours

Note: Effective upon acceptance of closure documents by NDEP

CAU Use Restriction Information

Site Controls: The use restricted area encompasses the area where surface soil contamination exceeds the FAL of 25 mrem in 2,250 hours. It is established at the boundary identified by the coordinates listed above and depicted in the attached figure. Warning sign have been placed where accesses through the fence are present.

UR Maintenance Requirements:

Description: **The UR is recorded in the FFACO database, NNSO/NSO Facility Management System, and the NNSA/NSO CAU/CAS files.**

Inspection/Maintenance Frequency: Annual post-closure inspections will be conducted to ensure postings are in place, intact, and legible.

UR Maintenance Requirements:

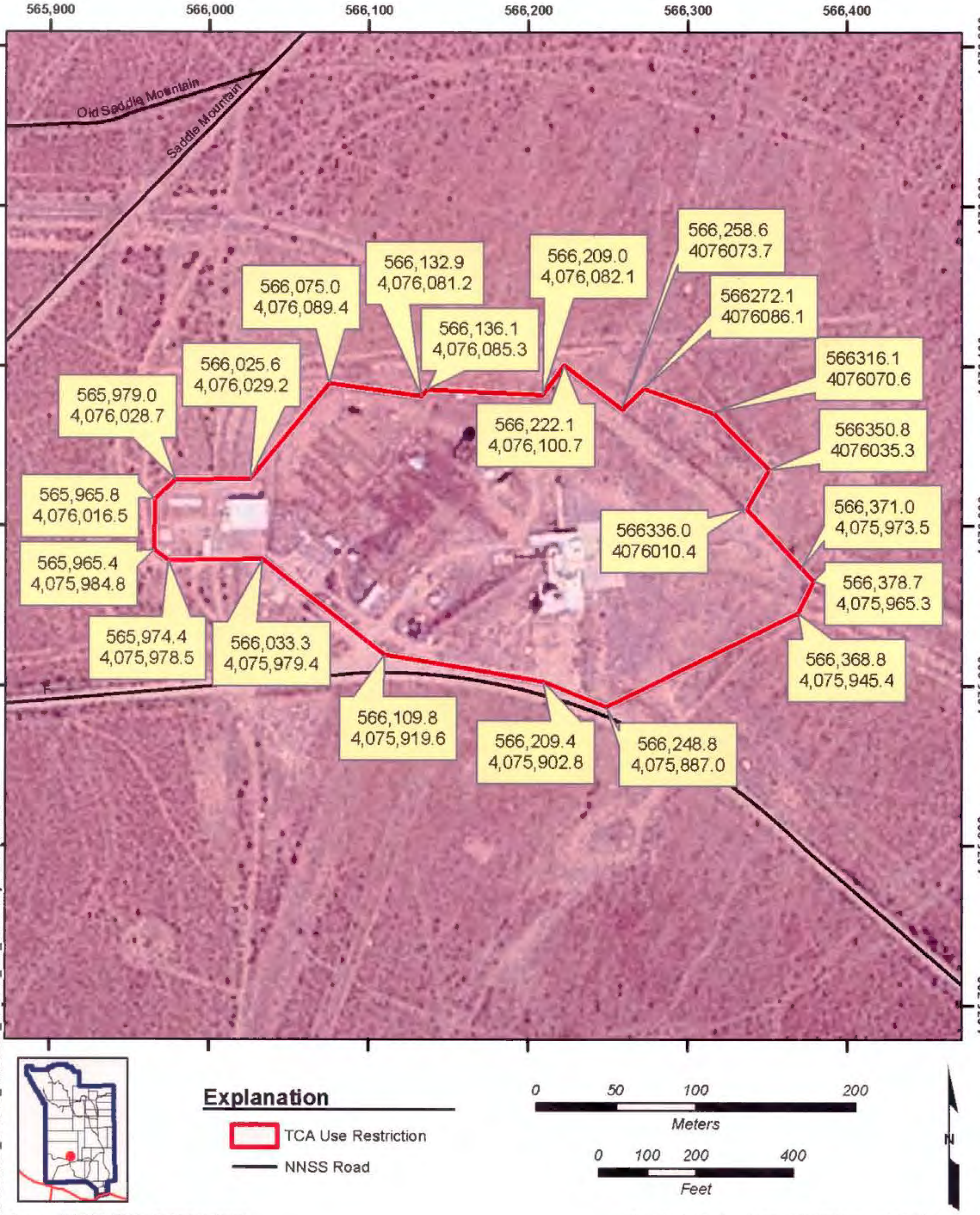
Description: **The Adminstrative UR is recorded in the FFACO database, NNSA/NSO Facility Management System, and the NNSA/NSO CAU/CAS files.**

Inspection/Maintenance Frequency: N/A

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

Comments: ______

Submitted By: /s/ Kevin Cabble **Date:** 8-9-11



H:\375\CADD_CR\375_CADDCR_252322_UR_Boundary.mxd - 6/23/2011

Source: N-I GIS, 2011; NNSA/NV, 2002b

Coordinate System: NAD 1927 UTM Zone 11N, Meters

CAU Use Restriction Information

CAU Number/Description: CAU 375, Area 30 Buggy Unit Craters

Applicable CAS Number/Description: CAS 30-45-01, U-30a, b, c, d, e Craters

Contact (Federal Sub-Project Director/Sub-Project): _____

FFACO Use Restriction Physical Description:

Surveyed Area (UTM, Zone 11, NAD 27, meters):

UR Points	Northing	Easting
Southeast point working	4,095,559.6	556,069.3
clockwise around use restriction	4,095,551.7	555,589.9
	4,095,564.0	555,927.9
	4,095,558.2	555,883.2
	4,095,575.4	555,860.7
	4,095,606.8	555,852.6
	4,095,645.1	555,802.8
	4,095,697.2	555,789.1
	4,095,811.5	555,780.4
	4,095,838.0	555,821.0
	4,095,849.5	555,868.6
	4,095,888.9	555,895.9
	4,095,895.7	555,938.1
	4,095,838.2	556,077.2
	4,095,773.6	556,142.3
	4,095,729.2	556,149.8
	4,095,611.3	556,125.4

Depth: No depth limitations

Survey Method (GPS, GIS, etc): Heads-up digitizing

Basis for UR(s):

Summary Statement: This FFACO use restriction is to protect site workers from inadvertent exposure. The crater and the electa field is assumed to contain radioactive contamination in excess of the FAL of 25 mrem/yr. Additional site information is presented in the CADD/CR for CAU 375. Personnel are restricted from performing work in this area that would require personnel to be present for other than short term activities. The permissible short term activities include site visits, maintenance of the fence, radiological surveys, short duration radiological training, and retrieval of objects within the use-restricted area. Any activities to be conducted within this area that are not consistent with these defined short term activities requires the prior notification and approval of NDEP.

Contaminants Table:

Maximum Concentration of Contaminants for CAU 375
CAS 30-45-01, U-30a, b, c, d, e Craters

Constituent	Maximum Concentration	Action Level	Units
TED	>25	25	mrem/336 hours

Site Controls: The use restricted area encompasses the area where surface soil contamination exceeds the FAL of 25 mrem in 336 hours. It is established at the boundary identified by the coordinates listed above and depicted in the attached figure. Warning sign have been placed where accesses through the fence are present.

Note: Effective upon acceptance of closure documents by NDEP

UR Maintenance Requirements:

Description: **The UR is recorded in the FFACO database, NNSO/NSO Facility Management System, and the NNSA/NSO CAU/CAS files.**

Inspection/Maintenance Frequency: Annual post-closure inspections will be conducted to ensure postings are in place, intact, and legible.

Administrative Use Restriction Physical Description*:

Surveyed Area (UTM, Zone 11, NAD 27, meters):

UR Points	Northing	Easting
Southeast point working	4,095,473.0	556,119.5
clockwise around admin use	4,095,440.6	556,030.0
restriction	4,095,464.8	555,913.5
	4,095,583.6	555,721.7
	4,095,674.6	555,642.9
	4,095,757.0	555,631.8
	4,095,880.4	555,649.5
	4,095,923.3	555,679.4
	4,095,999.0	556,055.9
	4,095,940.7	556,199.3
	4,095,757.1	556,302.0
	4,095,715.9	556,309.5
	4,095,638.6	556,286.5
	4,095,549.8	556,219.8

Depth: To 5 cm below undisturbed soil surface

Survey Method (GPS, GIS, etc): Heads-up digitizing

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

Basis for UR(s):

Summary Statement: This administrative use restriction is to protect site workers from inadvertent exposure. Data from surface sampling indicates that a worker could potentially receive a 25 mrem dose in approximately 510 hours of exposure to the surface location with the maximum detected radioactivity. Current land use at this site does not require site workers to be present for this amount of exposure time. However, as a best management practice, this administrative use restriction will prevent a future (more intensive) use of the area. Personnel are restricted from performing work in this location that would result in a more intensive use of the area than current land use. Activities consistent with the current land use include site visits, maintenance of the fence, radiological surveys, short duration radiological training, and retrieval of objects within the use-restricted area. Any activities to be conducted within this area that are not consistent with this defined current land use requires prior notification and approval of NDEP. The analytical results and locations of all samples collected are presented in the CADD/CR for CAU 375.

