Nevada
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Project

DOE/NV--1221

National Nuclear Security Administration

Closure Report for Corrective Action Unit 553: Areas 19, 20 Mud Pits and Cellars Nevada Test Site, Nevada

Controlled Copy No.: ___
Revision No.: 0

August 2007

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Environmental Restoration
Project

U.S. Department of Energy
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CLOSURE REPORT FOR CORRECTIVE ACTION UNIT 553: AREAS 19, 20 MUD PITS AND CELLARS NEVADA TEST SITE, NEVADA

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

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CLOSURE REPORT FOR
CORRECTIVE ACTION UNIT 553:
AREAS 19, 20 MUD PITS AND CELLARS
NEVADA TEST SITE, NEVADA

Approved by: /s/Sabine T. Curtis Date: 08/22/2007

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Acting Federal Project Director
Environmental Restoration Project

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List of Acronyms and Abbreviations

Ac	Actinium
ASTM	American Society for Materials
bgs	Below ground surface
CAI	Corrective Action Investigation
CAS	Chemical Abstracts Service
CAS	Corrective Action Site
CAU	Corrective Action Unit
CLP	Contract Laboratory Program
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 indicators
DQO	Data quality objective
DRO	Diesel-range organics
EPA	U.S. Environmental Protection Agency
Eu	Europium
FAL	Final action level
FD	Field duplicate
FFACO	*Federal Facility Agreement and Consent Order*
FSL	Field-screening level
FSR	Field-screening result
ft	Foot
ft^2	Square foot

List of Acronyms and Abbreviations *(Continued)*

GPS	Global Positioning System
ID	Identification
IDW	Investigation-derived waste
in.	Inch
keV	Kiloelectron volt
LCS	Laboratory control sample
LLNL	Lawrence Livermore National Laboratory
MDC	Minimum detectable concentration
mg/kg	Milligram per kilogram
mi	Mile
MS/MSD	Matrix spike
MSD	Matrix spike duplicate
NAC	*Nevada Administrative Code*
NDEP	Nevada Division of Environmental Protection
NIST	National Institute for 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
pCi/g	Picocuries per gram
POC	Performance object criteria
PPE	Personal protective equipment
PRG	Preliminary Remediation Goal
Pu	Plutonium

List of Acronyms and Abbreviations *(Continued)*

QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RBCA	Risk-based corrective action
RBSL	Risk-based screening level
RCRA	*Resource Conservation and Recovery Act*
RESRAD	Residual Radioactive
RPD	Relative percent difference
SAFER	Streamlined Approach for 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
TPH	Total petroleum hydrocarbons
U	Uranium
USGS	U.S. Geological Survey
VOC	Volatile organic compound
µg/kg	Micrograms per kilograms
%R	Percent recovery

Executive Summary

This Closure Report (CR) presents information supporting the closure of Corrective Action Unit (CAU) 553: Areas 19, 20 Mud Pits and Cellars, 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 553 are located within Areas 19 and 20 of the Nevada Test Site. Corrective Action Unit 553 is comprised of the following CASs:

- 19-99-01, Mud Spill
- 19-99-11, Mud Spill
- 20-09-09, Mud Spill
- 20-99-03, Mud Spill

The purpose of this CR is to provide documentation supporting the completed corrective actions and provide data confirming that the closure objectives for CASs within CAU 553 were met. To achieve this, the following actions were or will be 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 the Notice of Completion and closure of CAU 553 to be issued by Nevada Division of Environmental Protection.

From February 6 through May 24, 2007, closure activities were performed as set forth in the *Streamlined Approach for Environmental Restoration Plan for CAU 553, Areas 19, 20 Mud Pits and Cellars, Nevada Test Site, Nevada*. The purposes of the activities as 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.

Analytes detected during the closure activities were evaluated against final action levels (FALs) to determine contaminants of concern for CAU 553. Assessment of the data generated from closure

activities shows the FALs were not exceeded at any of the CASs; therefore, no corrective action was necessary. As a matter of best management practice, the spilled bentonite located in the roadway at CAS 20-09-09 was removed.

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

- No further corrective action is required at CASs 19-99-01, 19-99-11, 20-09-09, and 20-99-03.
- A Notice of Completion to DOE, National Nuclear Security Administration Nevada Site Office is requested from the Nevada Division of Environmental Protection for closure of CAU 553.
- Corrective Action Unit 553 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) 553, Mud Pits and Cellars, Nevada Test Site (NTS), Nevada. This complies with the requirements of the *Federal Facility Agreement and Consent Order* (FFACO) that was agreed to by the State of Nevada; U.S. Department of Energy (DOE), Environmental Management; U.S. Department of Defense; and DOE, Legacy Management (FFACO, 1996; as amended August 2006). Corrective Action Unit 553 contains four corrective action sites (CASs) located in Areas 19 and 20 of the NTS. The NTS is located approximately 65 miles (mi) northwest of Las Vegas, Nevada (Figure 1-1).

Corrective Action Unit 553 is comprised of the four CASs (Figure 1-2) listed below:

- 19-99-01, Mud Spill
- 19-99-11, Mud Spill
- 20-09-09, Mud Spill
- 20-99-03, Mud Spill

1.1 Purpose

This CR provides justification for the closure of CAU 553 without corrective action. This justification is based on process knowledge and the results of the investigative activities conducted according to the *Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 553: Areas 19, 20 Mud Pits and Cellars, Nevada Test Site, Nevada* (NNSA/NSO, 2006). The CAU 553 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 553 consists of two CASs in Area 19 and two CASs in Area 20. All four CASs consist of drilling mud spilled during drilling activities supporting underground nuclear weapons testing.

Corrective Action Site 19-99-01, located in Area 19 of the NTS, consists of a mud spill located on and around a dirt mound adjacent to the north side of the fenced U-19ad potential crater area east of

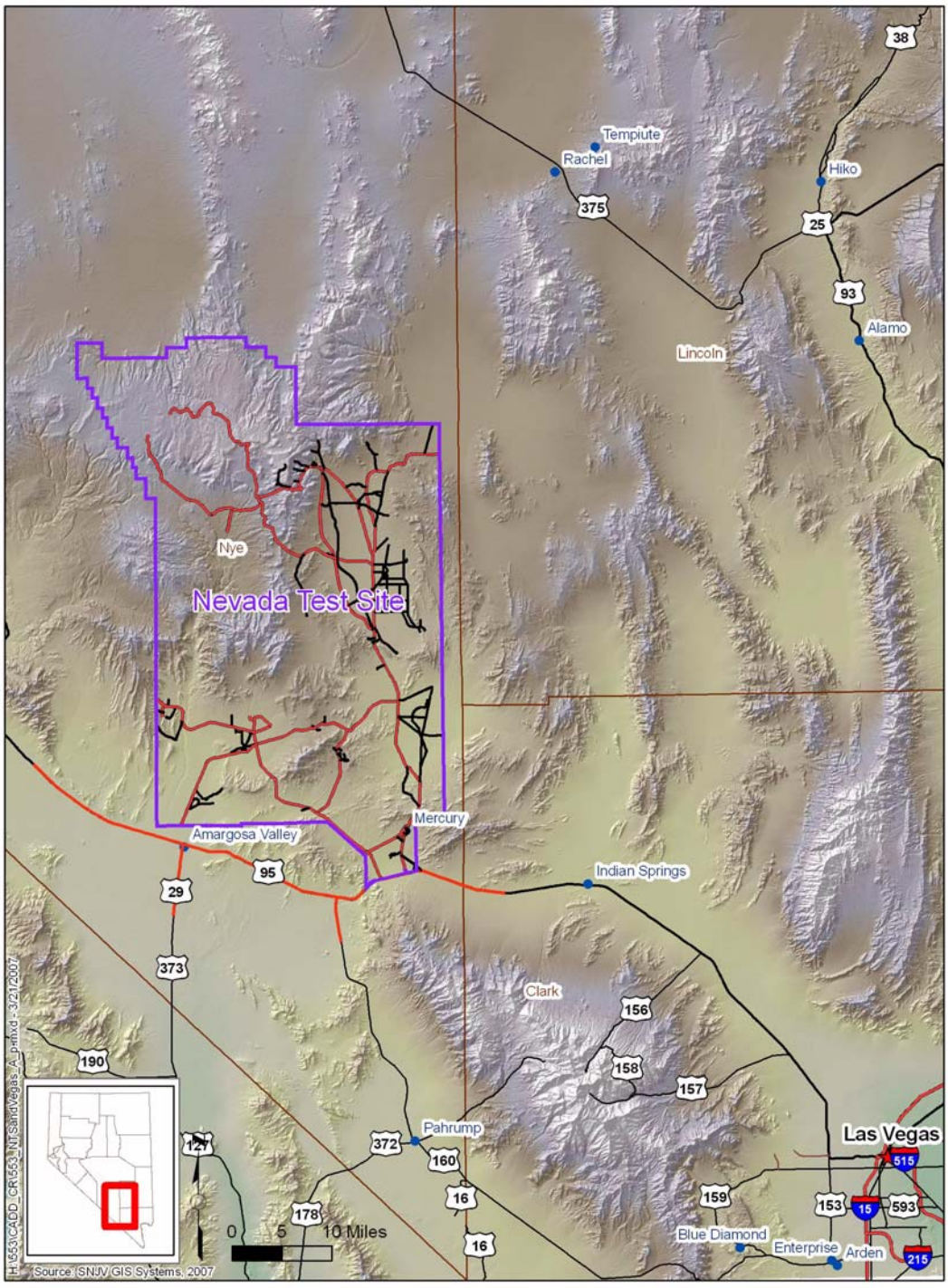

Figure 1-1
Nevada Test Site

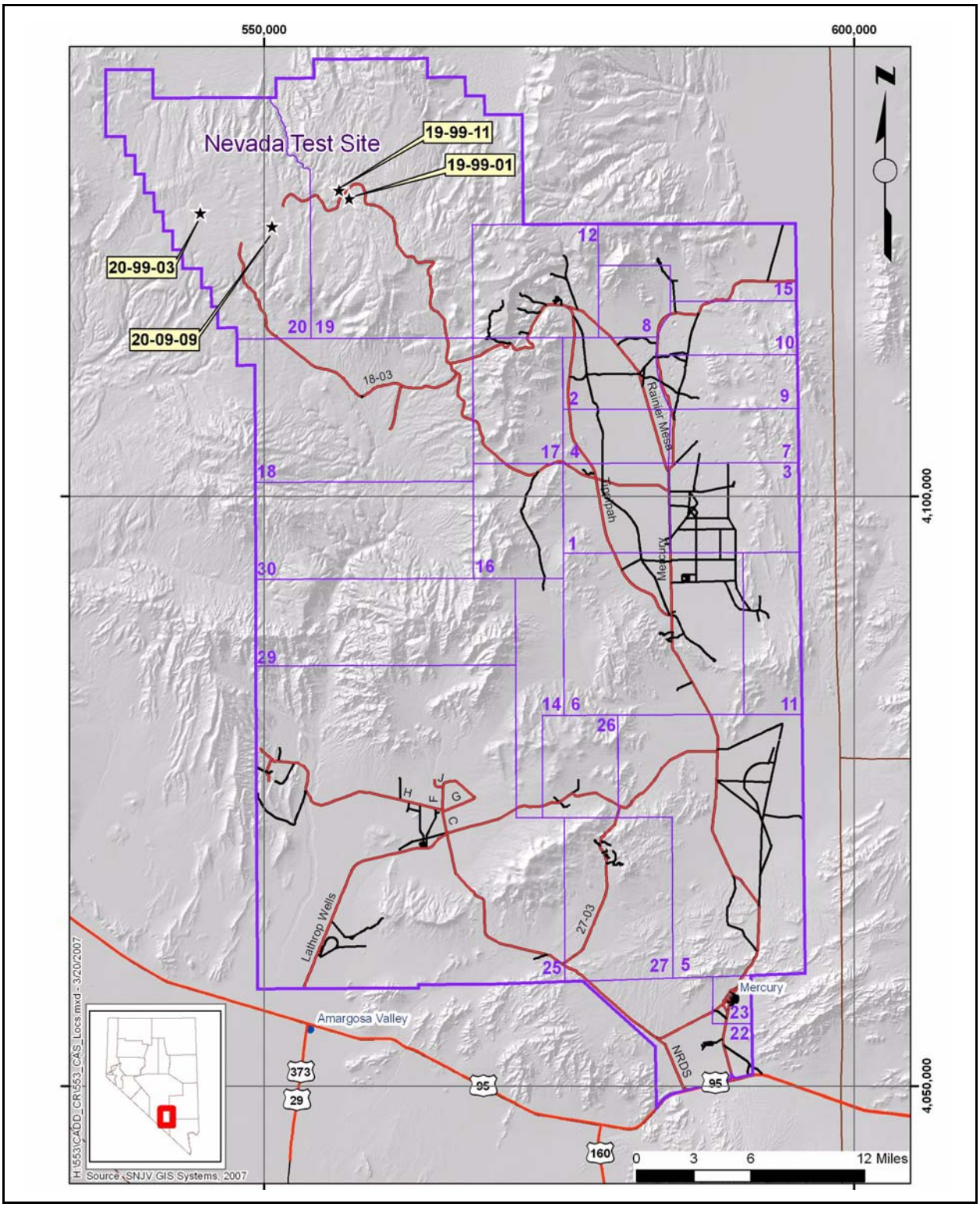

Figure 1-2
CAU 553, CAS Location Map

Pahute Mesa Road. The CAS consists of a spill that extends downslope with a small portion extending past the U-19ad fence line into the potential crater area.

Corrective Action Site 19-99-11 is located approximately 50 feet (ft) east of the U-19q/U-19z PS#1D potential crater area west of Pahute Mesa Road. The CAS consists of three separate mud spills.

Corrective Action Site 20-09-09 is located in Area 20 of the NTS in the immediate vicinity of the Area 20 Pahute Mesa Road Plant, which was used to mix drilling mud for various drilling activities in Area 20. The CAS consists of two separate mud spills in the facility parking area. These spills appear to be unused bentonite powder that was spilled before mixing.

Corrective Action Site 20-99-03 is located in Area 20 of the NTS southeast of the fenced U-20aq crater area. The CAS consists of a single mud spill that covers an area of approximately 225,000 square feet (ft^2).

1.2 Scope

The corrective action of no further action was completed by demonstrating that contaminants of potential concern (COPCs) are not present in concentrations greater than final action levels (FALs) within the CASs through environmental sample analysis. Various activities were conducted during the investigation to support the decision of no further action and included the following:

- Radiological and geophysical surveys.
- Field screening.
- Collection and laboratory analysis of environmental samples.
- Collection and analysis of quality control (QC) samples.
- Comparison of the analytical results to FALs to support the justification of why no further corrective action is necessary.
- Removal and disposal of the mud spill from the roadway at CAS 20-09-09.
- Documentation of a Notice of Completion and closure of CAU 553.

