Nevada
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DOE/NV--1547-ADD

National Nuclear Security Administration

Addendum to the Closure Report for Corrective Action Unit 411: Double Tracks Plutonium Dispersion (Nellis), Nevada Test and Training Range, Nevada

Controlled Copy No.: ___
Revision No.: 0

November 2016

UNCLASSIFIED

/s/ Joseph P. Johnston 11/01/2016
Joseph P. Johnston, Navarro CO Date

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ADDENDUM TO THE CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 411: DOUBLE TRACKS PLUTONIUM DISPERSION (NELLIS), NEVADA TEST AND TRAINING RANGE, NEVADA

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

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ADDENDUM TO THE CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 411: DOUBLE TRACKS PLUTONIUM DISPERSION (NELLIS), NEVADA TEST AND TRAINING RANGE, NEVADA

Approved by: /s/ Tiffany A. Lantow Date: 10/27/2016

Tiffany A. Lantow
Soils Activity Lead

Approved by: /s/ Janet Appenzeller-Wing Date: 10/27/2016

for Robert F. Boehlecke
Environmental Management Operations Manager

1.0 Purpose

The Corrective Action Unit (CAU) 411 Closure Report (CR) was published in June 2016 (NNSA/NFO, 2016). The purpose of this addendum is to clarify language in the CR relating to the field instrument for the detection of low-energy radiation (FIDLER), provide the waste disposal documentation for waste generated during the corrective action investigation (CAI), and reference a letter from the U.S. Air Force (USAF) regarding the closure of CAU 411.

1.1 FIDLER Data Quality

In order to clarify the data quality of the FIDLER radiological data collected as part of the CAI, the text in Section 4.1.10.3 of the CAU 411 CR was deleted and replaced with the following:

> "The FIDLER data meet the data quality requirements listed in Section 2.6.1 of the Soils QAP through the verification of acceptable instrument performance. This was accomplished through the use of control charts and daily operational tests (performing daily background and response checks). This assures that the instrument responds appropriately to higher levels of radiation with correspondingly higher readings. The FIDLER readings are used qualitatively to represent generally-observed radiation levels relative to the nearby background radiation level. These are expressed in terms of multiples of the background radiation level (i.e., multiples of background). The qualitative multiples of background values are used to distinguish a spatial pattern of where radioactivity is relatively higher and lower. These values become semi-quantitative if a relationship is established between the multiples of background values and quantitative dose levels that meets the quality criterion defined in the Soils RBCA document (NNSA/NFO, 2014).
>
> FIDLER data are also used qualitatively to guide the biasing of sampling locations. As used for these purposes, the quality of FIDLER survey data is sufficient to meet the requirements of decision-supporting data."

1.2 Waste Disposal Documentation

The CAU 411 CR was published before the disposal of the investigation-derived waste generated during the CAI. As stated in Appendix E of the CAU 411 CR, the waste disposal documentation for wastes generated during the CAI would be provided in an addendum. In order to maximize efficiency and economy, the wastes from CAU 411 were consolidated with investigation wastes from CAUs 412, 413, and 414, located on the Tonopah Test Range. The certificate of disposal for the container of consolidated wastes is presented in Appendix A.

1.3 USAF Memorandum

CAU 411 is located on the Nevada Test and Training Range, on lands legislatively withdrawn to USAF. The USAF is considered a stakeholder for the purposes of *Federal Facility Agreement and Consent Order* (FFACO) closure of CAU 411 and has been involved throughout the closure process. The U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office and the state regulator (Nevada Division of Environmental Protection) requested that USAF formalize their participation in the FFACO process by way of a memorandum. This memorandum (1) acknowledges USAF participation in the FFACO closure process, (2) confirms the Construction Worker exposure scenario for CAU 411, and (3) discusses the reevaluation of closure should land use change in the future. The memorandum is dated June 30, 2016 (Dempsey, 2016), and is available in the Soils Activity project files.

2.0 References

Dempsey, Col. T.E., U.S. Air Force, 99 NTTR/CC. 2016. Memorandum to R. Boehlecke (NNSA/NFO) titled "USAF Acknowledgment of Final Federal Facility Agreement and Consent Order (FFACO) Closure of Corrective Action Units (CAUs) 98 (Frenchman Flat), CAU 411 (Double Tracks), and 541 (Small Boy)," 30 June. Nellis AFB, NV.

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2016. *Closure Report for Corrective Action Unit 411: Double Tracks Plutonium Dispersion (Nellis) Nevada Test and Training Range, Nevada,* Rev. 0, DOE/NV--1547. Las Vegas, NV.

Appendix A

Waste Disposal Documentation

(1 Page)

COPY

Certificate of Disposal

This is to certify that the Waste Stream No. LITN-000000006, Revision 16, shipment number **ITL16022** with container numbers 412B01 was shipped and received at the Nevada National Security Site Radioactive Waste Management Complex in Area 5 for disposal as stated below.

Mark Heser	Navarro	LL Waste Coordinator
Shipped by	Organization	Title
/s/ Mark Heser		8/15/16
Signature		Date
Stephen E Wolf	NSTec	Waste Specialist
Received by	Organization	Title
/s/ Stephen E Wolf		08/16/16
Signature		Date

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Closure Report for Corrective Action Unit 411: Double Tracks Plutonium Dispersion (Nellis) Nevada Test and Training Range, Nevada

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June 2016

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/s/ Joseph P. Johnston 06/06/2016
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CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 411: DOUBLE TRACKS PLUTONIUM DISPERSION (NELLIS) NEVADA TEST AND TRAINING RANGE, NEVADA

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

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June 2016

CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 411:
DOUBLE TRACKS PLUTONIUM DISPERSION (NELLIS)
NEVADA TEST AND TRAINING RANGE, NEVADA

Approved by: /s/ Tiffany A. Lantow Date: 06/06/2016

Tiffany A. Lantow
Soils Activity Lead

Approved by: /s/ Jhon Carilli for Date: 06/06/2016

Robert F. Boehlecke
Environmental Management Operations Manager

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List of Acronyms and Abbreviations

Ac	Actinium
Ag	Silver
Al	Aluminum
Am	Americium
ASTM	ASTM International
bgs	Below ground surface
BMP	Best management practice
CA	Contamination area
CAA	Corrective action alternative
CAI	Corrective action investigation
CAS	Corrective action site
CAU	Corrective action unit
CD	Certificate of Disposal
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
CSM	Conceptual site model
CW	Construction worker
day/yr	Days per year
DOE	U.S. Department of Energy

List of Acronyms and Abbreviations *(Continued)*

DOELAP	U.S. Department of Energy Laboratory Accreditation Program
dpm/100 cm^2	Disintegrations per minute per 100 square centimeters
DQA	Data quality assessment
DQI	Data quality indicator
DQO	Data quality objective
DT	Double Tracks
EPA	U.S. Environmental Protection Agency
Eu	Europium
FAL	Final action level
FD	Field duplicate
FFACO	*Federal Facility Agreement and Consent Order*
FIDLER	Field instrument for the detection of low-energy radiation
FSR	Field-screening result
gal	Gallon
GPS	Global Positioning System
GZ	Ground zero
HCA	High contamination area
hr/day	Hours per day
hr/yr	Hours per year
IA	Industrial area
in.	Inch
LCS	Laboratory control sample
LLW	Low-level waste
m	Meter
m^2	Square meter
MDC	Minimum detectable concentration

List of Acronyms and Abbreviations *(Continued)*

M&O	Management and operating
mrem	Millirem
mrem/CW-yr	Millirem per Construction Worker year
mrem/IA-yr	Millirem per Industrial 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
NIST	National Institute of Standards and Technology
NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
NNSS	Nevada National Security Site
Np	Neptunium
NSTec	National Security Technologies, LLC
NTTR	Nevada Test and Training Range
PAL	Preliminary action level
pCi/g	Picocuries per gram
PI	Preliminary investigation
PPE	Personal protective equipment
PSM	Potential source material
Pu	Plutonium
QA	Quality assurance
QAP	Quality Assurance Plan
QC	Quality control
RBCA	Risk-based corrective action

List of Acronyms and Abbreviations *(Continued)*

RPD	Relative percent difference
RRMG	Residual radioactive material guideline
RWMC	Radioactive waste management complex
SAFER	Streamlined Approach for Environmental Restoration
SCL	Sample collection log
Sr	Strontium
TBD	To be determined
Tc	Technetium
TCLP	*Toxicity Characteristic Leaching Procedure*
TED	Total effective dose
Th	Thorium
TLD	Thermoluminescent dosimeter
TTR	Tonopah Test Range
U	Uranium
UCL	Upper confidence limit
UR	Use restriction
USAF	U.S. Air Force
UTM	Universal Transverse Mercator
UXO	Unexploded ordnance
yd^3	Cubic yard

Executive Summary

This Closure Report (CR) presents information supporting the clean closure of Corrective Action Unit (CAU) 411: Double Tracks Plutonium Dispersion (Nellis), located on the Nevada Test and Training Range, Nevada. CAU 411 consists of a release of radionuclides to the surrounding soil from a storage–transportation test conducted on May 15, 1963. This CR complies with the requirements of the *Federal Facility Agreement and Consent Order* (FFACO) that was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management; U.S. Department of Defense; and DOE, Legacy Management. CAU 411 consists of one corrective action site, NAFR-23-01, Pu Contaminated Soil.

Corrective action investigation (CAI) activities were performed in April and May 2015, as set forth in the *Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 411: Double Tracks Plutonium Dispersion (Nellis), Nevada Test and Training Range, Nevada;* and in accordance with the *Soils Activity Quality Assurance Plan*. The purpose of the CAI was to fulfill data needs as defined during the data quality objectives process. The CAU 411 dataset of investigation results were evaluated based on a data quality assessment. This assessment demonstrated the dataset is complete and acceptable for use in fulfilling the data needs identified by the data quality objectives process.

This CR provides documentation and justification for the clean closure of CAU 411 under the FFACO without further corrective action. This justification is based on historical knowledge of the site, previous site investigations, implementation of the 1996 interim corrective action, and the results of the CAI. The corrective action of clean closure was confirmed as appropriate for closure of CAU 411 based on achievement of the following closure objectives:

- Radiological contamination at the site is less than the final action level (FAL) using the construction worker exposure scenario (i.e., the radiological dose is less than the FAL).
- Removable alpha contamination is less than the high contamination area criterion.
- No potential source material is present at the site, and any impacted soil associated with potential source material has been removed so that remaining soil contains contaminants at concentrations less than the FALs.

- There is sufficient information to characterize investigation and remediation waste for disposal.

The CAI confirmed that further corrective action is not required at CAU 411. Based on the interim corrective action implemented in 1996, clean closure of the site is complete; the closure objectives established in the SAFER Plan have been achieved; and no further corrective action at the site is required.

The corrective action of clean closure meets all applicable federal and state regulations for closure of the site under the FFACO. Based on the implementation of these corrective actions, the DOE, National Nuclear Security Administration Nevada Field Office (NNSA/NFO) provides the following recommendations:

- No further corrective actions are necessary for CAU 411.
- The Nevada Division of Environmental Protection should issue a Notice of Completion to NNSA/NFO for closure of CAU 411.
- CAU 411 should be moved from Appendix III to Appendix IV of the FFACO.

1.0 Introduction

This Closure Report (CR) presents information supporting closure of Corrective Action Unit (CAU) 411, Double Tracks Plutonium Dispersion (Nellis), located on Range 71N of the Nevada Test and Training Range (NTTR), west of the Tonopah Test Range (TTR) (Figure 1-1). This document has been developed 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.

CAU 411 consists of a release of radionuclides to the surrounding soil from a storage–transportation test conducted on May 15, 1963 (NNSA/NFO, 2015b). The test used a conventional explosives detonation to disperse plutonium and depleted uranium to the environment. A detailed discussion of the history of this CAU is presented in the *Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 411: Double Tracks Plutonium Dispersion (Nellis), Nevada Test and Training Range, Nevada* (NNSA/NFO, 2015a).

CAU 411 has previously undergone extensive investigation involving soil sampling, geophysical surveys, and radiation surveys. In 1996, highly contaminated soil and debris was removed from the site as an interim corrective action. A summary of previous investigations and the 1996 remediation is found in the CAU 411 SAFER Plan (NNSA/NFO, 2015a). The 1996 interim corrective action was implemented using a concentration-based action level. Following the interim corrective action, work on CAU 411 was suspended. An effort was made in 2004 to restart the project using the previous concentration-based cleanup level, but this effort stalled in negotiation with the Nevada Division of Environmental Protection (NDEP). A renewed effort to close the CAU 411 site was initiated in 2014, using a risk-based action level of 25 millirem per year (mrem/yr).

The CAU 411 dose estimates presented in this CR are intended to estimate the maximum potential dose that any receptor could reasonably receive under current and foreseeable future use of the contaminated area. These dose estimates were made using conservative values for site physical properties, contaminant properties, dose conversion properties, and exposure durations. While this conservatism results in dose estimates that are higher than actual expected doses, it provides

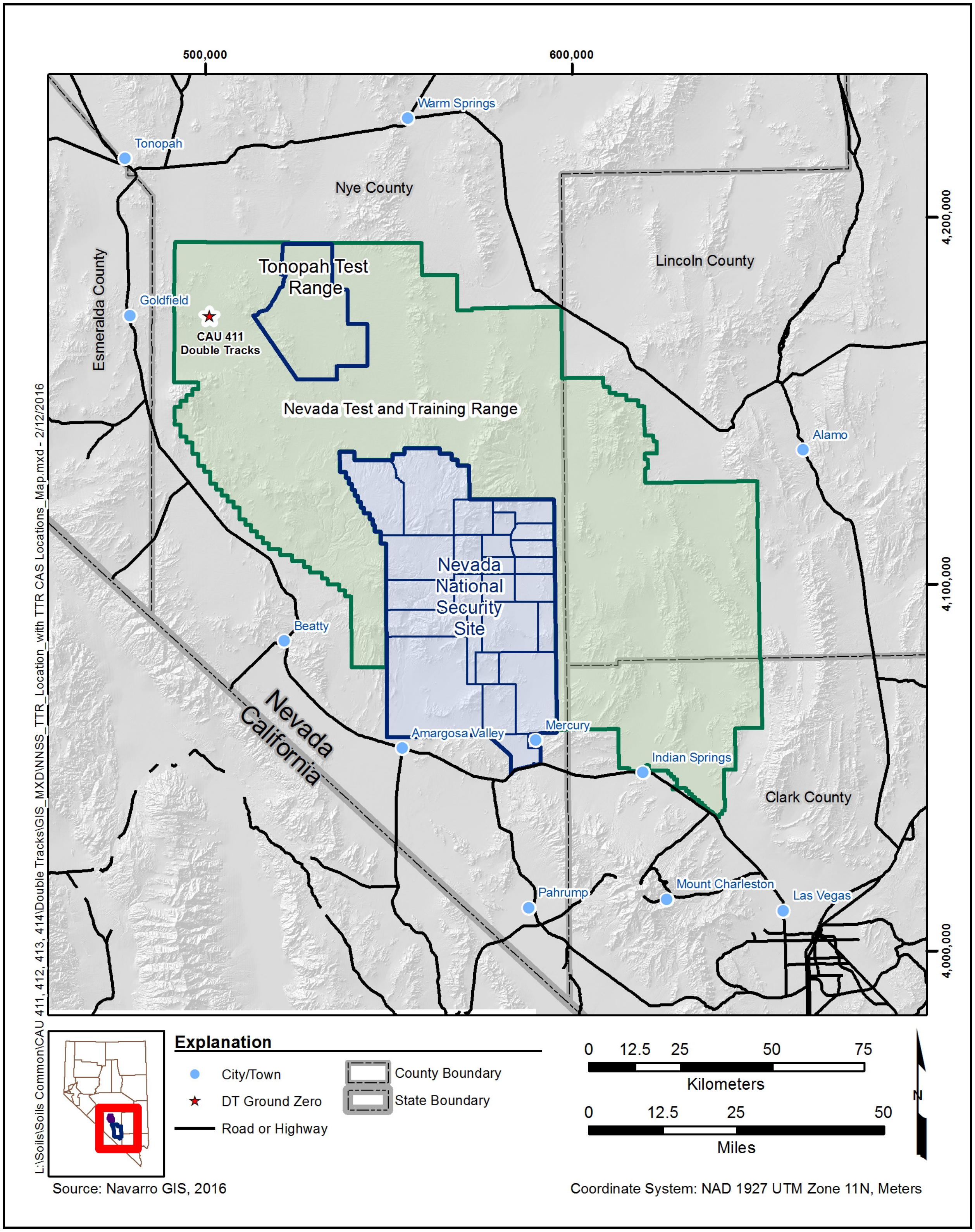

Figure 1-1
CAU 411 Location

protection against making a false-negative decision error (i.e., a decision that contamination exceeding final action levels [FALs] is not present when it actually is).

CAU 411 consists of a single corrective action site (CAS), NAFR-23-01, Pu Contaminated Soil. Because the CAU has only one CAS, the CAS nomenclature is generally not used in this CR. Instead, the CAS is referred to as the Double Tracks (DT) site or CAU 411 throughout this document.

1.1 Purpose

This CR provides documentation and justification for the clean closure of CAU 411 under the FFACO without further corrective action. This justification is based on historical knowledge of the site, the 1996 interim corrective action, subsequent site investigations, and the results of the corrective action investigation (CAI). CAI activities were completed in accordance with the SAFER Plan (NNSA/NFO, 2015a) and the *Soils Activity Quality Assurance Plan* (QAP) (NNSA/NSO, 2012), which establishes requirements, technical planning, and general quality practices. The evaluation of investigation results and the risk associated with site contamination was conducted in accordance with the *Soils Risk-Based Corrective Action* (RBCA) *Evaluation Process* (NNSA/NFO, 2014). The CAI data support the confirmation of clean closure as the appropriate corrective action at CAU 411, as proposed in the SAFER Plan.

1.2 Scope

An interim corrective action was conducted at CAU 411 in 1996 in which the most highly contaminated soil and debris were removed from the site. The scope of the interim corrective action was to remove soil and debris that exceeded the concentration-based action level of 200 picocuries per gram (pCi/g) total transuranics in place at the time. Post-remediation radiation surveys of the site verified that remediation to the 1996 action level was achieved. In 2015, a CAI was conducted to determine the radiological conditions at the site in relation to the current risk-based action level. This CR includes an evaluation of the CAU 411 dataset using the risk-based action level to determine whether clean closure is an appropriate corrective action for the site.

1.3 CR Contents

This CR is divided into the following sections and appendices:

- Section 1.0, "Introduction," summarizes the purpose, scope, and contents of this CR.
- Section 2.0, "Closure Activities," summarizes the closure activities, deviations from the SAFER Plan, the actual schedule, and the site conditions following completion of corrective actions.
- Section 3.0, "Waste Disposition," discusses the wastes generated and entered into an approved waste management system as a result of the corrective action.
- Section 4.0, "Closure Verification Results," summarizes verification activities and results.
- Section 5.0, "Conclusions and Recommendations," provides the conclusions and recommendations along with the rationale for their determination.
- Section 6.0, "References," provides a list of all referenced documents used in the preparation of this CR.
- Appendix A, *DQOs as Developed in the* SAFER *Plan,* references the data quality objectives (DQOs) as presented in Appendix B of the CAU 411 SAFER Plan.
- Appendix B, *Closure Certification*. This appendix is not applicable to CAU 411, because closure certification is required only for permitted or interim status hazardous waste facilities.
- Appendix C, *As-Built Documentation*. This appendix is not applicable to CAU 411, because the site was clean closed. In addition, the 1996 interim corrective action conducted at the site did not involve the construction of an engineered barrier or other structure for which as-built documentation is applicable.
- Appendix D, *Confirmation Sampling Test Results*, provides a description of the project objectives, confirmation sampling activities, and closure results.
- Appendix E, *Waste Disposition Documentation*, documents disposal of items removed or waste generated during closure activities.
- Appendix F, *Modifications to the Post-closure Plan*. This appendix is not applicable to CAU 411, because the site is being clean closed and a post-closure plan is not required.
- Appendix G, *Use Restrictions* (URs). This appendix is not applicable to CAU 411, because the site is being clean closed and FFACO URs are not required.

- Appendix H, *Risk Evaluation*, presents the risk evaluation results.
- Appendix I, *Evaluation of Corrective Action Alternatives* (CAAs). This appendix is not applicable to CAU 411, because the presumed corrective action of clean closure was proposed in the SAFER Plan and confirmed by the CAI.
- Appendix J, *Sample Location Coordinates*, presents the investigation sample location coordinates.
- Appendix K, *Nevada Division of Environmental Protection Comments*, contains NDEP comments on the draft version of this document.

1.3.1 Applicable Programmatic Plans and Documents

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

- SAFER Plan for CAU 411, Double Tracks Plutonium Dispersion (Nellis) (NNSA/NFO, 2015a)
- Soils Activity QAP (NNSA/NSO, 2012)
- Soils RBCA document (NNSA/NFO, 2014)
- FFACO (1996, as amended)

1.3.2 Data Quality Objectives Summary

The DQOs are presented in the SAFER Plan (NNSA/NFO, 2015a). The DQOs were developed to identify data needs, clearly define the intended use of the environmental data, and design a data collection program that will satisfy these purposes.

The problem statement for CAU 411 is as follows: "Existing information on the nature and extent of contamination is insufficient to determine whether site closure objectives have been achieved." To address this problem, the resolution of two decision statements is required:

- **Decision I.** "Does any location exceed the FALs?" The radiological FAL is a dose-based action level based on the construction worker (CW) exposure scenario, as detailed in Appendix H.

The RBCA dose evaluation does not address the potential for removable radioactive contamination to be transported to other areas. A discussion of the risks associated with removable contamination is presented in the Soils RBCA document (NNSA/NFO, 2014). For removable contamination, it is assumed that if the high contamination area (HCA) criterion is exceeded, the dose-based FAL of 25 millirem per Construction Worker year (mrem/CW-yr) is also exceeded and corrective action is required. The HCA criterion and removable contamination are further discussed in Sections D.2.5.2 and H.1.4.

- **Decision II.** "Is there sufficient information to achieve closure objectives?" Sufficient information is defined to include the following:

    - The lateral and vertical extent of contaminant of concern (COC) contamination
    - The information needed to predict potential remediation waste types and volumes

As stated in the SAFER Plan (NNSA/NFO, 2015a), the closure objectives for CAU 411 are as follows:

- Radiological contamination at the site is less than the FAL using the CW exposure scenario (i.e., the radiological dose is less than the FAL).

- Removable alpha contamination is less than the HCA criterion.

- No potential source material (PSM) is present at the site, and any impacted soil associated with PSM has been removed so that remaining soil contains contaminants at concentrations less than the FALs.

- There is sufficient information to characterize investigation and remediation waste for disposal.

1.3.3 Data Quality Assessment Summary

A data quality assessment (DQA) was conducted that evaluated the degree of acceptability and usability of the reported data in the decision-making process. This DQA is presented in Section 4.1. Using both the DQO and DQA processes helps to ensure that DQO decisions are sound and defensible.