CAU Use Restriction Information

Contaminants Table:

Maximum Concentration of Contaminants for CAU 375 CAS 30-45-01, U-30a, b, c, d, e Craters			
Constituent	**Maximum Concentration**	**Action Level**	**Units**
TED	110.3	25	mrem/2,250 hours

Site Controls: The administrative use restricted area encompasses the area where surface soil contamination exceeds the FAL of 25 mrem in 2,250 hours (the Industrial Area annual exposure scenario). It is established at the boundary identified by the coordinates listed above and depicted in the attached figure.

UR Maintenance Requirements:

Description: The Adminstrative UR is recorded in the FFACO database, NNSA/NSO Facility Management System, and the NNSA/NSO CAU/CAS files.

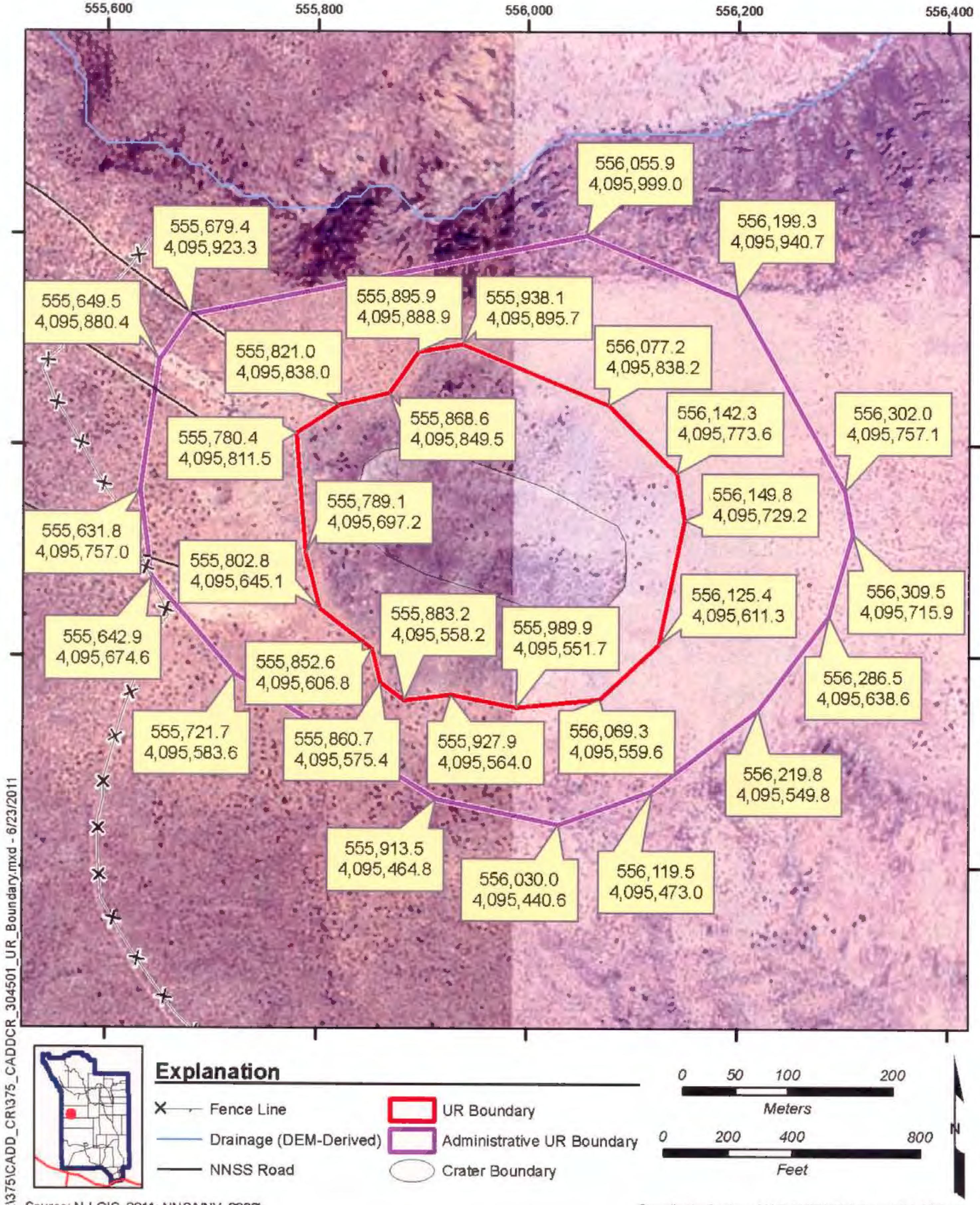
Inspection/Maintenance Frequency: N/A

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

Comments: ______

Submitted By: /s/ Kevin Cabble **Date:** 8-9-11

Note: Effective upon acceptance of closure documents by NDEP



Source: N-I GIS, 2011; NNSA/NV, 2002b

Coordinate System: NAD 1927 UTM Zone 11N, Meters

Attachment D-2

Waste Disposition Documentation

(10 Pages)

789 [illegible]
6-23-11

NTS On-Site HazMat Transfer - Published

Tracking No: DPM11TRD **Mesa Number:**

Carrier NSTEC
Vehicle G820424D
Driver: RUSSELL CROZIER

Depart: 23-JUN-2011

Arrival: 23-JUN-2011

From ROBERT ZION
NSTEC
BASE CAMP
MERCURY, NV 89023

Area: 18
Bldg: AIR STRIP
Phone 702/295-4594
Mobile. 702/466-4231

To: LOUIS GREGORY
NSTEC
BASE CAMP
TRU PAD
MERCURY, NV 89023
Area: 05
Bldg: 024
Phone: 702-295-2799
Mobile: 702/596-9414

Entered By ROBERT ZION
Modified By: ROBERT ZION

Date Entered: 23-JUN-2011
Date Modified: 23-JUN-2011

Shipped Material(s)	**Package(s)**	**Unit(s)**	**Guide No.**
UN/NA 3077, HAZARDOUS WASTE, SOLID, N.O.S., 9 (D008), EXCLUSIVE USE SHIPMENT, ONSITE TRANSFER.	1 TYPE A PACKAGE	1084.00 KILOGRAM(S) (GROSS)	171

Emergency Response Number
702-295-0311

Secondary Emergency Response Contact And/Or Comments
STEFAN DUKE 702/630-0423

In the event of an emergency on the Nevada Test Site, immediately contact the Operations Coordination 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/ Robert H. Zion Date 6/23/11 Time 1410

Received by /s/ Signature on File Date 6/23/11 Time 1600

UNCONTROLLED When Printed

Package Shipment and Disposal Request

Shipment Number: DPM11TRD

Date: 30-Jun-2011

Prepared By: /s/ Robert Zion

Manifest Number: 0000DPM11TRD

Package No:	**006162**	Contact (mSv/h):	**0.0002**	Completed Date:	**22-Jun-2011**
Container Code:	**100**	1 Meter (mSv/h):	**0.0002**	Operation Type:	**B**
External Volume (m^3):	**4.650E+00**	Gross Weight (kg):	**1.084E+03**	Total Activity (bq):	**3.597E+05**
Waste Volume (m^3):	**3.247E+00**	Net Weight (kg):	**4.160E+02**	Activity Date:	**23-Jun-2011**
Comment:				Accountable Material?	**N**

Waste Stream /Profile	Form Code	Form Description	Treatment Code	Treatment Description	Rev. No.	Revision Date	Nuclide	Qty (Bq)
LRY5MWFY09003	040		107		02	30-Nov-2009	PU-239	1.460E+04
LRY5MWFY09003	040		107		02	30-Nov-2009	PU-241	5.940E+04
LRY5MWFY09003	040		107		02	30-Nov-2009	CS-137	1.070E+05
LRY5MWFY09003	040		107		02	30-Nov-2009	CO-60	5.730E+04
LRY5MWFY09003	040		107		02	30-Nov-2009	SR-90	4.970E+04
LRY5MWFY09003	040		107		02	30-Nov-2009	EU-152	5.020E+04
LRY5MWFY09003	040		107		02	30-Nov-2009	EU-154	7.170E+03
LRY5MWFY09003	040		107		02	30-Nov-2009	EU-155	1.430E+04

Waste Stream /Profile	Rev. No.	Revision Date	EPA Code
LRY5MWFY09003	02	30-Nov-2009	D008

Reviewed By: /s/ Signature on File

NSTec
Form
FRM-0918

08/23/06
Rev. 0
Page 1 of 2

NTS LANDFILL LOAD VERIFICATION

SWO USE (Select One) AREA ☐ 23 ☐ 6 ☒ 9 ☒ 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: MIKE FLOYD Phone Number: 295-6653

Location / Origin: CAU 375 / Buggy A30 85 6/23/11

Waste Category: (check one) ☐ Commercial ☒ Industrial

Waste Type: (check one) ☒ NTS ☐ Non-Putrescible ☐ Putrescrible ☐ 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 NTS 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 NTS 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
☐ Light ballasts (contact SWO) ☐ Drained fuel filters (gas & diesel) ☐ Deconned Underground and Above Ground Tanks
☐ Hydrocarbons (contact SWO) ☐ Other ____

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 Management Area (CWMA) and to the best of my knowledge, does not contain radiological materials.

