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DOE/NV--1488

National Nuclear Security Administration

Corrective Action Decision Document for Corrective Action Unit 366: Area 11 Plutonium Valley Dispersion Sites Nevada National Security Site, Nevada

Controlled Copy No.: ___
Revision No.: 0

September 2012

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

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CORRECTIVE ACTION DECISION DOCUMENT FOR CORRECTIVE ACTION UNIT 366: AREA 11 PLUTONIUM VALLEY DISPERSION SITES NEVADA NATIONAL SECURITY SITE, NEVADA

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

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CORRECTIVE ACTION DECISION DOCUMENT
FOR CORRECTIVE ACTION UNIT 366:
AREA 11 PLUTONIUM VALLEY DISPERSION SITES
NEVADA NATIONAL SECURITY SITE, NEVADA

Approved by: /s/ Tiffany A. Lantow Date: 9/25/2012

Tiffany Lantow
Soils Activity Lead

Approved by: /s/ Wilhelm R. Wilborn Date: 9/25/12

for Robert F. Boehlecke
Environmental Management Operations Manager

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List of Acronyms and Abbreviations

Ac	Actinium
ALLW	Asbestos-containing low-level waste
Am	Americium
ASTM	ASTM International
bgs	Below ground surface
BMP	Best management practice
CA	Contamination area
CAA	Corrective action alternative
CADD	Corrective action decision document
CAI	Corrective action investigation
CAIP	Corrective action investigation plan
CAS	Corrective action site
CAU	Corrective action unit
CFR	*Code of Federal Regulations*
CLP	Contract Laboratory Program
cm	Centimeter
Co	Cobalt
COC	Contaminant of concern
COPC	Contaminant of potential concern
Cs	Cesium
CSM	Conceptual site model
CWD	Contaminated waste dump
day/yr	Days per year
DOE	U.S. Department of Energy
DQA	Data quality assessment
DQI	Data quality indicator

List of Acronyms and Abbreviations (Continued)

DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
Eu	Europium
FAL	Final action level
FD	Field duplicate
FFACO	*Federal Facility Agreement and Consent Order*
FIDLER	Field instrument for the detection of low-energy radiation
FSL	Field-screening level
FSR	Field-screening result
ft	Foot
ft^3	Cubic foot
gal	Gallon
GPS	Global Positioning System
GZ	Ground zero
HCA	High contamination area
hr/day	Hours per day
hr/yr	Hours per year
ID	Identification
IDW	Investigation-derived waste
in.	Inch
LCS	Laboratory control sample
LLW	Low-level waste
m	Meter
MDC	Minimum detectable concentration
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter

List of Acronyms and Abbreviations *(Continued)*

mi	Mile
MLLW	Mixed low-level waste
M&O	Management and operating
mrem	Millirem
mrem/IA-yr	Millirem per Industrial Area year
mrem/OU-yr	Millirem per Occasional Use Area year
mrem/RW-yr	Millirem per Remote Work Area year
mrem/yr	Millirem per year
N/A	Not applicable
NAC	*Nevada Administrative Code*
NAD	North American Datum
NDEP	Nevada Division of Environmental Protection
NIST	National Institute of Standards and Technology
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NNSS	Nevada National Security Site
NSTec	National Security Technologies, LLC
PAL	Preliminary action level
pCi	Picocurie
pCi/g	Picocuries per gram
POC	Performance Objective for the Certification of Nonhazardous Waste
PPE	Personal protective equipment
PRG	Preliminary Remediation Goal
PSM	Potential source material
Pu	Plutonium
QA	Quality assurance
QAP	Quality Assurance Plan

List of Acronyms and Abbreviations *(Continued)*

QC	Quality control
RBCA	Risk-based corrective action
RBSL	Risk-based screening level
RCRA	*Resource Conservation and Recovery Act*
RESRAD	Residual Radioactive
RRMG	Residual radioactivity material guideline
RSL	Regional Screening Level
RWMC	Radioactive waste management complex
SCL	Sample collection log
SDG	Sample delivery group
Sr	Strontium
SSTL	Site-specific target level
SVOC	Semivolatile organic compound
TBD	To be determined
TCLP	Toxicity Characteristic Leaching Procedure
TED	Total effective dose
TLD	Thermoluminescent dosimeter
TPH	Total petroleum hydrocarbons
TRS	Terrestrial radiological survey
U	Uranium
UCL	Upper confidence limit
UR	Use restriction
URMA	Underground radioactive material area
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
yd^3	Cubic yard

Executive Summary

This Corrective Action Decision Document (CADD) has been prepared for Corrective Action Unit (CAU) 366, Area 11 Plutonium Valley Dispersion Sites, located within Area 11 at the Nevada National Security Site, Nevada, in accordance with the *Federal Facility Agreement and Consent Order*. CAU 366 comprises six corrective action sites (CASs):

- 11-08-01, Contaminated Waste Dump #1
- 11-08-02, Contaminated Waste Dump #2
- 11-23-01, Radioactively Contaminated Area A
- 11-23-02, Radioactively Contaminated Area B
- 11-23-03, Radioactively Contaminated Area C
- 11-23-04, Radioactively Contaminated Area D

The purpose of this CADD is to identify and provide the rationale for the recommendation of corrective action alternatives (CAA) for the six CASs within CAU 366. Corrective action investigation (CAI) activities were performed from October 12, 2011, to May 14, 2012, as set forth in the *Corrective Action Investigation Plan for Corrective Action Unit 366: Area 11 Plutonium Valley Dispersion Sites.*

The approach for the CAI was divided into two facets: investigation of the primary release of radionuclides and investigation of other releases (contaminated waste dumps, migration in washes, releases to a decontamination station and hot park, and releases to the soil from potential source material [PSM]). The purpose of the CAI was to fulfill data needs as defined during the data quality objective (DQO) process. The CAU 366 dataset of investigation results was evaluated based on a data quality assessment. This assessment demonstrated the dataset is complete and acceptable for use in fulfilling the DQO data needs.

Investigation results were evaluated against final action levels (FALs) established in this document. A radiological dose FAL of 25 millirem per year was established based on the Occasional Use Area exposure scenario (80 hours of annual exposure). Radiological doses exceeding the FAL are present at five CASs, thus requiring corrective action. It was assumed that radionuclides were present at levels that require corrective action within the contaminated waste dumps associated with CASs 11-08-01 and 11-08-02 as well as within the high contamination areas (HCAs) associated with

CASs 11-23-02, 11-23-03, and 11-23-04. An additional area exceeding the FAL identified during the CAI is associated with a piece of radiological debris located west of the CAS 11-23-03 HCA.

During the CAI, two corrective actions were conducted. A 3-by-3-by-1-foot area of soil located outside the Project 56 contamination area was identified as containing removable radiological contamination exceeding HCA criteria. Subsequently, during the CAI, this soil was removed under a corrective action to reduce the radiological contamination to below the FAL. Additionally, it was determined during the CAI that two lead bricks and two batteries were PSM. Therefore, corrective actions were undertaken to remove the PSM and affected soil.

Recommended corrective actions were developed based on the evaluation of analytical data from the CAI and the assumed presence of contaminants of concern at specific locations, a review of future and current operations in Plutonium Valley, and the detailed and comparative analysis of the potential CAAs. The preferred CAAs were evaluated on technical merit focusing on performance, reliability, feasibility, safety, and cost. The alternatives were judged to meet all requirements for the technical components evaluated. The alternatives meet all applicable federal and state regulations for closure of the site and will reduce potential exposures to contaminated media to acceptable levels. Therefore, the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office provides the following recommendations:

- No further corrective action for CAS 11-23-01.
- Closure in place with use restriction for CASs 11-08-01, 11-08-02, 11-23-02, 11-23-03, and 11-23-04.

A Corrective Action Plan will be submitted to the Nevada Division of Environmental Protection that contains a detailed description of the proposed actions that will be taken to implement the selected corrective actions.

1.0 Introduction

This Corrective Action Decision Document (CADD) presents information supporting corrective action decisions for Corrective Action Unit (CAU) 366, Area 11 Plutonium Valley Dispersion Sites, located at the Nevada National Security Site (NNSS), Nevada. The corrective actions proposed in this document are in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) (1996, as amended) that was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management; U.S. Department of Defense; and DOE, Legacy Management. The NNSS is approximately 65 miles (mi) northwest of Las Vegas, Nevada (Figure 1-1).

CAU 366 comprises the six corrective action sites (CASs) that are shown on Figure 1-2 and listed below:

- 11-08-01, Contaminated Waste Dump #1
- 11-08-02, Contaminated Waste Dump #2
- 11-23-01, Radioactively Contaminated Area A
- 11-23-02, Radioactively Contaminated Area B
- 11-23-03, Radioactively Contaminated Area C
- 11-23-04, Radioactively Contaminated Area D

A detailed discussion of the history of this CAU is presented in the *Corrective Action Investigation Plan* (CAIP) *for Corrective Action Unit 366: Area 11 Plutonium Valley Dispersion Sites, Nevada National Security Site, Nevada* (NNSA/NSO, 2011).

1.1 Purpose

This CADD presents and evaluates potential corrective action alternatives (CAAs) and provides the rationale for the selection of recommended CAAs for the CASs in CAU 366. This includes a description of investigation activities, an evaluation of the data, and a description of CAAs. The investigative activities were completed in accordance with the CAIP except as noted in Section 2.1. The CAIP provides information relating to the scope and planning of the investigation. Therefore, that information will not be repeated in this document. The corrective action investigation (CAI) activities were completed in accordance with the *Soils Activity Quality Assurance Plan* (QAP) (NNSA/NSO, 2012a), which establishes requirements, technical planning, and general quality practices. The evaluation of investigation results and the risk associated with site contamination was

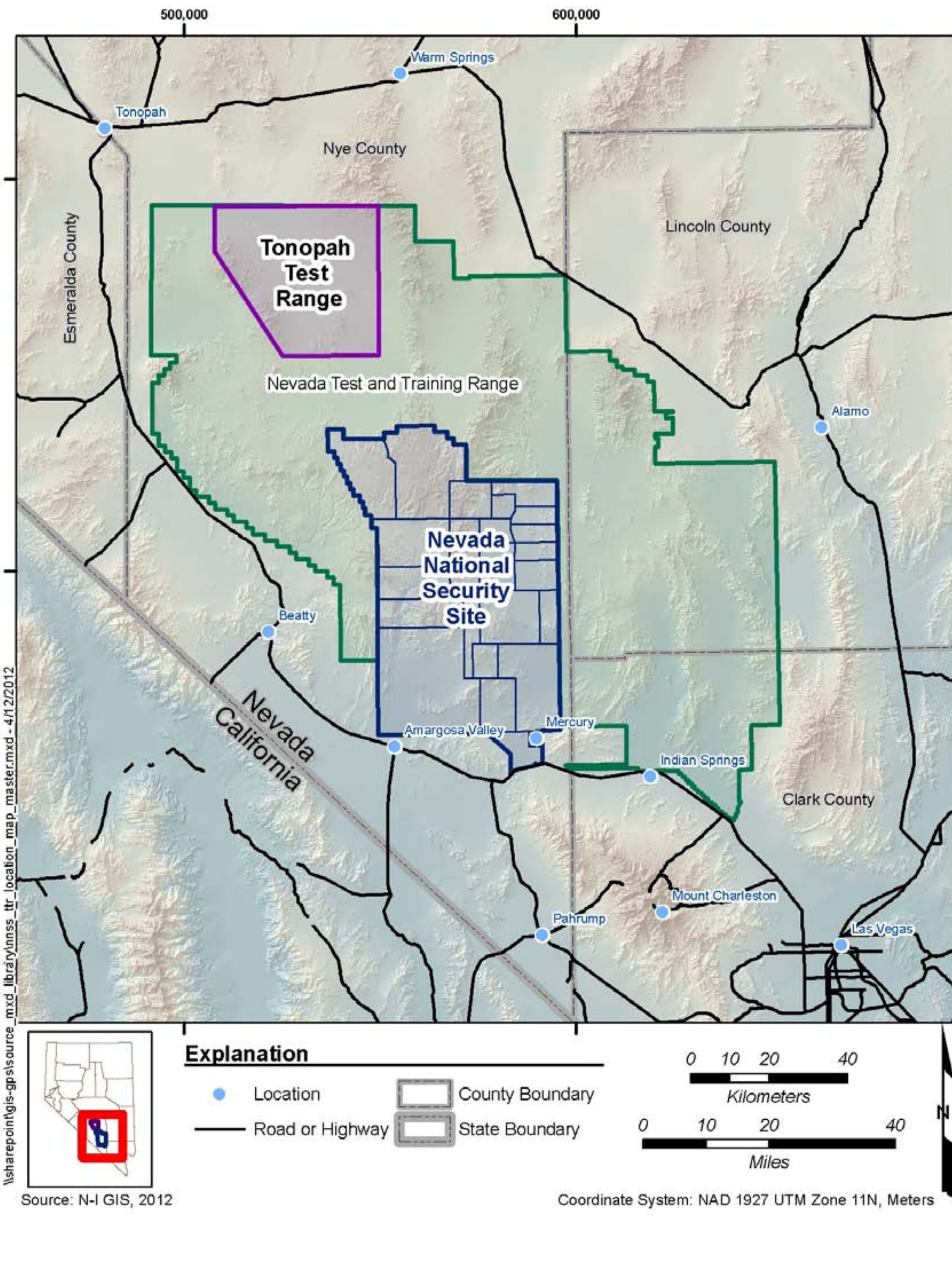

Figure 1-1
Nevada National Security Site

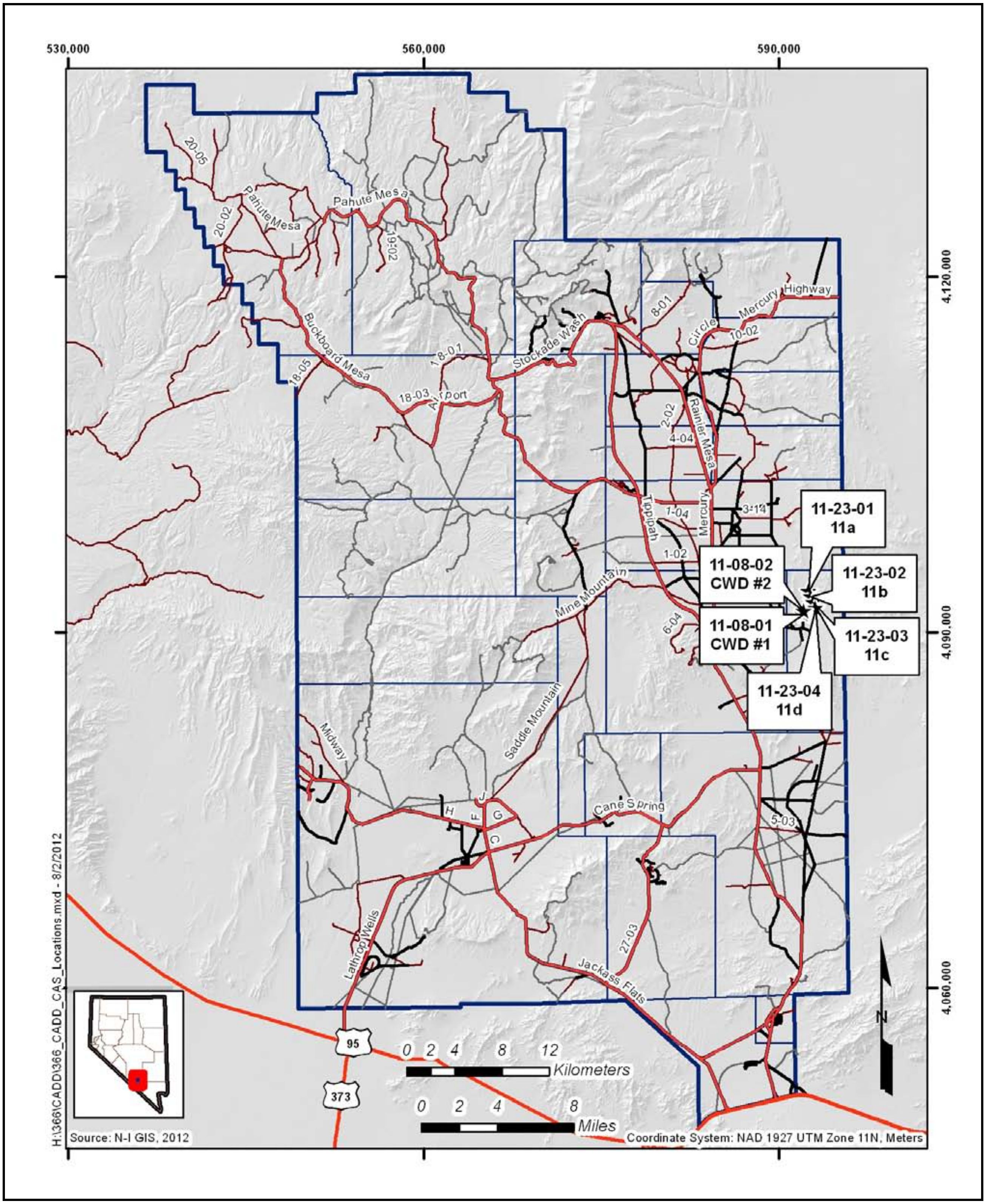

Figure 1-2
CAU 366, CAS Location Map

conducted in accordance with the *Soils Risk-Based Corrective Action* (RBCA) *Evaluation Process* (NNSA/NSO, 2012b).

CAU 366 consists of six inactive sites in Area 11 on the NNSS. All six CASs are located in Plutonium Valley and are associated with the safety experiments conducted as part of Project 56. Four experiments were conducted in close proximity and are referred to as the 11a, 11b, 11c, and 11d test areas. Two contaminated waste dumps (CWDs) were created for the disposal of test-related materials.

CASs 11-08-01 (referred to as CWD #1 in this document) and 11-08-02 (referred to as CWD #2 in this document) consist of a release of contaminants (primarily plutonium and enriched uranium) to the environment from stored debris (e.g., drums, cables) and buried metallic debris from material generated during the experimental activities at Project 56.

CASs 11-23-01, 11-23-02, 11-23-03, and 11-23-04 consist of a release of radioactive contaminants to the environment from four surface safety experiments conducted at four separate, close proximity test areas. Project 56 was the first test of a full-scale, completely assembled device to verify the nuclear safety in the event of an accidental detonation (e.g., handling, fire, electrical discharge). A primarily enriched uranium device was tested at CAS 11-23-01, while plutonium and enriched uranium devices were tested as CASs 11-23-02, 11-23-03, and 11-23-04. The following discusses the specifics of each CAS (DOE/NV, 2000):

- CAS 11-23-01 will be referred to as the 11a test area in this document. The safety experiment was detonated at the 11a test area on November 1, 1955, with a result of zero yield.
- CAS 11-23-02 will be referred to as the 11b test area in this document. The safety experiment was detonated at the 11b test area on November 3, 1955, with a result of zero yield.
- CAS 11-23-03 will be referred to as the 11c test area in this document. The safety experiment was detonated at the 11c test rea on November 5, 1955, with no yield.
- CAS 11-23-04 will be referred to as the 11d test area in the document. The safety experiment was detonated at the 11d test area on January 18, 1956 with a very slight yield.

Also included in the CAU 366 scope were potential releases to the soil from a Decontamination Station and Hot Park, drainage, and debris generated as a result of the Project 56 activities.

1.2 Scope

The CAI for CAU 366 was completed by demonstrating, through environmental soil and thermoluminescent dosimeter (TLD) sample analytical results and geophysical survey results, the nature and extent of contaminants of concern (COCs) at any CAS. For radiological releases, a COC is defined as the presence of radionuclides that jointly present a dose to a receptor exceeding a final action level (FAL) of 25 millirem per year (mrem/yr). For chemical releases, a COC is defined as the presence of a contaminant above its corresponding FAL. In accordance with the graded approach described in the Soils QAP (NNSA/NSO, 2012a), the quality required of a dataset will be determined by its intended use in decision making. Data used to define the presence of COCs are classified as decisional and will be used to make corrective action decisions. Survey data are classified as decision supporting and are not used, by themselves, to make corrective action decisions. As presented in Appendix D, the radiological and chemical FALs are based on the appropriate site-specific exposure scenario (occasional use area).

The RBCA dose evaluation does not address the potential for removable contamination to be transported to other areas. A discussion on the risks associated with removable radioactive contamination is presented in the Soils RBCA document (NNSA/NSO, 2012b). This requires corrective action for areas that exceed the high contamination area (HCA) criteria even though the area may not present a potential radiation dose to a receptor that exceeds the FAL. Therefore, it is assumed that removable contamination that exceeds HCA criteria requires corrective action.

Because the collection of samples was not feasible at some locations, an assumption was made that corrective action is required within the CWD #1 and #2 and within the established radiologically posted HCAs surrounding the 11b, 11c, and 11d test areas. For the remainder of the site, the scope of activities used to identify, evaluate, and recommend preferred CAAs for CAU 366 included the following:

- Performing visual inspections.
- Performing radiological surveys.
- Performing geophysical surveys.
- Collecting TLD samples.

- Collecting environmental samples for laboratory analyses.
- Collecting quality control (QC) samples for laboratory analyses.
- Removing potential source material (PSM) and contaminated soil for disposal.
- Collecting verification and waste management samples for laboratory analyses.
- Collecting Global Positioning System (GPS) coordinates of sample locations and points of interest.
- Evaluating corrective action objectives based on the results of the CAI and the CAA screening criteria.
- Recommending and justifying preferred CAAs.

1.3 CADD Contents

This CADD is divided into the following sections and appendices:

- Section 1.0, "Introduction," summarizes the purpose, scope, and contents of this CADD.
- Section 2.0, "Corrective Action Investigation Summary," summarizes the investigation field activities, the results of the CAI, and the need for corrective action.
- Section 3.0, "Evaluation of Alternatives," describes, identifies, and evaluates the steps taken to determine preferred CAAs.
- Section 4.0, "Recommended Alternatives," presents the preferred CAAs for each CAS and the rationale based on the corrective action objectives and screening criteria.
- Section 5.0, "References," provides a list of all referenced documents used in the preparation of this CADD.
- Appendix A, *Corrective Action Investigation Results*, provides a description of the project objectives, field investigation and sampling activities, CAI results, waste management, and quality assurance (QA). Sections A.3.0 through A.8.0 provide specific information regarding field activities, sampling methods, and laboratory analytical results from the CAI.
- Appendix B, *Data Assessment*, provides a data quality assessment (DQA) that reconciles data quality objective (DQO) assumptions and requirements to the CAI results.
- Appendix C, *Cost Estimates*, presents cost estimates for the construction, operation, and maintenance of the CAAs evaluated for each CAS.

- Appendix D, *Risk Assessment*, provides documentation of the chemical and radiological RBCA processes as applied to CAU 366.

- Appendix E, *Activity Organization*, identifies the DOE Soils Activity Lead and other appropriate personnel involved with the CAU 366 characterization and closure activities.

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

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

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

1.4 Applicable Programmatic Plans and Documents

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

- CAIP for CAU 366, Area 11 Plutonium Valley Dispersion Sites (NNSA/NSO, 2011)
- Soils QAP (NNSA/NSO, 2012a)
- Soils RBCA document (NNSA/NSO, 2012b)
- FFACO (1996, as amended)

2.0 Corrective Action Investigation Summary

The following subsections summarize the CAI activities and investigation results, and identify the necessity for corrective action at CAU 366. Detailed CAI activities and results for individual CAU 366 CASs are presented in Appendix A of this document.

2.1 Investigation Activities

CAI activities were performed as set forth in the CAIP (NNSA/NSO, 2011) from October 12, 2011, through May 14, 2012. The purpose of the CAU 366 CAI was to provide the additional information needed to resolve the following decision statements in the project-specific DQOs:

- Determining whether COCs are present in the soils associated with CAU 366.
- Determining the lateral and vertical extent of identified COCs.
- Ensuring adequate data have been collected to evaluate closure alternatives under the FFACO.

The scope of the CAI included the following activities:

- Performing visual inspections.
- Performing radiological surveys.
- Performing geophysical surveys.
- Collecting TLD samples.
- Collecting environmental samples for laboratory analyses.
- Collecting QC samples for laboratory analyses.
- Removing PSM and contaminated soil for disposal.
- Collecting verification and waste management samples for laboratory analyses.
- Collecting GPS coordinates of sample locations and points of interest.

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

- **Primary releases.** This release category is specific to the atmospheric deposition of radionuclide contamination onto the soil surface that has not been displaced through subsequent site activities. The contamination associated with the primary releases is limited to the top 5 centimeters (cm) of soil. Atmospheric releases of radionuclides that have been distributed at the NNSS from aboveground nuclear testing have been found to be predominately located in the upper 5 cm of undisturbed soil (McArthur and Kordas, 1983 and 1985; Gilbert et al., 1977; Tamura, 1977). Therefore, for the purposes of this CADD, surface is defined as the upper 5 cm of soil.

- **Other releases.** This release category includes any radionuclide contamination from test activities that is not limited to the surface 5 cm of soil. This includes radionuclide contaminants that were initially deposited onto the soil surface (as in the primary release category) but have subsequently been displaced through subsequent activities or migration in stormwater. This category also includes radionuclides that were deposited under mechanisms other than atmospheric deposition (such as radionuclides being driven into the soil by high explosives at each of the ground zero (GZ) areas, in landfills, or at debris like lead bricks). This includes any other chemical or radiological contamination that may be discovered during the investigation through the identification of biasing factors that are not part if a previously identified release.

For the primary release at the 11a, 11b, 11c, and 11d test areas, sample plots were established judgmentally based on the 1999 aerial radiation survey (BN, 1999) and the results of the terrestrial radiological surveys (TRSs). Within each sample plot, probabilistic sample locations were established based on a randomized grid. For other releases throughout the test area, sample plot or judgmental sample locations were selected based on biasing criteria such as elevated radiological readings, presence of radiological debris, knowledge of site operations, sediment accumulation areas, and PSM.

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

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

The potential internal dose at each soil sample location was determined based on the laboratory analytical results of soil samples and residual radioactivity material guidelines (RRMGs) that were calculated using the Residual Radioactive (RESRAD) computer code (Yu et al., 2001; NNSA/NSO, 2012b). The RRMGs are the activity concentrations of individual radionuclides in surface soil that would cause a receptor to receive an internal dose equal to the radiological FAL. The internal doses from each of the radionuclides are then summed to produce the total potential internal dose.

The calculated total effective dose (TED) (the sum of internal and external dose) for each sample location is an estimation of the true radiological dose (true TED). The TED is defined in 10 *Code of Federal Regulations* (CFR) Part 835 (CFR, 2012a) as the sum of the effective dose (for external exposures) and the committed effective dose (for internal exposures).

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

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

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

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

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

The reporting of investigation results and the evaluation of DQO decisions for different CSM components were organized into study groups. The study groups and the CASs associated with each study group are described in Table 2-1. Although the need for corrective action is evaluated separately for each study group, CAAs are evaluated for each FFACO CAS.

Table 2-1
CAU 366 Study Groups

Study Group	Description	FFACO CAS(s)
1	CWD #1, CWD #2, and 11a Trench	11-08-01, 11-08-02
2	11a, 11b, 11c, and 11d Test Areas	11-23-01, 11-23-02, 11-23-03, 11-23-04
3	Decontamination Station and Hot Park	11-23-04
4	Drainage	11-23-04
5	Radiological Debris	11-23-03
6	Other Debris	11-23-04

The following subsections describe specific investigation activities conducted at each CAS. Additional information regarding the investigation is presented in Appendix A. The migration pathway and release mechanism information gathered during the CAI were consistent with the CSM, and all information gathered during the CAI supports and validates the CSM as presented in the CAIP (NNSA/NSO, 2011).

2.1.1 Study Group 1

Investigation activities at CWDs #1 and #2 and the 11a trench included performing visual inspections, conducting TRSs, and conducting geophysical surveys. During the visual inspections, surface debris with highly elevated radiological survey readings were identified inside CWD #2 and in the 11a trench. The surface debris associated with CWD #2 was initially investigated as part of CAU 214, CAS 11-22-03.

The TRSs and geophysical surveys were conducted both outside and inside the posted boundary of CWD #1 (underground radioactive material area [URMA] posting), outside the posted boundary of CWD #2 (radiological posting URMA and HCA), and over the 11a trench and adjacent spoils pile. Due to the assumed presence of debris buried waste that would exceed FALs at CWD #2, no TRSs or geophysical surveys were conducted inside the fenced boundary. See Section A.3.1 for additional information on investigation activities conducted at CWDs #1 and #2 and the 11a trench. Results are reported in Section 2.2.1.1.

2.1.2 Study Group 2

Investigation activities at the 11a, 11b, 11c, and 11d test areas included performing visual inspections, conducting TRSs, staging TLDs, and collecting surface soil samples outside the HCAs. The TRSs were performed outside the HCAs and to the north/northeast to identify the spatial distribution of elevated radiological readings and verify the location of the fallout plume.

Sample plot locations were selected in areas of the most elevated radiological readings and in locations representative of aerial radiation survey isopleths. Sampling activities included the collection of composite soil samples from 10 sample plots to measure internal dose. In addition, TLDs were placed at the center of each sample plot and at 8 field background locations outside the fallout plume to measure external doses. See Section A.4.1 for additional information on investigation activities conducted at the test areas. Results of the sampling effort are reported in Section 2.2.1.2.

2.1.3 Study Group 3

Investigation activities of the Decontamination Station and Hot Park included performing visual inspections, conducting TRSs, staging TLDs, and collecting surface soil samples. The TRSs were performed in the areas identified on a historical engineering drawing as a Decontamination Station and Hot Park (LASL, date unknown). Two areas of elevated radiological readings were identified and investigated. No other biasing factors were identified.

Decontamination Station

As a result of the TRS, the area impacted by the Decontamination Station activities was posted as a contamination area (CA). Within the CA, there is evidence of an excavated area with a culvert that likely was used as a drainage pit. Field screening was performed in 5-cm increments to a depth of 20 cm in the area at the bottom of the pit that had the most elevated radiological readings (based on the TRS). It was determined that radiological readings for alpha contamination were most elevated on the surface and decreased with depth. A sample plot was located in the area with the most elevated radiological readings. Sampling activities included the collection of composite surface soil samples from one sample plot to measure internal dose and the placement of one TLD at the center of the sample plot to measure external dose.

Hot Park

The area identified as the Hot Park was determined to contain removable contamination at levels exceeding the HCA criteria. Two 55-gallon (gal) drums of soil were removed under a corrective action. Remaining soil did not exceed the HCA criteria for removable contamination. After soil removal, a sample plot was located in the area with the most elevated radiological readings. Sampling activities included the collection of composite surface soil samples from one sample plot to measure internal dose and the placement of one TLD at the center of the sample plot to measure external dose.

See Section A.5.1 for additional information on investigation activities conducted at the Decontamination Station and Hot Park. Results of the sampling effort are reported in Section 2.2.1.3.

2.1.4 Study Group 4

Investigation activities of the drainage included performing visual inspections, conducting TRSs, staging TLDs, and collecting surface and shallow subsurface soil samples. Sampling activities included the collection of biased samples from two sediment accumulation areas within the primary wash downgradient from the 11d test area. Samples were collected at 5-cm lifts from the ground surface to 30 cm below ground surface (bgs) within each of the two sediment accumulation areas. Samples were field screened, and the surface sample along with the sample with the highest FSR from each location were sent to the laboratory for analysis to measure the internal dose. A TLD was placed at each sample location to measure the external dose. See Section A.6.1 for additional information on investigation activities conducted in the drainage. Results of the sampling effort are reported in Section 2.2.1.4.

2.1.5 Study Group 5

Investigation activities for radiological debris included performing visual inspections, conducting TRSs, staging TLDs, and collecting surface soil samples. Biased samples for internal and external dose were collected adjacent to select pieces of elevated radiological debris to determine whether the debris is PSM. A single judgmental soil sample and a TLD were placed adjacent to five pieces of debris with either elevated radiological dose or elevated removable contamination. At one of these locations (A08), results were observed that were not consistent with radiation survey results. These anomalous results prompted resampling by placing a sample plot with a grid of 16 TLDs centered on the debris to better characterize the radiological conditions.

A location southwest of the 11c HCA was identified in the aerial survey as an extension of the americium plume that was initially assumed to be associated with migration of contaminants in a wash (N-I, 2012). During the CAI, it was discovered that this was not associated with migrating contaminants but rather with anomalous debris with high levels of radioactivity. Therefore, this area was included in the Study Group 5 investigation by placing a sample plot with a grid of 16 TLDs centered on the debris.

See Section A.7.1 for additional information on investigation activities associated with the radiological debris. Results of the sampling effort are reported in Section 2.2.1.5.

2.1.6 Study Group 6

Investigation activities for other debris included performing visual inspections and collecting soil samples. Two lead bricks and two batteries were located during the visual inspection of the Project 56 test area. The debris along with impacted soil were removed under a corrective action until verification samples confirmed remaining soil concentrations did not exceed FALs. See Section A.8.1 for additional information on investigation activities associated with the other debris. Results of the sampling effort are reported in Section 2.2.1.6.

2.2 Results

The summary of data from the CAI provided in Section 2.2.1 defines the areas within the CAU 366 study groups where the COCs exceeded the FALs and determines the extent of all identified COCs. Section 2.2.2 summarizes the assessment made in Appendix B, which demonstrates that the CAI results satisfy the DQO data requirements.

The preliminary action levels (PALs) and FALs for radioactivity are based on an annual dose limit of 25 mrem/yr. This dose limit is specific to the annual dose a receptor could potentially receive from a CAU 366 release. As such, it is dependent upon the cumulative annual hours of exposure to site contamination. The radionuclide RRMGs established in the CAIP were based on the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). It was subsequently determined to evaluate CAU 366 results based on the approved Soils RBCA document, as described in Section A.2.6. The PALs for radioactivity are based on a dose limit of 25 mrem/yr over an annual exposure time of 2,000 hours (i.e., the Industrial Area exposure scenario that a site worker would be exposed to site contamination for 250 day/yr and 8 hr/day). The FALs for radioactivity were established in Appendix D based on a dose limit of 25 mrem/yr over an annual exposure time of 80 hours (i.e., the Occasional Use Area exposure scenario defines that a site worker would be exposed to site contamination for 8 hr/day for 10 day/yr) for 5 years. To be comparable to these action levels, the CAU 366 investigation results are presented in terms of the dose a receptor would receive from site contamination under the Industrial Area (mrem/IA-yr), Remote Work Area (mrem/RW-yr), and Occasional Use Area (mrem/OU-yr) exposure scenarios.

The chemical PALs are based on the U.S. Environmental Protection Agency (EPA) Region 9 Regional Screening Levels (RSLs) for chemical contaminants in industrial soils (EPA, 2012) except where natural background concentrations of *Resource Conservation and Recovery Act* (RCRA) metals exceed the screening level (e.g., arsenic on the NNSS). The chemical FALs were established in Appendix D at the PAL concentrations.

2.2.1 Summary of Analytical Data

Results for each of the study groups are summarized in the following subsections. For radioactivity, results are reported as TED comparable to the radiological FAL as established in Appendix D. Calculation of the TED for each sample was accomplished through summation of internal and external dose as described. Chemical results are reported as individual analytical results compared to their individual FALs. PSM samples are evaluated against the PSM criteria and assumptions defined in Section 2.3 to determine whether a release of the waste to the surrounding environmental media could cause the presence of a COC in the environmental media (see Section 2.3). The FALs as established in Appendix D are based on the annual exposure duration of the Occasion Use Area scenario (80 hr/yr). The average and the 95 percent UCL TED values for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table 2-2.

2.2.1.1 Study Group 1

Contamination associated with CWDs #1 and #2 is assumed to exceed the FAL of 25 mrem/OU-yr. Visual inspection, geophysical surveys, and radiation surveys were used to determine whether buried debris exists beyond the CWD boundaries and, if so, the extent of buried debris. The results of the geophysical survey show buried metallic debris located in a mound adjacent to CWD #1. No buried metallic debris was identified outside the fenced boundary of CWD #2 or in the 11a trench. Due to the assumed presence of contamination that exceeds the FALs and buried metallic debris in the mound, corrective action is required for CASs 11-08-01 (including the adjacent mound) and 11-08-02. Figure A.3-3 shows the results of the geophysical surveys.

Table 2-2
TED at Sample Locations (mrem/yr)
(Page 1 of 2)

Plot or Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Study Group 2						
A01	0.4	1.4	0.1	0.2	0.0	0.1
B03	**25.4**	**34.3**	4.3	5.8	1.4	1.9
B04	2.8	3.7	0.5	0.6	0.2	0.2
B05	0.8	1.0	0.1	0.2	0.1	0.1
B06	0.5	0.6	0.1	0.1	0.0	0.0
B07	**50.9**	**68.0**	8.6	11.4	2.9	3.9
B08	3.8	5.6	0.6	0.9	0.2	0.3
B09	1.7	2.4	0.3	0.4	0.1	0.1
B10	0.8	1.1	0.1	0.2	0.1	0.1
B11	11.6	18.0	2.0	3.0	0.7	1.1
Study Group 3						
C01	0.5	1.4	0.1	0.2	0.0	0.1
C02	7.3	15.9	1.2	2.7	0.4	0.9
Study Group 4						
B01	1.3	2.4	0.2	0.4	0.1	0.1
B02	4.7	6.6	0.8	1.1	0.3	0.4
B12	3.5	3.8	0.6	0.6	0.2	0.2
B12 (subsurface)	1.7	--	0.3	--	0.1	--

Table 2-2
TED at Sample Locations (mrem/yr)
(Page 2 of 2)

Plot or Location	Industrial Area		Remote Work Area		Occasional Use Area	
	Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Study Group 5						
A08	**524.1**	**930.8**	**88.1**	**156.4**	**28.6**	**48.9**
	31.5	**48.2**	5.3	8.1	1.6	2.5
B13	**26.3**	**93.4**	4.4	15.7	1.3	4.7
B14	**40.2**	**49.7**	6.8	8.4	2.5	3.0
B15	9.7	11.7	1.6	2.0	0.6	0.7
B16	10.6	19.5	1.8	3.3	0.6	1.1
B21	**242.9**	**515.3**	**40.9**	**86.7**	13.8	**30.6**

Bold indicates the values exceeding 25 mrem/yr.

-- Indicates no 95% UCL TED value for the subsurface grab sample.

2.2.1.2 Study Group 2

The 95 percent UCL of TED for surface soils exceeded the PAL of 25 mrem/IA-yr at sample plots B03 and B07. No surface radiological contamination was found outside the default contamination boundaries that exceeds the FAL for the radiological dose (25 mrem/OU-yr) at any sample plots (Table 2-2). It is assumed that the removable radiological contamination associated with the three HCAs requires corrective action.

2.2.1.3 Study Group 3

The 95 percent UCL of TED for surface soils at the Decontamination Station (sample plot C02) did not exceed the PAL of 25 mrem/IA-yr (Table 2-2). Soil within the Hot Park was assumed to exceed the FAL of 25 mrem/OU-yr based on removable contamination being present that exceeded the HCA criteria. A corrective action of soil removal was completed. There were no exceedances of the FAL in verification samples (sample plot CO1) from the remaining soil; therefore, no further corrective action is required.

