ERRATA SHEET

The Following Corrections and Clarifications Apply to: Closure Report for Corrective Action Unit 124: Storage Tanks, Nevada Test Site, Nevada

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Appendix H, Risk Evaluation, Section H.1.7 G. Evaluation of Tier 1 Results, second paragraph: The reference to Table H.1-2 should be identified as Table H.1.7.

Nevada
Environmental
Restoration
Project

DOE/NV--1241

National Nuclear Security Administration

Closure Report for Corrective Action Unit 124: Storage Tanks Nevada Test Site, Nevada

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DOE/NV--1241

CLOSURE REPORT
FOR
CORRECTIVE ACTION UNIT 124:
STORAGE TANKS
NEVADA TEST SITE, NEVADA

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

Controlled Copy No.: ___

Revision No.: 0

January 2008

CLOSURE REPORT
FOR
CORRECTIVE ACTION UNIT 124:
STORAGE TANKS
NEVADA TEST SITE, NEVADA

Approved by: /s/ Kevin J. Cabble Date: 1/16/2008

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List of Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
AST	Aboveground storage tank
bgs	Below ground surface
BMP	Best management practice
CAI	Corrective Action Investigation
CAS	Corrective Action Site
CAU	Corrective Action Unit
cm	Centimeter
COC	Contaminant of concern
COPC	Contaminant of potential concern
CR	Closure Report
CSM	Conceptual site model
DOE	U.S. Department of Energy
DQA	Data quality assessment
DQI	Data quality indicator
DQO	Data quality objective
DRO	Diesel-range organics
EPA	U.S. Environmental Protection Agency
FAL	Final action level
FD	Field duplicate
FFACO	*Federal Facility Agreement and Consent Order*
FSL	Field-screening level
FSR	Field-screening result
ft	Foot
ft^2	Square foot
GRO	Gasoline-range organics

List of Acronyms and Abbreviations *(Continued)*

ID	Identification
IDW	Investigation-derived waste
in.	Inch
in./yr	Inches per year
LCS	Laboratory control sample
MDC	Minimum detectable concentration
mg/kg	Milligrams per kilogram
mrem/yr	Millirem per year
MS	Matrix spike
MSD	Matrix spike duplicate
N/A	Not applicable
NAC	*Nevada Administrative Code*
NAD	North American Datum
NCRP	National Council on Radiation Protection and Measurements
NDEP	Nevada Division of Environmental Protection
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NTS	Nevada Test Site
PAL	Preliminary action level
Pb	Lead
PB	Preparation blank
PCB	Polychlorinated biphenyl
POC	Performance objective criteria
pCi/g	Picocuries per gram
pCi/L	Picocuries per liter

List of Acronyms and Abbreviations *(Continued)*

PPE	Personal protective equipment
PRG	Preliminary Remediation Goal
Pu	Plutonium
PVC	Polyvinyl chloride
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
Ra	Radium
RadCon	Radiological Control
RBCA	Risk-based corrective action
RBSL	Risk-based screening level
RCRA	*Resource Conservation and Recovery Act*
RESRAD	Residual radioactive
RL	Reporting limit
RPD	Relative percent difference
SAFER	Streamlined Approach to Environmental Restoration
SCL	Sample collection log
SDG	Sample delivery group
SNJV	Stoller-Navarro Joint Venture
Sr	Strontium
SS	Site Supervisor
SSTL	Site-specific target level
SVOC	Semivolatile organic compound
TCLP	Toxicity Characteristic Leaching Procedure
Th	Thorium
TPH	Total petroleum hydrocarbons

List of Acronyms and Abbreviations *(Continued)*

U	Uranium
UGTA	Underground test area
UST	Underground storage tank
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
VSP	Visual Sample Plan
%R	Percent recovery

Executive Summary

This Closure Report (CR) presents information supporting the closure of Corrective Action Unit (CAU) 124: Storage Tanks, Nevada Test Site, Nevada. This CR complies with the requirements of the *Federal Facility Agreement and Consent Order* 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 Corrective Action Sites (CASs) within CAU 124 are located in Areas 8, 15, and 16 of the Nevada Test Site. Corrective Action Unit 124 is comprised of the following five CASs:

- 08-02-01, Underground Storage Tank
- 15-02-01, Irrigation Piping
- 16-02-03, Underground Storage Tank
- 16-02-04, Fuel Oil Piping
- 16-99-04, Fuel Line (Buried) and UST

The purpose of this CR is to provide documentation supporting the completed corrective actions and the data confirming that the closure objectives for CASs within CAU 124 were met. To achieve this, the following actions were performed:

- Review the current site conditions, including the concentration and extent of contamination.
- Implement any corrective actions necessary to protect human health and the environment.
- Properly dispose of corrective action and investigation wastes.
- Document Notice of Completion and closure of CAU 124.

From July 9 through July 26, 2007, closure activities were performed as set forth in the *Streamlined Approach for Environmental Restoration (SAFER) Plan for CAU 124, Storage Tanks, Nevada Test Site, Nevada*. The purposes of the activities defined during the data quality objectives process were:

- Determine whether contaminants of concern (COCs) are present.
- If COCs are present, determine their nature and extent, implement appropriate corrective actions, and properly dispose of wastes.

Constituents detected during the closure activities were evaluated against final action levels to determine COCs for CAU 124. Assessment of the data generated from closure activities indicates that no further action is necessary at the CASs as no COCs were present at any CAS. Debris removed from these CASs was disposed of as a best management practice.

The DOE, National Nuclear Security Administration Nevada Site Office provides the following recommendations:

- No further corrective action is required for CAU 124 CASs.
- A Notice of Completion to the DOE, National Nuclear Security Administration Nevada Site Office, is requested from the Nevada Division of Environmental Protection for closure of CAU 124.
- Corrective Action Unit 124 should be moved from Appendix III to Appendix IV of the *Federal Facility Agreement and Consent Order.*

1.0 Introduction

This Closure Report (CR) presents information supporting closure of Corrective Action Unit (CAU) 124, Storage Tanks, Nevada Test Site (NTS), Nevada. This report complies with the requirements of the *Federal Facility Agreement and Consent Order* (FFACO) that was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management; U.S. Department of Defense; and DOE, Legacy Management (FFACO, 1996; as amended January 2007). The NTS is located approximately 65 miles northwest of Las Vegas, Nevada (Figure 1-1).

Corrective Action Unit 124 is comprised of five Corrective Action Sites (CASs) located in Areas 8, 15, and 16 of the NTS as shown on Figure 1-2 and listed below:

- 08-02-01, Underground Storage Tank
- 15-02-01, Irrigation Piping
- 16-02-03, Underground Storage Tank
- 16-02-04, Fuel Oil Piping
- 16-99-04, Fuel Line (Buried) and UST

1.1 Purpose

This CR provides documentation and justification for the closure of CAU 124 without further corrective action. This justification is based on process knowledge and the results of the investigative activities conducted in accordance with the *Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 124: Storage Tanks, Nevada Test Site, Nevada* (NNSA/NSO, 2007). The SAFER Plan provides information relating to site history as well as the scope and planning of the investigation. Therefore, this information will not be repeated in this CR.

Corrective Action Unit 124 consists of one CAS in Area 8, one CAS in Area 15, and three CASs in Area 16. Additional information relating to the site history, planning, and scope of the closure is presented in the SAFER Plan (NNSA/NSO, 2007).

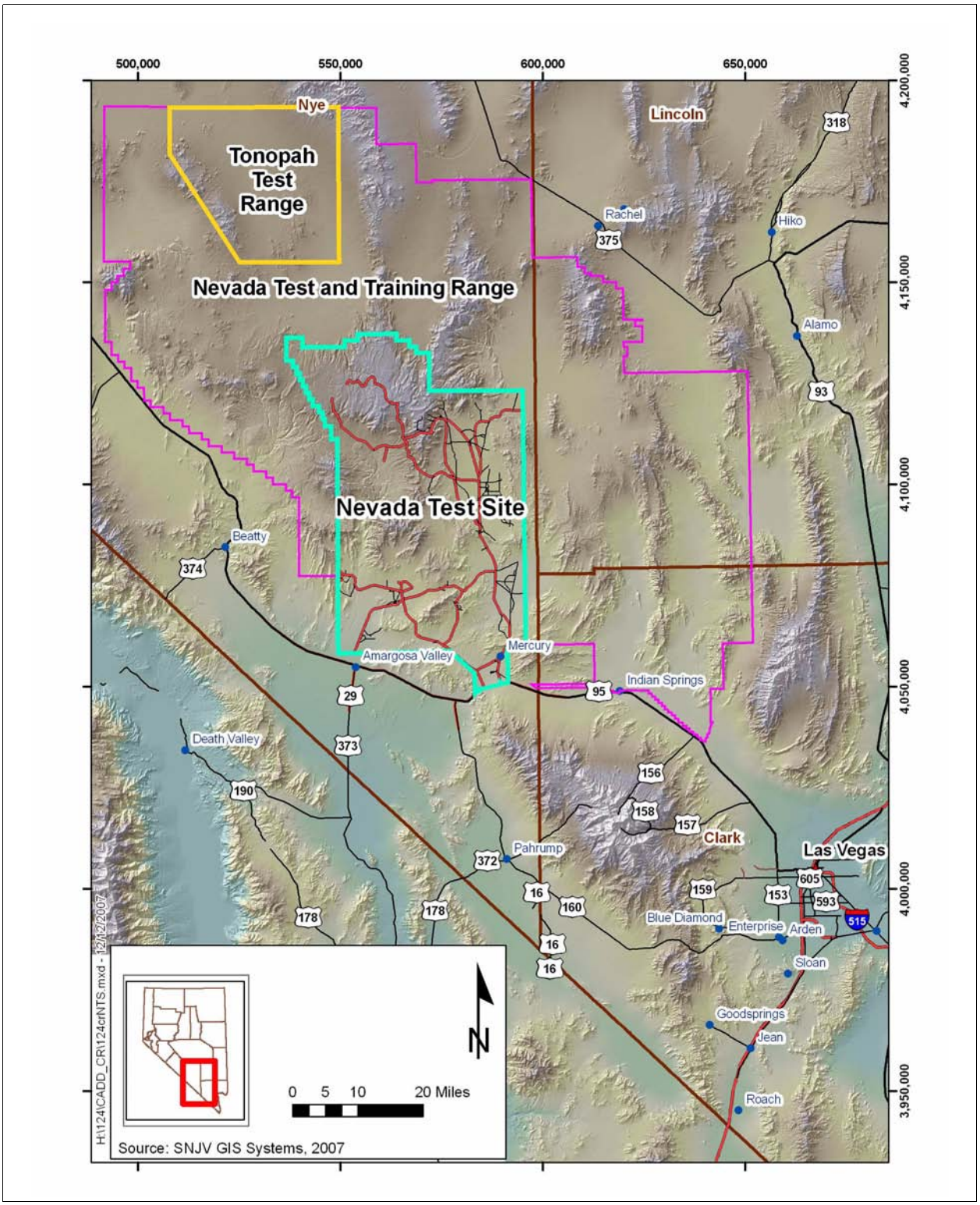


Figure 1-1
Nevada Test Site

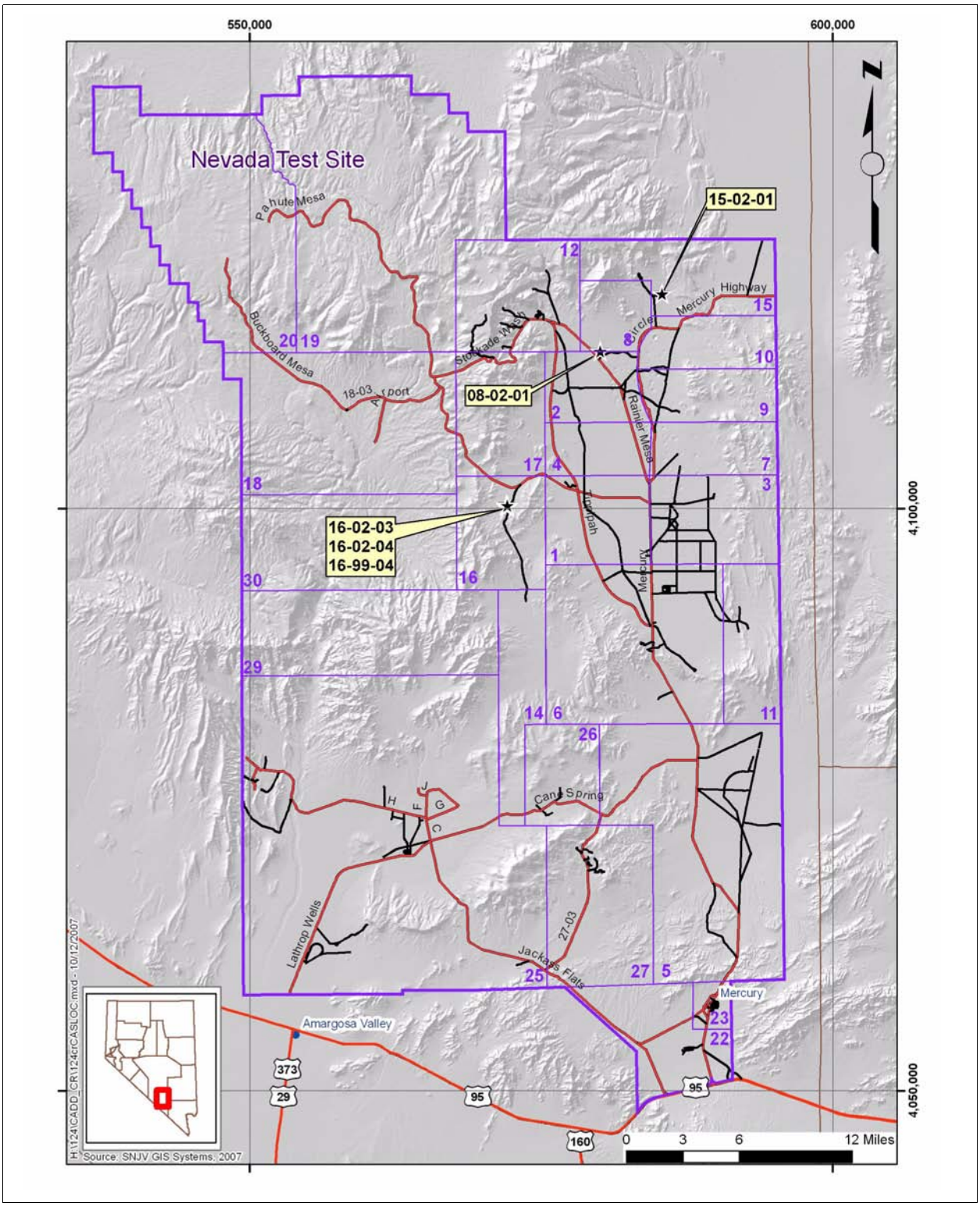


Figure 1-2
CAU 124 CAS Location Map

1.2 Scope

A corrective action of no further action was completed by demonstrating through environmental sampling and analytical results using random grid (CAS 15-02-01, Plots A and B) and judgmental sampling that contaminants of concern (COCs) do not exist within the CASs. Best management practices (BMPs) were completed by cutting, removing the stick-ups, and sealing piping as required at CAS 08-02-01 and the three Area 16 CASs. Loose debris within the CASs was also collected and disposed of and the ceramic drops were filled with native soils. Because no COCs were identified during the initial investigation, no delineation activities were required. Activities performed during the corrective action investigation (CAI) included:

- Removing surface debris and/or materials to facilitate sampling
- Performing radiological walkover surveys
- Performing radiological field screening
- Collecting environmental samples for laboratory analysis
- Collecting waste management samples
- Collecting quality control (QC) samples
- Performing BMP activities for Area 8 and 16 CASs

1.3 CR Contents

This CR is divided into the following sections and appendices:

Section 1.0 - Introduction: Summarizes the purpose, scope, and contents of this CR.

Section 2.0 - Closure Activities: Summarizes the closure activities, deviations from the CAU 124 SAFER Plan, the schedule, and the site conditions following completion of corrective actions.

Section 3.0 - Waste Disposition: Discusses the wastes generated and approved waste management processes.

Section 4.0 - Closure Verification Results: Describes verification activities and results.

Section 5.0 - Conclusions and Recommendations: Provides the conclusions and recommendations along with rationale for the determination.

Section 6.0 - References: Provides a list of all referenced documents used in the preparation of this CR.

Appendix A- *Data Quality Objectives as Developed in the SAFER Plan*: Provides the data quality objectives (DQOs) as presented in Appendix B of the SAFER Plan.

Appendix B - *Closure Certification*: Documents the specific closure activities completed for CAU 124. (This appendix does not apply to CAU 124.)

Appendix C - *As-Built Documentation*: Identifies the as-built drawings for each CAS. (This appendix does not apply to CAU 124.)

Appendix D - *Confirmation Sampling Test Results*: Provides a description of the project objectives, field closure and sampling activities, and closure results.

Appendix E - *NTS Load Verification Forms:* Provides load verification and shipping documentation for CAU 124.

Appendix F - *Modifications to the Post-Closure Plan*: Documents any modifications to the Post-Closure Plan. (This appendix does not apply to CAU 124.)

Appendix G - *Use Restrictions*: Documents the use restrictions. (This appendix does not apply to CAU 124.)

Appendix H - *Risk Evaluation*: Presents the risk assessment results and the methods for identifying the final action levels (FALs).

Appendix I - *Nevada Division of Environmental Protection* (NDEP) *Comments*: Contains comments on the draft version of this document.

1.3.1 Applicable Programmatic Plans and Documents

To ensure all project objectives, health and safety requirements, and QC procedures were adhered to, all closure activities were performed in accordance with the following documents:

- *Streamlined Approach for Environmental Restoration (SAFER) Plan for CAU 124, Storage Tanks* (NNSA/NSO, 2007)
- *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002)
- *Federal Facility Agreement and Consent Order* (FFACO, 1996; as amended January 2007)
- Approved standard operating procedures

1.3.2 Data Quality Objectives

This section contains a summary of the DQO process that is presented in Appendix A. The DQOs were developed to identify data needs, clearly define the intended use of the environmental data, and design a data collection program that satisfied these objectives.

The problem statement for CAU 124 CAI was: "Existing information on the nature and extent of potential contamination is insufficient to evaluate and confirm closure of the CAU 124 CASs." To address this question, the resolution of two decision statements was required:

- The Decision I statement is: "Is any COC present in environmental media within the CAS?" For judgmental sampling design, any analytical result for a contaminant of potential concern (COPC) 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 constituent analysis (NNSA/NSO, 2006). If a COC is detected, then Decision II must be resolved.
- The Decision II statement is: "If a COC is present, is sufficient information available to meet the closure objectives?" Sufficient information is defined to include:
  - Identifying the volume of media containing a COC bounded by analytical sample results in lateral and vertical directions.
  - The information needed to characterize investigation-derived waste (IDW) for disposal.
  - Information necessary to select the appropriate corrective action to complete site closure.

The presence of a COC would require a corrective action. A corrective action may also be necessary if there is a potential for wastes present at a site (i.e., potential source material) to release COCs into site environmental media.

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

- Physical waste containment could 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.
- If any liquid waste was released, waste containing a contaminant exceeding the *Resource Conservation and Recovery Act* (RCRA) toxicity characteristic concentration would cause a COC to be present in the surrounding media.
- Any non-liquid waste containing a contaminant exceeding an equivalent FAL concentration would cause a COC to be present in the surrounding media.

1.3.3 Data Quality Assessment Summary

The data quality assessment (DQA) presented in Section 4.1 includes an evaluation of the data quality indicators (DQIs) to determine the degree of acceptability and usability of the reported data in the decision-making process. The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps to ensure that DQO decisions are sound and defensible.

The DQA process as presented in Section 4.1 is comprised of the following steps:

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

Based on the results of the DQA presented in Section 4.1, the information generated during the investigation support the conceptual site model (CSM) assumptions, and the data collected meet the DQOs and support their intended use in the decision-making process.

2.0 Closure Activities

The following sections summarize the CAU 124 closure activities and any deviations from the original scope of work. Results of confirmation sampling for individual CAU 124 CASs are presented in Appendix D.

2.1 Description of Corrective Action Activities

The corrective action activities were conducted in accordance with the requirements set forth in the SAFER Plan (NNSA/NSO, 2007). Table 2-1 lists the corrective action activities conducted at each CAS.

Table 2-1
Corrective Action Activities Conducted at Each Corrective Action Site
To Meet SAFER Plan Requirements
(Page 1 of 2)

Corrective Action Activities	Corrective Action Sites				
	08-02-01 Underground Storage Tank	15-02-01 Irrigation Piping	16-02-03 Underground Storage Tank	16-02-04 Fuel Oil Piping	16-99-04 Fuel Line (Buried) and UST
Conducted surface radiological surveys	X	X	X	X	X
Performed geophysical/utility surveys	X	X	X	X	X
Performed site transects/walkovers	X	X	X	X	X
Collected soil samples from biased locations	X	X	X	X	X
Collected soil samples from random grid locations	--	X	--	--	--
Field-screened samples for alpha and beta/gamma radiation	X	X	X	X	X
Collected samples for waste characterization	X	--	--	--	--
Collected swipe samples for removable radioactivity	--	X	--	--	--

Table 2-1
Corrective Action Activities Conducted at Each Corrective Action Site
To Meet SAFER Plan Requirements
(Page 2 of 2)

Corrective Action Activities	Corrective Action Sites				
	08-02-01 Underground Storage Tank	15-02-01 Irrigation Piping	16-02-03 Underground Storage Tank	16-02-04 Fuel Oil Piping	16-99-04 Fuel Line (Buried) and UST
Cut associated piping and sealed as a best management practice	--	--	X	X	X
Submitted select samples for offsite laboratory analysis	X	X	X	X	X

-- = Not applicable

Closure verification samples were collected from surface and subsurface soils. Surface soil samples were collected by hand. Subsurface soil samples were collected using hand excavation and/or backhoe operations. All soil samples were field screened for alpha and beta/gamma radiation. The results were compared against field-screening levels (FSLs) to guide in the selection of CAS-specific verification sample locations. Resultant samples were shipped to offsite laboratories to be analyzed for appropriate chemical and radiological parameters.

A judgmental sampling scheme was implemented to select sample locations and evaluate analytical results, as outlined in the SAFER Plan. Judgmental sampling allows the methodical selection of sample locations that target the populations of interest (defined in the DQOs) rather than non-selective random locations.

For the judgmental sampling scheme, individual sample results (rather than average concentrations) are used to compare to FALs. Therefore, statistical methods to generate site characteristics concentrations (averages) are not necessary. If good prior information is available on the target site of interest, then the sampling may be designed to collect samples only from areas known to have the highest concentration levels on the target site. If the observed concentrations from these samples are

below the action level, then a decision can be made that the site contains safe levels of the contaminant without the samples being truly representative of the entire area (EPA, 2006). The judgmental sampling design was used to determine the existence of contamination at specific locations. Confidence in judgmental sampling scheme decisions was established qualitatively by the validation of the CSM and justification that sampling locations are the most likely locations to contain a COC, if a COC exists.

2.1.1 CAS 08-02-01 Closure Activities

The excavation revealed no underground storage tank (UST) in CAS 08-02-01. Confirmation samples were collected to meet the requirements of the SAFER Plan. The sample identifications (IDs), locations, types, and analyses are listed in Table 2-2. The analytical results confirm that no COCs were identified. Best management practices (BMPs) were completed by removing the stick-up as required at CAS 08-02-01. Loose debris within the CAS was also collected and disposed. A complete discussion of investigative activities and analytical results are in Appendix D.

Table 2-2
Samples Collected at CAS 08-02-01, Underground Storage Tank

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
A01	124A001	0.0 - 0.5	Soil	Environmental	Set 1
	124A002	0.0 - 0.5	Soil	Field Duplicate of 124A001	Set 1
A02	124A003	5.5 - 6.0	Soil	Environmental	Set 1
N/A	124A300	N/A	Water	Trip Blank	VOCs
N/A	124A301	N/A	Water	Field Blank	Set 1
N/A	124A302	N/A	Water	Trip Blank	VOCs
N/A	124A303	N/A	Water	Trip Blank	VOCs
N/A	124A500	N/A	Solid	Waste Management	Set 2
N/A	124A501	N/A	Liquid	Waste Management	VOCs

Set 1 = VOCs, SVOCs, RCRA Metals, TPH-DRO, PCBs, Gamma Spectroscopy
Set 2 = TCLP VOCs, Isotopic Uranium, Isotopic Plutonium, Strontium-90, Gamma Spectroscopy

bgs = Below ground surface
DRO = Diesel-range organics
ft = Foot
N/A = Not applicable
PCB = Polychlorinated biphenyl
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TCLP = Toxicity Characteristic Leaching Procedure
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

2.1.2 CAS 15-02-01 Closure Activities

Samples were collected to meet the requirements of the SAFER Plan. The sample IDs, locations, types, and analyses are listed in Table 2-3. The analytical results confirm that no COCs were identified. A complete discussion of investigative activities and analytical results are in Appendix D.

Table 2-3
Samples Collected at CAS 15-02-01, Irrigation Piping
(Page 1 of 3)

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
B01	124B027	0.0 - 0.5	Soil	Environmental	Set 3
B02	124B028	0.0 - 0.5	Soil	Environmental	Set 3
B03	124B031	0.0 - 0.5	Soil	Environmental	Set 3
B04	124B026	0.0 - 0.5	Soil	Environmental	Set 3
B05	124B012	0.0 - 0.5	Soil	Environmental	Set 3
B06	124B013	0.0 - 0.5	Soil	Environmental	Set 3
B07	124B014	0.0 - 0.5	Soil	Environmental	Set 3
B08	124B015	0.0 - 0.5	Soil	Environmental	Set 3
B09	124B001	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy
B10	124B002	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy
B11	124B003	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy
B12	124B004	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy
B13	124B005	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy
B14	124B006	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy
B15	124B035	0.0 - 0.5	Soil	Environmental	Set 3
B16	124B032	0.0 - 0.5	Soil	Environmental	Set 3
	124B033	0.0 - 0.5	Soil	Field Duplicate of 124B032	Set 3
B17	124B034	0.0 - 0.5	Soil	Environmental	Set 3
B18	124B036	0.0 - 0.5	Soil	Environmental	Set 3
B19	124B040	0.0 - 0.5	Soil	Environmental	Set 3

Table 2-3
Samples Collected at CAS 15-02-01, Irrigation Piping
(Page 2 of 3)

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
B20	124B039	0.0 - 0.5	Soil	Environmental	Set 3
B21	124B037	0.0 - 0.5	Soil	Environmental	Set 3, Gross Alpha/Beta
B22	124B038	0.0 - 0.5	Soil	Environmental	Set 3
B23	124B011	0.0 - 0.5	Soil	Environmental	Set 3
B24	124B007	0.0 - 0.5	Soil	Environmental	Set 3
B25	124B008	0.0 - 0.5	Soil	Environmental	Set 3
	124B009	0.0 - 0.5	Soil	Field Duplicate of 124B008	Set 3
B26	124B010	0.0 - 0.5	Soil	Environmental	Set 3
B27	124B016	0.0 - 0.5	Soil	Environmental	Set 3
	124B019	0.5 - 1.0	Soil	Environmental	Set 3
	124B021	N/A	Swipe	Environmental	Gamma Spectroscopy
B28	124B017	0.0 - 0.5	Soil	Environmental	Set 3
	124B018	0.5 - 1.0	Soil	Environmental	Set 3
	124B020	N/A	Swipe	Environmental	Gamma Spectroscopy
B29	124B024	0.0 - 0.5	Soil	Environmental	Set 3
	124B025	0.5 - 1.0	Soil	Environmental	Set 3
	124B023	N/A	Swipe	Environmental	Gamma Spectroscopy
B30	124B029	0.0 - 0.5	Soil	Environmental	Set 3
	124B030	0.5 - 1.0	Soil	Environmental	Set 3
	124B022	N/A	Swipe	Environmental	Gamma Spectroscopy
N/A	124B301	N/A	Water	Trip Blank	VOCs
N/A	124B302	N/A	Water	Trip Blank	VOCs
N/A	124B303	N/A	Water	Trip Blank	VOCs

Table 2-3
Samples Collected at CAS 15-02-01, Irrigation Piping
(Page 3 of 3)

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
N/A	124B304	N/A	Water	Field Blank	Set 3

Set 3 = VOCs, SVOCs, RCRA Metals, PCBs, Pesticides, Herbicides, Gamma Spectroscopy, Tritium Gamma Spectroscopy

bgs = Below ground surface
ft = Foot
N/A = Not applicable
PCB = Polychlorinated biphenyl
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
VOC = Volatile organic compound

2.1.3 CAS 16-02-03 Closure Activities

The location of CAS 16-02-03 was excavated and no UST was found. The steel piping was excavated by hand and revealed no biasing factors. Confirmation samples were collected to meet the requirements of the SAFER Plan. The sample IDs, locations, types, and analyses are listed in Table 2-4. The analytical results confirm that no COCs were identified. Best management practices (BMPs) were completed by cutting, removing the stick-ups, and sealing piping as required at this CAS. Loose debris was also collected and disposed of and the ceramic drops were filled with native soils. A complete discussion of investigative activities and analytical results are in Appendix D.

Table 2-4
Samples Collected at CAS 16-02-03, Underground Storage Tank
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
C01	124C001	0.0 - 0.5	Soil	Environmental	Set 1
C02	124C002	0.0 - 0.5	Soil	Environmental	Set 1
	124C003	0.0 - 0.5	Soil	Field Duplicate of 124A002	Set 1
C03	124C004	2.0 - 2.5	Soil	Environmental	Set 1
N/A	124C301	N/A	Water	Trip Blank	VOCs
N/A	124C302	N/A	Water	Source Blank	Set 1, TPH-GRO
N/A	124C303	N/A	Water	Equipment Rinsate	Set 1

Table 2-4
Samples Collected at CAS 16-02-03, Underground Storage Tank
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses

Set 1 = VOCs, SVOCs, RCRA Metals, TPH-DRO, PCBs, Gamma Spectroscopy

bgs = Below ground surface
DRO = Diesel-range organics
ft = Foot
GRO = Gasoline-range organics
N/A = Not applicable
PCB = Polychlorinated biphenyl
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

2.1.4 CAS 16-02-04 Closure Activities

The location of CAS 16-02-04 was excavated at all areas where connections to other lines or structures would have been made. The excavations revealed no biasing factors. Confirmation samples were collected to meet the requirements of the SAFER Plan. The sample IDs, locations, types, and analyses are listed in Table 2-5. Analytical results show that no COCs were identified. Best management practices (BMPs) were completed by cutting, removing the stick-ups, and sealing piping as required at this CAS. Loose debris was also collected and disposed of and the ceramic drops were filled with native soils. A complete discussion of investigative activities and analytical results are in Appendix D.

Table 2-5
Samples Collected at CAS 16-02-04, Fuel Oil Piping
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
D01	124D001	0.0 - 0.5	Soil	Environmental	Set 4
D02	124D002	0.0 - 0.5	Soil	Environmental	Set 4
D03	124D003	0.0 - 0.5	Soil	Environmental	Set 4
D04	124D004	0.0 - 0.5	Soil	Environmental	Set 4
	124D005	0.0 - 0.5	Soil	Field Duplicate of 124D004	Set 4
D05	124D006	0.0 - 0.5	Soil	Environmental	Set 4
	124D007	4.0 - 4.2	Soil	Environmental	Set 4
D06	124D008	0.0 - 0.5	Soil	Environmental	Set 4
D07	124D009	0.0 - 0.5	Soil	Environmental	Set 4

Table 2-5
Samples Collected at CAS 16-02-04, Fuel Oil Piping
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
D08	124D010	0.0 - 0.5	Soil	Environmental	Set 4
N/A	124D301	N/A	Water	Trip Blank	VOCs

Set 4 = VOCs, SVOCs, TPH-DRO

bgs = Below ground surface
DRO = Diesel-range organics
ft = Foot
N/A = Not applicable
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

2.1.5 CAS 16-99-04 Closure Activities

The location of CAS 16-99-04 was excavated, and no UST was found. The steel piping was excavated by hand and revealed no biasing factors. Confirmation samples were collected as specified in the SAFER Plan. The sample IDs, locations, types, and analyses are listed in Table 2-6. Analytical results show that no COCs were identified. Best management practices (BMPs) were completed by cutting, removing the stick-ups, and sealing piping as required at this CAS. Loose debris was also collected and disposed of and the ceramic drops were filled with native soils. A complete discussion of investigative activities and analytical results are in Appendix D.

Table 2-6
Samples Collected at CAS 16-99-04, Fuel Line (Buried) and UST

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
E01	124E001	0.0 - 0.5	Soil	Environmental	Set 5
	124E002	0.0 - 0.5	Soil	Field Duplicate of 124E001	Set 5
E02	124E003	0.0 - 0.5	Soil	Environmental	Set 5
E03	124E004	0.0 - 0.5	Soil	Environmental	Set 5
E04	124E005	0.0 - 0.5	Soil	Environmental	Set 5
E05	124E006	0.0 - 0.5	Soil	Environmental	Set 5
E06	124E007	4.5 - 5.0	Soil	Environmental	Set 5
E07	124E008	4.0 - 4.2	Soil	Environmental	Set 5
N/A	124E301	N/A	Water	Trip Blank	VOCs
N/A	124E302	N/A	Water	Field Blank	Set 1, TPH-GRO
N/A	124E303	N/A	Water	Trip Blank	VOCs
N/A	124E304	N/A	Water	Trip Blank	VOCs

Set 1 = VOCs, SVOCs, RCRA Metals, TPH-DRO, PCBs, Gamma Spectroscopy
(Due to the close proximity of Area 16 CASs, one environmental field blank was collected for all three Area 16 CASs.)
Set 5 = VOCs, SVOCs, TPH-DRO, TPH-GRO

bgs = Below ground surface
DRO = Diesel-range organics
ft = Foot
GRO = Gasoline-range organics
N/A = Not applicable
PCB = Polychlorinated biphenyl
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

2.2 Deviations from SAFER Plan as Approved

There were three minor deviations to the SAFER Plan requirements. Corrective Action Site 15-02-01 had two minor additions to the sample strategy. Polychlorinated biphenyls (PCBs) analysis was added to the samples that included pesticide analysis, and gross alpha and gross beta was added to one sample where field-screening results (FSRs) exceeded FSLs. The third deviation was that the analytical laboratory reported tritium in units of picocuries per gram (pCi/g) instead of picocuries per liter (pCi/L) (see Section D.4.2.8 for response to this deviation).

2.3 Corrective Action Schedule as Completed

The CAU 124, Storage Tanks, investigation, which consisted of excavation and sampling of soil, took place from July 9 through July 26, 2007. Table 2-7 presents a summary of these activities.

Table 2-7
Corrective Action Schedule for CAU 124

Date	Activity
July 9 to 13	CAS 15-02-01 Site mobilization and setup, soil sample collection, sample shipment.
July 16 to 23	Area 16 CASs Site mobilization and setup, excavation and soil sampling, site contouring, cut and seal piping, sample shipping.
July 23 to 26	CAS 08-02-01 Site mobilization and setup, excavation and soil sampling, site cleanup, sample shipping.

2.4 Site Plan/Survey Plat

This section does not apply to the CAU 124 CR.

3.0 Waste Disposition

Wastes generated during the SAFER Plan field activities include disposable personnel protective equipment (PPE), disposable sampling equipment, removed piping, hydrocarbon impacted soil, and housekeeping waste. The types, amounts, and disposal of the wastes are detailed in the following subsections. Newly generated wastes such as PPE/sampling debris (plastic/glass) have been characterized based on the associated soil samples and knowledge of the waste generating process. Site controls were in place to prevent the introduction of hazardous analytes to these waste streams.

3.1 Waste Streams

The waste generated by site closure activities at CAU 124 was segregated into the following waste streams:

- Sanitary waste (i.e., PPE, disposable sampling equipment, plastic sheeting, glass/plastic sample jars, and other debris such as associated piping)
- Hydrocarbon solids (soil from diesel spill)

3.2 Waste Sampling

Waste determinations were made utilizing process knowledge and media sample association. Direct sampling was performed to confirm the regulatory status of hydrocarbon IDW at CAS 08-02-01.

Two samples were collected for waste stream determination of a diesel fuel spill at CAS 08-02-01. The samples were analyzed for volatile organic compounds (VOCs) (free liquid), Toxicity Characteristic Leaching Procedure (TCLP) VOCs, gamma spectroscopy, isotopic uranium (U), isotopic plutonium (Pu), and strontium (Sr)-90 (solids).

3.3 Waste Disposal

Wastes generated during this CAI were demolition debris, PPE, hydrocarbon impacted soils, and general office waste. These wastes were managed as follows:

- During site closure activities, PPE and disposable sampling equipment generated were determined to be sanitary based on observations and process knowledge. Wastes were bagged, labeled, and placed in a roll-off box for disposal in an industrial landfill.

- Office waste and lunch trash and sanitary industrial waste was disposed of in designated sanitary dumpster at Building 23-153 allocated for disposal at the NTS sanitary waste landfills.

- Three drums of waste soil were characterized based on process knowledge, and direct sample data as hydrocarbon waste exceeding the regulatory threshold, established by the State of Nevada regulations (NDEP, 1997a and b). The recommended disposal location of these drums is the permitted NTS Hydrocarbon Landfill.

4.0 Closure Verification Results

Closure verification results consist of the analytical results from environmental samples that demonstrate that closure objectives were met. For no further action, verification results demonstrate that COCs are not present within the CASs of CAU 124.

The SAFER Plan identified that the right type, quality, and quantity of data are needed to resolve the DQO decision statements. To verify that the dataset obtained as a result of this investigation supports the DQO decisions, a DQA was conducted. Section 4.1 provides a summary of the DQA. Use restrictions were not required at any CAS in this CAU and are summarized in Section 4.2.

A summary of verification data from the closure activities as detailed in Appendix D is provided in this section. Except as noted in the following CAS-specific sections, CAU 124 sampling locations were accessible and sampling activities at planned locations were not restricted by buildings, storage areas, active operations, or aboveground and underground utilities. The following subsections provide a summary of the CAS-specific verification results as presented in Appendix D.

CAS 08-02-01, Underground Storage Tanks

No COCs were identified at this CAS. The analytical data support no further action for this CAS.

CAS 15-02-01, Irrigation Piping

No COCs were identified at this CAS. The analytical data support no further action for this CAS.

CAS 16-02-03, Underground Storage Tank

No COCs were identified at this CAS. The analytical data support no further action for this CAS.

CAS 16-02-04, Fuel Oil Piping

Total petroleum hydrocarbons were detected above the PAL in one sample collected in soil from this CAS. As the Tier 2 evaluation determined that the hazardous constituents of diesel were not detected above PALs, total petroleum hydrocarbons (TPH)-diesel-range organics (DRO) is not a COC. No COCs were identified at this CAS. The analytical data support no further action for this CAS.

CAS 16-99-04, Fuel Line (Buried) and UST

Total petroleum hydrocarbons were detected above the PAL in one sample collected in soil from this CAS. As the Tier 2 evaluation determined that the hazardous constituents of diesel were not detected above PALs, TPH-DRO is not a COC. No COCs were identified at this CAS. The analytical data support no further action for this CAS.