To the best of my knowledge, the waste described above contains only those materia site. I have verified this through the waste characterization method identified above a prohibited and allowable waste items. <u>I have contacted Property Management and ha</u> <u>is approved for disposal in the landfill</u>.

Radiological Survey Release for Waste Disposal
RCT Initials
____ This container/load meets the criteria for no added man-made radioactive material
____ 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:** 6/23/1
FRM-0648 (08/06

Print Name: MIKE FLOYD

Signature: /s/ Mike Floyd Date: 6/23/11

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): 3 CBS 6/23/11 Signature of Certifier: /s/ Don Bickford

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FRM-0266

04/10/08
Rev. 01

ONSITE WASTE TRANSPORT MANIFEST

Manifest Document No.: 1 1 N 3 7

Page 1 of 1

Generation/Out-of-Service Date: 6/23/11

1. Generator's Name, Organization, and Location: (Please Print)
NSTec Env. Restoration/Alissa Silvas
ER H330, 5SRA30C4
NNSS A-19 Airstrip, SAA #NSS1106

Generator's Phone . (295) 7185

2. Receiving Facility, Organization, Location (Please Print)
Hazardous Waste Storage Unit
WGS/Haz Waste Ops, H120
NNSS A-5, Bldg. 5-20

Contact Phone: (630) 0235

3a. Transporter Name: *(Please Print)* Brett Bushnell

Transport Date: 6/23/11

3b. Vehicle I.D. Number: G63-1104D

		4. U.S. D.O.T. Description. Include: EPA Waste Code and Package Tracking Numbers.	5. Containers		6. Total Quantity	7. Unit Wt./Vol.
			No.	Type		
a	X	UN2809, Waste Mercury, 8, III D009 NS-NSS-11-0084	1	DF	2	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: C.Gonzales 630-0235
Name & phone no.

a) ERG 172, Mercury ampoule from thermostat, from Area 30 Buggy site, CAU 375.

9. Released by: (Signature)
/s/ Signature on File
Date: 6/23/11

10. Received for Transport by: (Signature)
/s/ Signature on File
Date: 6/23/11

11. Discrepancy Indication:

12. Disposal/Accumulation Site Signature: *(Acknowledges acceptance of waste)*
/s/ Signature on File
Date: 6/23/11

NSTec
Form
FRM-0780

DRUM REPACK AND INSPECTION

03/31/11
Rev. 02

Page 1 of 1

Storage Site: A-5 HWSU - Cell A
Container/Repack # NS-NSS-11-0028
Date: 06/23/11

General Item Description: Mercury thermostat

(Circle **ALL** that apply)	[✓ Scrap-metal]	Dry	Wet	Light-Tubes	[✓ Plastic]	Pumpable	[✓ Toxic]	Vented	Oxidizer
	Sludge	Aerosols	Rags	[✓ Glass]	Lab Pack		[✓ Corrosive]	Polymer	Explosive
	[✓ Solid]	[✓ Liquid]	Wood	PPE	Gas (Cylinder)		Reactive	Flammable	

Proper Shipping Name: UN2809, Waste Mercury, 8, III
40 CFR Subpart CC applies: ☒ Yes ☐ No

EPA Codes: D009

Class: (Circle One) 2.1 2.2 2.3 3 4.1 4.2 4.3 5.1 5.2 6.1 6.2 [✓ 8] 9 Combustible Liquid NonHaz Liquid or Solid

RQ? ☐ Yes ☒ No RQ Value: N/A PG: III ERG#: 172

UN or NA # UN2809

Drum Size:	5-Gal	Weight:	6 lbs
Drum Type:	DF	Volume:	

Odor:
Color:
Layers: ☐ Single ☐ Bi- ☐ Multi-
Viscosity: ☐ Low ☐ Med ☐ Hi

Cyanides: ☐ Yes ☐ No
Marine Pollutant: ☐ Yes ☐ No
PCB's or Asbestos Present:
☐ Yes ☐ No Level's:
PIH: ☐ Yes ☐ No
PIH Zone

Comments: 1H2/Y30/S

Drum # or Item #	Waste Description	Estimated Waste Amount Transferred	Estimated Original Vol. / Pounds	EPA Codes	Gen. Date	Onsite Manifest
11-0084	Mercury Thermostat	1 thermostat	2 lbs	D009	06/23/11	11N37

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator ID Number: NV3890090001
2. Page 1 of 3
3. Emergency Response Phone: (702) 295-0311
4. Manifest Tracking Number: 000956235 FLE

GENERATOR

5. Generator's Name and Mailing Address

NSTEC FOR USDOE
P.O. BOX 98521, M/S NNSS-110
LAS VEGAS NV 89193

Generator's Phone: (702)295-7365

Generator's Site Address (if different than mailing address)

NSTEC FOR USDOE
NV NATIONAL SECURITY SITE, HWY 95
MERCURY NV 89023

6. Transporter 1 Company Name: CAST TRANSPORTATION
U.S. EPA ID Number: COR000005389

7. Transporter 2 Company Name:
U.S. EPA ID Number:

8. Designated Facility Name and Site Address

RINCHEM COMPANY
6133 EDITH BLVD., NE
ALBUQUERQUE NM 87107

Facility's Phone: (800)831-3655

U.S. EPA ID Number: NMD002208627

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes		
X	1. UN1993, Waste Flammable liquids, n.o.s., 3, II. Labpack.	1	DM	102	P	D001	D035	
X	2. UN1993, Waste Flammable liquids, n.o.s., 3, II. Labpack.	1	DM	62	P	D001	D018	D035
X	3. UN1956, Waste Compressed gas, n.o.s. (4, 4'-methylenediphenyl diisocyanate, 1,1,1,2-tetrafluoroethane) 2.2	1	DM	94	P	D003		
X	4. UN2809, Waste Mercury, 8, III	1	DF	6	P	D009		

14. Special Handling Instructions and Additional Information

1. ERG 128; NS-NSS-11-0012; PROFILE #RC9617. 2. ERG 128; 11-0052; PROFILE #RC9617. 3. ERG 126; 11-0013; PROFILE #RC8335. 4. ERG 172; 11-0028; PROFILE #RC6265. LOAD #11006.

15. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name: CIRILO CARLOS GONZALES ON BEHALF OF USDOE
Signature: /s/ Signature on File
Month 6 Day 28 Year 11

INT'L

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

TRANSPORTER

17. Transporter Acknowledgment of Receipt of Materials
Transporter 1 Printed/Typed Name: Roy Johnson
Signature: /s/ Roy Johnson
Month 6 Day 28 Year 11

Transporter 2 Printed/Typed Name:
Signature:
Month Day Year

DESIGNATED FACILITY

18. Discrepancy
18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection
Manifest Reference Number:

18b. Alternate Facility (or Generator)
U.S. EPA ID Number:
Facility's Phone:

18c. Signature of Alternate Facility (or Generator)
Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)
1.
2.
3.
4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a
Printed/Typed Name:
Signature:
Month Day Year

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DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

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UNIFORM HAZARDOUS WASTE MANIFEST (Continuation Sheet)