Based on the DQA, the nature and extent of COCs at CAU 411 have been adequately identified to verify the corrective action of clean closure. 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 Closure Activities

The SAFER Plan identified the presumed corrective action for CAU 411 as clean closure. This presumption was based on implementation of the interim corrective action in 1996 and data collected during subsequent investigations. In order to supplement existing data and determine whether site closure objectives have been achieved, additional data were collected at CAU 411 as part of a CAI. A discussion of CAI activities and the calculated dose at CAU 411 is presented in Appendix D. The methods used to calculate dose are detailed in the SAFER Plan (NNSA/NFO, 2015a) and the Soils RBCA document (NNSA/NFO, 2014).

2.1 Description of Corrective Action Activities

CAI activities were conducted in April and May 2015. Investigation activities at CAU 411 included visual surveys, ground-based radiation surveys, collection of surface and subsurface soil samples, and placement of thermoluminescent dosimeters (TLDs). The purpose of the CAI was to provide the additional information needed to determine whether site closure objectives, defined in Section 1.3.2, have been achieved.

For DQO Decision I, sample locations were established judgmentally based on the presence of biasing factors (e.g., highest radiation survey values). Using the contamination levels from the judgmental locations of highest potential contamination provides a conservative estimate of the contaminant exposure a receptor could receive from working at the release site. Where soil samples were collected in sample plots, an additional level of conservatism was added by evaluating the judgmental sample results probabilistically using the 95 percent upper confidence limit (UCL) of the average sample result to resolve DQO Decision I. For DQO Decision II, data were evaluated against the four site closure objectives to determine whether clean closure is an appropriate corrective action for CAU 411.

Data to calculate radiological dose were provided by the analytical results of TLD samples for external radiological dose, where available, and soil samples for the calculation of internal radiological dose. The calculated total effective dose (TED) for each sample location is an estimation of the true radiological dose (true TED). The TED is defined in 10 *Code of Federal Regulations*

(CFR) Part 835 (CFR, 2016b) as the sum of the effective dose (for external exposures) and the committed effective dose (for internal exposures). Methods used for calculating internal, external, and total dose are presented in the Soils RBCA document (NNSA/NFO, 2014). Deviations from these methods are discussed in Section 2.2.

The dose 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. In consultation with stakeholders—including NDEP; the U.S. Air Force (USAF); and DOE, National Nuclear Security Administration Nevada Field Office (NNSA/NFO)—the CW exposure scenario was determined applicable to the CAU 411 site (USAF, 2014). This scenario assumes primarily outdoor construction activities that may include road construction/maintenance, underground utilities excavation, and/or target or other structure placement in the vicinity of CAU 411. The most exposed individual in this scenario is defined as an adult construction worker who works at the site for 120 days per year (day/yr), 8 hours per day (hr/day), for a total of 960 hours per year (hr/yr). The construction worker spends an average of 6 hr/day outdoors and 2 hr/day indoors during the work day. It is assumed the construction worker does not obtain drinking water from the site. As presented in Appendix H, the radiological FAL is based on this exposure scenario.

The RBCA dose evaluation does not address the potential for removable contamination to be transported to other areas. A discussion of the risks associated with removable radioactive contamination is presented in the Soils RBCA document (NNSA/NFO, 2014). It is assumed that corrective action is required for areas that exceed the HCA criterion even though the area may not present a potential radiation dose to a receptor that exceeds the FAL (25 mrem/yr). Therefore, in addition to comparing the TED to the FAL to determine the need for corrective action, removable contamination levels must be compared to the HCA criterion (i.e., removable contamination preliminary action level [PAL]). If this criterion is exceeded, it will be assumed that the radiological FAL is exceeded. Additional discussion of the HCA criterion is presented in Section D.2.5.

In accordance with the graded approach described in the Soils Activity QAP (NNSA/NSO, 2012), the dataset quality will be determined by its intended use in decision making. Data used to define the presence of COCs (Decision I) are classified as decisional and will be used to make corrective action decisions. Radiation survey data are classified as decision supporting and are not used, by themselves, to make corrective action decisions.

2.2 Deviations from SAFER Plan as Approved

The SAFER Plan (NNSA/NFO, 2015a) requirements were met for this CAU, with the following exceptions:

- The SAFER Plan states that a TLD will be placed at each drainage sample location to measure external dose; however, TLDs were not placed at the drainage sample locations (A15 through A22) during the CAI. This omission was simply an oversight and does not adversely impact data usability or DQO decisions at these locations. One reason is that at CAU 411, external dose is not expected to contribute significantly to total dose, as the site COCs are primarily internal dose hazards. In addition, the Soils RBCA document allows for the estimation of external dose using residual radioactive material guidelines (RRMGs) or the use of field TLD data (NNSA/NFO, 2014). External dose at the drainage sample locations was estimated using the method described in Section D.2.4.2.
- For sample locations where no TLD data exist (e.g., drainage locations), the SAFER Plan states that external dose will be estimated using the methodology found in the Soils RBCA document (NNSA/NSO, 2014). However, an alternate method for deriving external dose at these locations was applied, as explained in Section D.2.4.2.

2.3 Corrective Action Schedule as Completed

Table 2-1 provides a timeline of major activities and associated documents that support closure of CAU 411.

Table 2-1
Timeline of CAU 411 Closure Activities

Year	Activity	Associated Document/Reference
1994–1995	Initial Site Characterization	Pre-FFACO planning documents
1996	Interim Corrective Action	
2012	Preliminary Investigation	Preliminary Investigation Results and Recommendations for CAUs 411, 412, 413, and 414 (N-I, 2013)
2015	Corrective Action Investigation	Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 411: Double Tracks Plutonium Dispersion (Nellis) (NNSA/NFO, 2015a)

2.4 Site Plan/Survey Plat

During the 1996 interim corrective action, approximately 2,000 cubic yard (yd^3) of soil and debris was removed from the DT site. After the interim corrective action, a radiation survey using the KIWI system was conducted to verify that contamination had been removed to the target action level (which was 200 pCi/g transuranics at the time). The area excavated during the interim corrective action and the results of the KIWI survey are shown in Figure 2-1. These survey results were also used in selection of sample locations for the CAI (see Section D.2.3.1). As part of the CAI, a radiation survey using a field instrument for the detection of low-energy radiation (FIDLER) was completed. This survey, shown in Figure D.2-1, represents the current radiological conditions at CAU 411.

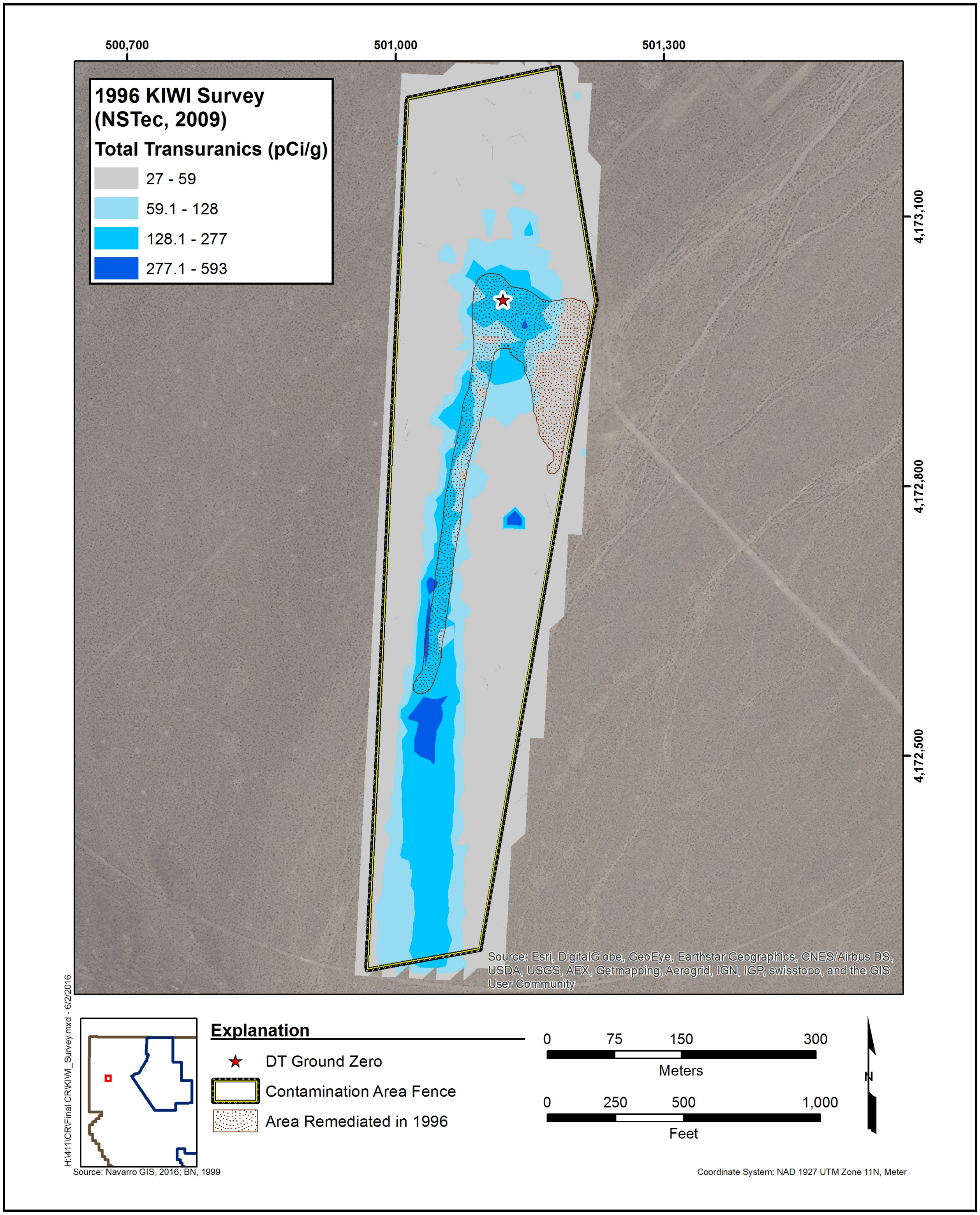

Figure 2-1
Post-Interim Corrective Action Radiation Survey Results

3.0 Waste Disposition

Remediation waste generated during the 1996 interim corrective action at CAU 411 included radiologically contaminated debris (concrete pieces, rebar, metal fragments), disposable personal protective equipment (PPE), and approximately 2,000 yd^3 of soil. All remediation waste was transported to the Nevada Test Site (now known as the Nevada National Security Site [NNSS]) for disposal.

This section addresses the characterization and management of investigation-derived wastes generated during the CAI; remediation waste was not generated as a result of the CAI. Waste management activities during the CAI were conducted as specified in the SAFER Plan (NNSA/NFO, 2015a).

3.1 Generated Wastes

The wastes listed in Table 3-1 were generated during CAI activities at CAU 411. Wastes were segregated to the greatest extent possible, and waste minimization techniques were integrated into the field activities to reduce the amount of waste generated. Controls were in place to minimize the use of hazardous materials and the unnecessary generation of hazardous and/or mixed waste. The amount, type, and source of waste placed into each container were recorded in waste management logs that are maintained in the CAU 411 file.

Table 3-1
CAU 411 Waste Summary Table

Waste Container Number	Waste Description	Waste Type	Waste Disposition			
			Disposal Facility	Waste Volume (yd^3)	Disposal Date	Disposal Doc[a]
412B01	Debris/soil/metal fragments from TTR CAUs 411, 412, 413, and 414	LLW	Area 5 RWMC	25.4	TBD	CD

[a]Copies of waste disposal documents are presented in Appendix E of this document.

CD = Certificate of Disposal
RWMC = Radioactive Waste Management Complex
TBD = To be determined

3.2 Waste Characterization and Disposal

Waste characterization was based on process knowledge, radiological surveys, soil samples, and direct samples of the waste. Waste characterization and disposition was based on federal and state regulations, permit limitations, and disposal facility acceptance criteria.

One waste characterization sample (AB1A501) was collected of the soil contained in drum 411A01. The sample was analyzed for Toxicity Characteristic Leaching Procedure (TCLP) metals and radionuclides. Based on the results presented in Table 3-2, this drum was characterized as low-level waste (LLW).

Table 3-2
Waste Management Sample Results Detected above MDCs

Sample Location	Sample Number	Sample Matrix	Parameter	Result (pCi/g)
Drum 411A01 (within waste container 412B01)	AB1A501	Soil	Ac-228	2.12
			Am-241	139 J-
			Cs-137	0.231
			Pu-239/240	261
			U-234	1.01 J
			U-238	0.846 J

Ac = Actinium
Am = Americium
Cs = Cesium
MDC = Minimum detectable concentration
Pu = Plutonium
U = Uranium

J = Estimated value.
J- = Estimated value low.

Waste container 411B01 was characterized using CAI soil sample results and radiological screening results. A direct waste characterization sample of this waste stream was not collected. The waste in this container was characterized as LLW.

The waste shipping and disposal documentation for CAU 411 are in Appendix E.

4.0 Closure Verification Results

The SAFER Plan identified the presumed corrective action for CAU 411 as clean closure. This presumption was based on implementation of the interim corrective action in 1996 and data collected during subsequent investigations. Closure verification data were collected during the CAI to determine whether site closure objectives have been achieved. The CAI results are presented in Appendix D. Each of the closure objectives defined in the SAFER Plan was achieved as indicated below:

- *Radiological contamination at the site is less than the FAL using the CW exposure scenario (i.e., the radiological dose is less than the FAL).* No sample location exceeded the radiological dose FAL. See Section D.2.5.
- *Removable alpha contamination is less than the HCA criterion.* Removable alpha contamination at the site was less than the HCA criterion, so it is assumed that the dose associated with removable contamination is less than the radiological dose FAL. See Section D.2.5.2.
- *No PSM is present at the site, and any impacted soil associated with PSM has been removed so that remaining soil contains contaminants at concentrations less than the FALs.* No PSM was identified at CAU 411. See Section D.2.1.
- *There is sufficient information to characterize investigation and remediation waste for disposal.* Soil sample results and radiological survey data are sufficient to characterize the investigation waste generated during the CAI; no remediation waste was generated during the CAI. See Section 3.0.

CAU 411 sampling locations were accessible, and sampling activities at planned locations were not restricted by buildings, storage areas, active operations, or aboveground and underground utilities.

4.1 Data Quality Assessment

The CAU 411 SAFER Plan identified the use of each dataset in making corrective action decisions (NNSA/NFO, 2015a). Aerial and ground-based radiological surveys were classified as decision-supporting data, for which limitations and data quality must be assessed. The quality of these datasets is discussed in Section 4.1.10. Analytical data from soil samples and TLD measurements were classified as decisional data, which require the highest level of quality assurance (QA)/quality control (QC). The DQA for the analytical dataset is discussed in Section 4.1.2. The quality of TLD data is assessed by the management and operating (M&O) dosimetry contractor at the NNSS, who maintains a comprehensive QA program in accordance with 10 CFR 830 (CFR, 2016a). The TLDs placed at CAU 411 to measure external dose are the same as those used in the routine NNSS environmental monitoring program. TLDs were obtained from, and measured by, the M&O contractor. TLD data meet rigorous data quality requirements outlined in a comprehensive QA program. This program addresses management, training, and qualification requirements; quality improvement and work processes; record keeping; performance; and program assessment. The effectiveness of the QA program is demonstrated, in part, through satisfactory completion and maintenance of the U.S. Department of Energy Laboratory Accreditation Program (DOELAP) accreditation. In addition, dosimetry program operations are routinely reviewed and improved through the use of blind audits, DOELAP performance testing, onsite audits, and internal assessments. Dosimetry program documents are reviewed biennially and updated as necessary.

TLDs were analyzed using automated TLD readers that are calibrated and maintained by the contractor. QA requirements for the TLD readers include daily QC tests, reader calibration, reader linearity, reader crossover, and reader heating tests. Process variances and the necessary corrective actions are tracked; and activities are implemented to approve, evaluate, and resolve process variances and control nonconforming items until corrective actions are completed. Processes are reviewed and improved during the execution of the process and as a result of internal and external assessments.

The SAFER Plan (NNSA/NFO, 2015a) identified that the right type, quality, and quantity of data are needed to resolve the DQO decision statements. To verify that the dataset obtained as a result of the CAI supports the DQO decisions, a DQA was conducted. The DQA process is the scientific evaluation of the actual investigation results to determine whether the DQO criteria established in the SAFER Plan were met and whether DQO decisions can be resolved at the desired level of confidence. The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps to ensure that DQO decisions are sound and defensible.

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

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

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

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

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

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

4.1.1 Review DQOs and Sampling Design

This section contains a review of the DQO process presented in the SAFER Plan (NNSA/NFO, 2015a). The DQO decisions are presented with the DQO provisions to limit false-negative or false-positive decision errors. Special features, potential problems, and deviations to the sampling design are also presented, as applicable.

The PAL and FAL 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 411 release and is dependent upon the cumulative annual hours of exposure to site contamination. The dose-based PAL for radioactivity was established in the SAFER Plan based on a dose limit of 25 mrem/yr over an annual exposure time of 960 hours (i.e., the CW exposure scenario) (USAF, 2014). An additional decision criterion applicable at CAU 411 is related to the amount of removable alpha radiation at the site. For removable contamination, it is assumed that if removable contamination levels are above the numeric criterion for posting an HCA (i.e., 2,000 disintegrations per minute per 100 square centimeters [dpm/100 cm^2]), then the radiological FAL of 25 mrem/CW-yr is exceeded and corrective action is required. Additional discussion of how removable contamination levels at the site are addressed for the purposes of site closure may be found in Section D.2.5.2 and the Soils RBCA document (NNSA/NSO, 2014). The dose-based radiological FAL is established in Appendix H.

The chemical PALs presented in the SAFER Plan were based on the U.S. Environmental Protection Agency (EPA) Region 9 Regional Screening Levels for chemical contaminants in industrial soils (EPA, 2016). Because no chemical releases were identified at CAU 411, no chemical analyses were completed for samples collected during the CAI, with the exception of waste characterization samples. Thus, the establishment of chemical FALs for making DQO decisions was not necessary and is not included in this CR.

4.1.2 Decision I

The Decision I statement presented in the SAFER Plan is as follows: "Does any location exceed the FALs?" Any contaminant that is present (or is assumed to be present) at concentrations exceeding its corresponding FAL will be defined as a COC. A COC may also be defined as a contaminant that, in combination with other like contaminants, is determined to jointly pose an unacceptable risk based on a multiple contaminant analysis (NNSA/NFO, 2014).

As the RBCA dose evaluation does not address the potential for removable contamination to be transported to other areas, a corrective action is assumed to be required for areas that exceed the HCA criterion (i.e., 2,000 dpm/100 cm^2), even though the area may not present a potential radiation dose to a receptor that exceeds the FAL.

As stated in the SAFER Plan, the dataset used to resolve DQO decisions for CAU 411 includes the data collected during the CAI and the soil sample data collected during the preliminary investigation (PI) conducted in 2012 (NNSA/NFO, 2015a). The resolution of Decision I determined that contamination at the site is not present at levels that require additional corrective action.

4.1.2.1 DQO Provisions To Limit False-Negative Decision Error

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

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

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

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

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

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

Criterion 1a (Confidence Judgmental Sample Locations Identify COCs)

To resolve Decision I (determine whether the FAL is exceeded at any location), samples were collected in areas most likely to contain a COC. Sample plot locations were selected based on the areas of highest radioactivity identified in aerial and KIWI radiation surveys (see Section D.2.3.1). During the CAI field investigation, sample plot locations were further biased to areas of highest radioactivity using FIDLER survey data. Judgmental sample locations within the drainages at CAU 411 were biased to sedimentation accumulation areas identified visually during the CAI.

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

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

- The samples are collected from unbiased locations within the sample plots.
- A sufficient sample size was collected (see Table 4-1).
- A false rejection rate of 0.05 was used in calculating the 95 percent UCLs and minimum sample size.

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

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

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

where

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

The use of this formula requires the input of basic statistical values associated with the sample data. Data from a minimum of three samples are required to calculate these statistical values and, as such, the least possible number of samples required to apply the formula is three. Therefore, in instances where the formula resulted in a value less than three, three is adopted as the minimum number of samples required. The results of the minimum sample size calculations and the number of samples collected are presented in Table 4-1. As shown in the table, the minimum number of sample plot and TLD samples was met or exceeded. The minimum sample size calculations were conducted for probabilistic sample locations as stipulated in the SAFER Plan (NNSA/NFO, 2015a) 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 4-1
Input Values and Determined Minimum Number of Samples for Sample Plots and TLDs

Sample Type	Sample Location	Standard Deviation	Minimum Sample Size	Samples Collected
Plot	A01	0.2	3	4
	A05	0.0	3	5
	A09	0.2	3	4
	A13	0.0	3	4
	A14	0.4	3	4
	A23	0.1	3	4
	A24	0.2	3	4
	A28	0.5	3	4
TLD	A13	0.0	3	3
	A14	0.3	3	3
	A23	0.5	3	3
	A24	1.5	3	3
	A28	0.7	3	3

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

Criterion 2 (Confidence in Detecting COCs Present in Samples)

To satisfy the second criterion, the dataset was assessed against the acceptance criterion for the data quality indicator (DQI) of sensitivity as defined in the Soils Activity QAP (NNSA/NSO, 2012). The sensitivity acceptance criterion is that analytical detection limits will be less than the corresponding FAL (NNSA/NFO, 2015a). For radionuclides, the criterion is that all detection limits are less than their corresponding CW internal dose RRMG. All of the analytical result detection limits for radionuclides were less than their corresponding RRMGs. Therefore, the DQI for sensitivity has been met for all contaminants, and no data were rejected due to sensitivity.

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

To satisfy the third criterion, the dataset was assessed against the acceptance criteria for the DQIs of precision, accuracy, comparability, completeness, and representativeness, as defined in the Soils Activity QAP (NNSA/NSO, 2012). The DQI acceptance criteria are presented in Table 6-1 of the SAFER Plan (NNSA/NFO, 2015a). The individual DQI results are presented in the following subsections.

Precision

Precision was evaluated as described in the SAFER Plan (NNSA/NFO, 2015a) and the Soils Activity QAP (NNSA/NSO, 2012). Precision was found to be equitable (less than 20 relative percent difference), with the exception of the isotopic results for Am-241 (Table 4-2). High variability in the sample matrix suggests that discrete particles of contamination are present within the samples. Therefore, mixing will not produce homogeneity. This variability does not mean the precision of the measurement is poor, but that activities are variable within the samples. This is commonly observed in samples containing these radionuclides because single particles of these isotopes within a sample can result in detectable activity attributed to the entire sample. The isotopic analyses of Am-241 were used only to estimate plutonium to americium ratios as discussed in the Representativeness section of Criterion 2. As stipulated in the Soils Activity QAP, when analyses of a particular contaminant do not meet the DQI criteria and the highest reported activity for that contaminant exceeds one-half its corresponding FAL, the data assessment must include explanations or justifications for their use or rejection. The highest reported activity for Am-241 that was qualified for precision was less than 0.003 percent of its corresponding FAL (or less than 0.1 mrem/yr). Therefore, the potential for a false-negative DQO decision error is negligible, and the results that were qualified for precision can be confidently used for decision making. As the precision rates for all other constituents meet the acceptance criteria for precision, the dataset is determined to be acceptable, and the results that were qualified for precision can be confidently used for decision making.