4.1 Data Quality Assessment

The DQA process is the scientific evaluation of the actual investigation results to determine whether the DQO criteria established in the SAFER Plan (NNSA/NSO, 2007) were met and whether DQO decisions can be resolved at the desired level of confidence. The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes help to ensure that DQO decisions are sound and defensible.

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

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

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

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

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

Step 5: Draw Conclusions from the Data – Perform the calculations required for the test.

4.1.1 Review DQOs and Sampling Design

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

4.1.1.1 Decision I

The Decision I statement as presented in the SAFER Plan: "Is any COC present in environmental media within the CAS?"

Decision I Rules:

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

Population Parameter: For judgmental sampling results, the population parameter is the maximum observed sample result from each individual sample.

4.1.1.1.1 DQO Provisions To Limit False Negative Decision Error

A false negative decision error (where consequences are more severe) was controlled by meeting the following criteria:

1. Having a high degree of confidence that locations selected will identify COCs, if present, anywhere within the CAS.
2. Having a high degree of confidence that analyses conducted will be sufficient to detect COCs present in the samples.

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

Criterion 1:

The following methods (stipulated in the SAFER Plan [NNSA/NSO, 2007]) were used in selecting sample locations.

1. Selection of sampling locations associated with USTs was accomplished during the DQO process.

2. Selection of sampling locations associated with surface and subsurface staining, odors, and presence of debris, etc., was accomplished by visual field observations.

Criterion 2:

All samples were analyzed using the analytical methods listed in Table 3-1 of the SAFER Plan. Also, radiological parameters are listed in Table 3-4, and chemical parameters are listed in Table 3-5 of the SAFER Plan. Table 4-1 provides a reconciliation of samples analyzed to the planned analytical program. Samples were submitted for all of the analytical methods specified in the SAFER Plan.

Sample results were assessed against the acceptance criterion for the DQI of sensitivity as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The sensitivity acceptance criterion defined in the SAFER Plan is that analytical detection limits will be less than the corresponding action level. This criterion was achieved for all analyses.

Table 4-1
CAU 124 Closure Report Analyses Performed

CAS	ANALYTES														
	Total VOCs	Total SVOCs	PCBs	Metals	TPH-DRO	TPH-GRO	Herbicides	Pesticides	Gamma Spectroscopy	Tritium	Gross Alpha/ Gross Beta	Isotopic[a] Uranium	Isotopic[a] Plutonium	Strontium-90[a]	TCLP VOCs[a]
08-02-01	RS	RS	RS	RS	RS	--	--	--	RS	--	--	RS	RS	RS	RS
15-02-01	RS	RS	S	RS	--	--	RS	RS	RS	RS	S	S	--	--	--
16-02-03	RS	RS	RS	RS	RS	--	--	--	RS	--	--	--	--	--	--
16-02-04	RS	RS	--	--	RS	--	--	--	--	--	--	--	--	--	--
16-99-04	RS	RS	--	--	RS	RS	--	--	--	--	--	--	--	--	--

[a] Waste management analyses only.

DRO = Diesel-range organics
GRO = Gasoline-range organics
PCB = Polychlorinated biphenyl
SVOC = Semivolatile organic compound
TCLP = Toxicity Characteristic Leaching Procedure
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

RS = Required and submitted
S = Not required but submitted

-- = Not applicable

Criterion 3:

To satisfy the third criterion, the entire dataset and sample results were assessed against the acceptance criteria for the DQIs of precision, accuracy, comparability, completeness, and representativeness, as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The DQI acceptance criteria are presented in Table 7-1 of the SAFER Plan (NNSA/NSO, 2007). As presented in Tables 4-2 through 4-4, these criteria were met for each the DQIs. However, all of the data were considered useful in supporting the DQO decision.

Precision

The duplicate precision is evaluated using relative percent difference (RPD), absolute difference, or normalized difference. Data precision of organic chemical constituents is determined by evaluating RPD. Inorganic precision is evaluated by RPD when both results are greater than or equal to five times the reporting limit (RL), and when either result is less than or equal to five times the absolute difference is evaluated. For the purpose of determining the data precision of chemical analyses, the RPD between duplicate analyses was calculated. For radionuclides, the RPD was not calculated unless both the sample and its duplicate had concentrations of the target radionuclide exceeding 5 times their minimum detectable concentration (MDC). Otherwise radionuclide, duplicate results were evaluated using the normalized difference. Table 4-2 provides the precision analysis results for tritium, the only constituent qualified for precision. No other radionuclide or chemical constituents were qualified for precision.

Table 4-2
Precision Measurements

Parameter	User Test Panel	Number of Analytes Qualified	Number of Measurements Performed	Percent within Criteria
Tritium	Tritium	15	30	50

As shown in Table 4-2, the precision rate for tritium did not meet the CAU 124 SAFER Plan acceptance criteria of 80 percent. However, there is negligible potential for a false negative DQO decision error because the highest reported activities are still very small in comparison to the FAL. The tritium concentrations ranged between 2.58 to 9.521 pCi/g. A FAL of 1.382E+07 pCi/g was

established through Residual Radioactive (RESRAD) computer code. Therefore, tritium results that were qualified for reasons of precision can be used confidently to support DQO decisions.

Accuracy

For the purpose of determining data accuracy of sample analyses, environmental soil samples were evaluated and incorporated into the accuracy calculation. The results qualified for accuracy were associated with matrix spike (MS) recoveries that were outside control limits and could potentially be reported at concentrations lower or higher than actual concentrations. Table 4-3 provides the chemical accuracy analysis results for all constituents qualified for accuracy. Accuracy rates are above the SAFER Plan criterion of 80 percent, except for mercury and barium, which have a rate of 75.7 and 2.7 percent, respectively (shown in bold). There were no radiological data qualified for accuracy.

Table 4-3
Accuracy Measurements

Parameter	User Test Panel	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Lead	Metals	4	37	89.2
Mercury	Metals	9	37	**75.7**
Barium	Metals	36	37	**2.7**

Of the 37 mercury results qualified for accuracy, 9 were associated with an MS recovery that exceeded the upper limits. This would indicate that the associated samples may have been reported at concentrations higher than actual. This inaccuracy could impact a DQO decision by causing a false positive decision error. However, this did not occur at CAU 124 because no mercury results exceeded the FAL. The other 26 mercury results qualified for accuracy were associated with an MS recovery that was below the limits. This would indicate that the associated samples may have been reported at concentrations lower than actual. However, there is negligible potential for a false negative DQO decision error because the reported values are very small in comparison to the action level (the FAL of 310 milligrams per kilogram [mg/kg] is significantly higher than the highest reported mercury concentration of 9.84 mg/kg). Therefore, the mercury results that were qualified for reasons of accuracy can be used confidently to support DQO decisions.

Of the 37 barium results qualified for accuracy, 36 were associated with an MS recovery that exceeded the upper limits. This would indicate that the associated samples may have been reported at concentrations higher than actual. This inaccuracy could impact a DQO decision by causing a false positive decision error. However, this did not occur at CAU 124 because barium results did not exceeded the FAL. The single barium result qualified for accuracy was associated with an MS recovery that was below the limit. This would indicate that the associated samples may have been reported at concentrations lower than actual. However, there is negligible potential for a false negative DQO decision error because the reported values are very small in comparison to the action level (the FAL of 6,700 mg/kg is significantly higher than the highest reported barium concentration of 403 mg/kg). Therefore, the barium results that were qualified for reasons of accuracy can be used confidently to support DQO decisions.

As the accuracy rate for all other analytes exceed 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 was used to address sampling and analytical requirements for CAU 124. 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 and locations that bound COCs). The sampling locations identified in the Criterion 1 discussion meet this criterion. Therefore, the analytical data acquired during the CAI are considered representative of the population parameters.

Comparability

Field sampling, as described in the SAFER Plan, was performed and documented in accordance with approved procedures in conformance with standard industry practices. Analytical methods and procedures approved by DOE were used to analyze, report, and validate the data. These methods and procedures are in conformance with applicable methods used in industry and government practices. Therefore, project datasets are considered comparable to other datasets generated using standard industry procedures, thereby meeting DQO requirements.

Completeness

The CAU 124 SAFER Plan defines acceptable criteria for completeness to be 80 percent of CAS-specific non-target analytes identified in the SAFER Plan having valid results and 100 percent of target analytes (including Decision II samples) having valid results. Also, the dataset must be sufficiently complete to be able to support the DQO decisions. Target analytes for CAU 124 are identified as the hazardous constituents of TPH-DRO within CASs 16-02-04 and 16-99-04. All data for target analytes were within the acceptable criteria. All data met the completeness criteria.

Methacrylonitrile was the only analyte that was rejected (Table 4-4). This constituent has not been detected at the NTS. Also, this was not identified as a potential contaminant during the DQO process, and there is no reason to suspect the presence of methacrylonitrile at any of the CAU 124 CASs. Therefore, the absence of a result for methacrylonitrile does not preclude the resolution of the DQO decisions. The dataset for CAU 124 has met the general completeness criteria as sufficient information is available to make the DQO decisions.

Table 4-4
Rejected Measurements

Parameter	Analytical Method	Number of Analytes Qualified	Number of Measurements Performed	Percent within Criteria
Methacrylonitrile	VOCs	55	55	0

VOC = Volatile organic compound

4.1.1.1.2 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 control samples with established control criteria were used in the evaluation of false positive analytical results during the Tier 2 validation process. Sample results impacted from false positive control criteria were accounted for qualified accordingly per approved Stoller-Navarro Joint Venture (SNJV) procedures. Of the 21 QA/QC samples submitted, no false positive analytical results were detected.

4.1.1.2 Decision II

Decision II as presented in the SAFER Plan: "If a COC is present, is sufficient information available to meet closure objectives?"

Decision Rules:

- If the observed concentration of any COC in a Decision II sample exceeds the PALs, then additional samples will be collected to complete the determination of the extent.
- If observed COC concentrations in a sample from all bounding directions are less than the PALs, then the decision will be that the extent of contamination has been defined in the lateral and/or vertical direction.
- If wastes are to be generated as part of a corrective action, samples will be collected to sufficiently characterize the potential wastes.

Population Parameters – The population parameters for Decision II data will be the observed concentration of each unbounded COC in any sample or the observed concentration of each sample used to characterize the potential waste streams.

4.1.1.2.1 DQO Provisions To Limit False Negative Decision Error

A false negative decision error (where consequences are more severe) is controlled by meeting the following criteria:

1. Having a high degree of confidence that the sample locations selected will identify the extent of the COCs.
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.

Criterion 1:

Sampling was performed in accordance with the SAFER Plan. Because there were no COCs identified, no additional sampling was necessary.

Criterion 2:

This criterion is not applicable because no COCs were identified during the Decision I activities; therefore, no remediation was required.

Criterion 3:

This criterion is not applicable because COCs were not identified during the Decision I activities; therefore, no remediation was required.

4.1.1.2.2 DQO Provisions To Limit False Positive Decision Error

The false positive decision error was controlled by assessing the potential for false positive analytical results. Quality control samples with established control criteria were used in the evaluation of false positive analytical results during the Tier 2 validation process. Sample results impacted from false positive control criteria were accounted for and qualified according to approved SNJV procedures. Of the 21 QA/QC samples submitted, no false positive analytical results were detected.

4.1.1.3 Sampling Design

The SAFER Plan made the following commitments for sampling:

1. Random sampling will be conducted at CAS 15-02-01, Plots A and B.

   Result: All random sample locations designated by the Visual Sample Plan (VSP) were collected and analyzed for the appropriate COPCs.

2. Biased locations will have soil samples collected beneath and/or adjacent to concrete pads, CAS 15-02-01 reservoir, irrigation piping; Area 8 and 16 USTs and associated piping, to identify releases of potential contaminants.

   Result: All collection and piping system components at each CAS were investigated by excavation, and the collection of soil samples adjacent to and from beneath the required components, such as the base of fuel line piping and irrigation lines.

4.1.2 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; therefore, a QA nonconformance report was not necessary. Data were validated and verified to ensure that the measurement systems were performed in accordance with the criteria specified. The validated dataset quality was found to be satisfactory except for methacrylonitrile.

4.1.3 Select the Test and Identify Key Assumptions

The test for making DQO Decision I for the judgmental sampling design was the comparison of the maximum analyte result from each CAS to the corresponding FAL. A test for making DQO Decision II was not necessary because no COCs were identified in any of the CAU 124 CASs, and delineation sampling was not necessary.

The key assumptions that could impact a DQO decision are listed in Table 4-5.

4.1.4 Verify the Assumptions

The results of the investigation support the key assumptions identified in the SAFER Plan DQOs and Table 4-5. All data collected during the CAI supported the CSM.

4.1.4.1 Other DQO Commitments

The SAFER Plan made the following commitments for sampling:

- Decision II sampling will consist of defining the extent of contamination where COCs have been confirmed at the Decision I locations. If COCs extend beyond Decision I locations, the additional Decision II samples will be collected from a location in the direction outward and in the downgradient direction. The Decision II locations will be positioned at an adequate distance from the step-out location and advanced to provide samples to profile the COC concentrations through the upper and lower boundaries of contamination. A clean sample (i.e., results less than FALs) will define the vertical and lateral extent of contamination at the respective locations. The contamination boundaries may need to be extrapolated to give an overall view of the lateral and vertical extent of contamination at the site.

Result: Not applicable because no COCs were identified.

Table 4-5
Key Assumptions

Exposure Scenario	Site workers are only exposed to contaminants of concern (COCs) through oral ingestion, inhalation, external exposure to radiation, or dermal contact (by absorption) of COCs absorbed onto the soils. Exposure to contamination is limited to site workers, construction/remediation workers, and military personnel conducting training. The investigation results did not reveal any potential exposures other than those identified in the conceptual site model (CSM).
Affected Media	Surface soil, shallow subsurface soil, and potentially perched (shallow) groundwater. Deep groundwater contamination is not a concern. Contaminants migrating to regional aquifers are not considered. The investigation results did not reveal any affected media other than those identified in the CSM.
Location of Contamination/Release Points	Release points are those identified in the Streamlined Approach to Environmental Restoration (SAFER) Plan The investigation results did not reveal any locations of contamination or release points other than those identified in the SAFER Plan.
Transport Mechanisms	Surface transport may occur as a result of a spill or storm water run-off. Surface transport beyond shallow substrate is not a concern. The investigation results did not reveal any transport mechanisms other than those identified in the CSM.
Preferential Pathways	None. The investigation results did not reveal any preferential migration pathways.
Lateral and Vertical Extent of Contamination	Investigation results did not reveal either surface or subsurface contamination. Therefore, the lateral or vertical extent of contamination is not applicable.
Groundwater impacts	None. COCs were not identified at any of the CASs. The investigation results did not reveal any indicators that groundwater could be potentially impacted.
Future Land Use	Nonresidential. The investigation results did not reveal any future land uses other than nonresidential.

4.1.5 Draw Conclusions from the Data

This section resolves the two DQO decisions for each of the CAU 124 CASs.

4.1.5.1 Decision Rules for Decision I

Decision Rule: If the concentration of any COPC in a target population exceeds the FAL for that COPC during the initial investigation, then that COPC is identified as a COC, and Decision II sampling will be conducted.

Result: No COCs were identified at the CAU 124 CASs.

Decision Rule: If all COPC concentrations are less than the corresponding PALs, then the decision will be no further action.

Result: As no COCs were identified, no further action is required to close the CAU 124 CASs.

4.1.5.2 Decision Rules for Decision II

Decision Rule: If the observed concentration of any COC in a Decision II sample exceeds the PALs, then additional samples will be collected to complete the determination of the extent.

Result: As no COCs were identified during the Decision I activities, bounding samples were not necessary or collected.

Decision Rule: If all observed COC population parameters are less than the PALs, then the decision will be that the extent of contamination has been defined in the lateral and/or vertical direction.

Result: As no COCs were identified during the Decision I activities, bounding samples were not necessary or collected.

4.2 Use Restrictions

Analytes detected in soil during the corrective action activities at CAU 124 were evaluated against PALs, and it was determined that no COCs were present. Therefore, no use restrictions are necessary at this CAU.

5.0 Conclusions and Recommendations

Based on the results of the closure activities, no further closure activities are necessary for CAU 124.

The DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) provides the following recommendations:

- No further corrective action is required at any CAU 124 CAS. Based on analytical results of the environmental samples collected at all CASs, COCs have not been released to the soil. Therefore, no corrective action is required at these CASs and there are no restrictions for future industrial reuse.
- No Corrective Action Plan is required for CAU 124.
- A Notice of Completion is requested from the NDEP for the closure of CAU 124.
- Corrective Action Unit 124 should be moved from Appendix III to Appendix IV of the FFACO.

6.0 References

EPA, see U.S. Environmental Protection Agency.

FFACO, see *Federal Facility Agreement and Consent Order.*

Federal Facility Agreement and Consent Order. 1996 (as amended). Agreed to by the State of Nevada; U.S. Department of Energy, Environmental Management; U.S. Department of Defense; and U.S. Department of Energy, Legacy Management.

NDEP, see Nevada Division of Environmental Protection.

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

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

Nevada Division of Environmental Protection. 1997a. *Class II Solid Waste Disposal Site for Municipal and Industrial Solid Waste, Area 23 of the NTS*, Permit SW 13 097 04. Carson City, NV.

Nevada Division of Environmental Protection. 1997b (as amended in August 2000). *Class III Solid Waste Disposal Site for Hydrocarbon Burdened Soils, Area 6 of the NTS*, Permit SW 13 097 02. Carson City, NV.

SNJV GIS Systems, see Stoller-Navarro Joint Venture Geographic Information Systems.

Stoller-Navarro Joint Venture Geographic Information Systems. 2007. ESRI ArcGIS Software.

U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. 2002. *Industrial Sites Quality Assurance Project Plan, Nevada Test Site, Nevada*, Rev. 3, DOE/NV--372. Las Vegas, NV.

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

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2007. *Streamlined Approach For Environmental Restoration (SAFER) CAU 124, Storage Tanks: Nevada Test Site, Nevada*, DOE/NV--1195, Rev. 0. Las Vegas, NV.

U.S. Environmental Protection Agency. 2006. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4. Washington, DC.

Appendix A

Data Quality Objectives as Developed in the SAFER Plan

Note: This appendix contains the DQOs presented as Appendix B in the CAU 124 SAFER Plan. Therefore, all cross references, page numbers, and header information in this appendix refer to the original document.

A.1.0 Introduction

This appendix describes the DQO process that is a seven-step strategic systematic method used to plan data collection activities and define performance criteria for the CAU 124, Storage Tanks, field investigation. The DQOs are designed to ensure that data collected will provide sufficient and reliable information to determine appropriate corrective actions, verify adequacy of existing information, provide sufficient data to implement the corrective actions, and verify closure.

The CAU 124 investigation will be based on the DQOs presented in this appendix as developed by NDEP and NNSA/NSO representatives. The seven steps of the DQO process presented in Sections A.2.0 through A.8.0 were developed in accordance with *EPA Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006) and the CAS-specific information presented in Section A.2.0.

This DQO process presents a judgmental sampling approach for CAU 124 CASs. In general, the procedures used in the DQO process provide:

- A method to establish performance or acceptance criteria that serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study.
- Criteria that will be used to establish the final data collection design such as:
  - The nature of the problem that has initiated the study and a CSM of the environmental hazard to be investigated.
  - The decisions or estimates that need to be made and the order of priority for resolving them.
  - The type of data needed.
  - An analytic approach or decision rule that defines the logic for how the data will be used to draw conclusions from the study findings.
- Acceptable quantitative criteria on the quality and quantity of data to be collected, relative to the ultimate use of the data.

- A data collection design that will generate data meeting the quantitative and qualitative criteria specified. A data collection design specifies the type, number, location, and physical quantity of samples and data, as well as QA/QC activities that will ensure sampling design and measurement errors are managed sufficiently to meet the performance or acceptance criteria specified in the DQOs.

A.2.0 Step 1 - State the Problem

Step 1 of the DQO process defines the problem that requires study; identifies the planning team, and develops a conceptual model of the environmental hazard to be investigated.

As a result of activities associated with each CAU 124 CAS, potentially hazardous and/or radioactive constituents may be present at concentrations that could potentially pose a threat to human health and the environment.

The problem statement for the CAU 124 CASs is: "Existing information on the nature and extent of potential contamination is insufficient to evaluate and confirm closure of the CAU 124 CASs."

A.2.1 Planning Team Members

The DQO planning team consists of representatives from NDEP, NNSA/NSO, SNJV, and National Security Technologies, LLC. The primary decision-makers are NDEP and NNSA/NSO representatives.

A.2.2 Conceptual Site Model

The CSM is used to organize and communicate information about site characteristics. It reflects the best interpretation of available information at any time. The CSM is a primary vehicle for communicating assumptions about release mechanisms, potential direction of migration pathways, or specific constraints. It provides a summary of how and where contaminants are expected to move and what impacts such movement may have. It is the basis for assessing how contaminants could reach receptors in the present and future. The CSM describes the most probable scenario for current conditions at CAU 124 CASs and defines the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. Accurate CSMs are important as they serve as the basis for all subsequent inputs and decisions throughout the DQO process.

The CSM was developed for CAU 124 using information from the physical setting, potential contaminant sources, release information, historical background information, knowledge from similar sites, and physical and chemical properties of the potentially affected media and COPCs.

The CSM consists of:

- Potential contaminant releases including media subsequently affected.
- Release mechanisms (the conditions associated with the release).
- Potential contaminant source characteristics including contaminants suspected to be present and contaminant-specific properties.
- Site characteristics including physical, topographical, and meteorological information.
- Migration pathways and transport mechanisms that describe the potential for migration and direction to where the contamination may be transported.
- The locations of points of exposure where individuals or populations may come in contact with a COC associated with a CAS.
- Routes of exposure where contaminants may enter the receptor.

If additional elements are identified during the investigation that are outside the scope of the CSM, the situation will be reviewed and a recommendation made as to how to proceed. In such cases, NDEP and NNSA/NSO will be notified and given the opportunity to comment on, and concur with the recommendation.

The applicability of the CSM to each CAS is summarized in Figure A.2-1 and discussed below. Table A.2-1 provides information on CSM elements that will be used throughout the remaining steps of the DQO process. Figure A.2-2 represents site conditions applicable to this CSM.

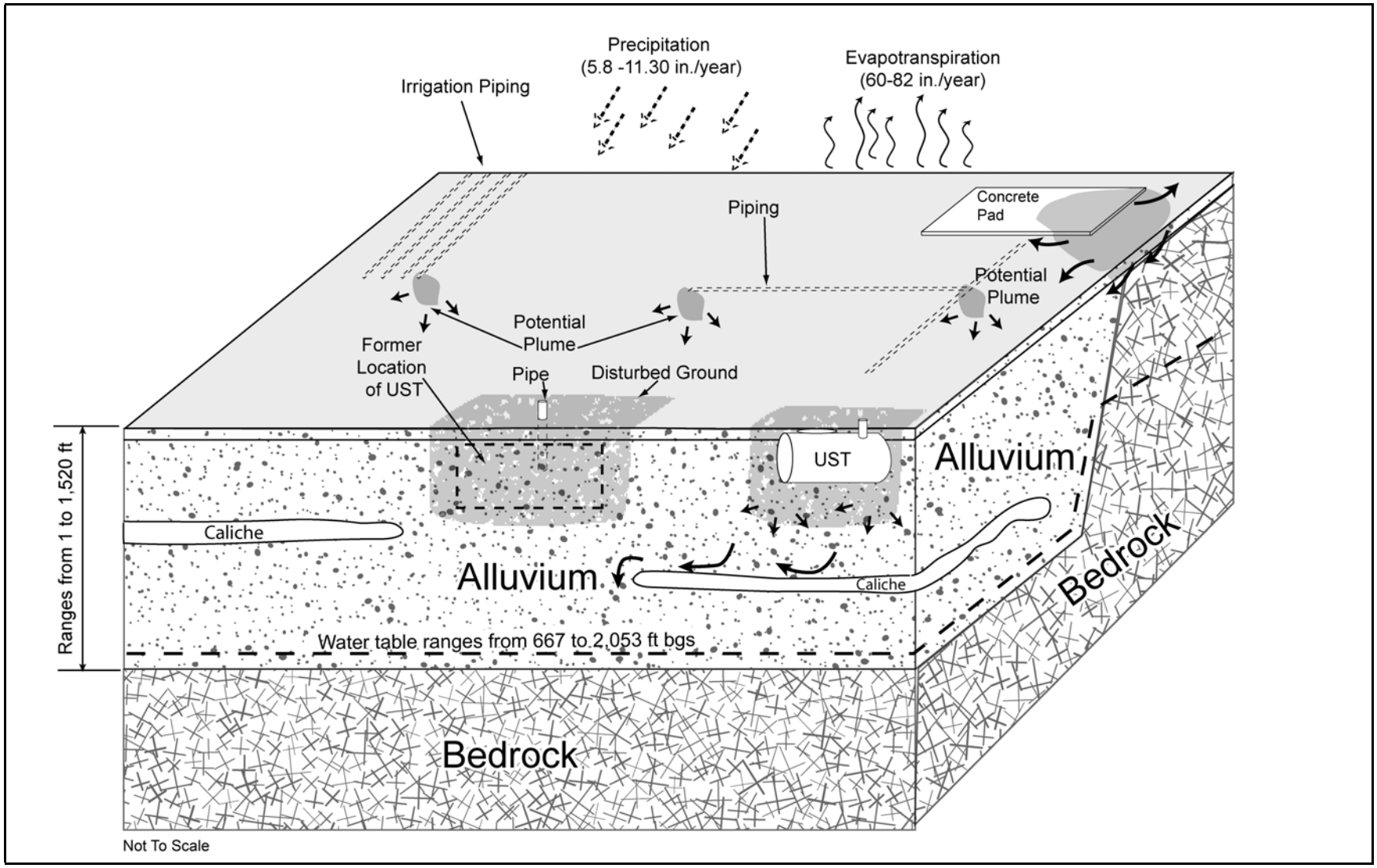


Figure A.2-1
Conceptual Site Model for CAU 124 CASs

Table A.2-1
Conceptual Site Model
Description of Elements for Each CAU 124 CAS
(Page 1 of 2)

CAS Identifier	08-02-01	15-02-01	16-02-03	16-02-04	16-99-04
CAS Description	**Underground Storage Tank**	**Irrigation Piping**	**Underground Storage Tank**	**Fuel Oil Piping**	**Fuel Line (Buried) and UST**
Site Status	Inactive and abandoned	Inactive and abandoned	Inactive and abandoned	Inactive and abandoned	Inactive and abandoned
Exposure Scenario	Occasional Use Area	Occasional Use Area	Occasional Use Area	Occasional Use Area	Occasional Use Area
Sources of Potential Soil Contamination	Releases associated with the contents of UST	Release associated with radionuclides mixed with the water in reservoir. Releases associated with direct spray of radionuclide. Release associated with use of metals for scientific testing. Releases associated with storage of chemicals in the former storage shed.	Releases associated with the contents of UST and associated piping	Release associated with fuel oil piping	Releases associated with the contents of UST and associated piping
Location of Contamination/ Release Point	Surface and subsurface soil at or near UST	Surface and subsurface soil at or in the fenced area plots. Area around/ adjacent to the concrete storage shed pad.	Surface and subsurface soil at or near UST	Surface and subsurface soil around and under piping main connections and ends	Surface and subsurface soil at or near UST. Surface and subsurface at ends of pipe.
Amount Released	Unknown	Unknown	Unknown	Unknown	Unknown
Affected Media	Surface and shallow subsurface soil	Surface and shallow subsurface soil	Surface and shallow subsurface soil	Surface and shallow subsurface soil	Surface and shallow subsurface soil

Table A.2-1
Conceptual Site Model
Description of Elements for Each CAU 124 CAS
(Page 2 of 2)

CAS Identifier	08-02-01	15-02-01	16-02-03	16-02-04	16-99-04
CAS Description	**Underground Storage Tank**	**Irrigation Piping**	**Underground Storage Tank**	**Fuel Oil Piping**	**Fuel Line (Buried) and UST**
Potential Contaminants	TPH-DRO,VOCs, SVOCs, Radionuclides, RCRA Metals, PCBs	Radionuclides to include tritium, VOCs, SVOCs, Pesticides, Herbicides, Metals	TPH-DRO, VOCs, SVOCs, Radionuclides, RCRA Metals, PCBs	TPH-DRO, VOCs, SVOCs	TPH-DRO/GRO, VOCs, SVOCs
Transport Mechanisms	Percolation of precipitation through subsurface media serves as the major driving force for migration of contaminants. However, because the arid environment of the NTS, percolation of precipitation is very small and migration of contaminants has been shown to be limited (USGS, 1995). Evaporation potentials significantly exceed available soil moisture from precipitation (i.e., 5.8 to 11.10 in./yr) (ARL/SORD 2006). Surface water runoff may provide for the transportation of some contaminants inside or outside of the CAS footprints.				
Migration Pathways	No other migration pathway anticipated other than in soil where it is expected. Vertical transport is expected to dominate over lateral transport due to small surface gradients.				
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. Groundwater flows from the northwest to the southeast ranging in depth from 667 ft bgs in Area 8, 2,053 ft bgs in Area 15, and 750 ft bgs in Area 16. Surface migration may occur as a result of runoff.				
Exposure Pathways	The potential for contamination exposure is limited to industrial and construction workers, and military personnel conducting training. These human receptors may be exposed to COPCs through oral ingestion, inhalation, dermal contact (absorption) of soil and/or debris due to inadvertent disturbance of these materials or irradiation by radioactive materials.				

AST = Aboveground storage tank
bgs = Below ground surface
COC = Contaminant of concern
COPC = Contaminant of potential concern
DRO = Diesel-range organics
ft = Foot
GRO = Gasoline-range organics
in./yr = Inches per year
NTS = Nevada Test Site
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
UST = Underground storage tank
VOC = Volatile organic compound

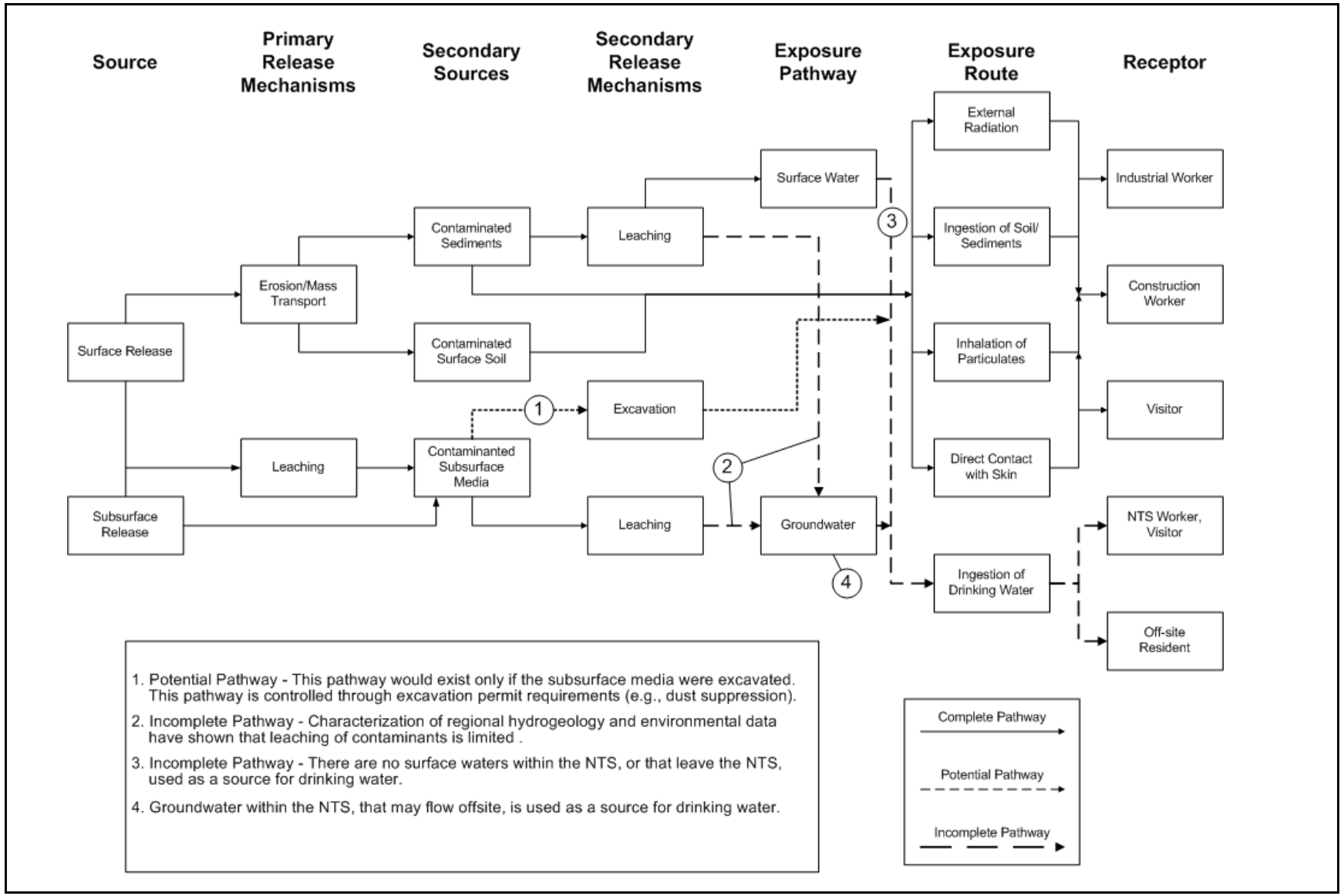


Figure A.2-2
Conceptual Site Model Diagram for CAU 124 CASs

A.2.2.1 Contaminant Release

The likely locations of the contamination and releases to the environment are the soils directly below and/or adjacent to the CSM surface and subsurface components (i.e., underground storage tanks, associated underground piping). The CSM accounts for potential releases resulting from overflow of system components that were present at the ground surface and/or from migration away from the sites of releases that are present at the ground surface.

A.2.2.2 Potential Contaminants

Contaminants of potential concern were identified during the planning process through the review of site history, process knowledge, personal interviews, past investigation efforts (where available), and inferred activities associated with the CASs. Because complete information regarding activities performed at the CAU 124 CASs is not available, contaminants detected at similar NTS sites were included in the contaminant lists to reduce uncertainty. The list of COPCs is intended to encompass the contaminants that could potentially be present at each CAS. The COPCs applicable to Decision I environmental samples from each CAU 124 CAS are defined as the constituents reported from the analytical methods stipulated in Table A.2-2.

During the review of site history documentation, process knowledge information, personal interviews, past investigation efforts (where available), and inferred activities associated with the CASs, some of the COPCs were identified as targeted contaminants at specific CASs. Targeted contaminants are those COPCs for which evidence in the available site and process information suggests that they may be reasonably suspected to be present at a given CAS. The targeted contaminants are required to meet a more stringent completeness criteria than other COPCs, thus providing greater protection against a decision error (see Section A.2.2). Targeted contaminants for each CAU 124 CAS are identified in Table A.2-3.

Table A.2-2
Analytical Program[a]
(Includes Waste Characterization Analyses)

Analyses[b]	08-02-01	15-02-01	16-02-03	16-02-04	16-99-04
Organic COPCs					
Total Petroleum Hydrocarbons-Diesel-Range Organics	X		X	X	X
Total Petroleum Hydrocarbons-Gasoline-Range Organics					X
Polychlorinated Biphenyls	X		X		
Semivolatile Organic Compounds[c]	X	X	X	X	X
Volatile Organic Compounds[c]	X	X	X	X	X
Pesticides[c]		X			
Herbicides[c]		X			
Inorganic COPCs					
Total *Resource Conservation and Recovery Act* Metals[c]	X	X	X		
Radionuclide COPCs					
Gamma Spectroscopy[d]	X	X	X		
Isotopic Uranium					
Isotopic Plutonium					
Strontium-90					
Tritium		X			
Waste Characterization Analyses					
Gross Alpha/Beta (Aqueous only)	X	X	X	X	X
Tritium	X	X	X	X	X
Gamma Spectroscopy[e]	X	X	X	X	X
Isotopic Uranium[e]	X	X	X	X	X
Isotopic Plutonium[e]	X	X	X	X	X
Strontium-90[e]	X	X	X	X	X

[a]The COPCs are the analytes reported from the analytical methods listed.
[b]If the volume of material is limited, prioritization of the analyses will be necessary.
[c]May also include Toxicity Characteristic Leaching Procedure analytes if sample is collected for waste management purposes.
[d]Results of gamma analysis will be used to determine if further radioanalytical analysis is warranted.
[e]Only required to collect if physically solid waste is generated that has the potential constituent.

COPC = Contaminant of potential concern
X = Required analytical method

Table A.2-3
Targeted Contaminants for CAU 124[a]

Corrective Action Site	Chemical Targeted Contaminant(s)	Radiological Targeted Contaminant(s)
08-02-01	None	None
15-02-01	None	None[b]
16-02-03	None	None
16-02-04	TPH-DRO	None
16-99-04	TPH-DRO	None

[a]If a COPC is detected at a concentration exceeding the action level, it will be identified as a target analyte.
[b]Iodine-131, although used at the EPA Farm, is not considered a target analyte due to its extremely short half-life of 8.01 days.

COPC = Contaminant of potential concern
DRO = Diesel-range organics
TPH = Total petroleum hydrocarbons

A.2.2.3 Contaminant Characteristics

Contaminant characteristics include, but are not limited to: solubility, density, and adsorption potential. In general, contaminants with large particle size, low solubility, high affinity for media, and/or high density can be expected to be found relatively close to release points. Contaminants with small particle size, high solubility, low affinity for media, and/or low density are found further from release points or in low areas where evaporation or ponding will concentrate dissolved constituents. Volatile COPCs may impact the air, and COPCs contained in a liquid media or are "dusts" dissolved by rainwater may infiltrate the subsoil and potentially impact groundwater. The COPCs that volatilize, such as VOCs, are not an anticipated concern at these CASs because of the age of the releases; therefore, if they were present in the past, they would be depleted over time. Infiltration of any COPC, beyond shallow soil, is not a concern at these sites as discussed in the groundwater impacts section.

A.2.2.4 Site Characteristics

Site characteristics are defined by the interaction of physical, topographical, and meteorological attributes and properties. Physical properties include permeability, porosity, hydraulic conductivity, degree of saturation, sorting, chemical composition, and organic content. Topographical and meteorological properties and attributes include slope stability, precipitation frequency, amounts, and runoff pathways; drainage channels and ephemeral streams, and evapotranspiration potential.

The NTS lies in the southern part of the Great Basin section of the Basin and Range physiographic province (USGS, 1995). The topography of this province consists of numerous north-south trending, linear mountain ranges separated by broad, flat-floored and gently-sloped valleys.

The general geology of the NTS consists of the following geologic units. The oldest units are complexly folded and faulted Paleozoic units composed mainly of carbonate rocks (limestone and dolomite) separated by a middle section of siliciclastic rocks (shale and quartzite). Tertiary-age volcanic tuff and lava overlay the Paleozoic units in many places. The valleys are covered with Tertiary and Quaternary-age alluvial and colluvial deposits that have eroded from the surrounding mountain ranges (ERDA, 1977).