2.2.1.4 Study Group 4

The 95 percent UCL of TED for the judgmental sample locations selected in the sedimentation areas did not exceed the PAL of 25 mrem/IA-yr (Table 2-2). No corrective action is required.

2.2.1.5 Study Group 5

The 95 percent UCL of TED for the judgmental sample locations for A08, B13, and B14 exceeded the PAL of 25 mrem/IA-yr; but as only the sample plot results are being used to determine the need for corrective action, only location (B21) exceeded the 25 mrem/OU-yr FAL. Therefore, corrective action is required (Table 2-2).

2.2.1.6 Study Group 6

Two lead bricks and two batteries and associated soil were assumed to be lead PSM. Samples 366B009 and 366B010 (field duplicate [FD]) at sample location B17 contained lead concentrations exceeding the FAL (results of 179,000 milligrams per kilogram [mg/kg] and 4,870 mg/kg, respectively). Additional soil was removed until verification samples from remaining soil did not contain contamination exceeding the FAL.The debris and impacted lead soil was removed under a corrective action. Verification samples were collected after the soil removal. Therefore, no further corrective action is required. The analytical results are summarized in Table 2-3.

Table 2-3
Lead Results in Verification Samples

Sample Location	Sample Number	Lead (mg/kg)
FALs		**800**
B17	366B014	25.2
B18	366B011	9.27
B19	366B012	10.5
B20	366B013	29.3

2.2.2 Data Assessment Summary

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

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

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

Sample locations that support the presence and/or extent of contamination at each study group are shown in Appendix B. Based on the results of the DQA presented in Appendix B, the nature and extent of COCs at CAU 366 have been adequately identified to develop and evaluate CAAs. The DQA also determined that information generated during the CAI support the CSM assumptions and the data collected met the DQOs and support their intended use in the decision-making process.

There were no sample results greater than one-half the FALs for which DQIs did not meet established criteria; therefore, the DQA determined that information generated during the investigation supports the CSM assumptions, and the data collected support their intended use in the decision-making process (NNSA/NSO, 2012a). Based on the results of the DQA presented in Appendix B, the DQO requirements have been met.

2.3 Need for Corrective Action

Analytes detected during the CAI were evaluated against FALs to identify COCs. The presence of a COC requires a corrective action. A corrective action may also be necessary if wastes that are present at a site (i.e., PSM) could potentially release COCs into site environmental media.

To evaluate PSM for the potential to result in the introduction of a COC to the surrounding environmental media, the following conservative assumptions were made:

- Any physical waste containment would fail at some point, and the contents would be released to the surrounding media.

- The resulting concentration of contaminants in the surrounding media would be equal to the concentration of contaminants in the waste.
- Any liquid waste containing a contaminant exceeding the RCRA toxicity characteristic concentration would cause a COC to be present in the surrounding media if the liquid was released.
- Any non-liquid waste containing a contaminant exceeding an equivalent FAL concentration would cause a COC to be present in the surrounding media.

CAAs are identified and evaluated in Section 3.0. The impacted volume and characteristics for each study group are provided in the following subsections. Volume calculations for contaminated material to be removed from each area are shown in Appendix C. CAAs are not evaluated for CASs that do not currently contain COCs or PSM (following corrective actions completed during the CAI).

The CAAs are identified in Section 3.0 and evaluated for their ability to ensure protection of the public and the environment in accordance with *Nevada Administrative Code* (NAC) 445A (NAC, 2012a), feasibility, and cost effectiveness.

2.3.1 Study Group 1

It was assumed that CWDs #1 and #2 would have radiological contamination present at levels exceeding the FAL of 25 mrem/OU-yr and require corrective action. Geophysical surveys determined buried metallic debris is present in a mound that is located adjacent to, but outside the fenced boundary of, CWD #1. Therefore, the extent of CWD #1 will include the mound. The minimum combined affected volume of material for CWD #1 and the mound is 72,000 cubic feet (ft^3). According to the results of the geophysical survey, no buried metallic debris is located outside the fenced boundary of CWD #2. Therefore, the minimum affected volume of material for CWD #2 is 42,000 ft^3. The depth dimensions for both CWDs were obtained from historical documentation (Lyon, 1955). No metallic debris was identified at the 11a trench, so no corrective action is required at that feature. However, based on the assumed presence of COCs in the soil at CWDs #1 and #2, the CAAs of clean closure and closure in place with administrative controls will be evaluated for CASs 11-08-01 and 11-08-02.

2.3.2 Study Group 2

It was assumed that the HCA posted boundaries at the 11b, 11c, and 11d test areas have radiological contamination present at levels that exceed the FAL of 25 mrem/OU-yr and would require corrective action. The 11b and 11c HCAs each measure approximately 3 acres while the 11d HCA measures approximately 7.5 acres. Additionally, various debris is present within the HCAs. The volume of radiologically impacted soil (to a depth of 1 foot [ft]) and debris within the HCAs is estimated to be 653,000 ft^3. No radiological contamination associated with Study Group 2 was identified outside the three HCA boundaries that exceeded the FAL of 25 mrem/OU-yr. Based on the assumed presence of COCs in the soil within the HCAs, the CAAs of clean closure and closure in place with administrative controls will be evaluated for CASs 11-23-02, 11-23-03, and 11-23-04.

2.3.3 Study Group 3

A corrective action of soil removal was completed at the Hot Park. During the subsequent investigation, it was determined that no additional contamination is present at the Decontamination Station and Hot Park at levels exceeding the FAL of 25 mrem/OU-yr. Therefore, no further corrective action is required for these CAS components.

2.3.4 Study Group 4

It was determined through the CAI that no contamination is present in the drainage at levels exceeding the FAL of 25 mrem/OU-yr. Therefore, no corrective action is required. As presented in Section A.6.3, there is no expectation that future migration of contaminants in the washes at CAU 366 will result in a dose exceeding the FAL beyond the corrective action boundary.

2.3.5 Study Group 5

An area of soil impacted by radiological debris was identified adjacent to the 11c test area HCA. Contamination is present at levels exceeding the FAL of 25 mrem/OU-yr. Therefore, corrective action is required. As the impacted area surrounds the Study Group 2 corrective action boundary, the total area to be considered for CAAs (inclusive of Study Group 2) is estimated to be 1,710,000 ft^3. Based on the presence of COCs in the soil, the CAAs of clean closure and closure in place with administrative controls will be evaluated.

2.3.6 Study Group 6

The lead bricks and batteries were PSM and required corrective action. The debris and impacted soil were removed and disposed of appropriately during the CAI. A corrective action was completed for the PSM and impacted soil. Therefore, no further corrective action is needed for this CAS component.

3.0 Evaluation of Alternatives

The purpose of this section is to present the corrective action objectives for CAU 366, describe the general standards and decision factors used to screen the various CAAs, and develop and evaluate a set of selected CAAs that will meet the corrective action objectives.

3.1 Corrective Action Objectives

The corrective action objective is to ensure that receptors are not subjected to an unacceptable risk from an exposure to a COC. For the judgmental sampling design, any contaminant associated with a release that is remaining at concentrations exceeding its corresponding FAL will be defined as a COC. For the probabilistic sampling design, any significant contaminant of potential concern (COPC) (as defined in Section A.2.2.2 of the CAIP) associated with a release from the CAS that has a 95th percent UCL of the average concentration 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 constituent analysis (NNSA/NSO, 2012b). Multiple constituent analyses are presented in Appendix D. Implementation of the corrective action will ensure that each release site will not pose an unacceptable risk to human health and the environment, and that conditions at each site are in compliance with all applicable laws and regulations. As presented in Section 2.3, the evaluation of the need for corrective action also includes the potential for wastes that are present at a site to cause the future contamination of site environmental media if the wastes were to be released.

The RBCA process used to establish FALs is described in the Soils RBCA document (NNSA/NSO, 2012b). This process conforms with NAC 445A.227, which lists the requirements for sites with soil contamination (NAC, 2012b). For the evaluation of corrective actions, NAC 445A.22705 (NAC, 2012c) requires the use of ASTM International (ASTM) Method E1739 (ASTM, 1995) to "conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary." For the evaluation of corrective actions, the FALs are established as the necessary remedial standard.

This RBCA process defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses:

- **Tier 1 evaluation.** Sample results from source areas (highest concentrations) are compared to action levels based on generic (non-site-specific) conditions (i.e., the PALs established in the CAIP [NNSA/NSO, 2011], except as noted in Section A.2.6). The FALs may then be established as the Tier 1 action levels or the FALs may be calculated using a Tier 2 evaluation.

- **Tier 2 evaluation.** Conducted by calculating Tier 2 site-specific target levels (SSTLs) using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 SSTLs are then compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis. Concentrations of total petroleum hydrocarbons (TPH) will not be used for risk-based decisions under Tier 2 or Tier 3. Rather, the individual chemicals of concern will be compared to the SSTLs.

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

A Tier 1 evaluation was conducted for all COPCs to determine whether contaminant levels satisfy the criteria for a quick regulatory closure or warrant a more site-specific assessment. This was accomplished by comparing individual source area contaminant concentration results to the Tier 1 action levels.

The contaminants detected at the CAU 366 CASs that exceeded Tier 1 action levels were as follows:

- TED at CASs 11-08-01, 11-08-02, 11-23-02, 11-23-03, and 11-23-04
- Lead at CAS 11-23-04

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

The calculated TEDs and the establishment of the Tier 2 action levels (presented in Appendix D) was based on risk to receptors. The radiological risk to receptors from contaminants at CAU 366 is due to chronic exposure to radionuclides (i.e., receiving a dose over time). Therefore, the risk to a receptor is directly related to the amount of time a receptor is exposed to the contaminants. A review of the current and projected use of this site determined that workers may only be present for a limited number of hours per year, and it is not reasonable to assume that any worker would be present at this site on a full-time basis (DOE/NV, 1996).

Based on current site usage, it was determined in the CAU 366 DQOs that the Occasional Use Area exposure scenario would be appropriate in calculating receptor exposure time. In order to quantify the maximum number of hours a site worker may be present at CAU 366, current and anticipated future site activities were evaluated as part of the CAI (see Appendix D). This evaluation concluded that the most exposed worker under current land usage is an inspection and maintenance worker that has the potential to be present at the site for up to 20 hr/yr. As a result, it was determined that the most exposed worker could not be exposed to site contamination for more time than is assumed under the Occasional Use exposure scenario (80 hr/yr). Therefore, the TEDs at each location were calculated using an exposure time of 80 hr/yr and the 95 percent UCL of the TED measured at each location was used to compare to the Tier 2 action level. The Tier 2 action level was also calculated using an exposure time of 80 hr/yr. Additional details of the Tier 2 evaluation for radionuclides are provided in Appendix D.

Using the 95 percent UCL of the TED at the location (B21) of maximum measured dose, a receptor would have to be exposed to this location for 34 hours to receive a dose of 25 millirem (mrem). Thus, a receptor exposed to CAU 366 contamination at location B21 for 80 hr/yr (Occasional Use scenario) would exceed the 25-mrem/yr dose limit. Therefore, the Tier 2 evaluation for radionuclides exceeds the FAL and radionuclides are considered a COC. The calculation of the FAL for radionuclides is presented in Appendix D.

3.2 Screening Criteria

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

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

The general corrective action standards are as follows:

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

The remedy selection decision factors are as follows:

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

3.2.1 Corrective Action Standards

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

Protection of Human Health and the Environment

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

Compliance with Media Cleanup Standards

The CAAs are evaluated for the ability to meet the proposed media cleanup standards. The media cleanup standards are the FALs defined in Section 3.1.

Control the Source(s) of the Release

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

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

The CAAs are evaluated for the ability to be conducted in accordance with applicable federal and state regulations (e.g., 40 CFR 260 to 282, "Hazardous Waste Management" [CFR, 2012b]; 40 CFR 761 "Polychlorinated Biphenyls," [CFR, 2012c]; and NAC 444.842 to 444.980, "Facilities for Management of Hazardous Waste" [NAC, 2011]).

3.2.2 Remedy Selection Decision Factors

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

Short-Term Reliability and Effectiveness

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

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

Reduction of Toxicity, Mobility, and/or Volume

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

Long-Term Reliability and Effectiveness

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

Feasibility

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

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

Cost

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

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

3.3 Development of Corrective Action Alternatives

This section identifies and briefly describes the viable corrective action technologies and the CAAs considered for the CASs at CAU 366. The CAAs are based on the current nature of contamination at CAU 366, which does not include contamination removed as part of the corrective actions completed during the CAI (Section 2.2.1). Based on the review of existing data, future use, and current operations at the NNSS, the following alternatives have been developed for consideration at CAU 366:

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

Regardless of the CAA selected, a best management practice (BMP) will be conducted consisting of the implementation of an administrative UR for areas that exceed the 25-mrem/IA-yr PAL.

3.3.1 Alternative 1 – No Further Action

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

3.3.2 Alternative 2 – Clean Closure

For contaminated surface and subsurface soil, Alternative 2 includes excavating and disposing of all impacted soil and debris containing COCs. A visual inspection will be conducted to ensure that surface debris has been removed before the completion of the corrective action. Verification soil samples will also be collected and analyzed for the presence of COCs once the known volume of contaminated soil is removed.

Any contaminated material that is removed will be disposed of at an appropriate disposal facility. All excavated areas will be returned to surface conditions compatible with the intended future use of the site. Overburden soil (as feasible), along with additional clean fill, will be used to backfill excavations after removal of the contaminated soil. Clean borrow soil may be removed from a nearby location for placement in the excavation, as necessary.

3.3.3 Alternative 3 – Closure in Place with Administrative Controls

For contaminated surface and subsurface soil, Alternative 3 includes the administrative activities and costs associated with a UR for CASs where contamination is present at levels that exceed the FALs (CWDs #1 and #2; HCAs in the 11b, 11c, and 11d test areas; radiological debris). Administrative controls will restrict inadvertent contact with contaminated media by prohibiting any activity that would cause significant exposure of site occupants to the identified COCs.

3.4 Evaluation and Comparison of Alternatives

Each CAA presented in Section 3.3 will be evaluated for CASs that contain a COC based on the general corrective action standards described in Section 3.2. This evaluation is presented in Table 3-1. Any CAA that does not meet the general corrective action standards will be removed from consideration.

The remaining CAAs will be further evaluated based on the remedy selection decision factors described in Section 3.2. This evaluation is presented in Tables 3-2 and 3-3. For each remedy selection decision factor, the CAAs are ranked relative to each other. The CAA with the least desirable impact on the remedy selection decision factor will be given a ranking of 1. The CAAs with increasingly desirable impacts on the remedy selection decision factor will receive increasing rank numbers. The CAAs that will have an equal impact on the remedy selection decision factor will receive an equal ranking number. The scoring listed in this table represents the sum of the remedy selection decision factor rankings for each CAA. The scoring does not include the BMP because the BMP will be performed regardless of the CAA selected. The evaluation of CAAs also does not include corrective actions that have been completed during the CAI. The removal of soil containing removable contamination exceeding HCA criteria in Study Group 3 and the removal of lead in Study Group 6 are considered to be corrective actions. These CAS components are part of CAS 11-23-04, which contains other radiological COCs for which CAAs will be evaluated.

Table 3-1
Evaluation of General Corrective Action Standards
for CASs 11-08-01, 11-08-02, 11-23-02, 11-23-03, and 11-23-04

CAA 1, No Further Action		
Standard	**Comply?**	**Explanation**
Protection of Human Health and the Environment	No	COCs are assumed to be present at concentrations that exceed the FAL.
Compliance with Media Cleanup Standards	No	COCs are assumed to be present at concentrations that exceed the FAL.
Control the Source(s) of the Release	No	COCs are assumed to be present at concentrations that exceed the FAL.
Comply with Applicable Federal, State, and Local Standards for Waste Management	Yes	This alternative will not generate waste.
CAA 2, Clean Closure		
Standard	**Comply?**	**Explanation**
Protection of Human Health and the Environment	Yes	Contamination exceeding the risk-based action levels would be removed.
Compliance with Media Cleanup Standards	Yes	Contamination exceeding the risk-based action levels would be removed.
Control the Source(s) of the Release	Yes	Contamination exceeding the risk-based action levels would be removed.
Comply with Applicable Federal, State, and Local Standards for Waste Management	Yes	Excavated waste can be managed in compliance with all standards.
CAA 3, Closure in Place with Administrative Controls		
Standard	**Comply?**	**Explanation**
Protection of Human Health and the Environment	Yes	URs would be implemented to protect site workers from inadvertent contact with COCs.
Compliance with Media Cleanup Standards	Yes	Although COCs will not be removed, the CASs would be controlled to prevent workers from coming in contact with COCs.
Control the Source(s) of the Release	Yes	Although COCs will not be removed, the source of the release will be controlled through site restriction.
Comply with Applicable Federal, State, and Local Standards for Waste Management	Yes	This alternative will not generate waste.

Table 3-2
Evaluation of Remedy Selection Decision Factors for CASs 11-08-01 and 11-08-02

CAA 1, No Further Action		
Factor	**Rank**	**Explanation**
Not evaluated, as this CAA did not meet the General Corrective Action Standards		
CAA 2, Clean Closure		
Standard	**Rank**	**Explanation**
Short-Term Reliability and Effectiveness	1	This alternative is reliable and effective but involves increased short-term exposure of site workers to COCs.
Reduction of Toxicity, Mobility, and/or Volume	2	This alternative would result in a decrease of toxicity and mobility.
Long-Term Reliability and Effectiveness	2	This alternative is reliable and effective at protecting human health and the environment because removal of contaminated media will prevent future exposure of site workers to COCs.
Feasibility	1	This alternative is the most complicated of the CAAs.
Cost	1	The excavation and waste disposal costs for this alternative are higher than the other CAA (see Appendix C for details).
Score	7	
CAA 3, Closure in Place with Administrative Controls		
Standard	**Rank**	**Explanation**
Short-Term Reliability and Effectiveness	2	This alternative is reliable and effective in providing increased protection of human health by preventing contact with COCs.
Reduction of Toxicity, Mobility, and/or Volume	1	This alternative will not reduce toxicity or mobility of the COCs that are present but will not generate excavation waste volumes.
Long-Term Reliability and Effectiveness	1	This alternative is reliable in the long term with ongoing maintenance. It is effective in providing increased protection of human health by preventing contact with COCs.
Feasibility	2	This alternative is easily implemented but requires long-term maintenance.
Cost	2	The installation and ongoing maintenance costs for this alternative are lower than the other CAA (see Appendix C for details).
Score	8	

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Table 3-3
Evaluation of Remedy Selection Decision Factors
for CASs 11-23-02, 11-23-03, and 11-23-04

CAA 1, No Further Action		
Factor	**Rank**	**Explanation**
Not evaluated, as this CAA did not meet the General Corrective Action Standards		
CAA 2, Clean Closure		
Standard	**Rank**	**Explanation**
Short-Term Reliability and Effectiveness	1	This alternative is reliable and effective but involves increased short-term exposure of site workers to COCs.
Reduction of Toxicity, Mobility, and/or Volume	2	This alternative would result in a decrease of toxicity and mobility.
Long-Term Reliability and Effectiveness	2	This alternative is reliable and effective at protecting human health and the environment because removal of contaminated media will prevent future exposure of site workers to COCs.
Feasibility	1	This alternative is the most complicated of the CAAs.
Cost	1	The excavation and waste disposal costs for this alternative are higher than the other CAA (see Appendix C for details).
Score	7	
CAA 3, Closure in Place with Administrative Controls		
Standard	**Rank**	**Explanation**
Short-Term Reliability and Effectiveness	2	This alternative is reliable and effective in providing increased protection of human health by preventing contact with COCs.
Reduction of Toxicity, Mobility, and/or Volume	1	This alternative will not reduce toxicity or mobility of the COCs that are present but will not generate excavation waste volumes.
Long-Term Reliability and Effectiveness	1	This alternative is reliable in the long term with ongoing maintenance. It is effective in providing increased protection of human health by preventing contact with COCs.
Feasibility	2	This alternative is easily implemented but requires long-term maintenance.
Cost	2	The installation and ongoing maintenance costs for this alternative are lower than the other CAA (see Appendix C for details).
Score	8	

4.0 Recommended Alternative

CAAs were evaluated based on the Occasional Use Area exposure scenario FALs developed in the risk assessment (see Appendix D). The recommended CAAs presented in this section meet all applicable state and federal regulations for closure of the sites and will minimize potential future exposure pathways to the contaminated media at CAU 366.

The corrective actions were evaluated based on technical merits focusing on reduction of toxicity, mobility and/or volume; reliability; short- and long-term feasibility; and cost. The corrective action recommendations for CAU 366 are based on the assumption that activities on the NNSS will be limited to those that are industrial in nature and that the NNSS will maintain controlled access (i.e., restrict public access and residential use). Should the future land use of the NNSS change such that these assumptions are no longer are valid, additional evaluation may be necessary.

Alternative 1, no further action, is the preferred corrective action for the CAS 11-23-01 (11a test area). Selection of this CAA is consistent with past practices for CASs that do not contain COCs.

Alternative 2, clean closure, was not selected as the preferred corrective action for any CASs within CAU 366.

Alternative 3, closure in place with administrative controls, was the highest-scoring CAA in Tables 3-2 and 3-3 and is selected as the preferred corrective action for CASs 11-08-01 (CWD #1), 11-08-02 (CWD #2), 11-23-02 (11b test area), 11-23-03 (11c test area and radiological debris), and 11-23-04 (11d test area). Selection of this CAA is consistent with past practices for CASs that contain COCs where the removal of contaminated media is not feasible due to the high associated risk, the alternative is cost-effective, the selected alternative can be safely completed, and at CASs where limited future activity is expected. The CAS-specific activities recommended to meet the requirements of Alternative 3, closure in place with administrative controls, include the following:

- Remove the two drums, and place soil over the remaining exposed debris at CWD #2.
- Implement a UR around the perimeter of the COCs.

As a BMP, it is recommended that an administrative UR be placed to encompass areas where soil exceeds the PAL of 25 mrem/IA-yr. To determine the extent of the area where the Industrial Area TED exceeds the FAL, a correlation of radiation survey values to the 95 percent UCL of Industrial Area TED values was conducted for each radiation survey (2010 aerial radiation survey [N-I, 2012] and the site-specific TRS). The radiation survey with the best correlation was the aerial survey. The isopleth shown in Figure A.11-1 encompasses the area that exceeds the 25-mrem/IA-yr PAL. This includes the Decontamination Station and portions of the 11b, 11c, and 11d test areas.

Establishing an administrative UR would prevent any inadvertent exposure of workers to site radioactivity if a more intensive use of the site were to be considered in the future. The administrative URs will be recorded and controlled in the same manner as the FFACO URs but will not require posting or inspections. The administrative and FFACO URs will be established in the Closure Report.

All URs are recorded in the FFACO database; the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) Facility Information Management System; and the NNSA/NSO CAU/CAS files. The development of URs for CAU 366 are based on current land use. Any proposed activity within a use restricted area that would result in a more intensive use of the site would require NDEP approval.

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Appendix A

Corrective Action Investigation Results

A.1.0 Introduction

This appendix presents the CAI activities and analytical results for CAU 366. CAU 366 consists of six CASs located in Area 11 of the NNSS (Figure A.1-1):

- 11-08-01, Contaminated Waste Dump #1
- 11-08-02, Contaminated Waste Dump #2
- 11-23-01, Radioactively Contaminated Area A
- 11-23-02, Radioactively Contaminated Area B
- 11-23-03, Radioactively Contaminated Area C
- 11-23-04, Radioactively Contaminated Area D

CASs 11-08-01 and 11-08-02 (referred to as CWD #1 and CWD #2, respectively, in this document) consist of a release of contaminants, primarily plutonium and enriched uranium, to the environment from wastes generated from the testing activities at Project 56.

CASs 11-23-01, 11-23-02, 11-23-03, and 11-23-04 consist of releases of radioactive contaminants to the environment from four surface safety experiments conducted at four separate, close proximity test areas. Safety experiments are used to verify the nuclear safety of weapons in the event of an accidental detonation (e.g., handling, fire, electrical discharge). A primarily enriched uranium device was tested at CAS 11-23-01, while plutonium and enriched uranium devices were tested at CASs 11-23-02, 11-23-03, and 11-23-04. The following discusses the specifics of each CAS (DOE/NV, 2000):

- CAS 11-23-01 will be referred to as the 11a test area in this document. The safety experiment was detonated at the 11a test area on November 1, 1955, with a result of zero yield.

- CAS 11-23-02 will be referred to as the 11b test area in this document. The safety experiment was detonated at the 11b test area on November 3, 1955, with a result of zero yield.

- CAS 11-23-03 will be referred to as the 11c test area in this document. The safety experiment was detonated at the 11c test area on November 5, 1955, with no yield.

- CAS 11-23-04 will be referred to as the 11d test area in the document. The safety experiment was detonated at the 11d test area on January 18, 1956 with a very slight yield.

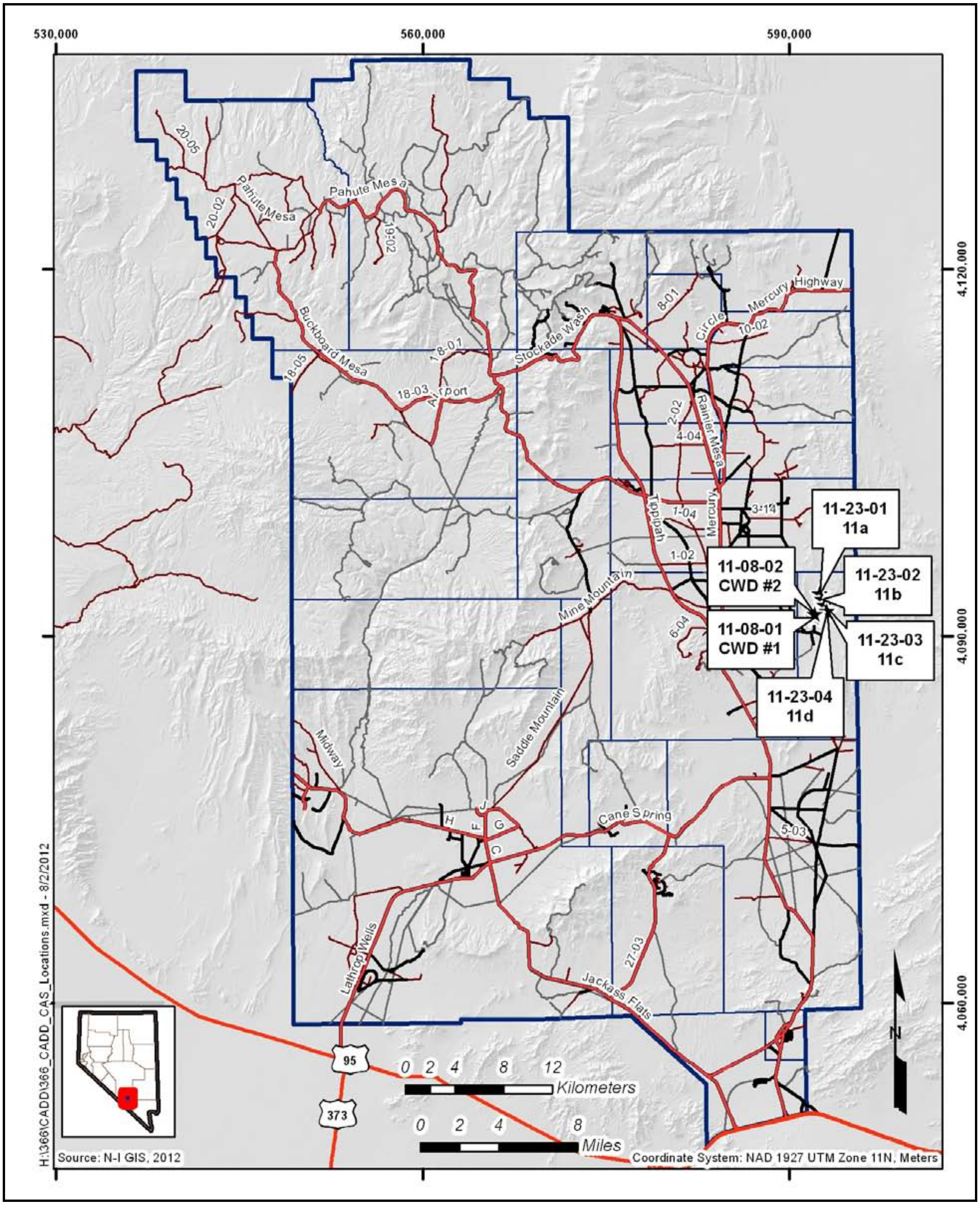

Figure A.1-1
CAU 366, CAS Location Map

Also included in the CAU 366 scope are potential releases to the soil from a Decontamination Station and Hot Park, drainage, radiological debris, and other debris (lead bricks, battery) generated as a result of the Project 56 activities. Additional information regarding the history of each site, planning, and the scope of the investigation is presented in the CAU 366 CAIP (NNSA/NSO, 2011).

A.1.1 Project Objectives

The objective of the investigation was to provide sufficient information to evaluate CAAs to support the closure of each CAS in CAU 366. This objective was achieved by identifying the nature and extent of COCs; by identifying potential corrective action wastes; and by evaluating, selecting, and implementing acceptable CAAs.

For radiological contamination, a COC is defined as the presence of radionuclides that jointly present a dose to a receptor exceeding the FAL of 25 mrem/yr. For other types of contamination, a COC is defined as the presence of a contaminant at a concentration exceeding its corresponding FAL concentration (see Section A.2.5).

A.1.2 Contents

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

- Section A.1.0 describes the investigation background, objectives, and the contents of this document.
- Section A.2.0 provides an investigation overview.
- Sections A.3.0 through A.8.0 provide study group-specific information regarding the field activities, sampling methods, and laboratory analytical results from investigation sampling.
- Section A.9.0 summarizes waste management activities.
- Section A.10.0 discusses the QA and QC processes followed and the results of QA/QC activities.
- Section A.11.0 provides a summary of the investigation results.
- Section A.12.0 lists the cited references.

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

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A.2.0 Investigation Overview

Field investigation and sampling activities for the CAU 366 CAI were conducted from October 12, 2011, to May 14, 2012. The following CAI activities were conducted:

- Inspected and verified the CAS features identified in the CAIP (NNSA/NSO, 2011).
- Performed visual inspections.
- Conducted TRSs.
- Conducted geophysical surveys.
- Established sample plots and composite sample aliquot locations.
- Staged TLDs at soil sample plots, background locations, and biased sample locations.
- Collected and submitted TLDs for analysis.
- Collected soil samples at sample plots and biased sampling locations.
- Submitted soil samples for offsite laboratory analysis.
- Collected GPS coordinates of sample locations, TLD locations, and points of interest.
- Conducted waste management activities (e.g., sampling, debris disposal).

The CAI activities were completed in accordance with the Soils QAP (NNSA/NSO, 2012a), which establishes requirements, technical planning, and general quality practices. The evaluation of investigation results and the risk associated with site contamination was conducted in accordance with the Soils RBCA document (NNSA/NSO, 2012b).

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

The reporting of investigation results and the evaluation of DQO decisions for different CSM components were organized into study groups. The study groups and the CASs, or CAS components, associated with each study group are described in Table A.2-1. Although the need for corrective action is evaluated separately for each study group, CAAs are evaluated for each FFACO CAS.

Table A.2-1
CAU 366 Study Groups

Study Group	Description	FFACO CAS(s)
1	CWD #1, CWD #2, and 11a Trench	11-08-01, 11-08-02
2	11a, 11b, 11c, and 11d Test Areas	11-23-01, 11-23-02, 11-23-03, 11-23-04
3	Decontamination Station and Hot Park	11-23-04
4	Drainage	11-23-04
5	Radiological Debris	11-23-03
6	Other Debris	11-23-04

The study groups were investigated by collecting TLD samples for external radiological dose measurements and collecting soil samples for the calculation of internal radiological dose. The field investigation was completed as specified in the CAIP (NNSA/NSO, 2011) with minor deviations described in Sections A.2.1 through A.2.5, which provide the general investigation and evaluation methodologies.

A.2.1 Sample Locations

Sample locations were selected based on interpretation of site-specific TRSs and historical investigations (1999 aerial radiological survey [BN, 1999b]); soil removal activities [Orcutt, 1982; Sunderland, 1987]); information obtained during site visits; and site conditions as provided in the CAIP (NNSA/NSO, 2011). Probabilistic soil sampling consisted of the collection of surface soil samples (as defined in Section A.2.0) within sample plots. Four composite samples were collected within each sample plot, and TLDs were located at the center of each sample plot. The randomly located aliquot locations were identified using a predetermined random-start, triangular grid pattern.

Judgmental sample locations were selected based on biasing factors such as visual identification of sedimentation areas in drainages, elevated radiological readings, contaminated debris, and locations of previous site operations. The center of each sample plot, judgmental sample locations, and CAS points of interest were surveyed with a GPS instrument. Appendix F presents these data in a tabular format. Specific sample locations and the rationale for selecting sample locations are shown in the study group-specific sections (Sections A.3.0 through A.8.0).

A.2.2 Investigation Activities

The investigation activities as listed in Section A.2.0 performed at CAU 366 were consistent with the field investigation activities stipulated in the CAIP (NNSA/NSO, 2011). The investigation strategy provided the necessary information to establish the nature and extent of contamination associated with each study group. The following subsections describe the specific investigation activities that took place at CAU 366.

A.2.2.1 Radiological Surveys

Aerial and ground-level radiological surveys were conducted at the CAU 366 features. Several aerial radiological surveys were performed at Plutonium Valley (Clark, 1983; BN, 1999a and b). An aerial radiological survey flown in 1999 was conducted at an altitude of 75 ft with 50-ft flight-line spacing (BN, 1999b). Data from this survey were primarily used during the investigation as these data provided better resolution of the distribution of site radioactivity. However, a more recently completed survey became available that was used to develop the CAU 366 corrective action boundaries (N-I, 2012).

Ground-level TRSs were performed to identify specific locations for sample plots and biased sample locations. Count-rate data were collected using three radiological instruments. Specifically, the Ludlum model 44-21 was used at the 11a test area, while the TSA Systems PRM-470 model plastic scintillator and a field instrument for the detection of low-energy radiation (FIDLER) were used to survey the remainder of the site features. Because the PRM-470 did not show any areas of significantly elevated gamma activity above background, the FIDLER results were used to show the elevated areas of americium (Am)-241. Count-rate and position data were collected and recorded at 1-second intervals, via a Trimble Systems GeoXT GPS unit. The travel speed was approximately 1 to 2 meters per second with the radiation detector held at a height of approximately 18 inches (in.) above the ground surface.

A.2.2.2 Field Screening

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

Field screening was used at CAU 366 to evaluate the presence of buried contamination and to aid in the selection of biased samples for laboratory analyses. Field screening was limited to radiological parameters and was conducted using an NE Electra instrument. To determine the presence of buried contamination, soil was removed and screened for radioactivity in 5-cm-depth increments to a total depth of 30 cm bgs or at refusal. These FSRs were used to determine whether subsurface contamination could be distinguished from surface contamination. Buried contamination was considered to be present only if the depth interval reading exceeded the FSL and there was a greater than 20 percent difference between the depth interval reading and the surface soil reading.

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

A.2.2.3 Soil Sampling

Soil sampling for sample plots consisted of the collection of four composite samples. Each composite sample comprised nine randomly located aliquots, resulting in a total of 36 randomly located aliquots collected from each plot. Each aliquot was collected using a "vertical-slice cylinder and bottom-trowel" method. This required the vertical insertion of the 3.5-in. inside diameter cylinder to a depth of 5 cm, excavation of the outside soil along one side of the cylinder (to permit trowel placement), and horizontal insertion of a trowel along the bottom of the cylinder. This method captured a cylindrical-shaped section of the soil from 0 to 5 cm bgs. After collection, each aliquot was placed in a pan (with a plastic bag lining the pan, which limited dust generation during transfer to a sample container [metal can]). After field screening of the sample, each sample was then transferred to an empty metal can. Each metal can was then sealed with a lid and a locking ring. All other soil samples were collected using the grab sample method.

A.2.2.4 Internal Dose Estimates

Internal dose was estimated using the radionuclide analytical results from soil samples and the corresponding RRMG (NNSA/NSO, 2012b). Soil concentrations of plutonium isotopes are inferred from gamma spectroscopy results as described in Section B.1.1.1.1.

The internal dose RRMG concentration for a particular radionuclide is that concentration in surface soil that would cause an internal dose to a receptor of 25 mrem/yr (under the appropriate exposure scenario) independent of any other radionuclide (assuming that no other radionuclides contribute dose). The internal dose RRMG for each detected radionuclide (in picocuries per gram [pCi/g] of soil) was derived using RESRAD computer code (Yu et al., 2001) under the appropriate exposure scenario (NNSA/NSO, 2012b).

The total internal dose corresponding to each surface soil sample was calculated by adding the dose contribution from each radionuclide. For each sample, the radionuclide-specific analytical result was divided by its corresponding internal RRMG (NNSA/NSO, 2012b) to yield a fraction of the 25-mrem/yr dose. The fractions for all radionuclides detected in a soil sample were summed to yield a total fraction for that sample. The total fraction was then multiplied by 25 to yield an internal dose estimate (in mrem/yr) at that sample location. For probabilistic sampling, a 95 percent UCL was calculated for the internal dose in a sample plot using the results of all soil samples collected in that plot (NNSA/NSO, 2012b). At judgmental sample locations where only one sample was collected, statistical inferences could not be calculated, and the single analytical result was used to calculate the internal dose.

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

A.2.2.5 External Dose Measurements

TLDs (Panasonic UD-814) were staged at CAU 366 with the objective of collecting *in situ* measurements to determine the external radiological dose. The TLDs were placed in background areas (beyond the influence of CAS releases), at the approximate center of each sample plot, and at other biased locations. The background locations were selected using the 1994 aerial flyover survey that shows the representative background radiation values (BN, 1999a). It was determined that the background TLD locations are representative of the general area and can be used as a good estimate of true average background dose for all the environmental TLDs. Each TLD was placed at a height of 1 m above the ground surface, which is consistent with TLD placement in the NNSS routine environmental monitoring program (see Section A.10.0). Once retrieved from the field locations, the TLDs were analyzed by automated TLD readers that are calibrated and maintained by the NNSS management and operating (M&O) contractor.

This approach allowed for the use of existing QC procedures for TLD processing. Details of the environmental monitoring TLD program and TLD QC are presented in Section A.10.0. All readings conformed to the approved QC program and are considered representative of the external radiological dose at each location.

The TLDs used at CAU 366 contain four individual elements. External dose at each TLD location is determined using the readings from TLD elements 2, 3, and 4. Each of these elements is considered to be a separate, independent measurement of external dose. A 95 percent UCL of the average of these measurements was calculated for each TLD location. Element 1 is designed to measure dose to the skin and is not relevant to the determination of the external dose for the purpose of this investigation.