Accuracy

Accuracy was evaluated as described in the SAFER Plan (NNSA/NFO, 2015a) and the Soils Activity QAP (NNSA/NSO, 2012). There were no sample results qualified for accuracy in the CAU 411 dataset; therefore, the dataset is determined to be acceptable for the DQI of accuracy.

Table 4-2
Precision Measurements

Constituent	Analyses	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Am-241	Americium	20	47	57.5

Representativeness

The DQO process as identified in Appendix B of the SAFER Plan (NNSA/NFO, 2015a) was used to address sampling and analytical requirements for CAU 411. 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]). The sampling locations identified in the Criterion 1a discussion meet this criterion.

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

Am-241 is reported by the gamma spectrometry method as well as the isotopic americium method. As the gamma spectrometry measurement is based on a much larger soil sample (usually 1 liter), the particle distribution problem discussed above is greatly diminished and the probability of the result being representative of the sampled site is much improved. Therefore, the ratios between the Am and

Pu isotopes will be established using the isotopic analytical results and these ratios will be used to infer concentrations of Pu isotopes using the gamma spectrometry results for Am-241. These inferred Pu values will be more representative of the sampled area than the isotopic results.

Based on the methodical selection of sample locations and the use of Am and Pu concentrations that are more representative of the sampled area, the analytical data acquired during the CAU 411 CAI are considered to adequately represent contaminant concentrations of the sampled population.

Comparability

Field sampling, as described in the SAFER Plan (NNSA/NFO, 2015a), 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 by the Soils Activity. Therefore, CAU 411 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 SAFER Plan.

Completeness

The SAFER Plan (NNSA/NFO, 2015a) defines acceptable criteria for completeness to be that the dataset is sufficiently complete to be able to make the DQO decisions. This is initially evaluated as 80 percent of release-specific analytes identified in the SAFER Plan having valid results. All of the CAU 411 data have valid results; therefore, the dataset has met the criteria for completeness and may be used to make DQO decisions.

4.1.2.2 DQO Provisions To Limit False-Positive Decision Error

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

4.1.3 Decision II

Decision II as presented in the SAFER Plan (NNSA/NFO, 2015a) is as follows: "Is there sufficient information to achieve closure objectives?" Sufficient information is defined to include the following:

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

As stated in the SAFER Plan (NNSA/NFO, 2015a), the closure objectives for CAU 411 are as follows:

- Radiological contamination at the site is less than the FAL using the CW exposure scenario (i.e., the radiological dose if less than the FAL).

- Removable alpha contamination is less than the HCA criterion.

- No PSM is present at the site, and any impacted soil associated with PSM has been removed so that remaining soil contains contaminants at concentrations less than the FALs.

- There is sufficient information to characterize investigation and remediation waste for disposal.

The resolution of Decision I determined that contamination at the site is not present at levels that require additional corrective action. Information presented in Section 3.0 demonstrate that sufficient information was available for the disposal of all wastes. Therefore, Decision II has been resolved by the achievement of all closure criteria.

4.1.4 Sampling Design

The SAFER Plan (NNSA/NFO, 2015a) stipulated that the following sampling processes would be implemented:

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

  Result. The location of the plots were selected judgmentally, and sample aliquots were collected within each plot probabilistically as described in Section D.2.3.

- Judgmental samples will be collected outside the contamination area (CA) fence within three identified drainages.

  Result. Judgmental samples were collected of the surface sediment at three drainages identified previously and two additional drainage locations identified during the CAI. Subsurface samples were collected at locations where the potential for buried contamination exists.

- Removable contamination samples will be collected at the locations of sample plots within the CA fence.

  Result. Removable contamination samples were collected at the three sample plots locations within the CA fence.

4.1.5 Conduct a Preliminary Data Review

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

4.1.6 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/CW-yr. The dose-based radiological FAL is based on an exposure duration to a site worker using the CW exposure scenario. The test for removable contamination was the comparison of site conditions to the HCA criterion of 2,000 dpm/100 cm^2 alpha contamination.

Based on the results of TLD and soil samples, radiological dose at CAU 411 does not exceed 25 mrem/CW-yr at any location. The average and the 95 percent UCL TED values for the CW and the industrial area (IA) exposure scenarios for all sample locations are presented in Table D.2-9. An explanation regarding the use of the IA scenario is found in Section D.2.5.3.

The key assumptions that could impact a DQO decision are listed in Table 4-3.

Table 4-3
Key Assumptions

Exposure Scenario	Construction worker
Affected Media	Surface and subsurface soil; drainage sediments
Location of Contamination/Release Points	Surface soil surrounding and downwind of GZ; surface/subsurface sediment in drainages
Transport Mechanisms	Potential transport mechanisms include surface water runoff, infiltration of precipitation, and wind.
Preferential Pathways	Surface water runoff and wind are preferential pathways for lateral migration of contaminants. Several drainages were identified exiting the CA fence in the southwest portion of the site. Therefore, there is the potential for contamination to have been buried in sediments within drainages. Due to high potential evapotranspiration in the area, infiltration of precipitation is not expected to be a significant migration pathway.
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.
Groundwater Impacts	None
Future Land Use	Military

GZ = Ground zero

4.1.7 Verify the Assumptions

The results of the investigation support the key assumptions identified in the CAU 411 DQOs and Table 4-3. All data collected during the CAI supported the CSM, and no revisions to the CSM were necessary.

4.1.8 Other DQO Commitments

The SAFER Plan (NNSA/NFO, 2015a) made the following commitments:

- One TLD will be placed in the center of each sample plot and at each drainage sample location.

  Result: One TLD was placed at each of the five sample plots established during the CAI. TLDs were not placed at the drainage sample locations (see Section D.2.7).

- Revisit locations of surface features identified in previous investigations to determine whether a potential release is present based on biasing factors such as stains, spills, or debris.

  Result. No indication of release(s) was identified at any of the previously identified locations. In addition, no other PSM and/or potential releases were identified during the CAI (see Section D.2.1).

4.1.9 Draw Conclusions from the Data

Decision I

Based on analytical results for samples collected during the 2012 PI and the CAI, radiological dose is not above the FAL of 25 mrem/CW-yr (see Section D.2.4.3).

Removable contamination samples indicate that the removable alpha contamination at CAU 411 is not above the HCA criterion of 2,000 dpm/100 cm^2. It is therefore assumed that the dose associated with removable contamination is not above the dose-based FAL of 25 mrem/CW-yr.

Decision II

In accordance with the SAFER Plan and based on achievement of the site closure objectives, the corrective action of clean closure was completed at CAU 411.

4.1.10 Data Quality for Decision-Supporting Data

The SAFER Plan identified aerial and ground-based radiological survey data as decision-supporting data (NNSA/NFO, 2015a). The following subsections discuss the quality of these datasets, including aerial, KIWI, and FIDLER radiological surveys; and removable contamination surveys.

4.1.10.1 Aerial Radiological Surveys

Aerial radiological surveys were conducted at CAU 411 in 1993 (EG&G, 1995) and 2006 (NSTec, 2007). An evaluation of aerial survey data was completed in 1995 (DOE/NV, 1995). The evaluation suggests that aerial surveys underestimate the intensity of highly localized radiation sources due to the wide field of view of the aerial system. The report also states that the method for processing survey data can impact sensitivity and/or spatial resolution. The report concludes that aerial survey data are useful for determining the general distribution of radionuclides at a site but are not recommended for more precise mapping of individual radionuclide distributions.

A comparison of the quality of the 1993 and 2006 surveys concluded that the surveys are consistent with regard to contaminant distribution; however, the 2006 survey provides better spatial resolution (NSTec, 2007). Thus, the 2006 survey was used to guide the selection of sample locations for the 2012 PI and the CAI.

The radiological surveys provide quality spatial data, with the limitation that the field of view from the aerial platform is not as precise as a ground-based survey. When these aerial surveys are used in conjunction with ground-based surveys that provide very high spatial resolution (less than 1 square meter [m^2]) and the data are used qualitatively, the quality of the 2006 aerial survey data is sufficient for guiding the biasing of sample locations and meets the requirements as decision-supporting data.

4.1.10.2 KIWI Radiological Surveys

In 1999, a report containing a rigorous review of the KIWI system and data processing methodology was published (BN, 1999). This report found no obvious errors in the techniques or procedures, and concluded that the measurement of surface activity by the KIWI is reproducible. The limitation of the KIWI data is that the results are in gross gamma counts, which are not directly comparable to a soil concentration. When these data are used qualitatively, the quality of KIWI survey data is sufficient for guiding the biasing of sample locations and meets the requirements as decision-supporting data.

4.1.10.3 FIDLER Radiological Surveys

The FIDLER detectors are calibrated annually and response-checked before use. In addition, a background survey is conducted before each radiological survey. The FIDLER data are processed using geospatial software and analyzed for trends. FIDLER data are paired with Global Positioning System (GPS) information to deliver high-quality spatial data. FIDLER data are used qualitatively for correlation to dose estimates to provide an estimate of the spatial extent of dose exceeding the FAL. These data are also used qualitatively to guide the biasing of sampling locations. When the FIDLER data are used qualitatively for these purposes, the quality of FIDLER survey data is sufficient to meet the requirements as decision-supporting data.

4.1.10.4 Removable Contamination Surveys

The removable contamination surveys conducted during the 2012 PI and CAI at CAU 411 used the "stomp and tromp" methodology. The survey method uses a tool to obtain a swipe sample of removable radioactive contamination from the ground surface. The sample is then analyzed by calibrated radiation instruments that undergo daily quality checks.

An assessment of this methodology was completed in 2000 (Tinney et al., 2000). The assessment concluded that the survey technique lacked verification and quality control, and was likely overly conservative in determining removable soil contamination. A qualitative assessment of the technique showed that the results of the surveys, averaged over large areas, appeared to be reproducible within ±30 percent. A correlation of the survey data to KIWI survey data resulted in a correlation coefficient of 0.75.

The results of the survey methodology are used as an indicator of the need to assume the radiological dose to an offsite receptor would exceed 25 mrem/yr. This assumption is necessary in the absence of a methodology to estimate the dose an offsite receptor could receive from the uncontrolled removal of removable contamination. The use of the removable contamination survey data is limited to only a qualitative indicator to implement the conservative assumption of the need for corrective action based on an unknown dose to an unknown receptor. When used in this manner, the quality of removable contamination survey data is sufficient to meet the requirements as decision-supporting data.

4.2 Use Restrictions

For site closure under the FFACO (1996, as amended), URs are required when contamination is left on site above action levels or as site-specific conditions warrant. Because no locations at CAU 411 exceed the FAL using the CW exposure scenario and site closure objectives have been achieved, no further corrective action is required, and FFACO URs are not necessary. As further explained in Section 5.0, if the exposure scenario or land use should change in the future, NNSA/NFO will need to reevaluate site closure and the need for URs.

5.0 Conclusions and Recommendations

The CAI for CAU 411 verified that radiological contamination is not present at the site in excess of the FAL and further corrective action is not required. Based on the interim corrective action implemented in 1996 and the CAI, clean closure of the site is complete and the closure objectives established in the SAFER Plan (NNSA/NFO, 2015a) have been achieved.

NNSA/NFO requests that NDEP issue a Notice of Completion for this CAU and approve transferring CAU 411 from Appendix III to Appendix IV of the FFACO. The DOE, under its regulatory authority for management of radioactive waste materials associated with environmental remediation activities, approves these actions (USC, 2012).

The closure of CAU 411 under the FFACO means that the selected corrective action has been accepted and approved by NDEP and other stakeholders. The closure of CAU 411 is based on an evaluation of both the CW and the IA exposure scenarios. The conservative estimates of dose at the locations of highest radioactivity were all below the FAL for both of these scenarios. If land use were to change that could result in potential exposures exceeding that of the IA exposure scenario (e.g., release of the property to the public), the closure of CAU 411 would need to be reevaluated. In the future, should the land custodian determine that a proposed mission use would not comport with the proposed closure of CAU 411, then NNSA/NFO will work with the custodian and NDEP to address and resolve cleanup issues associated with the proposed use or transfer/relinquishment. NNSA/NFO remains responsible for working with NDEP and other stakeholders as needed to revise or renegotiate any closure agreements, and remains liable for all costs associated with any future negotiation and/or remediation action for CAU 411, consistent with its responsibilities under applicable law.

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Appendix A

DQOs as Developed in the SAFER Plan

The DQOs are presented in Appendix B of the SAFER Plan (NNSA/NFO, 2015a).

Appendix B

Closure Certification

B.1.0 Closure Certification

Certification of closure is required for permitted or interim status hazardous waste facilities, and is not applicable to CAU 411.

Appendix C

As-Built Documentation

C.1.0 As-Built Documentation

This appendix is not applicable to CAU 411, because the site was clean closed. In addition, the 1996 interim corrective action conducted at the site did not involve the construction of an engineered barrier or other structure for which as-built documentation is applicable.

Appendix D

Confirmation Sampling Test Results

D.1.0 Introduction

This appendix presents the CAI activities and the calculated dose for CAU 411, Double Tracks Plutonium Dispersion (Nellis). The methods used to calculate dose are detailed in the SAFER Plan (NNSA/NFO, 2015a) and the Soils RBCA document (NNSA/NFO, 2014). CAU 411 comprises one CAS: NAFR-23-01, Pu Contaminated Soil and is located in Stonewall Flat on Range 71 North of the NTTR (Figure 1-1). CAU 411 consists of a release of radionuclides to the surrounding soil from a storage–transportation test conducted on May 15, 1963 (NNSA/NFO, 2015b). An interim corrective action was conducted at CAU 411 in 1996 in which the most highly contaminated soil and debris was removed from the site. Additional information regarding the history of the site, previous site investigation efforts, the interim corrective action, and the scope of the CAI is presented in the CAU 411 SAFER Plan (NNSA/NFO, 2015a).

The objective of the CAI was to provide sufficient information to determine whether the following site closure objectives have been achieved:

- Radiological contamination at the site is less than the FAL using the CW exposure scenario (i.e., the radiological dose is less than the FAL).
- Removable alpha contamination is less than the HCA criterion.
- No PSM is present at the site, and any impacted soil associated with PSM has been removed so that remaining soil contains contaminants at concentrations less than the FALs.
- There is sufficient information to characterize investigation and remediation waste for disposal.

As indicated in the SAFER Plan, the corrective action of clean closure will be confirmed as appropriate for closure of CAU 411 if the above closure objectives have been achieved.

D.2.0 Corrective Action Investigation

Field investigation and sampling activities for the CAU 411 CAI were conducted in April and May 2015. Investigation activities at CAU 411 included the following:

- Visual surveys, including debris removal
- Ground-based radiological surveys
- Collection of surface and subsurface soil samples
- Placement of TLDs

The investigation and sampling program adhered to the requirements set forth in the SAFER Plan (NNSA/NFO, 2015a) (except any deviations described herein) and in accordance with the Soils Activity QAP (NNSA/NSO, 2012), which establishes requirements, technical planning, and general quality practices. The evaluation of investigation results and the risk associated with site contamination was conducted in accordance with the SAFER Plan (NNSA/NFO, 2015a) and the Soils RBCA document (NNSA/NFO, 2014).

In accordance with the graded approach described in the Soils Activity QAP (NNSA/NSO, 2012), the quality required of a dataset will be determined by its intended use in decision making. The intended use of data collected in previous investigations at CAU 411 is presented in the SAFER Plan. CAI data used to calculate dose (i.e., soil sample and TLD data) are classified as decisional and will be used to make corrective action decisions. Radiation survey data are classified as decision supporting and are not used, by themselves, to make corrective action decisions.

D.2.1 Visual Surveys

As stated in the SAFER Plan (NNSA/NFO, 2015a), the locations of previously identified surface debris and surface features were to be reevaluated during the CAI to determine whether any biasing factors suggesting a release were evident. The surface debris identified during the 2012 PI included an abandoned weather station, four inert unexploded ordnance (UXO) items, and a single 55-gallon (gal) metal drum. The weather station and UXO items were left in place as there were no visible indications of a release. The 55-gal metal drum was removed for disposal. The empty drum was located southeast of the CAU 411 CA fence, and there were no visible or radiological biasing factors present or any other indications of a release associated with the drum. The surface features included a partially fenced area north of the CA fence, a cattle guard, and several drainage channels. There were no biasing factors present at any of these features; however, soil samples were collected at the drainage channels in accordance with the SAFER Plan (see Section D.2.3.3). No additional potential release locations or surface debris/features were identified during the CAI. Table D.2-1 presents the locations surveyed and associated actions taken during the CAI.

Table D.2-1
Visual Survey Results

Location Description	Action	Comments
Partially fenced area north of CA fence	None	No visible signs of release; FIDLER survey showed radiation levels consistent with background (see Figure D.2-1).
Abandoned weather station	None	No visible indication of release.
Cattle guard	None	No visible indication of release.
Drainage channels	Soil samples collected	See Section D.2.3.3.
UXO items	None	No visible indication of release.
Empty 55-gal drum	Removed	Drum located outside CA fence. No visible indication of release.

D.2.2 Radiological Surveys

An extensive FIDLER survey was completed at the site in 2012 during the PI at CAU 411 (N-I, 2013). The results of this survey were used to focus areas for additional FIDLER surveys during the CAI. The area surrounding GZ was targeted for additional surveys due to the presence of contaminated metal fragments and soil with elevated radiation levels identified in 2012. Two areas outside the CA fence (one west and one south) beyond the edge of the 2006 aerial survey path were targeted to bound detected radiation in these areas and ensure the locations of proposed sample plots were at the highest radiation areas. FIDLER surveys were also completed around all proposed soil sample plot locations to further bias the sample plots to the areas of highest FIDLER measurements.

In 2016, additional FIDLER surveys were conducted at CAU 411 inside and outside the CA fence. The objective of these surveys was to present the radiological conditions at the site at the time of closure. The entire area inside the CA fence was surveyed after several metal fragments identified near GZ during the CAI were removed for disposal (Section 3.1). Additional surveys were completed west and south of the CA fence to provide more comprehensive coverage of the site. Figure D.2-1 presents a composite of FIDLER data collected in 2012, 2015, and 2016. The FIDLER data shown inside the CA fence are exclusively from the 2016 data, which represent field conditions after the removal of some metal fragments during the CAI.

The FIDLER survey data presented in the SAFER Plan (NNSA/NFO, 2015a) were shown as discrete data points collected along the path that was walked/driven by the field technician. While these data are useful in identifying points of elevated radioactivity, they do not readily depict the contaminant distribution over the entire area surveyed. Using an inverse distance weighted interpolation technique, the discrete data points were processed to generate a continuous spatial distribution (i.e., interpolated surface), which is more easily compared to other datasets (e.g., soil sample data, aerial survey data). This interpolated surface maintains much of the variance inherent in the original point data, limiting the impact of averaging data over an area. The data variance is particularly important at sites where the contaminant distribution is heterogeneous, as at CAU 411. Another data processing technique was used to retain the intensity of radiation measured at point sources (e.g., metal fragments or isolated areas of soil with elevated radioactivity). This technique involved removing the point source data from the dataset before creating the interpolated surface and then overlaying the point source data on top of the surface. The combination of these two processes results in the display of both the general distribution of contamination and distinct areas of elevated radioactivity. Figure D.2-1 presents the interpolated surface for CAU 411.

D.2.3 Sampling Activities

Sampling activities at CAU 411 during the CAI consisted of the collection of composite surface soil samples from soil sample plots, placement of TLDs, and the collection of grab surface and subsurface soil samples from drainages. All soil samples collected at CAU 411 were submitted for gamma spectroscopy; Pu-241; and isotopic U, Pu, and Am analyses. All sample locations and points of interest were surveyed with a GPS instrument. Appendix J presents these GPS data in a tabular format. (See Tables D.2-2 and D.2-4 for the 2012 PI and 2015 CAI sample locations and the biasing factors used to select the locations.) Additional information on the selection of sample locations and biasing factors is found in the SAFER Plan (NNSA/NFO, 2015a) and the PI report (N-I, 2013). All sample locations for CAU 411 were selected judgmentally, using biasing factors such as radiological

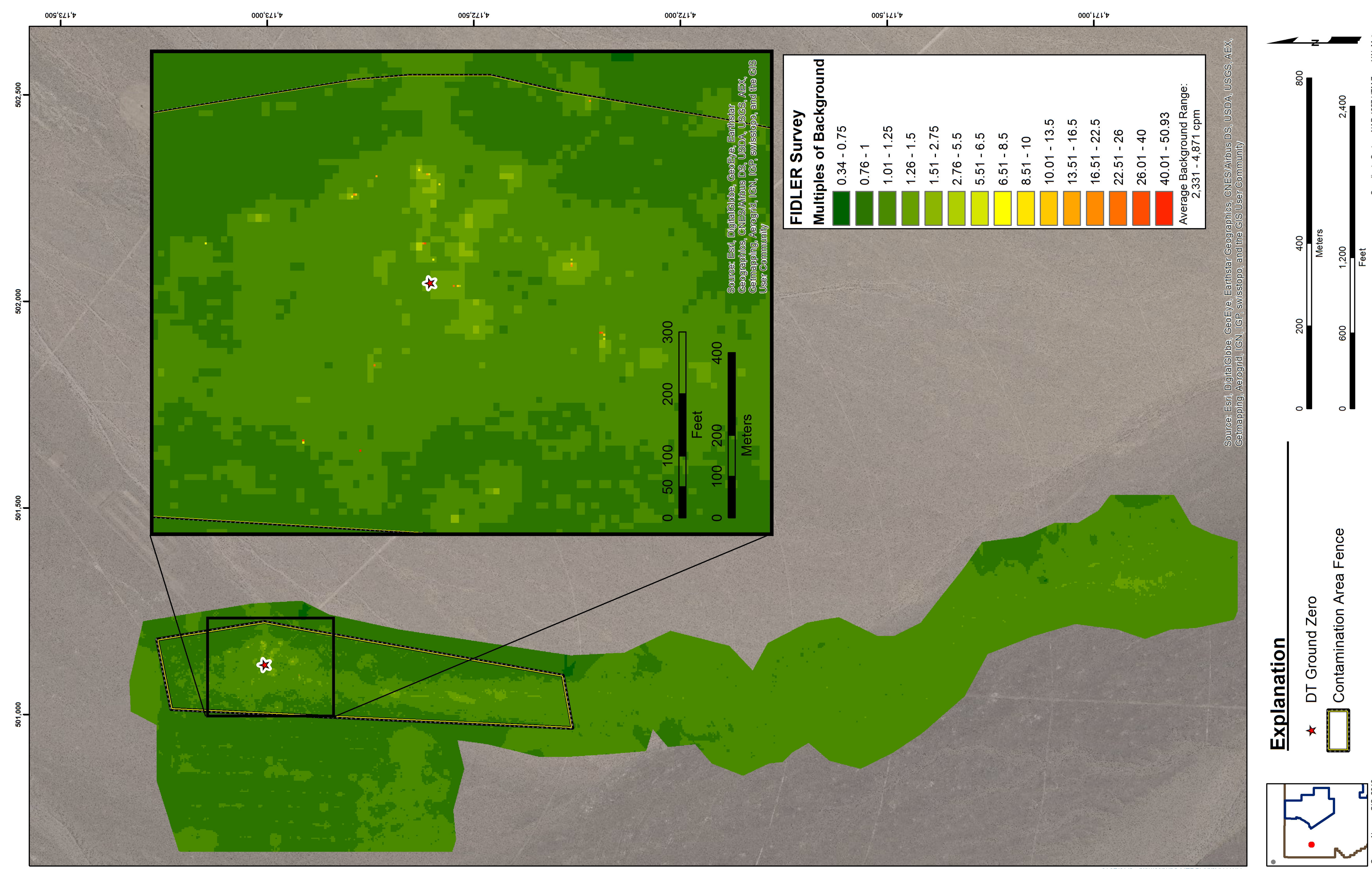

Figure D.2-1
FIDLER Survey Results (Composite of 2012, 2015, and 2016 Data)

survey results, potential migration routes, and/or the presence of debris. Where sample plots were established, soil samples were collected following a probabilistic approach. One or more composite samples were collected within each sample plot, and TLDs were located at the center of each sample plot established during the CAI. The subsample aliquot locations for each sample were identified using a predetermined random-start, triangular grid pattern.