The structural geology of the NTS is complex. Thousands of normal faults lie within the area and are responsible for the main characteristics of the Basin and Range topography (Winograd and Thordarson, 1975). Along with normal faults, strike-slip faults and shear zones cut and offset thrust faults in several places on the NTS. The complexity of the structural geology may influence the regional movement of groundwater (LLNL, 1982; Winograd and Thordarson, 1975).

Groundwater is not expected to be impacted in Areas 8, 15, and 16 of the NTS, because infiltration of precipitation through subsurface media typically serves as the major driving force for migration of contaminants. Because of the arid environment of the NTS, percolation of precipitation is small, and migration of contaminants has been shown to be limited. Evaporation potentials at the NTS range between 60 to 82 inches per year (in./yr), significantly exceeding the NTS average precipitation. The average precipitation across the CAU 124 sites ranges from 5.80 to 11.30 in./yr (ARL/SORD, 2006).

A.2.2.5 Migration Pathways and Transport Mechanisms

Migration pathways of potential contaminants include the lateral migration across surface soils/sediments and vertical migration of potential contaminants into and through subsurface soils. An important CSM element in developing a sampling strategy is the expected fate and transport of contaminants (how contaminants migrate through media and where they can be expected in the environment). Fate and transport of contaminants are presented in the CSM as the migration pathways and transport mechanism that could potentially move the contaminants throughout the

various media. Fate and transport are influenced by physical and chemical characteristics of the contaminants and media described in Sections A.2.2.3 and A.2.2.4.

Infiltration and percolation of precipitation serves as a driving force for downward migration of contaminants. However, due to the high potential evapotranspiration and the limited precipitation at the CASs, percolation of infiltrated precipitation at the NTS does not provide a significant mechanism for contaminants to impact groundwater (DOE/NV, 1992).

Contaminants can be expected to be found relatively close to release points or in low areas where settling may occur and evaporation will concentrate the constituents of concern. Given the relatively low surficial contouring of these CASs, lateral migration of potential COPCs of any major distance is unlikely. Also, because of the expected limited mobility, the affected media is typically the surface and shallow subsurface soil. Concentrations are expected to decrease with horizontal and vertical distance from the source.

Infiltration of COPCs beyond shallow subsurface soil is not a concern at these CASs. While contaminants within a weathered hydrocarbon spill/release may cover a visible area, they tend to be present in higher concentrations near the point of discharge and decrease with increased distance from the point of discharge, both laterally and vertically. For example, petroleum-based fuels in soil tend to be found in higher concentrations near the surface shortly after the spill/leak, then decrease as environmental processes work to reduce the concentrations where such factors as volatilization, microbial degradation, and photodegradation are most effective (i.e., at the surface). Just below the surface, these environmental processes are retarded, thereby resulting in less natural attenuation and greater residual concentration. Other factors such as adsorption to soil particles and vertical transport with precipitation also enhance the hydrocarbon concentrations within the shallow subsurface. Sampling in these preferential locations will increase the probability of detecting contamination if it is present anywhere within the CAS boundary.

A.2.2.6 Exposure Scenarios

Human receptors may be exposed to COPCs through oral ingestion, inhalation, dermal contact (absorption) of soil or debris due to inadvertent disturbance of these materials or irradiation by radioactive materials. The land-use and exposure scenarios for the CAU 124 CASs are listed in

Table A.2-4. These are based on NTS current and future land use (DOE/NV, 1998). Although all CASs are located in areas where former structures exist from past activities, no facilities are present to allow these CASs to be used as an assigned work station for NTS site personnel, and these CASs are at remote locations without site improvements, and where no regular work is performed. There is still the possibility, however, that site workers could occupy these locations on an occasional and temporary basis such as a military exercise or emergency preparedness training. Therefore, these sites are classified as occasional work areas.

Table A.2-4
Land-Use and Exposure Scenarios

Corrective Action Site	Record of Decision Land-Use Zone	Exposure Scenario
08-02-01	Nuclear Test Zone This area is reserved for dynamic experiments, hydrodynamic tests, and underground nuclear weapons and weapons effects tests. This zone includes compatible defense and nondefense research, development, and testing activities.	Occasional Use Area Worker will be exposed to the site occasionally (up to 80 hours per year for 5 years). Site structures are not present for shelter and comfort of the worker.
15-02-01	Reserved Zone (Within Nevada Test Site) This area includes land and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The reserved zone is also used for short duration exercises and training such as nuclear emergency response and Federal Radiological Monitoring and Assessment Center training and U.S. Department of Defense land-navigation exercises and training.	Occasional Use Area Worker will be exposed to the site occasionally (up to 80 hours per year for 5 years). Site structures are not present for shelter and comfort of the worker.
16-02-03 16-02-04 16-99-04	Nuclear and High Explosives Test Zone This area is designated within the Nuclear Test Zone for additional underground nuclear weapons tests and outdoor high explosive tests. This zone includes compatible defense and nondefense research, development, and testing activities.	Occasional Use Area Worker will be exposed to the site occasionally (up to 80 hours per year for 5 years). Site structures are not present for shelter and comfort of the worker.

The defined land-use zones at the NTS (DOE/NV, 1998) for the CAU 124 CASs specify future land uses that are consistent with current land uses. The nature of the future land-use zones precludes the presence of site workers except on an occasional or temporay basis during testing activities. The future land-use zones and exposure scenarios for CAU 124 are described in Table A.2-4.

A.3.0 Step 2 - Identify the Goal of the Study

Step 2 of the DQO process states how environmental data will be used in meeting objectives and solving the problem, identifies study questions or decision statement(s), and considers alternative outcomes or actions that can occur upon answering the question(s). Figure A.3-1 depicts the sequential flow of questions, answers, and action alternatives required to fulfill the objectives of the SAFER process.

A.3.1 Decision Statements

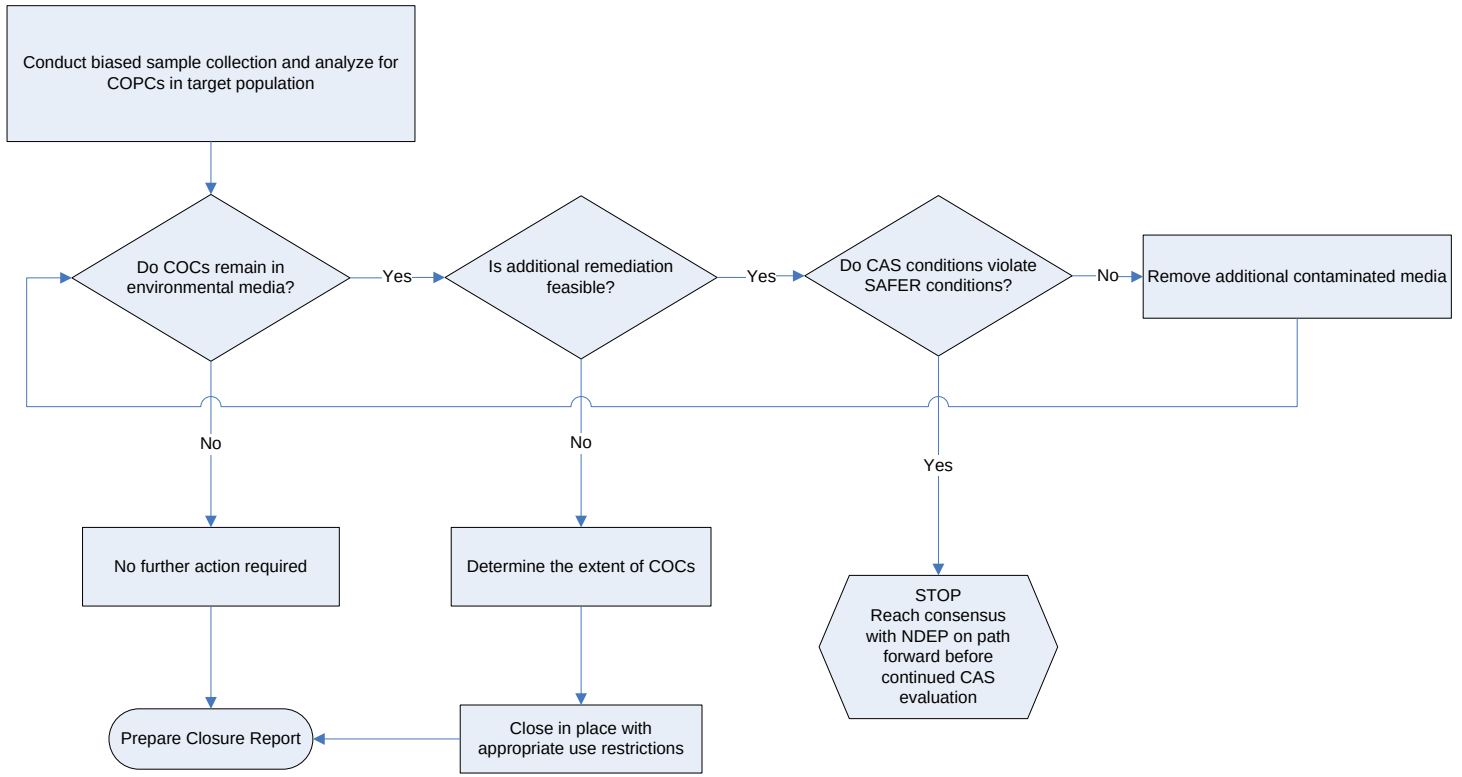
The Decision I statement is: "Is any COC present in environmental media within the CAS?" For judgmental sampling design, any analytical result for a COPC above the FAL will result in that COPC being designated as a COC. A COC may also be defined as a contaminant that, in combination with other like contaminants, is determined to jointly pose an unacceptable risk based on a multiple constituent analysis (NNSA/NSO, 2006). If a COC is detected, then Decision II must be resolved.

The Decision II statement is: "If a COC is present, is sufficient information available to meet the closure objectives?" Sufficient information is defined to include:

- Identifying the volume of media containing a COC bounded by analytical sample results in lateral and vertical directions.
- The information needed to characterize IDW for disposal.
- Information necessary to select the appropriate corrective action to complete site closure.

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

SAFER Decision Flow Logic Diagram



COC = Contaminant of concern
COPC = Contaminant of potential concern
NDEP = Nevada Division of Environmental Protection
SAFER = Streamlined Approach for Environmental Restoration

Figure A.3-1
SAFER Closure Decision Process for CAU 124

If sufficient information is not available to meet the closure objectives, then site conditions will be re-evaluated and additional samples collected (as long as the scope of the investigation is not exceeded and no CSM assumption is proven incorrect).

A.3.2 Alternative Actions to the Decisions

In this section, the alternative actions are identified that may be taken to solve the problem depending on the possible investigation outcomes.

A.3.2.1 Alternative Actions to Decision I

If no COC associated with a release from the CAS is detected, then further assessment of the CAS is not required, and the corrective action alternative of no further action will be selected. If a COC associated with a release from the CAS is detected, then additional sampling will be conducted to determine the extent of COC contamination. If the extent of the contamination is defined, and additional remediation is feasible, then clean close the site by removing the contaminated media. If the extent of contamination has been determined, and additional remediation is not feasible, then the extent of contamination will be defined and the contaminated area will be closed in place with appropriate use restrictions.

If the collection of verification samples confirm that contaminated media has been removed, then the clean closure objectives will have been met. If contamination still exists and additional remediation would violate the conditions of the SAFER, then work will stop and a consensus reached with NDEP on the path forward before continuing the CAS investigation.

A.3.2.2 Alternative Actions to Decision II

If sufficient information is available to define the extent of COC contamination, and confirm that closure objectives were met, then no further CAS assessment is required. If sufficient information is not available to define the extent of contamination, or confirm that closure objectives were met, then additional samples will be collected until the extent is defined.

A.4.0 Step 3 - Identify Information Inputs

Step 3 of the DQO process identifies the information needed, determines information sources, and identifies sampling and analysis methods that will allow reliable comparisons with FALs.

A.4.1 Information Needs

To resolve Decision I (determine whether a COC is present at a given CAS), samples must be collected and analyzed following these two criteria:

- Samples must either (a) be collected in areas most likely to contain a COC (judgmental sampling) or (b) properly represent contamination at the CAS (probabilistic sampling).
- The analytical suite selected must be sufficient to identify any COCs present in the samples.

To resolve Decision II (determine whether sufficient information is available to confirm closure objectives were met at each CAS), samples must be collected and analyzed to meet the following criteria:

- Collection must occur in areas contiguous to the contamination but where contaminant concentrations are below FALs.
- Waste samples or environmental media must provide sufficient information to characterize the IDW for disposal.
- Contaminated environmental media samples must provide sufficient information to determine potential remediation waste types.
- The analytical suites selected must be sufficient to detect COCs at concentrations equal to or less than their corresponding FAL.

A.4.2 Sources of Information

Information to satisfy Decision I and Decision II will be generated by collecting environmental samples using grab sampling, hand augering, direct push, backhoe excavation, drilling, or other appropriate sampling methods. These samples will be submitted to analytical laboratories that meet the quality criteria stipulated in the Industrial Sites QAPP (NNSA/NV, 2002a). Only validated data

from analytical laboratories will be used to make DQO decisions. Sample collection and handling activities will follow standard procedures.

A.4.2.1 Sample Locations

Design of the sampling approach for the CAU 124 CASs must ensure that the data collected are sufficient for selection of the appropriate corrective action (EPA, 2002). To meet this objective, the samples collected from each site should be from locations most likely to contain a COC, if present (judgmental). These sample locations, therefore, can be selected by means of biasing factors used in judgmental sampling (e.g., a stain likely to contain a spilled substance). The implementation of a judgmental approach for the selection of sample locations are discussed in the following sections.

Decision I sample locations at CAU 124 CASs will be determined based upon the likelihood of the soil containing a COC, if present at the CAS. These locations will be selected based on field-screening techniques, biasing factors, the CSM, and existing information. Analytical suites for Decision I samples will include the COPCs identified in Table A.2-2.

Field-screening techniques may be used to select appropriate sampling locations by providing semiquantitative data that can be used to comparatively select samples to be submitted for laboratory analyses from several screening locations. Field screening also may be used for health and safety monitoring and to assist in certain health and safety decision-making. The following field-screening methods and biasing factors may be used to select biased sample locations at CAU 124:

- Walkover surface area radiological surveys – A radiological survey instrument may be used to detect locations of elevated radioactivity of radiological contamination, as permitted by terrain and field conditions.
- Documented process knowledge on source and location of release (e.g., volume of release).
- Stains – A spot or area on the soil surface that may indicate the presence of a potentially hazardous liquid. Typically, stains indicate an organic liquid, such as an oil, has reached the soil and may have spread vertically and horizontally.
- Geophysical anomalies – A location identified during geophysical surveys that had results indicating surface or subsurface materials existed and were not consistent with the natural surroundings (e.g., buried concrete or metal, surface metallic objects).

- Drums, containers, equipment or debris – Materials that may have been used, or added to, a location, and that may have contained or come in contact with, hazardous or radioactive substances at some point during use.

- Lithology – Locations where variations in lithology (soil or rock) indicate different conditions or materials exist.

- Preselected areas based on process knowledge of the site – Locations for which evidence such as historical photographs, experience from previous investigations, or interviewee's input, exists that a release of hazardous or radioactive substances may have occurred.

- Preselected areas based on process knowledge of the contaminant(s) – Locations that may reasonably have received contamination, selected on the basis of the chemical and/or physical properties of the contaminant(s) in that environmental setting.

- Experience and data from investigations of similar sites.

- Visual indicators such as discoloration, textural discontinuities, disturbance of native soils, or other indication of potential contamination.

- Presence of debris, waste, or equipment.

- Odor.

- Physical and chemical characteristics of contaminants.

- Other biasing factors: Factors not previously defined for the CAI but that become evident once the site investigation begins.

Decision II sample step-out locations will be selected based on the CSM, biasing factors, and existing data. Analytical suites will include those parameters that exceeded FALs (i.e., COCs) in prior samples. Biasing factors to support Decision II sample locations include Decision I biasing factors plus available analytical results.

A.4.2.2 Analytical Methods

Analytical methods are available to provide the data needed to resolve the decision statements. The analytical methods and laboratory requirements (e.g., detection limits, precision, and accuracy) are provided in Tables 3-4 and A.2-3.

A.5.0 Step 4 - Define the Boundaries of the Study

Step 4 of the DQO process defines the target population of interest and relevant spatial boundaries, specifies temporal and other practical constraints associated with sample/data collection, and defines the sampling units on which decisions or estimates will be made.

A.5.1 Target Populations of Interest

The population of interest to resolve Decision I ("Is any COC present in environmental media within the CAS?") is any location within the site that is contaminated with any contaminant above a FAL (judgmental sampling. The populations of interest to resolve Decision II ("If a COC is present, is sufficient information available to evaluate potential corrective action alternatives?") are:

- Each one of a set of locations bounding contamination in lateral and vertical directions.
- Environmental media or IDW that must be characterized for disposal.
- Potential remediation waste.
- Environmental media where natural attenuation or biodegradation or construction/evaluation of barriers is considered.

A.5.2 Spatial Boundaries

Spatial boundaries are the maximum lateral and vertical extent of expected contamination at each CAS, as shown in Table A.5-1. Contamination found beyond these boundaries may indicate a flaw in the CSM and may require re-evaluation of the CSM before the investigation continues. Each CAS is considered geographically independent and intrusive activities are not intended to extend into the boundaries of neighboring CASs.

A.5.3 Practical Constraints

Practical constraints such as military activities at the NTS, weather (i.e., high winds, rain, lightning, extreme heat), utilities, threatened or endangered animal and plants, unstable or steep terrain, and/or access restrictions may affect the ability to investigate this site. The practical constraints associated with the investigation of the CAU 124 CASs are summarized in Table A.5-2.

Table A.5-1
Spatial Boundaries of CAU 124 CASs

Corrective Action Site	Spatial Boundaries
08-02-01	The footprint of the CAS (~30 x 40 feet [ft]) plus a 30-ft lateral buffer; 20 ft below ground surface (bgs) vertically.
15-02-01	The footprint of Plot A (~960 x 720 ft) and Plot B (~430 x 225 ft) plus a 150-ft lateral buffer; 20 ft bgs vertically; 20-ft lateral buffer outside reservoir berms.
16-02-03	The footprint of the CAS (~90 x 70 ft) plus a 75-ft lateral buffer; 20 ft bgs vertically.
16-02-04	The footprint of the CAS (~630 x 360 ft) plus a 200-ft lateral buffer; 20 ft bgs vertically.
16-99-04	The footprint of the CAS (~27 x 18 ft) plus a 200-ft lateral buffer; 20 ft bgs vertically (combined with CAS 16-02-04).

Table A.5-2
Practical Constraints for the CAU 124 Field Investigation

Corrective Action Site	Practical Constraints
08-02-01	Weather (i.e., high winds, rain, lightning, extreme heat/cold), above/underground utilities, potential radiological concern, loose and unconsolidated terrain.
15-02-01	Weather (i.e., high winds, rain, lightning, extreme heat/cold, above/below ground irrigation lines, concrete pads and water lines exposed in southeast corner of Plot A; potential radiological exposure, and loose and unconsolidated terrain.
16-02-03	Weather (i.e., high winds, rain, lightning, extreme heat/cold), restricted access due to Nevada Test Site (NTS) activities, above/below ground utilities, exposed/capped utility stick-ups, and loose and unconsolidated terrain; access roads unmaintained.
16-02-04	Weather (i.e., high winds, rain, lightning, extreme heat/cold), restricted access due to NTS activities, above/below ground utilities, several concrete pads with utility sitck-ups throughout CAS, and loose and unconsolidated terrain; access roads unmaintained.
16-99-04	Weather (i.e., high winds, rain, lightning, extreme heat/cold), restricted access due to NTS activities, above/below ground utilities, concrete pads with utility stick-ups, and loose and unconsolidated terrain; access roads unmaintained.

A.5.4 Define the Sampling Units

The scale of decision-making in Decision I is defined as the CAS. A COC detected within the CAS will cause the determination that the CAS is contaminated and needs further evaluation. The scale of decision-making for Decision II is defined as a contiguous area contaminated with a COC originating from the CAS. Resolution of Decision II requires this contiguous area to be bounded laterally and vertically.

A.6.0 Step 5 - Develop the Analytic Approach

Step 5 of the DQO process specifies appropriate population parameters for decision-making, defines action levels and generates an "If … then … else" decision rule that defines the conditions under which possible alternative actions will be chosen. This step also specifies the parameters that characterize the population of interest, the FALs, and confirms that the analytical detection limits are capable of detecting FALs.

A.6.1 Population Parameters

For judgmental sampling results, the population parameter is the observed concentration of each contaminant from each individual analytical sample. Each sample result will be compared to the FALs to determine the appropriate resolution to Decision I and Decision II. For Decision I, a single sample result for any contaminant exceeding a FAL would cause a determination that a COC is present within the CAS.

The Decision II population parameter is an individual analytical result from a bounding sample. For Decision II, a single bounding sample result for a contaminant exceeding a FAL would cause a determination that the contamination is not bounded.

A.6.2 Action Levels

The PALs presented in this section are to be used for site screening purposes. They are not intended to be used as cleanup action levels or FALs. However, they are useful in screening out contaminants not present in sufficient concentrations to warrant further evaluation and, therefore, streamline the consideration of remedial alternatives. The RBCA process used to establish FALs is described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). This process conforms with *Nevada Administrative Code* (NAC) 445A.227 (NAC, 2006a) which lists the requirements for sites with soil contamination. For the evaluation of corrective actions, NAC 445A.22705 (NAC, 2006b) requires the use of American Society for Testing and Materials (ASTM) Method E 1739-95 (ASTM, 1995) to "conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards (i.e., FALs) or to establish that corrective action is not necessary."

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 SAFER Plan). 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 level (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 TPH concentrations 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 E 1739-95 that consider site-, pathway-, and receptor-specific parameters.

The comparison of laboratory results to FALs and the evaluation of potential corrective actions will be included in the investigation report. The FALs will be defined (along with the basis for definition) in the investigation report.

A.6.2.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the U.S. Environmental Protection Agency (EPA) *Region 9 Risk-Based Preliminary Remediation Goals (PRGs)* for chemical contaminants in industrial soils (EPA, 2004). Background concentrations for RCRA metals and zinc will be used instead of PRGs when natural background concentrations exceed the PRG, as is often the case with arsenic on the NTS. Background is considered the average concentration, plus two standard deviations of the average concentration, for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998). For detected chemical COPCs without established PRGs, the protocol used by the EPA Region 9 in establishing PRGs (or similar) will be used to establish PALs. If used, this process will be documented in the investigation report.

A.6.2.2 Total Petroleum Hydrocarbons PALs

The PAL for TPH is 100 parts per million as listed in NAC 445A.2272 (NAC, 2006c).

A.6.2.3 Radionuclide PALs

The PALs for radiological contaminants (other than tritium) are based on the NCRP Report No. 129 recommended screening limits for construction, commercial, industrial land-use scenarios (NCRP, 1999) scaled to 25 millirem-per-year (mrem/yr) dose constraint (Murphy, 2004) and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). These PALs are based on the construction, commercial, and industrial land-use scenario provided in the guidance, and are appropriate for the NTS, based on future land-use scenarios as presented in Section A.2.2. The PAL for tritium is based on the Underground Test Area (UGTA) Project limit of 400,000 pCi/L for discharge of water containing tritium (NNSA/NV, 2002b).

Materials/structures that have the potential for surface contamination may be surveyed for unrestricted release as given in the *NV/YMP Radiological Control Manual* (NNSA/NSO, 2004).

A.6.3 Decision Rules

The decision rules applicable to both Decision I and Decision II are:

- If COC contamination is inconsistent with the CSM or extends beyond the spatial boundaries identified in Section A.5.2, then work will be suspended and the investigation strategy reconsidered, else the decision will be to continue sampling to define the extent.

The decision rules for Decision I are:

- If the population parameter of any COPC in the Decision I population of interest (defined in Step 4) exceeds the corresponding FAL, then that contaminant is identified as a COC, the contaminated material removed, or Decision II samples collected until an estimate of the extent of contaminated material has been made.

- If no COC associated with a release from the CAS is detected, then further assessment of the CAS is not required and the corrective action alternative of no further action will be selected. If a COC associated with a release from the CAS is detected, then additional sampling will be conducted to determine the extent of COC contamination. If the extent of the contamination is defined and additional remediation is feasible, then clean close the site by removing the contaminated media until all contamination has been removed. If the extent of contamination

has been determined and additional remediation is not feasible, then the contaminated area will be close in place with appropriate use restrictions and the extent of contamination defined.

- 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 action will be necessary.

The decision rules for Decision II are:

- If the population parameter (the observed concentration of any COC) in the Decision II population of interest (defined in Step 4) exceeds the corresponding FAL, then additional samples will be collected to complete the Decision II evaluation. If sufficient information is available to define the extent of COC contamination and confirm that closure objectives were met, then further assessment of the CAS is not required. If sufficient information is not available to define the extent of contamination or confirm that closure objectives were met, then additional samples will be collected until the extent is defined.

- If valid analytical results are available for the waste characterization samples defined in Section A.8.0, then the decision will be that sufficient information exists to characterize the IDW for disposal, and determine potential remediation waste types, else collect additional waste characterization samples.

A.7.0 Step 6 - Specify Performance or Acceptance Criteria

Step 6 of the DQO process defines the decision hypotheses, specifies controls against false rejection and false acceptance decision errors, examines consequences of making incorrect decisions from the test, and places acceptable limits on the likelihood of making decision errors.

A.7.1 Decision Hypotheses

The baseline condition (i.e., null hypothesis) and alternative condition for Decision I are:

- Baseline condition – A COC is present.
- Alternative condition – A COC is not present.

The baseline condition (i.e., null hypothesis) and alternative condition for Decision II are as follows:

- Baseline condition – The extent of a COC has not been defined.
- Alternative condition – The extent of a COC has been defined.

Decisions and/or criteria have false negative or false positive errors associated with their determination. The impact of these decision errors and the methods that will be used to control these errors are discussed in the following subsections. In general terms, confidence in DQO decisions based on judgmental sampling results will be established qualitatively by:

- The development of and concurrence of CSMs (based on process knowledge) by stakeholder participants during the DQO process.
- Testing the validity of CSMs based on investigation results.
- Evaluating the quality of the data based on DQI parameters.

A.7.2 False Negative Decision Error

The false negative decision error would indicate deciding that a COC is not present when it is (Decision I), or deciding that the extent of a COC has been defined when it has not (Decision II), or deciding that closure objectives were met when they were not (Decision II). In all cases, the potential consequence is an increased risk to human health and environment.

In judgmental sampling, the selection of the number and location of samples is based on knowledge of the feature or condition under investigation and on professional judgment (EPA, 2002). Judgmental sampling conclusions regarding the target population depend upon the validity and accuracy of professional judgment.

The false negative decision error (where consequences are more severe) for judgmental sampling designs is controlled by meeting these criteria:

- For Decision I, having a high degree of confidence that the sample locations selected will identify COCs, if present within the CAS. For Decision II, having a high degree of confidence that the sample locations selected will identify the extent of COCs.
- Having a high degree of confidence that analyses conducted will be sufficient to detect COCs present in the samples.
- Having a high degree of confidence that the dataset is of sufficient quality and completeness.

To satisfy the first criterion, Decision I samples must be collected in areas most likely to be contaminated by COCs (supplemented by random samples where appropriate). Decision II samples must be collected in areas that represent the lateral and vertical extent of contamination (above FALs). The following characteristics must be considered to control decision errors for the first criterion:

- Source and location of release
- Chemical nature and fate properties
- Physical transport pathways and properties
- Hydrologic drivers

These characteristics were considered during the development of the CSMs and selection of sampling locations. The field-screening methods and biasing factors listed in Section A.4.2.1 will be used to further ensure that appropriate sampling locations are selected to meet these criteria. Radiological survey instruments and field-screening equipment will be calibrated and checked in accordance with the manufacturer's instructions and approved procedures. The investigation report will present an assessment on the DQI of representativeness that samples were collected from those locations that best represent the populations of interest as defined in Section A.5.1.

To satisfy the second criterion, Decision I samples will be analyzed for the chemical and radiological parameters listed in Section 3.2 of the SAFER Plan. Decision II samples will be analyzed for those chemical and radiological parameters that identified unbounded COCs. The DQI of sensitivity will be assessed for all analytical results to ensure that all sample analyses had measurement sensitivities (detection limits) that were less than or equal to the corresponding FALs. If this criterion is not achieved, the affected data will be assessed (for usability and potential impacts on meeting site characterization objectives) in the investigation report.

To satisfy the third criterion, the entire dataset, as well as individual sample results, will be assessed against the DQIs of precision, accuracy, comparability, and completeness as defined in the Industrial Sites QAPP (NNSA/NV, 2002a) and in Section 6.2.2 of the SAFER Plan. The DQIs of precision and accuracy will be used to assess overall analytical method performance as well as to assess the need to potentially "flag" (qualify) individual contaminant results when corresponding QC sample results are not within the established control limits for precision and accuracy. Data qualified as estimated for reasons of precision or accuracy may be considered to meet the constituent performance criteria based on an assessment of the data. The DQI for completeness will be assessed to ensure that all data needs identified in the DQO have been met. The DQI of comparability will be assessed to ensure that all analytical methods used are equivalent to standard EPA methods so that results will be comparable to regulatory action levels that have been established using those procedures. Strict adherence to established procedures and QA/QC protocol protects against false negatives. Site-specific DQIs are discussed in more detail in Section 6.2.2 of the SAFER Plan.

To provide information for the assessment of the DQIs of precision and accuracy, the following QC samples will be collected as required by the Industrial Sites QAPP (NNSA/NV, 2002a):

- Field duplicates (minimum of 1 per matrix per 20 environmental samples)
- Laboratory QC samples (minimum of 1 per matrix per 20 environmental samples, or 1 per CAS per matrix, if less than 20 collected)

A.7.3 False Positive Decision Error

The false positive decision error indicates that a COC is present when it is not, or a COC is unbounded when it is not, resulting in unnecessary sampling and analysis, thus increased costs.

False positive results are typically attributed to laboratory and/or sampling/handling errors that could cause cross contamination. To protect against cross contamination, decontamination of sampling equipment will be conducted according to established and approved procedures, and only clean sample containers will be used. To determine whether a false positive analytical result may have occurred, the following QC samples will be collected as required by the Industrial Sites QAPP (NNSA/NV, 2002a):

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Equipment blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per source lot per sampling event)
- Field blanks (minimum of 1 per CAS, additional if field conditions change)

A.8.0 Step 7 - Develop the Plan for Obtaining Data

Step 7 of the DQO process selects and documents a design that will yield data that will best achieve performance or acceptance criteria. Judgmental sampling schemes will be implemented to select sample locations and evaluate analytical results for CAU 124. Judgmental sampling allows the methodical selection of sample locations that target the populations of interest (defined in Step 4).

A.8.1 Decision I Sampling

A judgmental sampling design will be implemented for CAU 124 CASs. Because individual sample results, rather than an average concentration, will be used to compare to FALs at the CASs undergoing judgmental sampling, statistical methods to generate site characteristics will not be used. Adequate representativeness of the entire target population may not be a requirement to developing a sampling design. If good prior information is available on the target site of interest, then the sampling may be designed to collect samples only from areas known to have the highest concentration levels on the target site. If the observed concentrations from these samples are below the action level, then a decision can be made that the site does not contain unsafe levels of the contaminant without the samples being truly representative of the entire area (EPA, 2006).

Sample locations will be selected to satisfy the DQI of representativeness in that samples collected from selected locations will best represent the populations of interest as defined in Section A.5.1. To meet this criterion for judgmentally sampled sites, a biased sampling strategy will be used for Decision I samples to target areas with the highest potential for contamination, if it is present in the CAS. Sample locations will be determined based on process knowledge, previously acquired data, or the field-screening and biasing factors listed in Section A.4.2.1. If biasing factors are present in soils below locations where Decision I samples were removed, additional Decision I soil samples will be collected at depth intervals selected by the SS based on biasing factors to a depth where the biasing factors are no longer present. The SS has the discretion to modify the judgmental sample locations, but only if the modified locations meet the decision needs and criteria stipulated in this DQO.

A.8.2 Decision II Sampling

To meet the DQI of representativeness for Decision II samples (that Decision II sample locations represent the population of interest as defined in Section A.5.1), judgmental sampling locations at each CAS will be selected based on the outer boundary sample locations where COCs were detected, the CSM, and other field-screening and biasing factors listed in Section A.4.2. In general, sample locations will be arranged in a triangular pattern around the Decision I location or area at distances based on site conditions, process knowledge, and biasing factors. If COCs extend beyond the initial step-outs, Decision II samples will be collected from incremental step-outs. Initial step-outs will be at least as deep as the vertical extent of contamination defined at the Decision I location and the depth of the incremental step-outs will be based on the deepest contamination observed at all locations. A clean sample (i.e., concentrations less than FALs) collected from each step-out direction (lateral or vertical) will define extent of contamination in that direction. The number, location, and spacing of step-outs may be modified by the SS, as warranted by site conditions.

The following sections discuss CAS-specific investigation activities, including proposed sample locations. As the sampling strategy for each CAS is developed, specific biasing factors will be described. In the absence of biasing factors, samples will be collected from the default sampling locations described for each CAS.

A.8.3 Corrective Action Site 08-02-01, Underground Storage Tank

The judgmental sample locations at CAS 08-02-01 have been selected based on the 4-inch (in.) polyvinyl chloride (PVC) pipe extending from the ground, and the disturbed and sightly subsided soils directly around the pipe.

Figure A.8-1 shows the site conditions for CAS 08-02-01. A Decision I sample will be collected at the surface contact beside the exposed pipe. Additional Decision I samples will be collected based on biasing factors during excavation of the UST described in Section A.4.2.1. The area of the UST will be excavated. If a UST is present, the contents, if any, of each phase inside the UST will be sampled; two soil samples will be collected at the base of the UST; one soil sample will be collected from the inlet, and one soil sample will be collected from the outlet as depicted in Figure A.8-2. The UST will be closed in accordance with NAC Section 459.9972, “UST Closure” and the contents, if any, will be

Figure A.8-1
Current Site Conditions at CAS 08-02-01

removed (NAC, 2005). The USTs and contents, if any, will be disposed of in accordance with Section 6.0 of the SAFER Plan.

If no UST is present, the excavated material will be observed for biasing factors, such as staining to the undisturbed native soil interface. If no biasing factors are observed, one soil sample will be collected at the undisturbed native soil interface. If the undisturbed soil interface cannot be determined, one soil sample will be collected at approximately 12 ft, and one soil sample will be collected at approximately 15 ft. Samples will be submitted for analysis in accordance with the analytical program listed in Table 3-1 of the SAFER Plan.

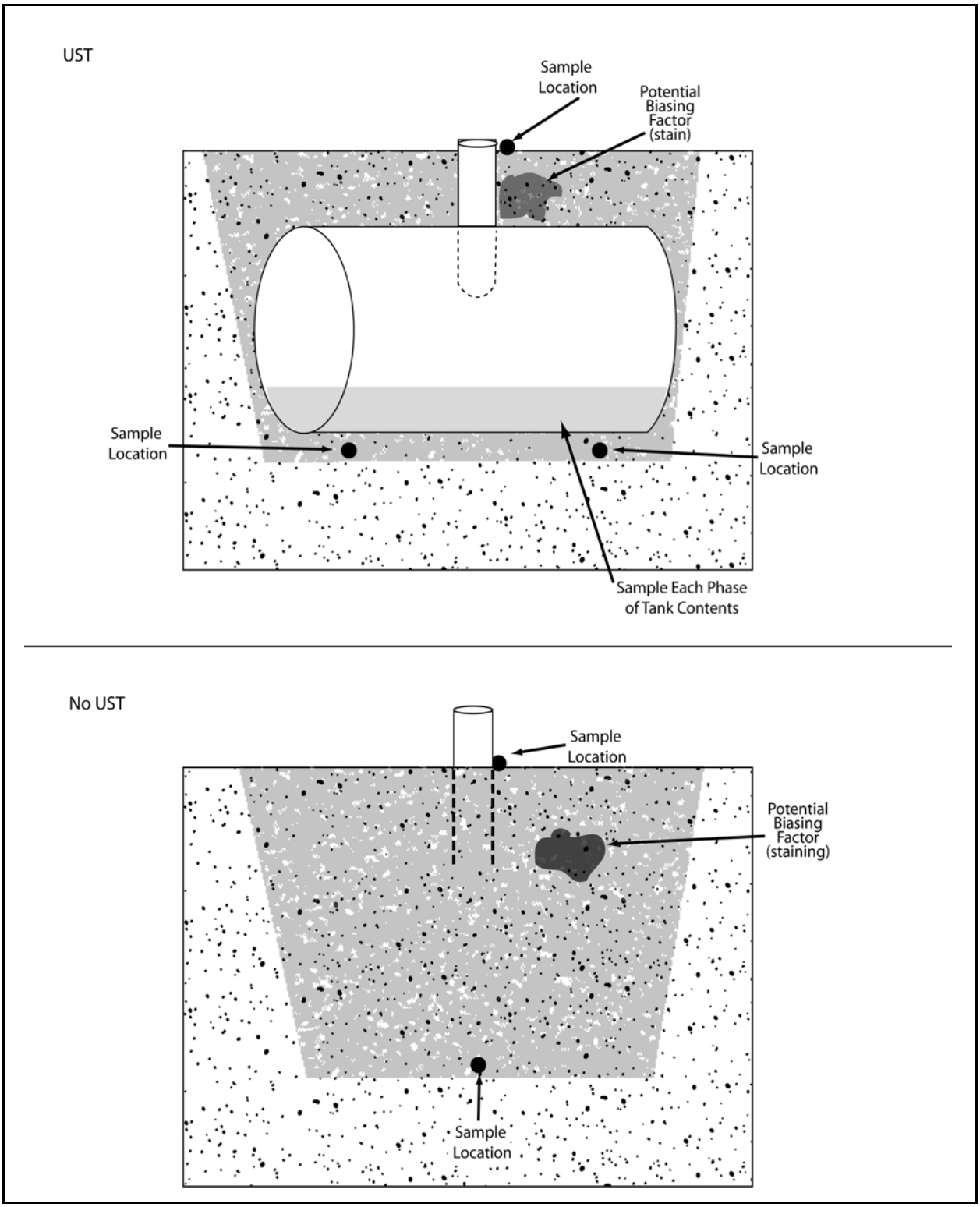


Figure A.8-2
Proposed Sample Locations at CAS 08-02-01

A.8.4 Corrective Action Site 15-02-01, Irrigation Piping

This section discusses the sampling and analysis design for CAS 15-02-01 located at Area 15 EPA Farm. The EPA Farm sample strategy is developed based on process knowledge, a 2006 geophysical survey, and a 2006 demarcation survey.

Figure A.8-3 shows the current site conditions for CAS 15-02-01. Figure A.8-4 shows the planned Decision I sample locations.