21. Generator ID Number: NV3890090001

22. Page 2 of 3

23. Manifest Tracking Number: 000956235 FLE

24. Generator's Name
NSTEC FOR USDOE
P.O. BOX 98521, M/S NNSS-110
LAS VEGAS NV 89193

25. Transporter ______ Company Name — U.S. EPA ID Number

26. Transporter ______ Company Name — U.S. EPA ID Number

27a. HM	27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	28. Containers No.	28. Containers Type	29. Total Quantity	30. Unit Wt./Vol.	31. Waste Codes		
X	5. Waste Consumer Commodity, ORM-D	1	DM	40	P	D001	D018	D035
X	6. UN2800, Waste Batteries, wet, non-spillable, 8, III	1	DF	2	P	D002	D008	
X	7. UN1726, Waste Aluminum chloride, anhydrous, 8, II	1	DF	3	P	D003		
	8. Universal Waste - Intact Fluorescent Lamps	13	DF	1240	P			
	9. Universal Waste - Broken Fluorescent Lamps	3	DF	41	P			
	10. Universal Waste - Metal Halide Lamps	2	DF	35	P			
	11. Universal Waste - High Pressure Sodium Lamps	1	DF	76	P			
	12. Universal Waste - Mercury Vapor Lamps	1	DF	9	P			
X	13. UN3028, Batteries, dry, containing potassium hydroxide solid, 8, III	2	DF	196	P			
X	14. UN3090, Lithium battery, 9, II	1	DF	89	P			

32. Special Handling Instructions and Additional Information

5. ERG171; 11-0051;PROFILE #RC6271. 6. ERG154; 11-0053;PROFILE #RC6279. 7. ERG137; 11-0018;PROFILE #RC9612. 8. 11-0055, -0057TO-0062, -0069, -0070, -0074 TO -0077;PROFILE #RC6814. 9. 11-0063,-0071,&-0078;PROFILE #RC6815. 10. 11-0054,-0072;PROFILE #RC6320. 11. 11-0073;PROFILE #RC6313. 12. 11-0056;PROFILE #RC6319. 13. ERG154; 11-0064, -0067;PROFILE #RC6816. 14. ERG138; 11-0066;PROFILE #RC6314. LOAD #11006.

GENERATOR

33. Transporter ______ Acknowledgment of Receipt of Materials
Printed/Typed Name — Signature — Month Day Year

34. Transporter ______ Acknowledgment of Receipt of Materials
Printed/Typed Name — Signature — Month Day Year

TRANSPORTER

35. Discrepancy

36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

DESIGNATED FACILITY

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DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)

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Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST (Continuation Sheet)

21. Generator ID Number: NV3890090001

22. Page 3 of 3

23. Manifest Tracking Number: 000956235 FLE

24. Generator's Name:
NSTEC FOR USDOE
P.O. BOX 98521, M/S NNSS-110
LAS VEGAS NV 89193

25. Transporter ______ Company Name
U.S. EPA ID Number

26. Transporter ______ Company Name
U.S. EPA ID Number

GENERATOR

27a. HM	27b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	28. Containers No.	28. Containers Type	29. Total Quantity	30. Unit Wt./Vol.	31. Waste Codes
X	15. UN2800, Batteries, wet, non-spillable, 8, III	1	DF	10	P	
X	16. UN1956, Compressed gas, n.o.s. (1,1,1,2-tetrafluoroethane, tris(1-chloro-2-propyl)phosphate), 2.2	1	DM	84	P	
	17.					

32. Special Handling Instructions and Additional Information

15. ERG 154; 11-0065; PROFILE #RC6819. 16. ERG 126; 11-0014; PROFILE #RC8343. LOAD #11006.

TRANSPORTER

33. Transporter ______ Acknowledgment of Receipt of Materials
Printed/Typed Name | Signature | Month Day Year

34. Transporter ______ Acknowledgment of Receipt of Materials
Printed/Typed Name | Signature | Month Day Year

DESIGNATED FACILITY

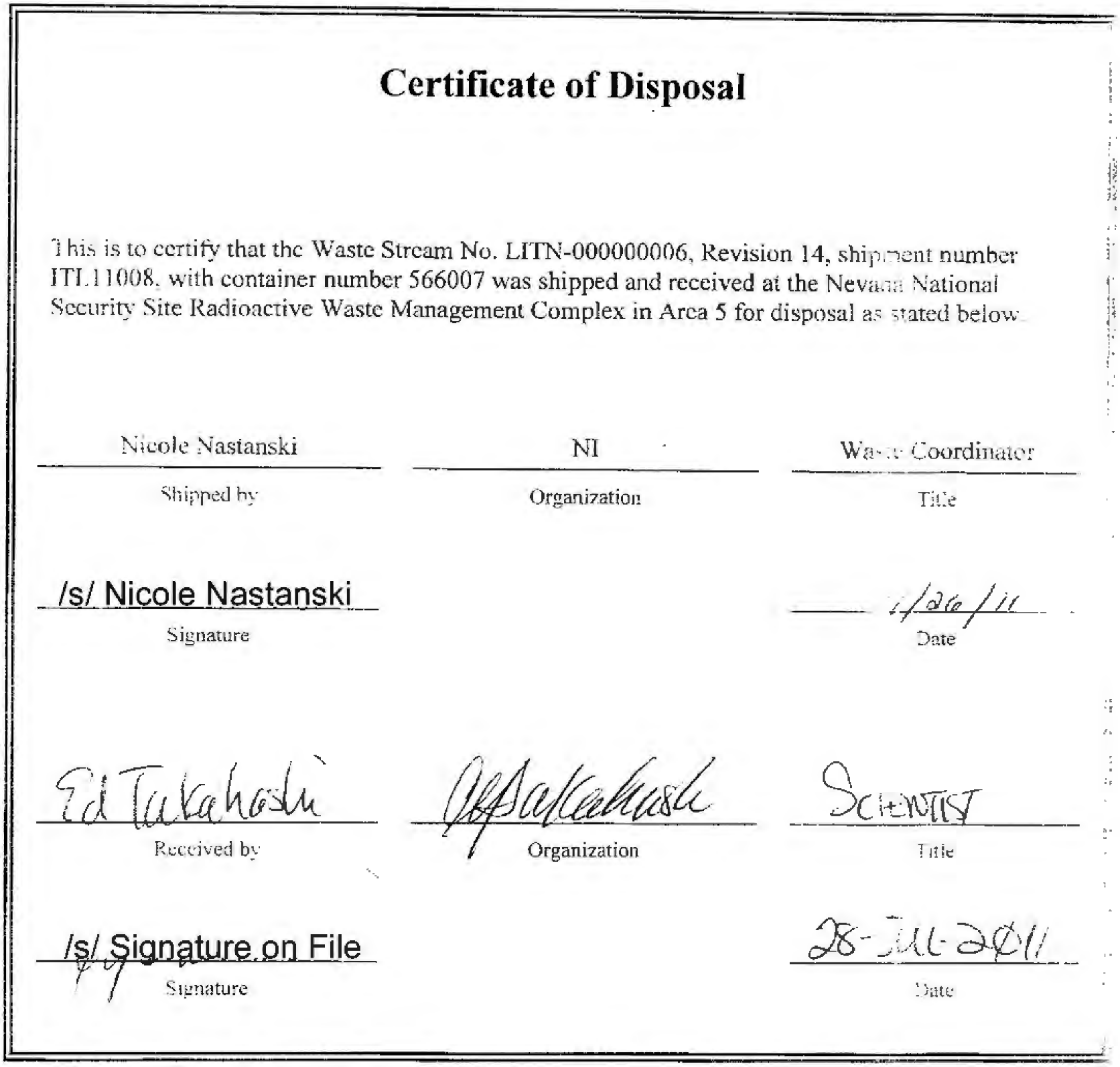
35. Discrepancy

36. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

UNCONTROLLED When Printed

EPA Form 8700-22A (Rev. 3-05) Previous editions are obsolete.

DESIGNATED FACILITY TO DESTINATION STATE (IF REQUIRED)



Certificate of Disposal

This is to certify that the Waste Stream No. LITN-000000006, Revision 14, shipment number ITL11008, with container number 566007 was shipped and received at the Nevada National Security Site Radioactive Waste Management Complex in Area 5 for disposal as stated below.