Judgmental sample locations in drainages were selected based on visually identified sedimentation areas and elevated radiological readings, where present. One or more grab samples were collected at each judgmental sample location.

CAU 411 sampling locations were accessible and sampling activities at planned locations were not restricted. The complete field documentation and laboratory data—including field activity daily logs, sample collection logs (SCLs), analysis request/chain-of-custody forms, laboratory certificates of analyses, and analytical results—are retained in CAU 411 files as hard copy documents or electronic media.

D.2.3.1 Sample Plots

A total of 33 soil samples from eight soil sample plots were collected at CAU 411. Three of the sample plots were sampled during the 2012 PI (A01, A05, and A09), and five were sampled during the CAI (A13, A14, A23, A24, and A28). The eight soil sample plot locations are shown in Figure D.2-2 (see Figure 2-1 of the SAFER Plan [NNSA/NFO, 2015a]). Table D.2-2 lists the soil samples collected from sample plots at CAU 411 and the biasing factors used to select the sample locations.

The soil sample plot locations sampled during the 2012 PI were selected primarily based on a visual assessment of contamination distribution as shown in the 1996 post-remediation KIWI survey and the 2006 aerial radiation survey (N-I, 2013). Because the KIWI survey was limited to the inside of the CA fence, the KIWI data were used to guide selection of sample plots located inside the fence. The areas with the most elevated radioactivity (as defined by the survey) were identified and a 10-by-10-meter (m) (100-m^2) plot was oriented in such a way that the entire plot would be wholly contained within the area. The 2006 aerial survey data were used in a similar manner to select plot locations outside the fence. Calculated activities for individual radionuclides obtained by *in situ*

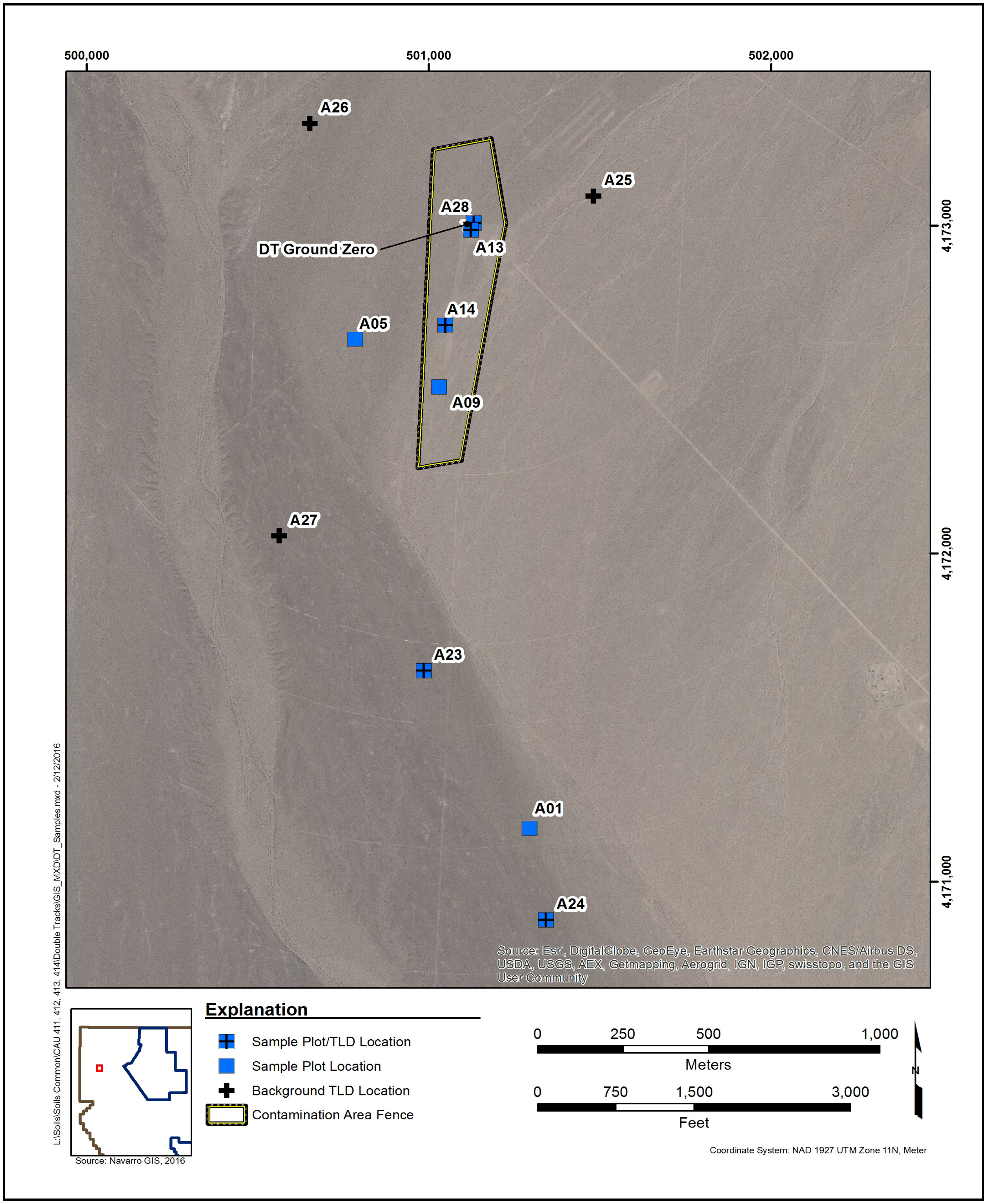

Figure D.2-2
Sample and TLD Locations

Table D.2-2
CAU 411 Sample Plot Soil Samples
(Page 1 of 2)

Location	Sample Number	Sample Date	Sample Location Biasing Factor	Depth (cm bgs)
A01	AB1A601	05/25/2012	2006 Aerial Survey; 2010 *In Situ* Gamma Spectroscopy FIDLER Field Measurements	0 - 5
	AB1A602			
	AB1A603			
	AB1A604			
A05	AB1A605	05/27/2012	2006 Aerial Survey; FIDLER Field Measurements	0 - 5
	AB1A606 (FD)			
	AB1A607			
	AB1A608			
	AB1A609			
A09	AB1A610	05/27/2012	1996 KIWI Survey; FIDLER Field Measurements	0 - 5
	AB1A611			
	AB1A612			
	AB1A613			
A13	AB1A614	04/16/2015	1996 KIWI Survey; FIDLER Field Measurements	0 - 5
	AB1A615			
	AB1A616			
	AB1A617			
A14	AB1A618	04/16/2015	1996 KIWI Survey; FIDLER Field Measurements	0 - 5
	AB1A619			
	AB1A620			
	AB1A621			
A23	AB1A622	04/23/2015	2006 Aerial Survey; FIDLER Field Measurements	0 - 5
	AB1A623			
	AB1A624			
	AB1A625			
A24	AB1A626	05/12/2015	2006 Aerial Survey; FIDLER Field Measurements	0 - 5
	AB1A627			
	AB1A628			
	AB1A629			

Table D.2-2
CAU 411 Sample Plot Soil Samples
(Page 2 of 2)

Location	Sample Number	Sample Date	Sample Location Biasing Factor	Depth (cm bgs)
A28	AB1A630	05/13/2015	FIDLER Field Measurements	0 - 5
	AB1A631			
	AB1A632			
	AB1A633			

bgs = Below ground surface
cm = Centimeter
FD = Field duplicate

gamma spectroscopy were also considered in sample plot selection (NSTec, 2011). The applicability of the *in situ* data, however, was limited to selection of plots outside the fence as no *in situ* measurements were collected inside the fence.

Sample plot locations for the CAI were also selected based on the 1996 KIWI and 2006 aerial surveys. For the CAI, however, these radiological survey data (aerial and KIWI) were modeled to produce average values over each 1,000-m^2 area of the site; the resulting model was then used to bias the selection of the sample locations to the areas of highest radioactivity. Two sample plots were located inside the CA fence at the two most elevated areas identified by the KIWI survey, and two plots were located outside the CA fence at the two most elevated areas identified by the 2006 aerial survey (NNSA/NFO, 2015a). The modeled survey results are shown in relation to the sample plot locations in Figures D.2-3 and D.2-4. A fifth sample plot location (A28) was added during the CAI based on elevated FIDLER measurements in the GZ area.

Before each sample plot was established in the field, a FIDLER survey was performed to identify a 100-m^2 area at the location with the highest FIDLER radiological readings. 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 aliquots collected from each plot. Each aliquot was collected using a “vertical-slice cylinder and bottom-trowel” method. This required the insertion of the 3.5-inch (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

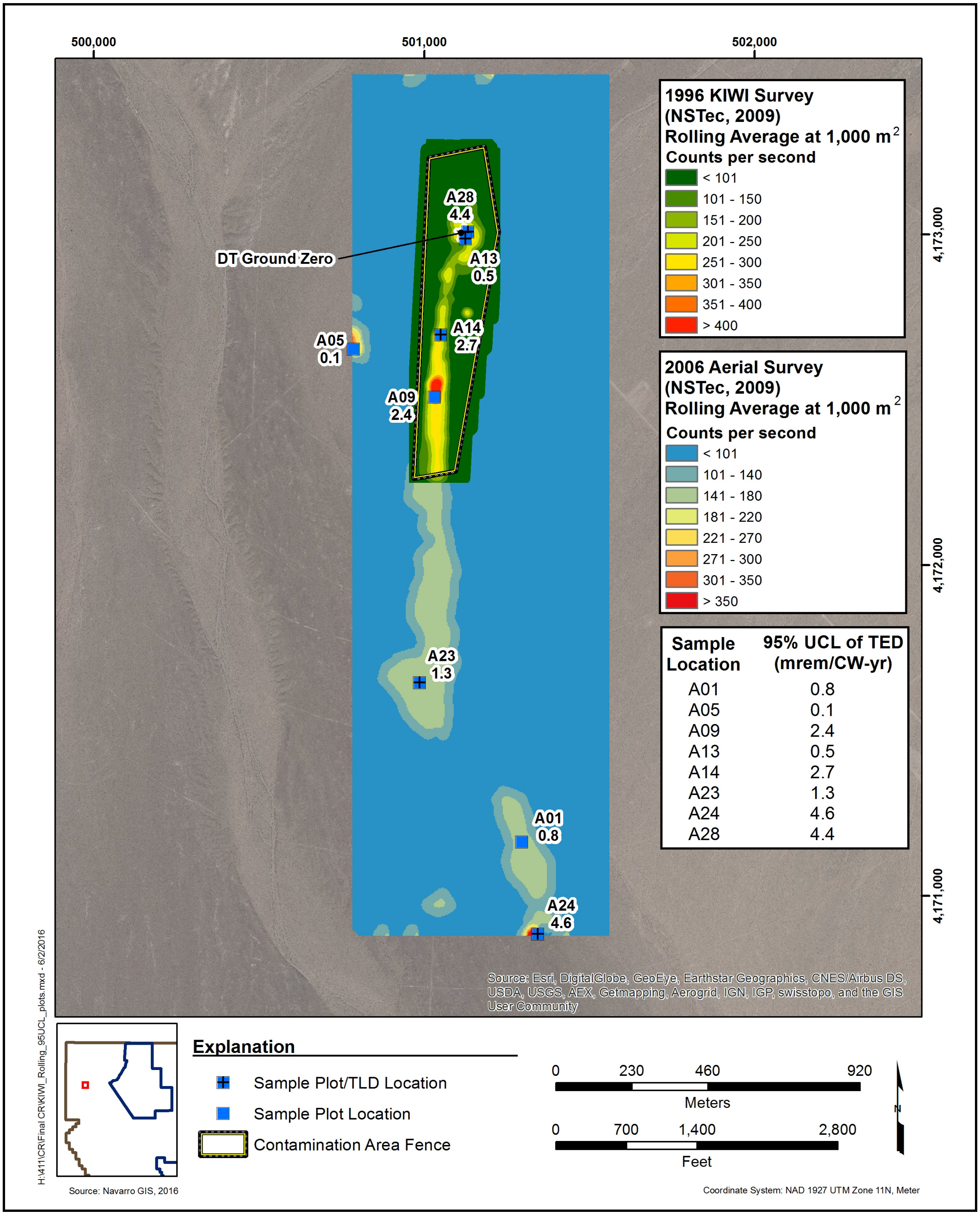

Figure D.2-3
95% UCL of the TED at Sample Plot Locations (mrem/CW-yr)

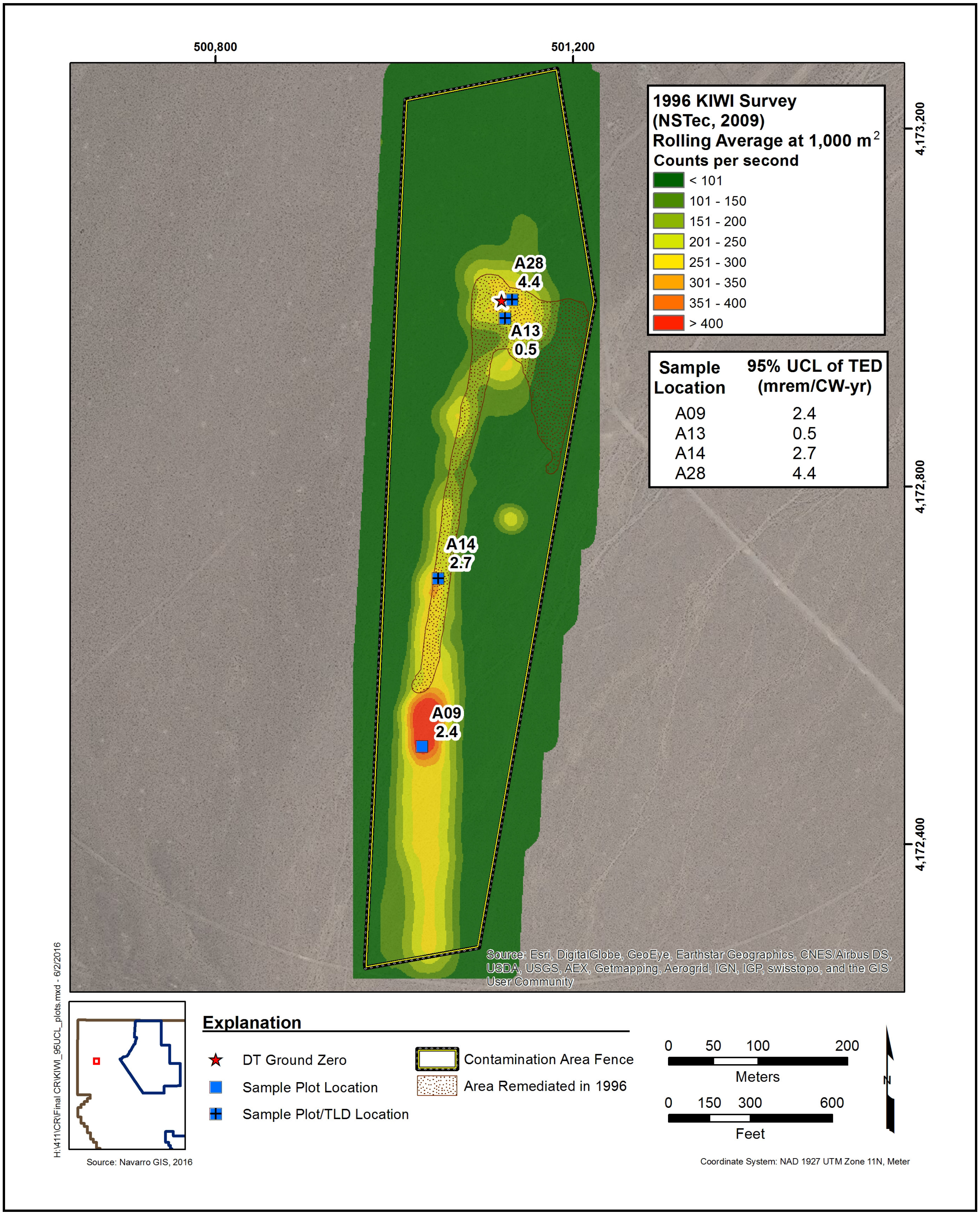

Figure D.2-4
95% UCL of the TED at Sample Plot Locations within CA Fence (mrem/CW-yr)

bottom of the cylinder. This method captured a cylindrical-shaped section of the soil from 0 to 5 cm bgs.

D.2.3.2 TLDs

A total of eight TLDs were staged at CAU 411 with the objective of collecting *in situ* measurements to determine the external radiological dose. One TLD was placed at the center of each of the five sample plots established during the CAI. TLDs were not placed at the three sample plots established during the 2012 PI or at any drainage locations sampled during the CAI (see Section D.2.7). TLDs were also placed at three background locations to measure background radiation. The background TLDs measure dose from natural sources in areas unaffected by CAU-related releases. The three background TLDs were placed outside the extent of the 2006 aerial radiation survey.

Table D.2-3 lists the number and location of TLDs placed at CAU 411 during the CAI; Figure D.2-2 shows the TLD locations.

Table D.2-3
CAU 411 TLDs

Location	TLD Number	Date Placed	Date Removed	Purpose
A13	6461	04/16/2015	09/01/2015	Sample plot
A14	6140	04/16/2015	09/01/2015	Sample plot
A23	6348	04/22/2015	09/01/2015	Sample plot
A24	6087	05/12/2015	09/01/2015	Sample plot
A25	6214	04/22/2015	09/01/2015	Background
A26	6115	04/22/2015	09/01/2015	Background
A27	6218	04/22/2015	09/01/2015	Background
A28	6204	05/13/2015	09/01/2015	Sample plot

Each TLD was placed at a height of 1 m above ground surface, which is consistent with TLD placement in the NNSS routine environmental monitoring program. Once retrieved from the field locations, the TLDs were analyzed by automated TLD readers that are calibrated and maintained by the NNSS M&O contractor. This approach allowed for the use of existing QC procedures for TLD processing. Details of the environmental monitoring TLD program and TLD QC are presented in

Section D.3.0. All readings conformed to the approved QC program and are considered representative of the external radiological dose at each location.

D.2.3.3 Drainages

Three drainage channels exiting the CA fence to the southwest were identified in the SAFER Plan; three additional drainage channels in this area were identified during the CAI. Where it was clear that two or more channels converged a short distance from the fence, these channels were considered a single channel. The SAFER Plan required the collection of samples from the two sedimentation accumulation areas closest to the fence within the three identified sample drainages (NNSA/NFO, 2015a). Additional grab samples were collected outside the CA fence at sediment accumulation areas in two of the newly identified channels. A total of 14 grab soil samples were collected from five drainage channels. The drainage sample locations are shown in Figure D.2-5.

Soil was removed at each drainage sample location and screened for radioactivity in 5-cm depth increments to a total depth of 30 cm bgs. These field-screening results (FSRs) were used to determine whether a subsurface contamination layer(s) could be distinguished from surface contamination, in accordance with the Soils RBCA document (NNSA/NFO, 2014). At locations where screening criteria was exceeded (A15, A17, A18, A19, and A22), the subsurface depth interval with the highest reading was sent for offsite laboratory analyses. Table D.2-4 lists the soil samples, sample depths, and biasing factors used to select the sample locations for the drainage samples collected at CAU 411. (See Table D.2-8 for the dose at each of the drainage sample locations.)

D.2.4 Dose Calculations

Soil sample and TLD data are used to calculate a TED that could potentially be received by a human receptor at the site. The TED is defined in 10 CFR Part 835 (CFR, 2016) as the sum of the effective dose (for external exposures) and the committed effective dose (for internal exposures). 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. Methods used for calculating internal, external, and total dose are presented in the Soils RBCA document (NNSA/NFO, 2014).