Two locations along the irrigation lines are selected in each Farm Plot. These locations will be the proximinal and distal ends of the irrigation lines. One swipe at each location; one surface and one subsurface (approximately 6 in.) soil sample will be collected. Four judgmental samples will be collected at randomized grid locations in each plot as determined using VSP software as shown on Figure A.8-4.

Within the boundary of CAS 15-02-01, there are two concrete pads. One was a greenhouse and one was a storage shed. Surface soil samples will be collected at the middle edge of each side of each concrete pad. Also, samples will be collected from the concrete pads based on biasing factors discussed in Section A.4.2.1 to determine if contamination on the pad could result in future release of COCs.

To confirm the demarcation survey, six judgmental surface soil samples will be collected outside the CAS 15-02-01 boundary. The results of this sampling will be used to determine the background radiological concentration that would not be associated with the potential application of radionuclides on the EPA Farm Plots. Due to the nature of the fallout from the atmospheric testing at NTS and the location of the EPA Farm, the following is a potential sampling strategy. One surface soil sample will be collected at an approximate distance of 25 to 30 ft southeast of the southwest corner. Two surface soil samples will be collected at an approximate distance of 25 to 30 ft from the west fence line along the western edge of Plot A. One surface soil sample at an approximate distance of 25 to 30 ft from the west fence line along the middle western edge of Plot B. Two surface soil samples will be collected 25 to 30 ft from the northern fence line of both Plot A and B and spaced approximately 100 ft apart.

Figure A.8-3
Current Site Conditions at CAS 15-02-01

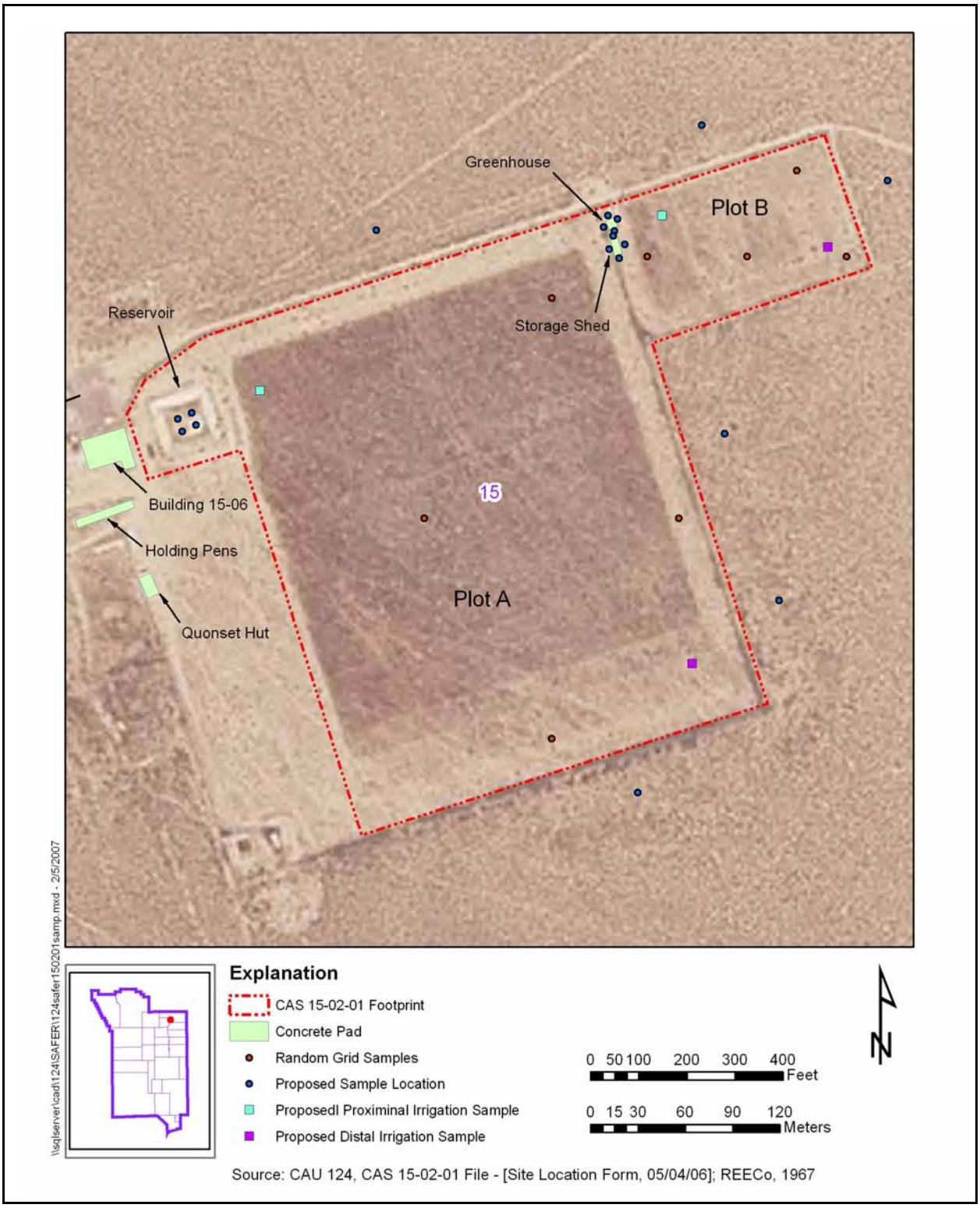


Figure A.8-4
Proposed Sample Locations at CAS 15-02-01

The sampling strategy of the reservior will include four judgmental surface soil samples. The results of this sampling will be used to determine the background radiological concentration that would not be associated with the potential mixing of radionuclides within the reservoir. If the concentrations are similar between the background and reservoir samples, contamination will be attributed to atmospheric sources and not the mixing of radionuclides for application to the fields. The potential sample strategy includes four judgmental surface samples are collected from the bottom of the reservior. Samples will be submitted for analysis in accordance with the analytical program listed in Table 3-1 of the SAFER Plan.

A.8.5 Corrective Action Site 16-02-03, Underground Storage Tank

The judgmental sample locations at CAS 16-02-03 have been selected based on two exposed 1-in. metal pipes extended from the surface, and the 2003 Science Applications International Corporation geophysical survey that located a UST and associated piping.

Figure A.8-5 shows the current site conditions for CAS 16-02-03. Figure A.8-6 shows the planned Decision I sample locations.

A Decision I sample will be collected at the surface contact next to the exposed pipe. Additional Decision I samples will be collected based on biasing factors during excavation of the UST described in Section A.4.2.1.

The area of the UST will be excavated. If a UST is present, the contents, if any, of each phase inside the UST will be sampled; two soil samples will be collected at the base of the UST; one soil sample will be collected from the inlet, and one soil sample will be collected from the outlet as depicted at the top of Figure A.8-6. The UST will be closed in accordance with NAC Section 459.9972, “UST Closure” and the contents, if any, will be removed (NAC, 2005). The USTs and contents, if any, will be disposed of in accordance with Section 6.0 of the SAFER Plan.

If no UST is present, the excavated material will be observed for any biasing factors, such as to the undisturbed native soil interface. If no biasing factors are observed, one soil sample will be collected at the undisturbed native soil interface as depicted at the bottom of Figure A.8-6. If the undisturbed soil interface cannot be determined, one soil sample will be collected at approximately 12 ft, and one

Figure A.8-5
Current Site Conditions at CAS 16-02-03

soil sample will be collected at approximately 15 ft. Samples will be submitted for analysis in accordance with the analytical program listed in Table 3-1 of the SAFER Plan.

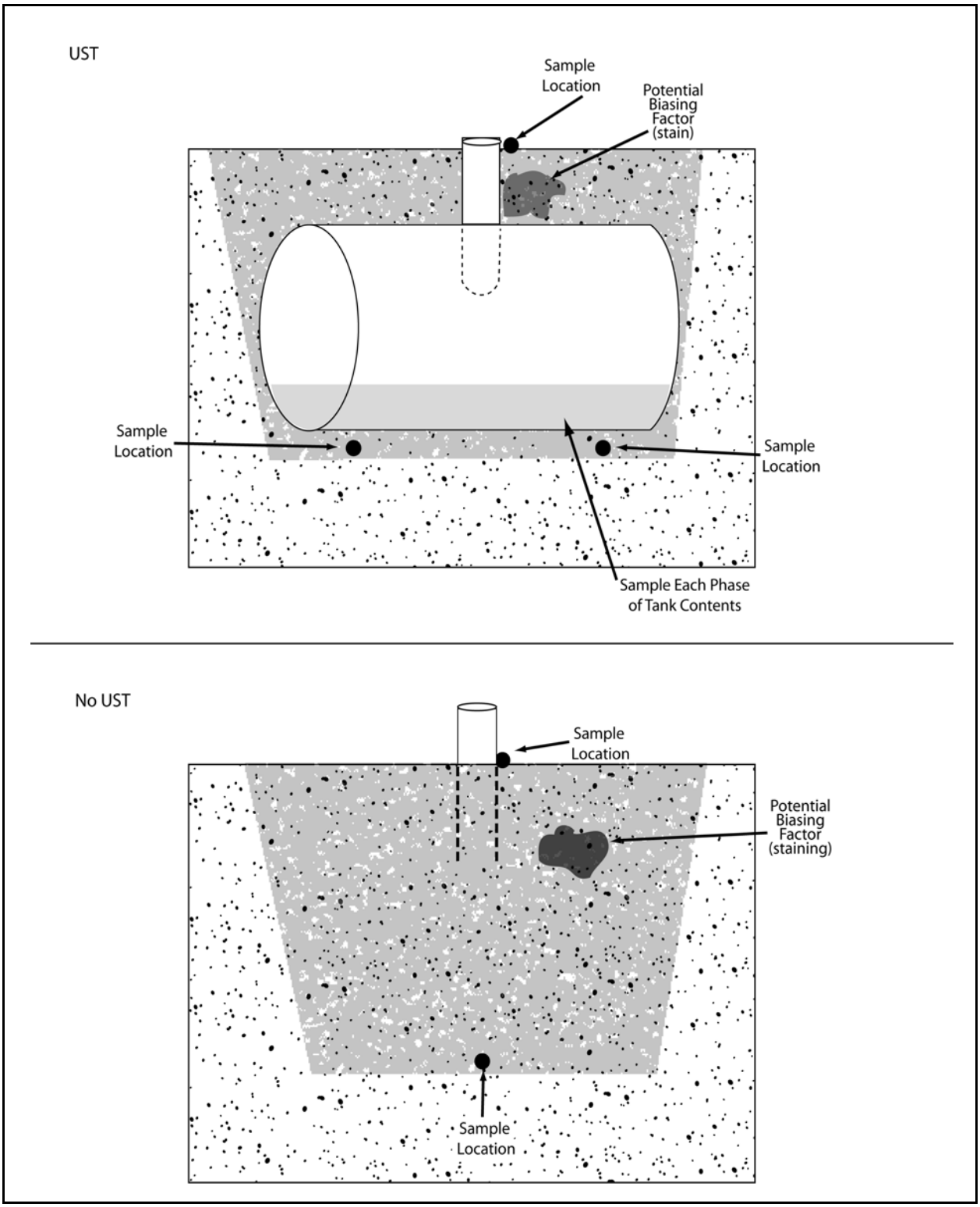


Figure A.8-6
Proposed Sample Locations at CAS 16-02-03

A.8.6 Corrective Action Site 16-02-04, Fuel Oil Piping

The sample locations at CAS 16-02-04 have been selected based on the fuel oil piping that was connected to a former 2,000-gal fuel oil aboveground storage tank (AST) and a recent informal utility survey concluded the fuel oil piping was still in place. Current site conditions are depicted in Figure A.8-7.

Figure A.8-7
Current Site Conditions at CAS 16-02-04

Decision I samples will be collected as depicted in Figure A.8-8 at all end-points along the fuel oil pipe line where connections would have been made. During excavation of the fuel oil piping ends additional samples may be collected if biasing factors are observed, such as staining as described in Section A.4.2.1.

Decision I surface soil samples will be collected at the middle edge of each side of the concrete pad. Samples will be submitted for analysis in accordance with the analytical program listed in Table 3-1 of the SAFER Plan.

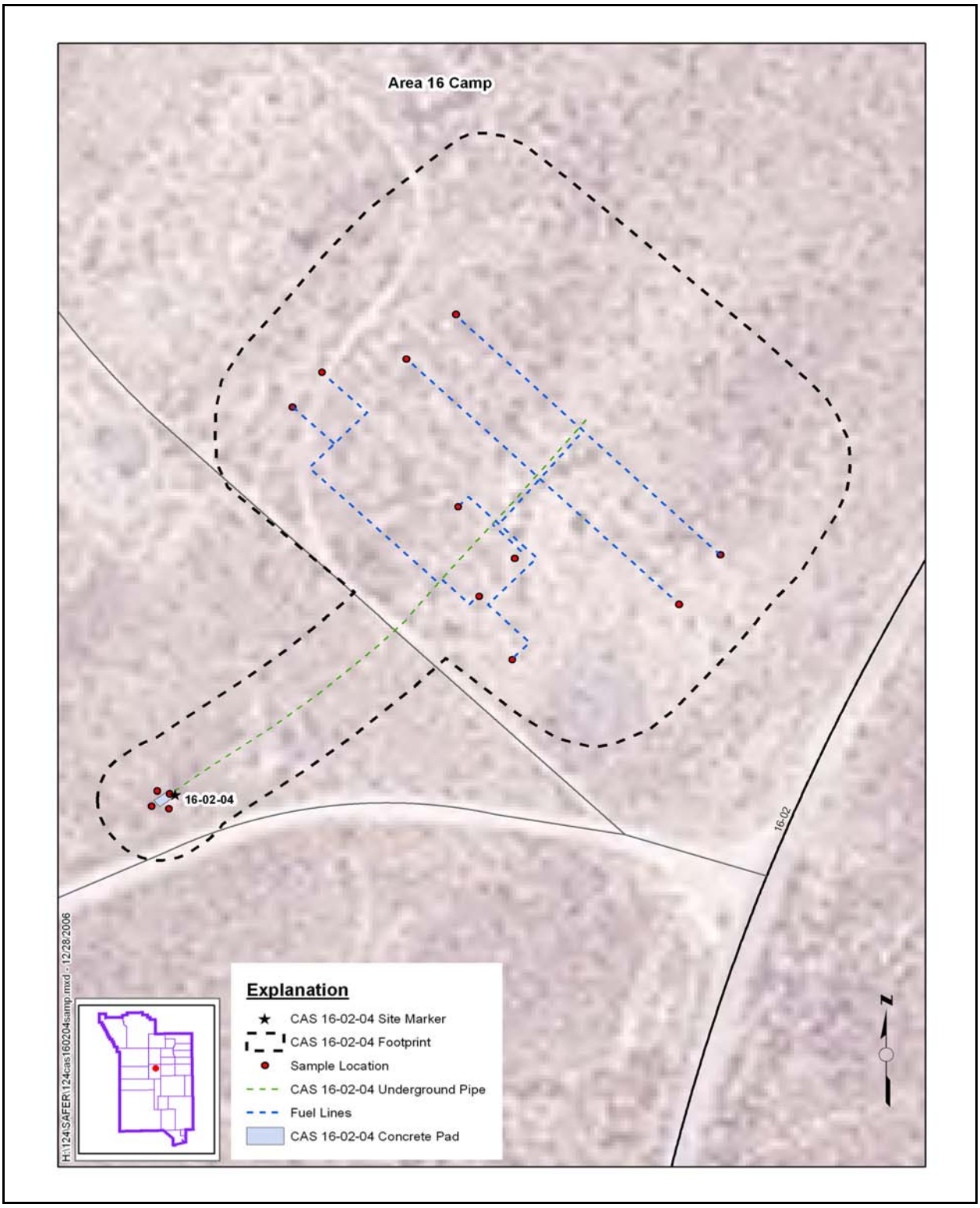


Figure A.8-8
Proposed Sample Locations for CAS 16-02-04

A.8.7 Corrective Action Site 16-99-04, Fuel Line (Buried) and UST

The judgmental sample locations at CAS 16-99-04 have been selected based on the 2003 geophysical survey that located a UST and associated piping.

Figure A.8-9 shows the current site conditions for CAS 16-99-04. Figure A.8-10 shows the planned Decision I sample locations.

Figure A.8-9
Current Site Conditions at CAS 16-99-04

Decision I surface soil samples will be collected at the middle edge of each side of the concrete pad. Also, one surface soil sample will be collected at the base of exposed piping associated with CAS 16-99-04.

A Decision I sample will be collected at the surface contact beside the exposed pipe. Additional Decision I samples will be collected based on biasing factors during excavation of the UST described in Section A.4.2.1.

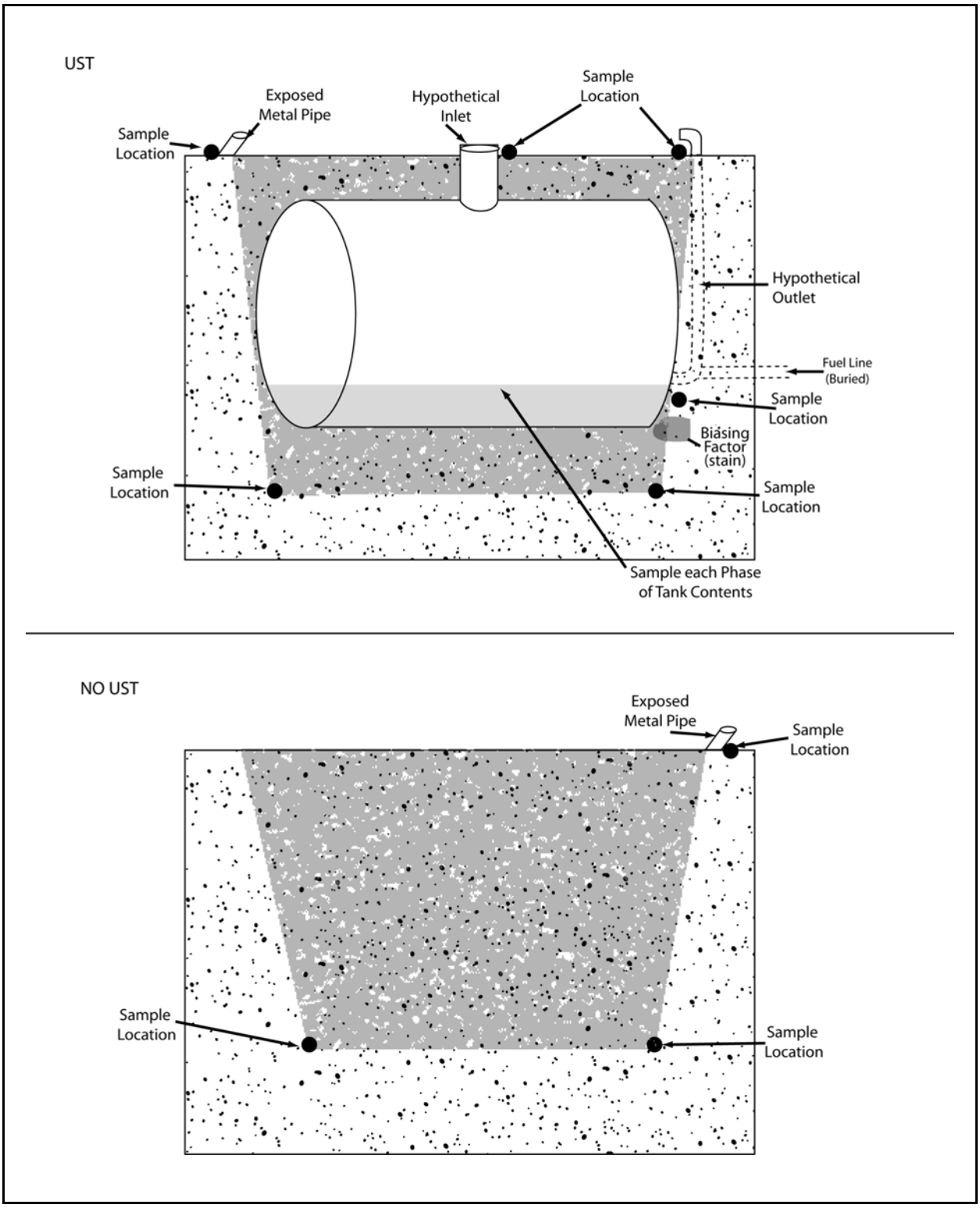


Figure A.8-10
Proposed Sample Locations at CAS 16-99-04

The area of the UST will be excavated. If a UST is present, the contents, if any, of each phase inside the UST will be sampled; two soil samples will be collected at the base of the UST; one soil sample will be collected from the inlet, and one soil sample will be collected from the outlet as depicted at the top of Figure A.8-10. The UST will be closed in accordance with NAC Section 459.9972, "UST Closure" and the contents, if any, will be removed (NAC, 2005). The USTs and contents, if any, will be disposed of in accordance with Section 6.0 of the SAFER Plan.

If no UST is present, the excavated material will be observed for biasing factors, such as staining to the undisturbed native soil interface. If no biasing factors are observed, one soil sample will be collected at the undisturbed native soil interface as depicted at the bottom of Figure A.8-10. If the undisturbed native soil interface cannot be determined, one soil sample will be collected at approximately 12 ft, and one soil sample will be collected at approximately 15 ft.

Decision I samples will be collected at all end-points along the fuel line where connections would have been made. During excavation of the fuel line additional soil samples may be collected if biasing factors are observed, such as staining, as described in Section A.4.2.1. Samples will be submitted for analysis in accordance with the analytical program listed in Table 3-1 of the SAFER Plan.

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Appendix B

Closure Certification

B.1.0 Closure Certification

This section does not apply to CAU 124.

Appendix C

As-Built Documentation

C.1.0 As-Built Documentation

This section does not apply to CAU 124.

Appendix D

Confirmation Sampling Test Results

D.1.0 Introduction

This appendix presents the CAI activities and analytical results for CAU 124, which is located in Areas 8, 15, and 16 of the NTS (Figure D.1-1), and comprised of the five CASs listed below:

- 08-02-01, Underground Storage Tank
- 15-02-01, Irrigation Piping
- 16-02-03, Underground Storage Tank
- 16-02-04, Fuel Oil Piping
- 16-99-04, Fuel Line (Buried) and UST

Corrective Action Unit 08-02-01, Underground Storage Tank, is located in Area 8 and believed to be associated with the Area 8 Trailer Park near the Area 2 Camp. This site was identified in the FFACO as a UST with unknown contents or usage (REECo, 1991). A 4-in. diameter, gray polyvinyl chloride (PVC) pipe, extending approximately 2 feet (ft) above the ground surface, was present but the UST had been removed previously.

Corrective Action Site 15-02-01, Irrigation Piping, is located in Area 15, consists of two farm plots used for experimental studies; a reservoir for water storage; a concrete pad from a former greenhouse, and a concrete pad from a former storage shed. Radionuclides used in experiments at CAS 15-02-01 included iodine-131 from dry-aerosol tests. This CAS was also subject to fallout from the dispersion of radionuclides from the U8d, U10h (Sedan) test, and other atmospheric tests conducted on the NTS. Tritium was also present from metabolism studies conducted at the EPA Farm (SWRHL, 1967; EPA, 1973; Adams, 2002).

Corrective Action Site 16-02-03, Underground Storage Tank, is located within the Area 16 Camp. According to engineering drawings, the UST may have been part of a water system designed to carry water to the trailers or part of a fuel oil system in the Area 16 Camp (REECo, 1962). The UST is not on the engineering drawings and was not identified during the field investigation.

Corrective Action Site 16-02-04, Fuel Oil Piping, is located within the Area 16 Camp. Engineering drawings reveal approximately 950 ft of underground piping that was originally connected to a 2,000-gallon aboveground storage tank (AST) that was previously removed (REECo, 1962). The exact date of removal is unknown or if there were releases of contamination from the removal.

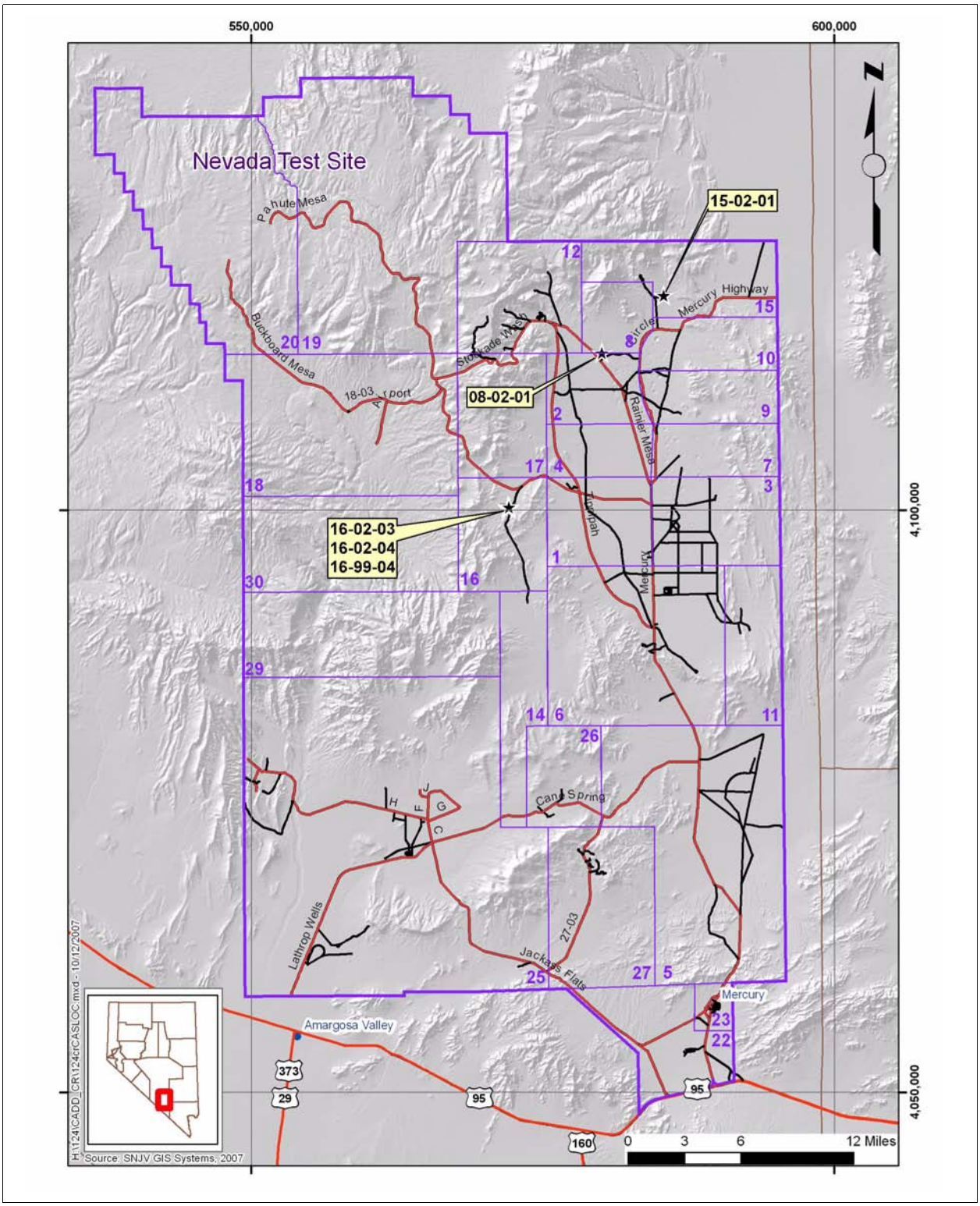

Figure D.1-1
CAU 124 CAS Location Map

Corrective Action Site 16-99-04, Fuel Line (Buried) and UST, is located within the Area 16 Camp. A site visit revealed a wooden post that reads “Fuel Line 18” Deep”; a 2-inch (in.) diameter, L-shaped metal pipe with turn valve above ground surface; a metal hose approximately 6 ft in length exposed loose on the ground surface; a 1-in. diameter vent pipe, and a concrete pad. Historical documentation makes references to the Area 16 ASTs and USTs; however, there is no specific information regarding CAS 16-99-04 (REECo, 1962).

Additional information regarding the history of each site, planning, and the scope of the investigation is presented in the SAFER Plan (NNSA/NSO, 2007).

D.1.1 Project Objectives

The primary objective of the investigation was to provide sufficient information to validate the assumptions used to select the corrective actions and to verify that closure objectives were met for each CAU CAS. This objective was achieved by determining that COCs are not present at any CAU 124 CASs.

The selection of soil and/or waste characterization sample locations was based on site conditions, and the strategy developed during the DQO process as presented in the SAFER Plan (see Appendix A). The sampling strategy primarily involved bias sample locations with some random sample locations at CAS 15-02-01.

D.1.2 Contents

This appendix contains information and data in sufficient detail to justify that no further corrective action is required at CAU 124. The contents of this appendix are as follows:

- Section D.1.0 describes the investigation background, objectives, and content.
- Section D.2.0 provides an investigation overview.
- Sections D.3.0 through D.7.0 provides CAS-specific information regarding the field activities, sampling methods, and laboratory analytical results from investigation sampling.
- Section D.8.0 summarizes the waste management activities.

- Section D.9.0 discusses the QA and QC procedures followed and results of the QA/QC activities.
- Section D.10.0 is a summary of the investigation results.
- Section D.11.0 lists the cited references.

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

D.2.0 Investigation Overview

Field investigation and sampling activities for the CAU 124 CAI were conducted from July 9, through July 26, 2007. Table D.2-1 lists the CAI activities that were conducted at each CAS.

Table D.2-1
Corrective Action Investigation Activities Conducted at Each Corrective Action Site To Meet the CAU 124 Plan

Corrective Action Investigation Activities	Corrective Action Sites				
	08-02-01	15-02-01	16-02-03	16-02-04	16-99-04
Conducted surface radiological surveys	X	X	X	X	X
Performed geophysical/utility surveys	X	X	X	X	X
Performed site transects/walkover	X	X	X	X	X
Collected soil samples from biased locations	X	X	X	X	X
Collected soil samples from random grid locations	--	X	--	--	--
Field-screened samples for alpha and beta/gamma radiation	X	X	X	X	X
Collected samples for waste characterization	X	--	--	--	--
Collected swipe samples for removable radioactivity	--	X	--	--	--
Cut associated piping and sealed as a best management practice	--	--	X	X	X
Submitted select samples for offsite laboratory analysis	X	X	X	X	X

-- = Not applicable

The investigation and sampling program was managed in accordance with the requirements set forth in the SAFER Plan. Field activities were performed in compliance with safety documents that are consistent with the DOE Integrated Safety Management System. Samples were collected and documented following approved protocols and procedures. Quality control samples (e.g., field blanks, equipment rinsate blanks, trip blanks, and duplicate samples) were collected as required by the Industrial Sites QAPP (NNSA/NV, 2002) and SAFER Plan. During field activities, waste minimization practices were followed according to approved procedures, including segregation of waste by waste stream.

Weather conditions at the sites varied to include intensive sun (high temperatures with low humidity), below average rainfall, intermittent cloudiness, and light to strong winds. There were no delays in site operations due to weather.

The CASs were investigated by conducting radiological surface screening and surveys, and sampling potential contaminant sources, surface and subsurface soils. Surface soil samples were collected by hand excavation. Subsurface soil samples were collected using a backhoe. The soil samples were field screened at specific locations for alpha and beta/gamma radiation and gamma-emitting radionuclides. The results were compared against screening levels to guide the CAS-specific investigations. Samples of soils, solids, and swipes were collected to support both environmental and waste characterization. Solid and sediment waste samples were field screened for radionuclides to guide in the selection of the samples shipped to offsite laboratories for analysis and worker safety.

Decision I sampling locations at CAU 124 were accessible and sampling activities at planned locations were not restricted. Because there were no COCs identified during the investigation, Decision II sampling was not required.

Sections D.2.1 through D.2.4 provide the investigation methodology and laboratory analytical information.

D.2.1 Sample Locations

Investigation locations selected for sampling were based on interpretation of existing engineering drawings, aerial and land photographs, interviews with former and current site employees, information obtained during site visits, and site conditions provided in the SAFER Plan. Sampling points for each site were selected based on the approach provided in the SAFER Plan. The planned biased and random sample locations are discussed in the text and represented on figures in the SAFER Plan. Actual environmental sample locations are shown on the figures included in Sections D.3.0 through D.7.0. Some locations were modified slightly from planned positions due to field conditions and observations. Sample locations were staked where appropriate and labeled. A Trimble GeoXT 2005 series Global Positioning System instrument was used to determine the sample location coordinates as well as CAS points of interest.

D.2.2 Investigation Activities

The investigation activities performed at CAU 124 were based on field investigation activities discussed in the SAFER Plan. The technical approach consisted of the activities listed in Table D.2-1. The investigation strategy allowed the nature and extent of contamination associated with each CAS to be established, if necessary. The following subsections describe the specific CAU 124 investigation activities.

D.2.2.1 Radiological Surveys

Radiological surveys (i.e., scanning, static, and swipe collection) were performed at all CASs during the CAI. Radiological surveys were performed to identify the nature and the extent of radiological contaminants at activities statistically greater than background. Radiological walkover surveys were conducted at CASs 08-02-01, 15-02-01, 16-02-03, 16-02-04, and 16-99-04 using a handheld plastic scintillation detector in conjunction with a global positioning receiver and datalogger. To conduct radiological static surveys to detect alpha and beta/gamma radiation, a handheld instrument was held within an inch over the sample for one minute. To support unrestricted release determinations per the *NV/YMP Radiological Control* (RadCon) *Manual* (NNSA/NSO, 2004), radiological surveys were performed at the CASs using various alpha and beta/gamma radiation detectors. Swipe samples were collected at CAS 15-02-01 for identification of removable contamination from the proximal and distal ends of the irrigation lines. These swipe samples were sent to an offsite laboratory for analysis.

D.2.2.2 Field Screening

Alpha and beta/gamma radiation were performed as specified in the SAFER Plan. Site-specific FSLs for alpha and beta/gamma radiation were defined as the mean background activity level, plus two times the standard deviation of readings from 10 background locations, selected near each CAS. The radiation FSLs are instrument-specific and were established for each instrument and CAS before use. The FSLs for gamma-emitting radionuclides were compared to the PALs established in the SAFER Plan (NNSA/NSO, 2007).

The CAS-specific sections of this document identify the CASs where field screening was conducted and how the FSLs were used to aid in the selection of sample locations. The FSRS were recorded on SCLs and are retained project files in hard copy.

D.2.2.3 Surface and Subsurface Soil Sampling

Soil samples were collected using "scoop and trowel" (surface hand-grab sampling) and backhoe. All sample locations were initially field screened for alpha and beta/gamma radiation before sampling began. Additional screening was conducted during sample collection to both guide the investigation and serve as a health and safety control and to protect the sampling team. Labeled sample containers were filled according to the following sequence: VOCs and TPH-gasoline-range organics (GRO) sample containers were filled with soil directly from the sample location. Additional soil was transferred into a stainless-steel pan, homogenized, and field screened for alpha and beta/gamma radiation. Samples for the analysis of gamma radiation and TPH-DRO were then collected from the homogenized soil. All remaining sample containers were then filled. Excess soil was returned to its original location.

Surface soil samples were collected from 0.0 to 0.5 ft below ground surface (bgs), at biased locations focusing on stained soil, aboveground features (i.e., concrete pads, exposed fuel oil piping), or areas with elevated radiological measurements, if present.

Subsurface soil samples were collected as a continuation at surface soil sample locations where native soil interface was determined, or where connections would have been made along the fuel lines to buildings. In addition to the collection of samples from biased locations, random surface sample locations were generated for Plots A and B at CAS 15-02-01, due to the absence of biasing factors. The sample locations were generated using VSP (PNNL, 2005).

D.2.2.4 Waste Characterization Sampling

Characterization of CAS-specific components, objects, materials, and waste was performed to support recommendations for disposal of these items during anticipated closure activities and to determine whether the CAS waste in question could be misrepresented as a source of potential soil contamination. Investigation methods included visual inspection, radiological surveys, and direct sampling. Waste characterization activities were intended to gather adequate information and data about the CAS to support decisions regarding the disposal of materials located within each CAS.

Samples were analyzed in accordance with the SAFER Plan (NNSA/NSO, 2007). The specific analyses for each CAS are listed in CAS-specific sections, and the analytical results are compared to

the federal limits for hazardous waste, NDEP hydrocarbon action limit, landfill acceptance criteria, and the limits in the NTS performance objective criteria (POC) (BN, 1995). The POC limits have been established for NTS hazardous waste generators to ensure that all hazardous waste shipped offsite contains no "added radioactivity."

Specific waste characterization sampling and analysis was conducted on the following potential waste stream:

- Soil samples collected from CAS 08-02-01 for waste stream determination of a diesel fuel spill. The samples were analyzed for TCLP VOCs, VOCs, gamma spectroscopy, isotopic U, isotopic Pu, and Sr-90.

D.2.2.5 Video Surveying

Video surveys were not applicable or conducted at the CAU 124 CASs.

D.2.3 Laboratory Analytical Information

Radiological analyses were performed by Eberline Services, of Oak Ridge, Tennessee. Chemical analyses were performed by EMAX Laboratories, Inc., of Torrance, California. The analytical suites and laboratory analytical methods used to analyze investigation samples are listed in Table D.2-2. Analytical results are reported in this appendix if they were detected above the MDCs. The complete laboratory data packages are available in the project files.

Table D.2-2
Laboratory Analytical Parameters and Methods, CAU 124 Investigation Samples[a]

Analytical Parameter	Analytical Method[b]
Volatile Organic Compounds	EPA SW-846 8260B[c]
Semivolatile Organic Compounds	EPA SW-846 8270C[c]
RCRA Metals[d]	EPA SW-846 6010B / 7470A / 7471A[c]
TPH-DRO	EPA SW-846 8015[c] Modified
TPH-GRO	EPA SW-846 8015[c] Modified
Polychlorinated Biphenyls	EPA SW-846 8082[c]
Pesticides	EPA SW-846 8081A[c]
Herbicides	EPA SW-846 8151A[c]
TCLP Volatile Organic Compounds	EPA SW-846 1311/8260B[c]
Gamma Spectroscopy	DOE EML HASL 300[e] Approved Laboratory SOPs[f]
Isotopic Uranium	DOE EML HASL-300[e] U-02-RC Modified, Approved Laboratory SOPs[f]
Isotopic Plutonium	DOE EML HASL-300[e] PU-02-RC/PU-10-RC Modified, Approved Laboratory SOPs[f]
Strontium-90	DOE EML HASL-300[g], Sr-02, Approved Laboratory SOPs[f]
Gross Alpha/Beta	EPA 900.0[g] Modified, Approved Laboratory SOPs[f]
Tritium	EPA 906.0[g] Modified, Approved Laboratory SOPs[f]

[a]Investigation samples include both environmental and waste characterization samples and associated quality control samples.
[b]The most current EPA, DOE, ASTM, or NIOSH or equivalent accepted analytical method may be used.
[c]*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, 3rd edition, Parts 1-4, SW-846 CD-ROM (EPA, 1996).
[d]Arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver.
[e]*The Procedures Manual of the Environmental Measurements Laboratory*, HASL-300 (DOE, 1997).
[f]Laboratory Standard Operating Procedures approved by SNJV in accordance with industry standards and the SNJV Model Statement of Work requirements (SNJV, 2006).
[g]*Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA, 1980).