1.3 Closure Report 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 553 SAFER Plan, the actual schedule, and the site conditions following completion of corrective actions.

Section 3.0 - Waste Disposition: Discusses the wastes generated and entered into an approved waste management system as a result of the corrective action.

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

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

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

Appendix A- *DQOs as Developed in the SAFER Plan*: Provides the data quality objectives (DQOs) as developed in the CAU 553 SAFER Plan.

Appendix B - *Closure Certification*. Documents the specific closure activities completed for the CAU. (This appendix does not apply to CAU 553.)

Appendix C - *As-Built Documentation*: Not used in the document.

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

Appendix E - *Waste Disposition Documentation*: Not used in the document.

Appendix F - *Modifications to the Post-Closure Plan*: Not used in the document.

Appendix G - *Use Restrictions:* Not used in the document.

Appendix H - *Risk Evaluation*: Summarizes risk assessment results.

Appendix I - *GPS Coordinates*: Contains Global Positioning System (GPS) coordinates of sample locations.

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

1.3.1 Applicable Programmatic Plans and Documents

To ensure adherence to all project objectives, health and safety requirements, and quality control procedures, all closure activities were performed according to the following documents:

- *Streamlined Approach for Environmental Restoration Plan (SAFER) for* CAU 553, *Areas 19, 20 Mud Pits and Cellars* (NNSA/NSO, 2006)
- *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002)
- *Federal Facility Agreement and Consent Order* (FFACO, 1996; as amended August 2006)
- *Project Execution Plan* (SNJV, 2006)
- Approved 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 environmental data, and design a data collection program that satisfied these purposes.

The problem statement for CAU 553 is: “Existing information on the nature and extent of potential contamination is insufficient to validate the assumptions used to select the corrective actions and to verify that closure objectives were met for the CASs in CAU 553.” To address this question, the resolution of two following decision statements is required:

- Decision I: "Does any contaminant of concern (COC) remain in environmental media within the CAS?" For the judgmental sampling design, any contaminant associated with a release from the CAS that is remaining at concentrations exceeding its corresponding FAL will be defined as a COC.

- Decision II: "Is sufficient information available to confirm that closure objectives were met? Sufficient information is defined to include:

  - Identification of the lateral and vertical extent of COC contamination in media, if present.

  - The information needed to characterize wastes for disposal.

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.

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 help 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 supports the conceptual site model (CSM) assumptions, and data collected, meet the DQOs to support their intended use in the decision-making process.

2.0 Closure Activities

The following sections summarize the CAU 553 closure activities and deviations, if any, from the original scope of work. Results of confirmation sampling for individual CAU 553 CASs are presented in Appendix D.

2.1 Description of Corrective Action Activities

The corrective action activities (i.e., the field investigations that supported the no further action determination) were conducted in accordance with the requirements set forth in the CAU 553 SAFER Plan (NNSA/NSO, 2006). Table 2-1 lists activities conducted in support of the no further action determination at each CAS. Refer to Appendix D for details of these activities.

Table 2-1
Corrective Action Activities Conducted at Each Corrective Action Site to Meet SAFER Plan Requirements

Corrective Action Activities	Corrective Action Sites			
	19-99-01 Mud Spill	19-99-11 Mud Spill	20-09-09 Mud Spill	20-99-03 Mud Spill
Conducted surface radiological surveys	X	X	X	X
Performed geophysical surveys	X			
Performed site walkovers to evaluate current site conditions	X	X	X	X
Collected closure verification soil samples from biased locations.	X	X	X	X
Collected waste characterization samples			X	
Field-screened samples for alpha and beta/gamma radiation	X	X	X	X
Submitted samples for off-site laboratory analysis	X	X	X	X
Removed spilled material as a housekeeping practice			X	

Closure verification samples were collected from potential contaminant sources and surface soils. Surface soil samples were collected by hand excavation using a "scoop and trowel" technique. No subsurface soil samples were collected. All surface sample locations were field screened for alpha and beta/gamma radiation before the start of sampling. Additional radiological screening was conducted during sample collection to both guide the investigation and serve as a health and safety control to protect the sampling team. Collected samples were shipped to off-site laboratories to be analyzed for chemical and radiological parameters agreed to during DQO planning.

A judgmental sampling scheme was implemented to select sample locations and evaluate analytical results, as outlined in the CAU 553 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.

In the judgmental sampling scheme, individual sample results rather than average concentrations are used to compare to FALs. Therefore, statistical methods to generate site characteristics (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 potential 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 levels of the contaminant that pose an unacceptable risk to human health or the environment without the samples being truly representative of the entire area (EPA, 2004). Confidence in judgmental sampling scheme decisions was established qualitatively by CSM validation and justification that sampling locations are the most likely locations to contain a COC, if a COC exists.

2.1.1 CAS 19-99-01, Closure Activities

In accordance with DQO requirements, three Decision I surface samples (0 to 0.5 ft below ground surface [bgs]), including one duplicate sample, were collected from two locations within the area of the mud spill. One location was a thick concentration of the drilling mud in a shallow depression on top of the mound and the second location was a low spot near the base of the dirt mound where the mud pooled (see Figure D.3-1). Construction debris in the mud spill area was not removed or investigated.

2.1.2 CAS 19-99-11, Closure Activities

Five Decision I surface samples (0 to 0.5 ft bgs), including one duplicate, were collected from four locations within the area of the three distinct mud spills. Samples were collected from two locations within the north spill and one location within each of the west and south spills (see Figure D.4-1). The sample locations within the north spill were from a yellow-stained area on the north end of the spill and a location where the staining was the darkest and most pronounced. The sample locations within the west and south spills were from the area where the staining was darkest (see Figure D.4-1). Debris in the area of the mud spills was not removed or investigated.

2.1.3 CAS 20-09-09, Closure Activities

Four Decision I surface samples (0 to 0.5 ft bgs), including one duplicate sample, were collected from three locations. The environmental samples were collected from within and beneath the piles of bentonite (see Figure D.5-1). Based on the analytical results of the bentonite sample, the two piles of bentonite were collected, and the drums were moved to Building 23-153. The bentonite was removed as a housekeeping activity.

2.1.4 CAS 20-99-03, Closure Activities

Five Decision I surface samples (0 to 0.5 ft bgs), including one duplicate, were collected from four locations; one from each quadrant of the spill within the area of the CAS. One sample was collected from where the soil appeared darker than the surrounding soil, one sample was collected from where the vegetation was much sparser than the surrounding area, one sample was collected from a low-area location where mud pooled, and the concentration of potential contaminants is assumed greatest; and one sample was collected from the lower edge of the spill, where it is assumed that liquids may have continued to flow after much of the solids had dropped out, out-flowing water is assumed to have passed (see Figure D.6-1).

2.2 Deviations from SAFER Plan as Approved

There were no deviations to the CAU 553 SAFER Plan requirements during the field investigation and all planned samples were collected according to the SAFER Plan. All environmental samples submitted to the laboratory from this CAU were analyzed for total volatile organic compounds

(VOCs), total semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH)-diesel-range organics (DRO), gamma spectrometry, isotopic uranium, (U) isotopic plutonium (Pu), and strontium (Sr)-90.

2.3 Corrective Action Schedule as Completed

Bentonite located in the roadway at CAS 20-09-09 was removed and transported to Building 23-153 on May 24, 2007.

2.4 Site Plans/Survey Plat

Site maps that show the components of each CAS (i.e., mud spills), sample locations, and coordinates of sample locations are presented in Appendix D.

3.0 Waste Disposition

Wastes generated during CAU 553 field activities were segregated to the greatest extent possible, and waste minimization techniques were used to minimize waste volume. The types, amounts, and disposal of wastes are detailed in the following subsections. Site controls were in place to prevent the introduction of hazardous constituents to these waste streams.

3.1 Waste Streams

The waste generated by site closure activities at CAU 553 was segregated into the following waste streams:

- Sanitary waste including, personal protective equipment (PPE), disposable sampling equipment, plastic sheeting, glass/plastic sample jars, and aluminum foil.
- Spilled bentonite from the roadway at CAS 20-09-09.

3.2 Waste Sampling

Waste determinations were made utilizing process knowledge and media sample association. No waste characterization samples were collected during the investigation of CAU 553, but an environmental sample was collected from the spilled bentonite in the roadway at CAS 20-09-09 and analyzed for the parameters listed in Table A.3-1. The analytical results are addressed in Appendix D.5.0. No contaminants in concentrations exceeding landfill restrictions were present.

3.3 Waste Disposal

The CAU 553 types and amounts of waste disposed of during the investigation activities are summarized as follows:

- Two bags of PPE and disposable sampling equipment were generated and determined to be sanitary based on observations and process knowledge. The bags were labeled and placed in a dumpster at Building 23-153 for disposal in a sanitary landfill.
- Two 55-gallon drums of bentonite were collected from CAS 20-09-09. A pickup and disposal request was generated to transport these drums to the NTS Area 9 U10c Industrial Waste

Landfill (NDEP, 1997a). The drums of the bentonite are currently at Building 153 in Mercury. The spilled bentonite was removed as a housekeeping activity.

- Office waste and lunch trash was disposed of in designated sanitary waste receptacles allocated for disposal at the NTS Area 23 Municipal and Industrial Solid Waste Landfill (NDEP, 1997b). Sanitary industrial waste was inspected and disposed of in designated sanitary industrial waste bins located at Building 23-153 and allocated for disposal at the NTS Area 9 U10c Industrial Waste Landfill (NDEP, 1997a).

4.0 Closure Verification Results

Closure verification results consist of the analytical results from environmental samples that demonstrate closure objectives were met. Verification results demonstrate that COCs do not exist within the CAU 553 CASs.

The CAU 553 SAFER Plan identified the type, quality, and quantity of data 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 and Section 4.2 summarizes land-use restrictions for each CAS, if any.

A summary of verification data from the closure activities (Appendix D) is provided in this section. Sampling locations for CAU 553 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 19-99-01, Mud Spill

No COPCs were identified in concentrations greater than the preliminary action levels (PALs). The analytical data support no further action.

CAS 19-99-11, Mud Spill

No COPCs were identified in concentrations greater than the PALs. The analytical data support no further action.

CAS 20-09-09, Mud Spill

No COPCs were identified in concentrations greater than the PALs. The analytical data support no further action. The spilled materials were removed and disposed of as a housekeeping activity.

CAS 20-99-03, Mud Spill

No COPCs were identified in concentrations greater than the PALs at this CAS. The analytical data support no further action.

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 CAU 553 SAFER Plan (NNSA/NSO, 2006) 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 a level of confidence agreed to during the DQO process. 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 a resolution of 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 is 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 data quality 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 change to a DQO decision.

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 required test calculations.

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 CAU 553 SAFER Plan: "Is a contaminant present within a CAS at a concentration that could pose an unacceptable risk to human health and the environment?"

Decision I Rules:

- If the population parameter of any COPC in a target population exceeds the FAL for that COPC, then the 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 would identify COCs, if present, anywhere within the CAS.
2. Having a high degree of confidence that analyses conducted would 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 to meet the criteria specified in the CAU 553 SAFER Plan.

Criterion 1:

The following methods [stipulated in the CAU 553 DQOs (NNSA/NSO, 2006)] were used in selecting sample locations considered to have the highest potential to contain COCs, if present.

1. Selection of sampling locations associated with field screening results was accomplished by analyzing samples for alpha and beta/gamma emitting radionuclides using a hand-held NE Technology Electra.

2. Selection of sampling locations associated with low points where drilling mud would accumulate and the selection of sampling locations associated with surface staining was accomplished by visual field observations.

Criterion 2:

All samples were analyzed using the analytical methods listed in the CAU 553 SAFER Plan Tables 7-2 and 7-3 and for the chemical and radiological parameters listed in the SAFER Plan Table 3-1. A reconciliation of samples analyzed to the planned analytical program is in Table 4-1.

Table 4-1
CAU 553 Analyses Performed

CAS	ANALYTES						
	Total VOCs	Total SVOCs	TPH-DRO	Gamma Spectroscopy	Isotopic Uranium	Isotopic Plutonium	Strontium-90
19-99-01	RS	RS	RS	RS	RS	RS	RS
19-99-11	RS	RS	RS	RS	RS	RS	RS
20-09-09	RS	RS	RS	RS	RS	RS	RS
20-99-03	RS	RS	RS	RS	RS	RS	RS

DRO = Diesel-range organics
SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

RS = Required and submitted

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 CAU 553 SAFER Plan is that analytical detection limits will be less than the corresponding action level. This criterion was not achieved for the analytical results listed in Table 4-2. Results not meeting the sensitivity acceptance criterion were not used in DQO decision-making and were therefore considered rejected data. The impact on DQO decisions is addressed in the assessment of completeness.

Table 4-2
Analytes Failing Sensitivity Criteria

Sample Number	Parameter	Minimum Detectable Concentration (µg/kg)	Final Action Level (µg/kg)
553B001	Dibenzo(A,H)Anthracene	240	210
	Benzo(A)Pyrene	240	210
553B002	Dibenzo(A,H)Anthracene	230	210
	Benzo(A)Pyrene	230	210
553B005	Dibenzo(A,H)Anthracene	230	210
	Benzo(A)Pyrene	230	210

µg/kg = Micrograms per kilogram

Criterion 3:

To satisfy the third criterion, the entire dataset (and individual sample results) were assessed against the acceptance criteria for the DQIs of precision, accuracy, comparability, completeness, and representativeness, as defined in the Industrial Sites QAPP (NNSA/NV, 2002). The DQI acceptance criteria are presented in Table 6-1 of the CAU 553 SAFER Plan. As presented in Tables 4-3 through 4-4, these criteria were met for each DQI.