Nicole Nastanski	NI	Waste Coordinator
Shipped by	Organization	Title
/s/ Nicole Nastanski		7/26/11
Signature		Date
Ed Takahashi		SCIENTIST
Received by	Organization	Title
/s/ Signature on File		28-JUL-2011
Signature		Date

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NTS On-Site HazMat Transfer - Published

Tracking No: ITL11008 **Mesa Number:**
Carrier: NSTEC
Vehicle: G820115B Trailers: E102477
Driver: JOSEPH WARD

Depart: 28-JUL-2011 Arrival: 28-JUL-2011

From: NICOLE NASTANSKI
NAVARRO-INTERA, LLC (N-I)
BASE CAMP
MERCURY, NV 89023

Area: 23
Bldg: 0153
Phone: 702-295-1839
Alt Phone: 702-465-0693
Mobile: 702-236-1540

To: LOU GREGORY
NSTEC
BASE CAMP
RWMS
MERCURY, NV 890
Area: 05
Bldg: RWMS
Phone: 9393
Alt Phone:
Mobile:

Entered By: NICOLE NASTANSKI Date Entered: 26-JUL-2
Modified By: NICOLE NASTANSKI Date Modified: 27-JUL-2

Shipped Material(s)	**Package(s)**	**Unit(s**	**Guide No.**
UN/NA 3321, RADIOACTIVE MATERIAL LOW SPECIFIC ACTIVITY (LSA-II), 7, PG I WASTE RADIONUCLIDES CS-137 PHYSICAL FORM: SOLID CHEMICAL FORM: OXIDE PACKAGE ACTIVITY 2.26E+10 BQ CATEGORY: RADIOACTIVE WHITE I, CONTAINER 556007 T/D 0211478	1 SEALAND CONTAINER	10570.00 KILOGRAM(S) (GROSS)	162

Emergency Response Number
702-295-0311

Secondary Emergency Response Contact And/Or Comments
NICOLE NASTANSKI 702-465-0693

In the event of an emergency on the Nevada Test Site, immediately contact the Operations Coordination 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/ Nicole Nastanski Date: 7/27 Time 1400

Received by /s/ Signature on File Date: 7/28/11 Time 1025

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Appendix E

Evaluation of Corrective Action Alternatives

E.1.0 Introduction

This appendix presents the corrective action objectives for CAU 375, describes the general standards and decision factors used to screen the various CAAs, and develops and evaluates a set of selected CAAs that will meet the corrective action objectives.

All CAAs for CAU 375 are based on the presumption that areas within the current NNSS boundary will be controlled in perpetuity and restricted from release to the public. As such, only industrial activities are permitted and risks to receptors under residential scenarios will not be considered. Should the control of the NNSS change in the future to include public access or residential use, the selected CAAs may need to be reconsidered.

E.1.1 Corrective Action Objectives

On May 1, 1996, EPA issued an Advance Notice of Proposed Rulemaking (ANPR) for corrective action for releases from solid waste management units at hazardous waste management facilities (EPA, 1996). The EPA states that the ANPR should be considered the primary corrective action implementation guidance (Laws and Herman, 1997). The ANPR states that a basic operating principle for remedy selection is that corrective action decisions should be based on risk. It emphasizes that current and reasonably expected future land use should be considered when selecting corrective action remedies and encourages use of innovative site characterization techniques to expedite site investigations.

The ANPR provides the following EPA expectations for corrective action remedies (EPA, 1996):

- Treatment should be used to address principal threats wherever practicable and cost effective.
- Engineering controls, such as containment, should be used where wastes and contaminated media can be reliably contained, pose relatively low long-term threats, or for which treatment is impracticable.
- A combination of methods (e.g., treatment, engineering, and institutional controls) should be used, as appropriate, to protect human health and the environment.
- Institutional controls should be used primarily to supplement engineering controls as appropriate for short- or long-term management to prevent or limit exposure.

- Innovative technologies should be considered where such technologies offer potential for comparable or superior performance or implementability, less adverse impacts, or lower costs.

- Usable groundwater should be returned to maximum beneficial use wherever practicable.

- Contaminated soils should be remediated as necessary to prevent or limit direct exposure and to prevent the transfer of unacceptable concentrations of contaminants from soils to other media

Implementation of the corrective action will ensure that contaminants remaining at each release site will not pose an unacceptable risk to human health and the environment, and that conditions at each site are in compliance with all applicable laws and regulations.

E.1.2 Screening Criteria

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

Corrective action alternatives 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

E.1.3 Corrective Action Standards

The following subsections describe 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 necessary to ensure the requirements are met. These measures may or may not be directly related to media cleanup, source control, or management of wastes.

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.

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 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, 2010a]; 40 CFR 761 “Polychlorinated Biphenyls,” [CFR, 2010b]; and NAC 444.842 to 98, “Management of Hazardous Waste” [NAC, 2008]).

E.1.3.1 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, (e.g., fugitive dusts, transportation of hazardous materials, and explosion)
- Protection of workers during implementation
- Adverse 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 using 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 – The feasibility of implementing a CAA given the existing set of waste and site-specific conditions.
- Administrative Feasibility – The administrative activities needed to implement the CAA (e.g., permits, URs, public acceptance, rights of way, offsite approval).

- Availability of Services and Materials – 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 Section E.3.0. The following is a brief description of each component:

- Capital Costs – Costs that 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 – Separate costs that include labor, training, sampling and analysis, maintenance materials, utilities, and health and safety measures. These costs are not included in the estimates.

E.1.4 Development of Corrective Action Alternatives

This section identifies and briefly describes the viable corrective action technologies and the CAAs considered for TCA and Buggy. Contamination providing a dose exceeding the 25 mrem/RW-yr FAL was not present in surface soils at these CASs but was assumed to be present in subsurface soils in the TCA fenced area and in the Buggy crater and ejecta field (default contamination areas).

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 375:

- Alternative 1 – No Further Action
- Alternative 2 – Clean Closure
- Alternative 3 – Closure in Place

E.1.4.1 Alternative 1 – No Further Action

Under the no further action alternative, no corrective action 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.

E.1.4.2 Alternative 2 – Clean Closure

Alternative 2 includes excavating and disposing of impacted soil and debris presenting a dose exceeding the 25-mrem/RW-yr FAL to a depth of 25 ft bgs (the maximum depth to which a construction activity might excavate for a building foundation or basement). A visual inspection will be conducted to ensure that contaminated surface debris have been removed before the completion of the corrective action. Verification soil samples will also be collected and analyzed for the presence of a dose exceeding the 25-mrem/RW-yr FAL following removal of contaminated soil.

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.

E.1.4.3 Alternative 3 – Closure in Place

For radiological contamination, Alternative 3 includes the implementation of a UR where a radiological dose is present at levels that exceed the 25 mrem/RW-yr FAL. This UR will restrict inadvertent contact with contaminated media by prohibiting any activity that would cause a site worker to be exposed to a dose exceeding 25 mrem/yr. Under this alternative, debris within the 25-mrem/RW-yr FAL area will not be removed.

E.1.5 Evaluation and Comparison of Alternatives

Each CAA presented in Section E.1.4 will be evaluated based on the general corrective action standards listed in Section E.1.2. This evaluation is presented in Table E.1-1. Any CAA that does not meet the general corrective action standards will be removed from consideration.

No contaminants were present at the TCA Bunker in concentrations that required corrective action; therefore, CAA 1 (no further action) was selected for this CAS.

Only CAAs 2 and 3 met the corrective action standard at TCA and Buggy and will be further evaluated based on the remedy selection decision factors described in Section E.1.2. This evaluation is presented in Table E.1-2. For each remedy selection decision factor, the CAAs are ranked relative to one another. The CAA with the least desirable impact on the remedy selection decision factor will be given a ranking of 1. The CAAs with increasingly desirable impacts on the remedy selection

Table E.1-1
Evaluation of General Corrective Action Standards

CAS 25-23-22, Contaminated Soils Site, and CAS 30-45-01, U-30a, b, c, d, e Craters

CAA 1, No Further Action

Standard	Comply?	Explanation
Protection of Human Health and the Environment	No	Subsurface contamination is present that could provide an excavation worker a dose exceeding the 25-mrem/RW-yr FAL.
Compliance with Media Cleanup Standards	No	Subsurface contamination is present that could provide an excavation worker a dose exceeding the 25-mrem/RW-yr FAL.
Control the Source(s) of the Release	Yes	The activities that generated these releases are complete. There are no ongoing releases.
Comply with Applicable Federal, State, and Local Standards for Waste Management	Yes	This alternative will not generate waste.

CAA 2, Clean Closure

Standard	Comply?	Explanation
Protection of Human Health and the Environment	Yes	Contamination exceeding the risk-based action levels will be removed.
Compliance with Media Cleanup Standards	Yes	Contamination exceeding the risk-based action levels will be removed.
Control the Source(s) of the Release	Yes	The activities that generated these releases are complete. There are no ongoing releases.
Comply with Applicable Federal, State, and Local Standards for Waste Management	Yes	Excavated waste can be managed in compliance with all standards.