Note: The term "modified" indicates modifications of approved methods. All modifications have been approved by SNJV Analytical Services.

ASTM = American Society of Testing and Materials
DOE = U.S. Department of Energy
DRO = Diesel-range organics
EML = Environmental Measurements Laboratory
EPA = U.S. Environmental Protection Agency
GRO = Gasoline-range organics
HASL = Health and Safety Laboratory
NIOSH = National Institute for Occupational Safety and Health
RCRA = *Resource Conservation and Recovery Act*
SOP = Standard Operating Procedure
SNJV = Stoller-Navarro Joint Venture
TCLP = Toxicity Characteristic Leaching Procedure
TPH = Total petroleum hydrocarbons

The analytical parameters are CAS-specific and were selected through the application of site process knowledge according to the DQOs presented in Appendix A. Validated analytical data for CAU 124 investigation samples were compiled and evaluated to confirm the presence, and define the extent, of contamination if present. The analytical results for the CAI are presented in Sections D.3.0 through D.10.0.

D.2.4 Comparison to Action Levels

A COC is defined as a 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 unacceptable risk based on a multiple constituent analysis (NNSA/NSO, 2006).

If COCs are present in a CAS, corrective action must be considered. The CAU 124 investigation FALs are defined for each CAS in Appendix H. Results that are equal to or greater than FALs are identified in bold text in the CAS-specific results tables (Sections D.3.0 through D.10.0).

The presence of a COC requires corrective action. A corrective action may also be necessary if there is a potential for wastes present at a site (i.e., potential source material) to release COCs into site environmental media.

To evaluate potential source material for the potential introduction of a COC into 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.

D.3.0 CAS 08-02-01, Underground Storage Tank Investigation Results

Corrective Action Site 08-02-01 is located in Area 8 and believed to be associated with the Area 8 Trailer Park, which is near the Area 2 Camp (Figure D.1-1). This site was identified in the FFACO as a UST with unknown contents and use (REECo, 1991). Several components were identified in the SAFER Plan for investigation, including the excavation of the potential UST and the determination of the aboveground piping. The images in Figure D.3-1 reflect the sample points and a depiction of CAS 08-02-01 before, during, and after investigative activities. Additional detail is provided in the SAFER Plan.

D.3.1 SAFER Activities

A total of three characterization samples (including 1 field duplicate [FD]) were collected during investigation activities at CAS 08-02-01. No samples were collected associated with a UST as there was not one identified during the CAI. The sample IDs, locations, types, and analyses are listed in Table D.3-1. The specific CAI activities conducted to satisfy the SAFER Plan requirements at this CAS are described in the following sections.

D.3.1.1 Field Screening

The soil samples were field screened for alpha and beta/gamma radiation. The FSRs were compared to FSLs to guide subsequent sampling decisions where appropriate. Field screening radiological FSLs were not exceeded in any samples.

D.3.1.2 Radiological Surveys

A radiological walkover survey was conducted at CAS 08-02-01 in 2003. The survey area encompassed approximately 28,000 square feet (ft^2). The CAS 08-02-01 maximum gamma radiation emission rate was not distinguishable from local background (Nicosia, 2003).

D.3.1.3 Visual Inspections

There was no visible staining or other biasing factors identified at CAS 08-02-01.

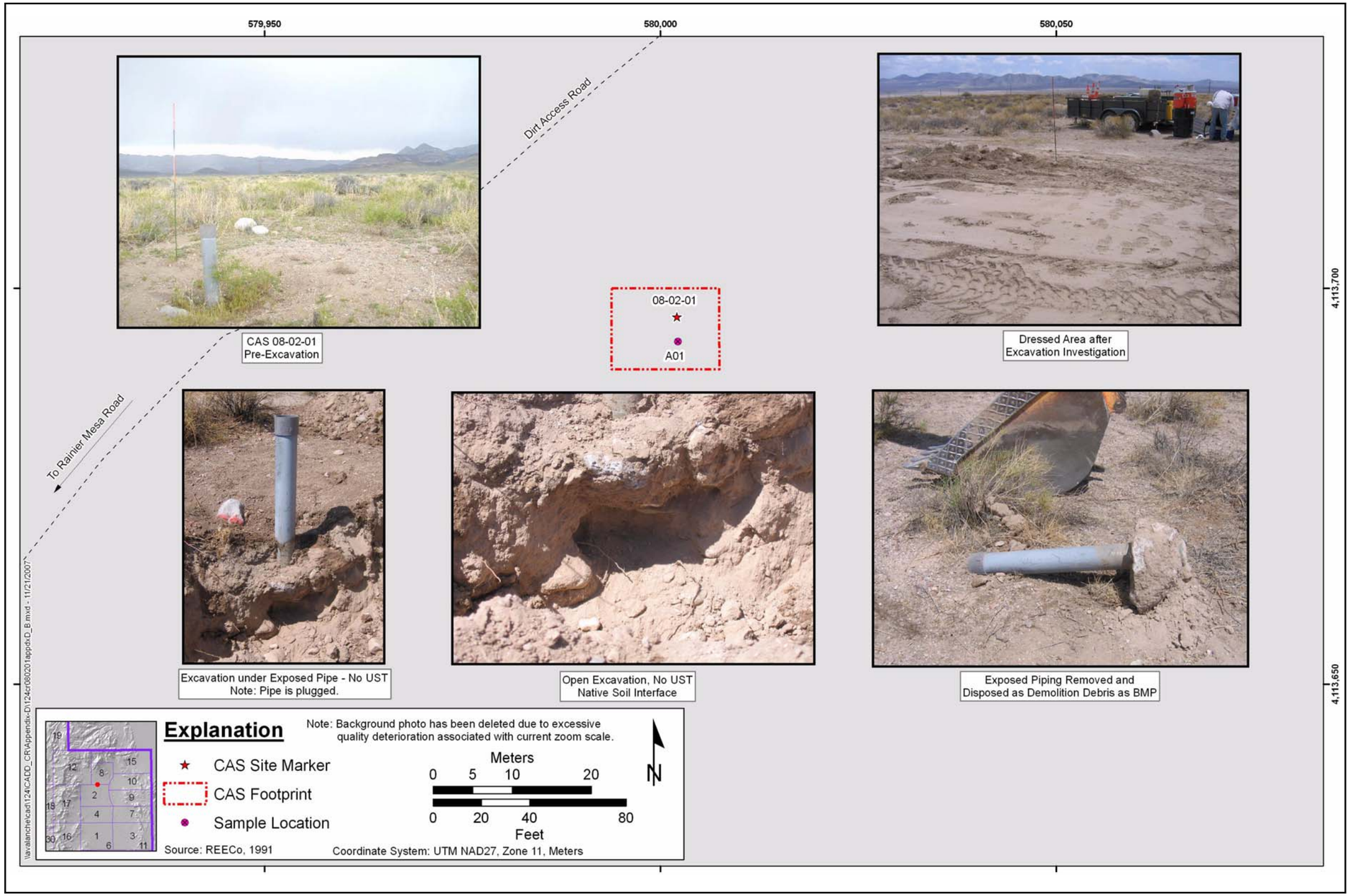

Figure D.3-1
Sample Locations and Excavation Activities at CAS 08-02-01, Underground Storage Tank

Table D.3-1
Samples Collected at CAS 08-02-01, Underground Storage Tank

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
A01	124A001	0.0 - 0.5	Soil	Environmental	Set 1
	124A002	0.0 - 0.5	Soil	Field Duplicate of 124A001	Set 1
A02	124A003	5.5 - 6.0	Soil	Environmental	Set 1
N/A	124A300	N/A	Water	Trip Blank	VOCs
N/A	124A301	N/A	Water	Field Blank	Set 1
N/A	124A302	N/A	Water	Trip Blank	VOCs
N/A	124A303	N/A	Water	Trip Blank	VOCs
N/A	124A500	N/A	Solid	Waste Management	Set 2
N/A	124A501	N/A	Liquid	Waste Management	VOCs

Set 1 = VOCs, SVOCs, RCRA Metals, TPH-DRO, PCBs, Gamma Spectroscopy
Set 2 = TCLP VOCs, Isotopic Uranium, Isotopic Plutonium, Strontium-90, Gamma Spectroscopy

bgs = Below ground surface
DRO = Diesel-range organics
ft = Foot
N/A = Not applicable
PCB = Polychlorinated biphenyl
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

D.3.1.4 Sample Collection

Decision I environmental sampling activities included the collection of surface and subsurface soil samples surrounding the PVC pipe, and at the native soil interface of the excavation, respectively (Figure D.3-1). No samples were collected associated with a UST as there was not one found during the CAI.

As a result of a diesel spill during the CAI, two waste characterization samples were collected. Waste sample results are discussed in Section D.8.0.

D.3.1.5 Deviations

Investigation samples were collected as outlined in the SAFER Plan and submitted for laboratory analysis. There were no deviations from the SAFER Plan.

D.3.2 Investigation Results

The following sections provide analytical results from the samples collected to complete investigation activities. Investigation samples were analyzed for the SAFER Plan-specified COPCs, which included VOCs, semivolatile organic compounds (SVOCs), TPH-DRO, RCRA metals, PCBs, and gamma-emitting radionuclides. The analytical parameters and laboratory methods used to analyze the investigation samples are listed in Table D.2-2. Table D.3-1 lists the sample-specific analytical suite for CAS 08-02-01. The CAS 08-02-01 waste characterization analytical results are discussed in Section D.8.0.

Analytical results from environmental samples with concentrations exceeding MDCs are summarized in the following sections. An evaluation was conducted on all contaminants detected above MDCs by comparing individual concentration or activity results against the FALs. Establishment of the FALs are presented in Appendix H. The FALs were established as the corresponding PAL concentrations (or activities) if the contaminant concentrations were below their respective PALs.

D.3.2.1 Volatile Organic Compounds

No VOCs were detected above MDCs at CAS 08-02-01.

D.3.2.2 Semivolatile Organic Compounds

No SVOCs were detected above MDCs at CAS 08-02-01.

D.3.2.3 Total Petroleum Hydrocarbons

The TPH-DRO concentrations for environmental samples collected at this CAS, that were reported above MDCs, are presented in Table D.3-2. No TPH-DRO was detected at concentrations exceeding the 100 mg/kg PAL. The FAL was established at the PAL concentration.

Table D.3-2
Sample Results for TPH-DRO Detected Above Minimum Detectable Concentrations at CAS 08-02-01, Underground Storage Tank

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Diesel-Range Organics
Preliminary Action Level[a]			100
A01	124A001	0.0 - 0.5	26
	124A002	0.0 - 0.5	14

[a]Based on *Nevada Administrative Code*, "Contamination of Soil: Establishment of Action Levels" (NAC, 2006).

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

D.3.2.4 RCRA Metals

The RCRA metals concentration for environmental samples collected at this CAS, that were detected above MDCs, are presented in Table D.3-3. No metals were detected at concentrations exceeding their PALs. The FALs were established at the PAL concentrations.

D.3.2.5 Polychlorinated Biphenyls

No PCBs were detected above MDCs at CAS 08-02-01.

Table D.3-3
Sample Results for RCRA Metals Detected Above Minimum Detectable Concentrations at CAS 08-02-01, Underground Storage Tank

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)				
			Arsenic	Barium	Cadmium	Chromium	Lead
Final Action Levels			**23[a]**	**67,000[b]**	**450[b]**	**450[b]**	**800[b]**
A01	124A001	0.0 - 0.5	2.34	165 (J)	0.644	1.18	6.98
	124A002	0.0 - 0.5	1.95	95.8 (J)	0.731	1.83	7.26
A02	124A003	5.5 - 6.0	2.75	73.9 (J)	--	2.11	10.6

[a]Based on the background concentrations for metals. Background is considered the mean plus two times the standard deviation for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (NBMG, 1998; Moore, 1999).
[b]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004)

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

J = Estimated value
-- = Not detected above minimum detectable concentrations

D.3.2.6 Gamma-Emitting Radionuclides

Gamma-emitting radionuclides concentration for environmental samples collected at this CAS, that were detected above MDCs, are presented in Table D.3-4. No gamma-emitting radionuclides were detected at concentrations exceeding their PALs. The FALs were established at the PAL concentrations.

Table D.3-4
Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentrations at CAS 08-02-01, Underground Storage Tank

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Actinium-228	Americium-241	Cesium-137	Lead-212	Lead-214	Thallium-208
Final Action Levels			**5[a]**	**12.7[b]**	**12.2[b]**	**5[a]**	**5[a]**	**5[a]**
A01	124A001	0.0 - 0.5	2.455	1.171	2.823	2.5	1.6	2.408 (J)
	124A002	0.0 - 0.5	2.637	0.911	2.482	2.658	1.56	2.33 (J)
A02	124A003	5.5 - 6.0	2.297	--	--	2.597	1.352	2.105 (J)

[a]Taken from the generic guidelines for residual concentrations of actinium-228, bismuth-214, lead-212, lead-214, thallium-208, and thorium-232, as found in Chapter IV of DOE Order 5400.5, Change 2, "Radiation Protection of the Public and Environment." (DOE, 1993). The PALs for these isotopes are specified as 5 pCi/g averaged over the first 15 cm of soil and 15 pCi/g for deeper soils (DOE, 1993). For purposes of this document, 15 cm is assumed to be equivalent to 0.5 ft (6 inches); therefore, 5 pCi/g represents the PALs for these radionuclides in the surface soil (0 to 0.5 ft depth).
[b]Taken from the construction, commercial, industrial land-use scenario in Table 2.1 of the NCRP Report No. 129, *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-millirem-per-year dose.

bgs = Below ground surface
cm = Centimeter
ft = Foot
NCRP = National Council on Radiation Protection and Measurements
PAL = Preliminary action level
pCi/g = Picocuries per gram

J = Estimated value
-- = Not detected above minimum detectable concentrations

D.3.3 Nature and Extent of Contamination

Based on the analytical results for environmental samples collected, there are no COCs at CAS 08-02-01.

D.3.4 Revised Conceptual Site Model

The SAFER Plan requirements were met at this CAS, and no revisions were necessary to the CSM.

D.4.0 CAS 15-02-01, Irrigation Piping Investigation Results

Corrective Action Site 15-02-01 is located at the former U.S. Environmental Protection Agency (EPA) Farm in Area 15 (Figure D.1-1) and consists of two farm plots, a reservoir, and two concrete pads. Farm Plots A and B are fenced with a short fence separating the two areas. Steel irrigation lines that span the entire length of each plot are visible at the surface. The irrigation lines are on the ground surface in some areas and below ground surface in others. The ground surface is mostly level in both plots.

The reservoir at the EPA Farm is a depression with surrounding berms. The depression is lined with concrete. The bottom of the reservoir is silty soils with dried moss.

The concrete pads are located within the footprint of Plot B of CAS 15-02-01. These pads are the remnants of a former greenhouse and storage shed. The concrete pads show no signs of staining or other biasing factors. The surrounding soils are gravelly mix with sediments. Figure D.4-1 depicts the CAS 15-02-01 with the locations where samples were collected.

D.4.1 SAFER Activities

A total of 40 characterization samples (including 2 FDs) were collected at CAS 15-02-01 during investigation activities. The sample IDs, locations, types, and analyses are listed in Table D.4-1. The specific CAI activities conducted to satisfy the SAFER Plan requirements at this CAS are described in the following sections.

D.4.1.1 Field Screening

The environmental samples were field screened for alpha and beta/gamma radiation. The FSRs were compared to FSLs to guide subsequent sampling decisions where appropriate. Field screening radiation FSLs had minor exceedances in several samples; however, only one exceeded background. The one sample (124B037) had an elevated reading approximately three times background and was collected from the middle side of the storage shed concrete pad. Gross alpha/gross beta was added to this sample suite.

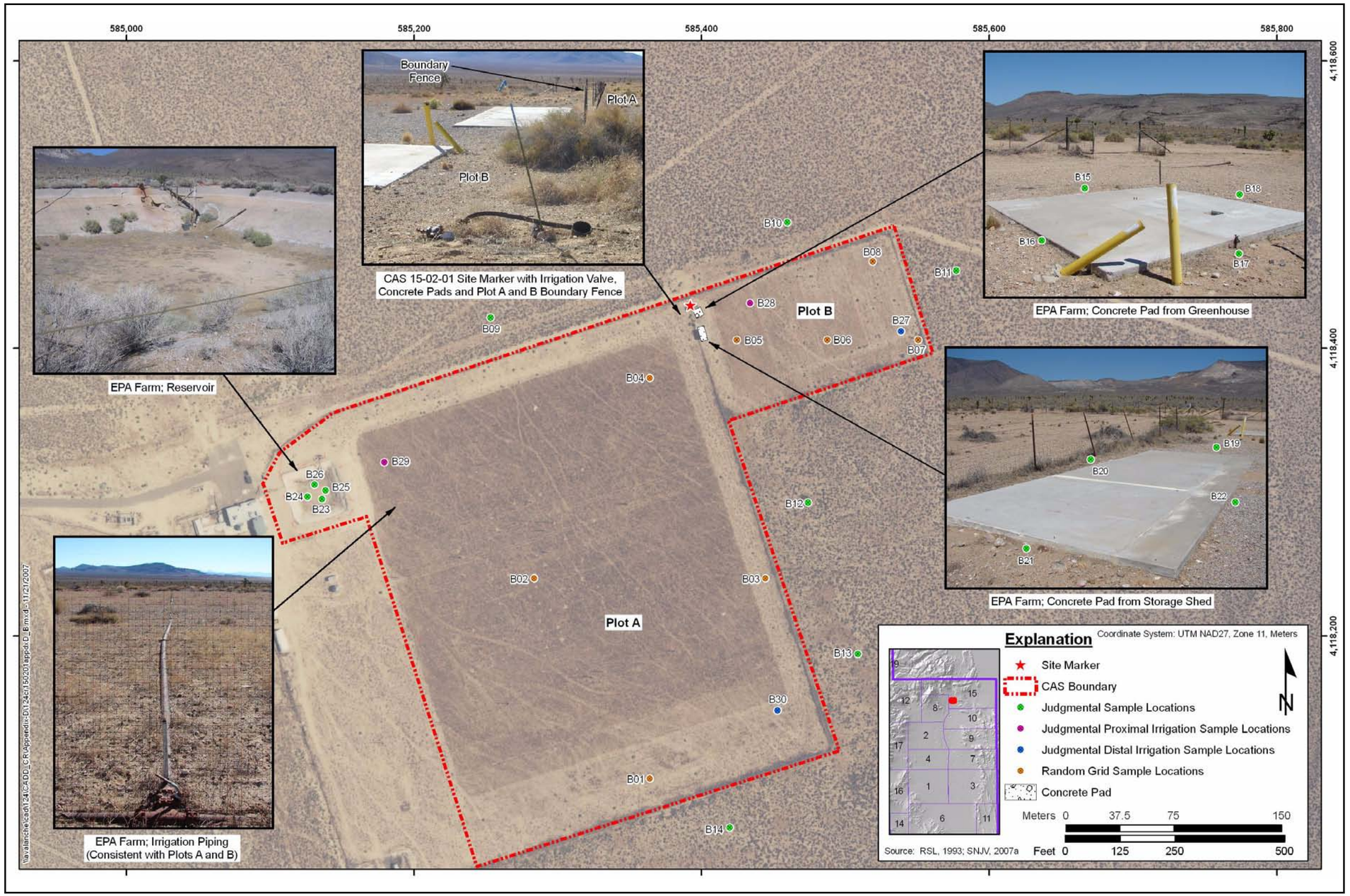

Figure D.4-1
Site Map and Sample Locations at CAS 15-02-01, Irrigation Piping

Table D.4-1
Samples Collected at CAS 15-02-01, Irrigation Piping
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
B01	124B027	0.0 - 0.5	Soil	Environmental	Set 3
B02	124B028	0.0 - 0.5	Soil	Environmental	Set 3
B03	124B031	0.0 - 0.5	Soil	Environmental	Set 3
B04	124B026	0.0 - 0.5	Soil	Environmental	Set 3
B05	124B012	0.0 - 0.5	Soil	Environmental	Set 3
B06	124B013	0.0 - 0.5	Soil	Environmental	Set 3
B07	124B014	0.0 - 0.5	Soil	Environmental	Set 3
B08	124B015	0.0 - 0.5	Soil	Environmental	Set 3
B09	124B001	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy
B10	124B002	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy
B11	124B003	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy
B12	124B004	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy
B13	124B005	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy
B14	124B006	0.0 - 0.5	Soil	Environmental	Gamma Spectroscopy
B15	124B035	0.0 - 0.5	Soil	Environmental	Set 3
B16	124B032	0.0 - 0.5	Soil	Environmental	Set 3
	124B033	0.0 - 0.5	Soil	Field Duplicate of 124B032	Set 3
B17	124B034	0.0 - 0.5	Soil	Environmental	Set 3
B18	124B036	0.0 - 0.5	Soil	Environmental	Set 3
B19	124B040	0.0 - 0.5	Soil	Environmental	Set 3
B20	124B039	0.0 - 0.5	Soil	Environmental	Set 3
B21	124B037	0.0 - 0.5	Soil	Environmental	Set 3, Gross Alpha/Beta
B22	124B038	0.0 - 0.5	Soil	Environmental	Set 3
B23	124B011	0.0 - 0.5	Soil	Environmental	Set 3

Table D.4-1
Samples Collected at CAS 15-02-01, Irrigation Piping
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
B24	124B007	0.0 - 0.5	Soil	Environmental	Set 3, Isotopic Uranium[a]
B25	124B008	0.0 - 0.5	Soil	Environmental	Set 3, Isotopic Uranium[a]
	124B009	0.0 - 0.5	Soil	Field Duplicate of 124B008	Set 3
B26	124B010	0.0 - 0.5	Soil	Environmental	Set 3
B27	124B016	0.0 - 0.5	Soil	Environmental	Set 3
	124B019	0.5 - 1.0	Soil	Environmental	Set 3
	124B021	N/A	Swipe	Environmental	Gamma Spectroscopy
B28	124B017	0.0 - 0.5	Soil	Environmental	Set 3
	124B018	0.5 - 1.0	Soil	Environmental	Set 3
	124B020	N/A	Swipe	Environmental	Gamma Spectroscopy
B29	124B024	0.0 - 0.5	Soil	Environmental	Set 3
	124B025	0.5 - 1.0	Soil	Environmental	Set 3
	124B023	N/A	Swipe	Environmental	Gamma Spectroscopy
B30	124B029	0.0 - 0.5	Soil	Environmental	Set 3
	124B030	0.5 - 1.0	Soil	Environmental	Set 3
	124B022	N/A	Swipe	Environmental	Gamma Spectroscopy
N/A	124B301	N/A	Water	Trip Blank	VOCs
N/A	124B302	N/A	Water	Trip Blank	VOCs
N/A	124B303	N/A	Water	Trip Blank	VOCs
N/A	124B304	N/A	Water	Field Blank	Set 3

[a] Isotopic Uranium performed on these two reservoir samples as Tier 2 due to the detection of lead-214

Set 3 = VOCs, SVOCs, RCRA Metals, PCBs, Pesticides, Herbicides, Gamma Spectroscopy, Tritium

bgs = Below ground surface
ft = Foot
N/A = Not applicable
PCB = Polychlorinated biphenyl
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
VOC = Volatile organic compound

D.4.1.2 Radiological Surveys

A radiological walkover survey at CAS 15-02-01 was conducted in November 2006. The survey area encompassed approximately 150,000 ft^2. The maximum gamma radiation emission rate was approximately 1.4 times local background (SNJV, 2007a). The survey did not identify any biased sample locations.

D.4.1.3 Visual Inspections

There was no visible staining or other biasing factors identified at CAS 15-02-01.

D.4.1.4 Sample Collection

Decision I environmental sampling activities included the collection of 40 surface and subsurface soil samples (including 2 FD), as shown in Figure D.4-1 and presented in the SAFER Plan. Surface soil samples (0.0 to 0.5 ft) were collected at all points referenced, except for the proximal ends, and distal ends of the irrigation lines in Plots A and B. These irrigation ends included subsurface samples from 0.5 to 1.0 ft bgs, and a swipe sample from inside each end of each line for each plot.

D.4.1.5 Deviations

Investigation samples were collected and submitted for laboratory analysis. There were three deviations from the planned sampling activities. Analysis for gross alpha and gross beta were added to the sample suite, for sample 124B037 due to a high FSL. Polychlorinated biphenyls were added to sample suites, except for the outer boundary gamma spectroscopy soil samples, and the swipe samples. The analytical laboratory reported tritium in units of pCi/g instead of pCi/L.
(See Section D.4.2.8 for the explanation for this deviation.)

D.4.2 Investigation Results

The following sections provide analytical results from the samples collected to complete investigation activities as outlined in the SAFER Plan. Investigation samples were analyzed for the SAFER Plan-specified COPCs, which included VOCs, SVOCs RCRA metals, pesticides, herbicides, gamma-emitting radionuclides, and tritium. The analytical parameters and laboratory methods used

in the investigation, along with the PCBs, are listed in Table D.2-2. Table D.4-1 lists the CAS 15-02-01 sample-specific analytical suite.

Analytical results from the environmental samples with concentrations exceeding MDCs are summarized in the following sections. An evaluation was conducted on all contaminants detected above MDCs by comparing individual concentration or activity results against the FALs. Establishment of the FALs are presented in Appendix H. The FALs were established as the corresponding PAL concentrations (or activities) if the contaminant concentrations were below their respective PALs.

D.4.2.1 Volatile Organic Compounds

The VOCs concentration for environmental samples collected at this CAS, that were detected above MDC, are presented in Table D.4-2. No VOCs were detected at concentrations exceeding their PALs. The FALs were established at the PAL concentrations.

Table D.4-2
Sample Results for VOCs Detected Above Minimum Detectable Concentrations at CAS 15-02-01, Irrigation Piping
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)			
			2-Butanone	Acetone	Trichlorofluoromethane	Xylenes (Total)
Final Action Levels[a]			**110,000**	**54,000**	**2,000**	**420**
B01	124B027	0.0 - 0.5	--	0.0089 (J)	--	--
B02	124B028	0.0 - 0.5	--	--	0.0027 (J)	--
B04	124B026	0.0 - 0.5	--	0.0066 (J)	0.0023 (J)	--
B05	124B012	0.0 - 0.5	--	--	0.0029 (J)	--
B07	124B014	0.0 - 0.5	--	0.0078 (J)	0.0024 (J)	--
B20	124B039	0.0 - 0.5	--	--	0.0022 (J)	--

Table D.4-2
Sample Results for VOCs Detected Above Minimum Detectable Concentrations at CAS 15-02-01, Irrigation Piping
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)			
			2-Butanone	Acetone	Trichlorofluoromethane	Xylenes (Total)
Final Action Levels[a]			**110,000**	**54,000**	**2,000**	**420**
B24	124B007	0.0 - 0.5	--	--	0.0026 (J)	--
B25	124B008	0.0 - 0.5	0.0099 (J)	0.062	0.0026 (J)	--
	124B009	0.0 - 0.5	0.015 (J)	0.081	0.0079	--
B27	124B016	0.0 - 0.5	0.007 (J)	0.089	0.0034 (J)	0.013
	124B019	0.5 - 1.0	--	0.013 (J)	--	--
B29	124B024	0.0 - 0.5	--	0.007 (J)	--	--

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004)

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

J = Estimated value
-- = Not detected above minimum detectable concentrations

D.4.2.2 Semivolatile Organic Compounds

No SVOCs were detected above MDCs at CAS 15-02-01.

D.4.2.3 RCRA Metals

The RCRA metals concentration for environmental samples collected at this CAS, that were detected above MDCs, are presented in Table D.4-3. No metals were detected at concentrations exceeding their PALs. The FALs were established at the PAL concentrations.

Table D.4-3
Sample Results for RCRA Metals Detected Above Minimum Detectable Concentrations at CAS 15-02-01, Irrigation Piping
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)						
			Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium
Final Action Levels			**23[a]**	**67,000[b]**	**450[b]**	**450[b]**	**800[b]**	**310[b]**	**5,100[b]**
B01	124B027	0.0 - 0.5	5.47	111 (J)	0.233 (J)	3.58	16.2	--	0.58
B02	124B028	0.0 - 0.5	7.6	138 (J)	0.913	5.64	17.1	--	--
B03	124B031	0.0 - 0.5	4.38	112	0.51	2.87	13.6	--	--
B04	124B026	0.0 - 0.5	4.87	119 (J)	0.715	4.58	14.8	--	--
B05	124B012	0.0 - 0.5	4.2	119 (J)	0.821	4.74	13.7	--	--
B06	124B013	0.0 - 0.5	4.03	115 (J)	0.574	3.82	11.8	--	--
B07	124B014	0.0 - 0.5	3	115 (J)	0.469 (J)	3.05	9.12	--	--
B08	124B015	0.0 - 0.5	3.63	115 (J)	0.584	4.33	12	--	--
B15	124B035	0.0 - 0.5	4.57	105 (J)	0.973	3.82	18.4	1.61 (J)	--
B16	124B032	0.0 - 0.5	4.26	106 (J)	0.673	4.15	17.2	9.84 (J)	--
	124B033	0.0 - 0.5	4.29	104 (J)	0.639	3.86	26.9	7.99 (J)	--
B17	124B034	0.0 - 0.5	4.4	86.2 (J)	0.67	2.92	11.6	0.206 (J)	--
B18	124B036	0.0 - 0.5	3.83	99.4 (J)	2.28	4.05	14	0.164 (J)	--
B19	124B040	0.0 - 0.5	4.38	104 (J)	0.558	3.04	12.7	--	--
B20	124B039	0.0 - 0.5	4.1	100 (J)	0.567	2.72	21.6	--	--
B21	124B037	0.0 - 0.5	4.95	96.6 (J)	0.618	2.93	13.3	--	--
B22	124B038	0.0 - 0.5	5.25	102 (J)	0.525	3.58	47.3	--	--
B23	124B011	0.0 - 0.5	11.1	194 (J)	1.74	43.2	40.6	0.516	--
B24	124B007	0.0 - 0.5	9.52	328 (J)	2.97	15.6	67.7	1.5	
B25	124B008	0.0 - 0.5	12.6	344 (J)	3.24	17.9	59.5	1.28	0.587 (J-)
	124B009	0.0 - 0.5	15.5	329 (J)	2.96	19	59.7	1.13	0.641 (J-)
B26	124B010	0.0 - 0.5	5.65	119 (J)	0.756	4.22	25.3	0.14	--
B27	124B016	0.0 - 0.5	3.62	113 (J)	0.444 (J)	3.83	9.15	--	--
	124B019	0.5 - 1.0	4.73	126 (J)	0.529	4.52	10.7	--	--
B28	124B017	0.0 - 0.5	6.01	111 (J)	0.767	3.63	11.3	--	--
	124B018	0.5 - 1.0	5.15	129 (J)	0.731	4.18	17.8	--	--

Table D.4-3
Sample Results for RCRA Metals Detected Above Minimum Detectable Concentrations at CAS 15-02-01, Irrigation Piping
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)						
			Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium
Final Action Levels			**23[a]**	**67,000[b]**	**450[b]**	**450[b]**	**800[b]**	**310[b]**	**5,100[b]**
B29	124B024	0.0 - 0.5	7.21	156 (J)	1.07	5.79	16.8	--	--
	124B025	0.5 - 1.0	6.09	113 (J)	0.64	3.96	15.2	--	--
B30	124B029	0.0 - 0.5	4.7	106 (J)	0.785	2.34	14	--	--
	124B030	0.5 - 1.0	6.68	103 (J)	0.701	3.88	13.6	--	--

[a]Based on the background concentrations for metals. Background is considered the mean plus two times the standard deviation for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (NBMG, 1998; Moore, 1999).
[b]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004)

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

J = Estimated value
J- = The result is an estimated quantity, but the result may be biased low
-- = Not detected above minimum detectable concentrations

D.4.2.4 Polychlorinated Biphenyls

No PCBs were detected above MDCs at CAS 15-02-01.

D.4.2.5 Pesticides

Pesticide concentrations in the environmental samples collected at this CAS, that were detected above MDCs, are presented in Table D.4-4. No pesticides were detected at concentrations exceeding their PALs. The FALs were established at the PAL concentrations.

D.4.2.6 Herbicides

No herbicides were detected above MDCs at CAS 15-02-01.

Table D.4-4
Sample Results for Pesticides Detected Above Minimum Detectable Concentrations at CAS 15-02-01, Irrigation Piping

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)								
			4,4'-DDD	4,4'-DDT	Beta-BHC	Delta-BHC	Endosulfan II	Endrin Aldehyde	Endrin	Heptachlor Epoxide	Heptachlor
Final Action Levels[a]			**10**	**7**	**1.3**	**0.36**	**3,700**	**180**	**180**	**0.19**	**0.38**
B02	124B028	0.0 - 0.5	--	--	0.00061 (J)	--	--	--	--	--	0.00061 (J)
B06	124B013	0.0 - 0.5	--	--	--	--	--	--	--	0.0011 (J)	--
B08	124B015	0.0 - 0.5	--	--	0.00084 (J)	--	--	--	--	--	--
B16	124B032	0.0 - 0.5	0.0023 (J)	0.002 (J)	--	--	0.0024 (J)	0.0022 (J)	0.0035	--	--
	124B033	0.0 - 0.5	0.0023 (J)	0.0019 (J)	--	--	0.0027 (J)	0.0025 (J)	0.0034	0.00065 (J)	--
B24	124B007	0.0 - 0.5	--	--	--	0.00069 (J)	--	--	--	--	--
B25	124B008	0.0 - 0.5	--	0.0015 (J)	--	--	--	--	--	0.0013 (J)	--

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004)

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

J = Estimated value
-- = Not detected above minimum detectable concentrations

D.4.2.7 Gamma-Emitting Radionuclides

Gamma-emitting radionuclide concentrations in the environmental samples collected at this CAS that were detected above MDCs are presented in Table D.4-5. The radionuclide lead (Pb)-214 was detected at an activity exceeding the PAL of 5 pCi/g in three of the five (one duplicate) surface soil samples collected in the reservoir. Concentrations reported are 6.202 pCi/g in 124B007, 7.69 pCi/g in 124B008, and 7.894 pCi/g in 124B009 (a duplicate sample of 124B008). Samples 124B010 and 124B011 results are 3.129 pCi/g and 4.153 pCi/g, respectively.

The concentration of Pb-214 measured in soil exceeds the established PAL of 5 pCi/g. This PAL was specifically derived from DOE Order 5400.5 based on the decay chain of thorium (Th)-230. This 5 pCi/g action level specified in DOE Order 5400.5 (DOE, 1993) is only applicable to radium (Ra)-226, Ra-228, Th-230, and Th-232. The order further states that "guidelines for residual concentrations of other radionuclides shall be derived from the basic dose limits by means of an environmental pathway analysis using specific property data where available." Although Pb-214 is a daughter within the Th-230 decay chain, it is not regulated per the above generic guidelines for thorium and radium; rather, it falls under the requirement for property-specific analysis. Therefore, the action level of 5 pCi/g is not an appropriate PAL for Pb-214 under the specific conditions at CAS 15-02-01 given that this CAS was not a site where specific activities were conducted using materials of thorium or radium. Rather, the presence of Pb-214 at this CAS is believed to be due to the presence of its natural parent (the decay series of U-238 or U-234).

The CAU 124 SAFER Plan defines radionuclide PALs as being based either on DOE Order 5400.5 or on National Council on Radiation Protection and Measurements (NCRP) Report No. 129 (DOE, 1993; NCRP, 1999). As the DOE Order based PAL for Pb-214 is not applicable for this CAS, the regulatory guideline for soil concentrations of uranium as indicated in NCRP 129 should be used. In this case, NCRP 129 specifically indicates that "if a radionuclide is present in the soil only as a result of decay of a precursor also present in the soil, only the screening limit for the parent should be used because the dose from the daughter product is included in that of the precursor." The PAL of interest in this case is U-238 or U-234 (U-234 is a daughter product of U-238). As the concentration of U-234 was found to be less than its prescribed PAL, it may be concluded that the Pb-214 concentrations within the soil at CAS are also below action levels.