Table 4-3
Rejected Measurements

Parameter	CAS Number	Analytical Method	Number of Analytes Qualified	Number of Measurements Performed	Percent within Criteria
Europium-155	14391-16-3	HASL-300	6	17	65
Mercury	7439-97-6	METALS	4	4	0

CAS = Chemical Abstracts Service
EPA = U.S. Environmental Protection Agency, SW-846 methods (EPA, 1996)

Table 4-4
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 adsorbed onto the soils. Exposure to contamination is limited to site workers, construction/remediation workers, visitors, 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. Groundwater contamination is not a concern. Contaminants migrating to regional aquifers are not considered. The investigation results did not reveal any affected media.
Location of Contamination/ Release Points	Release points are identified as locations that either most likely contain a COC, if present, or a location that will accurately confirm the absence of contamination within the CAS. The investigation results did not reveal any locations of contamination.
Transport Mechanisms	Surface transport may occur as a result of a spill or storm water runoff. Surface transport 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 pathways
Lateral and Vertical Extent of Contamination	The most significant migration pathway would be lateral because the discharge to groundwater “vertical migration” was not considered significant. The investigation results did not reveal any lateral and vertical migration of contamination.
Groundwater Impacts	None, the investigation results did not reveal any indicators that groundwater could be potentially impacted
Future Land Use	Nuclear test
Other Data Quality Objective Assumptions	None

Precision

The duplicate precision is evaluated using the relative percent difference (RPD) or normalized difference. To determine 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 five times their minimum detectable concentrations (MDCs). For radionuclides, duplicate results were evaluated using the normalized difference. No chemical analytes or radionuclides were qualified for precision.

Accuracy

For the purpose of determining data accuracy of sample analyses, environmental soil samples were evaluated and incorporated into the accuracy calculation. Results qualified for accuracy are associated with matrix spike (MS) recoveries that were outside control limits and could potentially be reported at concentrations lower or higher than actual concentrations. However, no chemical analytes or radionuclides were qualified for accuracy.

Representativeness

The DQO process, identified in Appendix A, was used to address sampling and analytical requirements for CAU 553. 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). The sampling locations identified in the Criterion 1 discussion meet this criterion. Therefore, the analytical data acquired during the CAU 553 Corrective Action Investigation (CAI) are considered representative of the population parameters.

Comparability

Field sampling, described in the CAU 553 SAFER Plan (NNSA/NSO, 2006), was performed and documented in accordance with approved procedures that are 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 553 SAFER Plan (NNSA/NSO, 2006) defines acceptable criteria for completeness to be 80 percent of identified CAS-specific non-target analytes having valid results and 100 percent of target analytes having valid results. Also, the dataset must be sufficiently complete to be able to make the DQO decisions. No target analytes were identified for CAU 553.

Rejected data (qualified as such or failed the criterion of sensitivity) were not used in the resolution of DQO decisions and not counted toward meeting the completeness acceptance criterion. Tables 4-2 and 4-3 provides the rejected data for the site. All analytes except europium (Eu)-155 and mercury

met the 80 percent acceptable criteria for non-target analytes. Because the 105 kiloelectron volt (keV) photo-peak of Eu-155 was not present for samples 553A001, 553A003, 553B004, 553D002, and 553D005, the results reported by the laboratory were rejected. Because a peak was not reported of 105 keV, Eu-155 can be considered a non-detect for these samples; therefore; the data are considered complete for the purpose of decision-making. There were no usable results for mercury because the samples were analyzed outside of holding time by more than 56 days. Mercury was not a COPC, but metals were analyzed to support waste characterization decisions. Therefore, the mercury result was not needed to make a decision regarding the site DQOs.

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 assurance/QC samples such as field blanks, trip blanks, laboratory control samples (LCSs), and method blanks were used to determine whether a false positive analytical result may have occurred. Of 14 QA/QC samples submitted, no false positive analytical results were detected.

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

4.1.1.2 Decision II

Decision II as presented in the CAU 553 SAFER Plan: "If a COC is present, is sufficient information available to meet closure objectives?" Because there were no COCs identified during the Decision I sampling, no Decision II sampling was necessary.

4.1.1.3 Sampling Design

The CAU 553 SAFER Plan made the following commitments for sampling:

- Sample locations at mud spills were determined based upon the likelihood of the mud, or soil containing a COC, if present. These locations were selected based on field-screening techniques, biasing factors, the CSM, and existing information.

  Result: Biasing factors were present and used to determine sample locations.

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 non-conformance report when data quality does not meet contractual requirements. All data received from the analytical laboratories met contractual requirements, and a QA non-conformance report was not generated. Data were validated and verified to ensure that the measurement systems performed in accordance with the criteria specified. The validated dataset quality was found to be satisfactory.

4.1.3 Select the Test and Identify Key Assumptions

The test for making DQO Decision I, the judgmental sampling design, was the comparison of the maximum analyte result from each CAS to the corresponding FAL on a point-by-point basis. Because none of the detected concentrations exceeded the PALs, DQO Decision II was not necessary.

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

4.1.4 Verify the Assumptions

The results of the investigation support the key assumptions identified in the CAU 553 DQOs and Table B.1-10 of the CAU 553 SAFER (NNSA/NSO, 2006). All data collected during the CAI support the CSM and do not necessitate CSM revision.

4.1.5 Draw Conclusions from the Data

This section resolves the two DQO decisions for each of the CAU 553 CASs. Because no COCs were present at any of the CASs, the second decision of determining extent was not required.

4.1.5.1 Decision Rules for Decision I

Decision Rule:

- If the concentration of 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.
- If a COC is detected, then the Decision II statement must be resolved.

- If no COCs are identified, then the decision will be no further action.

Result: Because no COPC concentration exceeded a FAL, no COCs were identified at any CAS, no further action is the recommended corrective action alternative, and the Decision II statement did not need resolution.

4.2 Use Restrictions

No analytes detected in soil during the corrective action activities at CAU 553 exceeded risk-based action levels. Therefore, no restrictions on the future use of these sites are necessary.

5.0 Conclusions and Recommendations

Based on the results of the closure activities, no further closure activities are necessary for CAU 553. The DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) provides the following recommendations:

- No further corrective action is required at CASs 19-99-01, 19-99-11, 20-09-09, and 20-99-03. Based on analytical results of the environmental samples collected, no COCs have been released to the soil at CAU 553 CASs; therefore, corrective action is not required. No Corrective Action Plan is required for CAU 553.

- A Notice of Completion is requested from the Nevada Division of Environmental Protection (NDEP) for the closure of CAU 553.

- Corrective Action Unit 553 should be moved from Appendix III to Appendix IV of the *Federal Facility Agreement and Consent Order.*

6.0 References

EPA, see U.S. Environmental Protection Agency.

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

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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.

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SNJV, see Stoller-Navarro Joint Venture.

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

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Appendix A

DQOs as Developed in the SAFER Plan

Note: This appendix contains the DQOs presented in SAFER Plan and consists of Appendix B of the SAFER Plan. Therefore, all cross-references and page numbers in this appendix refer to the original document.

A.1.0 Introduction

The DQO process described in this appendix is a seven-step, systematic planning process based on the scientific method used to plan data collection activities and define performance criteria for the CAU 553, Mud Pits and Cellars, field investigation. The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to determine the appropriate corrective actions, verify the adequacy of existing information, provide sufficient data to implement the corrective actions, and verify that closure was achieved.

The CAU 553 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.3.0 through A.9.0 were developed in accordance with U.S. Environmental Protection Agency (EPA) *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006).

In general, the procedures used in the DQO process provide:

- A method to establish performance or acceptance criteria, which 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 conceptual model 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 analytical 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 the 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 the QA/QC activities that ensure sampling design and measurement errors are managed sufficiently to meet the performance or acceptance criteria specified in the DQOs.

A.2.0 Background Information

The following four CASs that comprise CAU 553 are located in NTS Areas 19 and 20, as shown in Figure A.2-1:

- 19-99-01, Mud Spill
- 19-99-11, Mud Spill
- 20-09-09, Mud Spill
- 20-99-03, Mud Spill

The following sections provide a description, physical setting and operational history, release information, and previous investigation results for each CAS. The COPCs identified for the mud spills in CAU 553 have been determined based on historical knowledge and previous investigation results conducted under the *Mud Pit Risk-Based Closure Strategy Report* (NNSA/NSO, 2004a) and the CAU 530-535 CR (NNSA/NSO, 2006a). Both of these reports describe the operational drilling processes conducted at the NTS associated with nuclear testing. The CAU 553 mud spills are assumed to be a result of similar operational processes as the NTS mud pits as well as similarly compositional for mud and additive contents.

A.2.1 CAS 19-99-01, Mud Spill

Corrective Action Site 19-99-01 consists of the environmental release associated with a mud spill located on and surrounding a dirt mound located north and adjacent to the fenced U-19ad potential crater area (REECo, 1991).

Physical Setting - The CAS is located in Area 19 adjacent to the north side of the fenced U-19ad potential crater area east of Pahute Mesa Road. The mud spill is located on top of a dirt mound and the spill extends downslope in several directions with a small portion extending past the U-19ad fence line. The dirt mound is approximately 8 ft high and covers an area of approximately 1,250 ft^2. Scattered vegetation is growing on and around the dirt mound and within the mud. Several pieces of debris are visible within the area and the ground surface has been disturbed and mounded in several locations. Surface soil, including the mound, consists of light-brown to pinkish-brown, silt- to sand-size size volcanic material. The thickness of alluvium in the area is unknown; however, the U-19ad emplacement hole penetrated 4,392 ft of alluvium (NNSA/NSO, 2004b). The nearest

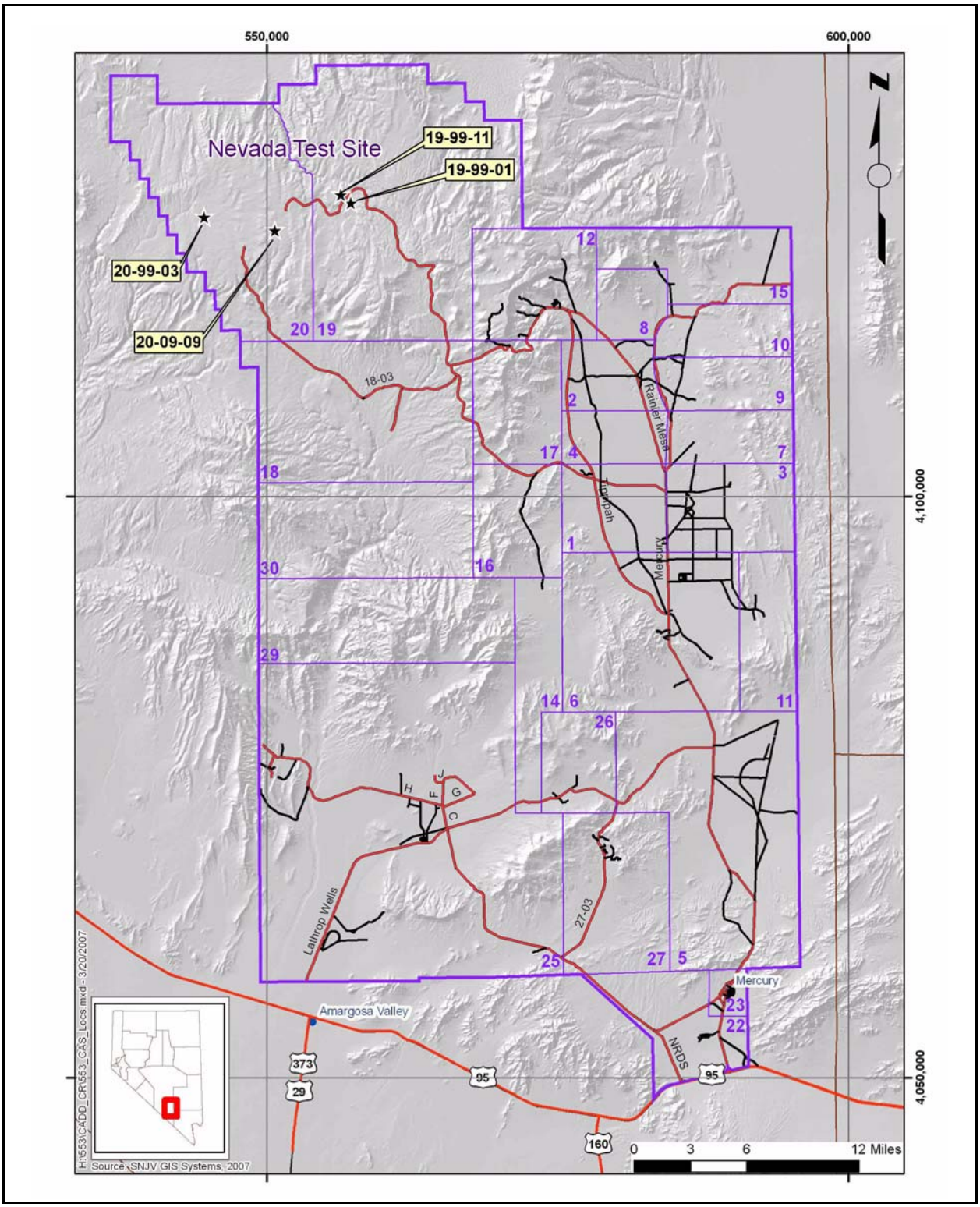

Figure A.2-1
Nevada Test Site Map with CAU 553 CAS Locations

U.S. Geological Survey (USGS) monitoring well to this CAS is Water Well U-19bk at about 1.9 mi northwest of the CAS with a depth to groundwater of 2,198 ft bgs (USGS/DOE, 2006a). The nearest water use well is inactive and located about 2.0 mi southeast of the CAS (USGS/DOE, 2006b).

Operational History - The area was used for conducting an underground weapons-related test at U-19ad. The LANL Chancellor test was conducted on September 1, 1983, as a part of Operation Phalanx (DOE/NV, 2000). Based on proximity, CAS 19-99-01 mud spill is believed to be associated with pre- and/or post-test drilling activities at U-19ad; however, several other tests were conducted in the vicinity of the mud spill and drilling activities at these tests may have contributed to the release of drilling mud. Therefore, the mud spill release is assumed to be similar in operation and composition to NTS mud pit material (DOE/NV, 2001).

Release Information - An environmental release associated with drilling activities occurred adjacent to the U-19ad potential crater area. The release may contain TPH and potentially radioactive constituents based on process knowledge of mud pits and drilling processes.

Previous Investigation Results - Geophysical surveys were conducted in 2002 (Shaw) and 2006 (Fahringer) and identified one anomaly to the west of the mound, most likely due to corrugated metal casing partially visible at the surface. No other buried metal was detected below the soil mound. A radiological survey conducted at the site identified elevated gamma readings in the southeast corner of the site; however, it was determined that the site poses no risk to human health or the environment from residual radiological contamination (Alderson, 2002). No soil analytical results were identified for this CAS.

A.2.2 CAS 19-99-11, Mud Spill

Corrective Action Site 19-99-11 consists of the environmental releases associated with three mud spills located approximately 50 ft east of the fenced U-19q/U-19q PS#1D potential crater area (REECo, 1991).