Estimates of external dose, in mrem/IA-yr, at the CAU 366 sites are presented as net values (i.e., the dose from background radiation has been subtracted from the raw result). The background TLDs measured the dose the TLDs were exposed to while not deployed in the field and dose from natural sources in areas unaffected by the CAU-related releases during field deployment.

A.2.3 Total Effective Dose

The measured TED represents the sum of the internal dose (calculated from soil sample results) and the external dose (calculated from TLD measurements) for each sample location. The measured TED calculated from sample results is an estimate of the true (unknown) TED. It is uncertain how well the measured TED represents the true TED. If a measured TED were directly compared to the FAL, any significant difference between the true TED and the measured TED could lead to decision errors. To reduce the probability of a false negative decision error for probabilistic sample results, a conservative estimate of the true TED (i.e., the 95 percent UCL) is used to compare to the FAL. By definition, there will be a 95 percent probability that the true TED is less than the 95 percent UCL of the measured TED. The probabilistic sampling design as described in the CAIP (NNSA/NSO, 2011) conservatively prescribes using the 95 percent UCL of the TED for DQO decisions. The 95 percent UCL of the TED at each sample location was calculated as the sum of the 95 percent UCLs of the internal and external doses.

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

A.2.4 Laboratory Analytical Information

Radiological analyses of the collected soil samples were performed by General Engineering Laboratories of Charleston, South Carolina. The analytical suites and laboratory analytical methods used to analyze investigation samples are listed in the CAIP (NNSA/NSO, 2011). Analytical results are reported in this appendix if they were detected above the minimum detectable concentrations (MDCs). The complete laboratory data packages are available in the project files.

Validated analytical data for CAU 366 investigation samples have been compiled and evaluated to determine the presence of COCs and to define the extent of COC contamination if present. The analytical results for each study group are presented in Sections A.3.0 through A.8.0.

The analytical parameters were selected through the application of site process knowledge as described in the CAIP (NNSA/NSO, 2011).

A.2.5 Comparison to Action Levels

The radiological PALs and FALs are based on an annual dose limit of 25 mrem/yr. This dose limit is specific to the annual dose a receptor could potentially receive from a CAU 366 release. As such, it is dependent upon the cumulative annual hours of exposure to site contamination. The PALs were established based on a dose limit of 25 mrem/yr over an annual exposure time of 2,000 hours (i.e., the Industrial Area exposure scenario in which a site worker is exposed to site contamination for 250 day/yr and 8 hr/day). The FALs were established in Appendix D based on a dose limit of 25 mrem/yr over an annual exposure time of 80 hours (i.e., the Occasional Use Area exposure scenario in which a site worker is exposed to site contamination for 10 day/yr and 8 hr/day).

Results for each of the study groups are presented in Sections A.3.0 through A.8.0. Radiological results are reported as doses that are comparable to the dose-based FAL as established in Appendix D. Chemical results are reported as individual concentrations that are comparable to individual chemical FALs as established in Appendix D. Results that are equal to or greater than FALs are identified by bold text in the study group-specific results tables.

A COC is defined as any contaminant present in environmental media exceeding a FAL. A COC may also be defined as a contaminant that, in combination with other like contaminants, is determined to jointly pose an unacceptable risk based on a multiple constituent analysis (NNSA/NSO, 2012b). If a COC is present at any location, corrective action will be required.

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

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

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

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

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

  - For non-liquid wastes, the dose resulting from radioactive contaminants in soil (following degradation of the waste and release of contaminants into soil) would be calculated using the activity of the contaminant in the waste divided by the mass of the waste (for each radioactive contaminant) and calculating the combined resulting dose using the RESRAD code (Murphy, 2004). If the resulting soil concentration exceeds the FAL, then the waste would be considered to be PSM.

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

A.2.6 Deviations

The radionuclide RRMGs were established in the CAIP (NNSA/NSO, 2011) based on the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). It was subsequently determined to evaluate CAU 366 results based on the approved Soils RBCA document (NNSA/NSO, 2012b). Therefore, RRMG and dose values were established using the Soils RBCA document rather than the RRMG values listed in the CAIP. This did not result in any changes to corrective action decisions or the extent of the FFACO UR established as a result of the radiological debris (Study Group 5). However, this did result in a slight decrease in the area of the administrative 25 mrem/IA-yr UR boundary.

A.3.0 Study Group 1

CWDs #1 and #2 and the 11a trench are located in Plutonium Valley in Area 11 of the NNSS. This study group consists of a release of radioactive material to the surface and subsurface soil as a result of material disposal associated with the Project 56 experiments. Additional detail on the history of CWDs #1 and #2 and the 11a trench is provided in the CAIP (NNSA/NSO, 2011). The location of this study group is shown on Figure A.3-1.

A.3.1 CAI Activities

Investigation activities for this study group (as stipulated in the CAIP) consisted of visual, radiological, and geophysical surveys. The specific CAI activities conducted to satisfy the CAIP requirements at this study group (NNSA/NSO, 2011) are described in the following subsections.

A.3.1.1 Visual Inspections

Visual inspections of CWDs #1 and #2 and the 11a trench included documenting the areas potentially impacted by the disposal of Project 56 test activities debris. All three features are located within the Project 56 CA boundary.

Visual inspection of CWD #1 verified that the dump has a radiological posting of an URMA. Minimal metallic surface debris is present within the fence lines. A mound was identified north of the CWD and is assumed to be associated with CWD #1. The mound has a minimal amount of metallic surface debris present.

Visual inspection of CWD #2 verified that the dump has radiological postings of an URMA and HCA. Two drums containing debris as well as partially buried cable are present within the fence lines.

The 11a trench does not have any additional radiological postings specific to the trench. Minimal metallic surface debris is present within the 11a trench that is being investigated as part of Study Group 5 (see Section A.7.0).

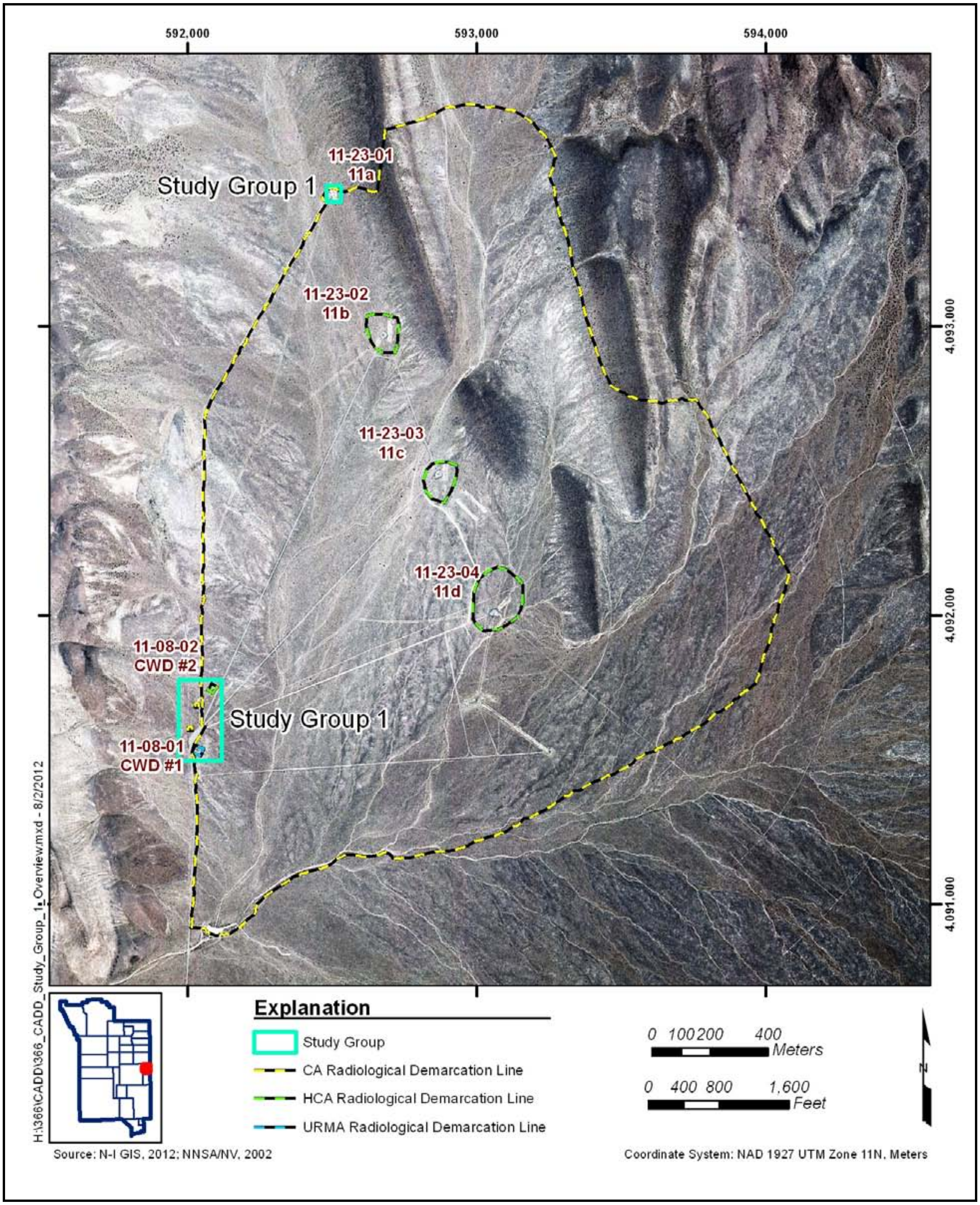

Figure A.3-1
Study Group 1, CAS Components General Location

A.3.1.2 Radiological Surveys

TRSs were performed outside the fence lines at both CWDs and at the 11a trench as described in the CAIP (NNSA/NSO, 2011). In addition, a survey was conducted inside the CWD #1. As noted in the CAIP, due to the presence of debris inside CWD #2, TRSs were to only be conducted outside the fence line of CWD #2.

A.3.1.3 Geophysical Surveys

Geophysical surveys using an EM-61-MK2A instrument were completed at CWDs #1 and #2 and the 11a trench to determine the presence of buried metallic debris. A survey was conducted outside the fence line of CWDs #1 and #2 and the 11a trench, as stipulated in the CAIP (NNSA/NSO, 2011). Additionally, a survey was completed inside the fence lines of CWD #1 and on the adjacent mound. As noted in the CAIP, due to the presence of surface debris within CWD #2, the survey was to be conducted outside the fence line only.

A.3.1.4 Deviations

No deviations to the CAIP (NNSA/NSO, 2011) were noted.

A.3.2 Investigation Results

The TRS showed no elevated radiological readings outside the fence line of CWDs #1 and #2. The TRS conducted in the 11a trench identified surface debris with elevated radiological readings. This debris is discussed in Section A.7.0. Figure A.3-2 presents a graphic representation of the data from the TRS.

The geophysical surveys determined some buried metallic debris was present in the mound adjacent to CWD #1, but no buried metallic debris was present outside the existing fence lines at CWD #2 or associated with the 11a trench. The signature present in the 11a trench is a result of surface metallic debris. The signatures present at CWD #1 are due to the fence posts and minimal surface debris. The signatures present at CWD #2 are due to the fence posts. The results of the geophysical survey are depicted on Figure A.3-3.

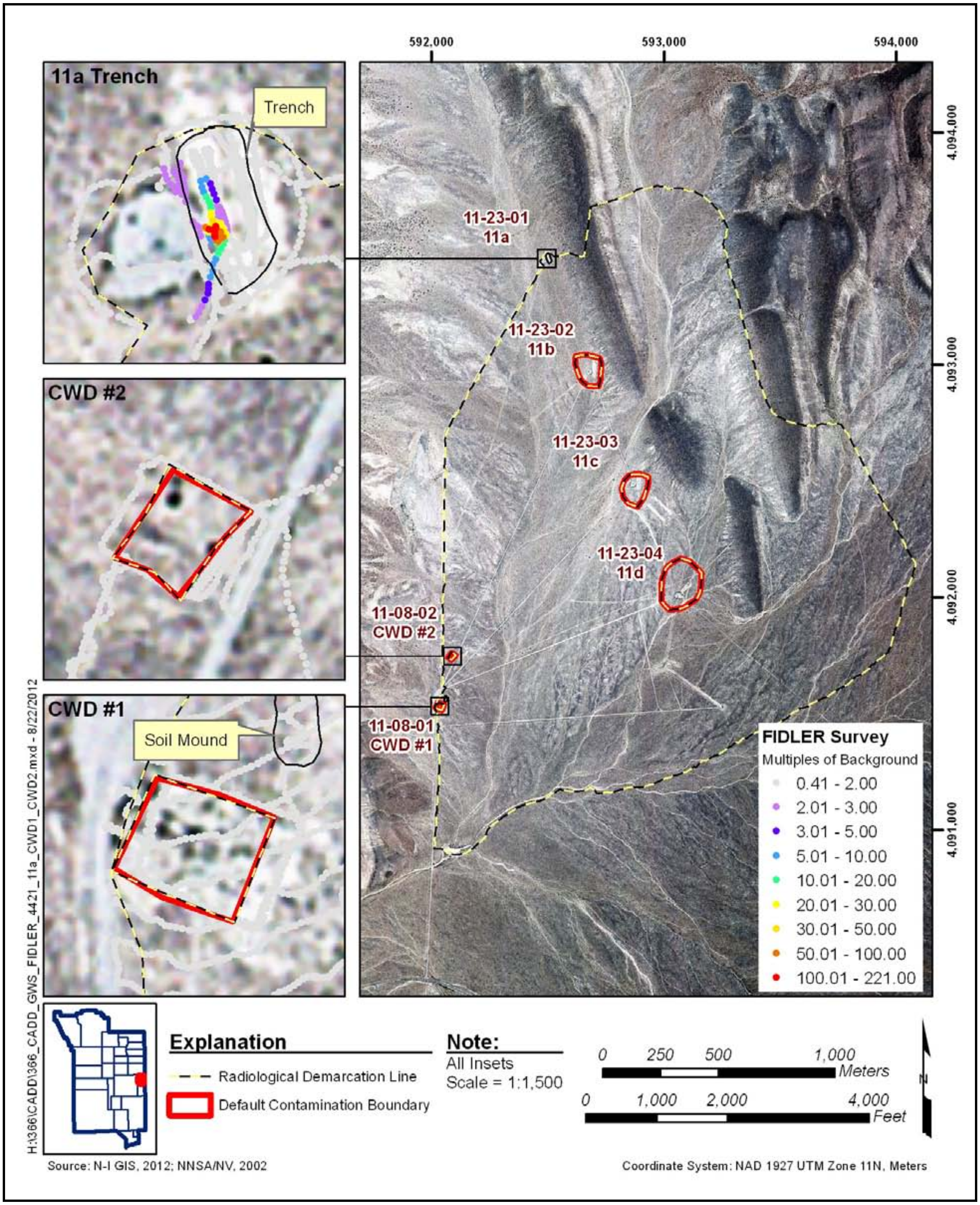

Figure A.3-2
TRS Results for Study Group 1

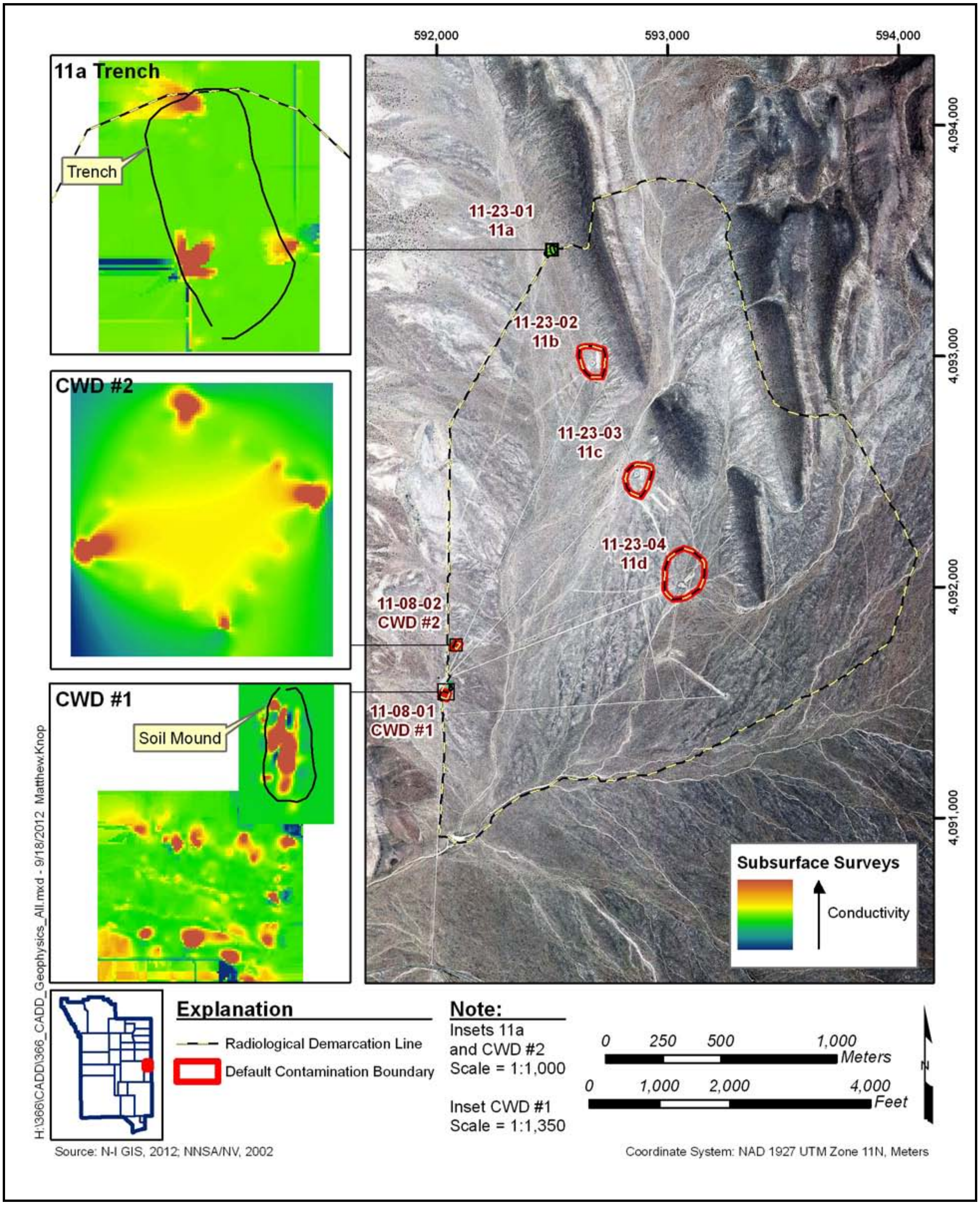

Figure A.3-3
Geophysical Survey Results for Study Group 1

It was determined in the DQOs that each CWD would require corrective action within its radiologically posted boundaries. Radiological and geophysical surveys would be conducted to verify that there were no biasing factors associated with the CWDs or 11a trench that required investigation or showed evidence of buried debris present outside the CWD fence lines or at the 11a trench. As noted in Section A.3.1.2, surface radiological debris in the 11a trench was identified as a biasing factor and is discussed in Section A.7.0. These activities were completed as planned.

A.3.3 Nature and Extent of Contamination

It is assumed that COCs exceeding FALs exist within CWDs #1 and #2; therefore, corrective action is required. A geophysical survey also revealed buried metallic debris outside the fence line and adjacent to CWD #1. Therefore, the corrective action boundary for CWD #1 will be expanded to include the mound containing buried material. There is no evidence of buried debris outside the fence line at CWD #2; therefore, the corrective action boundary presented in the CAIP is the boundary proposed for corrective action. There is no evidence of buried metallic debris in the 11a trench. Therefore, no corrective action is required for buried waste at this location. The identified surface debris is addressed as part of Study Group 5 (see Section A.7.0.).

Because COCs are present, a CAA of no further action is not an option. Therefore, the alternatives of clean closure and closure in place with administrative controls will be evaluated.

A.3.4 Revised CSM

The CAIP requirements (NNSA/NSO, 2011) were met at this CAS. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

A.4.0 Study Group 2

The 11a, 11b, 11c, and 11d test areas are located in Plutonium Valley in Area 11 of the NNSS. These features consist of a release of radioactive material to the soil from four safety experiments conducted using devices containing plutonium and enriched uranium. The areas impacted by the experiments are around the 11a, 11b, 11c, and 11d test areas. Additional detail on the history of these experiments is provided in the CAIP (NNSA/NSO, 2011). The location of this study group is shown on Figure A.4-1.

A.4.1 CAI Activities

A total of 42 environmental samples (including 2 FDs) were collected during investigation activities of the 11a, 11b, 11c, and 11d test areas. All samples were analyzed for gamma spectroscopy and isotopic Am, plutonium (Pu), and uranium (U); and at one sample location (B07), volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) were also analyzed. A total of 20 TLDs at 10 sample locations and 8 “field” background locations (2 of the 18 total locations had 2 TLDs placed) were collected during investigation activities in the 11a, 11b, 11c, and 11d test areas to measure external dose. The identification number, location, and purpose for each sample are listed in Table A.4-1. The specific CAI activities conducted to satisfy the CAIP requirements at this study group (NNSA/NSO, 2011) are described in the following subsections.

A.4.1.1 Visual Inspections

Visual inspections of the 11a, 11b, 11c, and 11d test areas were conducted over the course of the field investigation. The 11a, 11b, 11c, and 11d GZs were located. It was noted that there are no radiological postings at the 11a GZ while the other three GZs are posted HCAs. A deteriorated asphalt patch is located north of the 11c GZ. The asphalt patch was identified as a biasing factor that would require sampling. The sample location selected based on the visual inspection was location B07. No other biasing factors were identified.

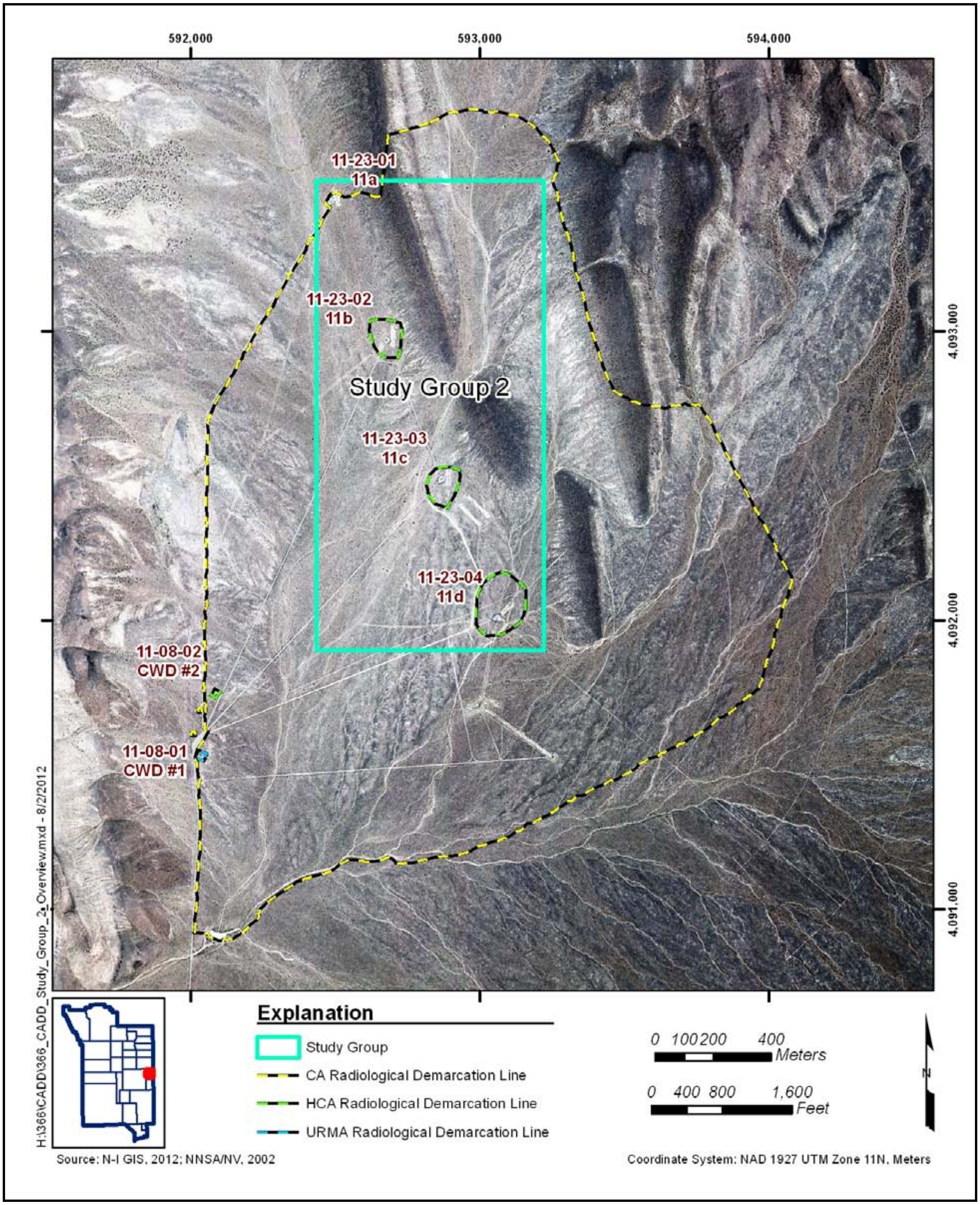

Figure A.4-1
Study Group 2, CAS Components General Location

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

Sample Location	Sample Number	Type	Purpose
A01	366A104	TLD	Sample Plot
	366A601	Soil	
	366A602		
	366A603		
	366A604		
A02	366A105	TLD	Background TLD
A03	366A101		
A04	366A102		
A05	366A103		
A06	366A106	TLD	Background TLD
	366A111		
A07	366A107		
A09	366A128		
B03	366B103	TLD	Sample Plot
	366B629	Soil	
	366B630		
	366B631		
	366B632		
B04	366B104	TLD	Sample Plot
	366B617	Soil	
	366B618		
	366B619		
	366B620		
B05	366B105	TLD	Sample Plot
	366B621	Soil	
	366B622		
	366B623		
	366B624		
B06	366B106	TLD	Sample Plot
	366B625	Soil	
	366B626		
	366B627		
	366B628		

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

Sample Location	Sample Number	Type	Purpose
B07	366B107	TLD	Sample Plot
	366B108		
	366B633	Soil	
	366B634		
	366B635		
	366B636		
	366B637		
	366B638		
B08	366B109	TLD	Sample Plot
	366B609	Soil	
	366B610		
	366B611		
	366B612		
B09	366B110	TLD	Sample Plot
	366B605	Soil	
	366B606		
	366B607		
	366B608		
B10	366B111	TLD	Sample Plot
	366B601	Soil	
	366B602		
	366B603		
	366B604		
B11	366B112	TLD	Sample Plot
	366B613	Soil	
	366B614		
	366B615		
	366B616		
B22	366B135	TLD	Background TLD

A.4.1.2 Radiological Surveys

GPS-assisted TRSs were performed in and around the four test areas. The surveys were conducted to identify the locations of the highest radiological readings and to confirm the location of the fallout plume. The results of the TRSs, along with the aerial radiological survey (BN, 1999), were used in selecting sample plot locations. The sample locations selected based on radiological surveys were A01 and B03 through B11. Figure A.4-2 presents a graphical representation of the data from the TRS, while Figure A.4-3 shows the sample locations.

A.4.1.3 Sample Collection

The following subsections discuss the TLD and soil samples collected as part of the CAI.

A.4.1.3.1 Soil Samples

Sampling activities for the determination of internal dose at the sample plots consisted of the collection of 42 primary release composite surface soil (defined in Section A.2.0) samples (which included 2 FDs) at 10 sample plots (A01, B03 through B11). Although some locations were modified (see Section A.4.1.4), plot locations were selected as established in the CAIP (NNSA/NSO, 2011). The plot locations were established in areas of elevated radiological readings as shown on radiological flyover surveys and detected during the TRSs conducted at the site. Additionally, an area of asphalt was identified as a biasing factor that would require sampling. All sample locations (Table A.4-1) are shown on Figure A.4-3.

A.4.1.3.2 TLD Samples

Eleven TLDs were installed and are associated with the 10 sample plot locations. Nine TLDs were placed at eight background field locations. All TLDs were placed to measure external doses (Table A.4-2). Details of the environmental monitoring TLD program and TLD QC are presented in Section A.10.0. See Figure A.4-3 for the sample locations.

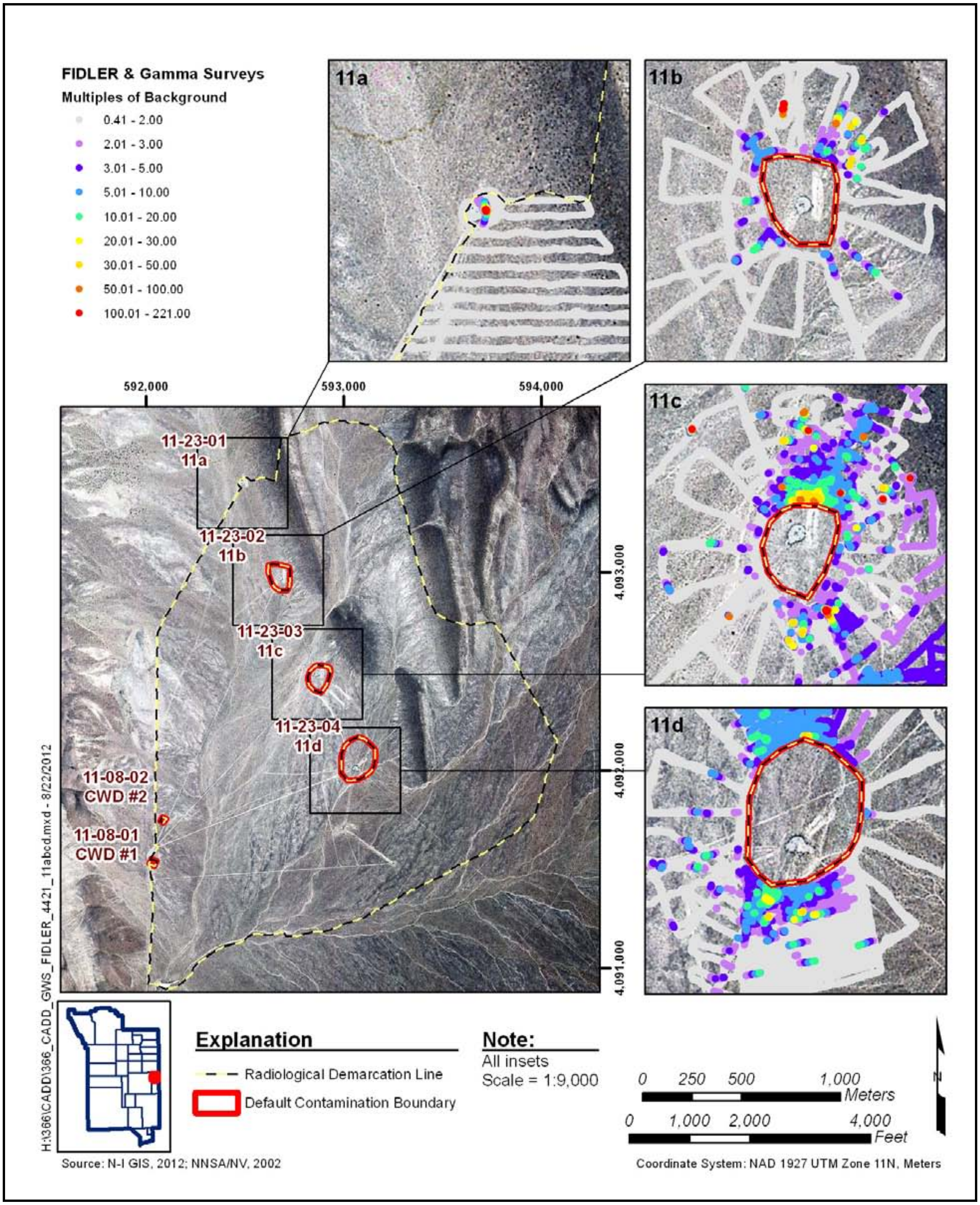

Figure A.4-2
TRS Results for Study Group 2

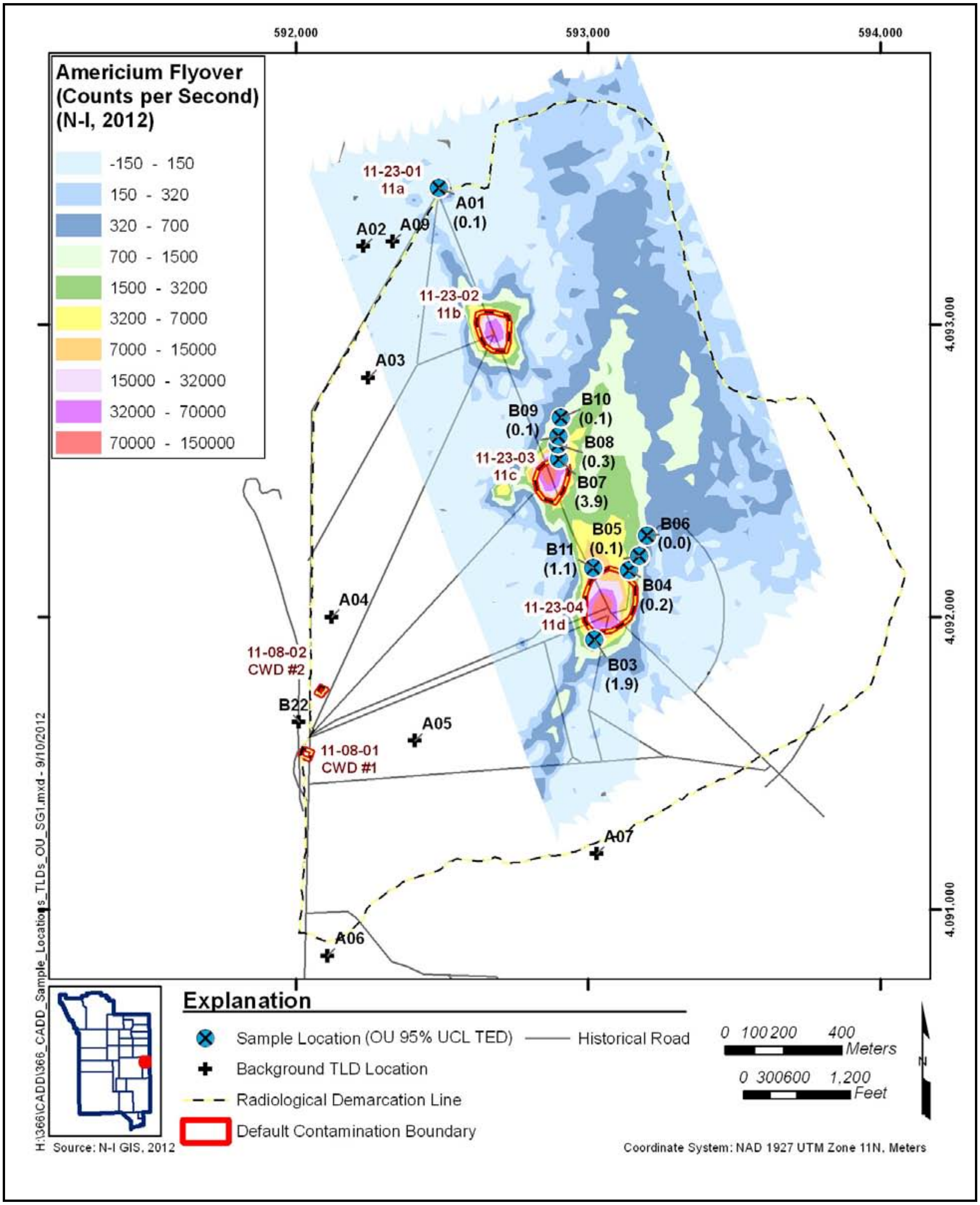

Figure A.4-3
Study Group 2, Sample Locations Including the 95% UCL of the TED

A.4.1.4 Deviations

Sample plot locations were selected using the 1999 radiological flyover survey (BN, 1999b) and TRSs as required in the CAIP (NNSA/NSO, 2011). As a result of the field investigation, the following three changes were made to the originally selected locations of the sample plot locations:

- It was determined that the location of the sample plot south of the 11d test area may have been impacted by the adjacent drainage. Because the area had been disturbed, an additional sample plot location with elevated radiological readings in an undisturbed location was selected. Therefore, samples were collected in the original location (B03) and a newly selected sample plot location (B11).
- In the CAIP, it was stated that a sample plot would be located in the area with the highest radiological readings near 11c as well as in an adjacent area with a deteriorated asphalt pad. Upon further investigation, it was determined that the asphalt overlapped the area with the highest radiological readings, so only one sample plot location (B07) was selected.
- The locations of the several sample plots east of the 11c test area as identified in the CAIP were altered due to terrain. Although the sample plots were relocated, the new sample plot locations (B08, B09, and B10) were selected using the same criteria as the original plots (i.e, isopleths identified on the radiological flyover survey, TRSs).

These changes did not have any impacts to DQO decisions.

A.4.2 Investigation Results

The following subsections present the analytical and computational results for soil and TLD samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NSO, 2011). The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr. Results that are equal to or greater than FALs are identified by bold text in the results tables.

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

The internal dose calculated from soil sample results, and the external dose calculated from TLD measurements were combined to determine TED at each sample location. External doses for TLD locations are summarized in Section A.4.2.1. Internal doses for each sample plot are summarized in Section A.4.2.2. The TEDs for each sampled location are summarized in Section A.4.2.3.

A.4.2.1 External Radiological Dose Measurements

Estimates for the external dose that a receptor would receive at each Study Group 2 TLD sample location were determined as described in Section A.2.2.5. Measurements for the external dose were calculated for the Industrial Area exposure scenario and then scaled (based on exposure duration) to the Remote Work Area and Occasional Use Area exposure scenarios for each TLD location. The standard deviation, number of elements, minimum sample size, and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.4-2. As shown in Table A.4-2, the minimum sample size was met for all locations in Study Group 2. The analytical results for the individual radionuclides in each composite sample and the corresponding calculated internal dose are presented in Appendix G.

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

Source	Location	Standard Deviation	Number of Elements	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
11a, 11b, 11c, and 11d Test Areas	A01	0.03	3	3	1.2	0.2	0.1
	B03	0.18	3	3	19.1	3.2	1.0
	B04	0.01	3	3	0.3	0.1	0.0
	B05	0.00	3	3	0.0	0.0	0.0
	B06	0.00	3	3	0.0	0.0	0.0
	B07	0.36	6	3	**29.2**	4.9	1.5
	B08	0.03	3	3	2.7	0.4	0.1
	B09	0.01	3	3	0.3	0.0	0.0
	B10	0.00	3	3	0.0	0.0	0.0
	B11	0.12	3	3	6.3	1.1	0.3

Bold indicates the values exceeding 25 mrem/yr.

The background dose at CAU 366 was determined to be the average of the background TLD results from locations A02 through A07, A09, and B22 (1.2 mrem/OU-yr).