Table D.4-5
Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentrations at CAS 15-02-01, Irrigation Piping
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)						
			Actinium-228	Americium-241	Cesium-137	Lead-212	Lead-214	Thallium-208	Thorium-234
Final Action Levels			**5[a]**	**12.7[b]**	**12.2[b]**	**5[a]**	**5[a,c]**	**5[a]**	**105[b]**
B01	124B027	0.0 - 0.5	--	1	1.847	1.141	0.931	0.839 (J+)	--
B02	124B028	0.0 - 0.5	1.107	1.653	2.569	1.51	1.35	1.165 (J+)	--
B03	124B031	0.0 - 0.5	1.06	--	--	1.389	1.252	0.909 (J+)	--
B04	124B026	0.0 - 0.5	1.129	1.413	1.502	1.26	1.504	1.235 (J+)	--
B05	124B012	0.0 - 0.5	1.336	3.674	4.078	1.435	1.556	1.203 (J)	--
B06	124B013	0.0 - 0.5	1.34	2.081	2.869	1.381	1.578	1.093 (J)	--
B07	124B014	0.0 - 0.5	1.306	2.434	3.021	1.387	1.593	1.066 (J)	--
B08	124B015	0.0 - 0.5	1.546	2.96	4.23	1.429	1.603	1.227 (J)	--
B09	124B001	0.0 - 0.5	1.014	2.325	2.375	1.129	1.163	1.014 (J)	--
B10	124B002	0.0 - 0.5	1.177	1.05	1.219	1.554	1.731	1.157 (J)	--
B11	124B003	0.0 - 0.5	1.413	1.855	2.23	1.492	1.665	1.11 (J)	--
B12	124B004	0.0 - 0.5	1.103	2.406	2.419	1.405	1.423	1.308 (J)	--
B13	124B005	0.0 - 0.5	--	1.717	2.113	1.105	1.232	0.821 (J)	--
B14	124B006	0.0 - 0.5	1.27	1.486	3.037	1.238	1.227	0.91 (J)	--
B15	124B035	0.0 - 0.5	0.993	1.111	1.318	0.929	1.151	0.84 (J+)	--
B16	124B032	0.0 - 0.5	1.32	1.284	1.022	1.187	1.357	0.795 (J+)	--
B16	124B033	0.0 - 0.5	1.298	1.018	1.207	1.235	1.419	1.032 (J+)	--
B17	124B034	0.0 - 0.5	1.316	1.149	0.957	1.214	1.248	0.735 (J+)	--
B18	124B036	0.0 - 0.5	1.358	2.601	1.465	1.348	1.032	0.931 (J+)	--
B19	124B040	0.0 - 0.5	1.225	3.158	2.797	1.366	1.282	0.809 (J+)	--
B20	124B039	0.0 - 0.5	1.002	3.972	3.63	1.173	1.143	0.838 (J+)	--
B21	124B037	0.0 - 0.5	0.997	0.967	1.254	1.191	1.351	1.385 (J+)	--
B22	124B038	0.0 - 0.5	1.61	1.381	1.324	1.306	1.141	1.292 (J+)	--

Table D.4-5
Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentrations at CAS 15-02-01, Irrigation Piping
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)						
			Actinium-228	Americium-241	Cesium-137	Lead-212	Lead-214	Thallium-208	Thorium-234
Final Action Levels			**5[a]**	**12.7[b]**	**12.2[b]**	**5[a]**	**5[a,c]**	**5[a]**	**105[b]**
B23	124B011	0.0 - 0.5	1.85	0.524	0.327	2.057	4.153	1.681 (J)	--
B24	124B007	0.0 - 0.5	1.157	0.444	0.39	1.457	6.202	1.23 (J)	--
B25	124B008	0.0 - 0.5	3.916	2.299	0.501	3.755	7.69	2.992 (J)	9.087
	124B009	0.0 - 0.5	3.242	1.054	0.642	3.291	7.894	2.532 (J)	--
B26	124B010	0.0 - 0.5	0.97	0.426	0.311	1.348	3.129	1.133 (J)	--
B27	124B016	0.0 - 0.5	1.236	2.028	1.556	1.343	1.542	1.125 (J)	--
	124B019	0.5 - 1.0	1.461	--	0.613	1.607	1.677	1.241 (J)	--
B28	124B017	0.0 - 0.5	1.11	1.451	2.077	1.153	1.278	0.994 (J)	--
	124B018	0.5 - 1.0	1.026	1.147	1.286	1.163	1.094	0.916 (J)	--
B29	124B024	0.0 - 0.5	1.167	1.976	1.901	1.366	1.937	1.08 (J)	--
	124B025	0.5 - 1.0	0.928	1.766	1.385	1.268	1.427	0.858 (J)	--
B30	124B029	0.0 - 0.5	1.262	0.802	1.475	1.109	1.415	1.107 (J+)	--
	124B030	0.5 - 1.0	1.081	0.889	1.587	1.385	1.33	0.894 (J+)	--

[a]Taken from the generic guidelines for residual concentrations of actinium-228, bismuth-214, lead-212, lead-214, thallium-208, and thorium-232, as found in Chapter IV of DOE Order 5400.5, Change 2, "Radiation Protection of the Public and Environment." (DOE, 1993). The PALs for these isotopes are specified as 5 pCi/g averaged over the first 15 cm of soil and 15 pCi/g for deeper soils (DOE, 1993). For purposes of this document, 15 cm is assumed to be equivalent to 0.5 ft (6 inches); therefore, 5 pCi/g represents the PALs for these radionuclides in the surface soil (0 to 0.5 ft depth).
[b]Taken from the construction, commercial, industrial land-use scenario in Table 2.1 of the NCRP Report No. 129, *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-millirem-per-year dose.
[c] See Table D.4.2.7

bgs = Below ground surface
cm = Centimeter
ft = Foot
NCRP = National Council on Radiation Protection and Measurements
PAL = Preliminary action level
pCi/g = Picocuries per gram
J = Estimated value
J+ = The result is an estimated quantity, but the result may be biased high
-- = Not detected above minimum detectable concentrations

D.4.2.8 Tritium

Tritium in soil analytical results for environmental samples collected at this CAS, that were detected above MDCs, are presented in Table D.4-6. The tritium concentrations ranged between 2.58 and 9.521 pCi/g. The analytical laboratory mistakenly reported the tritium results in units of pCi/g instead of pCi/L. Due to the nature of the measurement, the units could not be converted accurately. Therefore, it was necessary to use the RESRAD code to calculate an industrial action level (Tier 2 site-specific target level [SSTL]) for tritium as stipulated in *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). An action level of 13,820,000 pCi/g was established as the FAL for tritium. Based on this action level, tritium is not present above the Industrial scenario FAL.

Table D.4-6
Sample Results for Tritium Detected Above Minimum Detectable Concentrations at CAS 15-02-01, Irrigation Piping
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)
			Tritium
Final Action Levels[a]			13,820,000
B01	124B027	0.0 - 0.5	4.515
B04	124B026	0.0 - 0.5	3.577
B07	124B014	0.0 - 0.5	5.896 (J)
B08	124B015	0.0 - 0.5	4.334 (J)
B15	124B035	0.0 - 0.5	3.574
B16	124B032	0.0 - 0.5	7.323
	124B033	0.0 - 0.5	3.43
B17	124B034	0.0 - 0.5	3.703
B19	124B040	0.0 - 0.5	2.713
B20	124B039	0.0 - 0.5	3.695
B22	124B038	0.0 - 0.5	4.535
B24	124B007	0.0 - 0.5	2.58 (J)
B25	124B008	0.0 - 0.5	3.498 (J)
B26	124B010	0.0 - 0.5	2.747 (J)
B27	124B016	0.0 - 0.5	9.521 (J)
	124B019	0.5 - 1.0	2.685 (J)

Table D.4-6
Sample Results for Tritium Detected Above Minimum Detectable Concentrations at CAS 15-02-01, Irrigation Piping
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)
			Tritium
Final Action Levels[a]			13,820,000
B28	124B017	0.0 - 0.5	3.429 (J)
	124B018	0.5 - 1.0	3.511 (J)
B29	124B024	0.0 - 0.5	3.439 (J)
	124B025	0.5 - 1.0	4.156 (J)
B30	124B029	0.0 - 0.5	5.672
	124B030	0.5 - 1.0	3.411

[a]See Section D.4.2.8

bgs = Below ground surface
ft = Foot
pCi/g = Picocuries per gram

J = Estimated value

D.4.2.9 Uranium Isotopes

Isotopic U analytical results for environmental samples collected at this CAS that were detected above MDCs are presented in Table D.4-7. No isotopic Pu or U exceeded the PALs. The FALs were established at the PAL concentrations.

Table D.4-7
Sample Results for Isotopic Uranium Detected Above Minimum Detectable Concentrations at CAS 15-02-01, Irrigation Piping
(Page 1 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)		
			Uranium-234	Uranium-235	Uranium-238
Final Action Levels[a]			143	17.6	105
B24	124B007	0.0 - 0.5	2.388	--	1.266
B25	124B008	0.0 - 0.5	2.859	0.269	2.349

Table D.4-7
Sample Results for Isotopic Uranium Detected Above Minimum Detectable Concentrations at CAS 15-02-01, Irrigation Piping
(Page 2 of 2)

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)		
			Uranium-234	Uranium-235	Uranium-238
Final Action Levels[a]			143	17.6	105

[a]Taken from the construction, commercial, industrial land-use scenario in Table 2.1 of the NCRP Report No. 129, *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-millirem-per-year dose.

bgs = Below ground surface
ft = Foot
NCRP = National Council on Radiation Protection and Measurements
pCi/g = Picocuries per gram

-- = Not detected above minimum detectable concentrations

D.4.3 Nature and Extent of Contamination

Based on the analytical results for environmental samples collected, there are no COCs at CAS 15-02-01.

D.4.4 Revised Conceptual Site Model

The SAFER Plan requirements were met at this CAS, and no revisions were necessary to the CSM.

D.5.0 CAS 16-02-03, Underground Storage Tank Investigation Results

Corrective Action Site 16-02-03 is located within the Area 16 Camp (Figure D.1-1). This site was identified in the FFACO as a UST, due to two exposed pipes with unknown contents (REECo, 1962). Engineering drawings of this CAS did not reveal a UST. Several components were identified for investigation in the SAFER Plan, including the excavation of the potential UST and the associated piping. The visual inspection of CAS 16-02-03 identified a slightly disturbed area with two steel capped pipes extending approximately 0.5 ft above ground surface. No visible staining or other biasing factors were identified. The images in Figure D.5-1 reflect the sample points and a depiction of CAS 16-02-03 before, during, and after investigative activities. Additional detail is provided in the SAFER Plan.

D.5.1 SAFER Activities

A total of four characterization samples (including 1 FDs) were collected during investigation activities at CAS 16-02-03. The sample IDs, locations, types, and analyses are listed in Table D.5-1. The specific CAI activities conducted to satisfy the SAFER Plan requirements at this CAS are described in the following sections.

D.5.1.1 Field Screening

The environmental samples were field screened for alpha and beta/gamma radiation. The FSRs were compared to FSLs to guide subsequent sampling decisions where appropriate. Radiation field screening FSLs were not exceeded in any samples.

D.5.1.2 Radiological Surveys

A radiological walkover survey at CAS 16-02-03 was conducted in March 2007. The CAS 16-02-03 maximum gamma radiation emission rate was not distinguishable from local background (SNJV, 2007b).

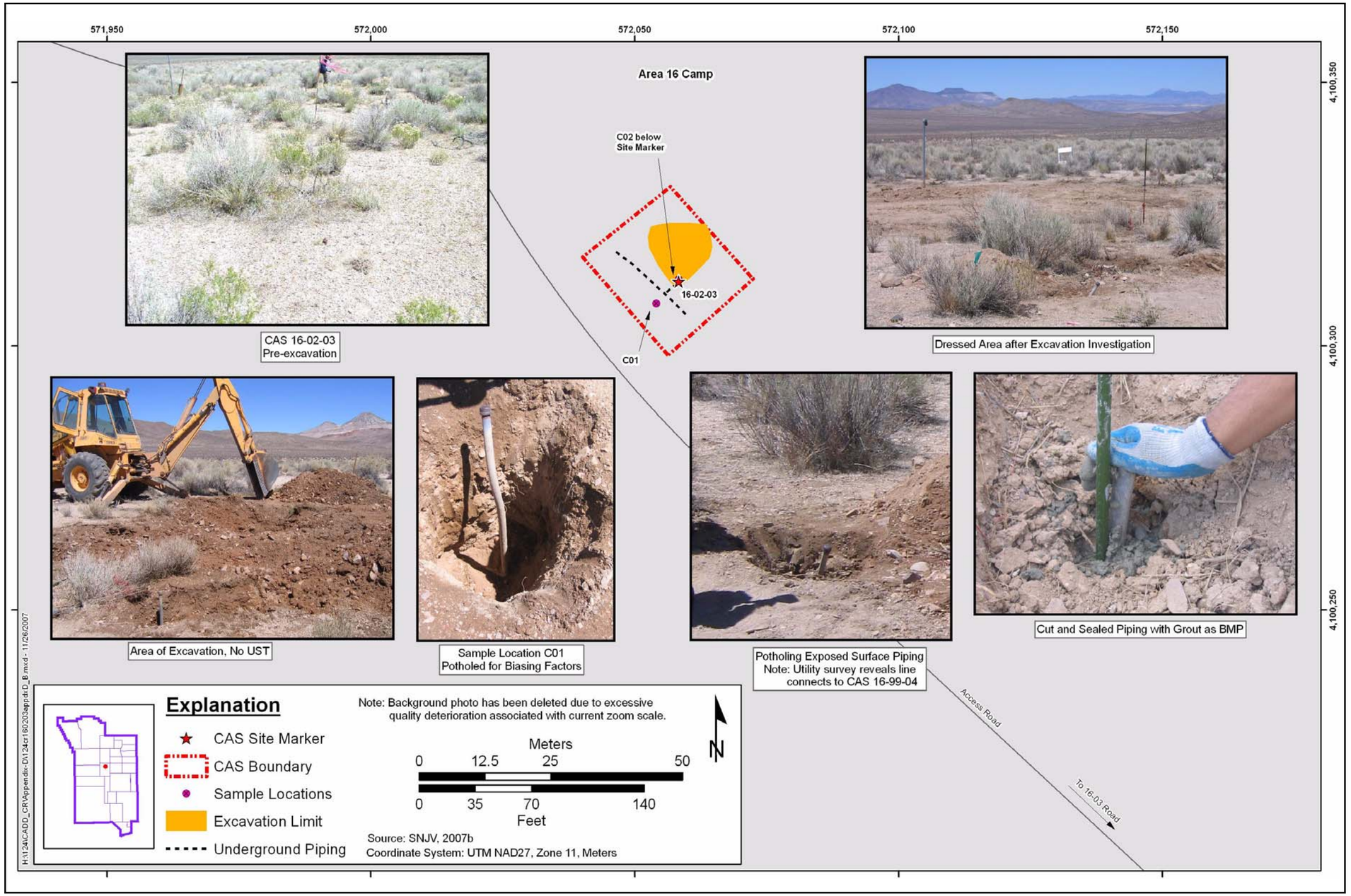

Figure D.5-1
Sample Locations and Excavation Activities at CAS 16-02-03, Underground Storage Tank

Table D.5-1
Samples Collected at CAS 16-02-03, Underground Storage Tank

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
C01	124C001	0.0 - 0.5	Soil	Environmental	Set 1
C02	124C002	0.0 - 0.5	Soil	Environmental	Set 1
	124C003	0.0 - 0.5	Soil	Field Duplicate of 124A002	Set 1
C03	124C004	2.0 - 2.5	Soil	Environmental	Set 1
N/A	124C301	N/A	Water	Trip Blank	VOCs
N/A	124C302	N/A	Water	Source Blank	Set 1, TPH-GRO
N/A	124C303	N/A	Water	Equipment Rinsate	Set 1

Set 1 = VOCs, SVOCs, RCRA Metals, TPH-DRO, PCBs, Gamma Spectroscopy

bgs = Below ground surface
ft = Foot
DRO = Diesel-range organics
GRO = Gasoline-range organics
N/A = Not applicable
PCB = Polychlorinated biphenyl
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

D.5.1.3 Visual Inspections

There was no visible staining or other biasing factors identified at CAS 16-02-03.

D.5.1.4 Sample Collection

Decision I environmental sampling activities included collection of samples at the surface, beside each exposed pipe and at the excavated native soil interface, where the UST was suspected to be located (Figure D.5-1). No samples were collected associated with a UST as there was not one found during the CAI.

D.5.1.5 Deviations

Investigation samples were collected as outlined in the SAFER Plan and submitted for laboratory analysis (NNSA/NSO, 2007). There were no deviations from the SAFER plan.

D.5.2 Investigation Results

Environmental investigation samples were analyzed for the SAFER Plan-specified COPCs, which included VOCs, SVOCs, TPH-DRO, RCRA metals, PCBs, and gamma-emitting radionuclides. The analytical parameters and laboratory methods used to analyze the investigative samples are listed in Table D.2-2. Table D.5-1 lists the CAS 16-02-03 sample-specific analytical suite.

Analytical results from the environmental samples, with concentrations exceeding MDCs, are summarized in the following sections. An evaluation was conducted on all contaminants detected above MDCs by comparing individual concentration or activity results to FALs. Establishment of the FALs is presented in Appendix H. The FALs were established as the corresponding PAL concentrations (or activities) if the contaminant concentrations were below their respective PALs.

D.5.2.1 Volatile Organic Compounds

The VOCs concentration in environmental samples collected at this CAS, that were detected above MDCs, are presented in Table D.5-2. Volatile organic compounds were not detected at concentrations exceeding their respective PALs. The FALs were established at the PAL concentrations.

Table D.5-2
Sample Results for VOCs Detected Above Minimum Detectable Concentrations at CAS 16-02-03, Underground Storage Tank

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Acetone
Final Action Levels[a]			54,000
C01	124C001	0.0 - 0.5	0.011 (J)
C02	124C002	0.0 - 0.5	0.0073 (J)
	124C003	0.0 - 0.5	0.0064 (J)

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004)

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

J = Estimated value

D.5.2.2 Semivolatile Organic Compounds

No SVOCs were detected above MDCs at CAS 16-02-03.

D.5.2.3 Total Petroleum Hydrocarbons

The TPH-DRO and-GRO concentrations in environmental samples collected at this CAS, that were detected above the MDCs, are presented in Table D.5-3. Total petroleum hydrocarbons-GRO were not detected above the MDC.

The TPH-DRO concentrations did not exceed the 100 mg/kg PAL. The FALs were established at the PAL concentrations.

Table D.5-3
Sample Results for TPH-DRO Detected Above Minimum Detectable Concentrations at CAS 16-02-03, Underground Storage Tank

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Diesel-Range Organics
Preliminary Action Levels[a]			100
C01	124C001	0.0 - 0.5	10
C02	124C002	0.0 - 0.5	15
	124C003	0.0 - 0.5	13

[a]Based on *Nevada Administrative Code*, "Contamination of Soil: Establishment of Action Levels" (NAC, 2006).

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

D.5.2.4 RCRA Metals

The RCRA metals concentrations in environmental samples collected at this CAS, that were detected above MDCs, are presented in Table D.5-4. No metals were detected at concentrations exceeding their PALs. The FALs were established at the PAL concentrations.

Table D.5-4
Sample Results for RCRA Metals Detected Above Minimum Detectable Concentrations at CAS 16-02-03, Underground Storage Tank

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)						
			Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Silver
Final Action Levels			**23[a]**	**67,000[b]**	**450[b]**	**450[b]**	**800[b]**	**310[b]**	**5,100[b]**
C01	124C001	0.0 - 0.5	4.14	217 (J)	0.265 (J)	5.9	53.6 (J)	--	--
C02	124C002	0.0 - 0.5	3.4	403 (J)	0.18 (J)	4.57	48.7 (J)	--	--
	124C003	0.0 - 0.5	3.73	126 (J)	0.31 (J)	5.6	18.9 (J)	--	--
C03	124C004	2.0 - 2.5	5.28	146 (J)	--	6.13	18.9 (J)	0.0384 (J)	1.74

[a]Based on the background concentrations for metals. Background is considered the mean plus two times the standard deviation for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (NBMG, 1998; Moore, 1999).
[b]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004)

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

J = Estimated value
-- = Not detected above minimum detectable concentrations

D.5.2.5 Polychlorinated Biphenyls

No PCBs were detected above MDCs at CAS 16-02-03.

D.5.2.6 Gamma-Emitting Radionuclides

Gamma-emitting radionuclide concentrations in environmental samples collected at this CAS, that were detected above MDCs, are presented in Table D.5-5. No gamma-emitting radionuclides were detected at concentrations exceeding their PALs. The FALs were established at the PAL concentrations.

Table D.5-5
Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentrations at CAS 16-02-03, Underground Storage Tank

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)					
			Actinium-228	Cesium-137	Lead-212	Lead-214	Thallium-208	Thorium-234
Final Action Levels			**5[a]**	**12.2[b]**	**5[a]**	**5[a]**	**5[a]**	**105[b]**
C01	124C001	0.0 - 0.5	2.382	0.453	2.645	1.324	2.115 (J+)	--
C02	124C002	0.0 - 0.5	2.802	0.279	2.857	1.723	2.338 (J+)	5.536
	124C003	0.0 - 0.5	2.43	0.394	3.121	1.856	2.092 (J+)	--
C03	124C004	2.0 - 2.5	3.097	--	3.063	1.596	2.504 (J+)	--

[a]Taken from the generic guidelines for residual concentrations of actinium-228, bismuth-214, lead-212, lead-214, thallium-208, and thorium-232, as found in Chapter IV of DOE Order 5400.5, Change 2, "Radiation Protection of the Public and Environment." (DOE, 1993). The PALs for these isotopes are specified as 5 pCi/g averaged over the first 15 cm of soil and 15 pCi/g for deeper soils (DOE, 1993). For purposes of this document, 15 cm is assumed to be equivalent to 0.5 ft (6 inches); therefore, 5 pCi/g represents the PALs for these radionuclides in the surface soil (0 to 0.5 ft depth).
[b]Taken from the construction, commercial, industrial land-use scenario in Table 2.1 of the NCRP Report No. 129, *Recommended Screening Limits for Contaminated Surface Soil and Review Factors Relevant to Site-Specific Studies* (NCRP, 1999). The values provided in this source document were scaled to a 25-millirem-per-year dose.

bgs = Below ground surface
cm = Centimeter
ft = Foot
NCRP = National Council on Radiation Protection and Measurements
pCi/g = Picocuries per gram

J+ = The result is an estimated quantity, but the result may be biased high
-- = Not detected above minimum detectable concentrations

D.5.3 Nature and Extent of Contamination

Based on the analytical results for environmental samples collected, there are no COCs at CAS 16-02-03.

D.5.4 Revised Conceptual Site Model

The SAFER Plan requirements were met at this CAS, and no revisions were necessary to the CSM.

D.6.0 CAS 16-02-04, Fuel Oil Piping Investigation Results

Corrective Action Site 16-02-04 is located within the Area 16 Camp (Figure D.1-1). This site was identified as having approximately 950 ft of fuel oil piping that was connected to an AST (REECo, 1991). The CAS 16-02-04 visual inspection showed little ground disturbance. Adjacent to the CAS site marker is a concrete pad that held the AST believed to have been connected to the fuel oil piping. The main connection at the concrete pad is a steel capped pipe exposed approximately 1.0 ft above ground surface. Other than this connection, the fuel oil piping is below ground surface, except for four locations, where the line has a stick-up where a connection would have been made. There are no other lines extending from the main fuel oil piping, which is consistent with the engineering drawings reviewed before the field effort. The images in Figure D.6-1 reflect the sample points and a depiction of CAS 16-02-04 before, during, and after investigative activities.

Several components were identified in the SAFER Plan for this investigation. Additional detail is provided in the SAFER Plan.

D.6.1 SAFER Activities

A total of 10 characterization samples (including 1 FD) were collected at CAS 16-02-04 during investigation activities. The sample IDs, locations, types, and analyses are listed in Table D.6-1 and shown on Figure D.6-1. The specific CAI activities conducted to satisfy the SAFER Plan requirements at this CAS are described in the following sections.

D.6.1.1 Field Screening

The environmental samples were field screened for alpha and beta/gamma radiation. The FSRs were compared to FSLs to guide subsequent sampling decisions where appropriate. Radiation field screening FSLs were not exceeded in any samples.

D.6.1.2 Radiological Surveys

A radiological walkover survey at CAS 16-02-04 was conducted in March 2007. The maximum gamma radiation emission rate for CAS 16-02-04 was not distinguishable from local background (SNJV, 2007b).

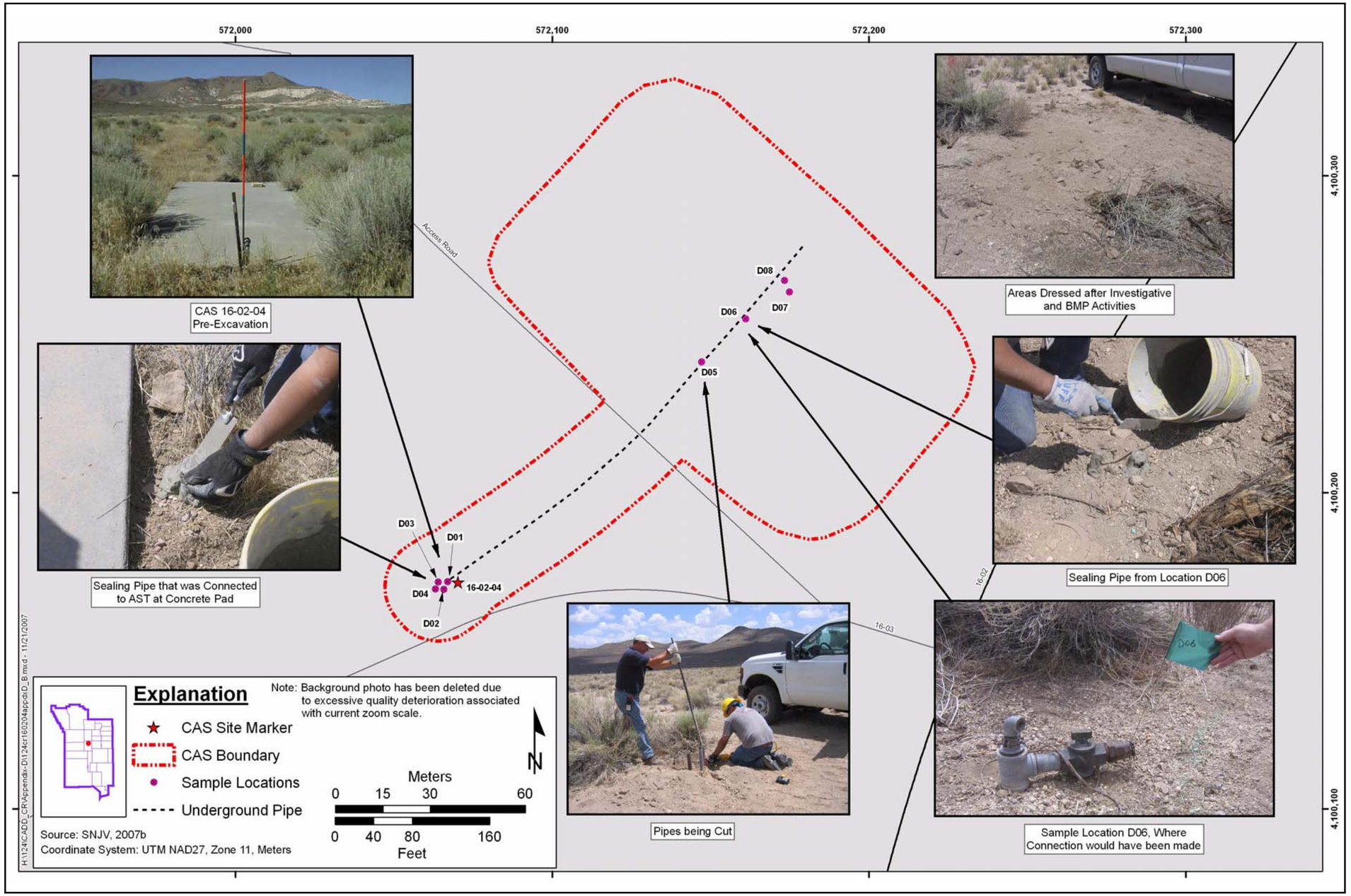

Figure D.6-1
Sample Locations and Investigation Activities at CAS 16-02-04, Fuel Oil Piping

Table D.6-1
Samples Collected at CAS 16-02-04, Fuel Oil Piping

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
D01	124D001	0.0 - 0.5	Soil	Environmental	Set 4
D02	124D002	0.0 - 0.5	Soil	Environmental	Set 4
D03	124D003	0.0 - 0.5	Soil	Environmental	Set 4
D04	124D004	0.0 - 0.5	Soil	Environmental	Set 4
	124D005	0.0 - 0.5	Soil	Field Duplicate of 124D004	Set 4
D05	124D006	0.0 - 0.5	Soil	Environmental	Set 4
	124D007	4.0 - 4.2	Soil	Environmental	Set 4
D06	124D008	0.0 - 0.5	Soil	Environmental	Set 4
D07	124D009	0.0 - 0.5	Soil	Environmental	Set 4
D08	124D010	0.0 - 0.5	Soil	Environmental	Set 4
N/A	124D301	N/A	Water	Trip Blank	VOCs

Set 4 = VOCs, SVOCs, TPH-DRO

bgs = Below ground surface
DRO = Diesel-range organics
ft = Foot
N/A = Not applicable
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

D.6.1.3 Visual Inspections

There was no visible staining or other biasing factors identified at CAS 16-02-04.

D.6.1.4 Sample Collection

Decision I environmental sampling activities included the collection of surface and subsurface soil samples (Figure D.6-1). Surface soil samples were collected at the mid-point of each side of the concrete pad. No concrete samples were taken due to a lack of biasing factors. Surface soil samples were also collected, along the fuel oil piping, at all discernible locations, where connections to either other lines or facilities would have been made. One subsurface soil sample (124D007) was collected, because several pipes were present, and the main piping turned slightly. This subsurface sample was collected to determine whether there was a release from joints; however, there were no obvious biasing factors (e.g., odor, staining).

D.6.1.5 Deviations

Investigation samples were collected as outlined in the SAFER Plan and submitted for laboratory analysis (NNSA/NSO, 2007). There were no deviations from the SAFER Plan.

D.6.2 Investigation Results

The following sections provide analytical results from the samples collected at CAS 16-02-04 to complete investigation activities as outlined in the SAFER Plan. Investigation samples were analyzed for the SAFER Plan-specified COPCs, which included VOCs, SVOCs, and TPH-DRO. The analytical parameters and laboratory methods used to analyze the investigation samples are listed in Table D.2-2. Table D.6-1 lists the CAS 16-02-04 sample-specific analytical suite.

Analytical results from the environmental samples with concentrations exceeding MDCs are summarized in the following sections. An evaluation was conducted on all contaminants detected above MDCs by comparing individual concentration or activity results against the FALs. Establishment of the FALs are presented in Appendix H. The FALs were established as the corresponding PAL concentrations or activities if the contaminant concentrations were below their respective PALs.

D.6.2.1 Volatile Organic Compounds

The VOCs concentrations in environmental samples collected at this CAS, that were detected above MDCs, are presented in Table D.6-2. Volatile organic compounds were not detected at concentrations exceeding their respective PALs. The FALs were established at the PAL concentrations.

Table D.6-2
Sample Results for VOCs Detected Above Minimum Detectable Concentrations at CAS 16-02-04, Fuel Oil Piping

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Acetone
Final Action Levels[a]			54,000
D02	124D002	0.0 - 0.5	0.043
D03	124D003	0.0 - 0.5	0.0083 (J)
D04	124D004	0.0 - 0.5	0.022
D05	124D006	0.0 - 0.5	0.016 (J)

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004)

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

J = Estimated value

D.6.2.2 Semivolatile Organic Compounds

No SVOCs were detected above MDCs at CAS 16-02-04.

D.6.2.3 Total Petroleum Hydrocarbons

The TPH-DRO concentrations in environmental samples collected at this CAS, that were detected above MDCs, are presented in Table D.6-3. One surface sample exceeded the PAL of 100 mg/kg for TPH-DRO. The TPH-DRO was moved to a Tier 2 evaluation, and FALs were established for the hazardous constituents of TPH-DRO. The Tier 2 evaluation determined that none of the hazardous constituents of DRO were identified in the VOC or SVOC analyses at concentrations above the respective PALs. Therefore, the TPH-DRO detected at this CAS is not considered a COC.

Table D.6-3
Sample Results for TPH-DRO Detected Above Minimum Detectable Concentrations at CAS 16-02-04, Fuel Oil Piping

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Diesel-Range Organics
Preliminary Action Levels[a]			**100**
D01	124D001	0.0 - 0.5	6.2 (J)
D02	124D002	0.0 - 0.5	14
D03	124D003	0.0 - 0.5	7.1 (J)
D04	124D004	0.0 - 0.5	8.6 (J)
	124D005	0.0 - 0.5	6.7 (J)
D05	124D006	0.0 - 0.5	67
D06	124D008	0.0 - 0.5	8.9 (J)
D07	124D009	0.0 - 0.5	**140**
D08	124D010	0.0 - 0.5	7.1 (J)

[a]Based on *Nevada Administrative Code*, "Contamination of Soil: Establishment of Action Levels" (NAC, 2006).

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

J = Estimated value

D.6.3 Nature and Extent of Contamination

Based on the analytical results for environmental samples collected, there are no COCs at CAS 16-02-04.

D.6.4 Revised Conceptual Site Model

The SAFER Plan requirements were met at this CAS, and no revisions were necessary to the CSM.

D.7.0 CAS 16-99-04, Fuel Line (Buried) and UST Investigation Results

Corrective Action Site 16-99-04 is located within the Area 16 Camp (Figure D.1-1). This site was identified in the FFACO as a fuel line and UST with unknown contents and use (REECo, 1991). The visual inspection of CAS 16-99-04 showed little ground disturbance. Adjacent to the CAS site marker is a concrete pad with four bolts inserted into the concrete. The fuel oil piping is below ground surface, except for the locations where the line has a stick-up where a connection would have been made. This line was traced by utility survey and visual inspection, and found to be connected to CAS 16-02-04, Fuel Oil Piping. There were no other lines identified during the visual inspection. Also verified is a wooden post that reads "Fuel Line 18" Deep"; a 2-in. diameter, L-shaped metal pipe with a turn valve; a metal hose on the ground surface, and a 1-in. copper vent line exposed approximately 6 in. above the ground surface.

Several components were identified in the SAFER Plan for investigation, including the excavation of the potential UST, and the determination and sealing of the above ground piping. The images in Figure D.7-1 reflect the sample points and a depiction of CAS 16-99-04 before, during, and after investigative activities. Additional detail is provided in the SAFER Plan.

D.7.1 SAFER Activities

A total of seven characterization samples (including 1 FDs) were collected at CAS 16-99-04 during investigation activities. The sample IDs, locations, types, and analyses are listed in Table D.7-1. The specific CAI activities conducted to satisfy the SAFER Plan requirements at this CAS are described in the following sections.

D.7.1.1 Field Screening

The environmental samples were field screened for alpha and beta/gamma radiation. The FSRs were compared to FSLs to guide subsequent sampling decisions where appropriate. Radiation field screening FSLs were not exceeded in any samples.

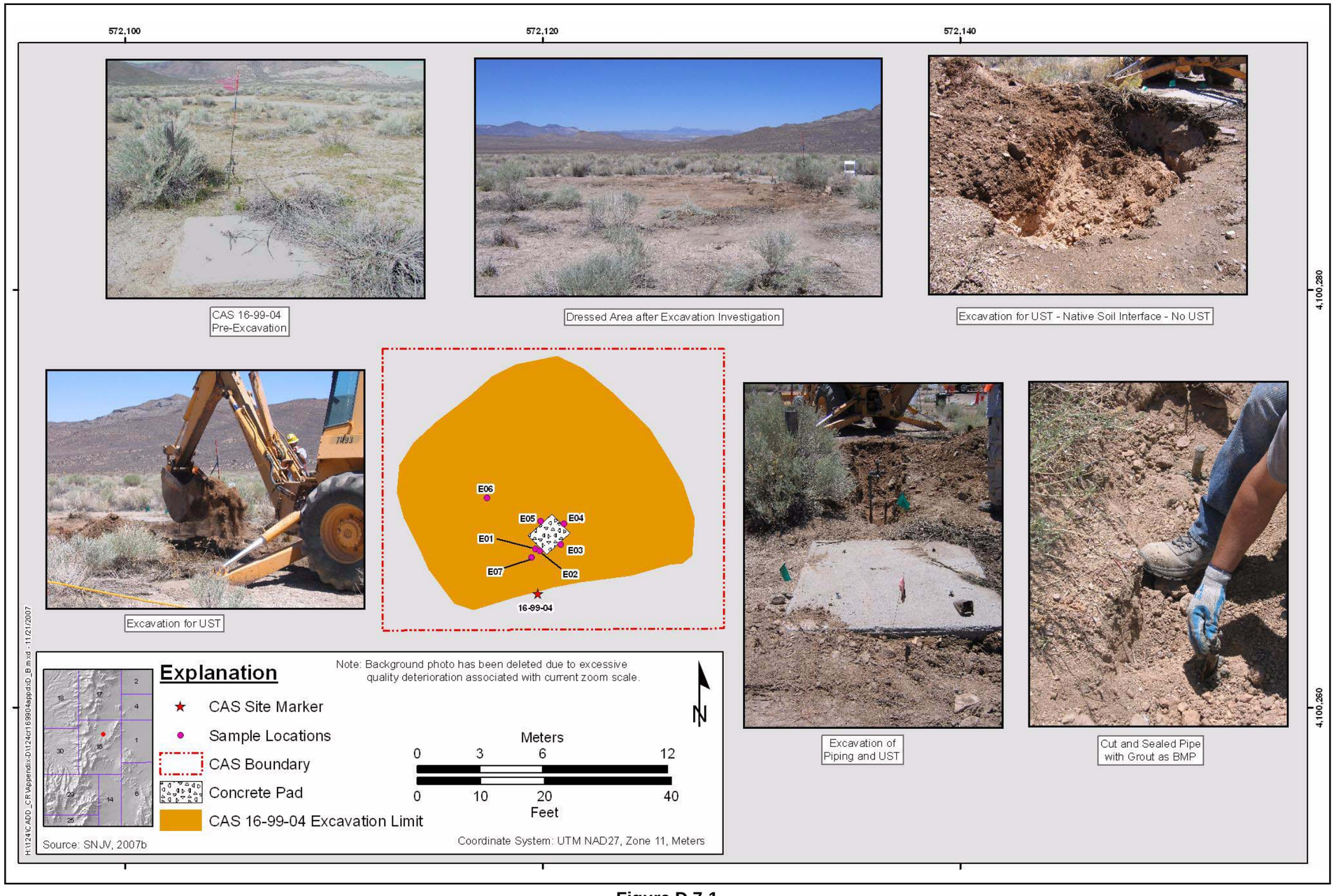

Figure D.7-1
Sample Locations and Investigation Activities at CAS 16-99-04, Fuel Line (Buried) and UST

Table D.7-1
Samples Collected at CAS 16-99-04, Fuel Line (Buried) and UST

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
E01	124E001	0.0 - 0.5	Soil	Environmental	Set 5
	124E002	0.0 - 0.5	Soil	Field Duplicate of 124E001	Set 5
E02	124E003	0.0 - 0.5	Soil	Environmental	Set 5
E03	124E004	0.0 - 0.5	Soil	Environmental	Set 5
E04	124E005	0.0 - 0.5	Soil	Environmental	Set 5
E05	124E006	0.0 - 0.5	Soil	Environmental	Set 5
E06	124E007	4.5 - 5.0	Soil	Environmental	Set 5
E07	124E008	4.0 - 4.2	Soil	Environmental	Set 5
N/A	124E301	N/A	Water	Trip Blank	VOCs
N/A	124E302	N/A	Water	Field Blank	Set 1, TPH-GRO
N/A	124E303	N/A	Water	Trip Blank	VOCs
N/A	124E304	N/A	Water	Trip Blank	VOCs

Set 1 = VOCs, SVOCs, RCRA Metals, TPH-DRO, PCBs, Gamma Spectroscopy
(Due to the close proximity of Area 16 CASs, one environmental field blank was collected for all three Area 16 CASs.)
Set 5 = VOCs, SVOCs, TPH-DRO, TPH-GRO

bgs = Below ground surface
DRO = Diesel-range organics
ft = Foot
GRO = Gasoline-range organics
N/A = Not applicable
PCB = Polychlorinated biphenyl
RCRA = *Resource Conservation and Recovery Act*
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

D.7.1.2 Radiological Surveys

A radiological walkover survey at CAS 16-99-04 was conducted March 2007. The maximum gamma radiation emission rate for CAS 16-99-04 was not distinguishable from local background (SNJV, 2007b).

D.7.1.3 Visual Inspections

There was no visible staining or other biasing factors identified at CAS 16-99-04.

D.7.1.4 Sample Collection

Decision I environmental sampling activities included the collection of 6 surface and 2 subsurface soil samples (including 1 FD) at the surface, beside each exposed pipe and at the native soil interface, where the UST was presumed to be (Figure D.7-1) as discussed in the SAFER Plan. Surface soil samples were also collected along each side of the concrete pad. No concrete samples were taken due to a lack of biasing factors.

D.7.1.5 Deviations

Investigation samples were collected as outlined in the SAFER Plan (NNSA/NSO, 2007) and submitted for laboratory analysis. There were no deviations from the SAFER Plan.

D.7.2 Investigation Results

The following sections provide analytical results from the samples collected to complete investigation activities as outlined in the SAFER Plan. Investigation samples were analyzed for the SAFER Plan-specified COPCs, which included VOCs, SVOCs, TPH-DRO and -GRO. The analytical parameters and laboratory methods used to analyze the investigation samples are listed in Table D.2-2. Table D.7-1 lists the CAS 16-99-04 sample-specific analytical suite.