Physical Setting - The CAS is located in Area 19 west of the Pahute Mesa Road near the U-19q potential crater area. The three separate mud spills are referred to as the south, north, and west spills and have a total area of approximately 1,167 ft^2. The south mud spill is the smallest and measures

approximately 216 ft^2 and consists of a thin weathered layer of brown-gray powdery mud that overlies a cracked harder layer of darker gray mud. The west spill is approximately 458 ft^2 and consists of a 1-ft-thick layer of crumbled gray mud overlying a 3-ft mound of native soil. The north spill is approximately 493 ft^2 and appears to consist of gray grout aggregate with areas of yellow staining. Black wire debris and wood fencing debris are visible on the surface. The nearest USGS monitoring well to this CAS is Water Well U-19bk at about 1.9 mi northwest of the CAS with a depth to groundwater of 2,198 ft bgs (USGS/DOE, 2006a). The nearest water use well is inactive and located about 2.0 mi southeast of the CAS (USGS/DOE, 2006c).

Operational History - The area was used for conducting an underground weapons-related test at U-19q. The Lawrence Livermore National Laboratory (LLNL) Camembert test was conducted on June 26, 1975, as a part of Operation Bedrock (DOE/NV, 2000). Based on proximity, CAS 19-99-11 mud spill is believed to be associated with post-test drilling activities at drill hole U-19q PS#1D. Therefore, the mud spill release is assumed to be similar in operation and composition to NTS mud pit material (DOE/NV, 2001).

Release Information - An environmental release associated with drilling activities occurred adjacent to the U-19q potential crater area. The release may contain TPH and potentially radioactive constituents based on process knowledge of mud pits and drilling processes.

Previous Investigation Results - No site specific geophysical or radiological surveys or analytical results were identified for this CAS.

A.2.3 CAS 20-09-09, Mud Spill

Corrective Action Site 20-09-09 consists of the environmental release associated with two bentonite mud spills located approximately 20 ft south of mud mixing plants at the Area 20 Pahute Mesa Mud Plant (REECo, 1992).

Physical Setting - The site is located in the Pahute Mesa Mud Plant at Rad-Safe Marker 20 P 114 in Area 20 and consists of two dry substance spills of dry, cracked, gray bentonite on the ground surface. The dimensions of the each spill are approximately 3 by 12 ft and 2 to 12 inches (in.) thick. The dimensions are easily visible compared to the graded pad/road surface. The soil within and around

the site appears to be native volcanic rock. The nearest well to CAS 20-09-09 is U20WW, located about 700 ft southwest of the CAS, at a depth of 2,050 ft bgs, and is an active withdrawal location for institutional use of water (USGS/DOE, 2006c).

Operational History - The site is the location of the inactive Pahute Mesa Mud Plant at which mud mixing and water distribution operations for drilling activities in Pahute Mesa were conducted (Geary, 1965). Mud was generated at the plant for use in Area 20 drilling activities. Drilling mud is typically a combination of powdered bentonite clay mixed with water to form a viscous fluid (REECo, 1994). The dry substance spill is believed to have resulted from these mud mixing activities and not used in actual drilling processes. Currently the site is marked as a DOE Operational Readiness Area.

Release Information - An environmental release associated with mud mixing activities occurred north of the mud mixing machines.

Previous Investigation Results - No site-specific geophysical or radiological surveys or analytical results were identified for this CAS.

A.2.4 CAS 20-99-03, Mud Spill

Corrective Action Site 20-99-03 consists of the environmental release associated with the mud spill located south/east of the fenced U-20aq crater area (REECo, 1991).

Physical Setting - The mud spill is located in Area 20 south of the U-20aq crater area and consists of one continuous area of dried mud on the ground surface. The spill area measures approximately 750 by 300 ft and is light pinkish-brown clay/silty material, dry, and cracked. The thickness varies between 1 and 6 in. thick. A pile of small steel pellets (based on visual observations of rust) is located on the northeast side of the spill but does not represent a health hazard. The dimensions of the mud spill are easily visible against the native black/red volcanic surface and an active dirt road dissects the spill in half. The nearest well is U-20WW, an unused test well, that is located approximately 2.4 mi south of the CAS (USGS/DOE, 2006a).

Operational History - The area was used to conduct Operation Charioteer, an underground Darwin test by LLNL and the United Kingdom, on June 25, 1986, in U-20aq (DOE/NV, 2000; RSN, 1991).

Based on proximity to U-20aq, CAS 20-99-03 mud spill is believed to be associated with post-test drilling activities at U-20aq. There is a potential that mud may have been drained in this area from metal piping used in drilling operations to direct the drilling fluids/cuttings from the drill hole to the mud pit. Another possibility is that a holding tank containing drill mud may have spilled in the area. Therefore, the mud spill release is assumed to be similar in operation and composition to NTS mud pit material (DOE/NV, 2001).

Release Information - An environmental release associated with drilling activities occurred adjacent to the U-19aq crater area. The release may contain TPH and potentially radioactive constituents based on process knowledge of mud pits and drilling processes.

Previous Investigation Results - No geophysical survey or analytical results were identified for this CAS. A radiological survey was conducted in 2006, and it was determined that the site poses no risk to human health or the environment from residual radiological contamination (SNJV, 2006).

A.3.0 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.

The problem statement for CAU 553 is: "Sufficient historical and analytical information is available to support a no further action closure alternative for all CASs in CAU 553; however, verification samples are required to confirm the absence of COCs at levels that could pose a risk to human health or the environment."

A.3.1 Planning Team Members

The DQO planning team consists of NDEP, NNSA/NSO, Stoller-Navarro Joint Venture (SNJV), and National Security Technologies, LLC representatives. The primary decision-makers are the NDEP and NNSA/NSO representatives. Table A.3-1 lists representatives from each organization in attendance at the July 27, 2006, DQO meeting.

Table A.3-1
Data Quality Objective Meeting Participants for CAU 553 July 27, 2006
(Page 1 of 2)

Affiliation	Department/Project Team Function
NDEP	NDEP Representative
NNSA/NSO	Environmental Restoration Project Federal Industrial Sites Sub-Project Task Manager
NSTec	Environmental Restoration Deputy Project Manager
NSTec	Environmental Restoration Field Support Manager
SNJV	Industrial Sites Project Manager
SNJV	Industrial Sites Technical Coordinator
SNJV	Industrial Sites (CAU 553) Task Lead
SNJV	*Federal Facility Agreement and Consent Order* Representative
SNJV	Quality Assurance Representative
SNJV	Analytical Services Chemical Data Validator
SNJV	Analytical Services Radiological Data Validator

Table A.3-1
Data Quality Objective Meeting Participants for CAU 553 July 27, 2006
(Page 2 of 2)

Affiliation	Department/Project Team Function
SNJV	Health and Safety Group Representative
SNJV	Environmental Compliance and Waste Management Representative
SNJV	Radiation Services Health Physicist

NDEP = Nevada Division of Environmental Protection
NNSA/NSO = U.S. Department of Energy, National Security Administration Nevada Site Office
NSTec = National Security Technologies, LLC
SNJV = Stoller-Navarro Joint Venture

A.3.2 Conceptual Site Model

The CSM is used to organize and communicate site characteristic information. It reflects the best interpretation of available information at any point in time. The CSM is a primary vehicle for communicating assumptions about release mechanisms, potential migration pathways, or specific constraints. It provides a summary of how and where contaminants are expected to move, and what impacts movement may have. It is the basis to assess in what manner contaminants could reach receptors in both the present and future. The CSM describes the most probable scenario for current conditions at each site 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 553 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 represents contamination of the surrounding environment due to migration of contaminants that are currently, or were formerly, present at each of the CASs. Migration of contaminants to areas not presently impacted can occur through infiltration and percolation of contaminants into the soil profile, lateral transportation (overland flow) of some contaminants as a result of surface water runoff or overflow of accumulated surface water in mud pits, or wind-borne re-suspension of contaminated surface particles.

The CSM consists of:

- Potential contaminant releases, including media subsequently affected.
- Release mechanisms (conditions associated with the release).
- Potential contaminant source characteristics, including contaminants suspected to be present.
- Site characteristics, including physical and meteorological information.
- Migration pathways and transport mechanisms that describe the potential for contamination migration and where it 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.

If additional elements are identified during the investigation that are outside the scope of this 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 and/or concur with the recommendation.

The applicability of this CSM to the mud pits is summarized in Table A.3-2 and discussed below. Table A.3-2 provides information on CSM elements that will be used throughout the remaining steps of the DQO process. Figure A.3-1 represents site conditions applicable to the CSM.

A.3.2.1 Contaminant Release

The mud spills of CAU 553 are assumed to have similar releases as those identified for the NTS mud pits in CAUs 530-535 and CAU 177. It is unknown whether the spills occurred before or after use in the drilling process where diesel and/or radioactivity may have been released. It can also be reasonably assumed the spill material composition is similar (i.e., mud/clay composition and properties) regardless if the release was associated with pre- or post-test drilling activities.

Table A.3-2
Analytical Program[a]

Analyses[b]	All Corrective Action Sites
Organic COPCs	
Total Petroleum Hydrocarbons-Diesel-Range Organics	X
Semivolatile Organic Compounds[c]	X
Volatile Organic Compounds[c]	X
Radionuclide COPCs	
Gamma Emitters	X
Isotopic Uranium	X
Isotopic Plutonium	X
Strontium-90	X

[a]The COPCs are the analytes reported from the analytical methods listed in Table A.5-1.
[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.

COPC = Contaminant of potential concern
X = Required analytical method

Although the Risk-Based Closure Strategy Report (RBCSR) eliminated VOCs, SVOCs, polychlorinated biphenyls (PCBs), and metals as COPCs from NTS mud pits (based on the conclusion that there is no analytical or process knowledge to suggest these constituents are present at significant concentrations in residual mud), TPH-DRO was the most frequently detected contaminant in residual mud. To be conservative, it was determined that the investigation of CAU 553 would evaluate the risk posed by TPH-DRO and verify the closure strategy of no further action for CAU 553 mud pits. Because complete information regarding activities performed at the CAU 553 mud spills is not available, VOCs, SVOCs, and radionuclides will also be included as COPCs.

The process associated with potential contamination at a mud pit is assumed to be the same process that may have contributed to contamination at a mud spill. The following section addresses the release of contaminants associated with the drilling mud.

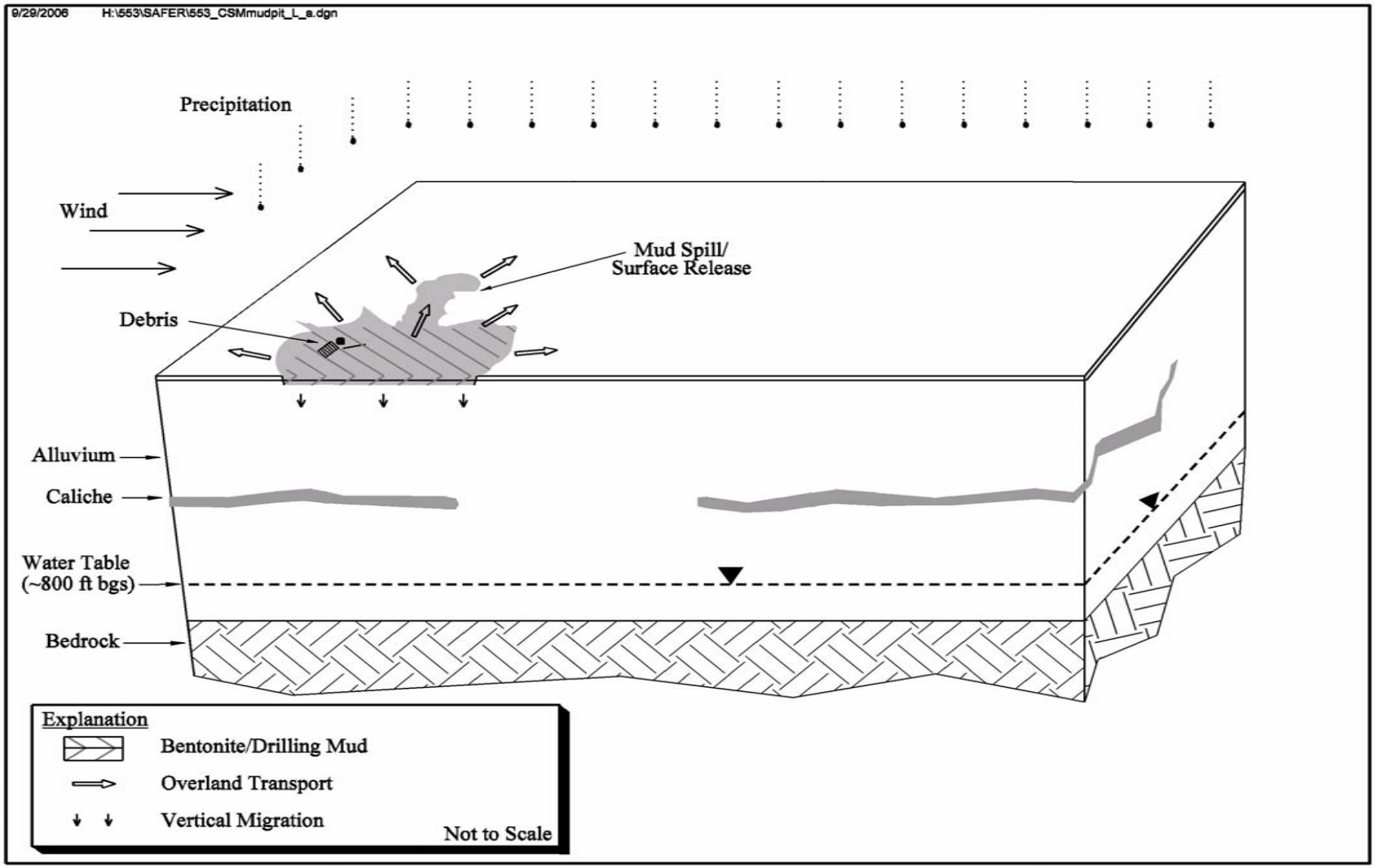

Figure A.3-1
Site Conceptual Model

A.3.2.2 Potential Contaminants

The COPCs for CAU 553 are defined as the analytes reported from the analyses identified in Table A.3-2. The list of COPCs is applicable to Decision I environmental samples from each mud spill and is intended to encompass all of the contaminants that could potentially be present. These contaminants 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 drilling mud processes.

Target analytes are those contaminants for which evidence and 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. For this investigation, no targeted analytes have been identified.

A.3.2.3 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 contaminants.