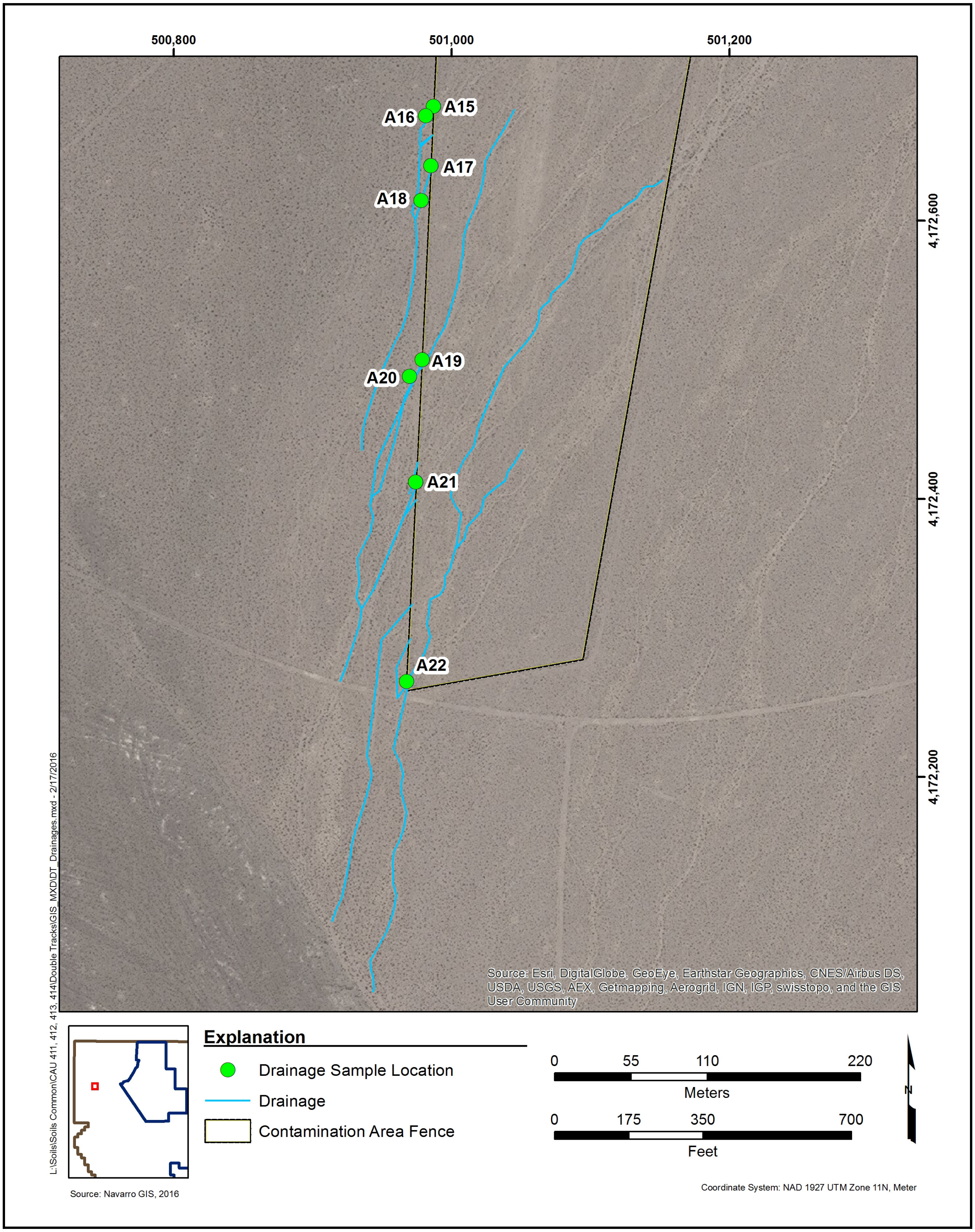

Figure D.2-5
Drainage Sample Locations

Table D.2-4
CAU 411 Drainage Samples

Drainage	Location	Sample Number	Sample Location Biasing Factor	Sample Date	Depth (cm bgs)
1	A15	AB1A001	Visible Sediment Accumulation Area; FIDLER Field Measurements	04/21/2015	0 - 5
		AB1A002	FSRs		20 - 25
	A16	AB1A003	Visible Sediment Accumulation Area; FIDLER Field Measurements	04/21/2015	0 - 5
2	A17	AB1A004	Visible Sediment Accumulation Area; FIDLER Field Measurements	04/21/2015	0 - 5
		AB1A005	FSRs		25 - 30
	A18	AB1A006	Visible Sediment Accumulation Area; FIDLER Field Measurements	04/21/2015	0 - 5
		AB1A007	FSRs		15 - 20
3	A19	AB1A008	Visible Sediment Accumulation Area; FIDLER Field Measurements	04/21/2015	0 - 5
		AB1A009	FSRs		5 - 10
	A20	AB1A010	Visible Sediment Accumulation Area; FIDLER Field Measurements	04/21/2015	0 - 5
		AB1A011 (FD)			
4	A21	AB1A012	Visible Sediment Accumulation Area; FIDLER Field Measurements	04/21/2015	0 - 5
5	A22	AB1A013	Visible Sediment Accumulation Area; FIDLER Field Measurements	04/21/2015	0 - 5
		AB1A014	FSRs		25 - 30

The calculated TED is an estimate of the true (unknown) TED. It is uncertain how well the calculated TED represents the true TED. If a calculated TED were directly compared to the FAL, any significant difference between the true TED and the calculated TED could lead to decision errors. To reduce the probability of a false-negative decision error for probabilistic sampling results, a conservative estimate of dose (i.e., the 95 percent UCL) is calculated. By definition, there will be a 95 percent probability that the true dose is less than the 95 percent UCL of the calculated dose. The probabilistic sampling design as described in the SAFER Plan (NNSA/NFO, 2015a) conservatively prescribes using the 95 percent UCL of the TED for DQO decisions. For sample locations where a TLD and multiple soil samples are collected (i.e., sample plots), the 95 percent UCL of the TED is calculated as the sum of the 95 percent UCLs of the internal and external doses. For grab sample locations where a TLD was also placed, the 95 percent UCL of the TED is calculated as the sum of the 95 percent UCL of the external dose and the calculated internal dose estimate. For sample locations where a TLD was not placed, external dose is estimated as described in Section D.2.4.2.

To reduce the probability of a false-negative decision error for judgmental sampling results, samples were biased to the locations of highest radioactivity and/or visible sedimentation areas. Samples from these locations will produce TED results that are higher than from adjacent locations of lower radioactivity (within the exposure area that is being characterized for dose). This will conservatively overestimate the true TED of the exposure area and protect against false-negative decision errors.

A minimum number of samples is required to assure sufficient confidence in dose statistics for probabilistic sampling such as the average and 95 percent UCL (EPA, 2006). As stated in the SAFER Plan, 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 4.1.2.1.

The following sections describe the calculation of internal, external, and TED at each sample location at CAU 411. The TED is compared to the radiological dose FAL, which is based on the CW exposure scenario. The CW exposure scenario assumes that a construction worker is present on a temporary basis at the site for 8 hr/day, 120 day/yr, resulting in a total of 960 hr/yr of potential exposure. The FAL is used in making DQO decisions related to FFACO site closure.

Dose calculations using the IA exposure scenario are also presented in the tables in this section for informational purposes. The IA scenario is a standard exposure scenario established in the Soils RBCA document (NNSA/NSO, 2014) that uses an exposure duration of 2,000 hr/yr and assumes a worker is assigned to the site for his or her entire career (25 years). If the calculated dose at a site exceeds 25 millirem per Industrial Area year (mrem/IA-yr), NNSA/NFO will determine whether an administrative UR or other institutional control is appropriate to guard against a more intensive future use of the site (i.e., a longer exposure duration).

D.2.4.1 Internal Dose Calculations

Internal dose was calculated using the radionuclide analytical results from soil samples and the corresponding RRMGs presented in the SAFER Plan (NNSA/NFO, 2015a). The internal dose RRMG for a particular radionuclide is that concentration in surface soil that would cause an internal dose to a receptor of 25 mrem/yr (under the appropriate exposure scenario) independent of any other radionuclide (assuming that no other radionuclides contribute dose). For each sample, the radionuclide-specific analytical result was divided by its corresponding internal RRMG to yield a fraction of the 25-mrem/yr dose, and then multiplied by 25 to yield an internal dose estimate (in mrem/yr) at that sample location. The total internal dose corresponding to each surface soil sample was calculated by adding the dose contribution from each radionuclide. Soil concentrations of Pu isotopes are inferred from gamma spectroscopy results as described in the representativeness discussion of Section 4.1.2.1. The internal doses for all radionuclides detected in a soil sample (excluding lead-212 and -214, niobium-94, potassium-40, and thallium-208) were then summed to yield an internal dose for that sample in accordance with the Soils RBCA document (NNSA/NFO, 2014). At sample plot locations, a 95 percent UCL was calculated for the internal dose in each sample plot using the results of all soil samples collected in that plot (NNSA/NFO, 2014). The standard deviation, number of samples, minimum sample size, average, and 95 percent UCL of the internal dose at sample plots are presented in Table D.2-5.

Table D.2-5
Average and 95% UCL Internal Dose at Sample Plot Locations

Sample Location	Standard Deviation (CW Scenario)	Number of Samples	Minimum Sample Size (CW Scenario)	Construction Worker (mrem/CW-yr)		Industrial Area (mrem/IA-yr)	
				Average	95%UCL	Average	95% UCL
A01	0.2	4	3	0.5	0.6	0.6	0.8
A05	0.0	5	3	0.0	0.0	0.0	0.0
A09	0.2	4	3	1.9	2.2	2.5	2.8
A13	0.0	4	3	0.4	0.5	0.6	0.6
A14	0.4	4	3	1.6	2.1	2.1	2.7
A23	0.1	4	3	0.1	0.2	0.2	0.3
A24	0.2	4	3	0.3	0.5	0.4	0.7
A28	0.5	4	3	0.8	1.5	1.1	1.9

For the drainage sample locations where only one or two samples were collected, statistical inferences could not be calculated, and the single analytical result (or average for FDs) was used to calculate the internal dose. The average internal doses at the drainage sample locations are presented in Table D.2-6.

Table D.2-6
Average Internal Dose at Drainage Sample Locations

Sample Location	Sample Depth (cm bgs)	Number of Samples	Construction Worker (mrem/CW-yr)	Industrial Area (mrem/IA-yr)
A15	0 - 5	1	0.0	0.1
	20 - 25	1	0.0	0.0
A16	0 - 5	1	0.0	0.1
A17	0 - 5	1	0.3	0.4
	25 - 30	1	0.0	0.0
A18	0 - 5	1	0.1	0.1
	15 - 20	1	1.5	1.9
A19	0 - 5	1	0.1	0.1
	5 - 10	1	0.0	0.0
A20	0 - 5	2	0.5	0.7
A21	0 - 5	1	2.7	3.5
A22	0 - 5	1	0.1	0.2
	25 - 30	1	0.1	0.2

D.2.4.2 External Dose Calculations

External dose may be estimated using the total dose RRMGs or may be calculated using TLD data. At CAU 411, TLD data were used to calculate external dose at the soil sample plot locations sampled during the CAI. The TLDs contain four individual elements. External dose at each TLD location is determined using the readings from TLD elements 2, 3, and 4. Each of these elements is considered to be a separate independent measurement of external dose. A 95 percent UCL of the average of these measurements was calculated for each TLD location. Element 1 is designed to measure dose to the skin and is not relevant to the determination of the external dose for the purpose of the CAI.

External dose estimates for CAU 411 are presented as net values (i.e., background radiation dose has been subtracted). The background dose at CAU 411 was calculated as the average of the background TLD results from locations A25, A26, and A27, which are shown in Figure D.2-2.

External dose was calculated for the IA exposure scenario (2,000-hour exposure duration) and then scaled to the CW exposure scenario (960-hour exposure duration) for each TLD location. This was accomplished by calculating the hourly rate (mrem/hr) for the IA scenario and multiplying this rate by the number of hours in the CW scenario (960 hours). The standard deviation, number of elements, minimum sample size, average, and 95 percent UCL values of external dose for the sample plot locations are presented in Table D.2-7.

Table D.2-7
Average and 95% UCL External Dose at Sample Plot Locations

Sample Location	Standard Deviation (CW Scenario)	Number of Elements	Minimum Sample Size (CW Scenario)	Construction Worker (mrem/CW-yr)		Industrial Area (mrem/IA-yr)	
				Average	95% UCL	Average	95% UCL
A01	N/A[a]	N/A[a]	N/A[a]	0.2	0.2	0.3	0.3
A05	N/A[a]	N/A[a]	N/A[a]	0.1	0.1	0.2	0.2
A09	N/A[a]	N/A[a]	N/A[a]	0.3	0.3	0.5	0.5
A13	0.0	3	3	0.0	0.0	0.0	0.0
A14	0.3	3	3	0.2	0.6	0.3	1.2
A23	0.5	3	3	0.4	1.1	0.9	2.3
A24	1.5	3	3	2.1	4.1	4.3	8.5
A28	0.7	3	3	1.9	2.9	4.0	6.1

[a] A TLD was not placed at this location. External dose was calculated in accordance with Section D.2.4.2 for this location.

N/A = Not applicable

At sample locations where no TLD was placed (2012 sample plots and drainage sample locations), a TLD equivalent external dose was calculated by multiplying the RESRAD-derived external dose by a correction factor. This correction factor was developed to account for an observed difference between RESRAD-derived external dose and TLD readings as described in the Soils RBCA document (NNSA/NFO, 2014). The correction factor was derived by evaluating previous data from Soils Activity sites where both TLD and RESRAD-derived external dose data were available. Evaluation of this data showed good correlation between these paired data with a weighted average correction factor of 1.58 for average TLD values and 1.69 for 95 percent UCL TLD values. The correlation of TLD dose to RESRAD external dose is presented in Figure D.2-6. This evaluation also demonstrated that this correction factor was not influenced by the type of release (e.g., weapons test or safety experiment) (Figure D.2-7) or the amount of activity present (Figure D.2-8). However, it demonstrated that at very low external dose levels (as external doses approached zero), the relationship between RESRAD-derived external dose and TLD external dose had no correlation. Therefore, attempting to use site-specific data to correct RESRAD-derived external dose at sites where external dose is low (such as at CAU 411) can result in erratic and erroneous results. The estimated external dose for the drainage sample locations are presented in Table D.2-8.

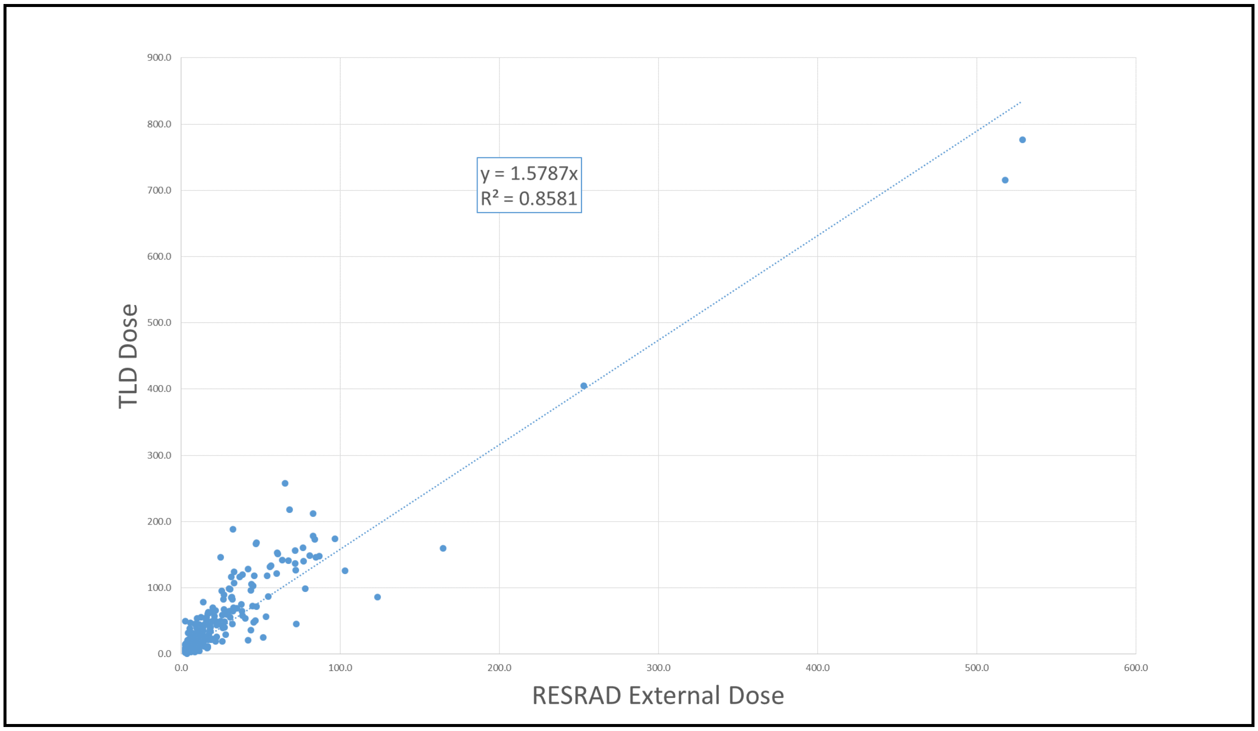

Figure D.2-6
Correlation of TLD Dose to RESRAD External Dose

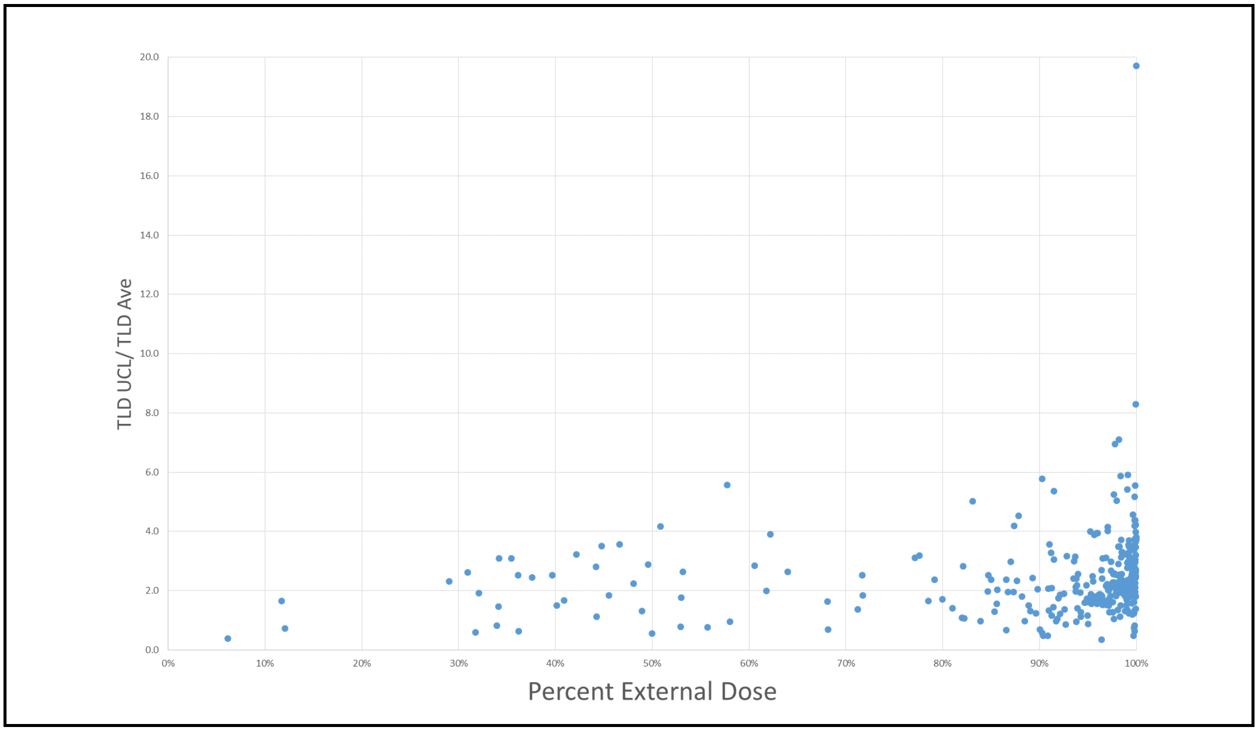

Figure D.2-7
Correlation of Correction Factor to Release Type

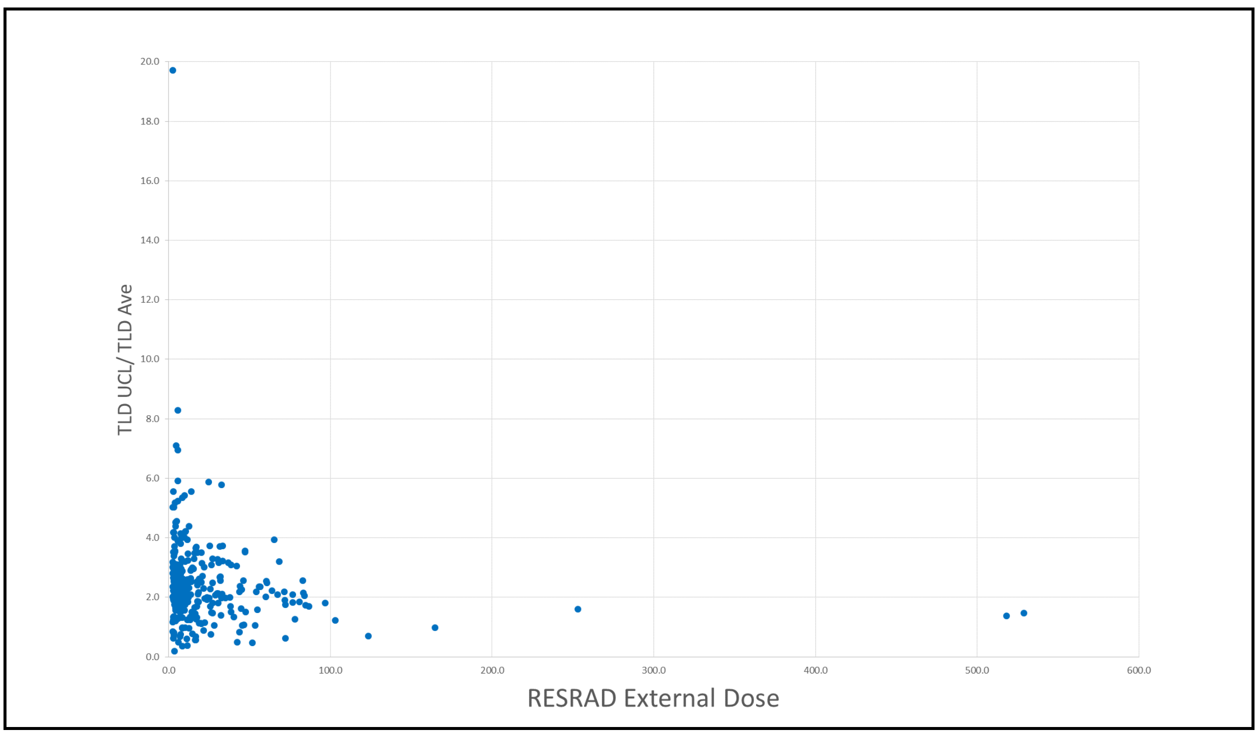

Figure D.2-8
Correlation of Correction Factor to External Dose

Table D.2-8
Average and 95% UCL External Dose at Drainage Sample Locations [a]

Sample Location	Sample Depth (cm bgs)	Construction Worker (mrem/CW-yr)		Industrial Area (mrem/IA-yr)	
		Average	95% UCL	Average	95% UCL
A15	0 - 5	0.1	0.1	0.2	0.2
	20 - 25	0.1	0.1	0.1	0.1
A16	0 - 5	0.3	0.3	0.5	0.6
A17	0 - 5	0.2	0.2	0.3	0.3
	25 - 30	0.1	0.1	0.1	0.1
A18	0 - 5	0.1	0.1	0.1	0.1
	15 - 20	0.2	0.2	0.4	0.4
A19	0 - 5	0.1	0.1	0.2	0.2
	5 - 10	0.1	0.1	0.1	0.1
A20	0 - 5	0.1	0.1	0.2	0.2
A21	0 - 5	0.3	0.3	0.5	0.6
A22	0 - 5	0.1	0.1	0.2	0.2
	25 - 30	0.1	0.1	0.1	0.1

[a] TLDs were not placed at drainage sample locations. External dose was calculated in accordance with Section D.2.4.2 for these locations.

D.2.4.3 Total Effective Dose

The TED for each sample plot, grab sample location, and TLD location was calculated by adding the external dose values and the internal dose values. The radionuclides that are the primary contributors to the TED at CAU 411 are Pu-239/240 and to a lesser extent, Am-241. Values for both the average TED and the 95 percent UCL of the TED for the CW and IA exposure scenarios are presented in Table D.2-9. None of the CAU 411 sample locations exceed the dose-based FAL of 25 mrem/CW-yr. The TED data for the sample plot locations are presented in Figures D.2-3 and D.2-4 in relation to the aerial and KIWI radiological survey data that were used to select the plot locations. The TED data for the drainage sample locations in relation to the FIDLER survey are presented in Figure D.2-9.