A.4.2.2 Internal Radiological Dose Estimations

Estimates for the internal dose that a receptor would receive at each sample location were determined as described in Section A.2.2.4. The standard deviation, number of samples, minimum sample size, and 95 percent UCL of the internal dose for each exposure scenario are presented in Table A.4-3. As shown in Table A.4-3, the minimum sample size was met for all locations in Study Group 2. The analytical results for the individual radionuclides in each composite sample and the corresponding calculated internal dose are presented in Appendix G. Table A.4-4 presents a comparison of the internal and external doses at each sample plot where TED exceeded the PAL.

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

Source	Location	Standard Deviation	Number of Samples	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
11a, 11b, 11c, and 11d Test Areas	A01	0.01	4	3	0.2	0.0	0.0
	B03	0.48	4	3	15.2	2.6	1.0
	B04	0.11	4	3	3.4	0.6	0.2
	B05	0.03	4	3	1.0	0.2	0.1
	B06	0.01	4	3	0.6	0.1	0.0
	B07	2.52	5	3	**38.9**	6.5	2.5
	B08	0.12	4	3	2.9	0.5	0.2
	B09	0.08	4	3	2.1	0.4	0.1
	B10	0.05	4	3	1.1	0.2	0.1
	B11	0.45	4	3	11.7	2.0	0.7

Bold indicates the values exceeding 25 mrem/yr.

Table A.4-4
Study Group 2, Ratio of Calculated Internal Dose to External Dose (mrem/IA-yr)

Source	Location	Average Internal Dose	Average External Dose	Average Total Dose	Internal to External Dose Ratio
11a, 11b, 11c, and 11d Test Areas	B03	12.5	12.9	**25.4**	1.0
	B07	**27.7**	23.2	**50.9**	1.2
				Average	1.1

Bold indicates the values exceeding 25 mrem/yr.

A.4.2.3 Total Effective Dose

The TED for each sample plot or TLD location was calculated by adding the external dose values and the internal dose values. Values for both the average TED and the 95 percent UCL of the TED for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table A.4-5.

Table A.4-5
Study Group 2 TED at Sample Locations (mrem/yr)

Source	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
11a, 11b, 11c, and 11d Test Areas	A01	0.4	1.4	0.1	0.2	0.0	0.1
	B03	**25.4**	**34.3**	4.3	5.8	1.4	1.9
	B04	2.8	3.7	0.5	0.6	0.2	0.2
	B05	0.8	1.0	0.1	0.2	0.1	0.1
	B06	0.5	0.6	0.1	0.1	0.0	0.0
	B07	**50.9**	**68.0**	8.6	11.4	2.9	3.9
	B08	3.8	5.6	0.6	0.9	0.2	0.3
	B09	1.7	2.4	0.3	0.4	0.1	0.1
	B10	0.8	1.1	0.1	0.2	0.1	0.1
	B11	11.6	18.0	2.0	3.0	0.7	1.1

Bold indicates the values exceeding 25 mrem/yr.

The 95 percent UCL TED for sampling locations B03 and B07 exceed the 25-mrem/IA-yr PAL. No sample plot locations exceed the 25-mrem/OU-yr FAL. The 95 percent UCL TED value for all sample locations in Study Group 2 are shown on Figure A.4-3.

Considering radioactive decay mechanisms only (with contamination erosion and transport mechanisms removed), the sampled location with the maximum TED (location B07) will decay to less than 25 mrem/IA-yr in 700 years.

A.4.2.4 Chemical Sample Results

Analytical results exceeding MDCs from the samples collected at asphalt sample plot location B07 are presented in the following subsections.

A.4.2.4.1 Volatile Organic Compounds

Analytical results for VOCs in the environmental samples collected at the asphalt location at B07 detected above MDCs are presented in Table A.4-6. No sample result exceeded a FAL.

Table A.4-6
VOC Sample Results above MDCs for Study Group 2

Sample Location	Sample Number	Depth (cm bgs)	COPCs (mg/kg)				
			Dichlorodifluoromethane	Methylene Chloride	Perchloroethylene	Toluene	Trichlorofluoromethane
FALs			400	53	2.6	45,000	3,400
B07	366B635	0.0 - 5.0	0.00133	0.00267 (J)	--	--	0.00175
	366B636	0.0 - 5.0	0.00128	0.00235 (J)	--	0.00034 (J)	0.00183
	366B637	0.0 - 5.0	0.00129	0.00294 (J)	--	--	0.00176
	366B638	0.0 - 5.0	0.00129	0.00302 (J)	0.00035 (J)	0.00048 (J)	0.00182

J = Estimated value
-- = No result

A.4.2.4.2 Semivolatile Organic Compounds

There were no targeted SVOCs detected above MDCs in the samples (366B635 through 366B638) collected at the asphalt location at B07. Therefore, no sample results exceeded the FAL.

A.4.3 Nature and Extent of Contamination

It was assumed that contamination within the three HCA boundaries associated with the 11b, 11c, and 11d test areas would require corrective action. Therefore, the HCA boundaries were established as the default contamination boundaries. As a result of the CAI, no COCs were identified outside these previously established default contamination boundaries. Therefore, the corrective action boundaries for Study Group 2 are established as the default contamination boundaries as shown in Figure A.4-3. Because contamination is assumed to be present exceeding the FAL, the alternatives of clean closure and closure in place with administrative controls will be evaluated.

A.4.4 Revised CSM

The CAIP requirements (NNSA/NSO, 2011) were met at this CAS. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

A.5.0 Study Group 3

The Decontamination Station and Hot Park are located in Plutonium Valley in Area 11 of the NNSS. The features consist of a release of radioactive material to the soil from decontamination activities and the storage of radiologically elevated vehicles and drums. The impacted area is located west of the Project 56 CA boundary. Additional detail on the history of the Decontamination Station and Hot Park is provided in the CAIP (NNSA/NSO, 2011). The location of this study group is shown on Figure A.5-1.

A.5.1 CAI Activities

Because the Hot Park contained removable contamination exceeding the HCA criteria, soil was removed from the Hot Park under a corrective action and then the area was sampled. A total of eight environmental samples were collected during investigation activities at the Decontamination Station and Hot Park. All samples were analyzed for gamma spectroscopy and isotopic Am, Pu, and U. A total of two TLDs were collected during investigation activities at the Decontamination Station and Hot Park to measure external dose. The sample location, number, type, and purpose for each sample are listed in Table A.5-1. The specific CAI activities conducted to satisfy the CAIP (NNSA/NSO, 2011) requirements at this study group are described in the following subsections.

A.5.1.1 Visual Inspections

Visual inspections of the Decontamination Station and Hot Park were completed. A non-engineered, drainage pit with a culvert pipe and an area of soil with elevated radiological activity were identified in the locations labeled on a historical engineering drawing as a Decontamination Station and Hot Park (LASL, date unknown). The drainage pit and surrounding area is referred to as the Decontamination Station. The are no features associated with the other area of radiologically elevated soil, which is referred to as the Hot Park.

A.5.1.2 Radiological Surveys

GPS-assisted TRSs were performed in the areas shown on a historical drawing as a Decontamination Station and Hot Park (LASL, date unknown). Two areas of soil with elevated radiological readings

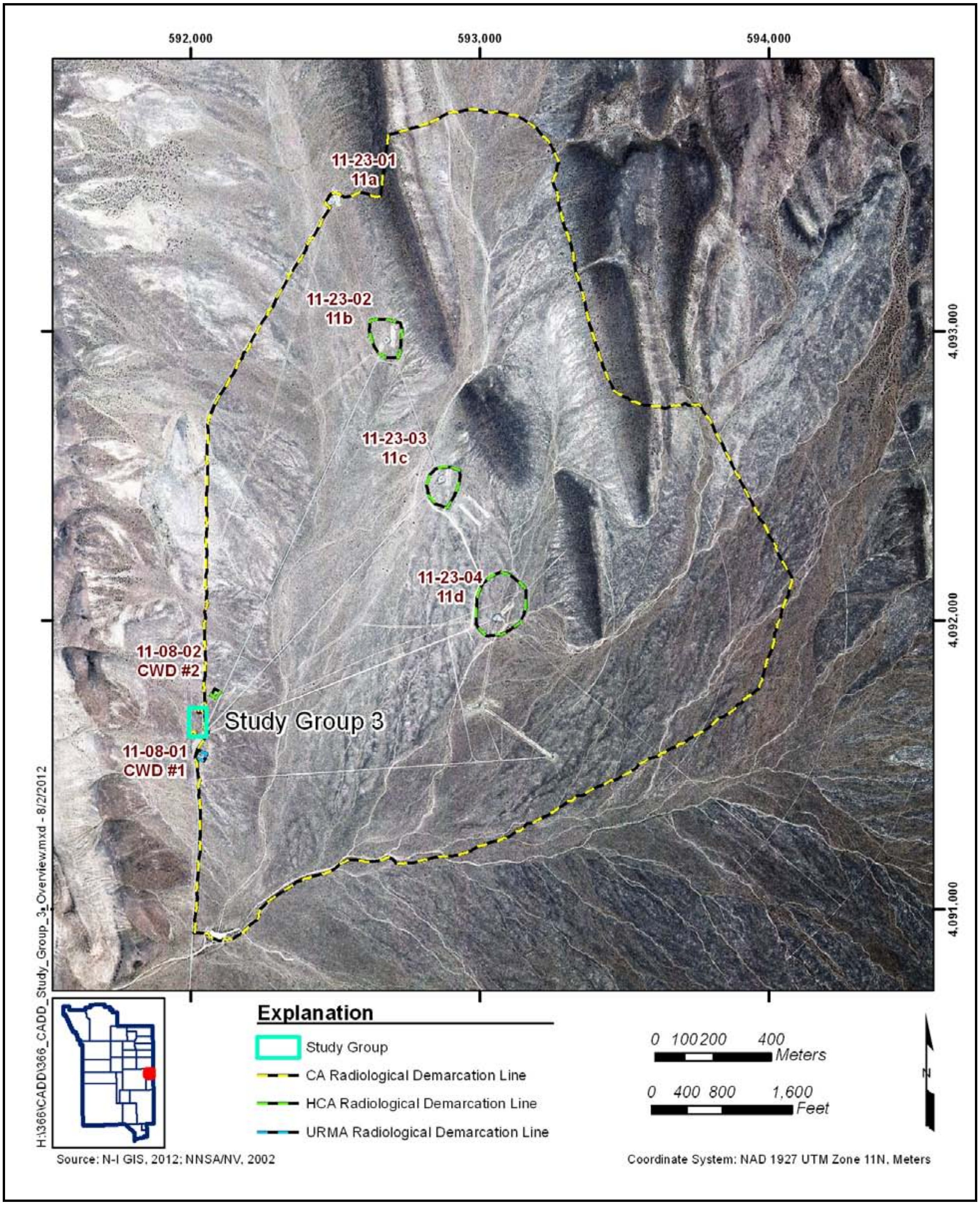

Figure A.5-1
Study Group 3, CAS Components General Location

Table A.5-1
Samples Collected at Study Group 3

Sample Location	Sample Number	Type	Purpose
C01	366C101	TLD	Sample Plot
	366C605	Soil	
	366C606		
	366C607		
	366C608		
C02	366C102	TLD	Sample Plot
	366C601	Soil	
	366C602		
	366C603		
	366C604		

were detected. The TRSs included collecting removable contamination data. Figure A.5-2 presents a graphic representation of the data from the TRSs.

A.5.1.3 Sample Collection

The following subsections discuss the TLD and soil samples collected as part of the CAI.

A.5.1.3.1 Soil Samples

Sampling activities at the Decontamination Station and Hot Park for the determination of internal dose consisted of collecting samples in plots. Sampling in the plots consisted of the collection of four composite surface soil (defined in Section A.2.0) samples at two plots (C01 and C02). The plots were established in the area of the anomalous radiological readings as detected during the TRSs conducted at the two locations of concern. All sample locations (Table A.5-1) are shown on Figure A.5-3.

A.5.1.3.2 TLD Samples

Two TLDs were installed at two locations (C01 and C02) at the Decontamination Station and Hot Park to measure the external doses associated with these other releases (Table A.5-1). Details of the environmental monitoring TLD program and TLD QC are presented in Section A.10.0.
See Figure A.5-3 for the sample locations.

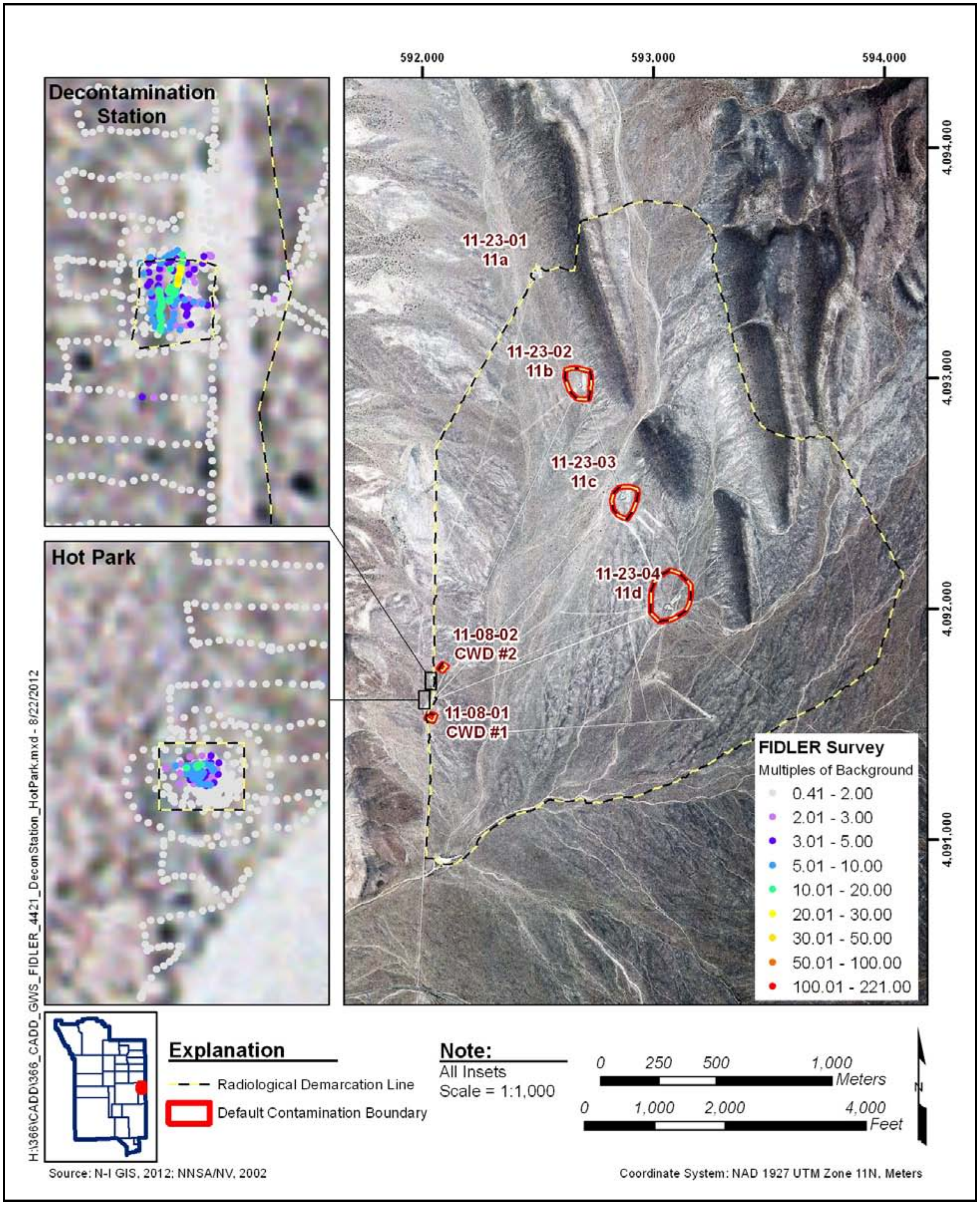

Figure A.5-2
TRS Results for Study Group 3

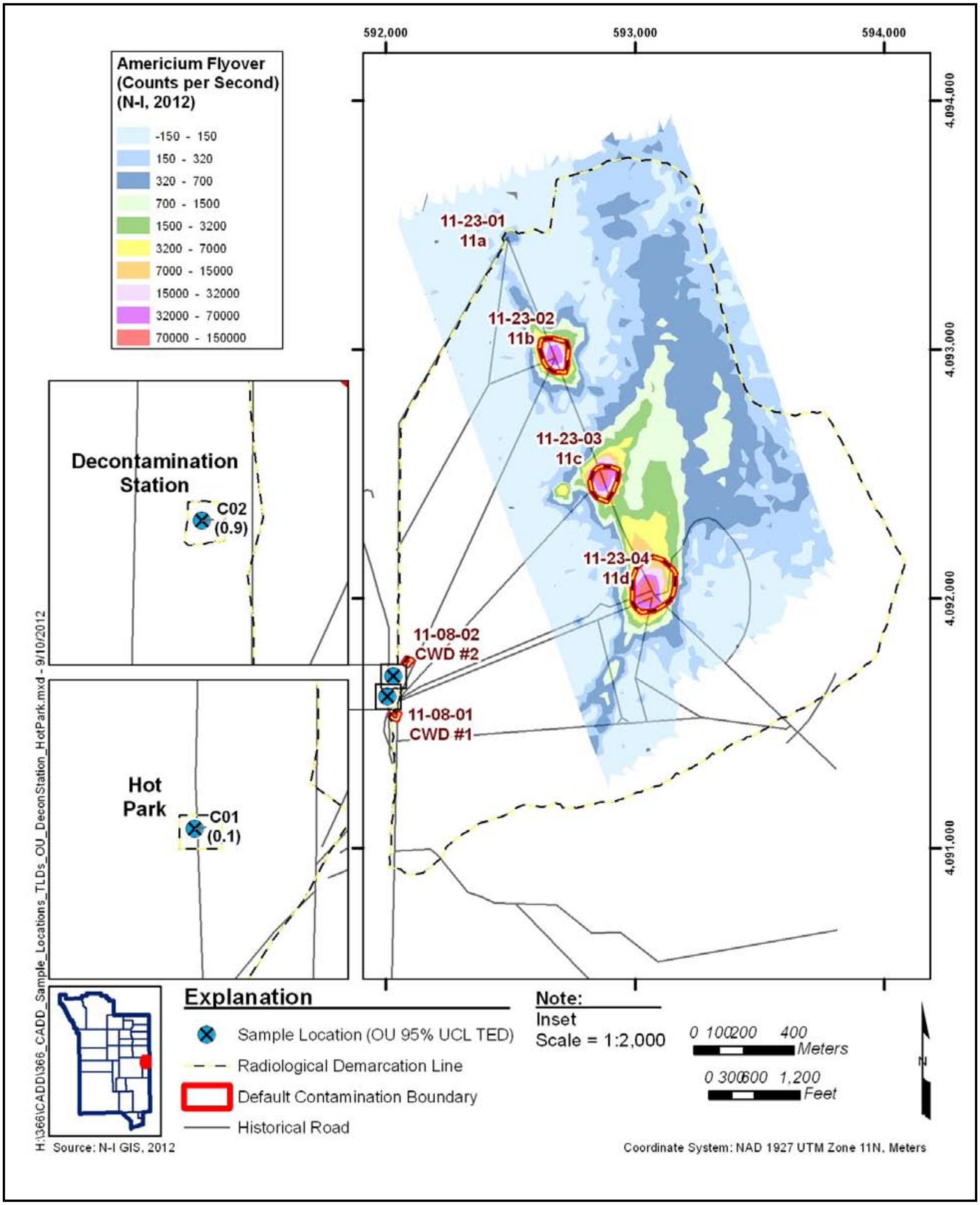

Figure A.5-3
Study Group 3, Sample Locations Including the 95% UCL of the TED

A.5.1.4 Deviations

There were no deviations to the CAIP (NNSA/NSO, 2011).

A.5.2 Investigation Results

Based on the presence of radiologically elevated soil and the removable contamination results, the Decontamination Station was posted as a CA and the Hot Park was posted as an HCA. As a corrective action, soil was removed from the Hot Park, and additional TRS activities were conducted. This resulted in the Hot Park being posted as a CA.

The following subsections present the analytical and computational results for soil and TLD samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NSO, 2011). The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr. Results that are equal to or greater than FALs are identified by bold text in the results tables.

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

The internal dose calculated from soil sample results, and the external dose calculated from TLD measurements were combined to determine TED at each sample location. External doses for TLD locations are summarized in Section A.5.2.1. Internal doses for each sample plot are summarized in Section A.5.2.2. The TEDs for each sampled location are summarized in Section A.5.2.3.

A.5.2.1 External Radiological Dose Measurements

Estimates for the external dose that a receptor would receive at each Study Group 3 TLD sample location were determined as described in Section A.2.2.5. Measurements for the external dose were calculated for the Industrial Area exposure scenario and then scaled (based on exposure duration) to the Remote Work Area and Occasional Use Area exposure scenarios for each TLD location. The standard deviation, number of elements, minimum sample size, and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.5-2. As shown in Table A.5-2, the minimum sample size was met for all locations in Study Group 3. The analytical results for the individual radionuclides in each composite sample and the corresponding calculated internal dose are presented in Appendix G.

Table A.5-2
Study Group 3, 95% UCL External Dose for Each Exposure Scenario

Source	Location	Standard Deviation	Number of Elements	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Hot Park	C01	0.03	3	3	1.2	0.2	0.1
Decontamination Station	C02	0.12	3	3	7.9	1.3	0.4

A.5.2.2 Internal Radiological Dose Estimations

Estimates for the internal dose that a receptor would receive at each sample plot at the Decontamination Station and Hot park were determined as described in Section A.2.2.4. The standard deviation, number of samples, minimum sample size, and 95 percent UCL of the internal dose for each exposure scenario are presented in Table A.5-3. As shown in Table A.5-3, the minimum sample size was met for all locations in Study Group 3. The analytical results for the individual radionuclides in each composite sample and the corresponding calculated internal dose are presented in Appendix G.

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

Source	Location	Standard Deviation	Number of Samples	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Hot Park	C01	0.01	4	3	0.2	0.0	0.0
Decontamination Station	C02	0.83	4	3	8.0	1.3	0.5

Bold indicates the values exceeding 25 mrem/yr.

A.5.2.3 Total Effective Dose

The TED for each sample location or TLD location was calculated by adding the external dose values and the internal dose values. Values for both the average TED and the 95 percent UCL of the TED for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table A.5-4. The TED at sample locations in the Decontamination Station and Hot Park did not exceed the 25-mrem/IA-yr PAL. The 95 percent UCL TED value for all sample locations in Study Group 3 are shown on Figure A.5-3.

Table A.5-4
Study Group 3, TED at Sample Locations (mrem/yr)

Source	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Hot Park	C01	0.5	1.4	0.1	0.2	0.0	0.1
Decontamination Station	C02	7.3	15.9	1.2	2.7	0.4	0.9

Bold indicates the values exceeding 25 mrem/yr.

A.5.3 Nature and Extent of Contamination

Based on the data evaluation and the proposed scenario, no COCs were identified in the Decontamination Station and Hot Park, following the removal of the soil that exceeded HCA criteria.

A.5.4 Revised CSM

The CAIP requirements (NNSA/NSO, 2011) were met at this CAS. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

A.6.0 Study Group 4

The drainage is located in Plutonium Valley in Area 11 of the NNSS. This feature consists of a release of radioactive material to drainages from the migration of Study Group 2 releases. The major drainage from the Study Group 2 area flows southwest of the 11d test area. Additional detail on the history of these experiments and the associated drainage is provided in the CAIP (NNSA/NSO, 2011). The location of this study group is shown on Figure A.6-1.

A.6.1 CAI Activities

A total of four environmental samples (including one FD) from two biased sample locations were collected during investigation activities of the drainage. All samples were analyzed for gamma spectroscopy; and isotopic Am, Pu, and U. A total of three TLDs from three locations (two soil sample locations and one TLD location) were collected during investigation of the drainage to measure external dose. The sample location, number, type, and purpose for each sample are listed in Table A.6-1. The specific CAI activities conducted to satisfy the CAIP requirements at this study group (NNSA/NSO, 2011) are described in the following subsections.

A.6.1.1 Visual Inspections

Visual inspection of the drainage was conducted. The drainage selected for investigation flows southwest from the 11d test area. It was noted that the area immediately outside the 11d test area appeared to be disturbed from migration activities, so sedimentation areas were numerous and closely spaced. The drainage began to have a more typical appearance further downstream from 11d. The configuration of the drainage (i.e., the spacing of the sedimentation areas) was the basis for selecting sample locations. As a result of the visual inspections, two sample locations (B01 and B02) were selected in the first sedimentation outside the 11d HCA and another location (B12) selected in a sedimentation area further downgradient.

A.6.1.2 Radiological Surveys

A TRS was completed starting just outside the 11d HCA and extending downstream to the edge of the CA. The survey was completed at the active channel, the bank deposits, and the younger and older

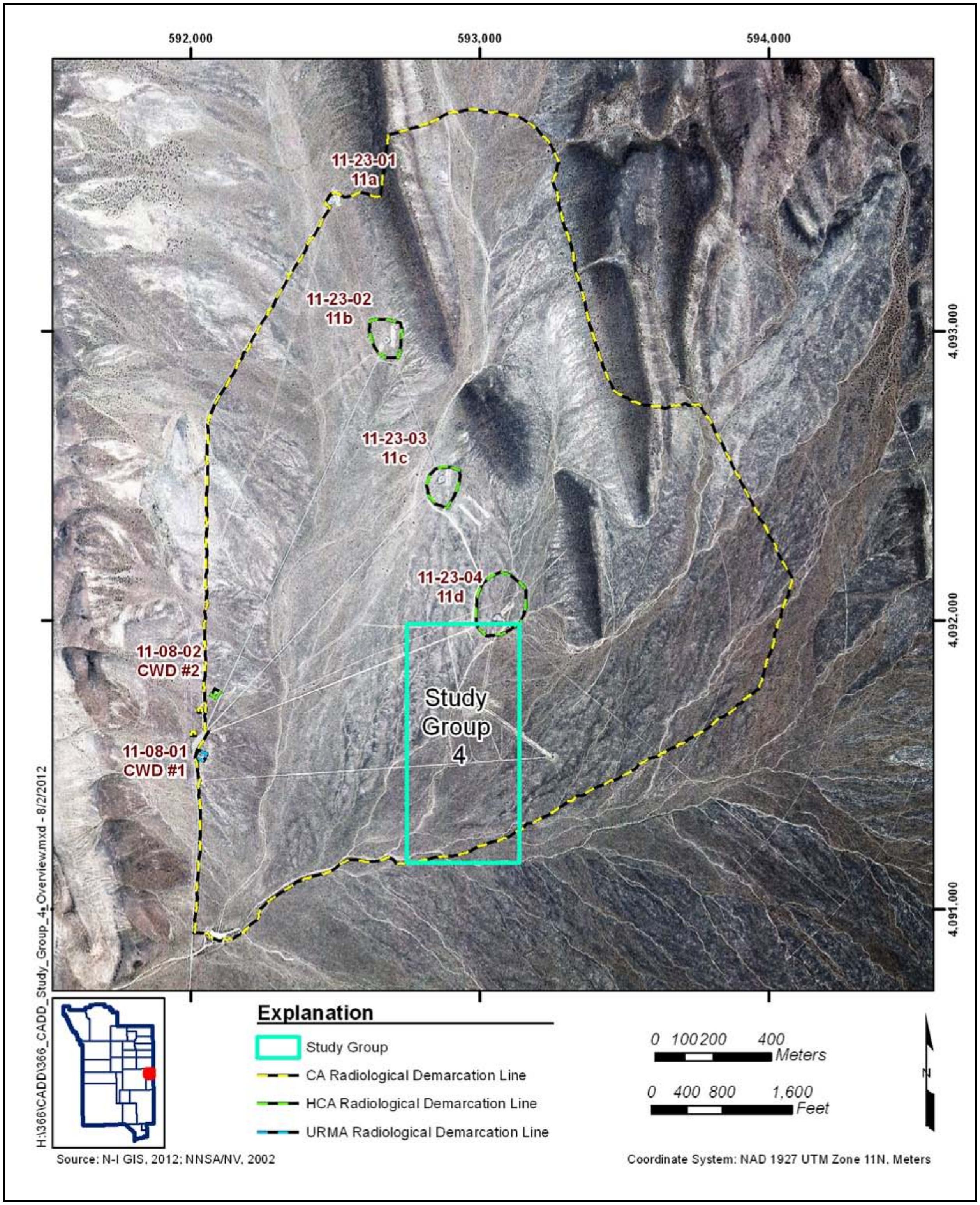

Figure A.6-1
Study Group 4, CAS Components General Location

Table A.6-1
Samples Collected at Study Group 4

Sample Location	Sample Number	Type	Purpose
B01	366B101	TLD	Grab Sample
	366B005	Soil	
	366B006		
B02	366B102	TLD	TLD Sample
B12	366B118	TLD	Grab Sample
	366B007	Soil	
	366B008		

terraces. No significant radiological readings were used to guide the sample location selection. Figure A.6-2 presents a graphic representation of the data from the TRS.

A.6.1.3 Sample Collection

The following subsections discuss the TLD and soil samples collected as part of the CAI.

A.6.1.3.1 Soil Samples

Samples were collected at 5-cm intervals vertically from the surface to a maximum depth of 30 cm. These grab samples were radiologically field screened, and the surface sample and any interval samples that exceeded the FSL were sent to the laboratory for analysis.

Sampling activities at the drainage for the determination of internal dose consisted of the collection of four judgmental surface soil (defined in Section A.2.0) samples (including one FD) at two locations (B01 and B12). The locations were established at two sedimentation areas downstream from the 11d test area. The first location (B01) was selected as it was the first sedimentation area identified outside the 11d HCA. The next sample location was originally to be placed at the next sedimentation area identified. However, because the next sedimentation area was in close proximity to the first sedimentation area, it was determined that a location further downstream would provide more comprehensive migration data. Therefore, location B12 was selected because it was a sedimentation area further downstream from the first sampled sedimentation area. The surface as well as a subsurface (10 to 15 cm) sample from location B12 were submitted for analyses. All sample locations (Table A.6-1) are shown on Figure A.6-3.

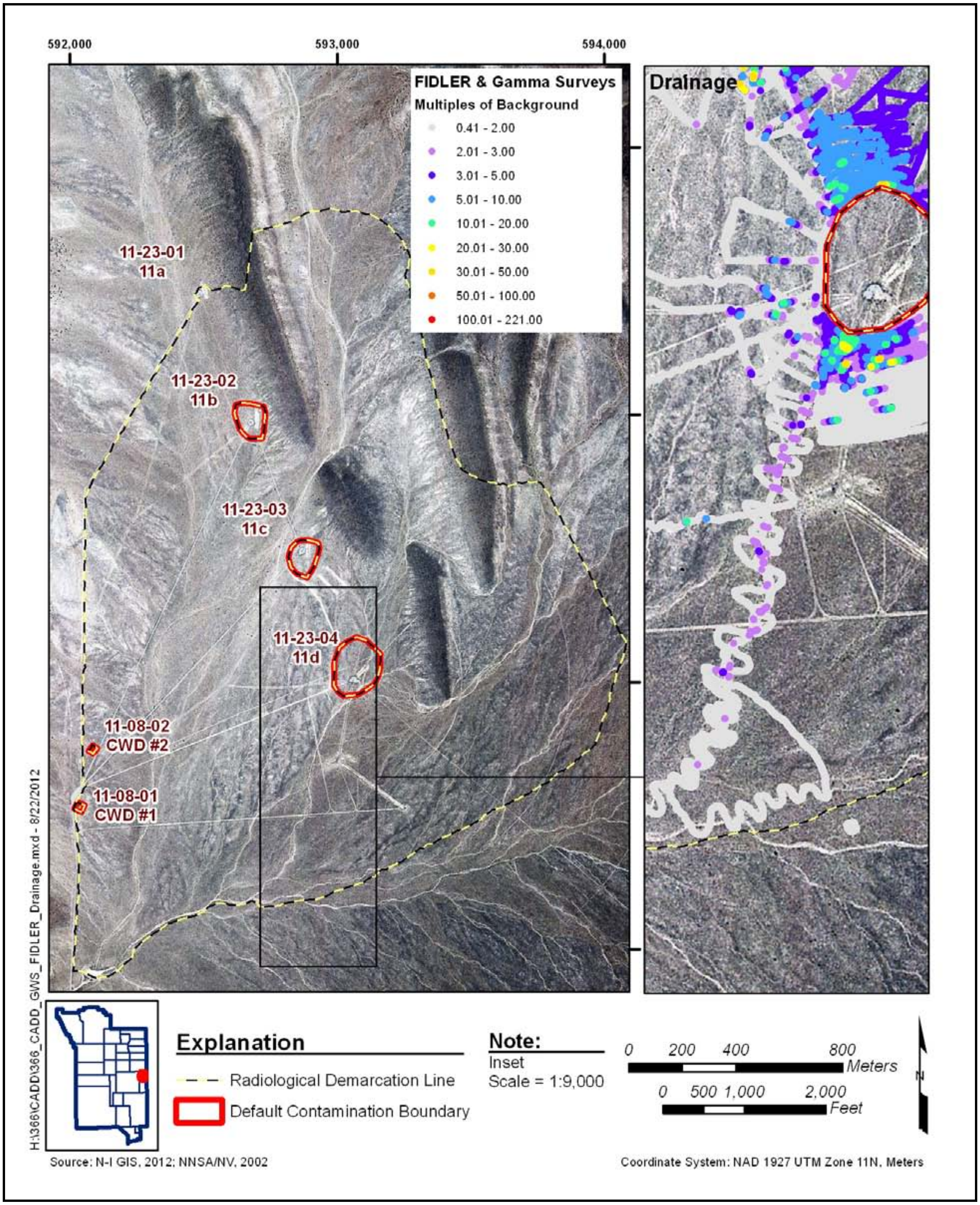

Figure A.6-2
TRS Results for Study Group 4

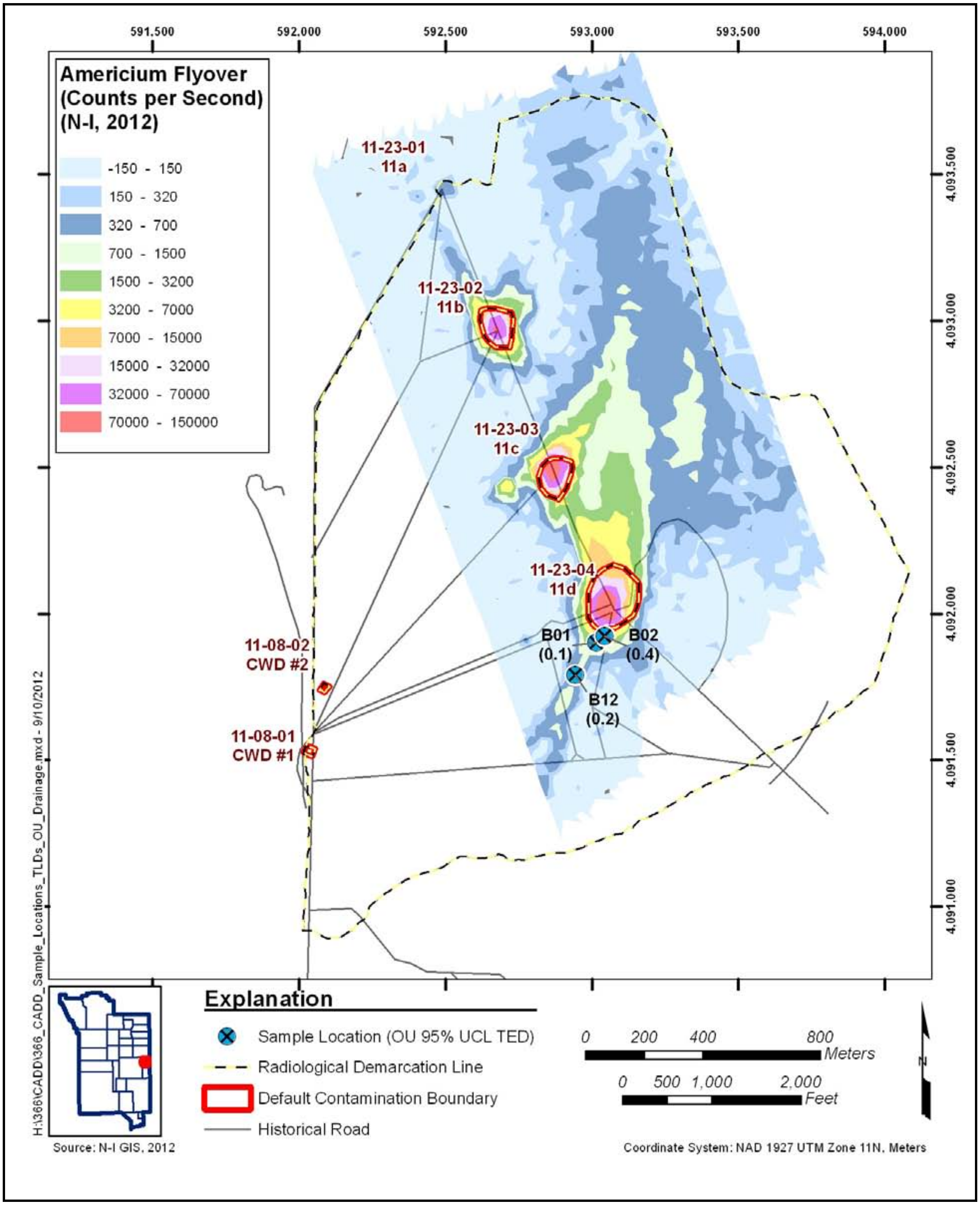

Figure A.6-3
Study Group 4, Sample Locations Including the 95% UCL of the TED

A.6.1.3.2 TLD Samples

Three TLDs were installed and are associated with two soil sample locations and one additional location. The first two TLDs (locations B01 and B02) were placed before soil collection. After TLD placement, a decision was made to sample (location B12) at a sedimentation area further downstream to collect more comprehensive migration data; therefore, a TLD remained in an area where soil was not sampled (location B02). The TLDs were placed to measure external doses (Table A.6-1). Details of the environmental monitoring TLD program and TLD QC are presented in Section A.10.0.
See Figure A.6-3 for TLD locations.

A.6.1.4 Deviations

It was stated in the CAIP (NNSA/NSO, 2011) that the two closest sedimentation areas in the drainage flowing out of the 11d HCA would be sampled. Because sedimentation areas just outside the 11d HCA were closely spaced and a sample plot for Study Group 2 was in the immediate area, it was decided that a sedimentation area further downstream would be sampled in addition to the sedimentation area adjacent to the 11d HCA. The decision was made so that better data regarding migration could be obtained. This change did not have any impacts to DQO decisions.

A.6.2 Investigation Results

The following subsections present the analytical and computational results for soil and TLD samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NSO, 2011). The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr.

Judgmental sampling was planned and implemented for Study Group 4 by selecting locations of maximum expected radioactivity that are not intended to be representative of the area. However, TLDs collect three independent measurements of external dose that can be used to calculate a 95 percent UCL of the external dose measurement. This adds an additional level of conservatism to the judgmental external dose estimate. Therefore, 95 percent UCL of the TED estimates will be reported for this study group as the total of the judgmental internal dose estimate and the 95 percent UCL of the judgmental external dose estimate.