The primary source of hydrocarbon contamination is the introduction of diesel as a lubricant during drilling. The primary source of potential radiological contamination is the release of drilling mud that may have been in contact with radioactive rock and circulated from the borehole to the mud pit during post-test drilling. Process knowledge indicates that bentonite clay is a major ingredient in drilling mud (IMANA, 2004). In general, clay minerals have high porosity, low permeability, and the property of expanding several times its original volume when saturated with water. This clay-water mixture has a viscosity several times that of water, making it useful as a drilling fluid (DOE/NV, 1998a). Based on the unique properties of bentonite and its prominent occurrence in drilling mud, it is believed that its use would help retard the migration of COPCs present in the mud. Furthermore, the residual drilling mud contained within the mud spill is expected to act as a barrier to prevent the

downward migration of contaminants into underlying native soil. The *Evaluation of Potential Hydrocarbon Transport at the UC-4 Emplacement Hole, Central Nevada Test Area* (DOE/NV, 1998a) reports data that support the conclusion that contamination within drilling mud does not migrate significantly based on TPH release experiments.

A.3.2.4 Site Characteristics

Site characteristics are the physical, topographical, and meteorological attributes and properties. Table A.3-3 lists the physical setting of the CAU 553 CASs. Listed for each CAS is the number of individual spills within the CAS boundary and the approximate dimensions of each spill area. In general, the mud spills are expected to have similar characteristics as NTS mud pits, because they were all released within the surface soil of the NTS using comparable mud pit processes.

Table A.3-3
Physical Setting of CAU 553 Corrective Action Sites

CAS	19-99-01	19-99-11	20-09-09	20-99-03
Number of Spill Areas	1	3	2	1
Mud Spill Dimensions	1,247 ft^2	North (493 ft^2) South (216 ft^2) West (458 ft^2)	Each about 12 x 3 ft	750 x 250 ft
Radiological Postings	None			
Fence	None			
Associated Test	Chancellor Test 1983	Camembert Test 1975	N/A	Darwin Test 1986
Test Release	None identified			

ft = Foot
ft^2= Square foot
N/A = Not applicable

The locations for a drilling mud release are directly onto the ground surface. The media affected by a release is typically the surface and shallow subsurface soil; however, due to the binding properties of bentonite, contamination is expected to be bound within the mud, with no migration to the native soil underlying the mud spills. Contamination, if any, is expected to be evenly dispersed and present at relatively uniform concentrations, because the mud would have been homogenized as it was circulated. This suggests that surface samples of the residual mud would be representative of the mud

throughout the depth of the mud spill. Contamination unrelated to the mud mixing/use process may be localized beneath potentially hazardous discarded drilling materials, if present.

A.3.2.4.1 Groundwater

Groundwater contamination is not considered a likely scenario at any CAU 553 CAS based on the depth to groundwater in Areas 19 and 20. Data from nearest wells indicate that groundwater levels may range from 2,100 to 2,800 ft bgs for Area 19 and 20 CASs (USGS/DOE, 2006c). Surface migration is not expected to be significant, because the characteristics of bentonite and/or clay material produce a high tension surface in which particles are not easily mobile even when saturated.

A.3.2.4.2 Migration Pathways and Transport Mechanisms

An important element of the CSM is the expected fate and transport of contaminants (i.e., 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 vertically and laterally throughout the various media. The pathways include air, surface water, and groundwater, and are the routes through which possible contamination could migrate from the site(s) to locations where a receptor might receive an exposure. Fate and transport are influenced by physical and chemical characteristics of the contaminants and media described in Sections A.3.2.3 and A.3.2.4. Given the characteristics of both the contaminants and the bentonite drilling mud, limited contaminant migration is expected.

Infiltration and percolation of precipitation serves as a driving force for the downward vertical migration of contaminants through the mud or underlying soil. Annual potential evapotranspiration at the Area 5 Radiological Waste Management Site has been estimated at 62.6 in. (Shott et al., 1997), but annual precipitation for this region is between 3.5 and 6 in. (Winograd and Thordarson, 1975). Therefore, percolation of infiltrated precipitation at the NTS does not provide a significant mechanism for vertical migration of contaminants to groundwater (DOE/NV, 1992; NNSA/NSO, 2004a).

Lateral migration of contaminants through impacted media is expected to be limited to within the physical boundaries of the mud spills due to the binding and high sorption properties of

clay/bentonite. Lateral migration may occur as a result of overland flow or erosion and is dependent on the percentage of clay/bentonite within the spill matrix. However, visible observations of the mud spill area extent suggests limited lateral migration over time.

Releases to the air may result from resuspension of contaminated surface soil particles with wind movement. Wind could potentially suspend surface soil particles and carry them beyond the boundaries of the mud spills but only if the hardened, partially cemented bentonite and/or mud is physically disturbed. Overall, airborne migration of contaminants is considered a minor transport mechanism for CAU 553.

A.3.2.5 Exposure Scenarios

Human receptors may be exposed to COPCs through oral ingestion, inhalation, or dermal contact (absorption) of drilling mud, soil, or debris due to inadvertent disturbance of these materials, or through irradiation by radioactive materials. The exposure of workers and visitors to site contaminants is very dependent upon the activites of the exposed individual at the site. Based on the future land use, as identified in the *Nevada Test Site Resource Management Plan* (DOE/NV, 1998b), the areas in which all CAU 553 CASs are located are restricted to industrial uses.

The appropriate exposure scenarios for all CAU 553 CASs is the Occasional Use Area, due to each site being in a remote area with no active improvements and the future land use designation is for outdoor tests and/or military training exercises. There is still the possibility, however, that site workers could occupy these locations on an occasional and temporary basis such as a military exercise (NNSA/NSO, 2006b). Investigation decisions will be based on the future land-use and exposure scenarios for CAU 553 provided in Table A.3-4.

Table A.3-4
Future Land-Use and Exposure Scenarios

CASs	Future Land-Use Zone	Exposure Scenario
All	Nuclear and High Explosives Test 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 non-defense research, development, and testing activities	Occasional Use Area This exposure scenario assumes exposure to industrial workers who are not assigned to the area as a regular work site but may occasionally use the site for intermittent or short-term activities. A site worker under this scenario is assumed to be on the site for 8 hours per day, 10 days per year, for 5 years.

Source: NNSA/NSO, 2006b

A.4.0 Step 2 - Identify the Goal of the Study

Step 2 of the DQO process states the manner in which environmental data will be used to meet objectives and solve the problem, identifies study questions or decision statement(s), and considers alternative outcomes or actions that can occur upon answering the question(s).

A.4.1 Decision Statements

The Decision I question is: "Is any COPC present in environmental media within a mud spill at a concentration exceeding its corresponding action level?" No further action will be supported if no COPCs are identified above corresponding action levels. For judgmental sampling design, any analytical result for a COPC above the FAL will result in that COPC being designated as a COC. If a COC is detected and remediation is feasible, then contaminated media may be removed for disposal and additional samples collected (see Figure 1-2). If a COC is detected and remediation is not feasible, then Decision II must be resolved.

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

- Identifying the volume of media containing any COC, as bounded by analytical sample results in lateral and vertical directions.
- Characterizing investigation-derived waste (IDW) for disposal.
- Determining potential remediation waste types.
- Evaluating the feasibility of potential closure options.

If sufficient information is not available to meet closure objectives, then site conditions will be re-evaluated and additional samples collected (provided the investigation scope is not exceeded and any CSM assumption has not been shown incorrect).

A.4.2 Alternative Actions to the Decisions

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

A.4.2.1 Alternative Actions to Decision I

If no COC associated with a release from the CAS is detected, then the mud spill will be closed via the no further action alternative. If a COC associated with a release from the CAS is detected, then the extent of COC contamination will be determined and additional information will be required to confirm that closure objectives were met.

A.4.2.2 Alternative Actions to Decision II

If sufficient information is available to define the extent of COC contamination, then a closure strategy of closure in place with administrative controls will be implemented and further assessment of the CAS is not required. If sufficient information is not available to define the extent of COC contamination and confirm that closure objectives were met, then additional samples will be collected.

A.5.0 Step 3 - Identify Information Inputs

This step identifies the necessary information, determines information sources, and identifies sampling and analysis methods to allow reliable comparisons of analytical results with FALs.

A.5.1 Information Needs

To resolve Decision I (determine whether a COC is present at a given CAS), samples need to be collected and analyzed following two criteria: (1) samples must be collected in areas most likely to contain a COC (judgmental sampling); and (2) 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 meet closure objectives at each CAS), samples shall be collected and analyzed to meet the following criteria:

- Samples must be collected in areas contiguous to the contamination but where contaminant concentrations are below FALs.
- Samples of the waste or environmental media must provide sufficient information to characterize the IDW for disposal.
- The analytical suites selected must be sufficient to detect contaminants at concentrations equal to or less than their corresponding FALs.

A.5.2 Sources of Information

Information to satisfy Decision I and Decision II will be generated by collecting environmental samples using grab sampling, hand augering, or other appropriate sampling methods. These samples will be submitted to analytical laboratories meeting the quality criteria stipulated in the Industrial Sites QAPP (NNSA/NV, 2002). Only validated data from analytical laboratories will be used to support DQO decisions. Sample collection and handling activities will follow standard procedures.

A.5.2.1 Sample Locations

Design of the sampling approaches for the CAU 553 CASs must ensure that the data collected are sufficient to support the selection of a corrective action alternative (EPA, 2002). To meet this

objective, the samples collected from each site should be from locations that either most likely contain a COC, if present, or will accurately confirm the absence of contamination within the CAS.

A judgmental sampling approach will be implemented for all mud spills. Biasing factors (including field-screening results [FSRs]) will be used to select the most appropriate samples from a particular location for submittal to the analytical laboratory. Biasing factors used for selection of sampling locations are listed in Section A.5.2.1.1. Sample locations may be modified based on site conditions, obvious debris or staining of soils, FSRs, or professional judgment if the modified locations meet the DQO decision needs and criteria stipulated. As biasing factors are identified and used for selection of sampling locations, they will be recorded in the appropriate field documents.

The implementation of the judgmental sampling approach for CAU 553 is summarized in the following section.

A.5.2.1.1 Judgmental Approach for Sample Location Selection

Decision I sample locations at mud spills will be determined based upon the likelihood of the mud, or soil in the case of CAS 20-09-09, containing a COC, if present. 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 all COPCs identified in Table A.3-2.

Field-screening techniques may be used to select appropriate sampling locations by providing semi-quantitative data that can be used to comparatively select samples to be submitted for laboratory analyses from several screening locations. Field screening may also be used for health and safety monitoring and to assist in making certain health and safety decisions. The following field-screening methods may be used to select analytical samples at CAU 553:

- Walkover surface area radiological surveys – A vehicle-mounted or hand-held radiological survey instrument over approximately 100 percent of the CAS boundaries, as permitted by terrain and field conditions to detect locations of elevated radioactivity.
- Alpha and beta/gamma radiation – A hand-held radiological survey instrument, or equivalent instrument/method, may be used at these CASs.
- Gamma-emitting radionuclides – A hand-held dose rate instrument.

Biasing factors may also be used to select samples to be submitted for laboratory analyses based on existing site information and site conditions discovered during the investigation. The following biasing factors will be considered in selecting locations for analytical samples at CAU 553:

- Documented process knowledge on source and location of release.
- Topography: Topographic lows within the spill area where contaminants could be expected to be concentrated.
- Stains: Any spot or area on the soil surface that may indicate the presence of a potentially hazardous liquid release. Typically, stains indicate an organic liquid (e.g., an oil) has reached the soil and may have spread out vertically and horizontally.
- Elevated radiation: Any location identified during radiological surveys that had alpha/beta/gamma levels significantly higher than surrounding background soil.
- Geophysical anomalies: Any location identified during geophysical surveys that had results indicating subsurface materials exist and are not consistent with the natural surroundings or process knowledge (e.g., buried concrete or metal, surface metallic objects).
- Drums, containers, equipment or debris: Materials of interest that may have been used at, or added to, a location, and that may have contained or come in contact with hazardous or radioactive substances at some point during their use.
- Lithology: Locations where variations in lithology (soil or rock) indicate that 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 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 suspected contaminant(s) in that environmental setting.
- Other biasing factors: Factors not previously defined for the investigation but become evident once the investigation of the site is under way.

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 previous samples. Biasing factors to support Decision II sample locations include Decision I biasing factors plus available analytical results.

A.5.2.2 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 specified in Sections 7.2.1 and 7.2.2 of the CAU 553 SAFER Plan. Table A.5-1 lists the analytes reported by the various analytical methods that are considered to be COPCs.

Table A.5-1
Analytes Reported by Analytical Methods

VOC		SVOC	TPH	Radionuclides
1,1,1-Trichloroethane	Methylene chloride	2,3,4,6-Tetrachlorophenol	Diesel-range organics	Plutonium-238
1,1,1,2-Tetrachloroethane	N-Butylbenzene	2,4-Dimethylphenol		Plutonium-239/240
1,1,2,2-Tetrachloroethane	N-Propylbenzene	2,4-Dinitrotoluene		Strontium-90
1,1,2-Trichloroethane	o-Dichlorobenzene (1,2)	2,4,5-Trichlorophenol		Uranium-234
1,1-Dichloroethane	p-Dichlorobenzene (1,4)	2,4,6-Trichlorophenol		Uranium-235
1,1-Dichloroethene	p-isopropyltoluene	2-Chlorophenol		Uranium-238
cis-1,2-Dichloroethene	sec-Butylbenzene	2-Methylnaphthalene		
1,2-Dichloroethane	Styrene	2-Methylphenol		Other parameters:
1,2-Dichloropropane	tert-Butylbenzene	2-Nitrophenol		
1,2,4-Trichlorobenzene	Tetrachloroethene	3-Methylphenol[a]		Gamma-emitting radionuclides including:
1,2,4-Trimethylbenzene	Toluene	4-Chloroaniline		
1,2-Dibromo-3-chloropropane	Total Xylenes	4-Methylphenol[a]		
1,3,5-Trimethylbenzene	Trichloroethene	4-Nitrophenol		
1,4-Dioxane	Trichlorofluoromethane	Acenaphthene		Actinium-228
2-Butanone	Vinyl acetate	Acenaphthylene		Americium-241
2-Chlorotoluene	Vinyl chloride	Aniline		Cesium-137
2-Hexanone		Anthracene		Cobalt-60
4-Methyl-2-pentanone		Benzo(a)anthracene		Europium-152
Acetone		Benzo(a)pyrene		Europium-154
Acetonitrile		Benzo(b)fluoranthene		Europium-155
Allyl chloride		Benzo(g,h,i)perylene		Lead-212
Benzene		Benzo(k)fluoranthene		Lead-214
Bromodichloromethane		Benzoic Acid		Niobium-94
Bromoform		Benzyl Alcohol		Potassium-40
Bromomethane		Bis(2-ethylhexyl) phthalate		Thallium-208
Carbon disulfide		Butyl benzyl phthalate		Thorium-234
Carbon tetrachloride		Carbazole		Uranium-235
Chlorobenzene		Chrysene		
Chloroethane		Dibenzo(a,h)anthracene		
Chloroform		Dibenzofuran		
Chloromethane		Diethyl Phthalate		
Chloroprene		Dimethyl Phthalate		
Dibromochloromethane		Di-n-butyl Phthalate		
Dichlorodifluoromethane		Di-n-octyl Phthalate		
Ethyl methacrylate		Fluoranthene		
Ethylbenzene		Fluorene		
Isobutyl alcohol		Hexachlorobenzene		
Isopropylbenzene		Hexachlorobutadiene[b]		
m-Dichlorobenzene (1,3)		Hexachloroethane		
Methacrylonitrile		Indeno(1,2,3-cd)pyrene		
Methyl methacrylate		Naphthalene[b]		
		Nitrobenzene		
		N-Nitroso-di-n-propylamine		
		Pentachlorophenol		
		Phenanthrene		
		Phenol		
		Pyrene		
		Pyridine		

[a]May be reported as 3,4-methylpenol
[b]May be reported with VOCs

SVOC = Semivolatile organic compound
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compound

A.6.0 Step 4 - Define the Boundaries of the Study

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

A.6.1 Target Populations of Interest

The population of interest to resolve Decision I ("Is any COC present in environmental media within a mud spill?") 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 meet closure objectives?") are:

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

Regardless of the sampling design, the population of interest for this investigation is surface soil (0- to 6-in. depth) defined as the residual drilling fluid within the boundary of a mud spill. In the case of CAS 20-09-09, where the residual drilling fluid is recommended for removal under a best management practice, the population of interest is surface soil directly beneath the removed drilling mud.