Table D.2-9
TED at Sample Locations (mrem/yr)

Location	Sample Location	Sample Depth (cm bgs)	Construction Worker		Industrial Area	
			Average TED	95% UCL of TED	Average TED	95% UCL of TED
Plot	A01	0 - 5	0.6	0.8	0.9	1.1
	A05	0 - 5	0.1	0.1	0.2	0.3
	A09	0 - 5	2.2	2.4	3.0	3.3
	A13	0 - 5	0.4	0.5	0.6	0.6
	A14	0 - 5	1.8	2.7	2.4	4.0
	A23	0 - 5	0.6	1.3	1.1	2.6
	A24	0 - 5	2.4	4.6	4.7	9.1
	A28	0 - 5	2.8	4.4	5.1	8.0
Drainage	A15	0 - 5	0.2	0.2	0.3	0.3
		20 - 25	0.1	0.1	0.1	0.1
	A16	0 - 5	0.3	0.4	0.6	0.6
	A17	0 - 5	0.5	0.5	0.7	0.8
		25 - 30	0.1	0.1	0.2	0.2
	A18	0 - 5	0.1	0.1	0.2	0.2
		15 - 20	1.7	1.7	2.3	2.3
	A19	0 - 5	0.1	0.2	0.2	0.2
		5 - 10	0.1	0.1	0.2	0.2
	A20	0 - 5	0.7	0.7	0.9	0.9
	A21	0 - 5	3.0	3.0	4.0	4.0
	A22	0 - 5	0.2	0.2	0.3	0.3
		25 - 30	0.2	0.2	0.3	0.3

D.2.5 Comparison to Action Levels

Two PALs for radioactivity were presented in the SAFER Plan: (1) an annual dose limit of 25 mrem/CW-yr and (2) a removable alpha contamination level. The PALs are used for screening purposes. Additional detail with regard to the PALs and the CW scenario may be found in the SAFER Plan (NNSA/NFO, 2015a).

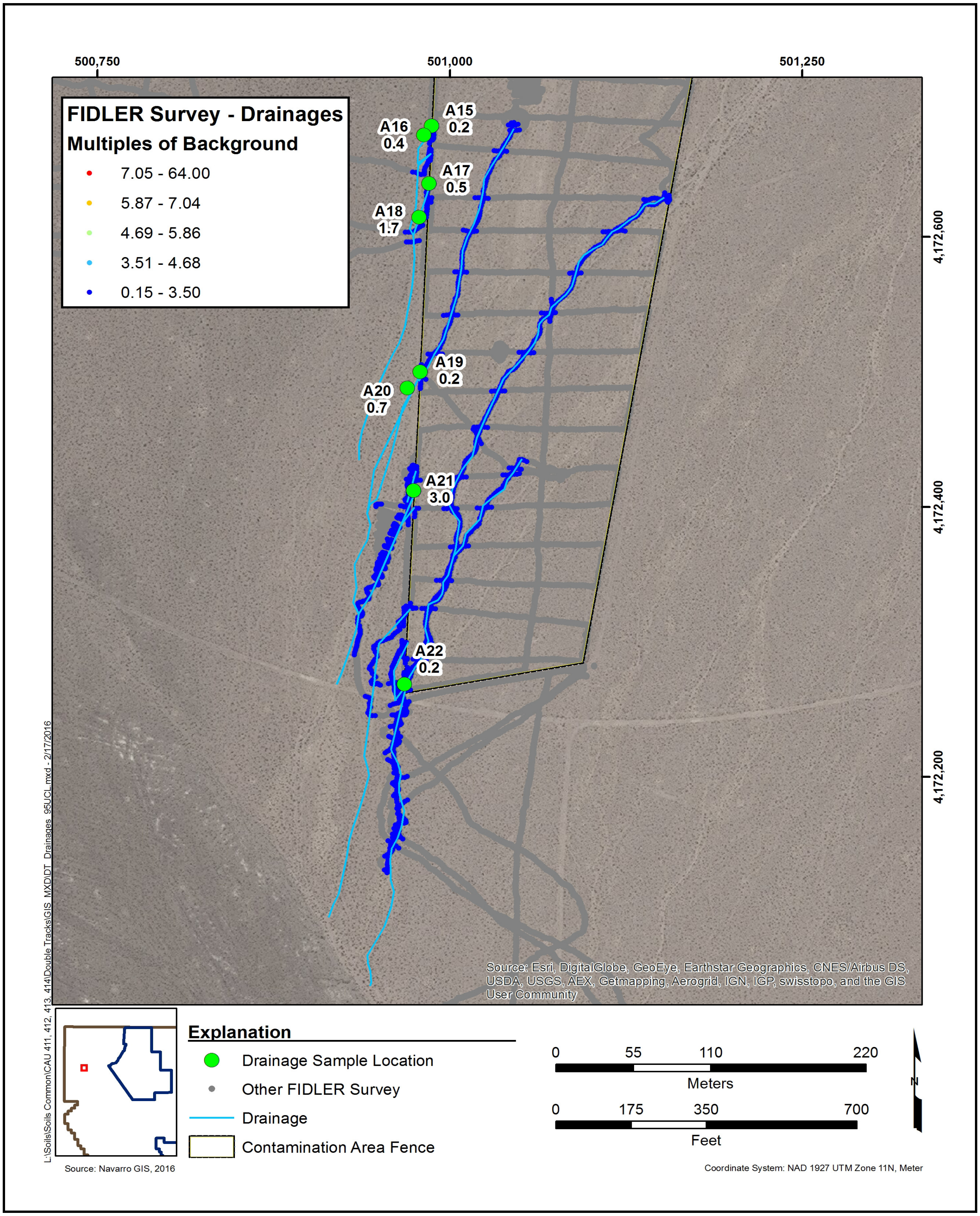

Figure D.2-9
95% UCL of the TED at Drainage Sample Locations (mrem/CW-yr)

The comparison of investigation data to the FAL is used to determine whether corrective action under the FFACO is required at a site. As discussed in Appendix H, the radiological dose-based FAL of 25 mrem/CW-yr was the only FAL established for CAU 411. The total dose and internal dose RRMGs associated with this FAL are presented in Tables D.2-10 and D.2-11, respectively. For removable contamination, if the HCA criterion of 2,000 dpm/100 cm^2 is exceeded, it is assumed that the dose-based radiological FAL of 25 mrem/CW-yr is also exceeded and corrective action is required. It should be noted that the HCA criterion is not dose-based. As such, it does not correlate with a dose value that could be compared to the 25-mrem/CW-yr FAL established for CAU 411. In the absence of a dose-based FAL specific to removable contamination, the assumption equating the HCA criterion to the total dose FAL was necessary to account for potential removable contamination risks at the site.

Table D.2-10
Total Effective Dose RRMGs for the CW Exposure Scenario
(Page 1 of 2)

Radionuclide	RRMG (pCi/g)
Ag-108m	5.36E+01
Al-26	3.46E+01
Am-241	3.27E+03
Am-243	3.94E+02
Cm-243	6.44E+02
Cm-244	1.14E+04
Co-60	3.68E+01
Cs-137	1.47E+02
Eu-152	7.69E+01
Eu-154	7.18E+01
Eu-155	1.93E+03
Nb-94	5.56E+01
Np-237	3.73E+02
Pu-238	5.82E+03
Pu-239/240	5.31E+03
Pu-241	2.63E+05
Sr-90	1.71E+04

Table D.2-10
Total Effective Dose RRMGs for the CW Exposure Scenario
(Page 2 of 2)

Radionuclide	RRMG (pCi/g)
Ag-108m	5.36E+01
Tc-99	2.32E+06
Th-232	1.06E+03
U-233	4.85E+04
U-234	5.66E+04
U-235	5.13E+02
U-238	2.92E+03

A soil sample at this RRMG value would present a TED potential of 25 mrem per calendar year.

Ag = Silver
Al = Aluminum
Cm = Curium
Co = Cobalt
Eu = Europium
mrem = Millirem
Nb = Niobium
Np = Neptunium
Sr = Strontium
Tc = Technetium
Th = Thorium

Table D.2-11
Internal Dose RRMGs for the CW Exposure Scenario
(Page 1 of 2)

Radionuclide	RRMG (pCi/g)
Ag-108m	5.72E+06
Al-26	4.59E+06
Am-241	6.68E+03
Am-243	6.67E+03
Cm-243	9.36E+03
Cm-244	1.14E+04
Co-60	4.44E+06
Cs-137	1.26E+06
Eu-152	7.28E+06
Eu-154	5.43E+06
Eu-155	3.79E+07
Nb-94	6.29E+06

Table D.2-11
Internal Dose RRMGs for the CW Exposure Scenario
(Page 2 of 2)

Radionuclide	RRMG (pCi/g)
Ag-108m	5.72E+06
Np-237	1.27E+04
Pu-238	5.84E+03
Pu-239/240	5.33E+03
Pu-241	2.76E+05
Sr-90	5.05E+05
Tc-99	1.90E+07
Th-232	5.68E+03
U-233	5.95E+04
U-234	6.10E+04
U-235	6.66E+04
U-238	6.97E+04

A soil sample at this RRMG value would present an internal dose potential of 25 mrem per calendar year.

This CR also presents a calculated radiological dose based on a 25-mrem/yr dose limit using the IA exposure scenario. The IA scenario is based on a 2,000-hr/yr exposure duration and is fully described in the Soils RBCA document (NNSA/NSO, 2014). The IA exposure scenario dose is evaluated to determine whether implementation of best management practices (BMPs) at CAU 411 is necessary (see Section D.2.5.3).

D.2.5.1 Radiological Dose

The FAL for CAU 411 was established based on a dose limit of 25 mrem/yr over an annual exposure time of 960 hours (i.e., the CW exposure scenario that assumes a construction worker would be exposed to site contamination 8 hr/day for 120 day/yr).

No location at CAU 411 exceeded the FAL of 25 mrem/CW-yr; thus, no corrective action is required.

D.2.5.2 Removable Contamination

As discussed in the Soils RBCA document (NNSA/NSO, 2014), it is assumed that corrective action is required at areas that exceed the HCA criterion of 2,000 dpm/100 cm^2 for removable alpha contamination. If an area exceeds this criterion, it is assumed that the dose-based radiological FAL is also exceeded and corrective action is necessary.

Removable contamination surveys were completed at three of the soil sample plots located within the CA fence (locations A09, A13, and A14). In addition, personnel were monitored for removable contamination during the CAI as they exited the CA fence. These data, combined with existing removable contamination survey data collected outside the CA fence in 2010 (NSTec, 2011), was used to determine whether the HCA criterion was exceeded at CAU 411. The removable alpha contamination survey data at the soil sample plot locations were all below the HCA criterion; the highest survey result (239 dpm/100 cm^2) was at location A14. Survey results for PPE worn during CAI sampling at the sample plots ranged from 0 to 2 dpm/100 cm^2. Figure D.2-10 shows the locations where removable contamination survey data were collected at CAU 411.

No area at CAU 411 exceeded the removable contamination HCA criterion; thus, it is assumed that the FAL of 25 mrem/CW-yr is also not exceeded and corrective action is not required.

D.2.5.3 Best Management Practices

In order to determine whether BMPs (e.g., administrative URs) are appropriate at CAU 411, a comparison is made to determine whether radiological dose exceeds the 25-mrem/IA-yr action level. The IA scenario is a standard exposure scenario established in the Soils RBCA document (NNSA/NSO, 2014) that uses an exposure duration of 2,000 hr/yr and assumes a worker is assigned to the site for his or her entire career (25 years). If the comparison indicates that the radiological dose to a industrial worker exceeds 25 mrem/IA-yr, NNSA/NFO will determine whether an administrative UR or other institutional control is appropriate to guard against a more intensive future use of the site (i.e., a longer exposure duration).

No location at CAU 411 exceeded the dose limit of 25 mrem/IA-yr; thus, no BMPs based on radiological dose are recommended.

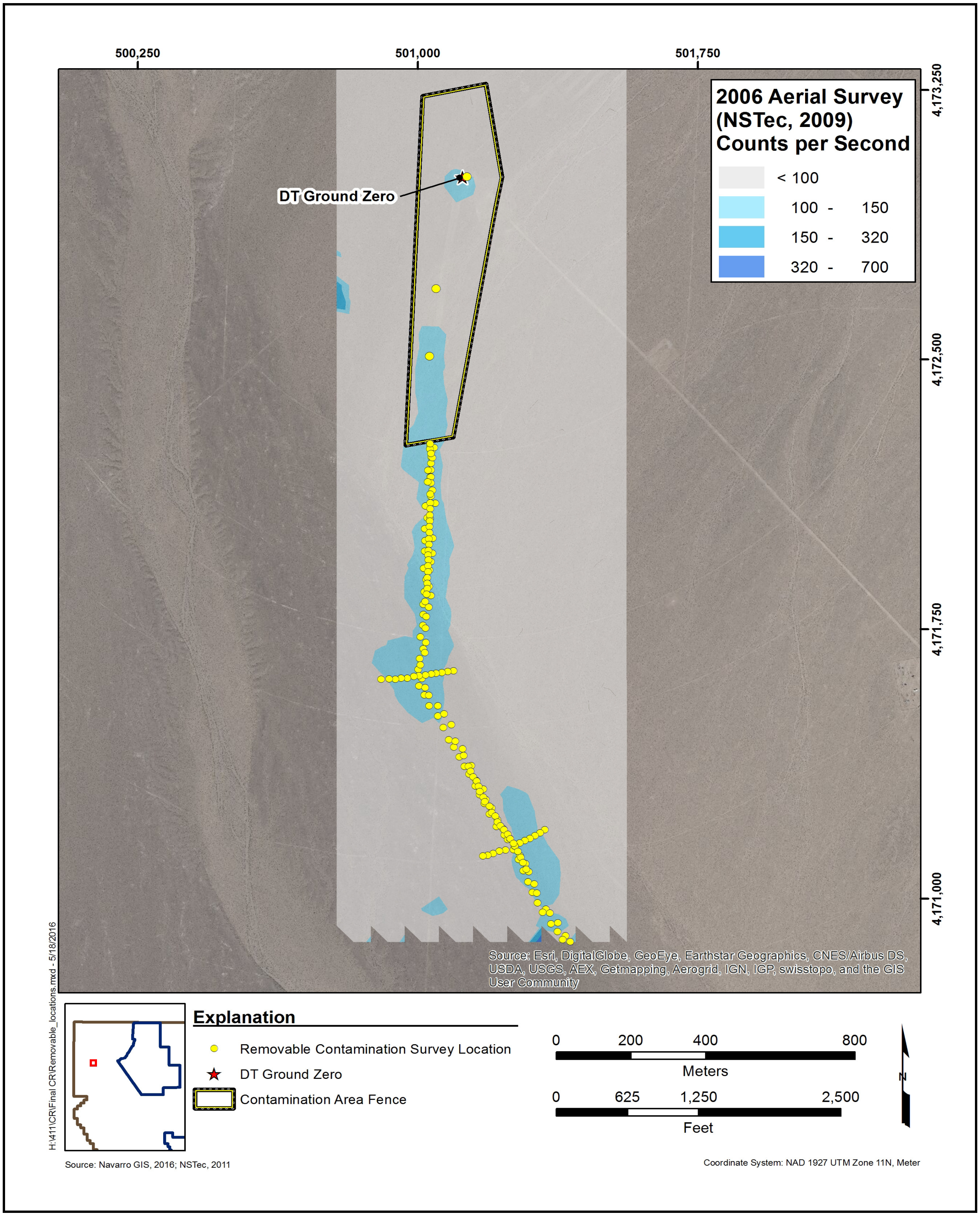

Figure D.2-10
Removable Contamination Survey Locations

D.2.6 Nature and Extent of COCs

The 25-mrem/CW-yr FAL was not exceeded at any location and no PSM or other releases were identified at the site. As a result, no COCs were identified at CAU 411.

D.2.7 Deviations from the SAFER Plan/Revised Conceptual Site Model

The SAFER Plan (NNSA/NFO, 2015a) requirements were met for this CAU, with the following exceptions:

- The SAFER Plan states that a TLD will be placed at each drainage sample location to measure external dose; however, TLDs were not placed at the drainage sample locations during the CAI. This omission was simply an oversight and does not adversely impact data usability or DQO decisions at these locations. One reason is that at CAU 411, external dose is not expected to contribute significantly to total dose, as the site COCs are primarily internal dose hazards. In addition, the Soils RBCA document allows for the estimation of external dose using RRMGs or the use of field TLD data (NNSA/NFO, 2014). External dose at the drainage sample locations was estimated using the method described in Section D.2.4.2.

- For sample locations where no TLD data exist (e.g., drainage locations), the SAFER Plan states that external dose will be estimated using the methodology found in the Soils RBCA document (NNSA/NSO, 2014). However, an alternate method for deriving external dose at these locations was applied, as explained in Section D.2.4.2.

All other SAFER Plan requirements were met at CAU 411. The information gathered during the CAI supports the CSM as presented in the SAFER Plan. Therefore, no revisions were necessary to the CSM.

D.3.0 Quality Assurance

This section contains a summary of QA/QC measures implemented during the sampling and analysis activities conducted in support of the CAU 411 CAI. The following subsections discuss the data validation process, QC samples, and nonconformances. A detailed evaluation of the DQIs is presented in Section 4.1.

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

D.3.1 Data Validation

Data validation was performed in accordance with the Soils Activity QAP (NNSA/NSO, 2012) and approved protocols and procedures. All laboratory data from samples collected and analyzed for CAU 411 were evaluated for data quality in a tiered process. Data were reviewed to ensure that samples were appropriately processed and analyzed, and the results were evaluated using validation criteria. Documentation of the data qualifications resulting from these reviews is retained in CAU 411 files as a hard copy and electronic media.

All laboratory data were subjected to a Tier I and Tier II data evaluation. A Tier III evaluation was performed on the analytical results for samples that represent 5 percent of the samples collected for site characterization.

D.3.1.1 Tier I Evaluation

Tier I evaluation for 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.

D.3.1.2 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.

- QC 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.

D.3.1.3 Tier III Evaluation

The Tier III review is an independent examination of the Tier II evaluation and the laboratory reported data. A Tier III review of 5 percent of the samples collected was performed by Analytical Quality Associates, Inc. of Albuquerque, New Mexico. The Tier II and Tier III evaluations were in agreement and evaluated data were used. 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.

D.3.2 Field QC Samples

The CAU 411 dataset contains two FD samples. One was collected during the PI from a sample plot (AB1A606) and the other was collected during the CAI from a drainage sample location (AB1A011). These samples were sent as blind samples to the laboratory to be analyzed for the investigation parameters listed in the SAFER Plan. For these samples, the duplicate results precision (i.e., relative percent differences [RPDs]) between the environmental sample results and their corresponding FD sample results) was evaluated.

D.3.3 Field Nonconformances

There were no field nonconformances identified for the CAI.

D.3.4 Laboratory Nonconformances

Laboratory nonconformances are generally due to fluctuation in analytical instrumentation operations, sample preparations, missed holding times, spectral interferences, high or low chemical yields/spike recoveries, or percent differences in duplicate precision. All laboratory nonconformances were reviewed for relevance and, where appropriate, data were qualified accordingly.

D.3.5 TLD Data Validation

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

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

1. *TLDs are exposed at the sample plots for an extended time period that approximates the 2,000 hours of exposure time used for the IA exposure scenario.* This long-term exposure allows for a more accurate estimate of external dose, taking into account temporal variations.

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

D.4.0 Summary

The SAFER Plan (NNSA/NFO, 2015a) identified the presumed corrective action for CAU 411 as clean closure. This presumption was based on implementation of the interim corrective action in 1996 and data collected during subsequent investigations. In order to supplement existing data and determine whether site closure objectives have been achieved, closure verification data were collected at CAU 411 as part of a CAI. The CAI confirmed that radionuclides at the site are not present in excess of the FAL and further corrective action at the site is not required.

Each of the closure objectives defined in the SAFER Plan was achieved as indicated:

- *Radiological contamination at the site is less than the FAL using the CW exposure scenario (i.e., the radiological dose is less than the FAL).* No sample location exceeded the radiological dose FAL.
- *Removable alpha contamination is less than the HCA criterion.* Removable alpha contamination at the site was less than the HCA criterion, so it is assumed that the dose associated with removable contamination is less than the radiological dose FAL.
- *No PSM is present at the site, and any impacted soil associated with PSM has been removed so that remaining soil contains contaminants at concentrations less than the FALs.* No PSM was identified at CAU 411.
- *There is sufficient information to characterize investigation and remediation waste for disposal.* Soil sample results and radiological survey data are sufficient to characterize the investigation waste generated during the CAI; no remediation waste was generated during the CAI.

Based on the interim corrective action implemented in 1996 and the CAI, clean closure of the site is complete; the closure objectives established in the SAFER Plan have been achieved; and no further corrective action at the site is required.

D.5.0 References

BN, see Bechtel Nevada.

Bechtel Nevada. 2003. *Nevada Test Site Routine Radiological Environmental Monitoring Plan*, DOE/NV/11718--804. Prepared for the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. Las Vegas, NV.

CFR, see *Code of Federal Regulations*.

Code of Federal Regulations. 2016. Title 10 CFR, Part 835, "Occupational Radiation Protection." Washington, DC: U.S. Government Printing Office.

EPA, see U.S. Environmental Protection Agency.

Navarro GIS, see Navarro Geographic Information Systems.

N-I, see Navarro-Intera, LLC.

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

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

NSTec, see National Security Technologies, LLC.

National Security Technologies, LLC. 2009. GIS Data Transmittal to U.S. Air Force, Product ID 20091029-01-P012-R04, 15 December. Las Vegas, NV.

National Security Technologies, LLC. 2011. *Nevada Test and Training Range Results of the 10 CFR 835 Posting Compliance Field Investigation, Clean Slates I, II, and III and Double Tracks, Tonopah Test Range, Nevada*. April. Las Vegas, NV.

Navarro Geographic Information Systems. 2016. ESRI ArcGIS Software.

Navarro-Intera, LLC. 2013. *Preliminary Investigation Results and Recommendations for CAUs 411, 412, 413, and 414, Nevada Test and Training Range and Tonopah Test Range, Nevada*, Rev. 0. N-I/28091--052. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2015a. *Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 411: Double Tracks Plutonium Dispersion (Nellis), Nevada Test and Training Range, Nevada*, Rev. 0, DOE/NV--1533. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2015b. *United States Nuclear Tests, July 1945 through September 1992*, DOE/NV--209-REV 16. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2012. *Soils Activity Quality Assurance Plan,* Rev. 0, DOE/NV--1478. Las Vegas, NV.

U.S. Environmental Protection Agency. 2006. *Data Quality Assessment: Statistical Methods for Practitioners,* EPA QA/G-9S, EPA/240/B-06/003. Washington, DC: Office of Environmental Information.