External doses for TLD locations are summarized in Section A.6.2.1. Internal doses for each sample plot are summarized in Section A.6.2.2. The TEDs for each sampled location are summarized in Section A.6.2.3.

A.6.2.1 External Radiological Dose Measurements

Estimates for the external dose that a receptor would receive at each Study Group 4 TLD sample location were determined as described in Section A.2.2.5. Measurements for the external dose were calculated for the Industrial Area exposure scenario and then scaled (based on exposure duration) to the Remote Work Area and Occasional Use Area exposure scenarios for each TLD location. Although the sampling design for Study Group 4 is judgmental, the standard deviation, number of elements, minimum sample size, and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.6-2.

Table A.6-2
Study Group 4, 95% UCL External Dose for Each Exposure Scenario

Source	Location	Standard Deviation	Number of Elements	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Drainage	B01	0.03	3	3	1.6	0.3	0.1
	B02	0.06	3	3	4.0	0.7	0.2
	B12	0.01	3	3	2.9	0.5	0.1
	B12 (subsurface)				0.8[a]	0.1[a]	0.0[a]

[a]The TLD result at sample location B12 was used to infer a TLD result for the subsurface sample. Therefore, there is no 95% UCL value. The value reported is the average inferred TLD value.

A.6.2.2 Internal Radiological Dose Estimations

Estimates for the internal dose that a receptor would receive at each judgmental sample location were determined as described in Section A.2.2.4. The internal dose for each exposure scenario are presented in Table A.6-3. A surface and shallow subsurface sample was collected at location B12 so two results are reported. The analytical results for the individual radionuclides in each composite sample and the corresponding calculated internal dose are presented in Appendix G.

Table A.6-3
Study Group 4, Internal Dose for Each Exposure Scenario

Source	Location	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Drainage	B01	0.8	0.1	0.1
	B02	2.6	0.4	0.2
	B12	0.9	0.2	0.1
	B12 (subsurface)	0.9	0.2	0.1

A.6.2.3 Total Effective Dose

The TED for each sample plot or TLD location was calculated by adding the external dose values and the internal dose values. Values for both the average TED and the 95 percent UCL of the TED for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table A.6-4. The TED at sample locations in the drainage did not exceed the 25-mrem/OU-yr FAL. The 95 percent UCL TED value for all sample locations in Study Group 4 are shown on Figure A.6-3.

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

Source	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Drainage	B01	1.3	2.4	0.2	0.4	0.1	0.1
	B02	4.7	6.6	0.8	1.1	0.3	0.4
	B12	3.5	3.8	0.6	0.6	0.2	0.2
	B12 (subsurface)	1.7	--	0.3	--	0.1	--

-- Indicates no 95% UCL TED value for the subsurface grab sample.

A.6.3 Nature and Extent of Contamination

No COCs were identified in the drainage. Because no COCs are present, no further action is required. The potential for future migration of COC levels of radioactivity in local drainages can be evaluated based on the physical properties of the soil and the contaminants, the 56 years since the contamination was released to the surface, and investigation results.

The primary contaminant responsible for generating potential dose is plutonium. Plutonium has the properties of very low solubility and high adsorption to soil particles. The physical characteristics of the geologic material at CAU 366 include medium to high adsorptive capacities, low moisture content, and a long distance to groundwater (approximately 1,544 ft bgs). Based on these physical and chemical factors, contamination is not expected to migrate except as attached to eroding soil particles.

The washes entering and leaving these areas are generally dry but are subject to infrequent but intense stormwater flows. During the 56 years since the releases occurred, many large storm events have occurred such as the El Nino-associated storms of March 1995 and February 1998 that caused regional flooding. Several small washes and two prominent washes flow through Plutonium Valley to a detention basin located just outside the northwestern corner of the CA. Two major washes were identified (the western 11c wash and the eastern 11d wash) in the CAIP (NNSA/NSO, 2011).

Based on the low dose levels presented in Section A.6.2.3 and the results of the Desert Research Institute sampling effort in May 2010 (as presented in the CAIP), radionuclides are being transported down the 11d wash but at levels much lower than the FAL. Low levels of dose were observed near the 11c HCA boundary and in the wash to the detention basin. No evidence of radionuclide transport was observed in the other identified wash (11c). Based on the following factors, it is not expected that migration of contaminants at CAU 366 could result in a dose exceeding the FAL beyond the corrective action boundaries:

- Occurrence of large storm events during the 56 years since the original deposition of radioactive material (and the subsequent erosion of surface soil) has not resulted in an extension of a corrective action boundary in any drainage relative to the surrounding area.
- Corrective action boundaries were not established based on actual measured dose but rather on estimates of the 95 percent UCL of dose from samples biased to locations of highest radioactivity (i.e., not representative of the area).

Therefore, it is not reasonable to expect that dose exceeding the FAL beyond the corrective action boundary will occur in the future.

A.6.4 Revised CSM

The CAIP requirements (NNSA/NSO, 2011) were met at this CAS. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

A.7.0 Study Group 5

Radiological debris generated as a result of Project 56 test activities is located in Plutonium Valley in Area 11 of the NNSS. The debris consist of a release of radioactive metallic fragments from safety experiments conducted with devices containing plutonium and uranium. Additional detail on the history of the radiological debris is provided in the CAIP (NNSA/NSO, 2011). The location of this study group is shown on Figure A.7-1.

A.7.1 CAI Activities

A total of 13 environmental samples (8 samples collected from 2 sample plots and 5 judgmental samples) were collected during investigation activities of the radiological debris. All samples were analyzed for gamma spectroscopy and isotopic Am, Pu, and U. A total of 37 TLDs were collected during investigation activities of the radiological debris. The sample location, number, type, and purpose for each sample are listed in Table A.7-1. The specific CAI activities conducted to satisfy the CAIP requirements at this study group (NNSA/NSO, 2011) are described in the following subsections.

A.7.1.1 Visual Inspections

Visual inspections of the Project 56 test area were conducted to identify the presence of radiological debris. Various shapes, sizes, and types of debris were identified. In general, the main debris items identified were small metallic pieces with some cables, wood, and other miscellaneous items also present. The other fairly typical type of debris was rusted metal lining remnants from the test cabs that had become twisted and perforated as a result of the testing activities. The debris was mainly scattered radially from the 11a, 11b, 11c, and 11d test areas. As a result of the visual inspection, debris was inventoried, and the information regarding size was used along with radiological surveys to determine sample locations.

A.7.1.2 Radiological Surveys

As presented in the CAIP (Section 2.5.6), a debris survey was conducted in the vicinity surrounding the four test areas and adjacent to CWDs #1 and #2 (NNSA/NSO, 2011). The debris was scanned

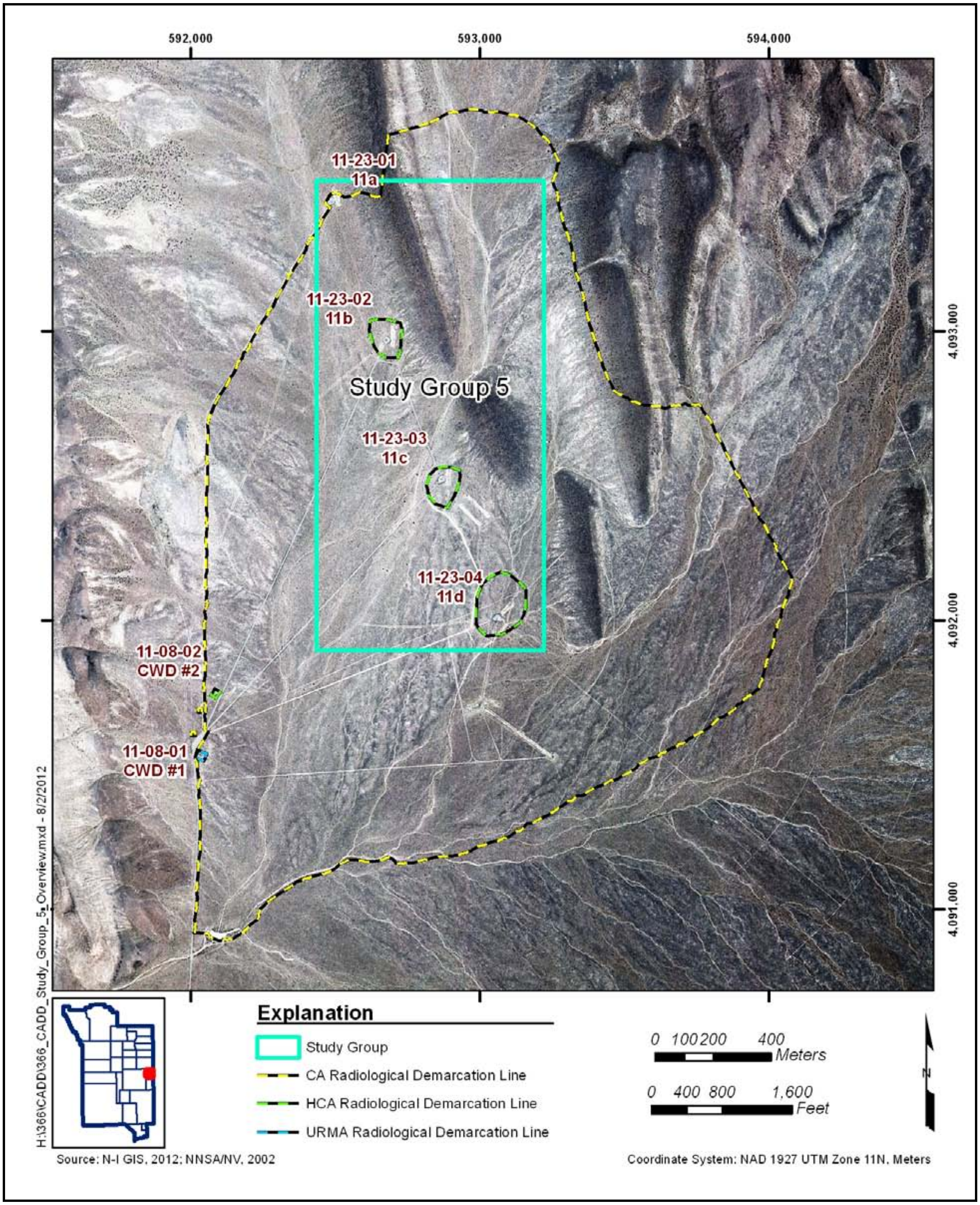

Figure A.7-1
Study Group 5, CAS Components General Location

Table A.7-1
Samples Collected at Study Group 5
(Page 1 of 2)

Sample Location	Sample Number	Type	Purpose
A08	366A112	TLD	TLD Grid
	366A113		
	366A114		
	366A115		
	366A116		
	366A117		
	366A118		
	366A119		
	366A120		
	366A121		
	366A122		
	366A123		
	366A124		
	366A125		
	366A126		
	366A127		
	366A108		Grab Sample
	366A001	Soil	
	366A605		Sample Plot
	366A606		
	366A607		
	366A608		
B13	366B114	TLD	Grab Sample
	366B004	Soil	
B14	366B115	TLD	
	366B002	Soil	
B15	366B116	TLD	
	366B003	Soil	
B16	366B117	TLD	
	366B001	Soil	

Table A.7-1
Samples Collected at Study Group 5
(Page 2 of 2)

Sample Location	Sample Number	Type	Purpose
B21	366B124	TLD	TLD Grid
	366B125		
	366B126		
	366B127		
	366B128		
	366B129		
	366B130		
	366B131		
	366B132		
	366B133		
	366B134		
	366B119		
	366B120		
	366B121		
	366B122		
	366B123		
	366B639	Soil	Sample Plot
	366B640		
	366B641		
	366B642		

with an NE Electra and swiped to determine the level of removable contamination. Any additional debris encountered during the CAI was also screened and included in the debris inventory for evaluation. The radiological surveys were used to identify the debris that had the most removable contamination and exhibited the highest external dose. As a result of the radiological surveys, and taking into consideration the size of the object, the radiological debris locations were selected (A08, B13 through B16, and B21).

A.7.1.3 Sample Collection

The following subsections discuss the TLD and soil samples collected as part of the CAI.

A.7.1.3.1 Soil Samples

The planned sampling activities for the determination of internal dose consisted of collecting judgmental samples at biased locations. The debris was selected for soil sampling based on the results of a radiological survey of the debris (including swipes to determine levels of removable contamination) as well as the size of the debris. Judgmental samples were collected from five debris locations (A08, B13 through B16). During the field investigation, it was determined that the judgmental sample at location A08 was not representative of the site conditions. The judgmental results at location A08 were anomalously high compared to results from other locations with similar radiation survey values. To better characterize dose at this location, a sample plot was centered on location A08 to conservatively estimate a probabilistic 95 percent UCL of dose at this judgmental location.

In addition, a location southwest of the 11c HCA was identified in the aerial survey as an extension of the americium plume that was initially assumed to be associated with the migration of contaminants in a wash. This plume can be seen on Figure A.7-2. During the CAI, it was discovered that this was not associated with migrating contaminants but rather anomalous debris with high levels of radioactivity. Therefore, this area was included in Study Group 5. A sample location (A21) was established at this location and a sample plot was sampled to conservatively estimate a probabilistic 95 percent UCL of dose at this judgmental location. Sampling in the plots consisted of the collection of four composite surface soil samples (defined in Section A.2.0). Final sample locations (Table A.7-1) are shown on Figure A.7-2.

A.7.1.3.2 TLD Samples

Thirty-seven TLDs were installed at six locations of selected radiological debris scattered throughout the Project 56 test area. Five TLDs were placed at individual debris locations (A08, B13 through B16) while a grid of 16 TLDs were placed in each sample plot at locations A08 and B21 (total of 32 TLDs), which are described in Section A.7.1.3.1. All TLDs were placed to measure external doses (Table A.7-1). Details of the environmental monitoring TLD program and TLD QC are presented in Section A.10.0. See Figure A.7-2 for the sample locations.

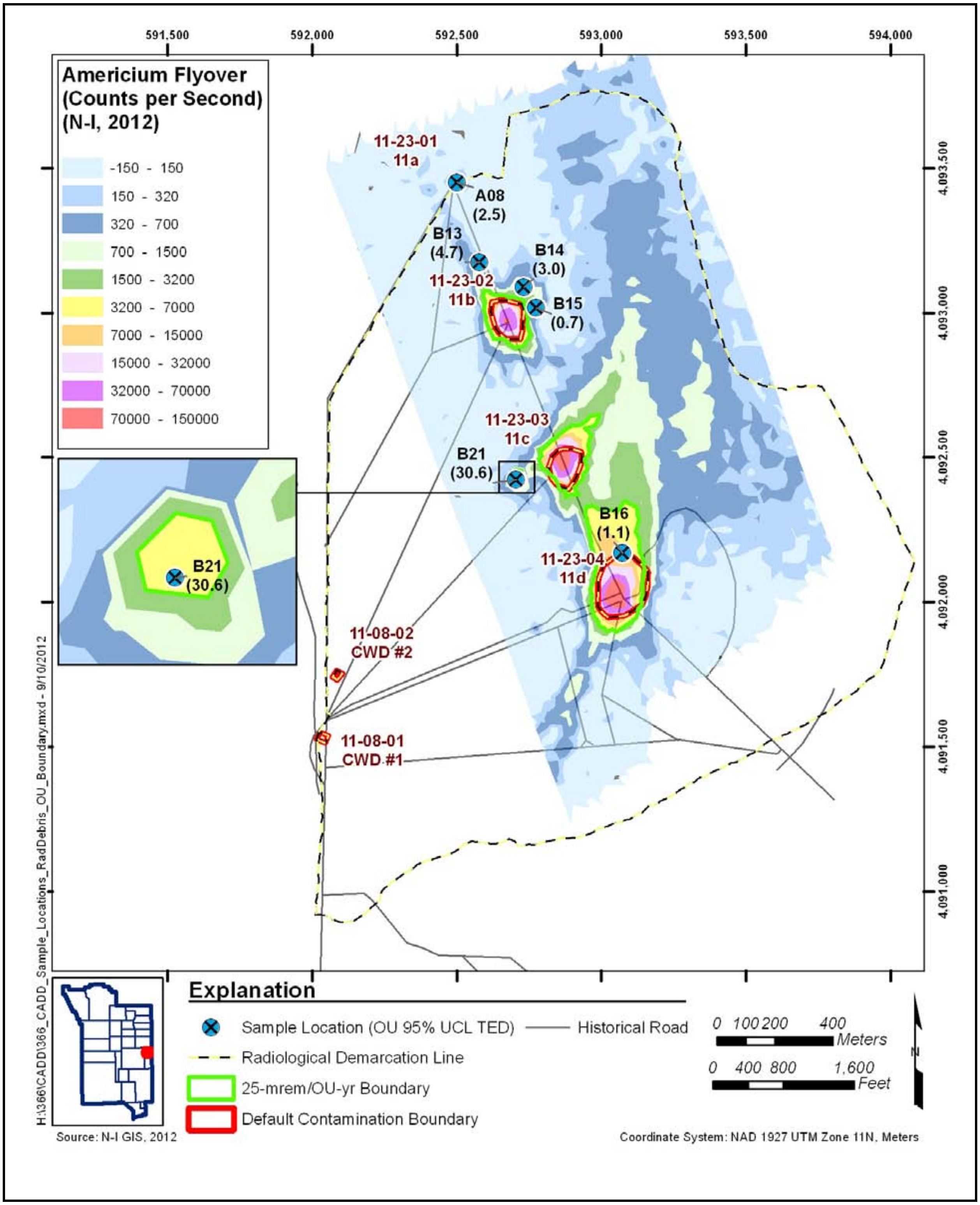

Figure A.7-2
Study Group 5, Sample Locations Including the 95% UCL of the TED

A.7.1.4 Deviations

It was stated in the CAIP (NNSA/NSO, 2011) that selected radiological debris would be investigated by collecting a judgmental sample and placing a low-volume air sampler adjacent to the debris. It was subsequently decided that an air sampler at these locations would not collect sufficient sample material to provide an accurate measurement. Therefore, it was determined to collect soil samples from which there is a higher confidence in producing measurable internal dose results.

In addition to judgmental samples, sample plots were placed at the two debris locations (A08 and B21) as described in Section A.7.1.3.1. It was determined that the probabilistic sample results from these judgmental locations were more conservatively representative of the dose at each location. Therefore, the sample plot results were used to identify the need for corrective action. This change did not have any impact to DQO decisions.

A.7.2 Investigation Results

The following subsections present the analytical and computational results for soil and TLD samples. All sampling and analyses were conducted as specified in the CAIP (NNSA/NSO, 2011). The radiological results are reported as doses that are comparable to the dose-based FAL of 25 mrem/OU-yr. Results that are equal to or greater than FALs are identified by bold text in the results tables. Judgmental grab sample results are presented for location A08; however, because the grab sample was not representative of the area, the probabilistic 95 percent UCL of the sample plot value was used to determine the need for corrective action (Section A.7.1.3.1).

For the probabilistic results from locations A08 and B21, a minimum number of samples is required to assure sufficient confidence in dose statistics such as the average and 95 percent UCL (EPA, 2006). As stated in the CAIP, if the minimum sample size criterion cannot be met, it must be assumed that contamination exceeds the FAL. The minimum sample size criterion for both of these locations was met. The calculation of the minimum sample size is described in Section B.1.1.1.1.

The internal dose calculated from soil sample results, and the external dose calculated from TLD measurements were combined to determine TED at each sample location. External doses for TLD locations are summarized in Section A.7.2.1. Internal doses for each sample plot are summarized in Section A.7.2.2. The TEDs for each sampled location are summarized in Section A.7.2.3.

A.7.2.1 External Radiological Dose Measurements

Probabilistic external dose estimates were calculated for the two sample plot locations. For the remaining sample locations, judgmental sampling was planned and implemented by selecting locations of maximum expected radioactivity that are not intended to be representative of the area. However, TLDs collect three independent measurements of external dose that can be used to calculate a 95 percent UCL of the external dose measurement. This adds an additional level of conservatism to the judgmental external dose estimate. Therefore, 95 percent UCL of the TED estimates will be reported for these judgmental locations as the total of the internal dose estimate and the 95 percent UCL of the judgmental external dose estimate.

Estimates for the external dose that a receptor would receive at each Study Group 4 TLD sample location were determined as described in Section A.2.2.5. Measurements for the external dose were calculated for the Industrial Area exposure scenario and then scaled (based on exposure duration) to the Remote Work Area and Occasional Use Area exposure scenarios for each TLD location. The standard deviation, number of elements, minimum sample size, and 95 percent UCL values of external dose for each exposure scenario are presented in Table A.7-2.

Table A.7-2
Radiological Debris, 95% UCL External Dose for Each Exposure Scenario

Source	Location	Standard Deviation	Number of Elements	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Radiological Debris	A08 (grab)	12.06	3	7.1	**753.5**	**126.6**	**37.7**
	A08 (plot)	2.95	48	3	**43.1**	7.2	2.2
	B13 (grab)	1.99	3	3	**91.7**	15.4	4.6
	B14 (grab)	0.28	3	3	14.0	2.3	0.7
	B15 (grab)	0.06	3	3	2.6	0.4	0.1
	B16 (grab)	0.26	3	3	13.3	2.2	0.7
	B21 (plot)	6.27	48	3	**150.0**	**25.2**	7.5

Bold indicates the values exceeding 25 mrem/yr.

A.7.2.2 Internal Radiological Dose Estimations

Estimates for the internal dose that a receptor would receive at each sample plot or judgmental sample location were determined as described in Section A.2.2.4. For the sample plot locations the standard deviation, number of samples, minimum sample size, and internal dose for each exposure scenario are presented in Table A.7-3. For the judgmental locations, grab samples results are reported in Table A.7-3 as a single sample result. The analytical results for the individual radionuclides in each composite sample and the corresponding calculated internal dose are presented in Appendix G.

Table A.7-3
Study Group 5, Internal Dose for Each Exposure Scenario

Source	Location	Standard Deviation	Number of Samples	Minimum Sample Size (OU Scenario)	Industrial Area (mrem/IA-yr)	Remote Work Area (mrem/RW-yr)	Occasional Use Area (mrem/OU-yr)
Radiological Debris	A08 (grab)	--	1	N/A	**177.3**	**29.9**	11.2
	A08 (plot)	0.45	4	3	5.1[a]	0.9[a]	0.3[a]
	B13 (grab)	--	1	N/A	1.7	0.3	0.1
	B14 (grab)	--	1	N/A	**35.7**	6.0	2.3
	B15 (grab)	--	1	N/A	9.1	1.5	0.6
	B16 (grab)	--	1	N/A	6.1	1.0	0.4
	B21 (plot)	44.28	4	79	**365.2**[a]	**61.5**[a]	23.1[a]

Bold indicates the values exceeding 25 mrem/yr.
[a]These values represent the 95% UCL.
-- Standard deviation cannot be calculated for single grab samples
N/A = Not applicable

A.7.2.3 Total Effective Dose

The TED for each sample location or TLD location was calculated by adding the external dose values and the internal dose values. Values for both the average TED and the 95 percent UCL of the TED for the Industrial Area, Remote Work Area, and Occasional Use Area exposure scenarios are presented in Table A.7-4. Because the judgmental sample value (48.9 mrem/OU-yr) was not representative at location A08 and the sample plot value (2.5 mrem/OU-yr) was used, the TED did not exceed the 25-mrem/OU-yr FAL. However, the TED at sample plot location B21 does exceed the 25-mrem/OU-yr FAL. The 95 percent UCL TED value for all sample locations in Study Group 5 are shown on Figure A.7-2.

Table A.7-4
Study Group 5 TED at Sample Locations (mrem/yr)

Source	Location	Industrial Area		Remote Work Area		Occasional Use Area	
		Average TED	95% UCL of TED	Average TED	95% UCL of TED	Average TED	95% UCL of TED
Radiological Debris	A08 (grab)	**524.1**	**930.8**	**88.1**	**156.4**	**28.6**	**48.9**
	A08 (plot)	**31.5**	**48.2**	5.3	8.1	1.6	2.5
	B13 (grab)	**26.3**	**93.4**	4.4	15.7	1.3	4.7
	B14 (grab)	**40.2**	**49.7**	6.8	8.4	2.5	3.0
	B15 (grab)	9.7	11.7	1.6	2.0	0.6	0.7
	B16 (grab)	10.6	19.5	1.8	3.3	0.6	1.1
	B21 (plot)	**242.9**	**515.3**	**40.9**	**86.7**	13.8	**30.6**

Bold indicates the values exceeding 25 mrem/yr.

Considering radioactive decay mechanisms only (with contamination erosion and transport mechanisms removed), the sampled location with the maximum TED (location B21) will decay to less than 25 mrem/OU-yr in 9 years and to less than 25 mrem/IA-yr in 3,930 years.

A.7.3 Nature and Extent of Contamination

There was exceedance of the FAL of 25 mrem/OU-yr at sample location B21 that requires corrective action. Because the debris at location B21 is visible on the radiological aerial flyover survey (N-I, 2012), the corrective action boundary will conservatively be established by the appropriate isopleth in which the debris at sample location B21 is located.

A.7.4 Revised CSM

The CAIP requirements (NNSA/NSO, 2011) were met at this CAS. The information gathered during the CAI supports the CSM as presented in the CAIP. Therefore, no revisions were necessary to the CSM.

A.8.0 Study Group 6

Debris (non-radiological) generated as a result of Project 56 test activities is located in Plutonium Valley in Area 11 of the NNSS. The debris consist of a release of lead to the soil from two lead bricks and two batteries. Additional detail on the history of the radiological debris is provided in the CAIP (NNSA/NSO, 2011). The location of this study group is shown on Figure A.8-1.

A.8.1 CAI Activities

A total of five environmental samples were collected during investigation activities of the other debris. All samples were analyzed for RCRA metals. The sample location, number, type, and purpose for each sample are listed in Table A.8-1. The specific CAI activities conducted to satisfy the CAIP requirements at this study group (NNSA/NSO, 2011) are described in the following subsections.

A.8.1.1 Visual Inspections

Visual inspections of the Project 56 test area were conducted over the course of the field investigation. Two lead bricks and two batteries (one intact and one broken) were located. No other debris of concern was identified. As a result of the visual inspection, the soil below the lead bricks (locations B19 and B20) and batteries (locations B17 and B18) was identified as requiring sampling.

A.8.1.2 Sample Collection

After the debris was removed, potentially contaminated soil was removed from the area impacted by the debris. A verification sample was then collected from the remaining soil surface. The initial verification sample results at location B17 exceeded the FALs for arsenic and lead. Additional soil was then removed, and an additional verification sample was collected. All sample locations (Table A.8-1) are shown on Figure A.8-2.

A.8.1.3 Deviations

There were no deviations to the CAIP (NNSA/NSO, 2011).

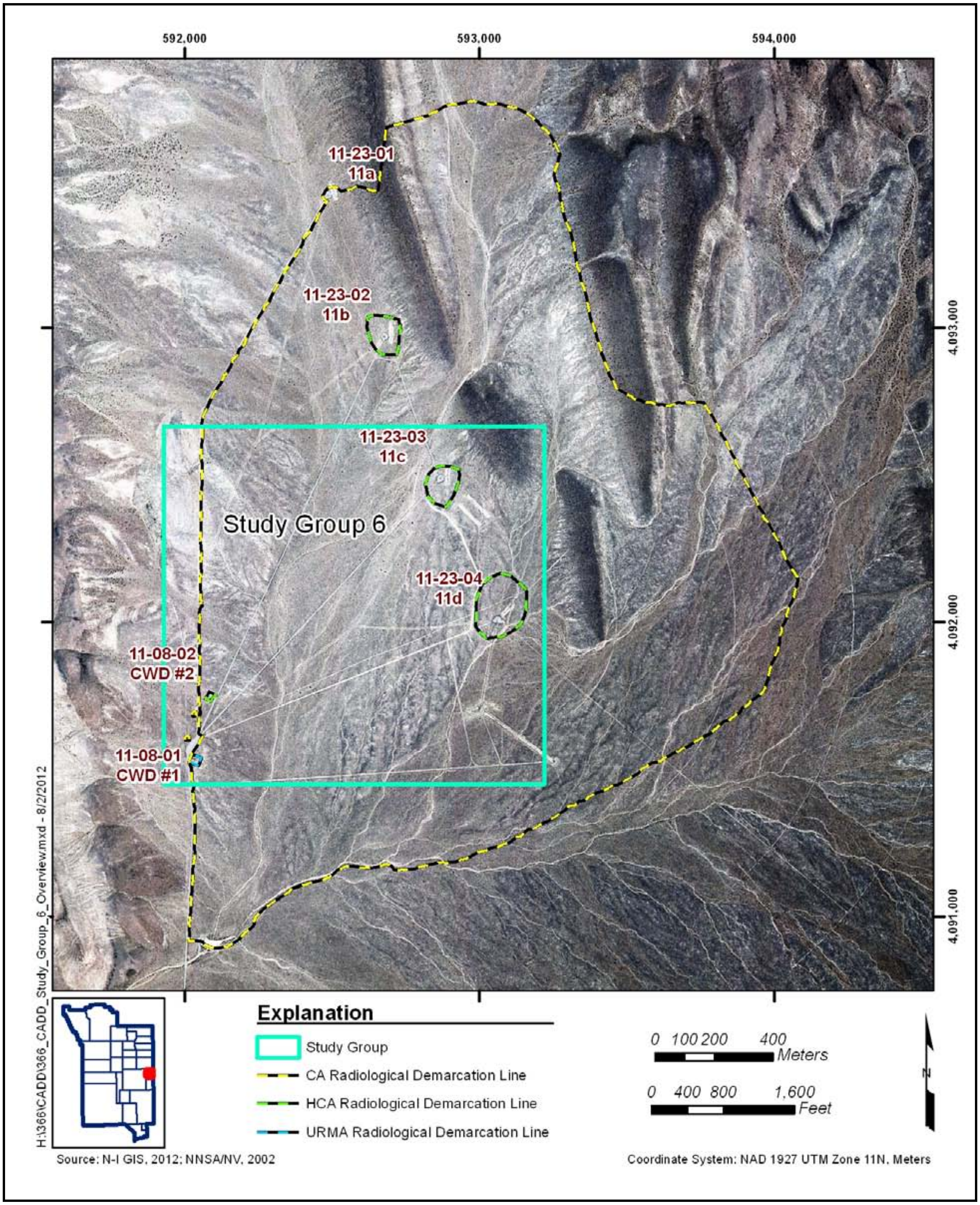

Figure A.8-1
Study Group 6, CAS Components General Location

Table A.8-1
Samples Collected at Study Group 6

Sample Location	Sample Number	Type	Purpose
B17	366B009	Soil	Grab Sample
	366B010		
	366B014		
B18	366B011	Soil	Grab Sample
B19	366B012	Soil	Grab Sample
B20	366B013	Soil	Grab Sample

A.8.2 Investigation Results

Analytical results detected above MDCs for RCRA metals in the environmental samples collected at two battery and two lead brick locations are presented in Table A.8-2. Sample 366B009 and FD sample 366B010 exceeded the FAL for lead and arsenic at sample location B17, where a broken battery was on the soil. Additional soil was removed from the area for disposal and an additional verification sample (366B014) was collected. No sample results from the remaining soil exceeded the FALs.

A.8.3 Nature and Extent of Contamination

It was assumed that COCs in soil initially exceeded the FAL at each of the debris locations. Therefore, a corrective action of soil removal and verification sampling was completed. All debris and impacted soil was removed and disposed of during the CAI. A corrective action of clean closure for this CAS component has been implemented.

A.8.4 Corrective Action Wastes

Two lead bricks and two batteries along with associated soil was collected. The material is classified as RCRA hazardous waste consisting of approximately 55 gal of waste, of which approximately 10 gal is composed of soil. See Table A.9-1 for a detailed waste summary.

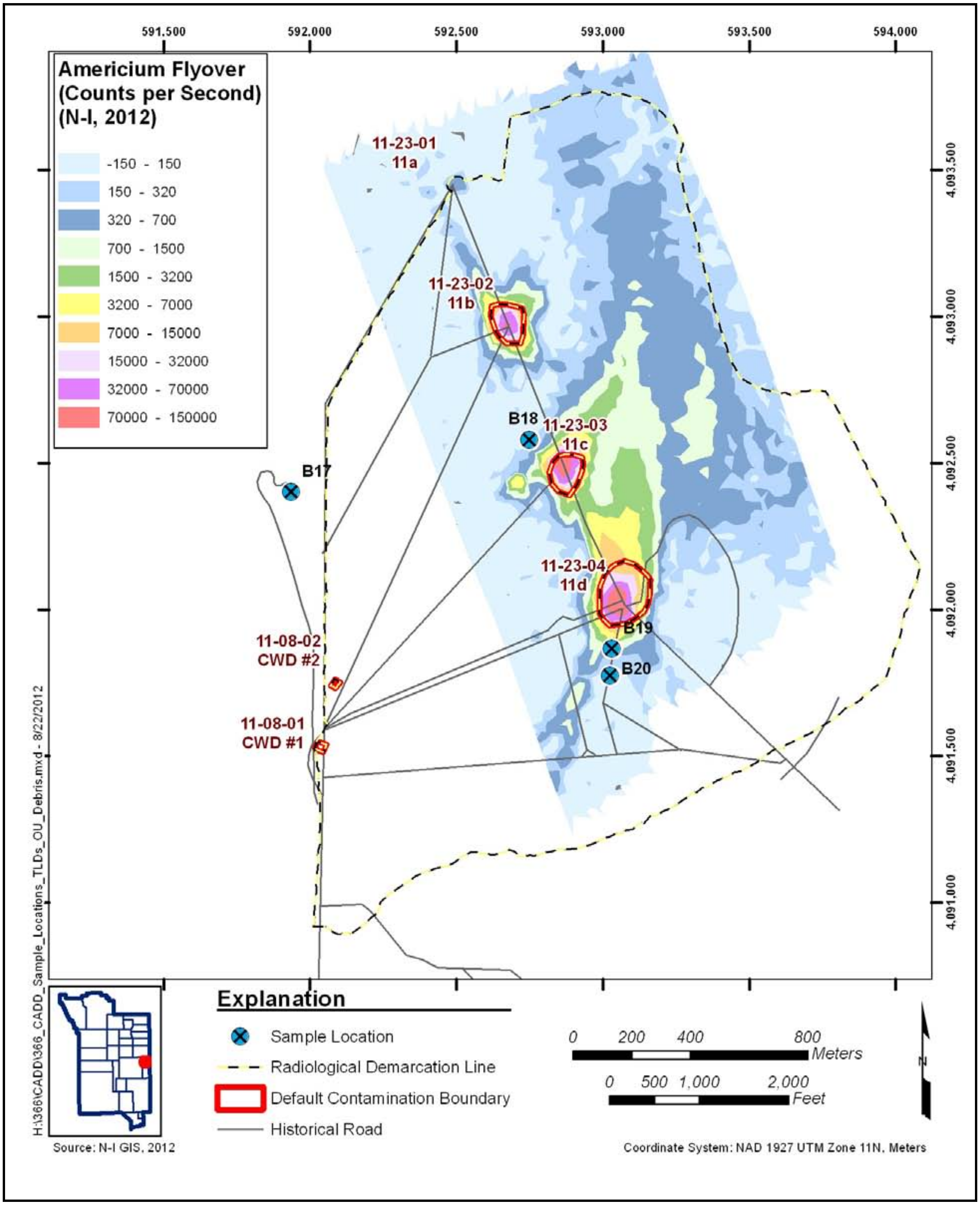

Figure A.8-2
Study Group 6 Sample Locations

Table A.8-2
RCRA Metal Sample Results above MDCs for Study Group 6

Sample Location	Sample Number	COPCs (mg/kg)						
		Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Silver
FALs		**23**	**190,000**	**800**	**N/A**	**800**	**43**	**5,100**
B17	366B009[a]	**115**	97.2	0.646	6.07	**179,000**	0.0277	0.905
	366B010[a]	6.21	88.9	0.465	5.38	**4,870**	0.0258	--
	366B014	2.8	72.8 (J)	0.205 (J)	4.69	25.2	0.0304	--
B18	366B011	2.09	80.6	--	4.39	9.27	0.0124 (J-)	--
B19	366B012	2.38	90.8	0.241 (J)	5.57	10.5	0.0157 (J-)	--
B20	366B013	2.82	114	--	6.45	29.3	0.0166 (J-)	--

Bold indicates the values exceeding the FAL.

[a]Samples 366B009 and 366B010 were collected after the initial soil removal. Because there was an exceedance of lead and arsenic, additional soil was removed and another verification sample collected (366B014).

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

A.9.0 Waste Management

Section A.9.1 addresses the characterization and management of investigation-derived waste (IDW) whereas Section A.9.2 addresses the potential corrective action waste that may be generated.

Waste management activities were conducted as specified in the CAIP (NNSA/NSO, 2011). IDW generated during the CAI were characterized based on process knowledge and FSRs. Controls were in place to minimize the use of hazardous materials and the unnecessary generation of hazardous and/or mixed waste.

A.9.1 Investigation-Derived Waste

The IDW listed in Table A.9-1 were generated during the field investigation activities of CAU 366. IDW was 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.

Table A.9-1
Waste Summary Table

Container Number	Waste Description	Waste Characterization	Waste Disposition			
			Disposal Facility	Waste Volume	Disposal Date	Disposal Doc[a]
366	Bulk Debris (PPE)	LLW	NNSS, Area 5 RWMC	5 yd^3	TBD	Pending
	Lead Debris (lead bricks [2], batteries [2], soil)	MLLW	Offsite Disposal Facility (TBD)	55 gal	TBD	Pending
	Soil	LLW	NNSS, Area 5 RWMC	110 gal	TBD	Pending

[a]Copies of waste disposal documents will be presented in the Closure Report.

LLW = Low-level waste
MLLW = Mixed low-level waste
PPE = Personal protective equipment
RWMC = Radioactive waste management complex
TBD = To be determined
yd^3 = Cubic yard

All waste dispositions were based on process knowledge, radiological surveys, site samples, and direct samples of the waste, when necessary. Waste characterization and disposition was based on federal and state regulations, permit limitations, and disposal facility acceptance criteria. The PPE and disposable sampling equipment generated during site activities were determined to be sanitary based on observation and process knowledge. The waste was bagged, marked, and placed in a roll-off for disposition at the industrial landfill.

A.9.1.1 Waste Characterization

The following subsections describe the wastes that were characterized based on analytical data, process knowledge, and radiological surveys.

A.9.1.1.1 Low-Level Waste

Two 55-gal drums of remediated soil were generated and characterized for disposal. The soil was remediated from an area of elevated radioactivity at the Hot Park. The waste was characterized using analytical results from a direct sample of the removed soil. Sample 366C501 was analyzed for gamma spectroscopy; isotopic Am, Pu, and U; and strontium (Sr)-90. Based on analytical results, the maximum activity concentrations of Am-241, Pu-238, and Pu-239/240 in the waste container exceeded the Area 9 U10c landfill limits. Therefore, the waste is characterized as LLW that was determined to meet the waste acceptance criteria of the NNSS Area 5 RWMC for disposal. The analytical results for waste characterization samples are presented in Table A.9-2.