Analytical results from the environmental samples, with concentrations exceeding MDCs, are summarized in the following sections. An evaluation was conducted on all contaminants detected above MDCs by comparing individual concentration or activity results against the FALs. Establishment of the FALs are presented in Appendix H. The FALs were established as the corresponding PAL concentrations or activities if the contaminant concentrations were below their respective PALs.

D.7.2.1 Volatile Organic Compounds

The VOCs concentrations in environmental samples collected at this CAS, that were detected above MDCs, are presented in Table D.7-2. Volatile organic compounds were not detected at concentrations exceeding their respective PALs. The FALs were established at the PAL concentrations.

Table D.7-2
Sample Results for VOCs Detected Above Minimum Detectable Concentrations at CAS 16-99-04, Fuel Line (Buried) and UST

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Acetone
Final Action Levels[a]			54,000
E01	124E001	0.0 - 0.5	0.0096 (J)
	124E002	0.0 - 0.5	0.011 (J)
E02	124E003	0.0 - 0.5	0.008 (J)
E05	124E006	0.0 - 0.5	0.0074 (J)

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2004)

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

J = Estimated value

D.7.2.2 Semivolatile Organic Compounds

No SVOCs were detected above MDCs at CAS 16-99-04.

D.7.2.3 Total Petroleum Hydrocarbons

The TPH-DRO and -GRO concentration in environmental samples collected at this CAS, that were detected above MDCs, are presented in Table D.7-3. One surface sample exceeded the PAL of 100 mg/kg for TPH-DRO. The TPH-DRO was moved to a Tier 2 evaluation and FALs were established for the hazardous constituents of TPH-DRO. The Tier 2 evaluation determined that none of the TPH-DRO hazardous constituents were identified in the VOC or SVOC analyses at concentrations above the respective PALs. Therefore, the TPH-DRO detected at this CAS is not considered a COC.

Table D.7-3
Sample Results for TPH-DRO Detected Above Minimum Detectable Concentrations at CAS 16-99-04, Fuel Line (Buried) and UST

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Diesel-Range Organics
Preliminary Action Levels[a]			**100**
E01	124E001	0.0 - 0.5	51
	124E002	0.0 - 0.5	88
E02	124E003	0.0 - 0.5	17
E03	124E004	0.0 - 0.5	11
E04	124E005	0.0 - 0.5	23
E05	124E006	0.0 - 0.5	**230**
E07	124E008	4.0 - 4.2	6.7 (J)

[a]Based on *Nevada Administrative Code*, "Contamination of Soil: Establishment of Action Levels" (NAC, 2006).

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram

J = Estimated value

D.7.3 Nature and Extent of Contamination

Based on the analytical results for environmental samples collected, there are no COCs at CAS 16-99-04.

D.7.4 Revised Conceptual Site Model

The SAFER Plan requirements were met at this CAS, and no revisions were necessary to the CSM.

D.8.0 Waste Management

Section D.8.1 addresses IDW management. No remediation wastes were generated.

D.8.1 Investigation-Derived Waste

During the field investigation activities of CAU 124, IDW was generated. The 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. Decontamination activities were planned and executed to minimize the volume of generated waste.

Two hazardous waste accumulation areas and one satellite accumulation area were established to manage hazardous and potentially hazardous waste generated during the CAI. The amount, type, and source of waste placed into each drum was recorded in waste management logbooks and maintained in the project files. There were no drums of hazardous waste generated from the CAI. Potentially hazardous waste generated during the CAI was placed in containers and labeled as "Hazardous Waste - Pending Analysis."

D.8.1.1 Waste Streams

During the investigation, IDW generated was segregated into the following waste streams:

- Sanitary waste (i.e., PPE, disposable sampling equipment, plastic sheeting, glass/plastic sample jars, and other debris such as associated piping).
- Hydrocarbon solids (soil from a diesel spill).

D.8.1.2 Waste Generated

A total of three drums of hydrocarbon waste at CAS 08-02-01 were generated during the investigation, as a result of a backhoe leaking diesel fuel. The three drums of IDW were characterized based on process knowledge and direct composite samples. Samples were analyzed for TCLP VOCs, VOCs, isotopic U, isotopic Pu, Sr-90, and gamma-emitting radionuclides. These data show the hydrocarbon waste to exceed the regulatory threshold established by the State of Nevada.

The disposal of these drums is the permitted NTS Area 6 Hydrocarbon Landfill (NDEP, 1997a and b).

Office waste and lunch trash was disposed of in designated sanitary dumpsters allocated for disposal at the NTS sanitary landfill. Sanitary waste was inspected and disposed of in designated sanitary dumpsters located at Building 23-153 and allocated for disposal at the NTS Sanitary Waste Landfill.

D.9.0 Quality Assurance

This section contains a summary of QA/QC measures implemented during the sampling and analysis activities conducted in support of the CAU 124 CAI. The following sections discuss the data validation process, QC samples, and nonconformances. A detailed evaluation of the DQIs is presented in Section 4.1.

Laboratory analyses were conducted for samples used in the decision-making process to provide a quantitative measurement of any 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 in the Industrial Sites QAPP (NNSA/NV, 2002).

D.9.1 Data Validation

Data validation was performed in accordance with the Industrial Sites QAPP (NNSA/NV, 2002) and approved protocols and procedures. All laboratory data from samples collected and analyzed for CAU 124 were evaluated for data quality in a tiered process described in Sections D.9.1.1 through D.9.1.3. Data were reviewed to ensure that samples were appropriately processed and analyzed, and the results were evaluated using validation criteria. Documentation of the data qualifications resulting from these reviews is retained in the project files in hard copy and electronic media.

All of the data analyzed as part of this investigation were subjected to Tier 1 and Tier 2 evaluations. A Tier 3 evaluation was performed on approximately 5 percent of the data analyzed.

D.9.1.1 Tier 1 Evaluation

Tier 1 evaluation for chemical and radiochemical analysis examines, but is not limited to:

- 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 a cover letter or case narrative.
- Completeness of certificates of analysis.

- Completeness of data packages.
- Completeness of signatures, dates, and times on chain of custody.
- Laboratory login report variance form included.
- Requested analyses performed on all samples.
- Date received/analyzed given for each sample.
- Correct concentration units indicated.
- Electronic data deliverable supplied.
- Results reported for field and laboratory QC samples.

D.9.1.2 Tier 2 Evaluation

Tier 2 evaluation for chemical analysis examines, but is not limited to:

- Correct detection limits achieved.
- Sample date, preparation date, and analysis date for each sample.
- Holding time criteria met.
- Quality control batch association for each sample.
- Cooler temperature upon receipt.
- Sample pH for aqueous samples, as required.
- Detection limits properly adjusted for dilution, as required.
- Blank contamination evaluated and applied to sample results/qualifiers.
- Matrix spike/matrix spike duplicate (MSD) percent recoveries (%R) and RPDs evaluated and qualifiers applied to laboratory results, as necessary.
- Field duplicate RPDs evaluated using professional judgment and qualifiers applied to laboratory results, as necessary.
- Laboratory duplicate RPDs evaluated and qualifiers applied to laboratory results, as necessary.
- Surrogate %R evaluated and qualifiers applied to laboratory results, as necessary.
- Laboratory control sample %R evaluated and qualifiers applied to laboratory results, as necessary.
- Initial and continuing calibration evaluated and qualifiers applied to laboratory results, as necessary.
- Internal standard evaluation.
- Mass spectrometer tuning criteria.
- Organic compound quantitation.

- Inductively coupled plasma interference check sample evaluation.
- Graphite furnace atomic absorption QC.
- Inductively coupled plasma serial dilution effects.
- Recalculation of 10 percent of laboratory results from raw data.

Tier 2 evaluation for radiochemical analysis examines, but is not limited to:

- 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 for Standards and Technology (NIST)-traceable sources.
- Calibration sources preparation was documented, demonstrating proper preparation and appropriateness for sample matrix, emission energies, and concentrations.
- Detector system response to daily or weekly background and calibration checks for peak energy, peak centroid, peak full-width half-maximum, and peak efficiency, depending on the detection system.
- Tracers NIST-traceable, appropriate for the analysis performed, and recoveries that met QC requirements.
- Documentation of all QC sample preparation complete and properly performed.
- Spectra lines, photon emissions, particle energies, peak areas, and background peak areas support the identified radionuclide and its concentration.

D.9.1.3 Tier 3 Evaluation

The Tier 3 review is an independent examination of the Tier 2 evaluation. A Tier 3 review of 5 percent of the sample analytical data was performed by TLI Solutions, Inc., Golden, Colorado. Tier 2 and Tier 3 results were compared and, where differences are noted, data were reviewed and changes were made accordingly. This review included the following additional evaluations:

Chemical:

- Re-calculation of all laboratory results from raw data.

Radioanalytical:

- Quality Control sample results (e.g., calibration source concentration, %R, and RPD) verified.
- Radionuclides and their concentration validated, as appropriate, considering their decay schemes, half-lives, and process knowledge and history of the facility and site.
- Each identified line in spectra verified against emission libraries and calibration results.
- Independent identification of spectra lines, area under the peaks, and quantification of radionuclide concentration in a random number of sample results.

D.9.2 Field Quality Control Samples

Field QC samples consisted of 11 trip blanks, 1 equipment rinsate blanks, 3 field blanks, 1 source blanks, 6 MS/MSDs, and 6 FDs collected and submitted for analysis by the laboratory analytical methods shown in Table D.2-2. The QC samples were assigned individual sample numbers and sent to the laboratory "blind." Additional samples were selected by the laboratory to be analyzed as a full laboratory QC.

Field blanks, source blanks, and equipment rinsates were analyzed for the applicable parameters listed in Table D.2-2, and trip blanks were analyzed only for VOCs.

During the CAI, 6 FDs were sent as blind samples to the laboratory to be analyzed for the investigation parameters listed in Table D.2-2. For these samples, the duplicate results precision (i.e., RPDs between the environmental sample results and their corresponding FD sample results) were evaluated.

D.9.2.1 Laboratory Quality Control Samples

Analysis of QC preparation blanks (PBs) were performed on each sample delivery group (SDG) for inorganics. Analysis for surrogate spikes and method blanks were performed on each SDG only for organics. 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 in hard copy and electronic media.

The laboratory included a PB, LCS, and a laboratory duplicate sample with each batch of field samples analyzed for radionuclides.

D.9.3 Field Nonconformances

There were no field nonconformances identified for the CAI.

D.9.4 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. There were no laboratory nonconformances identified for CAU 124.

D.10.0 Summary

Organic, inorganics, and radionuclide contaminants detected in environmental samples during the CAI were evaluated against FALs to determine the nature and extent of COCs at CAU 124. Assessment of the data generated from investigation activities indicates the FALs were not exceeded.

Based on the analytical results of the environmental samples collected at the CAU 124 CASs, no contamination has been released to the soil at any CAU 124 CAS. Therefore, no corrective actions are required at this CAU.

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Appendix E

NTS Landfill Load Verification

(2 Pages)

NSTec Form FRM-0918

NTS LANDFILL LOAD VERIFICATION

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

SWO USE (Select One) AREA ☐ 23 ☐ 6 ☐ 9 ☒ LANDFILL

For waste characterization, approval, and/or assistance, contact Solid Waste Operation (SWO) at 5-7898.

REQUIRED: WASTE GERERATOR INFORMATION

(This form is for rolloffs, dump trucks, and other onsite disposal of materials.)

Waste Generator: René Robles (SNJV WO) Phone Number: 5/2100

Location / Origin: CAU 124, CAS 16-99-04, Area 16: plastic liner

Waste Category: (check one)		☐ Commercial	☒ Industrial	
Waste Type: (check one)	☐ NTS	☐ Putrescrible	☒ FFACO-onsite	☐ WAC Exception
	☐ Non-Putrescible	☐ Asbestos Containing Material	☐ FFACO-offsite	☐ Historic DOE/NV
Pollution Prevention Category: (check one)		☒ Environmental management	☐ Defense Projects	☐ YMP
Pollution Prevention Category: (check one)		☒ Clean-Up	☐ Routine	
Method of Characterization: (check one)		☐ Sampling & Analysis	☒ Process Knowledge	☐ Contents

Prohibited Waste at all three NTS landfills: Radioactive waste; RCRA waste; Hazardous waste; Free liquids, PCBs above TSCA regulatory levels, and Medical wastes (needles, sharps, bloody clothing).

Additional Prohibited Waste at the Area 9 U10C Landfill: Sewage Sludge, Animal carcasses, Wet garbage (food waste); and Friable asbestos

REQUIRED: WASTE CONTENTS ALLOWABLE WASTES

Check all allowable wastes that are contained within this load:

NOTE: Waste disposal at the Area 6 Hydrocarbon Landfill must have come into contact with petroleum hydrocarbons or coolants, such as: gasoline (no benzene, lead); jet fuel; diesel fuel; lubricants and hydraulics; kerosene; asphaltic petroleum hydrocarbon; and ethylene glycol.

Acceptable waste at any NTS landfill:

☐ Asphalt	☐ Metal	☐ Wood	☐ Soil	☐ Paper	☐ Rocks / unaltered geologic materials	☐ Empty containers
☒ Plastic	☐ Wire	☐ Cable	☐ Cloth	☐ Rubber (excluding tires)	☐ Insulation (non-Asbestosform)	☐ Demolition debris
☐ Manufactured items: (swamp coolers, furniture, rugs, carpet, electronic components, PPE, etc.)						☐ Cement & concrete

Additional waste accepted at the Area 23 Mercury Landfill: ☐ Office Waste ☐ Food Waste ☐ Animal Carcasses ☐ Asbestos ☐ Friable ☐ Non-Friable (contact SWO if regulated load) Quantity: _____

Additional waste accepted at the Area 9 U10c Landfill:

☐ Non-friable asbestos	☐ Drained automobiles and military vehicles	☐ Solid fractions from sand/oil/water
☐ Light ballasts (contact SWO)	☐ Drained fuel filters (gas & diesel)	☐ Deconned Underground and Above Ground Tanks
☐ Hydrocarbons (contact SWO)	☐ Other _____	

Additional waste accepted at the Area 6 Hydrocarbon Landfill: ☐ _____

☐ Septic sludge	☐ Rags	☐ Drained fuel filters (gas & diesel)	☐ Crushed non-teme plated oil filters
☐ Plants	☐ Soil	☐ Sludge from sand/oil/water separators	☐ PCBs below 50 parts per million

REQUIRED: WASTE GENERATOR SIGNATURE

Initials: ____ **(If Initialed, no radiological clearance is necessary.)**

The above mentioned waste was generated outside of a Controlled Waste Management Area (CWMA) and to the best of my knowledge, does not contain radiological materials.

To the best of my knowledge, the waste described above contains only those ma site. I have verified this through the waste characterization method identified ab prohibited and allowable waste items. I have contacted Property Management an is approved for disposal in the landfill.

Print Name: Joe Molter

Signature: Joe Molter Date: 11/30/07

Note: "Food waste, office trash and animal carcasses do not require a radiologica must have signed removal certification statement with Load Verification."

Radiological Survey Release for Waste Disposal

RCT Initials

_____ This container/load meets the criteria for no added man-made radioactive material

_____ This container/load meets the criteria for Radcon Manual Table 4.2 release limits.

_____ This container/load is exempt from survey due to process knowledge and origin.

SIGNATURE: _____ DATE: 11/30/07

BN-0040 (10/05)

SWO USE ONLY

Load Weight (net from scale or estimate): _____ Signature of Certifier: _____

NSTec Form FRM-0918

NTS LANDFILL LOAD VERIFICATION

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

SWO USE (Select One) AREA ☐ 23 ☐ 6 ☐ 9 ☒ LANDFILL

For waste characterization, approval, and/or assistance, contact Solid Waste Operation (SWO) at 5-7898.

REQUIRED: WASTE GERERATOR INFORMATION

(This form is for rolloffs, dump trucks, and other onsite disposal of materials.)

Waste Generator: René Robles (SNJV WO) Phone Number: 5/2100

Location / Origin: CAU 124, CAS 08-02-01, Area 6; 3 Drums (Hydrocarbon soil) 124A01, 124A02, and 124A03

Waste Category: (check one)		☐ Commercial	☒ Industrial	
Waste Type: (check one)	☐ NTS	☐ Putrescrible	☒ FFACO-onsite	☐ WAC Exception
	☐ Non-Putrescible	☐ Asbestos Containing Material	☐ FFACO-offsite	☐ Historic DOE/NV
Pollution Prevention Category: (check one)		☒ Environmental management	☐ Defense Projects	☐ YMP
Pollution Prevention Category: (check one)		☒ Clean-Up	☐ Routine	
Method of Characterization: (check one)		☒ Sampling & Analysis	☒ Process Knowledge	☐ Contents
Prohibited Waste at all three NTS landfills:	Radioactive waste; RCRA waste; Hazardous waste; Free liquids, PCBs above TSCA regulatory levels, and Medical wastes (needles, sharps, bloody clothing).			
Additional Prohibited Waste at the Area 9 U10C Landfill:	Sewage Sludge, Animal carcasses, Wet garbage (food waste); and Friable asbestos			

REQUIRED: WASTE CONTENTS ALLOWABLE WASTES

Check all allowable wastes that are contained within this load:

NOTE: Waste disposal at the Area 6 Hydrocarbon Landfill must have come into contact with petroleum hydrocarbons or coolants, such as: gasoline (no benzene, lead); jet fuel; diesel fuel; lubricants and hydraulics; kerosene; asphaltic petroleum hydrocarbon; and ethylene glycol.

Acceptable waste at any NTS landfill:

☐ Asphalt ☐ Metal ☐ Wood ☐ Soil ☐ Paper ☐ Rocks / unaltered geologic materials ☐ Empty containers
☐ Plastic ☐ Wire ☐ Cable ☐ Cloth ☐ Rubber (excluding tires) ☐ Demolition debris
☐ Insulation (non-Asbestosform) ☐ Cement & concrete
☐ Manufactured items: (swamp coolers, furniture, rugs, carpet, electronic components, PPE, etc.)

Additional waste accepted at the Area 23 Mercury Landfill: ☐ Office Waste ☐ Food Waste ☐ Animal Carcasses
☐ Asbestos ☐ Friable ☐ Non-Friable (contact SWO if regulated load) Quantity: _____

Additional waste accepted at the Area 9 U10c Landfill:

☐ Non-friable asbestos ☐ Drained automobiles and military vehicles ☐ Solid fractions from sand/oil/water
☐ Light ballasts (contact SWO) ☐ Drained fuel filters (gas & diesel) ☐ Deconned Underground and Above Ground Tanks
☐ Hydrocarbons (contact SWO) ☐ Other _____

Additional waste accepted at the Area 6 Hydrocarbon Landfill: ☐ _____

☐ Septic sludge ☐ Rags ☐ Drained fuel filters (gas & diesel) ☐ Crushed non-terne plated oil filters
☐ Plants ☒ Soil ☐ Sludge from sand/oil/water separators ☐ PCBs below 50 parts per million

REQUIRED: WASTE GENERATOR SIGNATURE

Initials: _____ (if initialed, no radiological clearance is necessary.)

The above mentioned waste was generated outside of a Controlled Waste Management Area (CWMA) and to the best of my knowledge, does not contain radiological materials.

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

Print Name: Joe Molter

Signature: Joe Molter Date: 11/30/07

Note: "Food waste, office trash and animal carcasses do not require a radiologi must have signed removal certification statement with Load Verification."

Radiological Survey Release for Waste Disposal

RCT Initials

___ This container/load meets the criteria for no added man-made radioactive material

___ This container/load meets the criteria for Radcon Manual Table 4.2 release limits.

___ This container/load is exempt from survey due to process knowledge and origin.

SIGNATURE: _____ DATE: 11/28/07

BN-0646 (10/05)

SWO USE ONLY

Load Weight (net from scale or estimate): _____ Signature of Certifier: _____

Appendix F

Modifications to the Post-Closure Plan

F.1.0 Modifications to the Post-Closure Plan

This section does not apply to CAU 124.

Appendix G

Use Restrictions

G.1.0 Use Restrictions

This section does not apply to CAU 124.

Appendix H

Risk Evaluation

H.1.0 Risk Assessment

The risk-based corrective action (RBCA) process used to establish FALs is described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). This process conforms with NAC Section 445A.227, which lists the requirements for sites with soil contamination (NAC, 2006a). For the evaluation of corrective actions, *Nevada Administrative Code* (NAC) Section 445A.22705 (NAC, 2006b) requires the use of American Society for Testing and Materials (ASTM) Method E 1739-95 (ASTM, 1995) to "conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards (i.e., FALs) or to establish that corrective action is not necessary."

As defined in the DQOs, the presence of a COC would require corrective action. 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 released.

This section contains documentation of the RBCA process used to establish the FALs described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006). This process defines the three tiers (or levels) that establish FALs used to evaluate DQO decisions:

- Tier 1 – Sample results from source areas (highest concentrations) compared to risk-based screening levels (RBSLs) (i.e., PALs) based on generic (non-site-specific) conditions.
- Tier 2 – Sample results from exposure points compared to SSTLs calculated using site-specific inputs and Tier 1 formulas.
- Tier 3 – Sample results from exposure points compared to SSTLs, and points of compliance calculated using chemical fate/transport and probabilistic modeling.

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

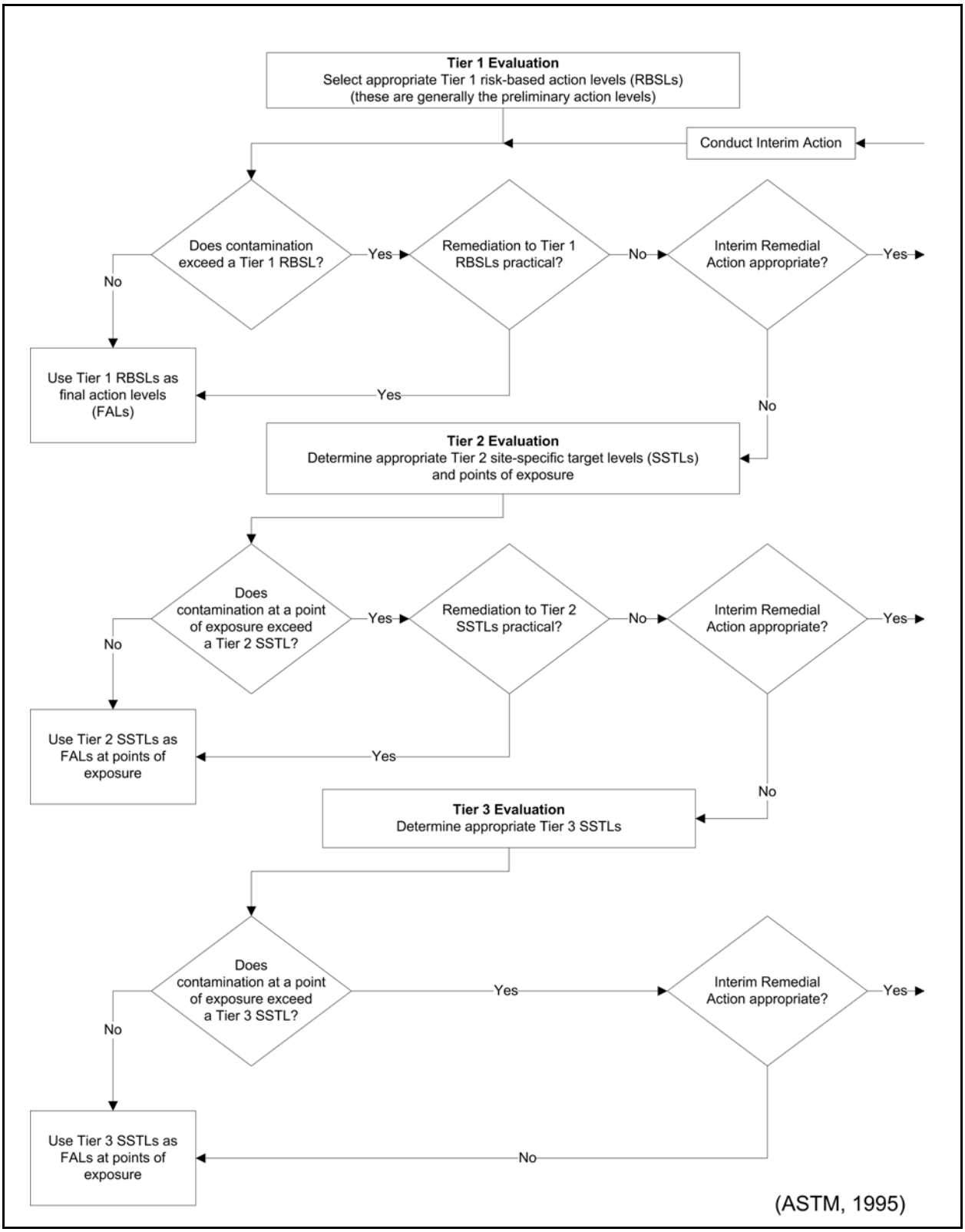

Figure H.1-1
Risk-Based Corrective Action Decision Process

H.1.1 A. Scenario

Corrective Action Unit 124 consists of the following five CASs:

- Corrective Action Unit 08-02-01 consists of a release associated with a UST. The CAS is currently not in use.
- Corrective Action Site 15-02-01, Irrigation Piping, consists of a release associated with two farm plots used for experimental studies, a reservoir, a concrete pad that was a greenhouse, and a concrete pad that was a storage shed. Radionuclides were used in experiments at CAS 15-02-01, which included iodine-131 from dry-aerosol tests and tritium (SWRHL, 1967; EPA 1973; Adams, 2002). This CAS is currently not in use.
- Corrective Action Site 16-02-03, Underground Storage Tank, consists of a release associated with a UST. This CAS is currently listed as not in use
- Corrective Action Site 16-02-04, Fuel Oil Piping, consists of a release associated with fuel oil piping and is located within the Area 16 Camp. Engineering drawings reveal approximately 950 ft of piping is still under ground that was originally connected to a 2,000-gallon AST. This CAS is currently not in use.
- Corrective Action Site 16-99-04, Fuel Line (Buried) and UST, consists of a release associated with a fuel line and UST. This CAS is currently not in use.

H.1.2 B. Site Assessment

The corrective action activities were conducted in accordance with the requirements set forth in the SAFER Plan (NNSA/NSO, 2007). Table H.1-1 lists the corrective action activities conducted at each CAS. Results of the CAI sampling data demonstrate that no COCs are present, and no further action is necessary at any CAU 124 CASs.

The maximum concentration of each contaminant identified at each CAS, and their corresponding PALs, are presented in Tables H.1-2 through H.1-6.

Table H.1-1
Corrective Action Activities Conducted at Each Corrective Action Site To Meet SAFER Plan Requirements

Corrective Action Activities	Corrective Action Sites				
	08-02-01 Underground Storage Tank	15-02-01 Irrigation Piping	16-02-03 Underground Storage Tank	16-02-04 Fuel Oil Piping	16-99-04 Fuel Line (Buried) and UST
Conducted surface radiological surveys	X	X	X	X	X
Performed geophysical/utility surveys	X	X	X	X	X
Performed site transects/walkover	X	X	X	X	X
Collected soil samples from biased locations	X	X	X	X	X
Collected soil samples from random grid locations	--	X	--	--	--
Field-screened samples for alpha and beta/gamma radiation	X	X	X	X	X
Collected samples for waste characterization	X	--	--	--	--
Collected swipe samples for removable radioactivity	--	X	--	--	--
Cut associated piping and sealed as a best management practice	--	--	X	X	X
Submitted select samples for offsite laboratory analysis	X	X	X	X	X

-- = Not applicable

Table H.1-2
Maximum Concentration of Detected Contaminants
for CAS 08-02-01, Underground Storage Tank

Constituent	Maximum Result	Sample Number	Depth (ft bgs)	Location	PAL	Units
Actinium-228	2.637	124A002	0.0 - 0.5	A01	5	pCi/g
Americium-241	1.171	124A001	0.0 - 0.5	A01	12.7	pCi/g
Arsenic	2.75	124A003	5.5 - 6.0	A02	23	mg/kg
Barium	165 (J)	124A001	0.0 - 0.5	A01	67,000	mg/kg
Cadmium	0.731	124A002	0.0 - 0.5	A01	450	mg/kg
Cesium-137	2.823	124A001	0.0 - 0.5	A01	12.2	pCi/g
Chromium	2.11	124A003	5.5 - 6.0	A02	450	mg/kg
Diesel-Range Organics	26	124A001	0.0 - 0.5	A01	100	mg/kg
Lead	10.6	124A003	5.5 - 6.0	A02	800	mg/kg
Lead-212	2.658	124A002	0.0 - 0.5	A01	5	pCi/g
Lead-214	1.6	124A001	0.0 - 0.5	A01	5	pCi/g
Thallium-208	2.637	124A002	0.0 - 0.5	A01	5	pCi/g

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram
PAL = Preliminary action level
pCi/g = Picocuries per gram

J = Estimated value

Table H.1-3
Maximum Concentration of Detected Contaminants
for CAS 15-02-01, Irrigation Piping
(Page 1 of 3)

Constituent	Maximum Result	Sample Number	Depth (ft bgs)	Location	PAL	Units
2-Butanone	0.015 (J)	124B009	0.0 - 0.5	B25	110,000	mg/kg
4,4'-DDD	0.0023 (J)	124B032	0.0 - 0.5	B16	10	mg/kg
4,4'-DDD	0.0023 (J)	124B033	0.0 - 0.5	B16	10	mg/kg
4,4'-DDT	0.002 (J)	124B032	0.0 - 0.5	B16	7	mg/kg
Acetone	0.089	124B016	0.0 - 0.5	B27	54,000	mg/kg
Actinium-228	3.916	124B008	0.0 - 0.5	B25	5	pCi/g

Table H.1-3
Maximum Concentration of Detected Contaminants
for CAS 15-02-01, Irrigation Piping
(Page 2 of 3)

Constituent	Maximum Result	Sample Number	Depth (ft bgs)	Location	PAL	Units
Americium-241	3.972	124B039	0.0 - 0.5	B20	12.7	pCi/g
Arsenic	15.5	124B009	0.0 - 0.5	B25	23	mg/kg
Barium	344 (J)	124B008	0.0 - 0.5	B25	67,000	mg/kg
Beta-BHC	0.00084 (J)	124B015	0.0 - 0.5	B08	1.3	mg/kg
Cadmium	3.24	124B008	0.0 - 0.5	B25	450	mg/kg
Cesium-137	4.23	124B015	0.0 - 0.5	B08	12.2	pCi/g
Chromium	43.2	124B011	0.0 - 0.5	B23	450	mg/kg
Delta-BHC	0.00069 (J)	124B007	0.0 - 0.5	B24	0.36	mg/kg
Endosulfan II	0.0027 (J)	124B033	0.0 - 0.5	B16	3,700	mg/kg
Endrin	0.0035	124B032	0.0 - 0.5	B16	180	mg/kg
Endrin aldehyde	0.0025 (J)	124B033	0.0 - 0.5	B16	180	mg/kg
Heptachlor	0.00061 (J)	124B028	0.0 - 0.5	B02	0.38	mg/kg
Heptachlor epoxide	0.0013 (J)	124B008	0.0 - 0.5	B25	0.19	mg/kg
Lead	67.7	124B007	0.0 - 0.5	B24	800	mg/kg
Lead-212	3.755	124B008	0.0 - 0.5	B25	5	pCi/g
Lead-214	**7.894**	124B009	0.0 - 0.5	B25	5	pCi/g
Mercury	9.84 (J)	124B032	0.0 - 0.5	B16	310	mg/kg
Selenium	0.641 (J)	124B009	0.0 - 0.5	B25	5,100	mg/kg
Thallium-208	2.992 (J)	124B008	0.0 - 0.5	B25	5	pCi/g
Thorium-234	9.087	124B008	0.0 - 0.5	B25	105	pCi/g
Trichlorofluoromethane	0.0079	124B009	0.0 - 0.5	B25	2,000	mg/kg
Tritium	9.521 (J)	124B016	0.0 - 0.5	B27	13,820,000	pCi/g
Uranium-234	2.859	124B008	0.0 - 0.5	B25	143	pCi/g
Uranium-235	0.269	124B008	0.0 - 0.5	B25	17.6	pCi/g
Uranium-238	2.349	124B008	0.0 - 0.5	B25	105	pCi/g
Xylenes	0.013	124B016	0.0 - 0.5	B27	420	mg/kg

Table H.1-3
Maximum Concentration of Detected Contaminants for CAS 15-02-01, Irrigation Piping
(Page 3 of 3)

Constituent	Maximum Result	Sample Number	Depth (ft bgs)	Location	PAL	Units

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram
PAL = Preliminary action level
pCi/g = Picocuries per gram

J = Estimated value

Table H.1-4
Maximum Concentration of Detected Contaminants for CAS 16-02-03, Underground Storage Tank

Constituent	Maximum Result	Sample Number	Depth (ft bgs)	Location	PAL	Units
Acetone	0.011 (J)	124C001	0.0 - 0.5	C01	54,000	mg/kg
Actinium-228	3.097	124C004	2.0 - 2.5	C03	5	pCi/g
Arsenic	5.28	124C004	2.0 - 2.5	C03	23	mg/kg
Barium	403 (J)	124C002	0.0 - 0.5	C02	67,000	mg/kg
Cadmium	0.31 (J)	124C003	0.0 - 0.5	C02	450	mg/kg
Cesium-137	0.453	124C001	0.0 - 0.5	C01	12.2	pCi/g
Chromium	6.13	124C004	2.0 - 2.5	C03	450	mg/kg
Diesel-Range Organics	15	124C002	0.0 - 0.5	C02	100	mg/kg
Lead	53.6 (J)	124C001	0.0 - 0.5	C01	800	mg/kg
Lead-212	3.121	124C003	0.0 - 0.5	C02	5	pCi/g
Lead-214	1.856	124C003	0.0 - 0.5	C02	5	pCi/g
Mercury	0.0384 (J)	124C004	2.0 - 2.5	C03	310	mg/kg
Silver	1.74	124C004	2.0 - 2.5	C03	5,100	mg/kg
Thorium-234	5.536	124C002	0.0 - 0.5	C02	105	pCi/g

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram
PAL = Preliminary action level
pCi/g = Picocuries per gram

J = Estimated value

Table H.1-5
Maximum Concentration of Detected Contaminants
for CAS 16-02-04, Fuel Oil Piping

Constituent	Maximum Result	Sample Number	Depth (ft bgs)	Location	PAL	Units
Acetone	0.043	124D002	0.0 - 0.5	D02	54,000	mg/kg
Diesel-Range Organics	**140**	124D009	0.0 - 0.5	D07	100	mg/kg

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram
PAL = Preliminary action level

Table H.1-6
Maximum Concentration of Detected Contaminants
for CAS 16-99-04, Fuel Line (Buried) and UST

Constituent	Maximum Result	Sample Number	Depth (ft bgs)	Location	PAL	Units
Acetone	0.011 (J)	124E002	0.0 - 0.5	E01	54,000	mg/kg
Diesel-Range Organics	**230**	124E006	0.0 - 0.5	E05	100	mg/kg

bgs = Below ground surface
ft = Foot
mg/kg = Milligrams per kilogram
PAL = Preliminary action level

J = Estimated value

H.1.3 C. Site Classification and Initial Response Action

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

Based on the SAFER Plan results, none of the CAU 124 CASs present immediate threat to human health, safety, and the environment; therefore, no interim response actions are necessary. Based on this information, all five CASs are determined to be Classification 4 sites, as defined by ASTM Method E 1739-95 (ASTM, 1995) and pose no demonstrated near- or long-term threats.

H.1.4 D. Development of Tier 1 Lookup Table of Risk-Based Screening Levels

Tier 1 action levels have been defined as the PALs established during the DQO process. The PALs are a tabulation of chemical-specific (but not site-specific) screening level, based on the type of media (soil) and potential exposure scenarios (industrial). These are very conservative estimates of risk, are preliminary in nature, and used as action levels for site-screening purposes. Although the PALs are not intended to be used as FALs, a FAL may be defined as the Tier 1 action level (i.e., PAL) value if individual contaminant analytical results are below the corresponding Tier 1 action level value. The FAL may also be established as the Tier 1 action level value if individual contaminant analytical results exceed the corresponding Tier 1 action level value, and implementing a corrective action based on the FAL, is practical. The PALs are defined as:

- The EPA *Region 9 Risk-Based Preliminary Remediation Goals (PRGs)* for Industrial Soils (2004).
- Background concentrations for RCRA metals will be evaluated when natural background exceeds the PAL, which is often the case with arsenic. Background is considered the mean plus two times the standard deviation based on data published in Mineral and Energy Resource Assessment of the Nellis Air Force Range (NBMG, 1998; Moore, 1999).
- The TPH concentration of 100 mg/kg per NAC 445A.2272 (NAC, 2006c).
- The PALs for radioactive contaminants are based on NCRP Report No. 129 recommended screening limits for construction, commercial, industrial land-use scenarios (NCRP, 1999) scaled to 25-millirem-per-year (mrem/yr) dose constraint (Appenzeller-Wing, 2004) and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).
- The PAL for tritium is based on the Underground Test Area (UGTA) Project limit of 400,000 pCi/L for discharge of water containing tritium (NNSA/NV, 2002). The activity of tritium in soil moisture of soil samples will be reported in units of pCi/L for comparison to this PAL.

The PALs were developed based on an industrial scenario. Because the CAU 124 CASs in Areas 8, 15, and 16 are not assigned work stations, and are considered to be in remote or occasional use areas, the use of industrial reuse based PALs is conservative. The Tier 1 lookup table is defined as the PAL concentrations or activities defined in the SAFER Plan (NNSA/NSO, 2007).

H.1.5 E. Exposure Pathway Evaluation

The DQOs stated that site workers would be exposed to COCs only through oral ingestion, inhalation, or dermal contact (absorption) due to exposure to potentially contaminated media (i.e., soil) at the CASs. Given the exposure scenarios at these CASs, the only potential exposure pathways would be through worker contact with the contaminated soil. The limited migration demonstrated by the analytical results, elapsed time since the suspected release, and depth to groundwater, supports the selection and evaluation only surface and shallow subsurface contact as the complete exposure pathways. Groundwater is not considered a significant exposure pathway.

H.1.6 F. Comparison of Site Conditions with Tier 1 Risk-Based Screening Levels

All analytical results from CAU 124 samples were less than corresponding Tier 1 action levels (i.e., PALs) except for those listed in Table H.1-7. The Tier 1 action level for tritium was not exceeded but a valid comparison with the action level could not be made. The analytical laboratory mistakenly reported tritium in units of pCi/g instead of the PAL units of pCi/L. Due to the nature of the tritium measurement, the units could not be accurately converted.

Table H.1-7
Contaminants Exceeding Tier 1 Action Levels

Contaminant	Tier 1 Action Levels	Units	Maximum Reported Value (mg/kg)		
			15-02-01	16-02-04	16-99-04
TPH-DRO	100	mg/kg	--	140	230
Tritium	400,000	pCi/L	NR	--	--

DRO = Diesel-range organics
mg/kg = Milligrams per kilogram
NR = Not reported
pCi/L = Picocuries per liter
TPH = Total petroleum hydrocarbons

-- = Not applicable

H.1.7 G. Evaluation of Tier 1 Results

For all contaminants at all CASs not listed in Table H.1-7, the FALs were established as the Tier 1 RBSLs. It was determined that no further action is required for these contaminants at these CASs.