Appendix E

Waste Disposition Documentation

Note: Disposal of the low-level radioactive waste generated at CAU 411 is currently pending. Waste disposal documentation will be included as an addendum to this CR upon receipt from the disposal facility.

Appendix F

Modifications to the Post-closure Plan

F.1.0 Modifications to the Post-closure Plan

This appendix is not applicable to CAU 411, because the site is being clean closed and a post-closure plan is not required.

Appendix G

Use Restrictions

G.1.0 Use Restrictions

This appendix is not applicable to CAU 411, because the site is being clean closed and FFACO URs are not required.

Appendix H

Risk Evaluation

H.1.0 Risk Assessment

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

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 Tier 1 action levels based on generic (non-site-specific) conditions (i.e., the PALs established in the CAU 411 SAFER Plan [NNSA/NFO, 2015a]). The FALs may then be established as the Tier 1 action levels, or the FALs may be calculated using a Tier 2 evaluation.

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

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

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

H.1.1 Scenario

CAU 411, Double Tracks Plutonium Dispersion (Nellis), comprises one CAS, NAFR-23-01, Pu Contaminated Soil. This CAU consists of a release of radionuclides to the surrounding soil from a storage–transportation test conducted on May 15, 1963 (NNSA/NFO, 2015b).

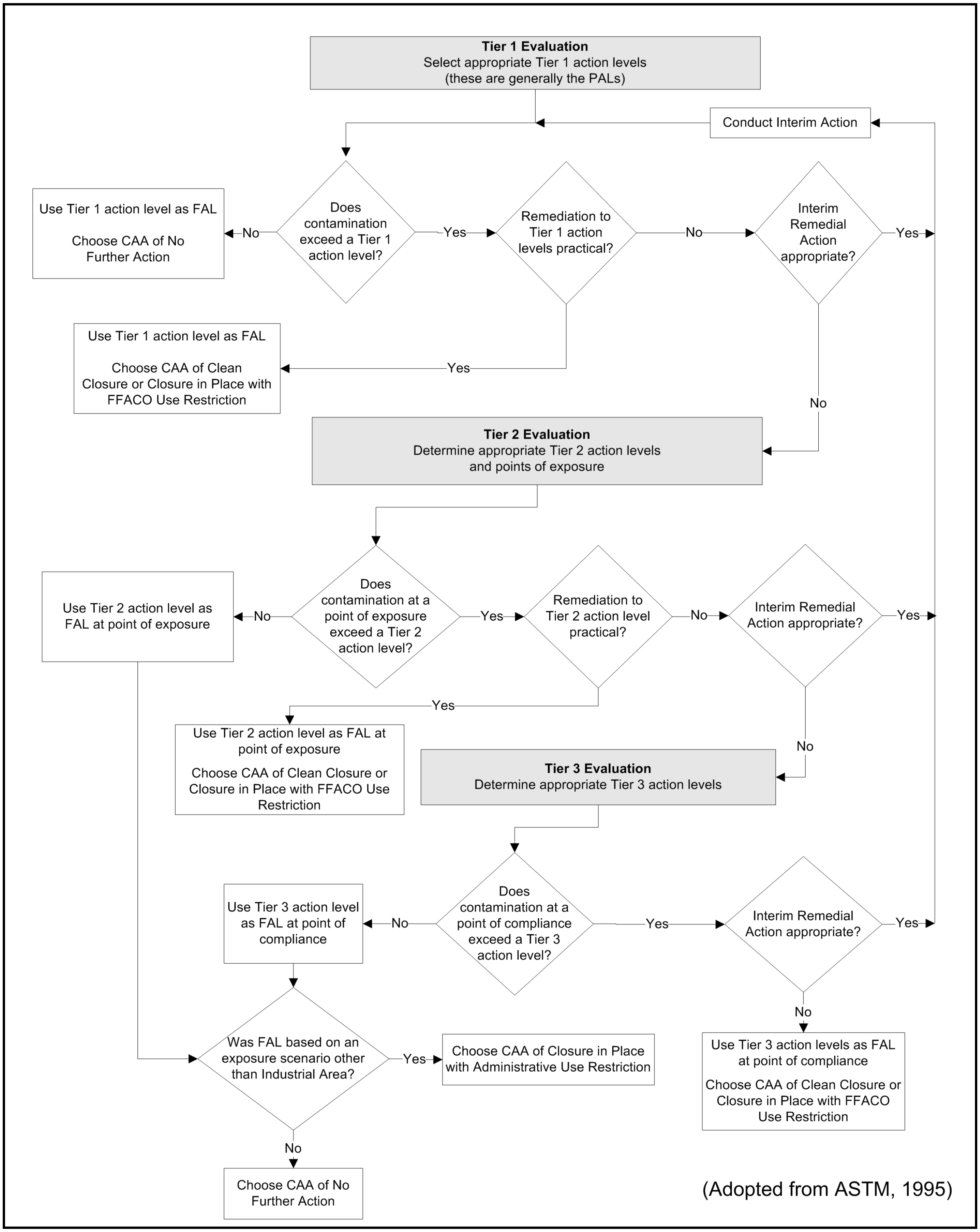

Figure H.1-1
RBCA Decision Process

H.1.2 Site Assessment

Investigation activities at CAU 411 included visual surveys, ground-based radiation surveys, collection of surface and subsurface soil samples, and placement of TLDs. The CAI results are presented in Appendix D. No soil sample location at CAU 411 exceeded a dose of 25 mrem/CW-yr. None of the CAI data or the existing removable contamination survey data exceeded the removable alpha contamination HCA criterion of 2,000 dpm/100 cm^2.

H.1.3 Site Classification and Initial Response Action

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

Based on the completion of the interim corrective action in 1996 and the CAI, CAU 411 does not contain contaminants that present an immediate threat to human health, safety, and the environment; therefore, no additional corrective interim response action is necessary at the site. CAU 411 has been determined to be a Classification 4 site as defined by ASTM Method E1739 (ASTM, 1995).

H.1.4 Development of Tier 1 Action Level Lookup Table

Tier 1 action levels are defined as the PALs listed in the SAFER Plan (NNSA/NFO, 2015a) as established during the DQO process. The PALs represent a very conservative estimate of risk, are preliminary in nature, and are generally used for site screening purposes. Although the PALs are not intended to be used as FALs, FALs may be defined as the Tier 1 action level (i.e., PAL) value if implementing a corrective action based on the Tier 1 action level is appropriate.

Two PALs for radioactivity were presented in the SAFER Plan: (1) a radiological dose-based action level (25 mrem/CW-yr) and (2) a removable contamination action level (2,000 dpm/100 cm^2). The PAL for removable contamination was determined inappropriate for use as a FAL as it is not based on dose or risk. For removable contamination, if the HCA criterion of 2,000 dpm/100 cm^2 is exceeded, it is assumed that the radiological FAL of 25 mrem/CW-yr is also exceeded and corrective action is required.

The radiological dose-based PAL was based on the CW exposure scenario, which assumes that a construction worker is present on a temporary basis at the site for 8 hr/day, 120 day/yr. This results in a total of 960 hr/yr of potential exposure. The 25-mrem/yr dose-based Tier 1 action level for radiological contaminants is determined by calculating the dose a site worker would receive if exposed to the site contaminants over an annual exposure period of 960 hours.

The 25-mrem/yr radiological FAL is consistent with the DOE dose constraint for the release or clearance of land found in DOE Order 458.1 (DOE, 2013). A 25-mrem/yr dose constraint for unrestricted use is also found in U.S. Nuclear Regulatory Commission (CFR, 2016) and Nevada state regulations (NAC, 2014c).

Chemical PALs were defined in the SAFER Plan; however, no chemical COPCs were defined or discovered during the CAI.

H.1.5 Exposure Pathway Evaluation

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

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

An exposure duration based on the CW scenario (960 hr/yr) was used to calculate the Tier 1 action levels (i.e., PALs). There are no sample locations at CAU 411 that exceed the Tier 1 action levels. Based on the unrealistic but conservative assumption that a construction worker would be exposed to the maximum dose calculated at any sampled location, this individual would receive a 25-mrem dose at CAU 411 in the exposure time listed in Table H.1-1.

Table H.1-1
Minimum Exposure Time To Receive a 25-mrem/yr Dose in the CW Exposure Scenario

Sample Location	Location of Maximum Dose	Average TED (mrem/CW-yr)	Minimum Exposure Time (hours)
Drainage	A21	3.0	8,018

H.1.7 Evaluation of Tier 1 Results

The CW exposure scenario was established by the USAF as the appropriate land use scenario for the CAU 411 site (USAF, 2014). The types of work activities that are currently conducted at the site are consistent with the CW scenario used in the development of the Tier 1 PAL. No sample location at CAU 411 exceeded the Tier 1 action level. However, in order to facilitate comparison of CAU 411 data to reasonable points of exposure (as opposed to source areas in the Tier 1 evaluation), a Tier 2 evaluation was conducted.

H.1.8 Tier 1 Remedial Action Evaluation

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

H.1.9 Tier 2 Evaluation

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

H.1.10 Development of Tier 2 Action Levels

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

The CW exposure scenario was established by the USAF as the appropriate land use scenario for the CAU 411 site (USAF, 2014). The types of work activities that are currently conducted at the site are consistent with the CW scenario used in the development of the Tier 1 PAL. Therefore, the Tier 2 action level is defined as 25 mrem/yr under the CW exposure scenario.

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

There are no locations at CAU 411 that exceed the radiological Tier 2 action level.

H.1.12 Tier 2 Remedial Action Evaluation

Based on the Tier 2 evaluation, soil contamination at CAU 411 is not present at levels that exceed Tier 2 action levels and no remedial actions are required. Therefore, the Tier 2 action level of 25 mrem/CW-yr is established as the FAL and a Tier 3 evaluation is not necessary.

H.2.0 Recommendations

The CAI for CAU 411 verified that contamination is not present at the site in excess of the FAL, and further corrective action is not required. Based on the interim corrective action implemented in 1996 and the CAI, clean closure of the site is complete, and the closure objectives established in the SAFER Plan (NNSA/NFO, 2015a) have been achieved.

The corrective action of clean closure at CAU 411 is based on an evaluation of both the CW and the IA exposure scenarios. The conservative estimates of dose at the locations of highest radioactivity were all below the FAL for both of these scenarios. If land use were to change that could result in potential exposures exceeding that of the IA exposure scenario (such as release of this property to the public), the closure of CAU 411 would need to be reevaluated.

H.3.0 References

ASTM, see ASTM International.

ASTM International. 1995 (reapproved 2015). *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, ASTM E1739 - 95(2015). West Conshohocken, PA.

CFR, see *Code of Federal Regulations.*

Code of Federal Regulations. 2016. Title 10 CFR, Part 20, "Standards for Protection Against Radiation." Washington DC: U.S. Government Printing Office.

DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency.

NAC, see *Nevada Administrative Code.*

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

Nevada Administrative Code. 2014a. NAC 445A.227, "Contamination of Soil: Order by Director for Corrective Action; Factors To Be Considered in Determining Whether Corrective Action Required." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 11 February 2016.

Nevada Administrative Code. 2014b. NAC 445A.22705, "Contamination of Soil: Evaluation of Site by Owner or Operator; Review of Evaluation by Division." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 11 February 2016.

Nevada Administrative Code. 2014c. NAC 459.316 to 459.3184 "Radiological Criteria for Termination of License." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 11 February 2016.

USAF, see U.S. Air Force, 99 ABW/CC.

U.S. Air Force, 99 ABW/CC. 2014. Letter to R.Boehlecke (NNSA/NFO) titled "Air Force Response to DOE Request to Close Five Radiological Sites on the NTTR," 2 May. Nellis AFB, NV.

U.S. Department of Energy. 2013. *Radiation Protection of the Public and the Environment,* DOE Order 458.1, Change 3. Washington, DC: Office of Health, Safety, and Security.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2015a. *Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 411: Double Tracks Plutonium Dispersion (Nellis), Nevada Test and Training Range, Nevada*, Rev. 0, DOE/NV--1533. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2015b. *United States Nuclear Tests, July 1945 through September 1992*, DOE/NV--209-REV 16. Las Vegas, NV.

U.S. Environmental Protection Agency. 1989. *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A),* EPA/540/1-89/002. Washington, DC: Office of Emergency and Remedial Response.

Appendix I

Evaluation of Corrective Action Alternatives

I.1.0 Evaluation of Corrective Action Alternatives

This appendix is not applicable to CAU 411, because the presumed corrective action of clean closure was proposed in the SAFER Plan and confirmed by the CAI.

Appendix J

Sample Location Coordinates

J.1.0 Sample Location Coordinates

The center of each sample plot and the locations of individual (judgmental) sample locations for CAU 411 were surveyed using a GPS instrument. Survey coordinates for these locations are listed in Table J.1-1.

Table J.1-1
Sample Plot and Drainage Sample Location Coordinates for CAU 411

Sample Plot/Location	Easting[a]	Northing[a]
A01	501295	4171163
A05	500786	4172654
A09	501031	4172509
A13	501132	4173008
A14	501049	4172697
A15	500987	4172682
A16	500982	4172675
A17	500985	4172640
A18	500978	4172615
A19	500979	4172500
A20	500970	4172488
A21	500974	4172412
A22	500968	4172269
A23	500986	4171644
A24	501343	4170884
A25	501481	4173091
A26	500652	4173313
A27	500563	4172055
A28	501124	4172988

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

NAD = North American Datum
UTM = Universal Transverse Mercator

Nine aliquot sample locations were established at each plot for each composite sample in accordance with the procedure described in the Soils RBCA document (NNSA/NSO, 2014). 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.

J.2.0 References

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

Appendix K

Nevada Division of Environmental Protection Comments

(14 Pages)

NEVADA ENVIRONMENTAL MANAGEMENT OPERATIONS ACTIVITY
DOCUMENT REVIEW SHEET

1. Document Title/Number: Closure Report for Corrective Action Unit 411: Double Tracks Plutonium Dispersion (Nellis), Nevada Test and Training Range, Nevada, February 2016	2. Document Date: February 2016
3. Revision Number:	4. Originator/Organization: Navarro
5. Responsible DOE NNSA/NFO Activity Lead: Tiffany Lantow	6. Date Comments Due: May 6, 2016
7. Review Criteria: Chris Andres and Scott Page, Nevada Division of Environmental Protection	
8. Reviewer/Organization Phone No.: (702) 486-2850, extensions 232 and 237	9. Reviewer's Signature:

10. Comment Number/Location		11. Type[a]	12. Comment	13. Comment Response
1.	Section Executive Summary, Page ES-1, 3rd Paragraph		After closure, how will USAF recognize that the site is "clean" under the "CW exposure scenario" but not for general use?; i.e., is there a system to inform current and future range users this real estate can be used for this scenario and to account for changes in mission or new proposed land use?	NNSA/NFO has provided USAF with GIS files delineating the contamination area fence boundary at CAU 411 and copies of all FFACO documents relating to site closure. NTTR site users must coordinate with the NTTR USAF Range Operations Center before accessing the range. USAF has indicated that they do not permit operations inside any of the fenced-off areas at the DT and CS sites. It is incumbent upon USAF to notify NNSA/NFO of mission and/or land use changes in order that NNSA/NFO may reevaluate site conditions. No revisions were made to the document.
2.	Section 1.0, Page 1, 3rd and 4th Paragraphs		Paragraph 3: a) 4th sentence: Insert "1996" between "The" and "interim" for clarity. b) Sentence beginning with, "An effort...": name the "regulators" c) Last sentence: suggest delete, the state is not directly relevant to CAU 411. Paragraph 4: d) 2nd sentence: Replace the phrase "conservative estimates" with "conservative assumptions". e) 2nd sentence: Replace the phrase "exposure paradigms", with "exposure scenarios" for consistency with Soils Activity prevailing nomenclature. f) 3rd sentence: Replace the phrase "this conservatism" with "these conservative assumptions"; change the phrase "will result" to "may result." g) 3rd sentence: Briefly explain what is meant by "false-negative decision error" (contamination exceeding FALs is not thought to be present when it actually is).	a) Revised as suggested. b) The sixth sentence of the third paragraph of Section 1.0 was revised to read, "An effort…negotiation with the Nevada Division of Environmental Protection (NDEP)." c) The last sentence of the third paragraph of Section 1.0 was deleted as suggested. d), e), f), and g): The fourth paragraph of Section 1.0 was revised to read, "The CAU 411 dose estimates presented in this CR are intended to estimate the maximum potential dose that any receptor could reasonably receive under current and foreseeable future use of the contaminated area. These dose estimates were made using conservative values for site physical properties, contaminant properties, dose conversion properties, and exposure durations. While this conservatism results in dose estimates that are higher than actual expected doses, it provides protection against making a false-negative decision error (i.e., a decision that contamination exceeding final action levels [FALs] is not present when it actually is)."

[a]Comment Types: M = Mandatory, S = Suggested.
Return Document Review Sheets to NNSA/NFO Environmental Management Operations Activity, Attn: QAC, M/S NSF 505

NEVADA ENVIRONMENTAL MANAGEMENT OPERATIONS ACTIVITY
DOCUMENT REVIEW SHEET

1. Document Title/Number: Closure Report for Corrective Action Unit 411: Double Tracks Plutonium Dispersion (Nellis), Nevada Test and Training Range, Nevada, February 2016	2. Document Date: February 2016
3. Revision Number:	4. Originator/Organization: Navarro
5. Responsible DOE NNSA/NFO Activity Lead: Tiffany Lantow	6. Date Comments Due: May 6, 2016
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8. Reviewer/Organization Phone No.: (702) 486-2850, extensions 232 and 237	9. Reviewer's Signature:

10. Comment Number/Location		11. Type[a]	12. Comment	13. Comment Response
3.	Section 1.2, Page 3, 1st Paragraph		a) 1st sentence: Change to "debris *were* removed" b) 2nd and 3rd sentences: For information, parenthetically add what were the "concentration-based level" and the "target action level".	a) Revised as suggested. b) The second sentence of Section 1.2 was revised to read, "...concentration-based action level of 200 picocuries per gram (pCi/g) total transuranics in place at the time." The target action level is the same as the concentration-based action level. The word "target" was replaced with "1996" in the third sentence of Section 1.2.
4.	Section 1.3, Page 4,		For every appendix described as "not applicable", include the one sentence explanation shown in each appendix stating why the appendix is not applicable.	The suggested statements were added to Appendices B, C, F, G, and I in Section 1.3.
5.	Section 1.3.2, Page 5, 3rd Paragraph		Last sentence: Editorial: "Construction Worker – year", insert hyphen.	Although the acronym contains a hyphen, the definition does not. (This is also true for millirem per Industrial Area year [mrem/IA-yr]). No revision was made to the document.
6.	Section 2.0, Page 7, 1st Paragraph		The sentence, "The CAI results and dose calculations are presented in Appendix D." Appendix D does not identify a listing or discussion of confirmatory sampling test results (e.g., analytical results) and dose calculations are not shown. Suggest re-titling the Appendix and adding the content to reflect the title. For example, add an additional column to Table D.2-2, "Results (or Detected COCs").	The last sentence of Section 2.0 was deleted and replaced with the following, "A discussion of CAI activities and the calculated dose at CAU 411 is presented in Appendix D. The methods used to calculate dose are detailed in the SAFER Plan (NNSA/NFO, 2015a) and the Soils RBCA document (NNSA/NFO, 2014)." The analytical data, TLD measurements, and removable contamination survey results are not presented in the CR because they are not directly comparable to the dose-based FAL (mrem/year), on which FFACO corrective action decisions are based. The dose calculations and supporting data are available for review upon request. No revisions were made to the document.
7.	Section 2.2, Page 9, 1st Paragraph		a) Section Heading: Describe how deviations from the SAFER Plan were "Approved". b) First bulleted paragraph: State the sample locations (A-15 to A22) where TLD data was planned but not taken.	a) This section header is referencing deviations from the approved SAFER Plan, not approved deviations. This section header is from the FFACO CR outline; no revisions were made to the document. b) The first sentence of the first bullet in Section 2.2 was revised to read, "...not placed at the drainage sample locations (A15 through A22) during the CAI."