One soft sided bulk bag (i.e., Super Sack) containing 5 yd^3 of bulk debris (PPE, disposable sampling equipment, and two empty drums) was generated during CAI activities from within radiologically posted CAs and HCAs. The waste was characterized using analytical results from all CAU 366 soil samples that were collected for environmental site characterization purposes. This is appropriate because the soil is the source of contamination on the waste. It was assumed that the maximum activity concentration reported for each isotope was uniformly distributed throughout the contents of the waste container. This activity concentration was conservatively applied to 3 percent of the mass of waste in the container. Based on the analytical results, the activity concentrations of Am-241, Pu-238, Pu-239/240, Pu-241, and U-234 in the waste container exceeded the Area 9 U10c landfill limits. Therefore, the waste is characterized as LLW that was determined to meet the waste acceptance criteria of the NNSS Area 5 RWMC for disposal.

Table A.9-2
Waste Management Results Detected at CAU 366

Sample Location	Sample Number	Matrix	Parameter	Result	Criteria	Units
B17 B18 B19 B20	366B501	Soil	Ac-228	1.49	N/A[a]	pCi/g
			Am-241	81.8	0.5[b]	
			Cs-137	0.768	3[b]	
			Am-241	32.2	0.5[b]	
			Pu-238	2.04	0.5[b]	
			Pu-239/240	120	0.5[b]	
			Pu-241	94.7	N/A[a]	
			U-234	0.843	0.9343[b]	
			U-238	0.658	10[b]	
			Barium	0.34 (J)	100[c]	mg/L
			Lead	107	5[c]	
C01	366C501	Soil	Ac-228	1.58	N/A[a]	pCi/g
			Am-241	720 (J)	10[d]	
			Cs-137	0.401	100[d]	
			Am-241	521	10[d]	
			Pu-238	60.1	10[d]	
			Pu-239/240	3,330	10[d]	
			Pu-241	124	100[d]	
			U-234	5.88	100[d]	
			U-235	0.251	100[d]	
			U-238	0.826	100[d]	

[a]These radionuclides do not have limits established by the U10c landfill or the POC.
[b]Radionuclide limits in the POC (BN, 1995)
[c]TCLP limit (CFR, 2012b)
[d]Radionuclide limits in NNSS U10c landfill permit (NNSA/NSO, 2010)

J = Estimated value.

Ac = Actinium
Cs = Cesium

A.9.1.1.2 Mixed Low-Level Waste

One 55-gal drum consisting of lead debris that is contaminated with lead and radioactivity was generated during the CAI. The waste was characterized using analytical data and process knowledge. The lead containing items generated include two radioactive lead bricks and lead-acid battery debris. The impacted soil from beneath each lead containing item was removed and packaged in the drum.

A composite waste characterization sample (366B501) of the soil was collected. The maximum concentration of each hazardous and radioactive constituent was determined and compared to the regulatory limits. The only source of chemical contamination is lead from the lead bricks and plates from the lead-acid batteries. The Toxicity Characteristic Leaching Procedure (TCLP) metals analysis of lead for sample 366B501 exceeded the regulatory level of 5 milligrams per liter (mg/L), making the waste hazardous for lead and RCRA regulated. In accordance with the *Nevada Test Site Performance Objective for the Certification of Nonradioactive Hazardous Waste* (POC) (BN, 1995), all hazardous waste destined for offsite treatment and disposal requires screening for radionuclides. The results for sample 366B501 exceeded the POC for Am-241, Pu-238, Pu-239/240, and U-234; therefore, the waste is characterized as MLLW. The waste will be transferred to National Security Technologies, LLC (NSTec), Waste Generator Services for transport and management at the Area 5 RWMC for ultimate treatment and disposal at an offsite treatment, storage, and disposal facility. The analytical results for waste characterization samples are presented in Table A.9-2.

A.9.2 Potential Corrective Action Waste

Potential remediation waste types that may be generated include one 55-gal drum of LLW debris and one 55-gal drum of asbestos-containing low-level waste (ALLW) associated with debris located inside a fenced and posted HCA at CAU 366. Currently, two abandoned 55-gal drums (previously closed as CAS 11-22-03 in CAU 214) are located inside the HCA. During the CAU 366 investigation, one drum was found to contain miscellaneous debris including 3/8-in. metal cable, coaxial cable, one 18-by-2-by-24-in. aluminum plate attached to a wood filter housing (no filter), loose PPE, some blown-in soil and plant debris, and other metal/wood debris. The drum condition was noted to have no lid, and breaches on the bottom and along the sides. The second drum was noted to be rusty but intact with a lid, and was found to contain a broken-up air filter and housing in a sealed plastic bag. Markings on the filter include “asbestos separators,” which indicates it is an asbestos-containing material. An asbestos warning label was therefore placed on the bagged contents and on the outside of the container.

According to the CAU 214 CADD (NNSA/NSO, 2004), swipe samples of cable debris were collected and analyzed for radioactivity with a reported maximum result of 2,430,000 +/- 340,000 picocuries (pCi) per sample. A sample of the filter media was collected from the second drum; the results indicate it did not fail TCLP for RCRA metals, and radionuclides were not detected. The exterior surface of the filter-containing drum, however, was swipe sampled and had a reported maximum result of 2,330 +/- 310 pCi per sample. Based on the reported activity concentrations and location within an HCA, the expected remediation waste types and volumes, if generated, include one 55-gal drum of LLW debris and one 55-gal drum of ALLW.

As a result of potential future remediation activities, it is estimated that a total of 110-gal of PPE waste may be generated as an additional LLW stream due to contact with radioactive materials.

A.10.0 Quality Assurance

This section contains a summary of QA/QC measures implemented during the sampling and analysis activities conducted in support of the CAU 366 CAI. The following subsections discuss the data validation process, QC samples, and nonconformances. A detailed evaluation of the DQIs is presented in Appendix B.

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

A.10.1 Data Validation

Data validation was performed in accordance with the Soils QAP (NNSA/NSO, 2012a) and approved protocols and procedures. All laboratory data from samples collected and analyzed for CAU 366 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 project files as a hard copy and electronic media.

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

A.10.1.1 Tier I Evaluation

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

- Sample count/type consistent with chain of custody.
- Analysis count/type consistent with chain of custody.
- Correct sample matrix.
- Significant problems and/or nonconformances stated in cover letter or case narrative.
- Completeness of certificates of analysis.

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

A.10.1.2 Tier II Evaluation

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

- Correct detection limits achieved.
- Blank contamination evaluated and, if significant, qualifiers are applied to sample results.
- Certificate of Analysis consistent with data package documentation.
- Quality control sample results (duplicates, laboratory control samples [LCSs], laboratory blanks) evaluated and used to determine laboratory result qualifiers.
- Sample results, uncertainty, and MDC evaluated.
- Detector system calibrated with National Institute of Standards and Technology (NIST)-traceable sources.
- Calibration sources preparation was documented, demonstrating proper preparation and appropriateness for sample matrix, emission energies, and concentrations.
- Detector system response to daily or weekly background and calibration checks for peak energy, peak centroid, peak full-width half-maximum, and peak efficiency, depending on the detection system.
- Tracers NIST-traceable, appropriate for the analysis performed, and recoveries that met QC requirements.
- Documentation of all QC sample preparation complete and properly performed.
- Spectra lines, photon emissions, particle energies, peak areas, and background peak areas support the identified radionuclide and its concentration.

A.10.1.3 Tier III Evaluation

The Tier III review is an independent examination of the Tier II evaluation. A Tier III review of 6.5 percent of the sample radiological data was performed by TLI Solutions, Inc., in Golden, Colorado. Tier II and Tier III results were compared and where differences were noted, data were reviewed and changes were made accordingly. This review included the following additional evaluations:

- Review
  - case narrative, chain of custody, and sample receipt forms,
  - lab qualifiers (applied appropriately),
  - method of analyses performed as dictated by the chain of custody,
  - raw data, including chromatograms, instrument printouts, preparation logs, and analytical logs,
  - manual integrations to determine whether the response is appropriate, and
  - 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, and
  - 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, and
  - at least one analyte per sample that contains positive results (hits); radiochemical results only require calculation checks on activity concentrations (not error).
- Verify that target compound detects identified in the raw data are reported on the results form.
- Document any anomalies for the laboratory to clarify or rectify. The contractor should be notified of any anomalies.

A.10.2 Field QC Samples

Three full laboratory QC samples were designated and submitted for analysis by the laboratory analytical methods discussed in Sections A.4.1, A.5.1, A.6.1, A.7.1, and A.8.1. Full laboratory QC samples are used to measure accuracy and precision associated with the matrix (see Appendix B for further discussion).

Additionally, four FDs were sent as blind samples to the laboratory to be analyzed for the investigation parameters listed in the above cited sections. For these samples, precision (i.e., relative percent differences between the environmental sample results and their corresponding FD sample results) were evaluated.

A.10.2.1 Laboratory QC Samples

Analysis of QC preparation blanks, LCSs, and laboratory duplicate samples was performed on each sample delivery group (SDG) for radionuclides. Initial and continuing calibration and LCSs were performed for each SDG. The results of these analyses were used to qualify associated environmental sample results. Documentation of data qualifications resulting from the application of these guidelines is retained in project files as both hard copy and electronic media.

A.10.3 Field Nonconformances

There were no field nonconformances identified for the CAI.

A.10.4 Laboratory Nonconformances

Laboratory nonconformances are generally due to inconsistencies in the analytical instrumentation operation, sample preparations, extractions, missed holding times, and fluctuations in internal standard and calibration results. A data review was conducted by reviewing QA reports and inspecting the data. All laboratory nonconformances were reviewed for relevance and where appropriate, data were qualified.

A.10.5 TLD Data Validation

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

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

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

2. *The use of a TLD to determine an individual's external dose is the standard in radiation safety and serves as the "legal dose of record" when other measurements are available.* Specifically, 10 CFR Part 835.402 (CFR, 2012) indicates that personal dosimeters must be provided to monitor individual exposures and that the monitoring program that uses the dosimeters must be accredited in accordance with a DOE Laboratory Accreditation Program.

A.11.0 Summary

Radionuclide and chemical contaminants detected in environmental samples collected during the CAI were evaluated against FALs to determine the nature and extent of COCs for CAU 366. Surface contamination within the 11b, 11c, and 11d HCAs, subsurface contamination at CWD #1, and surface and subsurface contamination at CWD #2 is assumed to be present at levels that require corrective action. Additionally, assessment of the data generated from surface soil samples indicates an exceedance of the FAL at a location where radiological debris is present (B21). Therefore, corrective action is required. Corrective actions were completed at all other locations where COCs were present (Hot Park, lead brick/battery locations). The following subsections summarize the results for each study group in CAU 366.

A.11.1 Study Group 1

No buried metallic debris was identified at the 11a trench. It is assumed that subsurface contamination is present within CWD #1 and the adjacent mound, and surface and subsurface contamination is present within CWD #2 at levels that require corrective action. Clean closure and closure in place corrective actions will be evaluated for CASs 11-08-01 and 11-08-02.

A.11.2 Study Group 2

It was assumed that contamination is present within the boundary of the 11b, 11c, and 11d HCAs that requires corrective action. The remainder of the test areas were sampled, and it was determined based on analytical results that no COCs associated with this study group were present outside the area established as requiring corrective actions. However, because COCs are assumed to be present within the HCAs, the alternatives of clean closure and closure in place with administrative controls will be evaluated for CASs 11-23-02, 11-23-03, and 11-23-04.

A.11.3 Study Group 3

During the field investigation, it was determined that soil in the Hot Park area was present at levels exceeding the HCA criteria. Because the affected area was limited, soil was removed and disposed of properly under a corrective action. Based on field observations and analytical results, no COCs are present in remaining soil at either the Decontamination Station or Hot Park. Therefore, no further corrective action is required for these CAS components.

A.11.4 Study Group 4

Based on field observations and analytical results, no COCs were identified in the drainage; therefore, no corrective action is required. The CAA is no further action.

A.11.5 Study Group 5

Based on analytical results, there was exceedance of the FAL (25 mrem/OU-yr) at radiological debris location B21. Because the debris at location B21 is visible on the radiological aerial flyover survey (N-I, 2012), the corrective action boundary will conservatively be established by the appropriate isopleth in which the debris at sample location B21 is located. Because COCs are present exceeding the FAL, the alternatives of clean closure and closure in place with administrative controls will be evaluated for CAS 11-23-03.

A.11.6 Study Group 6

Two lead bricks and two batteries, along with the associated contaminated soil, were removed and disposed of under a corrective action. Based on analytical results from the verifications sampling, no COCs are present in remaining soil. Therefore, no further corrective action is required for these CAS components.

A.11.7 Best Management Practices

As a BMP, it is recommended that an administrative UR be placed to encompass areas where soil exceeds the PAL of the 25 mrem/IA-yr. To determine the extent of the area where the Industrial Area TED exceeds the FAL, a correlation of radiation survey values to the 95 percent UCL of Industrial Area TED values was conducted for each radiation survey (2010 aerial radiation survey [N-I, 2012] and the site-specific TRS). The radiation survey with the best correlation was the aerial survey. The values were then interpolated using a kriging technique and isopleths established over the entire area of the aerial survey. The appropriate isopleth that corresponds to the 25-mrem/IA-yr PAL was identified as the administrative UR boundary. This recommended administrative UR boundary, as shown in Figure A.11-1, will encompass the areas that exceed the 25mrem/IA-yr. This includes portions of the 11b, 11c, and 11d test areas.

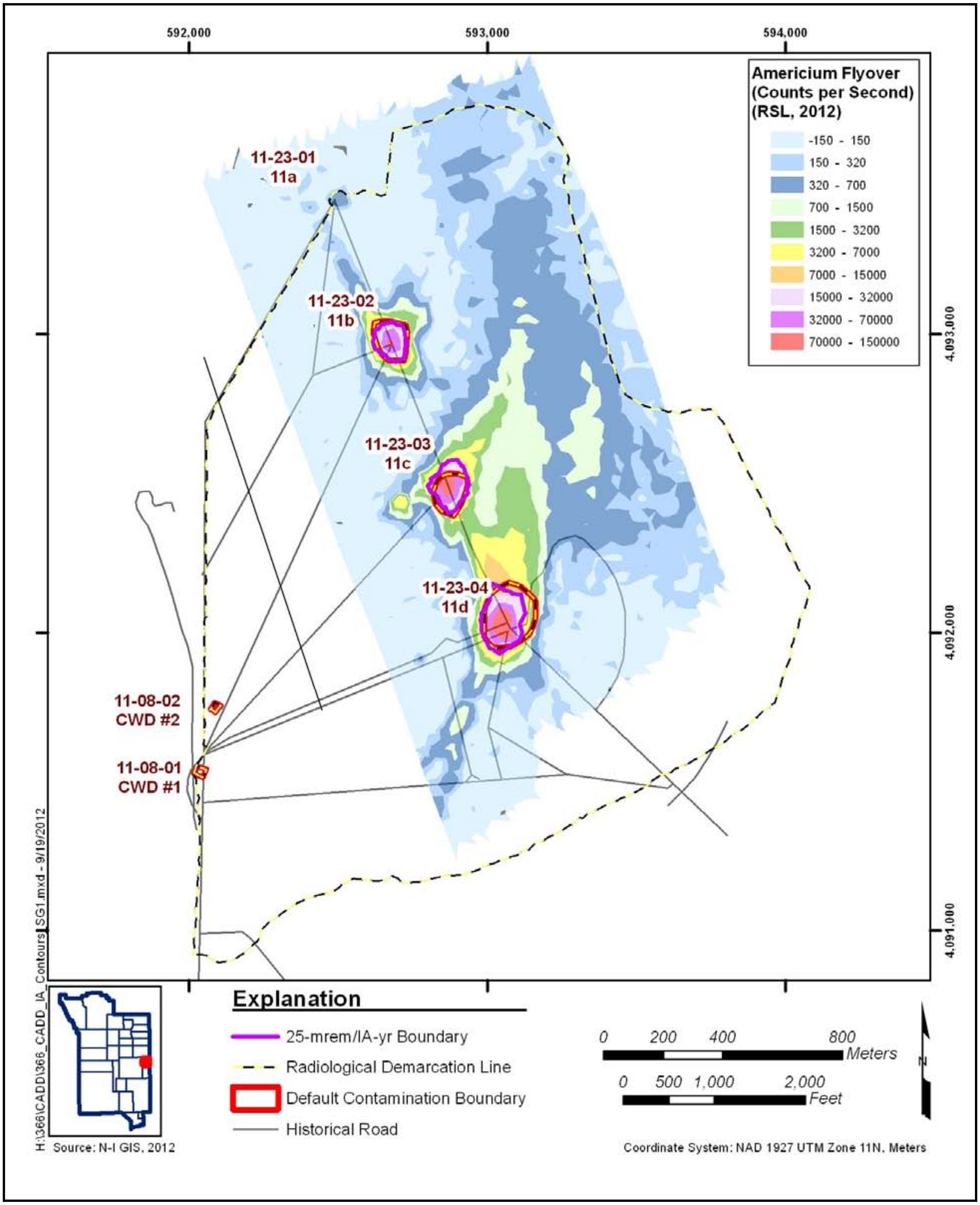

Figure A.11-1
BMP Administrative UR Boundary

A.12.0 References

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Appendix B

Data Assessment

B.1.0 Data Assessment

The DQA process is the scientific evaluation of the actual investigation results to determine whether the DQO criteria established in the CAU 366 CAIP (NNSA/NSO, 2011) were met and whether DQO decisions can be resolved at the desired level of confidence. The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes help to ensure that DQO decisions are sound and defensible.

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

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

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

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

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

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

B.1.1 Review DQOs and Sampling Design

This section contains a review of the DQO process presented in Appendix A of the CAIP (NNSA/NSO, 2011). The DQO decisions are presented with the DQO provisions to limit false negative or false positive decision errors. Special features, potential problems, or any deviations to the sampling design are also presented.

B.1.1.1 Decision I

The Decision I statement as presented in the CAIP (NNSA/NSO, 2011) is as follows: "Is any COC present in environmental media within the CAS?" For judgmental sampling design, any analytical result for a COPC above the FAL will result in that COPC being designated as a COC. For probabilistic (unbiased) sampling design, any COPC that has a 95 percent UCL of the average concentration above the FAL will result in that COPC being designated as a COC. A COC may 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/NSO, 2012). If a COC is detected, then Decision II must be resolved.

B.1.1.1.1 DQO Provisions To Limit False Negative Decision Error

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

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

Decision I for Study Group 1 and 2 (as stipulated in the DQOs), was already resolved for the areas within the default contamination boundaries since those areas were already identified as requiring corrective action. Therefore, Decision I sampling only applied to those areas outside the default contamination boundaries. To resolve Decision I (determine whether a COC is present at a CAS), samples were collected and analyzed following these two criteria:

- Samples must be collected in areas most likely to contain a COC (judgmental sampling).
- The analytical suite selected must be sufficient to identify any COCs present in the samples.

To resolve Decision I for the study groups outside the default contamination boundaries (as stipulated in the DQOs), the following activities were conducted:

Study Group 1

A geophysical survey was completed in the 11a trench. No subsurface metallic debris was identified.

Study Group 2

Probabilistic sample plot locations were selected at the highest radiological readings as detected during the TRSs and the 2010 aerial radiological survey (N-I, 2012). No COCs were detected.

Study Group 3

Probabilistic sample plots were selected at the highest radiological readings as detected during the TRS conducted in the Decontamination Station and Hot Park locations. No COCs were identified.

Study Group 4

Sampling locations were selected based on the presence of sedimentation areas located downgradient from the 11d HCA. The locations for sampling the 11d drainage consisted of selecting the first two downgradient sediment accumulation areas and an additional location further downstream. No COCs were identified.

Study Group 5

Judgmental samples were collected adjacent to five pieces of radiological debris selected based on the results of a radiological surveys (static scans, swipes for removable contamination). Additionally, two sample plots were placed at two radiological debris locations that had the highest dose and removable contamination as determined by radiological surveys conducted during the CAI. The FAL was exceeded at one radiological debris location.

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Study Group 6

Verification samples were collected at other debris locations (lead bricks, batteries) that was PSM. There were no COCs remaining after soil removal.

Criterion 1b

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

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

Selection of the sample aliquot locations within a sample plot (inclusive of Study Groups 2, 3, and 5) was accomplished using a random start, systematic triangular grid pattern for sample placement. This permitted an unbiased, equal-weighted chance that any given location within the boundaries of the sample plot would be chosen. Although the TLD locations were not established at random locations (i.e., they were placed at the center of the sample plot), they provided an integrated, unbiased measurement of dose from the plot area.

The minimum number of samples required for each sample plot was calculated for both the internal (soil samples) and external (TLD elements) dose samples. The minimum sample size (*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 B.1-1. As shown in this table, the minimum number of sample plot and TLD samples was met or exceeded, except for location B21 (which exceeds the FAL of 25mrem/OU-yr). The minimum sample size calculations were conducted as stipulated in the CAIP (NNSA/NSO, 2011) based on the following parameters:

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

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

Soil Samples				
Source	**Plot**	**Standard Deviation**	**Minimum Sample Size**	**Samples Collected**
Study Group 2	A01	0.01	3	4
	B03	0.48	3	4
	B04	0.11	3	4
	B05	0.03	3	4
	B06	0.01	3	4
	B07	2.52	3	5
	B08	0.12	3	4
	B09	0.08	3	4
	B10	0.05	3	4
	B11	0.45	3	4
Study Group 3	C01	0.01	3	4
	C02	0.83	3	4
Study Group 5	A08	0.45	3	4
	B21	44.28	79	4

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

Criterion 2

All samples were analyzed using the analytical methods and the following radiological analytes as listed in Section 3.2 of the CAIP (NNSA/NSO, 2011): gamma spectroscopy; and isotopic Am, U, and Pu. In addition to the radiological analyses, samples collected in sample plot location B07 containing asphalt were also sampled for VOCs and SVOCs. Sample collected from below two lead bricks and two batteries were analyzed for RCRA metals.

Sample results were assessed against the acceptance criterion for the DQI of sensitivity as defined in the Soils QAP (NNSA/NSO, 2012). The sensitivity acceptance criterion defined in the CAIP is that analytical detection limits will be less than the corresponding FAL (NNSA/NSO, 2011). Therefore, the criteria is that all detection limits are less than their corresponding Occasional Use area internal dose RRMGs for radionuclides. All of the analytical result detection limits for every radionuclide were less than their corresponding RRMGs; therefore, the DQI for sensitivity has been met for radionuclides, and no data were rejected due to sensitivity. This criterion was not achieved for the chemical analyte listed in Table B.1-2. Results not meeting the sensitivity acceptance criterion will not be used in making DQO decisions and will therefore be considered as rejected data. The impact on DQO decisions is addressed in the assessment of completeness.

Table B.1-2
Sensitivity Measurements

Parameter	Sample	Analyses	MDC (mg/kg)	Action Level (mg/kg)
n-Nitroso di-n-propylamine	366B633	SVOC	0.289	0.25
	366B634		0.292	
	366B635		0.299	
	366B636		0.297	
	366B637		0.297	
	366B638		0.298	

Criterion 3

To satisfy the third criterion, the entire dataset, as well as individual sample results, were assessed against the acceptance criteria for the DQIs of precision, accuracy, representativeness, comparability, and completeness, as defined in the Soils QAP (NNSA/NSO, 2012). The DQI acceptance criteria are presented in Table 6-1 of the CAIP (NNSA/NSO, 2011). The individual DQI results are presented in the following subsections.

Precision

Precision was evaluated as described in Section 6.2.3 of the CAIP (NNSA/NSO, 2011). Table B.1-3 provides the results for all constituents that were qualified for precision.

Table B.1-3
Precision Measurements[a]

Parameter	Analyses	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Eu-155	Gamma Spectroscopy	4	58	93

[a]SW-846 Methods (EPA, 2004 and 2008)

Eu = Europium

As shown in Table B.1-3, the precision rate for the isotope Eu-155 met the criteria of 80 percent specified in the CAIP (NNSA/NSO, 2011). Therefore, the results that were qualified for precision can be confidently used to support the DQO decision. As the precision rates for all other constituents meet the acceptance criteria for precision, the dataset is determined to be acceptable for the DQI of precision.

Accuracy

Accuracy was evaluated as described in Section 6.2.4 of the CAIP (NNSA/NSO, 2011). There were no radiological data qualified for accuracy. Therefore, the CAIP criterion of 80 percent accuracy was met for radiological constituents.

As shown in Table B.1-4, the CAIP criterion of 80 percent accuracy was not met for selenium. The samples qualified for selenium accuracy were estimated based on the matrix spike failing to meet QC criteria.

The potential for a false negative DQO decision error is negligible because the highest reported result for selenium that was qualified for accuracy is still small in comparison to the FAL. The highest qualified selenium concentration of 1.5 mg/kg is less than 1 percent of the FAL of 5,100 mg/kg.

Table B.1-4
Accuracy Measurements[a]

Parameter	Analyses	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Selenium	Metals	5	6	16.7

[a]SW-846 Methods (EPA, 2004 and 2008)

Therefore, use of the results that were qualified for accuracy will not result in a false negative decision error. As the accuracy rates for all other constituents meet the acceptance criteria for accuracy, the dataset is determined to be acceptable for the DQI of accuracy.

Representativeness

The DQO process as identified in Appendix A of the CAIP (NNSA/NSO, 2011) was used to address sampling and analytical requirements for CAU 366. During this process, appropriate locations were selected that enabled the samples collected to be representative of the population parameters identified in the DQO (the most likely locations to contain contamination [judgmental sampling] or that represent contamination of the sample plot [probabilistic sampling] and locations that bound COCs) (Section A.2.1). The sampling locations identified in the Criterion 1 discussion meet this criterion.

Plutonium may be present as a contaminant in soil in the form of small particles. As the soil sample volumes used for the analysis of isotopic Pu are small (e.g., 1 to 2 grams), the presence or absence of a particle of plutonium in a particular sample can make a significant difference in the calculated dose results. To ensure that sample results are more representative of the plutonium isotope concentrations in the area to which a receptor is exposed, concentrations of plutonium isotopes are inferred from americium results from a much larger, and therefore more representative, sample volume (e.g., 1 liter). This practice is justified by the process knowledge that contamination from any given source is expected to have the same americium to plutonium isotope ratios as the source material. This ratio is established based on the isotopic Am and isotopic Pu analytical results from the location that contains the maximum concentration of plutonium. The gamma spectrometry analysis reports an americium concentration from a 1-liter sample that is then used to infer concentrations of plutonium isotopes based on these ratios. This provides plutonium concentrations that are more representative of the area.

Therefore, the analytical data acquired during the CAU 366 CAI are considered representative of the population parameters.

Comparability

Field sampling, as described in the CAIP (NNSA/NSO, 2011), was performed and documented in accordance with approved procedures that are comparable to standard industry practices. Approved analytical methods and procedures per DOE were used to analyze, report, and validate the data. These are comparable to other methods used not only in industry and government practices, but most importantly are comparable to other investigations conducted for the NNSS. Therefore, project datasets are considered comparable to other datasets generated using these same standardized DOE procedures, thereby meeting DQO requirements.

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

Completeness

The CAIP (NNSA/NSO, 2011) defines acceptable criteria for completeness to be that the dataset is sufficiently complete to be able to make the DQO decisions. This is initially evaluated as 80 percent of CAS-specific analytes identified in the CAIP having valid results. Rejected data (either qualified as rejected or data that failed the criterion of sensitivity) were not used in the resolution of DQO decisions and are not counted toward meeting the completeness acceptance criterion. Table B.1-2 provides the failed sensitivity data for the site. The SVOC n-Nitroso di-n-propylamine failed the sensitivity criteria because the method detection limits exceeded the PAL. The MDLs ranged from 0.29 to 0.3 mg/kg, while the PAL is 0.25 mg/kg. The samples that failed sensitivity criteria contained asphalt materials, so the laboratory used reduced aliquots to avoid interferences and instrument contamination. n-Nitroso di-n-propylamine has never been detected at the NNSS and is a compound that is mainly used for research; as a result, there is no reason to suspect the presence of n-Nitroso di-n-propylamine. Therefore, the absence of usable results for this compound does not preclude the resolution of the DQO decisions. The dataset for CAU 366 has met the general completeness criteria as sufficient information is available to make the DQO decisions.

B.1.1.1.2 DQO Provisions To Limit False Positive Decision Error

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

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

B.1.1.2 Decision II

Decision II as presented in the CAIP (NNSA/NSO, 2011) is as follows: “Is sufficient information available to evaluate potential CAAs?” Sufficient information is defined to include the following:

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

A corrective action will be determined for any site containing a COC. The evaluation of the need for corrective action will include the potential for wastes that are present at the site to cause the future contamination of site environment media if the wastes were to be released.

For Study Groups 2, 3, 4, and 6, there were no COCs detected outside the default contamination boundaries. Therefore, Decision II was resolved. The following describes the Decision II sampling that was conducted for Study Groups 1 and 5:

Study Group 1

A geophysical survey was conducted at CWDs #1 and #2 to detect buried metallic debris beyond the fence lines of the dumps. It was determined that some metallic debris is present within a mound adjacent to CWD #1. Therefore, the mound will be included in the area that requires corrective action.

Study Group 5

One sample plot associated with a piece of radiological debris exceeded the FAL. A Decision II boundary associated with the contamination was determined by selecting the aerial radiological isopleth that corresponds with the location of the radiological debris

B.1.1.3 Sampling Design

The CAIP (NNSA/NSO, 2011) stipulated that the following sampling processes would be implemented:

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

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

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

  Result. Judgmental sampling was conducted at the 11d drainage, at specific radiological debris locations, and at hazardous debris locations. Probabilistic sampling was completed at judgmental sample locations for the Decontamination Station and Hot Park, and at two radiological debris locations.

B.1.2 Conduct a Preliminary Data Review

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

B.1.3 Select the Test and Identify Key Assumptions

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

The key assumptions that could impact a DQO decision are listed in Table B.1-5.

Table B.1-5
Key Assumptions

Exposure Scenario	Occasional Use Area
Affected Media	Surface, shallow, and subsurface soil; wash sediments
Location of Contamination/Release Points	Surface and subsurface soil within CWDs #1 and #2, surface soil surrounding the four test areas, surface soil directly below or adjacent to contaminated debris, surface/shallow subsurface sediment in washes, and surface/shallow subsurface soil from the Decontamination Station and Hot Park activities
Transport Mechanisms	Surface water runoff serves as the major driving force for lateral migration of contaminants while percolation of precipitation or runoff through subsurface media provides a driver for vertical transport of contaminants. Wind may cause limited resuspension and transport of windborne contaminants; however, this transport mechanism is less likely to cause migration of contamination at levels exceeding FALs.
Preferential Pathways	Vertical transport is expected to dominate over lateral transport due to small surface gradients. However, the CASs are located on an alluvial fan that drains to Yucca Flat, so there is some potential for lateral transport.
Lateral and Vertical Extent of Contamination	Contamination, if present, is expected to be contiguous to the release points. Concentrations are expected to decrease with distance and depth from the source. 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	Nuclear Test Zone.
Other DQO Assumptions	Subsurface contamination is present at CWDs #1 and #2 due to the buried waste. Surface contamination is present at the 11a, 11b, 11c, and 11d test areas due to the four safety experiments conducted at Plutonium Valley. Surface contamination is also present associated with radiological and hazardous debris. The CSM includes the potential for surface contamination associated with the drainages, Decontamination Station and Hot Park. The DQIs were satisfactorily met as discussed in Section B.1.1.1.1. The data collected during the CAI are considered to support the CSM and the DQO decision; therefore, no revisions to the CSM were necessary.

B.1.4 Verify the Assumptions

The results of the investigation support the key assumptions identified in the CAU 366 DQOs and Table B.1-5. All data collected during the CAI supported the CSM, and no revisions to the CSM were necessary.

B.1.4.1 Other DQO Commitments

The CAIP (NNSA/NSO, 2011) made the following commitments:

1. Decision I for the primary release scenario outside the default contamination boundaries will be evaluated by calculating TED in one sample plot established within the area of the highest uranium values (11a) or two sample plots with the highest americium values (11b, 11c, 11d) as determined by the results of a radiological walkover survey.

   Result: Decision I was resolved by the placement of TLDs and collection of environmental samples in three sample plots as required in the CAIP. The 95 percent UCL of the average TED did not exceed the FAL outside the default contamination boundaries.

2. A minimum of three sample plots along each of two vectors would be placed so that the outermost sample plot on each vector would be located beyond the 25-mrem/OU-yr dose boundary.

   Result. Six sample plots were placed along two vectors. The 95 percent UCL of the average TED did not exceed the FAL.

3. A sample plot will be placed in an area of asphalt-covered soil near the 11c GZ.

   Result. A sample plot was placed in the area of asphalt-covered soil. The 95 percent UCL of the average TED did not exceed the FAL.

4. A sample plot will be placed in the area with the most widespread elevated radiological readings from a TRS of the Decontamination Station and Hot Park locations.

   Result. Two sample plots were placed in two distinct areas (one being the Decontamination Station and the other being the Hot Park). The 95 percent UCL of the average TED did not exceed the FAL.

5. Conduct a geophysical survey in the 11a trench to determine whether the area requires corrective action based on the presence of buried material.

   Result. A geophysical survey was conducted, and no buried metallic debris was identified.

6. Sample the nearest two sediment accumulation areas present within the drainage located outside the 11d default contamination boundary.

   Result. The area just outside the 11d default contamination boundary was previously disturbed by migration activities. Therefore, a sediment accumulation area closest to the boundary was selected and a second sediment accumulation area was selected further downstream. The 95 percent UCL of the average TED did not exceed the FAL.

7. Place a TLD and a low-volume air sampler at two discrete debris items with maximum radiation survey values such that the debris may be considered PSM.

   Result. It was determined that a more conservative determination of whether radiologically impacted debris was PSM was to collect a judgmental soil sample and/or place a sample plot at select debris locations. Five judgmental locations and two sample plots were placed at six debris locations (one judgmental sample and one sample plot were collected to investigate one debris item). The 95 percent UCL of the average TED did exceed the FAL at one debris location (B21).

8. Determine whether a potential release is present based on biasing factors such as stains, spills, or debris.

   Result. Two lead bricks and two batteries were located and were assumed to be PSM. The PSM and impacted soil was removed and verification samples collected. One sample exceeded the PAL, so additional soil was collected and another verification sample collected. No COCs associated with these debris items remain in the soil.

B.1.5 Draw Conclusions from the Data

This section resolves the two DQO decisions for each of the CAU 366 CASs.

B.1.5.1 Decision Rules for Both Decision I and II

Decision rule. If COC contamination is inconsistent with the CSM or extends beyond the spatial boundaries identified in Section A.5.2 of the CAIP (NNSA/NSO, 2011), then work will be suspended and the investigation strategy will be reconsidered, else the decision will be to continue sampling.

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

B.1.5.2 Decision Rules for Decision I

Decision rule. If the population parameter of any COPC in the Decision I population of interest exceeds the corresponding FAL, then that contaminant is identified as a COC, and Decision II samples will be collected, else no further investigation is needed for that release in that population.

- **Result.** Because COCs were assumed to be present within the established default contamination boundaries in Study Groups 1 and 2 and also identified during the CAI in Study Group 5, Decision II needed to be resolved. No COCs were identified at Study Groups 3, 4, and 6; therefore, Decision II activities were not required.

Decision rule. If a COC exists at any CAS, then a corrective action will be determined, else no further action is required.

- **Result.** Because COCs were identified at Study Groups 1, 2, and 5, corrective actions are required.

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

- **Result.** Hazardous debris was identified as PSM, and a corrective action of debris and soil removal was completed. Radiological debris was identified as PSM and will require corrective action.

B.1.5.3 Decision Rules for Decision II

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

- **Result.** Decision II samples were not required because Decision I samples and the aerial radiological survey were used to define COC contamination.

Decision rule. If valid analytical results are available for the waste characterization samples, then the decision will be that sufficient information exists to determine potential remediation waste types and evaluate the feasibility of remediation alternatives, else collect additional waste characterization samples.

- **Result.** Valid analytical data were obtained to adequately characterize the material associated with the lead bricks and batteries. Data were determined to be adequate to determine waste types and evaluate alternatives.

B.2.0 References

EPA, see U.S. Environmental Protection Agency.

N-I, see Navarro-Intera, LLC.

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

Navarro-Intera, LLC. 2012. Data transfer to M. Knop from NSTec regarding Area 11 aerial radiological surveys, 26 June.

PNNL, see Pacific Northwest National Laboratory.

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2011. *Corrective Action Investigation Plan for Corrective Action Unit 366: Area 11 Plutonium Valley Dispersion Sites, Nevada National Security Site, Nevada*, Rev. 0, DOE/NV--1466. 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. 2004. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* OSWER 9240.1-45, EPA 540-R-04-004. October. Washington, DC: Office of Superfund Remediation and Technology Innovation.

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.

U.S. Environmental Protection Agency. 2008. *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review,* OSWER 9240.1-48, USEPA-540-R-08-01. June. Washington, DC: Office of Superfund Remediation and Technology Innovation.

Appendix C

Cost Estimates

C.1.0 Cost Estimates

Attachment C-1 contains the Cost Estimate Proposal Data Sheets for the corrective actions of closure in place with administrative controls and clean closure for the CAU 366 CASs.

Attachment C-1

Cost Estimates

(12 Pages)

UNCONTROLLED When Printed

EST ID: CAS 11-08-01	**National Security Technologies, LLC** **COST ESTIMATE PROPOSAL DATA SHEET**	**Date: 21-Jun-12**

SUBJECT: **CADD Alternatives Cost Estimates for CAU 366, CAS 11-08-01 (Contaminated Waste Dump #1)**

ESTIMATOR: **Alissa Silvas** **REF #:** ____

TYPE OF ESTIMATE:

X	ORDER OF MAGNITUDE	___	TITLE II
___	PRELIMINARY / PLANNING / STUDY	___	WORK ORDER
___	CONCEPTUAL / BUDGET	___	COMPARATIVE
___	TITLE I	___	OTHER

TYPE OF WORK:

___	NON-MANUAL ONLY
___	MANUAL ONLY
X	MANUAL & NON-MANUAL
___	OTHER

PROJECT WORK SCOPE IS EXPECTED TO BE PERFORMED BY:

DOE PRIME (LUMP SUM)	___	SUBCONTRACT	___
CONSTRUCTION	X	GPP	___
MAINTENANCE	___	OTHER	___

STATEMENT OF WORK

This estimate has been prepared to provide remedial alternative costs for closure of Corrective Action Site (CAS) 11-08-01, Contaminated Waste Dump #1. CAS 11-08-01 is in Corrective Action Unit (CAU) 366, Area 11 Plutonium Valley Dispersion Sites, and is an environmental restoration site listed in the *Federal Facility Agreement and Consent Order* . Two alternatives have been evaluated for closure of the site, including Closure in Place with Administrative Controls and Clean Closure. This estimate will be used to identify the most cost-effective alternative for closure of the site while remaining protective of human health and the environment.