Following the approved risk-based approach previously used for mud pits, soil samples from the surface of the residual drilling fluid are considered sufficient to adequately characterize the risk posed by mud pits, and similarly, mud spills. A review of data from previous mud pit investigations conducted under the complex process has demonstrated that TPH-DRO concentrations in surface soils are representative of the TPH-DRO concentrations throughout the depth of the residual drilling fluid (NNSA/NSO, 2004a). Although not suspected in the mud spills of CAU 553, the same process would apply to radiological constituents within residual drilling fluid. In addition, considering the

proposed industrial future land uses, the surface soil is the primary exposure point for future workers. Thus, samples collected from subsurface soils would yield no additional information.

A.6.2 Spatial Boundaries

Spatial boundaries are the maximum lateral and vertical extent of expected contamination at each mud pit, as shown in Table A.6-1. 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.

Table A.6-1
Spatial Boundaries of CAU 553 Mud Pits and Cellars

Feature	Spatial Boundaries
Mud Spills	The lateral boundaries are a 50-foot lateral buffer from the visible edges of the mud spills. The vertical boundary will be a depth of 10 feet below ground surface.

A.6.3 Practical Constraints

Investigation of these CASs may be impacted by physical constraints and activities at the NTS. General practical constraints include weather, rough terrain, and access restrictions. Access restrictions include NTS schedule conflicts with other entities, areas posted as contamination areas requiring appropriate work controls, or authorized access areas, and physical barriers (e.g., fences).

Specific constraints that may cause a temporary delay in sampling include potential restricted access to Area 19 and 20 CASs during winter months due to snow cover; restricted access to mud spills due to ponding of water following inclement weather, and military exercises, which would restrict access to Area 19 and 20.

Identified constraints that can limit intrusive sampling include buried debris, underground utilities, overhead power lines, and underlying geology (i.e., caliche, bedrock). Underground utilities surveys will be conducted at each CAS, before investigation activities begin, to determine whether utilities exist and, if so, determining the limit of spatial boundaries for intrusive activities.

A.6.4 Define the Scale of Decision-Making

The scale of decision-making for resolving Decision I and Decision II statements is defined as the individual mud spill within each CAS. This allows for individual mud spills within a CAS to be closed independent of one another. For Decision I, any COC identified in a mud spill will cause the determination that the residual mud is contaminated. Because contamination is expected to be bound within the matrix of the drilling mud, further evaluation is not necessary.

For resolving the Decision II statement, the maximum lateral extent would be defined as the visible edges of the mud spill area, and the vertical extent would be the depth of the residual drilling mud/grout, because contaminants are expected to be bound within the matrix of the drilling mud.

A.7.0 Step 5 - Develop the Analytical Approach

Step 5 of the DQO process specifies appropriate population parameters for making decisions, defines action levels, and generates an "If … then …" decision rule that involves the appropriate population parameter.

A.7.1 Population Parameters

For judgmental sampling results, the population parameter is the maximum 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 any contaminant exceeding a FAL would cause a determination that the contamination is not bounded.

A.7.2 Action Levels

The PALs presented in this section are to be used for site screening purposes. They are not necessarily intended to be used as cleanup action levels or FALs. However, they are useful in screening out contaminants that are not present in sufficient concentrations to warrant further evaluation and, therefore, streamline the consideration of remedial alternatives. 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, 2006b). This process conforms to *Nevada Administrative Code* (NAC) Section 445A.227, which lists the requirements for sites with soil contamination (NAC, 2005). For the evaluation of corrective actions, NAC Section 445A.22705 requires the use of American Society for Testing and Materials (ASTM) Method E 1739-95 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" (ASTM, 1995).

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

- Tier 1 - 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). 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 - Conducted by calculating Tier 2 site-specific target levels (SSTLs) using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 SSTLs are then compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis. Total 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 - 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 CR. The FALs will be defined (along with the basis for their definition) in the CR.

A.7.2.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the EPA *Region 9 Risk-Based Preliminary Remediation Goals (PRGs)* for chemical contaminants in industrial soils (EPA, 2004). 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 CR.

A.7.2.2 Total Petroleum Hydrocarbon PALs

The PAL for TPH is 100 parts per million as listed in NAC 445A.2272 (NAC, 2005).

A.7.2.3 Radionuclide PALs

The PALs for radiological contaminants are based on the NCRP Report No. 129 recommended screening limits for construction, commercial, industrial land-use scenarios (NCRP, 1999) using a 25 millirem per year 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 uses presented in Table A.3-4.

Solid media such as concrete and/or structures may pose a potential radiological exposure risk to site workers if contaminated. The radiological PAL for solid media will be defined as the unrestricted-release criteria defined in the NV/YMP RadCon Manual (NNSA/NSO, 2004c).

A.7.3 Measurement and Analysis Sensitivity

The measurement and analysis methods specified in Sections 7.2.1 and 7.2.2 of the CAU 553 SAFER Plan document and in the Industrial Sites QAPP (NNSA/NV, 2002) are capable of measuring analyte concentrations at or below the corresponding FALs for each COPC. See Section 7.2 of the CAU 553 SAFER Plan for additional details.

A.7.4 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.6.2, then work will be suspended and the investigation strategy will be reconsidered. For mud spills that are similar to NTS mud pits, if the characteristic concentration of a contaminant exceeds the action level, then the mud spill will be considered contaminated and closure alternatives will be evaluated.

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 analyte is identified as a COC, and removal of the material will be conducted, or Decision II samples collected to define the extent of COC contamination. If all COPC concentrations are less than the corresponding action levels in mud spills, then the decision will be no further action.

The decision rules for Decision II are:

- If the population parameter (the maximum 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 all bounding COC concentrations are less than the corresponding FALs, then the decision will be that the extent of contamination has been defined in the corresponding lateral and/or vertical direction.

- If valid analytical results are available for the waste characterization samples defined in Section A.9.0, then the decision will be that sufficient information exists to characterize the IDW for disposal, determine potential remediation waste types, and confirm that closure objectives were met.

A.8.0 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.8.1 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 CSM(s) (based on process knowledge) by stakeholder participants during the DQO process.
- Testing the validity of CSM(s) based on investigation results.
- Evaluating the quality of the data based on DQI parameters.

A.8.2 False Negative Decision Error

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

A.8.2.1 False Negative Decision Error for Judgmental Sampling

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 about the target population depend on 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:

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

To satisfy the first criterion, Decision I samples must be collected from 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 action levels). 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 CSM and the selection of sampling locations. The field-screening methods and biasing factors listed in Section A.5.2.1.1 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 according to the manufacturer's instructions and approved procedures. The CR will present an assessment on the DQI of representativeness (i.e., that samples were collected from those locations that best represent the populations of interest as defined in Section A.6.1).

To satisfy the second criterion, Decision I samples will be analyzed for the chemical and radiological parameters listed in Section 4.1. 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 CR.

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, 2002) and in Section 7.2. The DQIs of precision and accuracy will be used to assess overall analytical method performance as well as the need to potentially "flag" (qualify) individual analyte 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 analyte performance criteria based on an assessment of the data. The DQI of 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.

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, 2002):

- Field duplicates (FDs) (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.8.3 False Positive Decision Error

The false positive decision error would mean that a COC is present when it is not, or a COC is unbounded when it is not, resulting in increased costs for unnecessary sampling and analysis and potentially for unnecessary corrective actions.

False positive results are typically attributed to laboratory and/or sampling/handling errors that could cause cross contamination. To control 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, 2002):

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Equipment rinsate blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per lot of source material that contacts sampled media)
- Field duplicates (1 per 20 environmental samples or 1 per CAS per matrix, if less than 20)
- Field blanks (1 per 20 environmental samples or 1 per day)
- Laboratory QC samples (1 per 20 environmental samples or 1 per CAS per matrix, if less than 20)

A.9.0 Step 7 - Develop the Plan for Obtaining Data

Step 7 of the DQO process selects and documents a design that will yield data to best achieve performance or acceptance criteria. A judgmental sampling design will be implemented for all CAU 553 CASs. Even in the absence of biasing factors, the sampling planned is considered judgmental because of the limited spatial boundaries of each spill. A summary of the sampling approach and data evaluation for each CAS is presented in Table A.9-1. Section A.9.1 provides the specific judgmental sampling approach that will be implemented to select verification sample locations and evaluate analytical results at all CASs.

Table A.9-1
Summary of Sampling Approach and Data Evaluation for CAU 553

Feature with Applicable CASs	Description	Decision I Parameters	Evaluation of Data
19-99-01 19-99-11 20-09-09 20-99-03	Judgmental Sampling Approach	• Initial number of locations: 2 - 4 • Soil profile depth(s): Surface (0 - 6 in.) at biasing factors	Point-by-point comparison of each analytical result to the FAL

FAL = Final action level
in. = Inch

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 develop a sampling design. If adequate prior information is available on the 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 a contaminant without the samples being truly representative of the entire area (EPA, 2006).

All 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.6.1. To meet the DQI criterion for judgmental sampling sites, a biased sampling strategy will be used for Decision I to target areas with the highest potential for contamination, if it is present anywhere in the spill area. Sample locations will be determined based on process knowledge, previously acquired

data, or the field screening and biasing factors listed in Section A.5.2.1.1. 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 Site Supervisor (SS) based on biasing factors to a depth where the biasing factors are no longer present. The SS has the discretion to modify the sample locations at judgmentally sampled CASs, but only if the modified locations meet the decision needs and criteria stipulated in this DQO.

A.9.1 Mud Spill Sampling Designs

Sufficient historical site knowledge and previous sampling results from similar mud pit/spill investigations exist to indicate that the mud spills in CAU 553 can be closed under the no further action alternative. To support this closure alternative, surface verification samples will be collected using a judgmental sampling design from each individual mud spill within CAU 553 to confirm that COCs are not present at concentrations that pose a risk to human health or the environment. Samples to be collected at mud spills will be obtained using hand scoops, hand auger, or other appropriate method. The following sections outline the judgmental sample design for each CAS and also describes any additional activities that may be performed as best management practices. During the investigation for all CASs in CAU 553, the SS has the discretion to modify the sample locations or order additional biased samples to be collected, but only if the new locations meet the decision needs and criteria stipulated in this DQO. The SS will use professional judgment to determine whether biasing factors (e.g., stains, elevated screening levels) are found during Decision I sampling that might indicate the need to take subsurface Decision II samples.

A.9.1.1 CAS 19-99-01, Mud Spill

The mud spill at this CAS is not contiguous and is located in several areas on and surrounding an 8-ft-high soil mound. The thickest concentrations of mud/clay material can be found in localized shallow depressions atop the mound and low areas on the ground surface at the base of the mound where the mud spilled down the sides. A minimum of two biased samples will be collected from the mound area with the locations biased towards staining, elevated FSRs, and/or the thickest deposits of mud, assuming COPCs will be concentrated in these areas. Debris surrounding the mud spill within the CAS boundaries will not be removed or investigated. Geophysical surveys of the mound indicate

no debris is buried, and the nature of the mud spill suggests that mud was only deposited on the mound surface. Figure A.9-1 shows the proposed sample locations.

A.9.1.2 CAS 19-99-11, Mud Spill

This CAS has three distinct mud spill areas. Verification samples will be collected from each spill in a location with the highest potential to find contamination if present. In the absence of staining or elevated FSRs, a sample will be collected in either the topographic low, within the spill area where contaminants could be expected to be concentrated, or in the center of the spill, if no other biasing factors exist. For the north spill, it is anticipated the grout material will be sampled directly in two locations, with at least one location at a yellow-stained area on the north end. For the west spill, the darker gray silt/clay material lying atop the native volcanic material will be sampled. For the south spill, any stained area or the darkest gray coloring of the mud will be sampled. Figure A.9-2 shows the proposed sample locations.

A.9.1.3 CAS 20-09-09, Mud Spill

Due to the location of the two bentonite spills within an DOE Operational Readiness Area, it is recommended that both bentonite piles be removed as a best management practice and managed as waste. Samples will be collected from the material directly for waste management purposes. A soil verification sample will then be collected from beneath each of the removed bentonite piles to confirm the absence of COPCs in the underlying soil. If COCs are shown to be present, then Decision II samples will be collected, if deemed necessary. Figure A.9-3 shows the proposed sample locations.

A.9.1.4 CAS 20-99-03, Mud Spill

The mud spill at this CAS is contiguous and encompasses a large area (750 by 250 ft) where the mud is relatively evenly distributed across the site. This mud spill is the only area of concern for this CAS. The pile of steel pellets (based on visual observation of rust) located north of the mud spill does not represent an environmental hazard and therefore will not be investigated further. A radiological survey performed on the mud spill indicates no elevated radiological contamination. Based on these data and previous mud pit sampling investigation results, there is no indication that a fuller characterization of the spill area is necessary. Therefore, only four verification samples are

recommended; one from each quadrant of the spill area. Figure A.9-4 shows the proposed sample locations. Biasing factors will be identified during a site walkdown and the proposed locations will be refined based on the site conditions. It is anticipated that most of the verification samples will be collected in pooled, concentrated areas of the mud due to the lack of apparent staining throughout the mud spill.