[a]Comment Types: M = Mandatory, S = Suggested.
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8.	Section 4.1.2.1, Page 17, Criterion 1a		The sentences, "Sample plot locations were selected based on the areas of highest radioactivity identified in aerial and KIWI radiation surveys (Section D.2.3.1). Sample plot locations were further biased to areas of highest radioactivity using FIDLER survey data." Section 2.6 of the Soils QAP: "When decision supporting data are used, limitations and explanations of data quality must be presented in the applicable FFACO reports." As written, no such assessments are apparent in Section 4.1. In agreement with (IAW) the QAP, evaluate the data quality for aerial KIWI, and FIDLER data sets used in the judgmental sampling location selection per the requirements for decision-supporting data.	The following was added before the first paragraph of Section 4.1: "The CAU 411 SAFER Plan identified the use of each dataset in making corrective action decisions (NNSA/NFO, 2015a). Aerial and ground-based radiological surveys were classified as decision-supporting data, for which limitations and data quality must be assessed. The quality of these datasets is discussed in Section 4.1.10. Analytical data from soil samples and TLD measurements were classified as decisional data, which require the highest level of quality assurance (QA)/quality control (QC). The DQA for the analytical dataset is discussed in Section 4.1.2. The quality of TLD data is assessed by the management and operating (M&O) dosimetry contractor at the NNSS, who maintains a comprehensive QA program in accordance with 10 CFR 830 (CFR, 2016a). The TLDs placed at CAU 411 to measure external dose are the same as those used in the routine NNSS environmental monitoring program. TLDs were obtained from, and measured by, the M&O contractor. TLD data meet rigorous data quality requirements outlined in a comprehensive QA program. This program addresses management, training, and qualification requirements; quality improvement and work processes; record keeping; performance; and program assessment. The effectiveness of the QA program is demonstrated, in part, through satisfactory completion and maintenance of the U.S. Department of Energy Laboratory Accreditation Program (DOELAP) accreditation. In addition, dosimetry program operations are routinely reviewed and improved through the use of blind audits, DOELAP performance testing, onsite audits, and internal assessments. Dosimetry program documents are reviewed biennially and updated as necessary. TLDs were analyzed using automated TLD readers that are calibrated and maintained by the contractor. QA requirements for the TLD readers include daily QC tests, reader calibration, reader linearity, reader crossover, and reader heating tests. Process variances and the necessary corrective actions are tracked; and activities are implemented to approve, evaluate, and resolve process variances and control nonconforming items until corrective actions are completed. Processes are reviewed and improved during the execution of the process and as a result of internal and external assessments." The following subsections were added after Section 4.1.9: ***"4.1.10 Data Quality for Decision-Supporting Data*** The SAFER Plan identified aerial and ground-based radiological survey data as decision-supporting data (NNSA/NFO, 2015a). The following subsections discuss the quality of these datasets, including aerial, KIWI, and FIDLER radiological surveys; and removable contamination surveys. ***4.1.10.1 Aerial Radiological Surveys*** Aerial radiological surveys were conducted at CAU 411 in 1993 (EG&G, 1995) and 2006 (NSTec, 2007). An evaluation of aerial survey data was completed in 1995 (DOE/NV, 1995). The evaluation suggests that aerial surveys underestimate the intensity of highly localized radiation sources due to the wide field of view of the aerial system. The report also states that the method for processing survey data can impact sensitivity and/or spatial resolution. The report concludes that aerial

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				survey data are useful for determining the general distribution of radionuclides at a site but are not recommended for more precise mapping of individual radionuclide distributions. A comparison of the quality of the 1993 and 2006 surveys concluded that the surveys are consistent with regard to contaminant distribution; however, the 2006 survey provides better spatial resolution (NSTec, 2007). Thus, the 2006 survey was used to guide the selection of sample locations for the 2012 PI and the CAI. The radiological surveys provide quality spatial data, with the limitation that the field of view from the aerial platform is not as precise as a ground-based survey. When these aerial surveys are used in conjunction with ground-based surveys that provide very high spatial resolution (less than 1 square meter [m^2]) and the data are used qualitatively, the quality of the 2006 aerial survey data is sufficient for guiding the biasing of sample locations and meets the requirements as decision-supporting data. ***4.1.10.2 KIWI Radiological Surveys*** In 1999, a report containing a rigorous review of the KIWI system and data processing methodology was published (BN, 1999). This report found no obvious errors in the techniques or procedures, and concluded that the measurement of surface activity by the KIWI is reproducible. The limitation of the KIWI data is that the results are in gross gamma counts, which are not directly comparable to a soil concentration. When these data are used qualitatively, the quality of KIWI survey data is sufficient for guiding the biasing of sample locations and meets the requirements as decision-supporting data. ***4.1.10.3 FIDLER Radiological Surveys*** The FIDLER detectors are calibrated annually and response-checked before use. In addition, a background survey is conducted before each radiological survey. The FIDLER data are processed using geospatial software and analyzed for trends. FIDLER data are paired with Global Positioning System (GPS) information to deliver high-quality spatial data. FIDLER data are used qualitatively for correlation to dose estimates to provide an estimate of the spatial extent of dose exceeding the FAL. It is also used qualitatively to guide the biasing of sampling locations. When the FIDLER data are used qualitatively for these purposes, the quality of FIDLER survey data is sufficient to meet the requirements as decision-supporting data. ***4.1.10.4 Removable Contamination Surveys*** The removable contamination surveys conducted during the 2012 PI and CAI at CAU 411 used the “stomp and tromp” methodology. The survey method uses a tool to obtain a swipe sample of removable radioactive contamination from the ground surface. The sample is then analyzed by calibrated radiation instruments that undergo daily quality checks. An assessment of this methodology was completed in 2000 (Tinney et al., 2000). The assessment concluded that the survey technique lacked verification and quality control, and was likely overly conservative in determining removable soil

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7. Review Criteria: Chris Andres and Scott Page, Nevada Division of Environmental Protection	
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			contamination. A qualitative assessment of the technique showed that the results of the surveys, averaged over large areas, appeared to be reproducible within ±30 percent. A correlation of the survey data to KIWI survey data resulted in a correlation coefficient of 0.75. The results of the survey methodology are used as an indicator of the need to assume the radiological dose to an offsite receptor would exceed 25 mrem/yr. This assumption is necessary in the absence of a methodology to estimate the dose an offsite receptor could receive from the uncontrolled removal of removable contamination. The use of the removable contamination survey data is limited to only a qualitative indicator to implement the conservative assumption of the need for corrective action based on an unknown dose to an unknown receptor. When used in this manner, the quality of removable contamination survey data is sufficient to meet the requirements as decision-supporting data."

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9.	Section 4.1.3, Page 23, 2nd Paragraph		a) First bullet: Consider the following as a possible revision, "The radiological dose resulting from the residual contamination at the site is less than the FAL using the CW exposure scenario." b) Second bullet: "Removable alpha contamination is less than the HCA criterion." There is no tabulated or statistical summary of the removable contamination data set. Demonstrate the removable alpha dataset in comparison with the 2,000 dpm/100 cm^2 limit in Section D.2.5.2.	a) The sentence after the first two bullets of Section 4.1.3 was revised to read, "As stated in the SAFER Plan (NNSA/NFO, 2015a), the closure objectives for CAU 411 are as follows: • Radiological contamination at the site is less than the FAL using the CW exposure scenario (i.e., the radiological dose is less than the FAL)." This revision, or similar language, was also made in the following sections where the closure objectives are stated: Executive Summary, Section 1.3.2, Section 4.0, Section D.1.0, and Section D.4.0. b) The following was added before the last sentence of the second paragraph of Section D.2.5.2, "The removable alpha contamination survey data at the soil sample plot locations were all below the HCA criterion; the highest survey result (239 dpm/100 cm^2) was at location A14. Survey results for PPE worn during CAI sampling at the sample plots ranged from 0 to 2 dpm/100 cm^2." Note: The draft CR erroneously reported that a removable contamination survey was completed at sample plot location A28. To correct this error, the first sentence of the second paragraph of Section D.2.5.2 was revised to read, "Removable contamination surveys were completed at three of the soil sample plots… (locations A09, A13, and A14)." Location A28 was also removed from Figure D.2-7 (Figure D.2-10 in the final document).
10.	Section 5.0, Page 27, 1st Paragraph		Because this CAU is wholly on NTTR, some verification (memorandum?) of USAF concurrence/coordination with conclusions and recommendations seems appropriate (see comment 1); refer to letter from Boehlecke to Maj. Kice, 25 Mar 2014, Subject: "Transmittal of Feb 5 Meeting Notes and Associated Documents".	A letter has been requested from USAF for CAU 411 site closure.

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11.	Appendix B, Page B-1		State why this appendix is not applicable.	Appendix B, Section B.1.0 was revised to read, "Certification of closure is required for permitted or interim status hazardous waste facilities, and is not applicable to CAU 411."
12.	Section D.1.0, Page D-1, 1st Paragraph		The sentence: "This appendix presents the CAI activities and ***analytical results*** for CAU 411, Double Tracks Plutonium Dispersion (Nellis)." However, the appendix does not identify tabulated analytical results for soil sampling or removable alpha activity measurements, which are the basis for evaluating if site closure objects have been met. Include soil sampling and removable alpha data IAW the Appendix title.	The first sentence of Section D.1.0 was deleted and replaced with the following, "This appendix presents the CAI activities and the calculated dose for CAU 411, Double Tracks Plutonium Dispersion (Nellis). The methods used to calculate dose are detailed in the SAFER Plan (NNSA/NFO, 2015a) and the Soils RBCA document (NNSA/NFO, 2014)." Also, see response to comments #6 and #9.
13.	Section D.2.0, Page D-2, 3rd Paragraph		3rd sentence: "CAI data used to define…"; explicitly specify which of these CAI data were classified as decisional for corrective action decisions.	The third sentence of the second paragraph of Section D.2.0 was revised to read, "CAI data used to calculate dose (i.e., soil sample and TLD data) are classified as decisional...".

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14.	Section D.2.2, Page D-3, 1st Paragraph		a) Radiological surveys are decision-supporting data used to aid in judgmental sampling. This section provides history on the CAI activities but does not provide any limitations and explanations of data quality. Include the limitations, data appropriateness, and data quality required for decision-supporting data as stated in the Soils QAP. Additionally, to assist the reader in determining if biasing was correct for the judgmental samples, the data set should be provided with an explanation of how the data was evaluated to determine a biased sampling location. b) 1st sentence: add reference. c) Add explanation and purpose of the large surveyed area west of GZ and CA fence; add discussion about the significant of Multiples of Background (MOB) at or below (2-3?) throughout the survey area; add MOB interpretation for high count areas in inset used for sample plot bias. d) The Figure data appears to be substantially smoothed by kriging: 1. Add brief explanation of data processing (were data lost?) 2. If MOB ranges do not appear in the Figure, why do they show in legend?	a) See response to comment #8 regarding data quality for decision-supporting data. The biasing of sample locations is discussed in the SAFER Plan and Section D.2.3.1. No revisions were made to the document. b) The first sentence was revised to read, "...at CAU 411 (N-I, 2013)." c) The fourth sentence of Section D.2.2 was deleted and replaced with the following, "Two areas outside the CA fence (one west and one south) beyond the edge of the 2006 aerial survey path were targeted to bound detected radiation in these areas and ensure the locations of proposed sample plots were at the highest radiation areas." The last sentence of the first paragraph of Section D.2.2 was deleted and replaced with the following, "In 2016, additional FIDLER surveys were conducted at CAU 411 inside and outside the CA fence. The objective of these surveys was to present the radiological conditions at the site at the time of closure. The entire area inside the CA fence was surveyed after several metal fragments identified near GZ during the CAI were removed for disposal (Section 3.1). Additional surveys were completed west and south of the CA fence to provide more comprehensive coverage of the site. Figure D.2-1 presents a composite of FIDLER data collected in 2012, 2015, and 2016. The FIDLER data shown inside the CA fence are exclusively from the 2016 data, which represent field conditions after the removal of some metal fragments during the CAI." d) The following was added as the second paragraph of Section D.2.2, "The FIDLER survey data presented in the SAFER Plan (NNSA/NFO, 2015a) were shown as discrete data points collected along the path that was walked/driven by the field technician. While these data are useful in identifying points of elevated radioactivity, they do not readily depict the contaminant distribution over the entire area surveyed. Using an inverse distance weighted interpolation technique, the discrete data points were processed to generate a continuous spatial distribution (i.e., interpolated surface), which is more easily compared to other datasets (e.g., soil sample data, aerial survey data). This interpolated surface maintains much of the variance inherent in the original point data, limiting the impact of averaging data over an area. The data variance is particularly important at sites where the contaminant distribution is heterogeneous, as at CAU 411. Another data processing technique was used to retain the intensity of radiation measured at point sources (e.g., metal fragments or isolated areas of soil with elevated radioactivity). This technique involved removing the point source data from the dataset before creating the interpolated surface and then overlaying the point source data on top of the surface. The combination of these two processes results in the display of both the general distribution of contamination and distinct areas of elevated radioactivity. Figure D.2-1 presents the interpolated surface for CAU 411". 1. No data were lost in the data processing; however, specific data were intentionally omitted from the process as indicated in response c) above. 2. The intent of including a number of range values (colors) on this figure is to show the variance in the dataset. The ranges were revised in the figure legend to ensure that data within each range/color are shown on the figure.

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15.	Section D.2.2, Page D-4, Figure D-2.1		e) NOTE: As delivered to NDEP on 23 Feb 2016, this figure was missing in the CR. FFACO documents transmitted to NDEP for review must include all referenced figures. Missing figures are not acceptable, and could result in the document being deemed deficient. Following an April 26, 2016 email request, the missing Figure was emailed to NDEP on April 27, 2016 and has generated the following comments: f) Several surveys are referenced in Sec. D.2.2. It appears not obvious on Figure D.2-1 which data from date(s) are shown or if the image is a composite of all surveys. Revise Figure to differentiate. g) Provide a scale bar for the enlarged area. h) Adding the 'Sample plot/TLD' and 'Sample Plot' locations would be appropriate since the stated Figure's purpose is to show how FIDLER was used to bias sample plots.	e) No response required. f) See response to comment 14 c). The title of Figure D.2-1 was revised to read, "FIDLER Survey Results (Composite of 2012, 2015, and 2016 Data)" g) A scale bar was added to the inset in Figure D.2-1. h) The purpose of this figure is to show radiological conditions at the site at the time of closure. The data from inside the CA fence were collected in 2016 and were not used to bias sample locations, so putting sample locations on this figure may be misleading. The CAU 411 sample locations are shown in Figure D.2-3. No revisions were made to the document.
16.	Section D.2.3, Page D-5, 2nd Paragraph		1st sentence: To clarify the sampling strategy, please develop and add a simple table that identifies each sample location, its biasing factor, and the results; e.g., Table J.1-1 with no coordinates, but adding 'Bias' and 'Results' columns.	A new column titled "Sample Location Biasing Factor" was added to Tables D.2-2 (CAU 411 Sample Plot Soil Samples) and D.2-4 (CAU 411 Drainage Samples). The biasing factors used to select the sample location or to select a sample for lab analysis are listed in the columns. In addition, the following was inserted after the second sentence of the fourth paragraph of Section D.2.3, "(See Tables D.2-2 and D.2-4 for the 2012 PI and 2015 CAI sample locations and the biasing factors used to select the locations.) Additional information on the selection of sample locations and biasing factors is found in the SAFER…". The fourth paragraph of Section D.2.3 was moved toward the end of the first paragraph.

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17.	Section D.2.3.1, Page D-6, Figures D.2-1 and D.2-2		Examining Figures D.2-1 (FIDLER) and D.2-2 (Samples), with the exception of a few difficult-to-discern outliers, the entire survey area is essentially at background. Therefore, this Figure requires interpretation about how it was used to bias sample locations.	The rationale for selection of sampling locations for the CAI was outlined in detail in the SAFER Plan (Section B.8.0). The interpolated FIDLER survey data shown in Figure D.2-1 were not used to bias sample locations. No revisions were made to the document.
18.	Section D.2.3.1, Page D-6, 2nd Paragraph		a) 2nd sentence: Suggest providing reference to the KIWI survey figure in the SAFER (i.e., Figure 2-1) and reproduce it here IAW the similar FIDLER discussion and figure presentation, Figure D.2-1. b) 3rd sentence: Briefly describe the highest value "isopleth/contour" concept and how it was used to establish location of sample plot.	a) The following was added to the end of the second sentence, "…(see Figure 2-1 of the SAFER Plan [NNSA/NFO, 2015a])." b) The third sentence in the second paragraph of Section D.2.3.1 was revised to read, "The areas with the most elevated radioactivity (as defined by the survey) were identified... would be wholly contained within the area."
19.	Section D.2.3.2, Page D-9, 1st Paragraph		3rd sentence: After this sentence, also please insert the fact that planned TLD data as described in Section 2.2 were not taken.	The third sentence was revised to read, "...during the 2012 PI or at any drainage locations sampled during the CAI (see Section D.2.7)."
20.	Section D.2.3.2, Page D-10, Figure D.2-3		a) The figure indicates elevated gamma readings at sample location A05 and A24, but then inexplicably truncates them. b) Discuss the truncation of the elevated readings for sample locations A05 and A24 by adding truncated surveyed area if available. c) The title of this Figure appears to be incorrect. d) Verify that Figure D.2-3 is referenced in this document.	a) and b) The figure presents the full extent of the 2006 aerial survey outside the CA fence (blue rectangle). The A05 and A24 locations are on the periphery of the survey extent. FIDLER surveys were completed at these two areas and are shown on Figure D.2-1. No revisions were made to the document. c) A table was inserted to Figure D.2-3 that includes the sample location and 95% UCL of the TED. d) Figure D.2-3 is referenced in the third paragraph of Section D.2.3.1 (page D-6 of the CR). No revisions were made to the document.
21.	Section D.2.3.2, Page D-11, Figure D.2-4		e) The title of this Figure appears to be incorrect. f) Verify that Figure D.2-4 is referenced in document.	e) A table was inserted in Figure D.2-4 that includes the sample location and 95% UCL of the TED. f) Figure D.2-4 is referenced in the third paragraph of Section D.2.3.1 (page D-6 of the CR). No revisions were made to the document.

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22.	Section D.2.3.3, Page D-14, 2nd Paragraph		g) The sentence beginning with, "At locations where screening criteria was exceeded...": add a discussion of the results. h) Provide the field screening value and analytical results for each of these sampling locations with the highest reading.	g) The following was added to the end of the second paragraph, "(See Table D.2-8 for the dose at each of the drainage sample locations.)" h) The second paragraph of Section D.2.3.3 was deleted. The second sentence of the third paragraph was revised to read, "…surface contamination, in accordance with the Soils RBCA document (NNSA/NFO, 2014)" The third, fourth, and sixth sentences of the third paragraph were deleted.
23.	Section D.2.4, Page D-15, Table D.2-4		i) The table would be much enhanced by adding the field screening values and analytical results for sampling locations with the highest readings.	i) See response to comment #22 h).
24.	Section D.2.4.1, Page D-16, 1st Paragraph		j) The sentence: "The internal dose for all radionuclides detected in a soil sample were then summed to yield an internal dose for that sample." The internal dose RRMGs listed on Table D.2-11 do not include naturally occurring radionuclides or daughter products although the document states all detected radionuclides were used to calculate an internal dose. Without the radionuclide analytical results from the soil samples, the validity of this statement cannot be verified. k) Provide the analytical results of the soil samples and include the internal dose calculation data set. l) Add reference to RBCA where appropriate. m) Suggest re-phrase sentence to "The internal dose for detected COC radionuclides in a soil sample were then summed to yield internal dose for that sample in accordance with methods described in the RBCA."	j) The sentence was revised to read, "The internal doses for all radionuclides detected in a soil sample (excluding lead-212 and -214, niobium-94, potassium-40, and thallium-208) were then summed to yield an internal dose for that sample in accordance with the Soils RBCA document (NNSA/NFO, 2014)." k) See response to comment #6. l) and m) See response to j.

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25.	Section D.2.4.2, Page D-18, 1st Paragraph		The sentence, "External dose estimates for CAU 411 are presented as net values (i.e., background radiation dose has been subtracted from the raw result)." Clarify that this is not raw (un-corrected TLD element data), since an element specific factor has been applied to normalize the element specific data sets.	The first sentence of the second paragraph of Section D.2.4.2 was revised to read," ...as net values (i.e., background radiation dose has been subtracted)." The term "raw result" was removed from the text as indicated above so as not to imply that the TLD data used to calculate dose are uncorrected.
26.	Section D.2.4.2, Page D-18, 2nd Paragraph		The sentence, "External dose was calculated for the IA exposure scenario (2,000-hour exposure duration) and then scaled to the CW exposure scenario (960-hour exposure duration) for each TLD location." Provide an example calculation of how the scaling was performed.	The following was inserted after the first sentence of the third paragraph of Section D.2.4.2, "This was accomplished by calculating the hourly rate (mrem/hr) for the IA scenario and multiplying this rate by the number of hours in the CW scenario (960 hours)."
27.	Section D.2.4.2, Page D-18, 3rd Paragraph		The sentence, "The correction factor was derived by evaluating previous data from Soils Activity sites where both TLD and RESRAD-derived external dose data were available." Add a graph of the data indicating the correlation.	Three correlation graphs were added to Section D.2.4.2 and are referenced in the last paragraph of that section. The three graphs contain (1) TLD dose vs. RESRAD external dose, (2) TLD correction factor vs. Release type, and (3) TLD correction factor vs. RESRAD external dose.
28.	Section D.2.4.2, Page D-19, 1st Paragraph		The sentence, "Therefore, attempting to correct RESRAD-derived external dose using data with very low external dose values (such as at CAU 411) can result in erratic and erroneous results." Provide a graph showing the correlation since the methodology is not defined.	

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29.	Table D.2-8, Page D-20		Re-title table so it is clear these are estimated values based on calculation and not measured values. The footnote is easily overlooked and the superscript footnote character does not appear in the table.	The footnote is meant to highlight the fact that the external dose at the drainage sample locations was calculated, not measured. In fact, all of the doses presented in this CR (internal and external) are estimates, in that they are calculated and not directly measured. No revisions were made to the title of Table D.2-8; however, the superscript letter "a" was added after the title.
30.	Appendix E		NOTE: As delivered to NDEP on 23 Feb 2016, the contents of appendix were missing. FFACO documents transmitted for NDEP for formal review must include all referenced sections. Missing sections are not acceptable, and could result in the document being deemed deficient. An explanation needs to be included as to why this documentation was omitted.	The "Note" in Appendix E was revised to read, "Note: Disposal of the low-level radioactive waste generated at CAU 411 is currently pending. Waste disposal documentation will be included in an addendum to this CR upon receipt from the disposal facility." (However, if the waste disposal documentation becomes available before the CR is submitted to NDEP, the forms will be submitted as part of this appendix.)
31.	Appendix G		Will inspections or other forms of monitoring be conducted, i.e., on the CA fence and signage?	No inspection or monitoring is required by the FFACO at CAU 411. No revisions were made to the document. Note: Inspection and maintenance of the existing CA may be required in accordance with the Occupational Radiation Protection (10 CFR 835) program.

[a]Comment Types: M = Mandatory, S = Suggested.
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NEVADA ENVIRONMENTAL MANAGEMENT OPERATIONS ACTIVITY
DOCUMENT REVIEW SHEET

1. Document Title/Number: Closure Report for Corrective Action Unit 411: Double Tracks Plutonium Dispersion (Nellis), Nevada Test and Training Range, Nevada, February 2016	2. Document Date: February 2016
3. Revision Number:	4. Originator/Organization: Navarro
5. Responsible DOE NNSA/NFO Activity Lead: Tiffany Lantow	6. Date Comments Due: May 6, 2016
7. Review Criteria: Chris Andres and Scott Page, Nevada Division of Environmental Protection	
8. Reviewer/Organization Phone No.: (702) 486-2850, extensions 232 and 237	9. Reviewer's Signature:

10. Comment Number/Location		11. Type[a]	12. Comment	13. Comment Response
32.	Section H.2.0, Page H-7, 2nd Paragraph		a) 1st sentence: change TTR to NTTR. b) Last sentence: "...will have to be reevaluated." Even with no formal FFACO LURs presented in Appendix G, the site will likely remain unavailable for unrestricted use. As such, in lieu of UR content in Appendix G, there remain land use coordination issues that could be touched on, e.g.: description and GIS data transfer to USAF of surveyed CA area points/boundaries; list and location of residual contaminations; proposed missions that may arise under the agreed-on/future land use scenarios; documentation of AF acceptance of closure plan; and an administrative mechanism for addressing proposed future land use changes that would change the CW scenario, including notification of NDEP. None of this is addressed (see comments 1, 10).	a) The second paragraph of Section H.2.0 was rewritten as follows, "The corrective action of clean closure at CAU 411 is based on an evaluation of both the CW and the IA exposure scenarios. The conservative estimates of dose at the locations of highest radioactivity were all below the FAL for both of these scenarios. If land use were to change that could result in potential exposures exceeding that of the IA exposure scenario (such as release of this property to the public), the closure of CAU 411 would need to be reevaluated." b) See response to comment #1. In addition, clarification was added regarding land use scenarios evaluated by the CR. The third paragraph of Section 5.0 was rewritten as follows, "The closure of CAU 411 under the FFACO means that the selected corrective action has been accepted and approved by NDEP and other stakeholders. The closure of CAU 411 is based on an evaluation of both the CW and the IA exposure scenarios. The conservative estimates of dose at the locations of highest radioactivity were all below the FAL for both of these scenarios. If land use were to change that could result in potential exposures exceeding that of the IA exposure scenario (e.g., release of the property to the public), the closure of CAU 411 would need to be reevaluated. In the future, should the land custodian determine that a proposed mission use would not comport with the proposed closure of CAU 411, then DOE will work with the custodian and NDEP to address and resolve cleanup issues associated with the proposed use or transfer/relinquishment. DOE remains responsible for working with NDEP and other stakeholders as needed to revise or renegotiate any closure agreements, and remains liable for all costs associated with any future negotiation and/or remediation action for CAU 411, consistent with its responsibilities under applicable law."

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