SCOPE:

Conduct site closure using the following alternative:
Closure in Place with Administrative Controls

BASIS:

CAS 11-08-01 is located in Area 11 of the Nevada National Security Site. As a result of the tests conducted in Plutonium Valley, the wooden cabs that the devices were placed in, sand that surrounded the test beds, and other items such as cable, metal, and various items associated with the test activities became radiologically contaminated. Contaminated Waste Dump #1 was used to dispose of this material as well as contaminated clothing and equipment. The fenced and posted Underground Radioactive Material Area at CAS 11-08-01 measures 105 by 93 feet. The site is located southwest of the four ground zero test areas and is situated within the large site-encompassing Contamination Area. Closure in Place with Administrative Controls includes installing four use restriction warning signs on sign posts around the landfill.

ALTERNATIVE SPECIFIC BASIS OF ESTIMATE/ASSUMPTIONS

Closure in Place with Administrative Controls

- Installing use restriction warning signs on sign posts

EST ID: CAS 11-08-01	National Security Technologies, LLC COST ESTIMATE PROPOSAL DATA SHEET	Date: 21-Jun-12

ASSUMPTIONS:

- Equipment will remain operational to support the planned completion of field work.
- Work will be performed during a normal workday (no provision for overtime has been provided). Shifts are based on 10-hour days, 4 days per week.
- This estimate does not include efficiencies that may be realized if work for similar activities at similar sites can be completed concurrently.
- This estimate does not include costs for project management.

ESCALATION:

No escalation factors have been applied. All costs are in FY12, Rev. 4, dollars.

CONTINGENCY:

Contingency costs are not included in this estimate.

RATES:

Rates are based on FY12 (Rev. 4) rates effective 10/01/2011 and were applied using the FY12 cost model.

COST ALTERNATIVES SUMMARY:

Closure in Place with Administrative Controls

1. Installing use restriction warning signs on sign posts

Construction Costs: $43,000

REVIEW / CONCURRENCE:

/s/ Signature on File 6/28/12
Project Manager Date

/s/ Signature on File 6/28/12
Business Manager Date

/s/ Signature on File 6/27/12
Project Controls Date

EST ID: CAS 11-08-01	National Security Technologies, LLC COST ESTIMATE PROPOSAL DATA SHEET	Date: 21-Jun-12

SUBJECT: CADD Alternatives Cost Estimates for CAU 366, CAS 11-08-01 (Contaminated Waste Dump #1)

ESTIMATOR: Alissa Silvas REF #: ______

TYPE OF ESTIMATE:

X	ORDER OF MAGNITUDE	___	TITLE II		
___	PRELIMINARY / PLANNING / STUDY	___	WORK ORDER		
___	CONCEPTUAL / BUDGET	___	COMPARATIVE		
___	TITLE I	___	OTHER		

TYPE OF WORK:

___	NON-MANUAL ONLY
___	MANUAL ONLY
X	MANUAL & NON-MANUAL
___	OTHER

PROJECT WORK SCOPE IS EXPECTED TO BE PERFORMED BY:

DOE PRIME (LUMP SUM)	___	SUBCONTRACT	___
CONSTRUCTION	X	GPP	___
MAINTENANCE	___	OTHER	___

STATEMENT OF WORK

This estimate has been prepared to provide remedial alternative costs for closure of Corrective Action Site (CAS) 11-08-01, Contaminated Waste Dump #1. CAS 11-08-01 is in Corrective Action Unit (CAU) 366, Area 11 Plutonium Valley Dispersion Sites, and is an environmental restoration site listed in the *Federal Facility Agreement and Consent Order*. Two alternatives have been evaluated for closure of the site, including Closure in Place with Administrative Controls and Clean Closure. This estimate will be used to identify the most cost-effective alternative for closure of the site while remaining protective of human health and the environment.

SCOPE:

Conduct site closure using the following alternative:
Clean Closure

BASIS:

CAS 11-08-01 is located in Area 11 of the Nevada National Security Site. As a result of the tests conducted in Plutonium Valley, the wooden cabs that the devices were placed in, sand that surrounded the test beds, and other items such as cable, metal, and various items associated with the test activities became radiologically contaminated. Contaminated Waste Dump #1 was used to dispose of this material as well as contaminated clothing and equipment. The fenced and posted Underground Radioactive Material Area at CAS 11-08-01 measures 105 by 93 feet. The site is located southwest of the four ground zero test areas and is situated within the large site-encompassing Contamination Area. Clean Closure includes excavation and disposal of debris and soil in the landfill and in an adjacent debris mound. The landfill is 105 by 93 feet, and debris is assumed to be buried up to 6 feet deep. The adjacent debris mound is 86 by 35 feet, and is 4 feet high. The total volume of soil and debris is 72,000 cubic feet. Debris and soil would be disposed as low-level waste in Area 5 of the Nevada National Security Site.

ALTERNATIVE SPECIFIC BASIS OF ESTIMATE/ASSUMPTIONS

Clean Closure

- Excavation of landfill and adjacent debris mound
- Disposal of soil and debris as low-level waste
- Backfilling the landfill area

EST ID: CAS 11-08-01	National Security Technologies, LLC COST ESTIMATE PROPOSAL DATA SHEET	Date: 21-Jun-12

ASSUMPTIONS:

- Equipment will remain operational to support the planned completion of field work.
- Work will be performed during a normal workday (no provision for overtime has been provided). Shifts are based on 10-hour days, 4 days per week.
- This estimate does not include efficiencies that may be realized if work for similar activities at similar sites can be completed concurrently.
- This estimate does not include costs for project management.

ESCALATION:

No escalation factors have been applied. All costs are in FY12, Rev. 4, dollars.

CONTINGENCY:

Contingency costs are not included in this estimate.

RATES:

Rates are based on FY12 (Rev. 4) rates effective 10/01/2011 and were applied using the FY12 cost model.

COST ALTERNATIVES SUMMARY:

Clean Closure

1. Excavation and disposal of debris and soil in landfill and adjacent debris mound

Construction Costs: $1,240,000

REVIEW / CONCURRENCE:

/s/ Signature on File — 6/28/12
Project Manager — Date

/s/ Signature on File — 6/27/12
Business Manager — Date

/s/ Signature on File — 6/27/12
Project Controls — Date

EST ID: CAS 11-08-02

National Security Technologies, LLC
COST ESTIMATE PROPOSAL DATA SHEET

Date: 21-Jun-12

SUBJECT: CADD Alternatives Cost Estimates for CAU 366, CAS 11-08-02 (Contaminated Waste Dump #2)

ESTIMATOR: Alissa Silvas

REF #:

TYPE OF ESTIMATE:				TYPE OF WORK:	
X	ORDER OF MAGNITUDE		TITLE II		NON-MANUAL ONLY
	PRELIMINARY / PLANNING / STUDY		WORK ORDER		MANUAL ONLY
	CONCEPTUAL / BUDGET		COMPARATIVE	X	MANUAL & NON-MANUAL
	TITLE I		OTHER		OTHER

PROJECT WORK SCOPE IS EXPECTED TO BE PERFORMED BY:

DOE PRIME (LUMP SUM)		SUBCONTRACT	
CONSTRUCTION	X	GPP	
MAINTENANCE		OTHER	

STATEMENT OF WORK

This estimate has been prepared to provide remedial alternative costs for closure of Corrective Action Site (CAS) 11-08-02, Contaminated Waste Dump #2. CAS 11-08-02 is in Corrective Action Unit (CAU) 366, Area 11 Plutonium Valley Dispersion Sites, and is an environmental restoration site listed in the *Federal Facility Agreement and Consent Order* . Two alternatives have been evaluated for closure of the site, including Closure in Place with Administrative Controls and Clean Closure. This estimate will be used to identify the most cost-effective alternative for closure of the site while remaining protective of human health and the environment.

SCOPE:

Conduct site closure using the following alternative:
Closure in Place with Administrative Controls

BASIS:

CAS 11-08-02 is located in Area 11 of the Nevada National Security Site. As a result of the tests conducted in Plutonium Valley, the wooden cabs that the devices were placed in, sand that surrounded the test beds, and other items such as cable, metal, and various items associated with the test activities became radiologically contaminated. Contaminated Waste Dump #2 was used to dispose of this material as well as contaminated clothing and equipment. The fenced area at CAS 11-08-02 is 78 by 92 feet, and is posted as a High Contamination Area and Underground Radioactive Material Area. The site is located southwest of the four ground zero test areas and is situated within the large site-encompassing Contamination Area. Closure in Place with Administrative Controls includes constructing a non-engineered 3-foot-thick soil cover over the landfill and installing four use restriction warning signs on sign posts around the landfill.

ALTERNATIVE SPECIFIC BASIS OF ESTIMATE/ASSUMPTIONS

Closure in Place with Administrative Controls

- Constructing a non-engineered 3-foot-thick soil cover over the landfill
- Installing use restriction warning signs on sign posts

EST ID: CAS 11-08-02	National Security Technologies, LLC COST ESTIMATE PROPOSAL DATA SHEET	Date: 21-Jun-12

ASSUMPTIONS:

- Equipment will remain operational to support the planned completion of field work.
- Work will be performed during a normal workday (no provision for overtime has been provided). Shifts are based on 10-hour days, 4 days per week.
- This estimate does not include efficiencies that may be realized if work for similar activities at similar sites can be completed concurrently.
- This estimate does not include costs for project management.

ESCALATION:

No escalation factors have been applied. All costs are in FY12, Rev. 4, dollars.

CONTINGENCY:

Contingency costs are not included in this estimate.

RATES:

Rates are based on FY12 (Rev. 4) rates effective 10/01/2011 and were applied using the FY12 cost model.

COST ALTERNATIVES SUMMARY:

Closure in Place with Administrative Controls

1. Constructing a non-engineered 3-foot-thick soil cover over the landfill
2. Installing use restriction warning signs on sign posts

Construction Costs: $243,000

REVIEW / CONCURRENCE:

/s/ Signature on File 6/28/12

Project Manager Date

/s/ Signature on File 6/28/12

Business Manager Date

/s/ Signature on File 6/27/12

Project Controls Date

EST ID: CAS 11-08-02

National Security Technologies, LLC
COST ESTIMATE PROPOSAL DATA SHEET

Date: 21-Jun-12

SUBJECT: CADD Alternatives Cost Estimates for CAU 366, CAS 11-08-02 (Contaminated Waste Dump #2)

ESTIMATOR: Alissa Silvas **REF #:**

TYPE OF ESTIMATE:

X ORDER OF MAGNITUDE
___ PRELIMINARY / PLANNING / STUDY
___ CONCEPTUAL / BUDGET
___ TITLE I
___ TITLE II
___ WORK ORDER
___ COMPARATIVE
___ OTHER

TYPE OF WORK:

___ NON-MANUAL ONLY
___ MANUAL ONLY
X MANUAL & NON-MANUAL
___ OTHER

PROJECT WORK SCOPE IS EXPECTED TO BE PERFORMED BY:

DOE PRIME (LUMP SUM) ___
CONSTRUCTION X
MAINTENANCE ___
SUBCONTRACT ___
GPP ___
OTHER ___

STATEMENT OF WORK

This estimate has been prepared to provide remedial alternative costs for closure of Corrective Action Site (CAS) 11-08-02, Contaminated Waste Dump #2. CAS 11-08-02 is in Corrective Action Unit (CAU) 366, Area 11 Plutonium Valley Dispersion Sites, and is an environmental restoration site listed in the *Federal Facility Agreement and Consent Order*. Two alternatives have been evaluated for closure of the site, including Closure in Place with Administrative Controls and Clean Closure. This estimate will be used to identify the most cost-effective alternative for closure of the site while remaining protective of human health and the environment.

SCOPE:

Conduct site closure using the following alternative:
Clean Closure

BASIS:

CAS 11-08-02 is located in Area 11 of the Nevada National Security Site. As a result of the tests conducted in Plutonium Valley, the wooden cabs that the devices were placed in, sand that surrounded the test beds, and other items such as cable, metal, and various items associated with the test activities became radiologically contaminated. Contaminated Waste Dump #2 was used to dispose of this material as well as contaminated clothing and equipment. The fenced area at CAS 11-08-02 is 78 by 92 feet, and is posted as a High Contamination Area and Underground Radioactive Material Area. The site is located southwest of the four ground zero test areas and is situated within the large site-encompassing Contamination Area. Clean Closure includes excavation and disposal of debris and soil in the landfill. The landfill is 78 by 92 feet, and debris is assumed to be buried up to 6 feet deep. The total volume of soil and debris is 42,000 cubic feet. Debris and soil would be disposed as low-level waste in Area 5 of the Nevada National Security Site.

ALTERNATIVE SPECIFIC BASIS OF ESTIMATE/ASSUMPTIONS

Clean Closure

- Excavation of landfill
- Disposal of soil and debris as low-level waste
- Backfilling the landfill area

EST ID: CAS 11-08-02	National Security Technologies, LLC COST ESTIMATE PROPOSAL DATA SHEET	Date: 21-Jun-12

ASSUMPTIONS:

- Equipment will remain operational to support the planned completion of field work.
- Work will be performed during a normal workday (no provision for overtime has been provided). Shifts are based on 10-hour days, 4 days per week.
- This estimate does not include efficiencies that may be realized if work for similar activities at similar sites can be completed concurrently.
- This estimate does not include costs for project management.

ESCALATION:

No escalation factors have been applied. All costs are in FY12, Rev. 4, dollars.

CONTINGENCY:

Contingency costs are not included in this estimate.

RATES:

Rates are based on FY12 (Rev. 4) rates effective 10/01/2011 and were applied using the FY12 cost model.

COST ALTERNATIVES SUMMARY:

Clean Closure

1. Excavation and disposal of debris and soil in landfill

Construction Costs: $863,000

REVIEW / CONCURRENCE:

/s/ Signature on File — 6/28/12
Project Manager — Date

/s/ Signature on File — 6/28/12
Business Manager — Date

/s/ Signature on File — 6/27/12
Project Controls — Date

National Security Technologies, LLC

COST ESTIMATE PROPOSAL DATA SHEET

EST ID: CASs 11-23-02, 11-23-03, and 11-23-04

Date: 21-Jun-12

SUBJECT: CADD Alternatives Cost Estimates for CAU 366, CAS 11-23-02 (Radioactively Contaminated Area B), CAS 11-23-03 (Radioactively Contaminated Area C), and CAS 11-23-04 (Radioactively Contaminated Area D)

ESTIMATOR: Alissa Silvas **REF #:** ____

TYPE OF ESTIMATE:

X	ORDER OF MAGNITUDE	___	TITLE II
___	PRELIMINARY / PLANNING / STUDY	___	WORK ORDER
___	CONCEPTUAL / BUDGET	___	COMPARATIVE
___	TITLE I	___	OTHER

TYPE OF WORK:

___	NON-MANUAL ONLY
___	MANUAL ONLY
X	MANUAL & NON-MANUAL
___	OTHER

PROJECT WORK SCOPE IS EXPECTED TO BE PERFORMED BY:

DOE PRIME (LUMP SUM)	___	SUBCONTRACT	___
CONSTRUCTION	X	GPP	___
MAINTENANCE	___	OTHER	___

STATEMENT OF WORK

This estimate has been prepared to provide remedial alternative costs for closure of Corrective Action Site (CAS) 11-23-02, Radioactively Contaminated Area B, CAS 11-23-03, Radioactively Contaminated Area C, and CAS 11-23-04, Radioactively Contaminated Area D. These CASs are in Corrective Action Unit (CAU) 366, Area 11 Plutonium Valley Dispersion Sites, and are environmental restoration sites listed in the *Federal Facility Agreement and Consent Order*. Two alternatives have been evaluated for closure of the sites, including Closure in Place with Administrative Controls and Clean Closure. This estimate will be used to identify the most cost-effective alternative for closure of the sites while remaining protective of human health and the environment.

SCOPE:

Conduct site closure using the following alternative:
Closure in Place with Administrative Controls

BASIS:

CASs 11-23-02, 11-23-03, 11-23-04 are located in Area 11 of the Nevada National Security Site. These CASs are defined as the release of contaminants to the environment from four surface safety experiments in the Project 56 test series conducted at four separate, close proximity test areas. A small amount of debris, including metal, lead bricks, and batteries, is present throughout the test areas and within open trenches adjacent to the east side of the ground zero at each test location. The ground zero and trenches at each test location are located in fenced and posted High Contamination Areas. Additional debris is present within the three High Contamination Areas. The sites are located within a large site-encompassing fenced and posted Contamination Area. Closure in Place with Administrative Controls includes installing approximately 40 use restriction warning signs on sign posts around large site-encompassing Contamination Area.

ALTERNATIVE SPECIFIC BASIS OF ESTIMATE/ASSUMPTIONS

Closure in Place with Administrative Controls

- Installing use restriction warning signs on sign posts

EST ID: CASs 11-23-02, 11-23-03, and 11-23-04	National Security Technologies, LLC COST ESTIMATE PROPOSAL DATA SHEET	Date: 21-Jun-12

ASSUMPTIONS:

- Equipment will remain operational to support the planned completion of field work.
- Work will be performed during a normal workday (no provision for overtime has been provided). Shifts are based on 10-hour days, 4 days per week.
- This estimate does not include efficiencies that may be realized if work for similar activities at similar sites can be completed concurrently.
- This estimate does not include costs for project management.

ESCALATION:

No escalation factors have been applied. All costs are in FY12, Rev. 4, dollars.

CONTINGENCY:

Contingency costs are not included in this estimate.

RATES:

Rates are based on FY12 (Rev. 4) rates effective 10/01/2011 and were applied using the FY12 cost model.

COST ALTERNATIVES SUMMARY:

Closure in Place with Administrative Controls

1. Installing use restriction warning signs on sign posts

Construction Costs: $57,000

REVIEW / CONCURRENCE:

/s/ Signature on File 6/28/12

Project Manager Date

/s/ Signature on File 6/28/12

Business Manager Date

/s/ Signature on File 6/27/12

Project Controls Date

National Security Technologies, LLC

COST ESTIMATE PROPOSAL DATA SHEET

EST ID: CASs 11-23-02, 11-23-03, and 11-23-04

Date: 21-Jun-12

SUBJECT: CADD Alternatives Cost Estimates for CAU 366, CAS 11-23-02 (Radioactively Contaminated Area B), CAS 11-23-03 (Radioactively Contaminated Area C), and CAS 11-23-04 (Radioactively Contaminated Area D)

ESTIMATOR: Alissa Silvas **REF #:** ______

TYPE OF ESTIMATE:

X	ORDER OF MAGNITUDE	___	TITLE II
___	PRELIMINARY / PLANNING / STUDY	___	WORK ORDER
___	CONCEPTUAL / BUDGET	___	COMPARATIVE
___	TITLE I	___	OTHER

TYPE OF WORK:

___	NON-MANUAL ONLY
___	MANUAL ONLY
X	MANUAL & NON-MANUAL
___	OTHER

PROJECT WORK SCOPE IS EXPECTED TO BE PERFORMED BY:

DOE PRIME (LUMP SUM)	___	SUBCONTRACT	___
CONSTRUCTION	X	GPP	___
MAINTENANCE	___	OTHER	___

STATEMENT OF WORK

This estimate has been prepared to provide remedial alternative costs for closure of Corrective Action Site (CAS) 11-23-02, Radioactively Contaminated Area B, CAS 11-23-03, Radioactively Contaminated Area C, and CAS 11-23-04, Radioactively Contaminated Area D. These CASs are in Corrective Action Unit (CAU) 366, Area 11 Plutonium Valley Dispersion Sites, and are environmental restoration sites listed in the *Federal Facility Agreement and Consent Order*. Two alternatives have been evaluated for closure of the sites, including Closure in Place with Administrative Controls and Clean Closure. This estimate will be used to identify the most cost-effective alternative for closure of the sites while remaining protective of human health and the environment.

SCOPE:

Conduct site closure using the following alternative:
Clean Closure

BASIS:

CASs 11-23-02, 11-23-03, 11-23-04 are located in Area 11 of the Nevada National Security Site. These CASs are defined as the release of contaminants to the environment from four surface safety experiments in the Project 56 test series conducted at four separate, close proximity test areas. A small amount of debris, including metal, lead bricks, and batteries, is present throughout the test areas and within open trenches adjacent to the east side of the ground zero at each test location. The ground zero and trenches at each test location are located in fenced and posted High Contamination Areas. Additional debris is present within the three High Contamination Areas. The sites are located within a large site-encompassing fenced and posted Contamination Area. Clean Closure includes removal and disposal of debris and 1 foot of soil from the three High Contamination Areas. The total volume of soil and debris is 653,000 cubic feet. Debris and soil would be disposed as low-level waste in Area 5 of the Nevada National Security Site.

ALTERNATIVE SPECIFIC BASIS OF ESTIMATE/ASSUMPTIONS

Clean Closure

- Removal of debris and 1 foot of soil from the three High Contamination Areas
- Disposal of soil and debris as low-level waste

EST ID: CASs 11-23-02, 11-23-03, and 11-23-04	National Security Technologies, LLC COST ESTIMATE PROPOSAL DATA SHEET	Date: 21-Jun-12

ASSUMPTIONS:

- Equipment will remain operational to support the planned completion of field work.
- Work will be performed during a normal workday (no provision for overtime has been provided). Shifts are based on 10-hour days, 4 days per week.
- This estimate does not include efficiencies that may be realized if work for similar activities at similar sites can be completed concurrently.
- This estimate does not include costs for project management.

ESCALATION:

No escalation factors have been applied. All costs are in FY12, Rev. 4, dollars.

CONTINGENCY:

Contingency costs are not included in this estimate.

RATES:

Rates are based on FY12 (Rev. 4) rates effective 10/01/2011 and were applied using the FY12 cost model.

COST ALTERNATIVES SUMMARY:

Clean Closure

1. Excavation and disposal of debris and 1 foot of soil from the three High Contamination Areas

Construction Costs: $7,600,000

REVIEW / CONCURRENCE:

/s/ Signature on File — 6/28/12
Project Manager — Date

/s/ Signature on File — 6/28/12
Business Manager — Date

/s/ Signature on File — 6/27/12
Project Controls — Date

Appendix D

Evaluation of Risk

D.1.0 Risk Assessment

The RBCA process used to establish FALs is described in the *Soils Risk-Based Corrective Action Evaluation Process* (NNSA/NSO, 2012). This process conforms with NAC 445A.227, which lists the requirements for sites with soil contamination (NAC, 2012a). For the evaluation of corrective actions, NAC 445A.22705 (NAC, 2012b) requires the use of ASTM Method E1739 (ASTM, 1995) to "conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary." For the evaluation of corrective actions, the FALs are established as the necessary remedial standard.

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

- **Tier 1 evaluation.** Sample results from source areas (highest concentrations) are compared to risk-based screening levels (RBSLs) based on generic (non-site-specific) conditions (i.e., the PALs established in the CAU 366 CAIP [NNSA/NSO, 2011], except as noted in Section A.2.6). 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 SSTLs using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 SSTLs are then compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis. Total concentrations of total petroleum hydrocarbons will not be used for risk-based decisions under Tier 2 or Tier 3. Rather, the individual chemicals of concern will be compared to the SSTLs.

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

The RBCA decision process stipulated in the Soils RBCA document (NNSA/NSO, 2012) is summarized in Figure D.1-1.

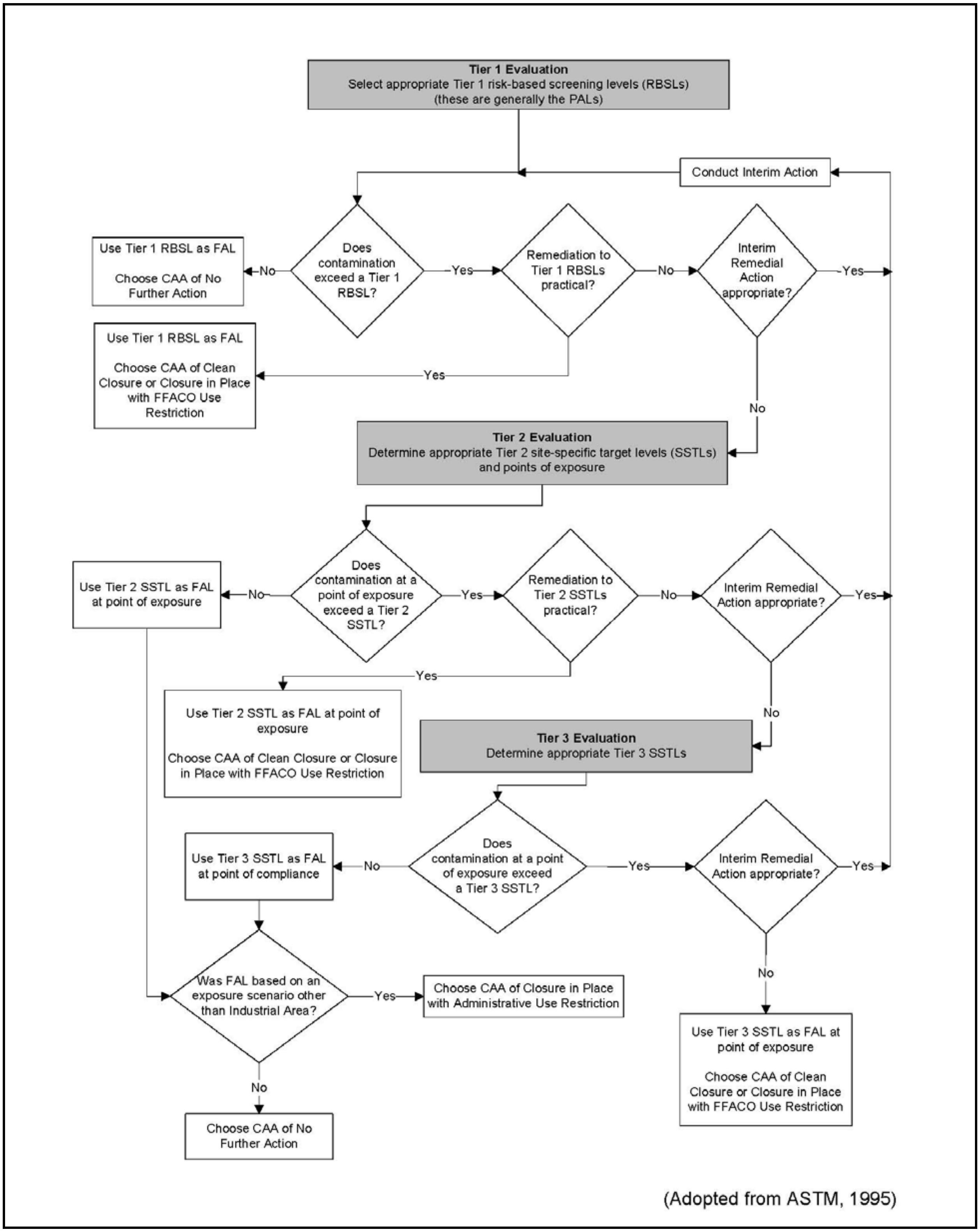

Figure D.1-1
RBCA Decision Process

D.1.1 Scenario

CAU 366, Area 11 Plutonium Valley Dispersion Sites, comprises the following six CASs within Area 11 of the NNSS:

- 11-08-01, Contaminated Waste Dump #1
- 11-08-02, Contaminated Waste Dump #2
- 11-23-01, Radioactively Contaminated Area A
- 11-23-02, Radioactively Contaminated Area B
- 11-23-03, Radioactively Contaminated Area C
- 11-23-04, Radioactively Contaminated Area D

All six CASs are located in Plutonium Valley and are associated with the test activities conducted as part of Project 56.

CASs 11-08-01 (referred to as CWD #1 in this document) and 11-08-02 (referred to as CWD #2 in this document) consist of a release of radioactive contaminants, primarily plutonium and enriched uranium, to the environment from stored and buried debris generated from the testing activities at Project 56.

CASs 11-23-01 (11a test area), 11-23-02 (11b test area), 11-23-03 (11c test area), and 11-23-04 (11d test area) consist of a release of radioactive contaminants to the environment from four surface safety experiments conducted at four separate, close proximity test areas. Project 56 was the first test of a full-scale, completely assembled device to verify the nuclear safety in the event of an accidental detonation (e.g., handling, fire, electrical discharge). A primarily enriched uranium device was tested at 11a test area, while plutonium and enriched uranium devices were tested at 11b, 11c, and 11d test areas.

Also included in the CAU 366 scope were potential releases to the soil from a Decontamination Station and Hot Park, drainage, and debris generated as a result of the Project 56 activities.

D.1.2 Site Assessment

The CAI activities and results are presented in Table D.1-1.

Table D.1-1
Corrective Action Investigation Summary

Study Group	Site Conditions	Investigation Activities	Maximum TED IA/yr	Maximum TED OU/yr
1	The 11a trench and CWDs #1 and #2 are inside a large CA that encompasses most of the areas affected by Project 56. TRSs and geophysical surveys were completed at all three locations. • 11a trench: Adjacent to the 11a GZ; no subsurface metallic debris present. • CWD #1: URMA posted dump with an adjacent unposted mound; the mound contains buried metallic debris and is considered to be part of CWD #1. • CWD#2: HCA and URMA posted dump with debris (drums, cables) on the surface; the debris has highly elevated removable contamination. No subsurface metallic debris present outside the posted dump.	TRS, Geophysical Surveys	Assumed >25 mrem/yr within the posted areas of CWDs #1 and #2. The mound has been included with the scope of CWD #1.	Assumed >25 mrem/yr within the posted areas of CWDs #1 and #2. The mound has been included with the scope of CWD #1.
2	The 11a, 11b, 11c, and 11d test areas consist of a GZ and surrounding area that may have been impacted by a release. All four test areas are located within a CA while the 11b, 11c, and 11d GZs are posted HCAs. Ten sample plots were placed in the areas selected based on TRSs as well as aerial radiological surveys. The areas were selected to determine where the highest dose was present as well as in areas to determine how the dose decreased with distance from the GZs.	TRSs, Sampling	68.0 mrem/yr in sample plots Assumed >25 mrem/yr within the HCAs.	3.9 mrem/yr in sample plots Assumed >25 mrem/yr within the HCAs.
3	The Decontamination Station and Hot Park locations were identified using TRSs. A sample plot was selected at each location and was placed in the area with the most widespread radiological contamination. Sampling in the Hot Park was conducted after a corrective action of soil removal was completed.	TRSs, Sampling, Soil Removal	15.9 mrem/yr	0.9 mrem/yr
4	The 11d drainage was investigated by sampling three locations downgradient from the 11d HCA. The first two sedimentation areas outside the 11d HCA were in close proximity, so an additional location was selected further down gradient from the 11d HCA to obtain more comprehensive migration data.	TRSs, Sampling	6.6 mrem/yr	0.4 mrem/yr
5	Radiological debris was evaluated by selecting six pieces of debris for investigation. The debris that had enough volume and put off the greatest external dose as determined by radiological scans and/or had a high level of removable contamination was selected for evaluation. Five grab samples and two sample plots (including a grid of TLDs) were collected to determine whether the debris was PSM.	TRSs, Radiological Surveys, Sampling	515.3 mrem/yr	30.6 mrem/yr
6	Two lead bricks and two batteries along with the associated lead-impacted soil were removed. Verification samples were collected to confirm no COCs were present after soil removal.	Sampling, Debris and Soil Removal	N/A	N/A

D.1.3 Site Classification and Initial Response Action

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

Based on the CAI results, contamination at CAU 366 does not present an immediate threat to human health, safety, and the environment; therefore, no interim response actions are necessary at these sites. However, corrective actions are required due to the presence of removable contamination that exceeds HCA criteria, and radiological dose that exceeds or is assumed to exceed the 25-mrem/OU-yr FAL. Thus, CAU 366 has been determined to be a Classification 2 site as defined by ASTM Method E1739.

D.1.4 Development of Tier 1 Lookup Table of RBSLs

Tier 1 RBSLs are defined as the PALs listed in the CAIP (NNSA/NSO, 2011) as established during the DQO process (except as noted in Section A.2.6). 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 RBSL (i.e., PAL) value if implementing a corrective action based on the Tier 1 RBSL would be appropriate.

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

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

- Region 9 RSLs for chemical contaminants (EPA, 2012).
- Background concentrations for RCRA metals will be evaluated when natural background exceeds the PAL, as is often the case with arsenic. Background is considered the mean plus two times the standard deviation of the mean based on data published in Mineral and Energy Resource Assessment of the Nellis Air Force Range (NBMG, 1998; Moore, 1999).

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

The PALs were developed based on an industrial scenario. Because the CAU 366 CASs in Area 11 are not assigned work stations and are considered to be an occasional use area, the use of industrial scenario-based PALs is conservative.

D.1.5 Exposure Pathway Evaluation

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

D.1.6 Comparison of Site Conditions with Tier 1 RBSLs

The HCAs at CASs 11-23-02, 11-23-03, and 11-23-04; and the CWDs at CASs 11-08-01 and 11-08-02 are assumed to contain significant contamination and require corrective action. Therefore, these areas are not included in the RBCA evaluations. Rather, the RBCA evaluations will be limited to the areas outside the HCA and CWD areas. An exposure time based on the Industrial Area scenario (2,000 hr/yr) was used to calculate site radiological doses (TED). These values were compared to the Tier 1 RBSL (25-mrem/IA-yr dose) that is also based on an exposure time of 2,000 hr/yr.

The Industrial Area scenario-based TEDs for all sample plots at each CAU 366 CAS that exceed the Tier 1 RBSL (i.e., PAL) are listed in Table D.1-2. Based on the conservative assumption that a site worker would be exposed to the maximum dose measured at any sample plot location outside any CWD or HCA, this site worker would receive a 25-mrem dose at each of the locations in the exposure times listed in Table D.1-3.

Table D.1-2
Locations Where TED Exceeds the Tier 1 RBSL at CAU 366 (mrem/IA-yr)

Location ID	Average Total	95% UCL Total
A08	**31.5**	**48.2**
B03	**25.4**	**34.3**
B07	**50.9**	**68.0**
B21	**242.9**	**515.3**

Bold indicates the values exceeding 25 mrem/yr.

Table D.1-3
Minimum Exposure Time to Receive a 25-mrem/yr Dose

Location of Maximum Dose	Average TED (mrem/IA-yr)	Minimum Exposure Time (hours)	Maximum 95% UCL TED (mrem/IA-yr)	Minimum Exposure Time (hours)
A08	**31.5**	1,187	**48.2**	1,037
B03	**25.4**	1,969	**34.3**	1,458
B07	**50.9**	982	**68.0**	735
B21	**242.9**	206	**515.3**	97

Bold indicates the values exceeding 25 mrem/yr.

In addition, PSM was encountered in the form of lead-acid batteries and lead bricks at various locations that require corrective action.

D.1.7 Evaluation of Tier 1 Results

For the radiological contamination, NNSA/NSO determined that remediation to the RBSL is not appropriate. The risk to receptors from contaminants at CAU 366 is due to chronic exposure to radionuclides (i.e., receiving a dose over time). Therefore, the risk to a receptor is directly related to the amount of time a receptor is exposed to the contaminants. A review of the current and projected use at all sites in CAU 366 determined that workers may only be present at these sites for a few hours per year (see Section D.1.10), and it is not reasonable to assume that any worker would be present at this site for 2,000 hr/yr (DOE/NV, 1996). Therefore, it was determined to conduct a Tier 2 evaluation.

For the chemical contamination assumed to require corrective action (i.e., the PSM), it was determined that remediation to the Tier 1 RBSLs were feasible and appropriate. Therefore, the FALs for chemical contaminants at CAU 366 were established at the Tier 1 RBSLs.

D.1.8 Tier 1 Remedial Action Evaluation

For the PSM of lead bricks and lead-acid batteries, it was determined that remediation was feasible and appropriate. The PSM and adjacent soil were removed under a corrective action. Final verification sample results were less than the FAL for lead. Therefore, this removal was considered a complete removal of the contamination, and additional corrective action is not necessary.

As evidenced by the CAI results at CAU 366, radioactivity is present in soil at levels exceeding the Tier 1 RBSL. However, remediation to the Tier 1 RBSL was not considered appropriate or practical, and the radioactivity in the soil at CAU 366 was passed on to a Tier 2 evaluation.

D.1.9 Tier 2 Evaluation

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

D.1.10 Development of Tier 2 Table of SSTLs

The Tier 2 action levels are typically compared to contaminant values that are representative of areas at which an individual or population may come in contact with a COC originating from a CAS. This concept is illustrated in the EPA’s Human Health Evaluation Manual (EPA, 1989). This document states that “the area over which the activity is expected to occur should be considered when averaging the monitoring data for a hot spot. For example, averaging soil data over an area the size of a residential backyard (e.g., an eighth of an acre) may be most appropriate for evaluating residential soil pathways.” When evaluating industrial receptors, the area over which an industrial worker is exposed may be much larger than for residential receptors. For a site that is limited to industrial uses, the receptor would be a site worker, and patterns of employee activity would be used to estimate the area over which the receptor is exposed. This can be very complicated to calculate, as industrial worker may perform routine activities at many locations where only a portion of these locations may be contaminated. A more practical measure of integrated risk to radiological dose for an industrial worker is to calculate the portion of total work time that the worker is in proximity to elevated radioactivity—and, therefore, able to receive a dose. For example, site workers may have routine activities that require them to be exposed to a radioactive location for 200 hours out of each year. If the workers’ industrial work schedule was 8 hr/day for 250 day/yr—or 2,000 hr/yr (as is used for the

Industrial Area exposure scenario)—site workers would receive 10 percent of the potential annual dose that they would otherwise receive if exposed to the radioactive location for the entire work year.

For the development of radiological Tier 2 SSTLs, the annual dose limit for a site worker is 25 mrem/yr (the same as was used for the Tier 1 evaluation). The Tier 2 evaluation is based on a receptor exposure time that is more specific to actual site conditions. The maximum potential exposure time for the most exposed worker at any CAU 366 CAS was determined based on an evaluation of current and reasonable future activities that may be conducted at the site. Activities on the NNSS are strictly controlled through a formal work control process. This process requires facility managers to authorize all work activities that take place on the land or at the facilities within their purview. As such, these facility managers are aware of all activities conducted at the site. The facility managers responsible for the area of CAU 366 identified the general types of work activities that are currently conducted at the site, such as fencing/posting inspection and maintenance workers. Site activities that may occur in the future were identified by assessing tasks related to maintenance of existing infrastructure and long-term stewardship of the site (e.g., inspection and maintenance of UR signs, trespasser). In order to estimate the amount of time a site worker might spend conducting current or future activities, the NNSA/NSO and/or M&O contractor departments responsible for these activities were consulted. Under the current land use at each of the CAU 366 CASs, the following workers were identified as being potentially exposed to site contamination:

- **Inspection and maintenance worker.** Workers sent to conduct the annual inspection of the postings and fencing around the CAU 366 CA and adjacent Decontamination Station and Hot Park. The UR requires a periodic inspection to ensure that the fencing is intact and the signs are legible. This will require two people to spend up to 20 hr/yr at the CAU.