CAA 3, Closure in Place with Administrative Controls

Standard	Comply?	Explanation
Protection of Human Health and the Environment	Yes	A UR will be implemented to protect excavation workers from inadvertant dose.
Compliance with Media Cleanup Standards	Yes	Although COCs will not be removed, site will be controlled to prevent workers from receiving a dose exceeding the 25-mrem/RW-yr FAL.
Control the Source(s) of the Release	Yes	The activities that generated these releases are complete. There are no ongoing releases.
Comply with Applicable Federal, State, and Local Standards for Waste Management	Yes	This alternative will not generate radioactive waste. Hazardous or mixed wastes will be removed, and disposed of or recycled.

decision factor will receive increasing rank numbers. The CAAs that will have an equal impact on the remedy selection decision factor will receive an equal ranking number. The scoring listed in this table represents the sum of the remedy selection decision factor rankings for each CAA.

The five EPA remedy selection decision factors are short-term reliability and effectiveness; reduction of toxicity, mobility, and/or volume; long-term reliability and effectiveness; feasibility; and cost. These factors are provided in Table E.1-2.

The first remedy selection decision factor—short-term reliability and effectiveness—is a qualitative measure of the impacts on human health and the environment during implementation of the CAA. While clean closure is both reliable and effective in the long-term, this alternative involves increased, short-term exposure of site workers to radiological contamination during soil and debris removal. In contrast, closure in place does not require removal of soil, and there is no short-term exposure of site workers; signs are posted, and disturbance of contaminated soil and debris is not necessary.

The second remedy selection decision factor—reduction of toxicity, mobility, and/or volume—is a qualitative measure of changes in characteristics of contaminated media that result from implementation of the CAA. Under clean closure, contaminated media that exceed FALs (to a depth of 25 ft bgs) would be removed from the area, thereby eliminating both mobility and the onsite volume of contaminated media. In contrast, closure in place does not reduce toxicity, mobility, or volume.

The third remedy selection decision factor—long-term reliability and effectiveness—is a qualitative evaluation of performance following site closure, and into the future. Removal of contaminated media for clean closure provides long-term reliability and effectiveness, whereas closure in place does not.

The fourth remedy selection decision factor—feasibility—includes an evaluation of the requirements for construction and operation as well as administrative constraints. For the closure in place alternative, no construction is required other than the installation of postings. Some maintenance and administrative requirements would be onging. For the clean closure alternative, substantial construction, operation, and administrative actions consistent with soil removal and management of generated wastes are needed.

Table E.1-2
Evaluation of Remedy Selection Decision Factors

CAS 25-23-22, Contaminated Soils Site, and CAS 30-45-01, U-30a, b, c, d, e Craters

CAA 1, No Further Action

Factor	Rank	Explanation
Not evaluated, as this CAA did not meet the General Corrective Action Standards		

CAA 2, Clean Closure

Standard	Rank	Explanation
Short-Term Reliability and Effectiveness	1	This alternative is reliable and effective, but involves increased short-term exposure of site workers to COCs during soil removal operations.
Reduction of Toxicity, Mobility, and/or Volume	2	This alternative will result in a decrease of toxicity and mobility, but will generate significant waste volumes.
Long-Term Reliability and Effectiveness	2	This alternative is reliable and effective at protecting human health and the environment because removal of the contaminated media will eliminate future exposure of site workers to COCs. However, the short term exposure to site workers would increase.
Feasibility	1	This option would involve the excavation, disposal, and backfill of over 310,000 m^3 of soil involving one extremely remote location requiring the construction of 12 miles of road to accommodate the equipment.
Cost	1	Cost is estimated to be approximately $274 million.
Score	7	

CAA 3, Closure in Place with Administrative Controls

Standard	Rank	Explanation
Short-Term Reliability and Effectiveness	2	This alternative is reliable and effective in providing increased protection of human health by preventing contact with COCs.
Reduction of Toxicity, Mobility, and/or Volume	1	This alternative will not reduce toxicity or mobility of the COCs that are present, but will not generate excavation waste volumes.
Long-Term Reliability and Effectiveness	1	This alternative is reliable in the long term with ongoing maintenance. It is effective in providing protection of human health by preventing inadvertent contact with COCs.
Feasibility	2	This alternative is easily implemented, but requires maintenance and long-term monitoring.
Cost	2	The installation costs are estimated at $25,000. Ongoing maintenance costs for this alternative are estimated at $1,000 annually.
Score	8	

The fifth remedy selection decision factor—cost—includes assessment of both capital (direct) costs of implementation and costs for operation and maintenance of the corrective action. As shown in Table E.1-2, the estimated cost for clean closure would be approximately $274 million, while the costs for closure in place are limited to those derived from acquiring, hanging, inspecting, and occasionally replacing, UR signs (estimated to be $25,000 for the first year and $1,000 for each year thereafter).

E.2.0 Recommended Alternative

Three CAAs were evaluated for TCA and Buggy: no further action (CAA 1), clean closure (CAA 2), and closure in place (CAA 3). Only CAA 2 and CAA 3 met all requirements for general corrective action standards (Section E.1.2) for TCA and Buggy. In general, for the clean closure alternative, near-surface soils would be removed from the sites to a depth of 25 ft bgs. For the closure in place alternative, potential worker exposure to radiological contamination would be controlled through the implementation of URs. Both CAAs would, therefore, be protective of human health and the environment, comply with media cleanup standards, and control the source of release. As supported by the following discussion, further examination of the two CAAs in light of the five EPA remedy selection decision factors resulted in the selection of closure in place as the preferred CAA for both TCA and Buggy.

Based upon the five remedy selection decision factors, clean closure received an overall score of 7 (less desirable), whereas closure in place received an overall score of 8 (more desirable). This result was not only the product of an examination of the two CAAs in light of the five remedy selection decision factors, but also in consideration of the current NNSS administrative controls (e.g., NNSS access restrictions and control of site activities), the remoteness of the sites, no nearby structures or activities, no current or planned use of the sites, the present-day stability of the contaminated soil at the sites through the evolution of a mature plant community, and the development of soil surface durability (i.e., soil crust). Also, the clean closure alternative is not feasible at either CAS.

The surface and subsurface contamination at TCA is located within a fenced radioactive material area. Removal of the contaminated material would require the excavation and backfill of about 52,000 m^3 of soil and the removal of the remains of support structures from a 7-acre area. This removal action would pose significant safety risks, be extremely difficult and expensive, and would not provide significant additional protection to potential future receptors.

The removal of soils from Buggy would require the excavation of 230,000 m^3 of soil and the backfill of 260,000 m^3 of soil, exposing workers to high-risk activities including the construction of approximately 12 miles of road in order to allow the necessary equipment access to the site. This corrective action would not remove deeper contamination in the area of the crater, and a UR may still be required. Currently, the contaminated material beneath the Buggy crater is covered by eroded material that has blown in and is not accessible to expose workers or the public to radioactivity. Therefore, this removal action would pose significant safety risks, be extremely difficult and expensive, and would not provide significant additional protection to potential future receptors.

Therefore, selection of the CAA of closure in place for both TCA and Buggy is consistent with past practices for CASs that contain COCs and where there would be significant costs and short-term health risks to workers involved in cleanup activities. However, if use of the NNSS should change in the future to include public access or residential use, the selected CAAs would need to be reconsidered.

E.3.0 Cost Estimates

The cost estimate for clean closure is estimated at approximately $274 million to conduct the following activities:

- Preparation and procurement
- Grub surface contamination
- Excavate, load, and dispose contaminated soil (approximately 310,000 m^3)
- Dispose of debris
- Equipment decontamination

The estimated costs for clean closure of CAU 375 was based on removing contaminated soil within the default contamination boundary. Specifically, soil within the fenced area at TCA would be removed. The cost for clean closure of TCA was estimated at approximately $22 million. For Buggy, soil within the 39-μR/hr isopleth from the 1994 flyover survey (BN, 1999) would be removed. The cost for clean closure of Buggy was estimated to be approximately $252 million. This includes excavation, loading and processing, transportation, disposal, site restoration, and site support.

The costs for closure in place, however, are limited to those derived from acquiring, hanging, inspecting, and occasionally replacing UR signs, and are estimated at approximately $25,000 for the first year and $1,000 for each year thereafter.

E.4.0 References

BN, see Bechtel Nevada.

Bechtel Nevada. 1999. *An Aerial Radiological Survey of the Nevada Test Site,* DOE/NV/11718--324. Prepared for the U.S. Department of Energy, Nevada Operations Office. Las Vegas, NV: Remote Sensing Laboratory.

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EPA, see U.S. Environmental Protection Agency.

Laws, E.P., and S.A. Herman, U.S. Environmental Protection Agency. 1997. Memorandum to RCRA/CERCLA Senior Policy Managers Region I–X titled "Use of the Corrective Action Advance Notice of Proposed Rulemaking as Guidance," 17 January. Washington, DC: Offices of Solid Waste and Emergency Response, and Enforcement and Compliance Assurance.