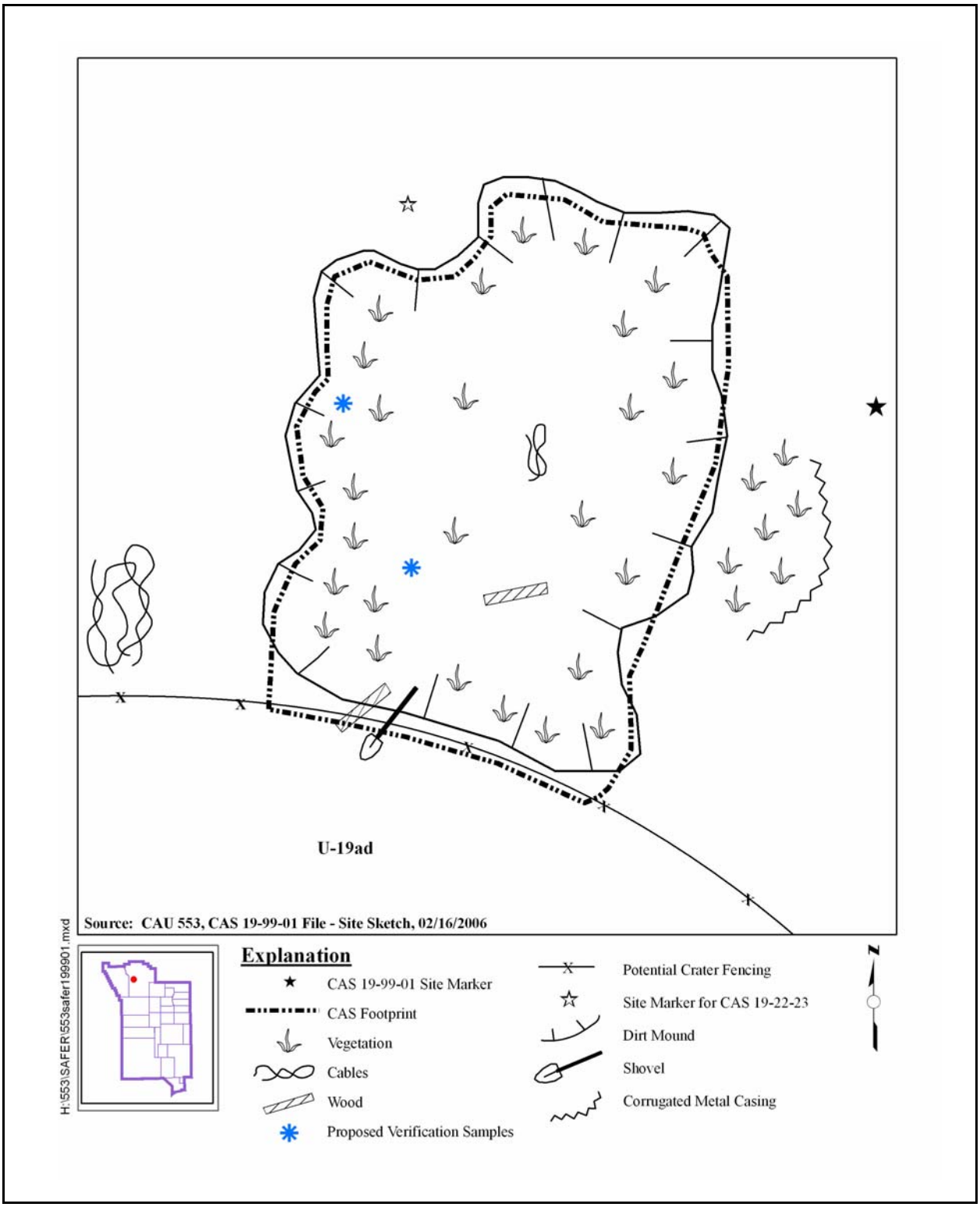

Figure A.9-1
Proposed Sample Locations CAS 19-99-01

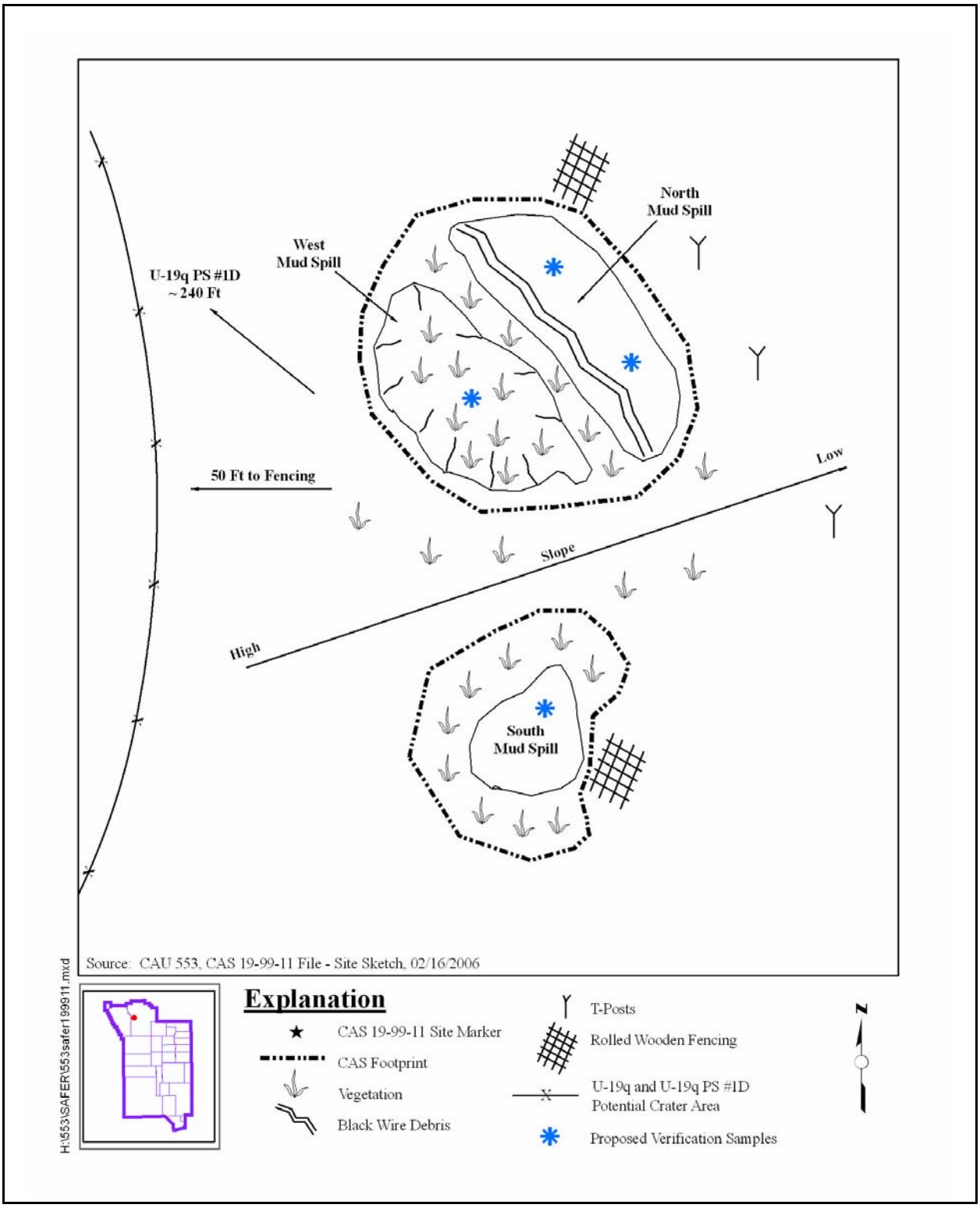

Figure A.9-2
Proposed Sample Locations CAS 19-99-11

Figure A.9-3
Proposed Sample Locations CAS 20-09-09

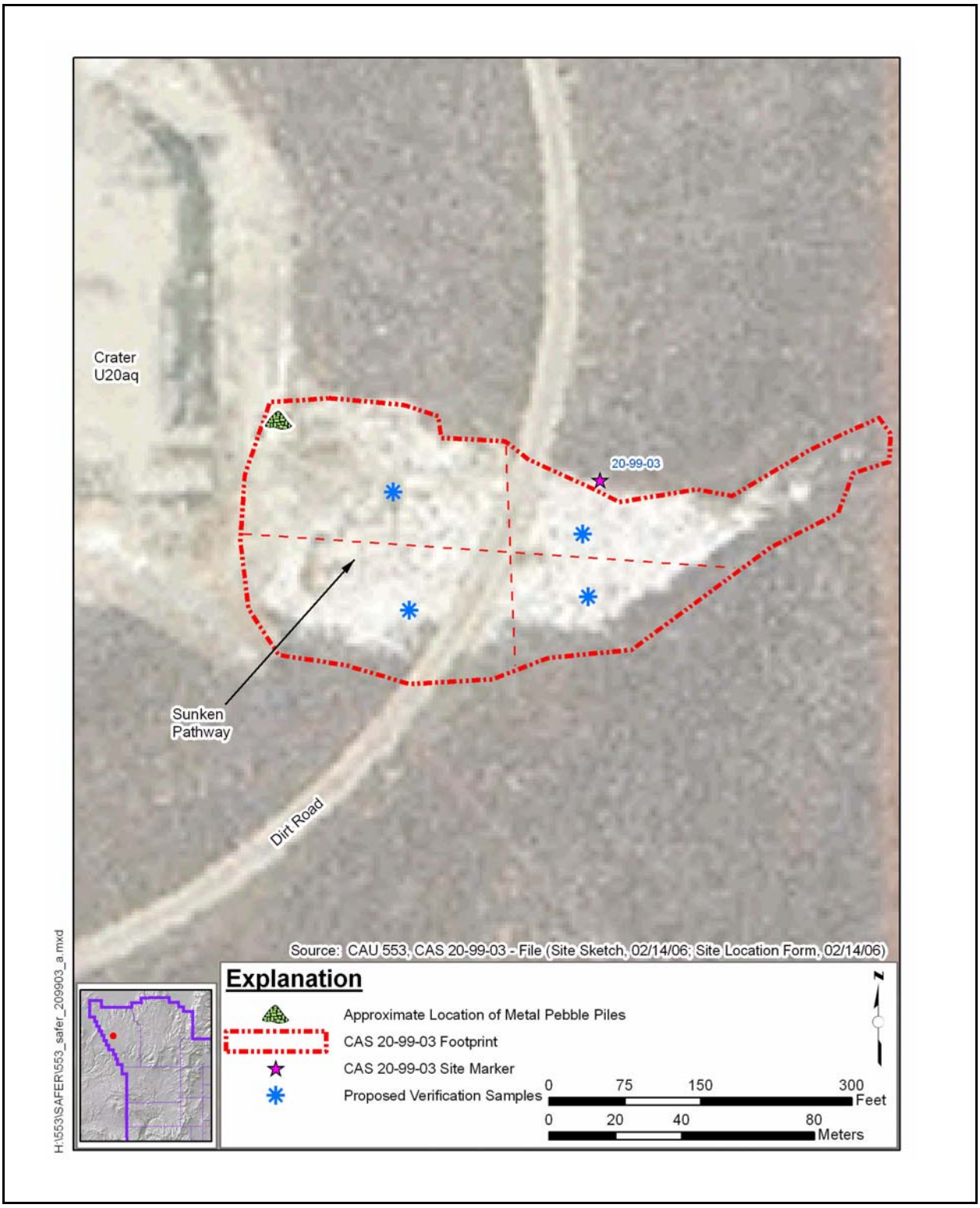

Figure A.9-4
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Appendix B

Closure Certification

This section does not apply to CAU 553.

Appendix C

As-Built Documentation

This section does not apply to CAU 553.

Appendix D

Confirmation Sampling Test Results

D.1.0 Introduction

This appendix presents the CAI activities and analytical results for CAU 553. Corrective Action Unit 553 is located in Areas 19 and 20 of the NTS (Figure 1-1), and is comprised of the four CASs listed below:

- 19-99-01, Mud Spill
- 19-99-11, Mud Spill
- 20-09-09, Mud Spill
- 20-99-03, Mud Spill

Corrective Action Unit 553 consists of four CASs, two located in Area 19 and two located in Area 20. All four CASs consist of drilling mud spills or spilled bentonite. Three of the spills are potentially associated with post-test drilling while the spilled bentonite is located at the Area 20 mud plant and is assumed to not have been exposed to any test related activity.

The CAI was conducted in accordance with the CAU 553 SAFER Plan as developed under the FFACO (FFACO, 1996; as amended August 2006). Additional information regarding the history of each site, planning, and the scope of the investigation is presented in the CAU 553 SAFER Plan (NNSA/NSO, 2006a).

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 CAS in CAU 553. This objective was achieved by collecting environmental samples of the spilled mud and/or affected soils for analysis to determine the presence of COCs. Because no COCs were present, further sampling was not necessary.

The selection of soil sample locations was based on site conditions, and the strategy developed during the DQO process (Appendix A) as presented in the CAU 553 SAFER Plan. The sampling strategy was based on the collection of surface samples from the various mud spills and locating them based on radiological screening and other visible biasing factors identified during the sample collection activities. All CASs within CAU 553 were sampled following this judgmental approach.

D.1.2 Contents

This appendix contains information and data in sufficient detail to support a determination that no further corrective action is required at CAU 553. 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.6.0 provide CAS-specific information regarding the field activities, sampling methods, and laboratory analytical results from investigation sampling.
- Section D.7.0 summarizes waste management activities.
- Section D.8.0 discusses the QA/QC procedures followed to ensure the data quality met the requirements specified in the CAU 553 SAFER Plan.
- Section D.9.0 is a summary of the investigation results.
- Section D.10.0 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 project files as hard copies or electronic media.

D.2.0 Investigation Overview

Field investigation and sampling activities for the CAU 553 CAI were conducted from February 6 through 8, 2007. Table D.2-1 lists the CAI activities that were conducted at each of the CASs.