As the tritium values could not be directly compared to a Tier 1 action level, a Tier 2 SSTL for tritium was developed under a Tier 2 evaluation.

It was determined by NNSA/NSO that remediation of TPH-DRO to the Tier 1 action level of 100 mg/kg Table H.1-2 is not practical. Therefore, a Tier 2 SSTL was calculated for TPH-DRO at these CASs.

H.1.8 H. Tier 1 Remedial Action Evaluation

No remedial actions will be conducted based on Tier 1 RBSLs.

H.1.9 I. Tier 2 Evaluation

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

H.1.10 J. Development of Tier 2 Table of Site-Specific Target Levels

Evaluation of Tritium

Development of a Tier 2 SSTL for tritium at CAS 15-02-01 was calculated using the RESRAD computer code (version 6.22) and site-specific parameters. The RESRAD calculations were based on continued industrial use of the site assuming that a worker will be onsite for 250 days per year, 8 hours per day, for a duration of 25 years. A more detailed discussion of the RESRAD code, site-specific parameters used, and the printed RESRAD outputs are provided in Attachment A of this appendix. The Tier 2 SSTL for tritium at CAS 15-02-01 was established at 13,820,000 pCi/g.

Evaluation of TPH-DRO SSTLs

Method E1739-95 stipulates that risk evaluations for TPH-DRO contamination be calculated and evaluated based on the risk posed by the potentially hazardous constituents of TPH-DRO. Section 6.4.3 ("Use of Total Petroleum Hydrocarbon Measurements") of ASTM Method E1739-95 states: "TPHs should not be used for risk assessment because the general measure of TPH-DRO provides insufficient information about the amounts of individual chemical(s) of concern present" (see also Sections X1.5.4 and X1.42 of Method E1739-95 in ASTM, 1995). Therefore, the individual potentially hazardous constituents in will be evaluated for risk in place of TPH-DRO. The SSTLs were established for the individual potentially hazardous constituents in TPH-DRO at the corresponding PAL concentrations. (Note: The PALs were based on an industrial use scenario in the

CAIP.) These SSTLs and the maximum reported level for each diesel constituent per CAS are presented in Table H.1-8.

Table H.1-8
Tier 2 SSTLs and CAU 124 Results for Hazardous Constituents of Diesel

Common Name	SSTL (mg/kg)	Maximum Reported Value (mg/kg)	
		16-02-04	16-99-04
1,3,5-Trimethylbenzene	70	ND	ND
2-Methylnaphthalene[a]	190	ND	ND
Benz(a)anthracene	2.1	ND	ND
Benzene	1.4	ND	ND
Benzo(a)pyrene	0.2	ND	ND
Ethylbenzene	400	ND	ND
Naphthalene	190	ND	ND
Toluene	520	ND	ND
Xylenes[b]	420	ND	ND
n-Butylbenzene	240	ND	ND
n-Propylbenzene	240	ND	ND
Benzo(k)fluoranthene	21	ND	ND
Benzo(b)fluoranthene	21	ND	ND
Fluorene	26,000	ND	ND
Phenanthrene	100,000	ND	ND
Fluoranthene	22,000	ND	ND
Pyrene	29,000	ND	ND
Chrysene	210	ND	ND
Anthracene	100,000	ND	ND
Benzo(g,h,i)perylene	29,000	ND	ND

[a]Uses PRG for napthalene as surrogate
[b]Total of m-, o-, and p-xylenes

mg/kg = Milligrams per kilogram
ND = Nondetect
SSTL = Site-specific target level

H.1.11 K. Comparison of Site Conditions with Tier 2 Table Site-Specific Target Levels

The Tier 2 action levels are typically 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. Points of exposure are defined as those locations are areas at which an individual or population may come in contact with a COC originating from a CAS. For CAU 124, the Tier 2 action level for tritium was compared to maximum contaminant concentrations from each sample location.

The maximum concentration for tritium at CAS 15-02-01 (9.521 pCi/g) was less than corresponding Tier 2 action level of 13,820,000 pCi/g. Therefore, the FAL for tritium at CAS 15-02-01 was established as the Tier 2 SSTL.

No hazardous constituents of TPH-DRO listed in Table H.1-8 exceed their corresponding PALs. Therefore, the FALs for the hazardous constituents of TPH-DRO and CAS 16-02-04 and CAS 16-99-04 are established as the corresponding PAL concentrations.

H.1.12 L. Tier 2 Remedial Action Evaluation

Based on the Tier 2 evaluation of tritium at CAS 15-02-01, and the hazardous constituents of TPH-DRO at CASs 16-02-04 and 16-99-04, these contaminants do not pose an unacceptable risk to human health and the environment. Therefore, no further action is necessary.

As all contaminant FALs were established as Tier 1 or Tier 2 action levels, a Tier 3 evaluation was not necessary.

H.2.0 Recommendations

Because all of the site contaminant concentrations in soils from the analysis of CAU 124 samples were less than the corresponding FALs, at all locations, it was determined that contamination does not pose a significant risk to human health, safety, or the environment at these locations; therefore, corrective actions are not required.

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Attachment A

Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit (CAU) 124, CAS 15-02-01, Irrigation Piping, Nevada Test Site, Nevada

Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit (CAU) 124, Corrective Action Site (CAS) 15-02-01, Irrigation Piping, Nevada Test Site, Nevada

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Derivation of Residual Radioactive Material Guidelines for Radionuclides in Soil at Corrective Action Unit (CAU) 124, Corrective Action Site (CAS) 15-02-01, Irrigation Piping, Nevada Test Site, Nevada

1.0 Introduction

The U.S. Department of Energy (DOE), the U.S. and the National Nuclear Security Administration Nevada Site Office (NNSA/NSO) Environmental Restoration Division have numerous sites impacted from the development, testing, and production of nuclear weapons. These impacts can take the form of chemical and/or radiological contaminants. Similar to its approach for chemical contamination, NNSA/NSO are committed to properly evaluating, radiologically characterizing, and where appropriate, remediating these sites to ensure the doses to radiation workers and members of the public are maintained as low as-reasonably achievable, at a minimum, below the primary dose limits as stated in DOE Order 5400.5 (DOE, 1993).

To accomplish this, the potential for residual radioactive contamination in soils must be evaluated to determine the status of compliance with the requirements of DOE Order 5400.5 (DOE, 1993). The DOE Order 5400.5 requires that: "The Authorized Limits shall be established to (1) provide that, at a minimum, the basic dose limits … will not be exceeded, or (2) be consistent with applicable generic guidelines." Because generic guidelines have not been established for volumetric residual radioactivity for the radionuclides of concern at CAU 124 CAS 15-02-01, Authorized Limits or final action levels (FALs) were derived using the Residual Radioactivity (RESRAD) model and computer code (Yu et al., 2001). The goal of this effort was to produce Authorized Limits, in units of picocuries per gram (pCi/g) in soil above background, for CAU 124 CAS 15-02-01 that would result in radiation doses less than 25 mrem per year (mrem/yr) to an industrial worker at the site.

To develop the FALs, a "realistic" yet conservative radiation dose analysis was conducted using approved exposure scenarios and site-specific data to determine the translation between surface soil concentrations and individual radiation doses. For this analysis, site-specific data included soil sampling results obtained during site investigation activities at CAU 124 CAS 15-02-01, and meteorological data obtained from the Air Resources Laboratory/Special Operations and Research Division (ARL/SORD, 2007). This report provides the radiation dose modeling analysis supporting the technical derivation of the Authorized Limits for CAU 124 CAS 15-02-01, Irrigation Piping, Nevada Test Site (NTS), Nevada. This report also defines the radionuclides considered and approved exposure scenarios for the NTS, identifies the applicable exposure pathways and key input data or assumptions, presents the radiation doses for unit concentrations of radionuclides in soil, and establishes the FALs for CAU 124 CAS 15-02-01.

2.0 Site Closure Activities and Sample Results

Radionuclides were found in the samples from surface, channels, and sediments. The RESRAD calculations are based on validated analytical sample results obtained during site investigation activities and other applicable information specified in the SAFER (NNSA/NSO, 2007). Because the lack of specific discharge information, RESRAD calculation is based upon the value of the mean tritium concentration found in the samples. Appendix A of the CAU 124 Closure Report contains a detailed description of the sample results, analytical parameters, and laboratory methods used to analyze the soil samples. The tritium concentrations (including background) detected at the CAU 124 CAS 15-02-01 are listed in Table 2-1, Tritium Results Found in CAU 124 CAS 15-02-01 Soil Samples.

Table 2-1
Tritium Results Found in CAU 124 CAS 15-02-01 Soil Samples

Sample Number	Concentration (pCi/g)
124B027	4.515
124B026	3.577
124B014	5.896
124B015	4.334
124B035	3.574
124B032	7.323
124B033	3.43
124B034	3.703
124B040	2.713
124B039	3.695
124B038	4.535
124B007	2.58
124B008	3.498
124B010	2.747
124B016	9.521
124B019	2.685
124B017	3.429
124B018	3.511
124B024	3.439
124B025	4.156
124B029	5.672
124B030	3.411

pCi/g = Picocuries per gram

3.0 Initial Concentrations for Principal Radionuclides

Principal radionuclides are defined as radionuclides with a half-life greater than six months. The decay products of any principal radionuclide down to, but not including, the next principal radionuclide in its decay chain are defined as associated radionuclides. The RESRAD assumes that a principal radionuclide is in secular equilibrium with its associated radionuclides at the point of exposure. Therefore, associated radionuclides and radionuclides with half-lives less than six months are not input into the RESRAD calculations.

3.1 Authorized Values for Initial Concentrations of Principal Radionuclides

The authorized exposure scenarios specify that value of the arithmetic mean plus the 95 percent upper confidence limit (UCL) obtained from site-specific sampling results be entered as the principal radionuclide concentrations for RESRAD calculates. The sample results for all samples with radionuclide concentrations above the MDC within the land parcels are entered into the U.S. Environmental Protection Agency (EPA) software application ProUCL version 3.0. The ProUCL software is used to calculate the 95 percent UCL for principal radionuclide concentrations based on the distribution of the unknown mean.

For instances where the ProUCL software determined that there was not enough data to calculate the 95 percent UCL for a specific radionuclide, the maximum concentration from the sample dataset was used as the initial concentration for that radionuclide.

3.2 Authorized Values Initial Concentrations of Principal Radionuclides for Area Averaging/Location Specific Scenarios

The DOE Order 5400.5 (DOE, 1993) states: "Residual concentrations of radioactive material in soil are defined as those in excess of background concentrations averaged over an area of 100 m^2" (5400.5, IV, 4.a.). DOE Order 5400.5 also states: "If the average concentration of any surface or below-surface area less than or equal to 25 m^2, exceeds the limit or guideline by a factor of $(100/A)^{0.5}$, [where A is the area (in square meters) of the region in which concentrations are elevated], limits for "hot-spots" shall also be developed and applied" (5400.5, IV, 4.a.(1)). DOE Order 5400.5, IV, 4.a.(1) indicates that criterion for these location-specific analysis is discussed in DOE G 441.1-XX (DOE, 2002) Section 5.2.2.

The purpose of the location-specific analysis criterion is to ensure that applying the homogeneous criteria, in which the concentrations of residual radioactive material are averaged over a 100-square meter (m^2) area, does not result in the release of small areas that, because of averaging, contain unacceptably high concentrations of residual radioactive material. The location-specific criterion is used to supplement Authorized Limits for larger areas and is intended to prevent excessive exposures from a small, contaminated area that is within a larger area that meets the basic Authorized Limits. Thus, it is intended for use in areas where the residual radioactive material concentrations are not uniform. Also, the above criterion was derived conservatively, assuming the Authorized Limits were based on a dose constraint of 25 mrem/yr and selected to ensure unlikely exposure conditions would not cause the primary dose limit (100 mrem/yr) to be exceeded. The authorized exposure scenarios specify that the value of the maximum concentration of principal radionuclides obtained from site-specific

sampling results be entered as the principal radionuclide concentrations for RESRAD location-specific calculations. The authorized area parameters for RESRAD location-specific calculations are 1 m^2, 10 m^2, and 100 m^2 contamination areas.

3.3 Inhomogeneous Contamination and Initial Radionuclide Concentrations

A contaminated zone is inhomogeneous if it contains a contaminated region within which the concentration of a radionuclide exceeds three times the average for the contaminated zone. The RESRAD uses a mathematical construct that assumes uniform distribution of radionuclides within a volume. However, RESRAD recognizes that radiological contamination is inhomogeneous in nature and provides detailed guidance for applying inhomogeneous criteria (e.g., location-specific criteria, sum of fractions rule). The RESRAD User's Manual states that the inhomogeneous release criteria are generally more realistic and hence less restrictive than the homogeneous release criteria (Yu, et.al, 2001). This shows that the approved initial radionuclide concentration values (i.e., arithmetic mean plus 95 percent UCL or the maximum radionuclide concentration from the sample dataset) will result in more restrictive release criteria. The arithmetic mean plus the 95 percent UCL are used for the initial concentrations of principal radionuclides when the sample results are obtained using a random sampling method. The maximum radionuclide concentration values are used for the initial concentrations of principal radionuclides when the sample results are obtained using a non-random (e.g., bias or judgmental sampling) sampling method.

The RESRAD states that a statistical approach should always be considered as a first priority regarding the estimation of soil concentrations, as cited in the *Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil* (Yu et al., 1993). The 95 percent UCL represents a value that has a 5 percent chance that the actual mean of the dataset would exceed it. The 95 percent UCL is computed using the EPA code ProUCL. The code calculates the 95 percent UCL based on the distribution of the dataset (e.g., normal, log-normal, gamma, non-parametric).

The ProUCL software has been developed to compute an appropriate 95 percent UCL of the unknown population mean to support exposure assessment and cleanup decisions for EPA projects. A 95 percent UCL of the unknown population arithmetic mean is often used to:

- Estimate the exposure point concentration (EPC) term,
- Determine the attainment of cleanup standards,
- Estimate background level mean contaminant concentrations, or
- Compare the soil concentrations with site-specific soil screening levels.

It is important to compute a reliable, conservative, and stable 95 percent UCL of the population mean using the available data. The 95 percent UCL should approximately provide the 95 percent coverage for the unknown population mean.

The EPA has recommended that the maximum value of the dataset be used for the initial EPC term when the 95 percent UCL exceeds the maximum (EPA, 1992). However, if the maximum value of the dataset is used, then most of the statistical data associated with the distribution of the dataset are ignored (except for the maximum). Therefore, by using the mean plus the 95 percent

UCL the statistical data associated with the dataset are retained, and the value approaches or exceeds the maximum value of the dataset as recommended by EPA.

3.4 Initial Concentrations of Principal Radionuclide for CAU 124 CAS 15-02-01

The initial radionuclide concentrations used for the RESRAD calculations are those listed in Table 2-1. Because no specific information was available for the origin of the tritium and the random sampling scheme, the mean concentration of tritium found on location is used for RESRAD analysis.

4.0 Authorized RESRAD Exposure Pathways and Scenarios

This section describes the input parameters, exposures scenarios, and guidance for calculating site-specific radiological remediation levels for projects using the RESRAD computer code, as agreed to by NNSA/NSO, Stoller-Navarro Joint Venture (SNJV), the NTS management and operating (M&O) contractor, and Nevada Division of Environmental Protection (NDEP).

4.1 Guidance for RESRAD Calculations

The guidance in this section was developed by NNSA/NSO, SNJV, the M&O contractor, and NDEP and is only applicable to soils containing residual radioactive material. This guidance does not apply to structures, facilities, equipment, and building materials containing contaminated surfaces or volume contamination. The primary dose limit for any member of the public is 100-millirem (mrem) total effective dose equivalent in a year. This limit applies to the sum of internal and external doses resulting from all modes of exposure to all radiation sources other than background radiation and doses received as a patient from medical sources as required by DOE 5400.5, II.1.a.(3)(a) (DOE, 1993). The dose constraint is defined as one quarter of the dose limit (i.e., 25-mrem) and will be applied to ensure that in 1,000 years, the maximally exposed individual does not exceed the dose constraint in any single year. The requirements of Chapter IV of DOE 5400.5 Chapter IV will not specifically apply if NNSA/NSO chooses to continue to own and actively control access or use of the site. However, the radiation protection requirements in the other sections of DOE 5400.5 will apply to NNSA/NSO owned and maintained sites.

Due to the large spatial variability in background amongst sites, the "above background criterion" will be defined as the concentration of a specific radionuclide in soil that equals or exceeds its corresponding preliminary action level (PAL). The source data for these radionuclide specific PALs are taken directly from National Council on Radiation Protection and Measurements Report No. 129 Table 2.1, Construction, Commercial, Industrial land-use scenario column for a 25-mrem dose constraint (NCRP, 1999). The generic guidelines for residual concentrations of radium (Ra)-226, Ra-228, thorium (Th)-230, and Th-232 are found in Chapter IV of DOE Order 5400.5, Change 2, *Radiation Protection of the Public and Environment* (DOE, 1993).

Background radiation refers to the local area and includes:

- Concentration of naturally occurring radionuclides.
- Cosmic radiation.
- Radionuclides of anthropogenic origin that have been globally dispersed and are present at low concentrations such as fallout from nuclear weapons. (Note: This is not the case at the NTS because the historical aspects of the NTS [e.g., above- and below-ground testing, and other operations resulted in dispersion of radionuclides locally].)

Due to the impracticality of determining "true" background, a dose constraint with no background subtraction will be used (i.e., a dose constraint not in excess of background). The

use of the dose constraint with no background subtraction is a far more conservative and sensitive approach because it does not deal with the uncertainty of natural background.

4.2 Description of Approved Scenarios

Detailed description for each scenario can be found in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006).

4.3 Residual Radioactive Material Guideline

The residual radioactive material guideline represents the concentration of residual radioactive material that can remain in place and still allow use of that area without radiological restrictions. Using site-specific parameters and sample analysis results, the radioactive material guideline, G, can be calculated for a given dose limit of H_{EL} for an individual as follows;

$$G = H_{EL} / DSR ,$$

where DSR is the total dose/source concentration ratio. The dose limit H_{EL}, used to derive the residual radioactive material guideline is 25 mrem/yr.

Single radionuclide guidelines are calculated for individual radionuclides such that the annual dose to industrial/construction workers at the site should not exceed an annual dose limitation of 25 mrem/yr. Sites contaminated with two or more radionuclides (i.e., a mixture of radionuclides) require further evaluation to ensure that collective exposures from individual radionuclides do not exceed the 25 mrem/yr annual dose constraint. This evaluation is performed using a sum of the fractions method. The initial soil concentration of each radionuclide is divided by the single radionuclide guideline for that radionuclide to produce a ratio. These ratios are then summed. If the sum is less than or equal to unity, then the collective annual dose from all radionuclides at the site should not exceed the 25 mrem/yr annual dose constraint. If the sum does exceed unity, the annual dose to industrial/construction workers could exceed the 25 mrem/yr dose constraint, even if the concentrations of residual radionuclides at the site are below the single radionuclide guideline values. For sites where the sum of the ratios exceeds unity, residual radioactive material guidelines for mixtures of radionuclides are calculated such that the following equation is satisfied;

$$\overline{M} = \sum_i \overline{S}_i(t_o) / G_i(t_m) \leq 1$$

Where: $\overline{M}$ = average mixture sum (dimensionless)

$\overline{S}_i(t_o)$ = initial concentration of the *i*th principal radionuclide averaged over an area determined by scenario activities

$G_i(t_m)$ = single radionuclide soil concentration guideline for the *i*th principal radionuclide at time t maximum.

For a site where the sum of the ratios does not exceed unity, the residual radioactive guidelines for single radionuclides are the radionuclide concentrations to be used as the FAL. For sites where the sum of the ratios exceeds unity, the residual radioactive guidelines for mixtures of radionuclides are mathematically adjusted so that the above equation is satisfied. Those adjusted values are then used as the FAL.

5.0 RESRAD Calculations for CAU 124 CAS 15-02-01, Irrigation Piping

This section discuses the RESRAD calculations and results for CAU 124 CAS 15-02-01. Industrial Worker scenario is selected as the exposure scenario because the operational history of the CAS.

5.1 User Input Parameters

The RESRAD default parameters that were modified for the calculations performed for CAU 124 CAS 15-02-01 in this report and the site-specific values entered are presented in Table 5-1, RESRAD Parameter Input Values for CAU 124 CAS 15-02-01. The initial tritium concentration used for analyses is the mean of those listed in Table 2-1.

5.2 Radionuclide Concentrations and Dose Estimates

The maximum dose results from RESRAD calculations for the CAU 124 CAS 15-02-01 is 7.596E-06 mrem/yr occurring at year zero (current year) and the dose will decrease to zero until year 10. The detailed RESRAD results for this CAS are provided in Exhibit 1, RESRAD Summary Report: CAU 124 CAS 15-02-01.

Uncertainty in the derivation of dose estimates and dose/source contribution ratios comes from the distribution of possible input parameter values, as well as uncertainty in the conceptual model used to represent the site. The pathway contributing to the total annual dose at the time of maximum dose occurs are almost all (99.38 percent) for inhalation, and only minute amount (0.62 percent) for soil ingestion pathways (Table 5-2). Therefore, uncertainties in the following parameters: Erosion rates, thickness of contaminated zone, and occupancy factors have the greatest significance on the model predictions.

Because the tritium concentrations found at this site pose a dose level below the 25 mrem/yr constraint under the current site conditions, remediation alternative is not necessary for the site.

5.3 Residual Radioactive Material Guidelines for CAU 124 CAS 15-02-01

The sum of the ratios for CAU 124 CAS 15-02-01 does not exceed unity. Table 5-3 presents the calculations results for deriving guidelines for radionuclides for this CAS. The FAL for the CAU 124 CAS 15-02-01 scenario is the RESRAD material guideline values for single radionuclide.

Table 5-1
RESRAD Parameters Input Values for CAU 124 CAS 15-02-01
(Page 1 of 2)

Parameter	Units	CAU 124 CAS 15-02-01	Defaults	Reference/Rationale
Area of CZ	m^2	1.000E+02	1.000E+04	Estimated using the sampling boundary
Thickness of CZ	m	1.500E-01	2.000E+00	Top layer of the contamination soil
Principal radionuclides	pCi/g	See Table 2-1	0.0	Initial concentrations are the mean concentrations from sample results: maximum for biased sample or average for random sample.
Average Annual Wind Speed	m/sec	4.07	2.000E+00	NNSA/NSO, 2007
Precipitation	m/yr	1.000E-00	1.000E+00	Data from Air Resources Laboratory
Runoff Coefficient	-	4.000E-01	2.000E-01	Open Sandy Loam 30% impervious Table 10.1 (Yu, et al., 1993)
Inhalation Rate	m^3/yr	8.40E+03	8.400E+03	NNSA/NSO, 2007, RESRAD default
Mass Loading for Inhalation	g/m^3	6.00E-04	1E-04	The estimated mass loading for construction activities. (Yu, et al., 1993)
Exposure Duration	yr	25	30	Standard for Industrial/Commercial Scenario
Shielding Factor Inhalation	-	1.0	0.4	Assumes no indoor time fraction
Shielding Factor External Gamma	-	1.0	0.7	Assumes no indoor time fraction
Fraction of Time Spent Indoors	-	0.0	0.5	Assumes no indoor time fraction
Fraction of Time Spent Outdoors	-	8.55E-02	0.25	NNSA/NSO, 2007
Soil Ingestion Rate	g/yr	108	36.5	NNSA/NSO, 2007

Table 5-1
RESRAD Parameters Input Values for CAU 124 CAS 15-02-01
(Page 2 of 2)

Parameter	Units	CAU 124 CAS 15-02-01	Defaults	Reference/Rationale

CZ = Contaminated Zone
g/m^3 = Grams per cubic meter
g/yr = Grams per year
m = Meter
m^2 = Square meter
m/sec = Meters per second
m/yr = Meters per year
m^3/yr = Cubic meters per year
pCi/g = Picocuries per gram
RESRAD = Residual Radioactive
yr = Year
- = Not applicable

Table 5-2
Maximum Dose Contributions for CAU 124 CAS 15-02-01
Using Scenario B (dose as mrem/yr)

Radionuclide	Ground		Inhalation		Soil		Total	
	Annual Dose	Fraction	Annual Dose	Fraction	Annual Dose	Fraction	Annual Dose	Fraction
Tritium	0.000E+00	0.0000	7.549E-06	0.9938	4.723E-08	0.0062	7.596E-06	1.0000

mrem/yr = Millirem per year

Table 5-3
CAU 124 CAS 15-02-01 Sum of Fractions and Proportional Scaling and Final Action Level Determination

Radionuclide	Initial Radionuclide Concentration (pCi/g)	Final Action Level (pCi/g)
Tritium	4.200E+00	1.382E+07

pCi/g = Picocuries per gram

6.0 References

ARL/SORD, see Air Resources Laboratory/Special Operations and Research Division.

Air Resources Laboratory/Special Operations and Research Division. 2007. "Climatological Information and Data." As accessed at http://www.sord.nv.doe.gov on 20 October 20.

DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency.

NCRP, see National Council on Radiation Protection and Measurements.

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

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

Exhibit 1

RESRAD Summary Report:
CAU 124 CAS 15-02-01

(20 pages)

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Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	H-3	6.400E-08	6.400E-08	DCF2(1)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(2)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(3)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(4)
B-1	U-234	1.320E-01	1.320E-01	DCF2(5)
B-1	U-238	1.180E-01	1.180E-01	DCF2(6)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(7)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	H-3	6.400E-08	6.400E-08	DCF3(1)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(2)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(3)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(4)
D-1	U-234	2.830E-04	2.830E-04	DCF3(5)
D-1	U-238	2.550E-04	2.550E-04	DCF3(6)
D-1	U-238+D	2.687E-04	2.550E-04	DCF3(7)
D-34	Food transfer factors:			
D-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(1,1)
D-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,2)
D-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(1,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(2,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(2,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(4,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(4,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(5,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(5,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(6,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(6,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC(1,1)
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(1,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(2,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(3,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(4,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(4,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(5,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(5,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(6,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.500E-01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): H-3	4.200E+00	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): U-234	2.859E+00	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): U-238	2.349E+00	0.000E+00	---	S1(6)
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(6)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for H-3				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.039E+01	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.426E-02	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.426E-02	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.217E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.165E-02	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.704E-05	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	0.000E+00	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	100.00 square meters	H-3	4.200E+00
Thickness:	0.15 meters	U-234	2.859E+00
Cover Depth:	0.00 meters	U-238	2.349E+00

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.804E-01	1.720E-01	1.563E-01	1.119E-01	4.259E-02	1.164E-03	0.000E+00	0.000E+00
M(t):	7.215E-03	6.879E-03	6.253E-03	4.474E-03	1.704E-03	4.655E-05	0.000E+00	0.000E+00

0Maximum TDOSE(t): 1.804E-01 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	7.549E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.723E-08	0.0000
U-234	5.648E-04	0.0031	1.453E-02	0.0806	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.159E-03	0.0120
U-238	1.508E-01	0.8358	1.068E-02	0.0592	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.685E-03	0.0093
Total	1.513E-01	0.8389	2.522E-02	0.1398	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.844E-03	0.0213

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.596E-06	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.726E-02	0.0957
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.631E-01	0.9043
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.804E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	1.203E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.527E-15	0.0000
U-234	5.399E-04	0.0031	1.381E-02	0.0803	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.052E-03	0.0119
U-238	1.438E-01	0.8363	1.015E-02	0.0590	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.601E-03	0.0093
Total	1.444E-01	0.8395	2.396E-02	0.1393	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.653E-03	0.0212

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.211E-12	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.640E-02	0.0954
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.556E-01	0.9046
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.720E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
H-3	0.000E+00	0.0000	3.056E-26	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.912E-28	0.0000
U-234	4.936E-04	0.0032	1.247E-02	0.0798	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.853E-03	0.0119
U-238	1.309E-01	0.8374	9.162E-03	0.0586	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.446E-03	0.0092
Total	1.314E-01	0.8405	2.163E-02	0.1384	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.299E-03	0.0211

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.075E-26	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.482E-02	0.0948
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.415E-01	0.9052
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.563E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	3.618E-04	0.0032	8.714E-03	0.0779	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.295E-03	0.0116
U-238	9.407E-02	0.8410	6.400E-03	0.0572	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.010E-03	0.0090
Total	9.443E-02	0.8443	1.511E-02	0.1351	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.305E-03	0.0206

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.037E-02	0.0927
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.015E-01	0.9073
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.119E-01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	1.554E-04	0.0036	3.084E-03	0.0724	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.581E-04	0.0108
U-238	3.627E-02	0.8517	2.263E-03	0.0531	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.570E-04	0.0084
Total	3.643E-02	0.8553	5.346E-03	0.1255	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.151E-04	0.0191

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.697E-03	0.0868
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.889E-02	0.9132
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.259E-02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	2.115E-05	0.0182	6.001E-05	0.0516	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.870E-06	0.0076
U-238	1.025E-03	0.8805	4.233E-05	0.0364	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.678E-06	0.0057
Total	1.046E-03	0.8987	1.023E-04	0.0879	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.555E-05	0.0134

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.003E-05	0.0774
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.074E-03	0.9226
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.164E-03	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	H-3	1.000E+00	1.809E-06	2.882E-13	7.321E-27	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	6.036E-03	5.737E-03	5.182E-03	3.625E-03	1.288E-03	2.501E-05	0.000E+00	0.000E+00
U-234	Th-230	1.000E+00	6.612E-08	1.934E-07	4.268E-07	1.055E-06	1.810E-06	1.040E-06	0.000E+00	0.000E+00
U-234	Ra-226+D	1.000E+00	2.844E-09	1.942E-08	9.705E-08	7.111E-07	3.428E-06	5.427E-06	0.000E+00	0.000E+00
U-234	Pb-210+D	1.000E+00	1.164E-13	1.690E-12	1.833E-11	3.729E-10	4.308E-09	1.147E-08	0.000E+00	0.000E+00
U-234	äDSR(j)		6.036E-03	5.737E-03	5.183E-03	3.627E-03	1.293E-03	3.149E-05	0.000E+00	0.000E+00
0U-238	U-238	5.400E-05	2.851E-07	2.709E-07	2.447E-07	1.710E-07	6.056E-08	1.153E-09	0.000E+00	0.000E+00
0U-238+D	U-238+D	9.999E-01	6.944E-02	6.623E-02	6.024E-02	4.320E-02	1.656E-02	4.570E-04	0.000E+00	0.000E+00
U-238+D	U-234	9.999E-01	8.483E-09	2.433E-08	5.136E-08	1.079E-07	1.113E-07	7.127E-09	0.000E+00	0.000E+00
U-238+D	Th-230	9.999E-01	6.198E-14	4.208E-13	2.075E-12	1.449E-11	6.119E-11	6.315E-11	0.000E+00	0.000E+00
U-238+D	Ra-226+D	9.999E-01	2.005E-15	2.922E-14	3.196E-13	6.715E-12	8.479E-11	2.961E-10	0.000E+00	0.000E+00
U-238+D	Pb-210+D	9.999E-01	6.580E-20	1.970E-18	4.593E-17	2.708E-15	8.569E-14	5.735E-13	0.000E+00	0.000E+00
U-238+D	äDSR(j)		6.944E-02	6.623E-02	6.024E-02	4.320E-02	1.656E-02	4.570E-04	0.000E+00	0.000E+00

The DSR includes contributions from associated (half-life ó 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	1.382E+07	8.673E+13	*9.597E+15	*9.597E+15	*9.597E+15	*9.597E+15	*9.597E+15	*9.597E15
U-234	4.142E+03	4.357E+03	4.824E+03	6.892E+03	1.933E+04	7.939E+05	*6.247E+09	*6.247E+09
U-238	3.600E+02	3.775E+02	4.150E+02	5.787E+02	1.510E+03	5.470E+04	*3.361E+05	*3.361E+05

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
H-3	4.200E+00	0.000E+00	1.809E-06	1.382E+07	1.809E-06	1.382E+07
U-234	2.859E+00	0.000E+00	6.036E-03	4.142E+03	6.036E-03	4.142E+03
U-238	2.349E+00	0.000E+00	6.944E-02	3.600E+02	6.944E-02	3.600E+02

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	H-3	1.000E+00	7.596E-06	1.211E-12	3.075E-26	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	1.726E-02	1.640E-02	1.482E-02	1.037E-02	3.682E-03	7.151E-05	0.000E+00	0.000E+00
U-234	U-238	9.999E-01	1.993E-08	5.714E-08	1.206E-07	2.534E-07	2.615E-07	1.674E-08	0.000E+00	0.000E+00
U-234	äDOSE(j)		1.726E-02	1.640E-02	1.482E-02	1.037E-02	3.682E-03	7.153E-05	0.000E+00	0.000E+00
0Th-230	U-234	1.000E+00	1.890E-07	5.529E-07	1.220E-06	3.016E-06	5.176E-06	2.973E-06	0.000E+00	0.000E+00
Th-230	U-238	9.999E-01	1.456E-13	9.884E-13	4.874E-12	3.405E-11	1.437E-10	1.483E-10	0.000E+00	0.000E+00
Th-230	äDOSE(j)		1.890E-07	5.529E-07	1.220E-06	3.016E-06	5.176E-06	2.973E-06	0.000E+00	0.000E+00
0Ra-226	U-234	1.000E+00	8.131E-09	5.552E-08	2.775E-07	2.033E-06	9.800E-06	1.552E-05	0.000E+00	0.000E+00
Ra-226	U-238	9.999E-01	4.710E-15	6.864E-14	7.508E-13	1.577E-11	1.992E-10	6.955E-10	0.000E+00	0.000E+00
Ra-226	äDOSE(j)		8.131E-09	5.552E-08	2.775E-07	2.033E-06	9.800E-06	1.552E-05	0.000E+00	0.000E+00
0Pb-210	U-234	1.000E+00	3.329E-13	4.833E-12	5.240E-11	1.066E-09	1.232E-08	3.278E-08	0.000E+00	0.000E+00
Pb-210	U-238	9.999E-01	1.546E-19	4.627E-18	1.079E-16	6.362E-15	2.013E-13	1.347E-12	0.000E+00	0.000E+00
Pb-210	äDOSE(j)		3.329E-13	4.833E-12	5.240E-11	1.066E-09	1.232E-08	3.278E-08	0.000E+00	0.000E+00
0U-238	U-238	5.400E-05	6.696E-07	6.364E-07	5.747E-07	4.017E-07	1.423E-07	2.708E-09	0.000E+00	0.000E+00
U-238	U-238	9.999E-01	1.631E-01	1.556E-01	1.415E-01	1.015E-01	3.889E-02	1.074E-03	0.000E+00	0.000E+00
U-238	äDOSE(j)		1.631E-01	1.556E-01	1.415E-01	1.015E-01	3.889E-02	1.074E-03	0.000E+00	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	H-3	1.000E+00	4.200E+00	6.739E-07	1.735E-20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0U-234	U-234	1.000E+00	2.859E+00	2.735E+00	2.504E+00	1.837E+00	7.579E-01	3.421E-02	4.897E-06	1.719E-19
U-234	U-238	9.999E-01	0.000E+00	6.371E-06	1.749E-05	4.278E-05	5.296E-05	7.968E-06	3.423E-09	4.009E-22
U-234	äS(j):		2.859E+00	2.735E+00	2.504E+00	1.837E+00	7.579E-01	3.422E-02	4.900E-06	1.723E-19
0Th-230	U-234	1.000E+00	0.000E+00	2.517E-05	7.230E-05	2.079E-04	4.270E-04	5.725E-04	5.741E-04	5.559E-04
Th-230	U-238	9.999E-01	0.000E+00	2.910E-11	2.470E-10	2.243E-09	1.171E-08	2.854E-08	3.025E-08	2.929E-08
Th-230	äS(j):		0.000E+00	2.517E-05	7.230E-05	2.079E-04	4.270E-04	5.725E-04	5.742E-04	5.560E-04
0Ra-226	U-234	1.000E+00	0.000E+00	5.435E-09	4.650E-08	4.341E-07	2.434E-06	6.928E-06	7.762E-06	7.518E-06
Ra-226	U-238	9.999E-01	0.000E+00	4.200E-15	1.068E-13	3.212E-12	4.877E-11	3.099E-10	4.087E-10	3.961E-10
Ra-226	äS(j):		0.000E+00	5.435E-09	4.650E-08	4.341E-07	2.434E-06	6.928E-06	7.762E-06	7.518E-06
0Pb-210	U-234	1.000E+00	0.000E+00	5.592E-11	1.416E-09	4.194E-08	6.128E-07	3.570E-06	4.532E-06	4.391E-06
Pb-210	U-238	9.999E-01	0.000E+00	3.248E-17	2.455E-15	2.382E-13	9.864E-12	1.463E-10	2.385E-10	2.314E-10
Pb-210	äS(j):		0.000E+00	5.592E-11	1.416E-09	4.194E-08	6.128E-07	3.571E-06	4.533E-06	4.392E-06
0U-238	U-238	5.400E-05	1.268E-04	1.214E-04	1.111E-04	8.149E-05	3.363E-05	1.518E-06	2.174E-10	7.648E-24
U-238	U-238	9.999E-01	2.349E+00	2.247E+00	2.057E+00	1.509E+00	6.227E-01	2.811E-02	4.027E-06	1.416E-19
U-238	äS(j):		2.349E+00	2.247E+00	2.057E+00	1.509E+00	6.227E-01	2.811E-02	4.027E-06	1.416E-19

THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time = 4.94 seconds

Appendix I

Nevada Division of Environmental Protection Comments

(1 page)

NEVADA ENVIRONMENTAL RESTORATION PROJECT

DOCUMENT REVIEW SHEET

1. Document Title/Number: Draft Closure Report for Corrective Action Unit 124: Storage Tanks, Nevada Test Site, Nevada	**2. Document Date:** 12/07/2007
3. Revision Number: 0	**4. Originator/Organization:** Stoller-Navarro
5. Responsible NNSA/NV ERP Project Manager: Kevin J. Cabble	**6. Date Comments Due:** 12/27/2007
7. Review Criteria: Full	
8. Reviewer/Organization/Phone No: Don Elle and Ted Zaferatos, NDEP, 486-2850	**9. Reviewer's Signature:**

10. Comment Number/Location	11. Type*	12. Comment	13. Comment Response	14. Accept
1.) Appendix H, Risk Evaluation, Page H-10, Section H.1.7	Mandatory	The verbiage in Section H.1.7 identifies Table H.1-7 as Table H.1-2.	The verbiage in Section H.1.7 that identifies Table H.1-2 has been changed to identify Table H.1-7.	
2.) Suggestion Concerning Best Management Practices	Suggested	The sealing or cutting of pipes in four of the five CASs within the CAU is mentioned in Section 1.2 on page 4. Positive reinforcement of the extent of the closure work conducted could be achieved if the piping work were briefly detailed in the Closure Activities portion of the report (Section 2).	A discussion of the Best Management Practice activities regarding the piping at CASs 08-02-01, 16-02-03, 16-02-04, and 16-99-04 has been added to the Closure Activities portion of the report (Section 2).	

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