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Appendix F

Data Tables

F.1.0 Data Tables for TCA

Analytical results for gamma-emitting and isotopic radionuclide environmental samples collected at the sample plot at TCA that were detected above MDCs are presented in Table F.1-1. The DQO decisions for radionuclide contamination were resolved using TED, which is the sum of the internal dose (calculated from radionuclide analytical results using RESRAD [Yu et al., 2001]) and external dose (measured from TLDs). Although the net internal and external doses are reported directly in this document, the individual radionuclide analytical results and the individual TLD element results are not presented. Therefore, these results are presented in this appendix for completeness.

Results for TLDs staged at TCA including field background are presented in Table F.1-2.

Table F.1-1
Sample Results for Isotopic Analyses at TCA

Sample Location	**Radionuclide**	**Ac-228**	**Cs-137**	**Co-60**	**Eu-152**	**Nb-94**	**Pu-239/240**	**Sr-90**	**U-234**	**U-235**	**U-238**
	RRMG (IA)	2,274	140,900	551,300	1,177,000	3,499,360	2,215	59,470	19,600	21,200	20,890
	RRMG (RW)	13,410	1,955,000	7,229,000	13,240,000	39,660,000	12,680	807,500	137,900	155,400	149,600
	RRMG (OU)	38,520	37,560,000	74,210,000	81,740,000	349,200,000	35,820	9,949,000	447,000	336,100	492,200
	Sample Number	[redacted]									
AA1	375AA01	1.42	62.7	0.06	3.25	0.45	0.25	--	0.90	0.71	0.90
AA2	375AA02	1.51	45.8	--	3.30	0.35	0.10	--	1.24	0.69	0.00
AA3	375AA03	1.54	45.5	--	2.70	0.47	1.56	113	25.8	0.74	1.60
AA4	375AA04	1.46	57.9	0.07	2.83	0.49	1.22	334	128	1.66	5.85
AT14	375A001	1.87	0.14	--	--	--	--	--	0.93	0.79	0.12
AT15	375A002	2.09	--	--	--	--	--	--	0.86	0.80	0.10
AT12	375A003	1.65	0.68	--	1.31	--	--	--	0.85	0.74	0.07
AT13	375A004	1.64	0.24	--	0.55	--	--	--	0.75	0.74	0.05
	375A005	1.68	0.26	--	0.60	--	--	--	0.82	0.84	0.03

-- = Not detected above MDCs.

Table F.1-2
TLD Results for TCA (mrem/IA-yr)

Location ID	TLD1				
	Element			Avg.	95% UCL
	2	3	4		
AT01	36.6	35.9	30.1	**34.2**	**40.2**
AT02	29.5	30.3	24.9	**28.2**	**33.1**
AT03	26.9	21.2	23.5	23.8	**28.7**
AT04	19.3	17.9	17.7	18.3	19.8
AT05	34.7	29.7	28.2	**30.9**	**36.6**
AT06	18.8	16.3	14.0	16.4	20.4
AT07	18.4	18.5	13.1	16.7	21.8
AT08	20.1	14.6	15.1	16.6	21.7
AT09	11.6	13.5	5.9	10.3	17.0
AT10	16.7	12.5	12.0	13.7	18.1
AT11	-0.4	0	-3.8	-1.4	2.1
AT12	6.0	2.9	0.9	3.3	7.6
AT13	2.4	4.2	0.2	2.3	5.7
AT14	0.2	0.1	-3.4	-1.0	2.4
AT15	4.1	1.9	0.5	2.2	5.2
AT16	1.3	3.2	-0.3	1.4	4.3

Bold indicates the average and 95 UCL values exceeding 25 mrem/yr.

F.2.0 Data Tables for Buggy

Analytical results for gamma-emitting and isotopic radionuclide environmental samples collected at the sample plot at Buggy that were detected above MDCs are presented in Table F.1-3. The DQO decisions for radionuclide contamination were resolved using TED, which is the sum of the internal dose (calculated from radionuclide analytical results using RESRAD [Yu et al., 2001]) and external dose (measured from TLDs). Although the net internal and external doses are reported directly in this document, the individual radionuclide analytical results and the individual TLD element results are not presented. Therefore, these results are presented in this appendix for completeness.

Results for TLDs staged at TCA including field background are presented in Table F.1-4.

Table F.1-3
Sample Results for Isotopic Analyses at Buggy

Sample Location	Radionuclide	Ac-228	Ag-108M	Am-241	Cs-137	Co-60	Eu-152	Eu-154	Pu-238	Pu-239/240	Sr-90	U-234	U-235	U-238
	RRMG (IA)	2,274	1,000,000	2,816	140,900	551,300	1,177,000	3,499,360	2,423	2,215	59,470	19,600	21,200	20,890
	RRMG (RW)	13,410	1,000,000	16,120	1,955,000	7,229,000	13,240,000	39,660,000	13,880	12,680	807,500	137,900	155,400	149,600
	RRMG (OU)	38,520	1,000,000	45,550	37,560,000	74,210,000	81,740,000	349,200,000	39,220	35,820	9,949,000	447,000	336,100	492,200
	Sample Number	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
BA1	375BA01	1.39	1.88	749	47.7	5.66	28.6	7.09	49.3	632	12.5	2.45	--	0.595
BA2	375BA02	1.67	1.6	583	43.9	4.82	25.4	5.95	13.7	199	10.2	1.54	--	0.569
BA3	375BA03	1.98	1.08	484	29.1	3.28	16.7	4.09	11.3	273	19.9	1.8	--	0.854
BA4	375BA04	1.72	1.81	682	48.7	5.93	32.1	7.4	17.8	356	10.9	4.17	--	0.713
B31	375BX01	1.73	--	28.8	15.3	1.17	3.75	1.33	282	128	3.68	1.98	--	0.794
B32	375BX02	2.24	--	58.5	22.3	2.49	8.23	2.32	116	89.4	5.95	2.83	--	1.03
	375BX03	1.71	--	75.1	22.4	2.96	10.5	--	39.6	104	5.24	5.11	--	1.08
B28	375BX09	2.26	--	2.38	0.643	--	--	--	0.234	1.28	--	0.938	--	0.944
	375BX10	2.18	--	2.08	0.593	--	--	--	0.197	2.42	--	0.785	--	0.806
B12	375BX11	2.02	--	1.74	0.594	--	--	--	0.049	0.451	--	0.952	0.0777	0.988
	375BX12	2.44	--	0.504	0.216	--	--	--	--	0.024	--	0.874	0.0541	0.897

Ag = Silver

-- = Not detected above MDCs.

Table F.1-4
TLD Results for Buggy (mrem/IA-yr)
(Page 1 of 2)

Location ID	Element									Avg	95% UCL
	2	3	4	2	3	4	2	3	4		
	TLD 1			TLD 2			TLD 3				
B00	12.0	13.1	11.2	--	--	--	--	--	--	12.1	13.7
B01	12.1	9.9	8.1	--	--	--	--	--	--	10.0	13.4
B02	11.9	12.2	9.3	--	--	--	--	--	--	11.2	13.8
B03	26.1	25.4	21.0	--	--	--	--	--	--	24.2	**28.9**
B04	106.6	94.8	85.7	93.9	75.6	85.2	95.9	81.4	74.6	**88.2**	**94.7**
B05	56.2	52.0	44.7	--	--	--	--	--	--	**51.0**	**60.8**
B06	14.2	11.8	11.6	--	--	--	--	--	--	12.5	15.0
B07	16.9	13.9	11.8	--	--	--	--	--	--	14.2	18.5
B08	38.8	36.4	33.5	--	--	--	--	--	--	**36.2**	**40.7**
B09	17.1	11.2	12.1	--	--	--	--	--	--	13.5	18.9
B10	14.9	12.3	10.3	--	--	--	--	--	--	12.5	16.4
B11	6.5	3.6	3.6	--	--	--	--	--	--	4.6	7.4
B12	10.2	8.8	7.0	--	--	--	--	--	--	8.7	11.4
B13	102.4	96.6	89.0	101.7	84.3	82.3	98.8	90.1	92.0	**93.0**	**97.5**
B14	45.5	40.8	38.8	--	--	--	--	--	--	**41.7**	**47.5**
B15	22.7	20.3	18.7	--	--	--	--	--	--	20.6	23.9
B16	10.2	7.5	5.8	--	--	--	--	--	--	7.8	11.6
B17	6.4	3.8	2.5	--	--	--	--	--	--	4.2	7.6
B18	49.5	45.4	39.7	--	--	--	--	--	--	**44.9**	**53.1**
B19	8.9	8.4	8.1	--	--	--	--	--	--	8.5	9.1
B20	--	44.2	42.9	46.7	43.3	38.1	43.7	38.4	37.6	**41.8**	**44.1**
B21	11.3	8.6	6.8	--	--	--	--	--	--	8.9	12.7
B22	50.9	51.8	45.1	--	--	--	--	--	--	**49.2**	**55.4**
B23	18.6	14.6	15.1	--	--	--	--	--	--	16.1	19.7
B24	14.7	14.1	12.0	--	--	--	--	--	--	13.6	16.0
B25	23.5	23.0	19.5	--	--	--	--	--	--	22.0	**25.7**
B26	42.1	39.4	32.3	--	--	--	--	--	--	**37.9**	**46.4**