- **Trespasser.** This would include workers or individuals that do not have a specific work assignment at this CAU. Although the sites will be posted with warning signs, workers could enter this area inadvertently and come in contact with site contamination. This is assumed to be an infrequent occurrence (i.e., once per year) that would result in a potential exposure of less than a day (8 hours).

Under the current land use at CAU 366, the most exposed worker would be the inspection and maintenance worker, who would not be exposed to site contamination for more than 20 hr/yr. Based on the conservative assumption that the most exposed worker would be exposed to the maximum average dose measured at any sampled location (B21) for the entire 20 hours, this worker could receive a maximum potential dose of 3.44 mrem. To receive a dose of 25 mrem/yr, a worker would have to be present at this location for 145 hours.

In the CAU 366 DQOs, it was conservatively determined that the Occasional Use Area exposure scenario (as listed in Section 3.1.1 of the CAIP [NNSA/NSO, 2011]) would be appropriate in calculating receptor exposure time based on current land use at all CAU 366 CASs. This exposure scenario assumes exposure to site workers who are not assigned to the area as a regular work site but may occasionally use the site for intermittent or short-term activities. Site workers under this scenario are assumed to be on the site for an equivalent of 80 hr/yr.

D.1.11 Comparison of Site Conditions with Tier 2 Table SSTLs

The 25-mrem/yr dose-based Tier 2 SSTL for the sample locations based on the Occasional Use Area exposure scenario was accomplished by calculating dose (i.e., TED) at the site over an annual exposure period of 80 hours (8 hr/day, 10 day/yr). The TEDs calculated using the Occasional Use Area exposure scenario were then compared to the 25-mrem/OU-yr Tier 2 SSTL. As shown in Table D.1-4, the TED values exceeded the 25-mrem/OU-yr Tier 2 SSTL at one debris location. Therefore, corrective actions will be required for radiological debris contamination at CAU 366 beyond the HCA and CWD boundaries.

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

Plot/Location	Average TED	95% UCL TED
A08	1.6	2.5
B03	1.4	1.9
B07	2.9	3.9
B21	13.8	**30.6**

Bold indicates the values exceeding 25 mrem/yr.

D.1.12 Tier 2 Remedial Action Evaluation

Based on the Tier 2 evaluation, the radiological debris surface soils pose an unacceptable risk to human health and the environment and corrective action is necessary. Any corrective action would also need to address the contamination in the CWDs and HCAs that were assumed to require corrective action. A corrective action of clean closure would require extensive excavations of approximately 2.5 million ft^3 of soil and debris. Based on the large volume of potential remediation waste and the presence of HCA conditions that would expose remediation workers to high levels of removable contamination, a corrective action of closure in place with administrative controls for the areas encompassed by the Tier 2 SSTL corrective action boundaries is recommended. As this corrective action is practical and appropriate for the contamination at CAU 366, the Tier 2 SSTL is established as the FAL for radiological contamination and corrective actions will be implemented.

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

D.2.0 Recommendations

Because the TED values for radiological debris surface soils at locations exceed the corresponding FALs (using the Occasional Use Area exposure scenario), it was determined that surface soil contamination at these locations warrant corrective actions. Surface contamination is assumed to exist within the HCAs that exceed the Occasional Use Area exposure scenario-based FAL of 25 mrem/OU-yr. Additionally, subsurface contamination is assumed to exist within the CWDs that exceed the Occasional Use Area exposure scenario-based FAL of 25 mrem/OU-yr. Also, lead bricks and lead-acid batteries were present that exceed PSM criteria. Therefore, corrective actions are necessary for contamination at CAU 366.

A corrective action was implemented for the lead bricks, lead-acid batteries, and adjacent soils based on Tier 1 RBSLs. A corrective action was also implemented for soils at the Hot Park that exceeded the HCA criteria. A corrective action of closure in place with administrative controls is recommended for the radiological debris soil contamination at CAU 366. This corrective action is also recommended for the HCA and CWD areas.

The radiological FAL was based on an exposure time of 80 hr/yr of site worker exposure to CAS surface soils. Should the land use at CAU 366 change such that industrial land use activities are proposed to be conducted at this site, a site worker could be potentially exposed to a dose exceeding 25 mrem/yr. Therefore, it is recommended that an administrative UR be implemented at CAU 366 as a BMP that would restrict future industrial land use without NDEP notification.

The corrective actions for CAU 366 are based on the assumption that activities on the NNSS will be limited to those that are industrial in nature and that the NNSS will maintain controlled access (i.e., restrict public access and residential use). Should the future land use of the NNSS change such that these assumptions no longer are valid, additional evaluation may be necessary.

D.3.0 References

ASTM, see ASTM International.

ASTM International. 1995 (reapproved 2002). *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites,* ASTM E1739 - 95(2002). West Conshohocken, PA.

DOE/NV, see U.S. Department of Energy, Nevada Operations Office.

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NAC, see *Nevada Administrative Code.*

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Nevada Administrative Code. 2012a. 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 6 June.

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Appendix E

Activity Organization

E.1.0 Activity Organization

The NNSA/NSO Soils Activity Lead is Tiffany Lantow. She can be contacted at (702) 295-7645.

The identification of the activity Health and Safety Officer and the Quality Assurance Officer can be found in the appropriate plan. However, personnel are subject to change, and it is suggested that the NNSA/NSO Soils Activity Lead be contacted for further information. The Task Manager will be identified in the FFACO Monthly Activity Report prior to the start of field activities.

UNCONTROLLED When Printed

Appendix F

Sample Location Coordinates

F.1.0 Sample Location Coordinates

Sample location coordinates for sample plots, TLDs, judgmental samples, and background TLD locations were collected during the CAI using a GPS instrument. These coordinates identify the field sampling locations (e.g., northing, easting) of the center of the sample plots (including the TLD location), individual (judgmental) sample locations, and background TLD locations established for the features associated with CAU 366 and are listed in Table F.1-1 (see exceptions in the table footnote).

Nine aliquot sample locations were established at each plot for each composite sample (4 composite samples, 36 aliquot sample locations). A systematic triangular grid pattern was used based on a randomly generated origin or starting point. 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.

Table F.1-1
Sample Location Coordinates for CAU 366
(Page 1 of 2)

Sample Plot/Location	Northing	Easting
Study Group 2		
A01	4093466.30	592488.48
B03	4091922.62	593020.85
B04	4092158.22	593140.26
B05	4092208.99	593173.97
B06	4092278.06	593201.60
B07	4092540.36	592899.63
B08	4092588.37	592897.01
B09	4092618.10	592898.11
B10	4092680.86	592905.81
B11	4092166.82	593017.23
Study Group 3		
C01	4091607.46	592007.15
C02	4091688.87	592031.61

Table F.1-1
Sample Location Coordinates for CAU 366
(Page 2 of 2)

Sample Plot/Location	Northing	Easting
Study Group 4		
B01	4091901.41	593014.28
B02	4091922.82	593044.64
B12	4091791.40	592944.56
Study Group 5		
A08[a]	4093451.23	592501.65
B13	4093175.47	592579.03
B14	4093089.13	592730.86
B15	4093018.62	592775.34
B16	4092170.27	593073.30
B21[a]	4092424.12	592705.43
Study Group 6		
B17	4092401.53	591934.94
B18	4092580.41	592748.28
B19	4091866.59	593030.56
B20	4091774.65	593025.27
Background TLDs		
A02	4093267.15	592232.44
A03	4092817.88	592248.14
A04	4092000.05	592122.79
A05	4091578.05	592407.01
A06	4090842.11	592108.72
A07	4091191.08	593028.81
A08	4093451.23	592501.65
A09	4093283.53	592332.95
B22	4091641.22	592011.42

[a]Although a grid of 16 TLDs was established at sample plot locations A08 and B21, one pair of coordinates is supplied for each sample plot location. Additional details for the location of each TLD within the grid can be found in the project files.

Appendix G

Data Tables

G.1.0 Data Tables

Analytical results for gamma-emitting and isotopic radionuclide environmental samples collected at CAU 366 that were detected above MDCs are presented in Tables G.1-1 and G.1-2. Because individual radionuclide results were not used for decisions, these results are presented in this appendix for completeness.

Analytical results for RCRA metals and VOCs chemical environmental samples collected at CAU 366 that were detected above MDCs are presented in Tables G.1-3 and G.1-4.

Internal dose estimations (mrem/IA-yr) for individual samples within each sample plot are presented in Table G.1-5.

Results for TLDs staged at sample locations and background locations are presented in Table G.1-6.

Table G.1-1
Gamma-Emitting Radionuclide Sample Results Detected above MDCs at CAU 366
(Page 1 of 3)

Sample Location	Sample Number	Depth (cm bgs)	COPCs (pCi/g)				
			Ac-228	Am-241	Co-60	Cs-137	Eu-155
A01	366A601	0 - 5	2	--	--	0.188	--
	366A602	0 - 5	1.59	--	--	0.238	--
	366A603	0 - 5	1.64	1.37	--	0.23	--
	366A604	0 - 5	1.69	--	--	0.316	--
A08	366A001	0 - 5	1.55	7,640	--	0.198	--
	366A605	0 - 5	1.61	7	--	0.0956	--
	366A606	0 - 5	1.33	225	--	0.103	--
	366A607	0 - 5	1.73	92.4	--	0.127	--
	366A608	0 - 5	1.65	120	--	0.156	--
B01	366B005	0 - 5	1.8	36.1	--	0.0915	--
	366B006	0 - 5	1.84	33.8	--	0.0983	--
B03	366B629	0 - 5	1.68	492	0.0628	0.315	--
	366B630	0 - 5	1.68	483	0.13	0.323	--
	366B631	0 - 5	1.77	502	--	0.277	--
	366B632	0 - 5	1.58	683	--	0.352	--

Table G.1-1
Gamma-Emitting Radionuclide Sample Results Detected above MDCs at CAU 366
(Page 2 of 3)

Sample Location	Sample Number	Depth (cm bgs)	COPCs (pCi/g)				
			Ac-228	Am-241	Co-60	Cs-137	Eu-155
B04	366B617	0 - 5	1.6	136	0.0483	0.352	--
	366B618	0 - 5	1.62	138 (J)	--	0.341	--
	366B619	0 - 5	1.72	101	0.078	0.262	--
	366B620	0 - 5	1.72	98	--	0.269	--
B05	366B621	0 - 5	1.87	35.3	--	0.199	--
	366B622	0 - 5	1.97	42.9	--	0.246	--
	366B623	0 - 5	1.78	31	--	0.223	--
	366B624	0 - 5	1.83	32.4	0.0556	0.163	--
B06	366B625	0 - 5	1.74	22.7	--	0.266	--
	366B626	0 - 5	1.78	21.5	--	0.39	--
	366B627	0 - 5	1.63	21.7	--	0.287	--
	366B628	0 - 5	1.72	17.6	--	0.233	--
B07	366B633	0 - 5	1.66	1,820	--	0.255	--
	366B634	0 - 5	1.65	957	--	0.23	--
	366B635	0 - 5	1.67	783	--	0.168	--
	366B636	0 - 5	1.76	755	0.211	0.189	--
	366B638	0 - 5	1.71	1,650	--	0.284	--
B08	366B609	0 - 5	1.8	95.4 (J)	--	0.153	--
	366B610	0 - 5	1.71	79	0.0383	0.151	--
	366B611	0 - 5	1.78	129	--	0.268	--
	366B612	0 - 5	1.61	76.2	--	0.2	--
B09	366B605	0 - 5	1.6	86.4	--	0.241	--
	366B606	0 - 5	1.85	85.7	--	0.192	--
	366B607	0 - 5	1.85	54.8	0.0437	0.184	--
	366B608	0 - 5	1.77	59.3	--	0.147	--
B10	366B601	0 - 5	1.91	20.4	--	0.174	--
	366B602	0 - 5	2	44.5	--	0.289	--
	366B603	0 - 5	1.76	35.7	--	0.236	--
	366B604	0 - 5	1.72	33.8	--	0.215	--

Table G.1-1
Gamma-Emitting Radionuclide Sample Results Detected above MDCs at CAU 366
(Page 3 of 3)

Sample Location	Sample Number	Depth (cm bgs)	COPCs (pCi/g)				
			Ac-228	Am-241	Co-60	Cs-137	Eu-155
B11	366B613	0 - 5	1.85	330	0.0755	0.314	--
	366B614	0 - 5	1.65	500 (J)	--	0.387	--
	366B615	0 - 5	1.82	449	0.211	0.439	--
	366B616	0 - 5	1.7	315 (J)	0.342	0.257	--
B12	366B007	0 - 5	1.8	38.6	--	0.125	--
	366B008	10 - 15	1.73	39.6	--	0.0979	--
B13	366B004	0 - 5	1.65	72.3	--	0.177	--
B14	366B002	0 - 5	1.52	1,540	--	0.318	--
B15	366B003	0 - 5	1.59	388	0.0896	0.432	0.305 (J)
B16	366B001	0 - 5	1.77	264	--	0.369	--
B21	366B639	0 - 5	1.7	1,190	--	0.218	--
	366B640	0 - 5	1.4	18,600	--	0.339	--
	366B641	0 - 5	1.74	553	--	0.27	--
	366B642	0 - 5	1.77	880	--	0.258	--
C01	366C605	0 - 5	1.86	7.5	--	0.336	--
	366C606	0 - 5	1.79	6.1	--	0.236	--
	366C607	0 - 5	1.9	9.38	--	0.274	--
	366C608	0 - 5	1.72	7.44	--	0.333	--
C02	366C601	0 - 5	1.83	24.9	--	0.169	--
	366C602	0 - 5	1.81	392	--	0.483	--
	366C603	0 - 5	1.84	97.1	--	0.24	--
	366C604	0 - 5	1.98	79.8	--	0.29	--

Co = Cobalt

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

Table G.1-2
Isotope Sample Results Detected above MDCs at CAU 366
(Page 1 of 4)

Sample Location	Sample Number	Depth (cm bgs)	COPCs (pCi/g)									
			Am-241	Pu-238	Inferred Pu-238	Pu-239/240	Inferred Pu-239/240	Pu-241	Inferred Pu-241	U-234	U-235	U-238
A01	366A601	0 - 5	0.199	--	--	1.73	--	--	--	119	3.78	1.33
	366A602	0 - 5	0.088	--	--	0.844	--	--	--	366	13.4	2.36
	366A603	0 - 5	0.089	--	0.15	0.475	8.6	--	3.1	146	4.69	1.44
	366A604	0 - 5	0.0784	--	--	0.511	--	--	--	277	9.51	2.65
A08	366A001	0 - 5	260 (J)	42.2	812	2,710	47,823	709	17,023	75.8	4.58	74.9
	366A605	0 - 5	0.37	--	0.74	1.94	43.8	--	15.6	103	3.83	1.24
	366A606	0 - 5	2.57	0.157	23.9	13.7	1,408	--	501	236	8.52	2.76
	366A607	0 - 5	1.36	0.158	9.8	7.06	578	--	206	87.5	3.19	1.43
	366A608	0 - 5	0.706	0.129	12.8	5.78	751	--	267	60.2	2.14	1.19
B01	366B005	0 - 5	59.5 (J)	5.26	3.8	347	226	139	80.4	1.03	--	0.66
	366B006	0 - 5	28.7	3.23	3.6	175	212	82.1	75.3	0.915	0.0579	0.674
B03	366B629	0 - 5	425	37	52.3	2,140	3,080	1,130	1,096	2.53	0.161	0.753
	366B630	0 - 5	305	29.9	51.3	1,840	3,023	741	1,076	1.95	0.157	0.567
	366B631	0 - 5	292	35.9	53.4	1,680	3,142	708	1,119	1.83	--	0.577
	366B632	0 - 5	310	27.5	72.6	1,700	4,275	704	1,522	2.29	--	0.512
B04	366B617	0 - 5	66.8	7.38	14.5	453	851	238	303	1.07	0.111	0.625
	366B618	0 - 5	48.2	6.34	14.7	266	864	127	307	0.868	--	0.552
	366B619	0 - 5	33.8	3.42	10.7	204	632	98.4	225	0.891	0.0896	0.549
	366B620	0 - 5	45	5.18	10.4	329	613	114	218	0.681	0.0533	0.45

Table G.1-2
Isotope Sample Results Detected above MDCs at CAU 366
(Page 2 of 4)

Sample Location	Sample Number	Depth (cm bgs)	COPCs (pCi/g)									
			Am-241	Pu-238	Inferred Pu-238	Pu-239/240	Inferred Pu-239/240	Pu-241	Inferred Pu-241	U-234	U-235	U-238
B05	366B621	0 - 5	57.3 (J)	4.3	3.8	224	221	110 (J)	78.7	1.05	--	0.565
	366B622	0 - 5	33.1 (J)	3.62	4.6	203	269	82.7	95.6	1.02	0.0693	0.689
	366B623	0 - 5	54.8	6.07	3.3	349	194	180	69.1	1.23	--	0.629
	366B624	0 - 5	10.1	1.45	3.4	71	203	31	72.2	0.791	0.0792	0.679
B06	366B625	0 - 5	6.08	0.627	2.4	34.4	142	--	50.6	0.77	0.0789	0.729
	366B626	0 - 5	39 (J)	2.94	2.3	172	135	88.5	47.9	0.899	--	0.634
	366B627	0 - 5	6.64	0.72	2.3	38.2	136	--	48.4	0.671	0.069	0.828
	366B628	0 - 5	11.4	1.15	1.9	57	110	--	39.2	0.777	--	0.662
B07	366B633	0 - 5	392	42.9	193	2,290	11,392	900	4,055	2.65	--	0.758
	366B634	0 - 5	1,920	201	102	11,500	5,990	4,000	2,132	8.74	--	0.625
	366B635	0 - 5	326	31.6	83.2	1,740	4,901	819	1,745	2.36 (J)	0.186 (J)	0.571 (J)
	366B636	0 - 5	218 (J)	18.4	80.3	926	4,726	376	1,682	2.23	--	0.761
	366B638	0 - 5	217	23.3	175	1,460	10,328	579	3,677	2.51	0.219	0.263
B08	366B609	0 - 5	14.3	1.16	10.1	71.9	597	31.7	213	1.64	--	0.511
	366B610	0 - 5	19.8	2.47	8.4	132	495	--	176	1.54	--	0.652
	366B611	0 - 5	56.8 (J)	3.75	13.7	207	807	183	287	0.85	--	0.594
	366B612	0 - 5	48.7	4.45	8.1	258	477	94.3	170	1.15	--	0.744
B09	366B605	0 - 5	20.7 (J)	2.65	9.2	153	541	73.4	193	0.815	--	0.487
	366B606	0 - 5	8.32	1.39	9.1	72.3	536	25	191	4.66	0.145	0.645
	366B607	0 - 5	--	1.1	5.8	57.6	343	--	122	0.553	--	0.382
	366B608	0 - 5	--	1.36	6.3	84.1	371	--	132	1.52	--	0.627

Table G.1-2
Isotope Sample Results Detected above MDCs at CAU 366
(Page 3 of 4)

Sample Location	Sample Number	Depth (cm bgs)	COPCs (pCi/g)									
			Am-241	Pu-238	Inferred Pu-238	Pu-239/240	Inferred Pu-239/240	Pu-241	Inferred Pu-241	U-234	U-235	U-238
B10	366B601	0 - 5	2.15	0.36	2.2	19.8	128	--	45.5	0.435	--	0.5
	366B602	0 - 5	3.75	0.511	4.7	29.2	279	--	99.2	0.631	--	0.705
	366B603	0 - 5	11	1.75	3.8	90.6	223	30.6	79.5	1.12	--	0.665
	366B604	0 - 5	5.9	0.823	3.6	44.3	212	25.2	75.3	0.585	--	0.695
B11	366B613	0 - 5	205	16.7	35.1	1,170	2,066	--	735	1.23	0.091	0.487
	366B614	0 - 5	312	40	53.2	2,270	3,130	--	1,114	1.81	--	0.431
	366B615	0 - 5	314	34.8	47.7	1,950	2,811	--	1,000	2	0.115	0.439
	366B616	0 - 5	139	14.2	33.5	1,040	1,972	--	702	1.41	0.0963	0.458
B12	366B007	0 - 5	12.5	1.18	4.1	67.5	242	32.2	86.0	0.698	--	0.596
	366B008	10 - 15	13.6	1.3	4.2	69.5	248	32.8	88.2	0.649	--	0.593
B13	366B004	0 - 5	12.3	--	7.7	252	453	--	161	1.14	--	0.405
B14	366B002	0 - 5	1,200 (J)	134	164	8,530	9,640	3,270	3,431	14.4	0.916	--
B15	366B003	0 - 5	272	46.4	41.2	2,790	2,429	1,120	865	114	--	27.5
B16	366B001	0 - 5	61.5	9.56	28.1	522	1,653	228	588	1.25	--	0.389
B21	366B639	0 - 5	5.78	0.588	126	29.6	7,449	--	2,652	0.783	--	0.809
	366B640	0 - 5	16,500	2,410	1,977	126,000	116,429	--	41,445	--	--	--
	366B641	0 - 5	2.29	0.229	58.8	12.2	3,462	--	1,232	0.749	--	0.854
	366B642	0 - 5	10	--	93.5	51.5	5,508	--	1,961	--	--	--

Table G.1-2
Isotope Sample Results Detected above MDCs at CAU 366
(Page 4 of 4)

Sample Location	Sample Number	Depth (cm bgs)	COPCs (pCi/g)									
			Am-241	Pu-238	Inferred Pu-238	Pu-239/240	Inferred Pu-239/240	Pu-241	Inferred Pu-241	U-234	U-235	U-238
C01	366C605	0 - 5	1.96	0.239	0.8	18	46.9	--	16.7	0.945	--	0.809
	366C606	0 - 5	0.845	0.178	0.6	5.59	38.2	--	13.6	0.841	--	0.805
	366C607	0 - 5	1.52	0.31	1.0	13.6	58.7	--	20.9	1.06	--	0.959
	366C608	0 - 5	1.01	0.176	0.8	8.05	46.6	--	16.6	0.898	--	0.991
C02	366C601	0 - 5	12	1.34	2.6	95.2	156	32.9	55.5	1.12	--	0.861
	366C602	0 - 5	136	17.9	41.7	1,080	2,454	417	873	2.49	0.135	0.729
	366C603	0 - 5	45	5.82	10.3	346	608	99.2	216	1.27	--	0.664
	366C604	0 - 5	126 (J)	14	8.5	976	500	314	178	3.29	0.12	0.969

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

Table G.1-3
RCRA Metal Sample Results above MDCs at CAU 366

Sample Location	Sample Number	Depth (in. bgs)	COPCs (mg/kg)						
			Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Silver
FALs			23	190,000	800	N/A	800	43	5,100
B17	366B009	2.0 - 6.0	115	97.2	0.646	6.07	179,000	0.0277	0.905
	366B010	2.0 - 6.0	6.21	88.9	0.465	5.38	4,870	0.0258	--
	366B014	10 - 12	2.8	72.8 (J)	0.205 (J)	4.69	25.2	0.0304	--
B18	366B011	1.0 - 2.0	2.09	80.6	--	4.39	9.27	0.0124 (J-)	--
B19	366B012	1.0 - 2.0	2.38	90.8	0.241 (J)	5.57	10.5	0.0157 (J-)	--
B20	366B013	2.0 - 3.0	2.82	114	--	6.45	29.3	0.0166 (J-)	--

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

Table G.1-4
VOC Sample Results Detected above MDCs at CAU 366

Sample Location	Sample Number	Depth (cm bgs)	COPCs (mg/kg)				
			Dichlorodifluoromethane	Methylene chloride	Perchloroethylene	Toluene	Trichlorofluoromethane
FALs			400	53	2.6	45,000	3,400
B07	366B635	0 - 5	0.00133	0.00267 (J)	--	--	0.00175
	366B636	0 - 5	0.00128	0.00235 (J)	--	0.00034 (J)	0.00183
	366B637	0 - 5	0.00129	0.00294 (J)	--	--	0.00176
	366B638	0 - 5	0.00129	0.00302 (J)	0.00035 (J)	0.00048 (J)	0.00182

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

Table G.1-5
Internal Dose Estimations at CAU 366 Sample Plots (mrem/IA-yr)

Sample Plot	Sample					Average for Sample Plot	95% UCL for Sample Plot
	1	2	3	4	5		
A01	0.8	0.19	0.11	0.15	--	0.1	0.2
A08	0.22	5.34	2.20	2.83	--	2.65	5.1
B03	11.43	11.22	11.66	15.86	--	12.54	15.2
B04	3.17	3.22	2.36	2.29	--	2.76	3.4
B05	0.84	1.01	0.74	0.77	--	0.84	1.0
B06	0.54	0.51	0.52	0.42	--	0.50	0.6
B07	42.24	22.22	18.18	17.53	38.30	27.69	38.9
B08	2.23	1.85	3.01	1.78	--	2.22	2.9
B09	2.02	2.01	1.29	1.39	--	1.68	2.1
B10	0.49	1.05	0.84	0.80	--	0.80	1.1
B11	7.67	11.62	10.43	7.32	--	9.26	11.7
B21	27.62	431.5	12.85	20.43	--	123.11	365.2
C01	0.19	0.16	0.23	0.19	--	0.19	0.2
C02	0.59	9.11	2.27	1.87	--	3.46	8.0

-- = Duplicate not taken for this plot.

Table G.1-6
CAU 366 TLD Results (mrem/IA-yr)
(Page 1 of 3)

TLD	Element	Location																												
		A01	A02	A03	A04	A05	A06	A07	A08	A09	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16	B21	B22	C01	C02
1	2	0.0	28.3	29.6	28.3	29.8	33.1	30.9	6.8	35.8	0.0	2.3	21.4	0.3	0.0	0.0	35.8	2.8	0.3	0.0	6.3	3.5	88.2	13.6	2.5	13.2	194.4	40.1	1.1	7.8
	3	0.0	28.1	30.7	28.8	29.5	32.1	30.8	2.0	29.8	0.2	1.5	12.8	0.0	0.0	0.0	23.3	1.8	0.0	0.0	1.5	3.1	2.5	2.3	0.0	2.5	190.1	37.4	0.0	4.9
	4	1.1	28.0	29.5	27.0	29.5	32.3	29.9	4.4	29.4	1.5	4.2	14.1	0.0	0.0	0.0	23.8	1.2	0.0	0.0	1.1	3.1	1.4	0.6	0.0	1.2	197.0	33.6	0.0	1.8
2	2	--	--	--	--	--	34.0	--	3.7	--	--	--	--	--	--	--	23.8	--	--	--	--	--	--	--	--	--	22.5	--	--	--
	3	--	--	--	--	--	32.9	--	1.3	--	--	--	--	--	--	--	22.9	--	--	--	--	--	--	--	--	--	21.6	--	--	--
	4	--	--	--	--	--	31.6	--	3.9	--	--	--	--	--	--	--	44.5	--	--	--	--	--	--	--	--	--	28.2	--	--	--
3	2	--	--	--	--	--	--	--	15.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.3	--	--	--
	3	--	--	--	--	--	--	--	19.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0	--	--	--
	4	--	--	--	--	--	--	--	21.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.7	--	--	--
4	2	--	--	--	--	--	--	--	11.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	184.2	--	--	--
	3	--	--	--	--	--	--	--	10.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	249.4	--	--	--
	4	--	--	--	--	--	--	--	9.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	394.6	--	--	--
5	2	--	--	--	--	--	--	--	12.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	28.9	--	--	--
	3	--	--	--	--	--	--	--	7.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	28.2	--	--	--
	4	--	--	--	--	--	--	--	11.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25.6	--	--	--
6	2	--	--	--	--	--	--	--	11.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	547.0	--	--	--
	3	--	--	--	--	--	--	--	9.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	585.1	--	--	--
	4	--	--	--	--	--	--	--	8.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	518.5	--	--	--
7	2	--	--	--	--	--	--	--	5.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	68.7	--	--	--
	3	--	--	--	--	--	--	--	1.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	46.1	--	--	--
	4	--	--	--	--	--	--	--	3.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	59.4	--	--	--

Table G.1-6
CAU 366 TLD Results (mrem/IA-yr)
(Page 2 of 3)

TLD	Element	Location																												
		A01	A02	A03	A04	A05	A06	A07	A08	A09	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16	B21	B22	C01	C02
8	2	--	--	--	--	--	--	--	7.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	21.1	--	--	--
	3	--	--	--	--	--	--	--	7.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.0	--	--	--
	4	--	--	--	--	--	--	--	5.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18.2	--	--	--
9	2	--	--	--	--	--	--	--	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20.8	--	--	--
	3	--	--	--	--	--	--	--	3.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17.5	--	--	--
	4	--	--	--	--	--	--	--	7.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22.0	--	--	--
10	2	--	--	--	--	--	--	--	4.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	127.3	--	--	--
	3	--	--	--	--	--	--	--	4.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	128.9	--	--	--
	4	--	--	--	--	--	--	--	1.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	135.6	--	--	--
11	2	--	--	--	--	--	--	--	138.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18.9	--	--	--
	3	--	--	--	--	--	--	--	175.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17.0	--	--	--
	4	--	--	--	--	--	--	--	202.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18.2	--	--	--
12	2	--	--	--	--	--	--	--	7.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	225.6	--	--	--
	3	--	--	--	--	--	--	--	8.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	175.1	--	--	--
	4	--	--	--	--	--	--	--	6.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	194.9	--	--	--
13	2	--	--	--	--	--	--	--	45.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	413.7	--	--	--
	3	--	--	--	--	--	--	--	19.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	394.6	--	--	--
	4	--	--	--	--	--	--	--	13.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	420.8	--	--	--
14	2	--	--	--	--	--	--	--	6.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	61.3	--	--	--
	3	--	--	--	--	--	--	--	5.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	59.6	--	--	--
	4	--	--	--	--	--	--	--	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	68.7	--	--	--

Table G.1-6
CAU 366 TLD Results (mrem/IA-yr)
(Page 3 of 3)

TLD	Element	Location																												
		A01	A02	A03	A04	A05	A06	A07	A08	A09	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16	B21	B22	C01	C02
15	2	--	--	--	--	--	--	--	41.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	251.8	--	--	--
	3	--	--	--	--	--	--	--	36.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	202.5	--	--	--
	4	--	--	--	--	--	--	--	29.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	228.0	--	--	--
16	2	--	--	--	--	--	--	--	373.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	182.0	--	--	--
	3	--	--	--	--	--	--	--	193.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	185.4	--	--	--
	4	--	--	--	--	--	--	--	201.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	168.0	--	--	--
17	2	--	--	--	--	--	--	--	199.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3	--	--	--	--	--	--	--	327.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	4	--	--	--	--	--	--	--	773.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

-- = No result

Appendix H

Nevada Division of Environmental Protection Comments

(5 Pages)

STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION

NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
protecting the future for generations

Brian Sandoval, Governor
Leo M. Drozdoff, P.E., Director
Colleen Cripps, Ph.D., Administrator

September 10, 2012

Robert F. Boehlecke, Manager
Environmental Management Operations
National Nuclear Security Administration
Nevada Site Office
P. O. Box 98518
Las Vegas, NV 89193-8518

RE: Review of Draft Corrective Action Decision Document (CADD) for Corrective Action Unit (CAU) 366: Area 11 Plutonium Valley Dispersion Sites,
Nevada National Security Site, Nevada
Federal Facility Agreement and Consent Order

Dear Mr. Boehlecke,

The Nevada Division of Environmental Protection, Bureau of Federal Facilities (NDEP) staff has received and reviewed the draft CADD for Corrective Action Unit (CAU) 366: Area 11 Plutonium Valley Dispersion Sites. NDEP's review of this document did not indicate any deficiencies.

If you have any questions regarding this matter contact me at (702) 486-2850 ext.233.

Sincerely,

/s/ Jeff MacDougall

Jeff MacDougall, Ph.D., C.P.M.
Supervisor
Bureau of Federal Facilities

THM/TZ/JW/SP:jjm

cc: J. T. Fraher, DTRA/CXTS, Kirtland AFB, NM
N-I Central Files, MS NSF 156
NSTec Correspondence Control, MS NLV008
T. A. Lantow, EMO, NNSA/NSO, Las Vegas, NV
FFACO Group, EMOS, NNSA/NSO, Las Vegas, NV

Nevada Environmental Management Operations Activity
DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Corrective Action Decision Document for Corrective Action Unit 366: Area 11 Plutonium Valley Dispersion Sites, Nevada National Security Site, Nevada	**2. Document Date:**	8/3/2012
3. Revision Number:	0	**4. Originator/Organization:**	Navarro-INTERA
5. Responsible NNSA/NSO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Jeff MacDougall, NDEP, 486-2850	**9. Reviewer's Signature:**	

10. Comment Number/Location	11. Type*	12. Comment	13. Comment Response	14. Accept
1.) Other Applicable Comments		General changes to the CAU 366 CADD resulting from the review of CAUs 105 and 570 CAIPs.	1. Section titles were revised to reflect the FFACO outline 2. Statements were added to ensure that each figure had an appropriate callout 3. Figures were updated for consistency (including the clarification of the radiological demarcation line)	
2.) Other Applicable Comments		Explanation of changes in the CAU 366 CADD regarding the use of the Soils Risk-Based Corrective Action (RBCA) Evaluation Process document.	The draft CADD used the radionuclide RRMGs established in the CAIP based on the Industrial Sites Project Establishment of Final Action Levels document. It was subsequently determined to update the draft CADD to conform with the recently approved Soils RBCA document with the corrected RRMG values. Therefore, RRMG and dose values have been updated and the associated text and figures were revised to reflect the updated values. This had a minor impact on the suggested Best Management Practice IA/yr boundary but did not have any impact to the corrective action boundary established as a result of the radiological debris (Study Group 5). As this was a deviation to the CAIP, a new section (A.2.6) has been added to the document (see comment #10 of this document review sheet). Additionally, references to this section were added throughout the document, as needed.	
3.) Page 5, Section 1.1, Paragraph 1		Change based on NDEP review of recent FFACO documents.	The following sentence was added: "The corrective action investigation (CAI) activities were completed in accordance with the *Soils Activity Quality Assurance Plan* (QAP) (NNSA/NSO, 2012a), which established requirements, technical planning, and general quality practices.	

Nevada Environmental Management Operations Activity
DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Corrective Action Decision Document for Corrective Action Unit 366: Area 11 Plutonium Valley Dispersion Sites, Nevada National Security Site, Nevada	**2. Document Date:**	8/3/2012
3. Revision Number:	0	**4. Originator/Organization:**	Navarro-INTERA
5. Responsible NNSA/NSO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Jeff MacDougall, NDEP, 486-2850	**9. Reviewer's Signature:**	

10. Comment Number/Location	11. Type*	12. Comment	13. Comment Response	14. Accept
4.) Page 5, Section 1.2, Paragraph 1		Change based on NDEP recent review of FFACO documents.	The following sentences were added: "In accordance with the graded approach described in the Soils QAP (NNSA/NSO, 2012a), the quality required of a dataset will be determined by its intended use in decision making. Data used to define the presence of COCs are classified as decisional and will be used to make corrective action decisions. Survey data are classified as decision supporting and are not used, by themselves, to make corrective action decisions."	
5.) Page 15, Section 2.2, Paragraph 2		Change to the document as a result of comment #2 on this document review sheet.	Insert the following: "The radionuclide RRMGs established in the CAIP were based on the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). It was subsequently determined to evaluate CAU 366 results based on the approved Soils RBCA document, as described in Section A.2.6."	
6.) Page 20, Section 2.3, Paragraph 3		Unsolicited technical revision	The term "study groups" was changed to "CASs" since the corrective action alternatives are evaluated on a CAS basis and not per study group.	

Nevada Environmental Management Operations Activity
DOCUMENT REVIEW SHEET

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3. Revision Number:	0	**4. Originator/Organization:**	Navarro-INTERA
5. Responsible NNSA/NSO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Jeff MacDougall, NDEP, 486-2850	**9. Reviewer's Signature:**	

10. Comment Number/Location	11. Type*	12. Comment	13. Comment Response	14. Accept
7.) Page A-5, Section A.2.0, Paragraph 2		Change based on NDEP review of recent FFACO documents.	Paragraph 2 was replaced with the following: The CAI activities were completed in accordance with the Soils QAP (NNSA/NSO, 2012a), which establishes requirements, technical planning, and general quality practices. The evaluation of investigation results and the risk associated with site contamination was conducted in accordance with the Soils RBCA document (NNSA/NSO, 2012b). In accordance with the graded approach described in the Soils QAP (NNSA/NSO, 2012a), the quality required of a dataset will be determined by its intended use in decision making. Data used to define the presence of COCs are classified as decisional and will be used to make corrective action decisions. Survey data are classified as decision supporting and are not used, by themselves, to make corrective action decisions. As presented in Appendix D, the radiological and chemical FALs are based on the appropriate site-specific exposure scenario (occasional use area).	
8.) Page A-11, Section A.2.4, Paragraph 1 and Section A.2.5, Paragraph 1		Unsolicited technical revision	Change the Soils QAP reference to the CAIP (NNSA/NSO, 2011). The change was made as the analytical methods are listed in the CAIP and not the QAP.	
9.) Page A-12, Section A.2.5, Paragraph 3		Unsolicited technical revision	Change the last sentence to "If a COC is present at any location, a corrective action will be required." The reason for the change is to add clarity.	

Nevada Environmental Management Operations Activity
DOCUMENT REVIEW SHEET

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3. Revision Number:	0	**4. Originator/Organization:**	Navarro-INTERA
5. Responsible NNSA/NSO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Jeff MacDougall, NDEP, 486-2850	**9. Reviewer's Signature:**	

10. Comment Number/Location	11. Type*	12. Comment	13. Comment Response	14. Accept
10.) Page A-12, Section A.2.6		Change to the document as a result of comment #2 on this document review sheet.	The following has been added: Section A.2.6, Deviations The radionuclide RRMGs were established in the CAIP (NNSA/NSO, 2011) based on the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). It was subsequently determined to evaluate CAU 366 results based on the approved Soils RBCA document (NNSA/NSO, 2012b). Therefore, RRMG and dose values were established using the Soils RBCA process document rather than the RRMG values listed in the CAIP. This did not result in any changes to corrective action decisions or the extent of the FFACO UR established as a result of the radiological debris (Study Group 5). However, this did result in a slight decrease in the area of the administrative 25 mrem/IA-yr UR boundary.	
11.) Page A-66, Table A.9-1		Unsolicited technical revision	Revised the table footnote as follows: "Copies of waste disposal documents will be presented in the final Closure Report." The waste will be shipped during the corrective action plan (CAP) phase.	

Library Distribution List

	Copies
U.S. Department of Energy National Nuclear Security Administration Nevada Site Office Technical Library P.O. Box 98518, M/S NSF 151 Las Vegas, NV 89193-8518	1 (Uncontrolled, electronic copy)
U.S. Department of Energy Office of Scientific and Technical Information P.O. Box 62 Oak Ridge, TN 37831-0062	1 (Uncontrolled, electronic copy)
Southern Nevada Public Reading Facility c/o Nuclear Testing Archive P.O. Box 98521, M/S 400 Las Vegas, NV 89193-8521	2 (Uncontrolled, electronic copy)
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