Table F.1-4
TLD Results for Buggy (mrem/IA-yr)
(Page 2 of 2)

Location ID	Element									Avg	95% UCL
	2	3	4	2	3	4	2	3	4		
	TLD 1			TLD 2			TLD 3				
B27	55.4	49.9	44.3	--	--	--	--	--	--	**49.9**	**59.2**
B28	12.6	13.3	8.8	--	--	--	--	--	--	11.6	15.7
B29	4.1	4.5	3.4	--	--	--	--	--	--	4.0	4.9
B30	9.6	7.5	4.8	--	--	--	--	--	--	7.3	11.4
B31	19.9	15.1	13.2	--	--	--	--	--	--	16.1	21.9
B32	37.8	32.7	27.7	--	--	--	--	--	--	**32.7**	**41.2**
B33	0.9	0.5	-0.4	--	--	--	--	--	--	0.3	1.5
B40	3.3	0.3	0.7	--	--	--	--	--	--	1.4	4.1
B41	-0.5	-2.2	-1.8	--	--	--	--	--	--	-1.5	0.0
B42	-0.4	-0.2	0.7	--	--	--	--	--	--	0.0	1.0
B43	-0.9	-0.4	0.6	--	--	--	--	--	--	-0.2	1.0
B44	1.8	2.0	0.5	--	--	--	--	--	--	1.4	2.8

-- = No TLD deployed.

Bold indicates the average and 95 UCL values exceeding 25 mrem/yr.

F.3.0 References

Yu, C., A.J. Zielen, J.J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo III, W.A. Williams, and H. Peterson. 2001. *User's Manual for RESRAD Version 6*, ANL/EAD-4. Argonne, IL: Argonne National Laboratory, Environmental Assessment Division. (Version 6.4 released in December 2007.)

Appendix G

Sample Location Coordinates

G.1.0 Sample Location Coordinates

The center of each sample plot and the locations of individual (judgmental) sample locations for the CAU 375 CASs were surveyed using a GPS instrument. Survey coordinates for these locations are listed in Tables G.1-1 through G.1-3.

Table G.1-1
Sample Plot/Location Coordinates for TCA[a]

Easting[b]	Northing[b]	Sample Plot/Location
566,312	4,076,039	AA (Plot)
Sedimentation Areas and Judgmental Sample Locations		
566,091	4,076,099	A01 (Judgmental)
566,277	4,075,817	AT12 (Sed. Area)
566,191	4,075,763	AT13 (Sed. Area)
566,026	4,075,846	AT14 (Sed. Area)
566,029	4,075,790	AT15 (Sed. Area)

[a] Plot coordinates listed are for the approximate center of the sample plot
[b] UTM Zone 11, NAD 1927 (U.S. Western) in meters.

Table G.1-2
Sample Location Coordinates for TCA Bunker

Easting[a]	Northing[a]	Sample Location
566,183	4,076,025	A02 (Judgmental)

[a] UTM Zone 11, NAD 1927 (U.S. Western) in meters.

Table G.1-3
Sample Plot/Location Coordinates for Buggy[a]
(Page 1 of 2)

Easting[b]	Northing[b]	Sample Plot/Location
555,769	4,095,813	BA (Plot)
Sedimentation Areas and Judgmental Sample Locations		
555,932	4,096,025	B12 (Sed. Area)
555,919	4,096,016	B28 (Sed. Area)
556,085	4,095,523	B31 (Sed. Area)
556,120	4,095,522	B32 (Sed. Area)

Table G.1-3
Sample Plot/Location Coordinates for Buggy[a]
(Page 2 of 2)

Easting[b]	Northing[b]	Sample Plot/Location
555,804	4,095,156	B34 (Judgmental)
555,804	4,095,154	B35 (Judgmental)
555,802	4,095,154	B36 (Judgmental)
555,800	4,095,155	B37 (Judgmental)
555,452	4,096,067	B38 (Judgmental)
555,692	4,095,837	B39 (Judgmental)

[a] Plot coordinates listed are for the approximate center of the sample plot
[b] UTM Zone 11, NAD 1927 (U.S. Western) in meters.

Nine aliquot sample locations were established at each plot for each composite sample (4 composite samples, 36 aloquoit sample locations). The VSP software (PNNL, 2007) was used to derive coordinates for a systematic triangular grid pattern based on a randomly generated origin or starting point. The sample aliquot locations for each composite sample are in a tabular format in terms of east and north distances from the southwest corner stake at each plot (Table G.1-4).

Table G.1-4
Sample Plot Location Distance (TCA & Buggy) in Meters

Sample Location		
Composite Number	**Easting (Distance m)**	**Northing (Distance m)**
1	2.2	1.6
	5.7	1.6
	9.3	1.6
	0.4	4.7
	4.0	4.7
	7.5	4.7
	2.2	7.8
	5.7	7.8
	9.3	7.8
2	2.2	0.9
	5.8	0.9
	9.3	0.9
	0.4	4.0
	3.9	4.0
	7.5	4.0
	2.2	7.1
	5.8	7.1
	9.3	7.1
3	0.9	2.0
	4.4	2.0
	8.0	2.0
	2.6	5.1
	6.2	5.1
	9.8	5.1
	0.9	8.2
	4.4	8.2
	8.0	8.2
4	0.8	3.1
	4.4	3.1
	7.9	3.1
	2.6	6.2
	6.1	6.2
	9.7	6.2
	0.8	9.2
	4.4	9.2
	7.9	9.2

In some cases, aliquot locations were moved due to surface/subsurface obstructions or conditions (e.g., rocks, vegetation, and animal burrows). These offsets (distance and direction) of each aliquot location were recorded in the project files. It is important to note that if an offset was less than the nominal 4-in. width of core sampler, the original coordinate was not modified.

G.2.0 References

PNNL, see Pacific Northwest National Laboratory.

Pacific Northwest National Laboratory. 2007. *Visual Sample Plan, Version 5.0 User's Guide*, PNNL-16939. Richland, WA.

Appendix H

Nevada Division of Environmental Protection Comments

(1 Page)

NEVADA ENVIRONMENTAL RESTORATION PROJECT

DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Corrective Action Decision Document/Closure Report for Corrective Action Unit 375: Area 30 Buggy Unit Craters, Nevada National Security Site, Nevada	**2. Document Date:**	7/6/2011
3. Revision Number:	0	**4. Originator/Organization:**	Navarro-INTERA
5. Responsible NNSA/NSO Federal Sub-Project Director:	Kevin J. Cabble	**6. Date Comments Due:**	8/5/2011
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Jeff MacDougall, NDEP, 486-2850 ext. 233	**9. Reviewer's Signature:**	

10. Comment Number/Location	**11. Type***	**12. Comment**	**13. Comment Response**	**14. Accept**
1.) Appendix D, Section D.1.1	Mandatory	For TCA closure activities, where contamination extended beyond the existing fence line, signs were posted to “encompass” the contaminated area. Explain, or provide additional details as to how signs “encompass” the designated contaminated area (i.e., are the signs connected in such a manner as to create a boundary).	Section D.1.1 was revised as follows: "Where the corrective action boundary extended beyond the existing fence line, a three-strand fence was constructed and signs affixed that encompass the corrective action boundary." Discussion - Section A.3.3 explains how the TCA UR is defined by the default contamination area (the fenced area at TCA) and the area outside of the fence line that exceeded the 25-mrem/yr dose rate. Figure A.3-7 shows the 25-mrem/yr dose line and where the existing fence line was extended to include the area. Coordinates for the resulting UR are recorded in the official use restriction, and signs were placed on the fence at appropriate intervals to inform visitors to the area.	
2.) Appendix D, Page D-2	Mandatory	As it pertains to the discussion on the administrative UR and CA boundary, the CA boundary encompasses the administrative UR; for sites where both CA and administrative UR have been established, is the entire CA also designated as “use restricted” and do the coordinates provided in Appendix D-1 reflect this larger area (i.e., the CA)?	The UR boundary is based on the corrective action boundary and not on the CA boundary. In cases where the UR signs are hung on existing fences, the UR coordinates provided in the official use restriction are for the corrective action boundaries and not the coordinates of the fences.	

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