Table D.2-1
Corrective Action Activities Conducted at Each Corrective Action Site to Meet SAFER Plan Requirements

Corrective Action Activities	Corrective Action Sites			
	19-99-01 Mud Spill	19-99-11 Mud Spill	20-09-09 Mud Spill	20-99-03 Mud Spill
Conducted surface radiological surveys	X	X	X	X
Performed geophysical surveys	X			
Performed site walkovers to evaluate current site conditions	X	X	X	X
Collected closure verification soil samples from biased locations.	X	X	X	X
Collected waste characterization samples			X	
Field-screened samples for alpha and beta/gamma radiation	X	X	X	X
Submitted samples for off-site laboratory analysis	X	X	X	X
Removed spilled material as a housekeeping practice			X	

The investigation and sampling program was managed according to the requirements set forth in the CAU 553 SAFER Plan (NNSA/NSO, 2006a). 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, trip blanks, and duplicate samples) were collected as required by the Industrial Sites QAPP (NNSA/NV, 2002) and the CAU 553 SAFER Plan (NNSA/NSO, 2006a). During field activities, waste minimization practices were followed according to approved procedures, including waste stream segregation by waste stream.

Weather conditions at the site varied to include sun (moderate to low temperatures), intermittent cloudiness, and sustained winds. These conditions did not cause the delay of work or impact the quality of the analytical data.

The CASs were investigated by initially conducting radiological surface screening and sampling potential contaminant areas within the CAS. Soil samples were collected by hand excavation. All environmental samples were field screened for alpha and beta/gamma radiation before containerization. The results of the field screening and the sample screening were compared against background levels to guide in the CAS-specific investigations.

All CAU 553 Decision I sampling locations were accessible and sampling activities at planned locations were not restricted.

Sections D.2.1 through D.2.4 provide the investigation methodology, site geology and hydrology, and laboratory analytical information.

D.2.1 Sample Locations

Investigation locations selected for sampling were based on information obtained during site visits, radiological walkover surveys, and the approach presented in the CAU 553 SAFER Plan. The planned biased sample locations are discussed in the text and are represented on figures in the SAFER Plan. Actual environmental sample locations are shown on the figures included in Sections D.3.0 through D.6.0. Some locations were modified slightly from planned positions due to field conditions and observations. Sample locations were staked and labeled after sampling was completed. A Trimble Pathfinder ProXRSTM GPS instrument was used to determine the sample location coordinates. Appendix I presents these data in a tabular format.

D.2.2 Investigation Activities

The field investigation activities performed at CAU 553 were based on activities discussed in the CAU 553 SAFER Plan (NNSA/NSO, 2006a). The technical approach consisted of the activities listed in Table D.2-1. The investigation strategy allowed the nature of contamination associated with each CAS to be established. Because no COCs were identified, Decision II sampling was not

necessary. The following sections describe the site-specific investigation activities that took place during the CAU 553 investigation.

D.2.2.1 Radiological Surveys

Radiological surveys (i.e., scanning and static) were performed at all the CASs during the CAI to identify the locations of elevated radiological contamination. Radiological walkover surveys were conducted at the CASs using a hand-held scintillation detector in conjunction with a GPS receiver and datalogger. After a sample was collected and moved to the sampling table, a radiological static survey to detect alpha and beta/gamma radiation was conducted by holding the instrument within an inch of the material for one minute. To support unrestricted release determinations per the NV/YMP RadCon Manual (NNSA/NSO, 2004), radiological surveys were performed at each CAS using an NE Technology Electra with dual-alpha and beta/gamma radiation scintillation probe.

D.2.2.2 Field Screening

Field-screening activities (walkover surveys) for alpha and beta/gamma radiation were performed as specified in the CAU 553 SAFER Plan. All sample locations were also screened for alpha and beta/gamma radiation before sampling to guide the investigation and serve as a health and safety control measure.

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 that were considered to be unaffected by the 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 CAU 553 SAFER Plan (NNSA/NSO, 2006a).

Alpha and beta/gamma radiation field-screening was performed at each CAS using an NE Technology Electra fitted with a DP6 dual-alpha and beta/gamma radiation scintillation probe. Field-screening results are recorded on the SCLs retained in project files.

D.2.2.3 Surface and Subsurface Soil Sampling

Soil samples were collected using "scoop and trowel" (surface hand-grab sampling). All sample locations were initially field screened for alpha and beta/gamma radiation before the start of sampling. Additional screening was conducted during sample collection to both guide the investigation and serve as a health and safety control to protect the sampling team. Labeled VOC sample containers were filled with soil directly from the sample location. Additional soil was transferred into an aluminum pan, homogenized, and field screened for alpha and beta/gamma radiation. All remaining sample containers were then filled. Excess soil was returned to its original location and the sample containers appropriately disposed based on field-screening and/or analytical results.

Surface soil samples were collected from 0.0 to 0.5 ft bgs at biased locations focusing on stained soil, aboveground features (i.e., areas where spilled drilling muds may have pooled), areas where the vegetation was not as dense as the surrounds, or with elevated radiological measurements.

D.2.2.4 Waste Characterization Sampling

Characterization of CAS-specific waste was performed to support recommendations for disposal of these items during anticipated closure activities and to determine whether the waste in question at these CASs could be acting as a source of potential soil contamination. Investigation methods included visual inspection, radiological surveys, and direct sampling of the contents of piles of bentonite. Waste characterization activities were intended to gather adequate information and data about the CAS to support decisions regarding the disposal of the piles of bentonite located within CAS 20-09-09.

Samples were analyzed according to the CAU 553 SAFER Plan (NNSA/NSO, 2006a). 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 being shipped off-site contains no "added radioactivity."

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

- Samples collected from the piles of bentonite at CAS 20-09-09.

D.2.3 Laboratory Analytical Information

Radiological analyses were performed by Eberline Services of Oakridge, 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 553 Investigation Samples[a]

Analytical Parameter	Analytical Method
Total volatile organic compounds	Water and Soil - SW-846 8260B[b]
Total semivolatile organic compounds	Water and Soil - SW-846 8270C[b]
Total petroleum hydrocarbons (diesel-range organics)	Water and Soil - SW-846 8015B (modified)[b]
Gamma spectroscopy	Water and Soil - EPA 901.1[c] and DOE/EML 4.5.2.3[c]
Isotopic uranium (U)	Water and Soil - DOE/EML Procedure U-02[c]
Isotopic plutonium (Pu)	Water - DOE/EML Procedure Pu-10[c] Soil - DOE/EML Procedure Pu-02[c]
Strontium (Sr)-90	Water - DOE/EML Procedure Sr-02[c] Solid - DOE/EML Procedure Sr-02[c]

[a]Investigation samples include both environmental and waste characterization samples and associated quality control samples.
[b]U.S. Environmental Protection Agency (EPA) *Test Methods for Evaluating Solid Waste*, *Physical/Chemical Methods*, 3rd Edition, Parts 1-4, SW-846 CD-ROM (EPA, 1996).
[c]Environmental Measurements Laboratory (EML) *Procedures Manual* (EML, 1990).

DOE = U.S. Department of Energy

Validated analytical data for CAU 553 investigation samples have been compiled and evaluated to confirm the presence and define the extent of contamination, if present. The analytical results for each CAS are presented in Sections D.3.0 through D.6.0. A discussion of the DQA is provided in Section 4.1 of the main document.

The analytical parameters are CAS-specific and were selected through the application of site process knowledge according to the DQOs (Appendix A).

D.2.4 Comparison to Action Levels

A COC is defined as a contaminant present in environmental media FAL. A COC may also be defined as a contaminant that, in combination with other like contaminants, is determined to jointly pose an unacceptable risk based on a multiple constituent analysis (NNSA/NSO, 2006b).

If COCs are present, a corrective action must be considered for the CAS. The FALs for CAU 553 are defined for each CAS as PALs.

D.3.0 CAS 19-99-01, Mud Spill Investigation Results

Corrective Action Site 19-99-01 is located in Area 19 of the NTS (Figure 1-2) adjacent to the north side of the fenced U-19ad potential crater area east of Pahute Mesa Road. The feature identified in the CAU 553 SAFER Plan for investigation is the mud spill that extends down a small mound of dirt in several directions with a small portion extending past the U-19ad fence line. Additional detail is provided in the SAFER Plan.

D.3.1 SAFER Activities

Three characterization samples (including 1 FD) were collected during investigation activities at CAS 19-99-01. The sample locations, identifications (IDs), types, and analyses are listed in Table D.3-1. The specific CAI activities conducted to satisfy the CAU 553 SAFER Plan requirements at this CAS are described in the following sections.

Table D.3-1
Samples Collected at CAS 19-99-01, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
A01	553A001	0.0 - 0.5	Soil	Environmental	Set 1
	553A002	0.0 - 0.5	Soil	Field Duplicate of #553A001	Set 1
A02	553A003	0.0 - 0.5	Soil	Environmental, MS/MSD	Set 1
N/A	553A301	N/A	Water	Trip Blank	VOCs
N/A	553A302	N/A	Water	Field Blank	Set 1

Set 1 = VOCs, SVOCs, TPH-DRO, Gamma Spectroscopy, Isotopic Uranium, Isotopic Plutonium, Strontium-90

bgs = Below ground surface
DRO = Diesel-range organics
ft = Feet
MS/MSD = Matrix spike/matrix spike duplicate
N/A = Not applicable
TPH = Total petroleum hydrocarbons
SVOC = Semivolatile organic compound
VOC = Volatile organic compound

D.3.1.1 Field Screening

Investigation samples were field screened for alpha and beta/gamma radiation. The FSRs were compared to FSLs to guide subsequent sampling decisions where appropriate. Gross alpha radiation FSLs were not exceeded. Beta/gamma radiation FSLs were not exceeded.

D.3.1.2 Radiological Surveys

A radiological walkover survey was conducted on the area where the spilled mud is located at CAS 19-99-01. The survey identified no elevated radiological count rates in the surface soil (Figure D.3-1). No environmental samples were collected as a direct result of the walkover survey.

D.3.1.3 Visual Inspections

Two features associated with the mud spill were identified within the CAS. These features consisted of the location that appears to be where the mud was spilled and flowed from and a small depression where it appears the mud may have pooled. It is assumed that if contaminants were present within the CAS, the greatest likelihood would be at these locations; therefore, environmental samples were collected at these locations.

D.3.1.4 Sample Collection

Decision I environmental sampling activities included the collection of surface samples from sample location A01, the apparent location of the spill, and sample location A02, a shallow depression where the mud and potential contaminants appear to have pooled (Figure D.3-1).

One environmental sample and one FD were collected from sample location A01. One environmental sample, a double volume for laboratory QC, was collected from sample location A02.

D.3.1.5 Deviations

Investigation samples were collected as outlined in the CAU 553 SAFER Plan (NNSA/NSO, 2006a) and submitted for laboratory analysis. There were no deviations from the investigation as outlined in the SAFER Plan.

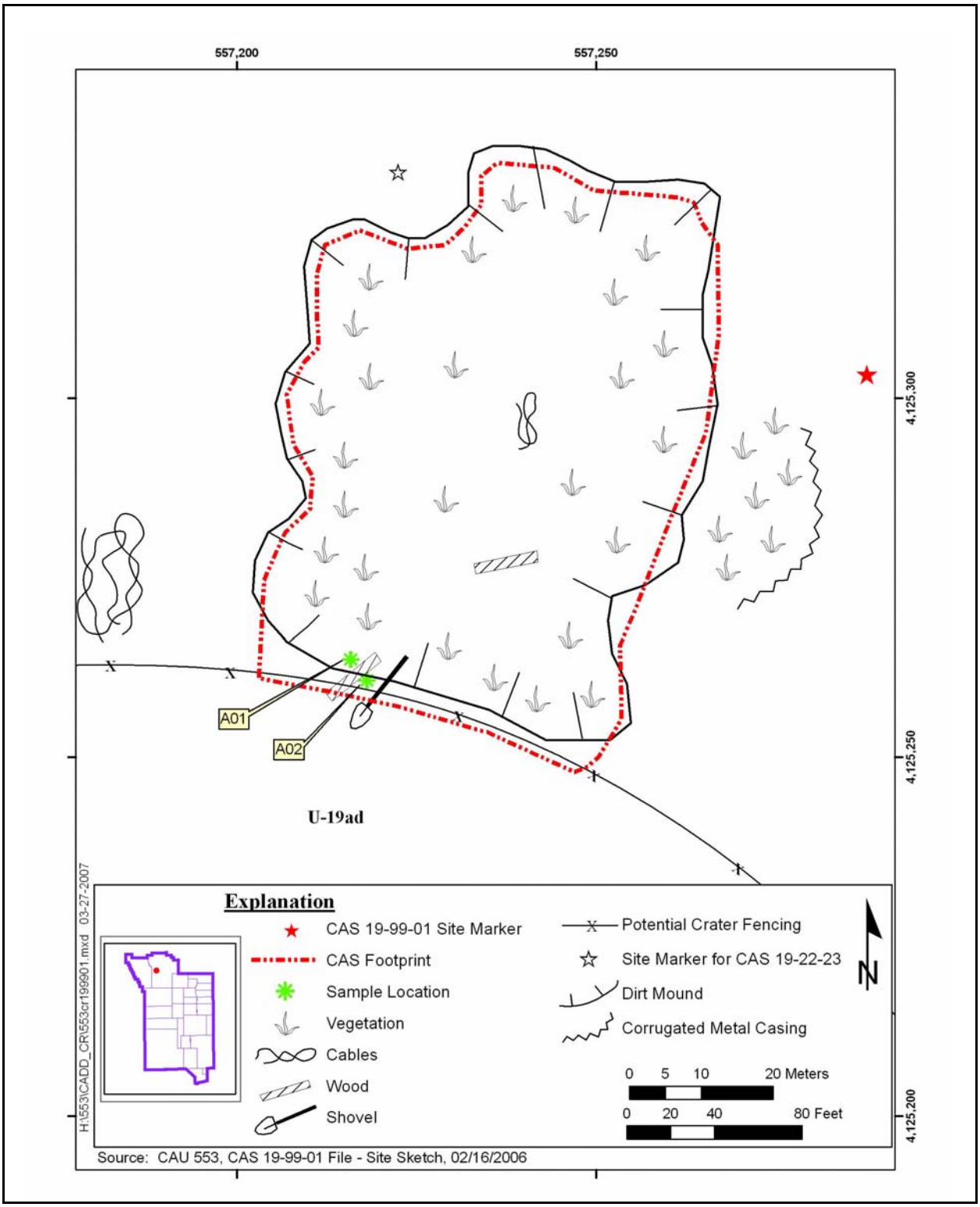

Figure D.3-1
Sample Locations at CAS 19-99-01, Mud Spill

D.3.2 Investigation Results

The following sections provide analytical results from the samples collected to complete investigation activities as outlined in the CAU 553 SAFER Plan. Investigation samples were analyzed for the SAFER Plan-specified COPCs, which included VOCs, SVOCs, TPH-DRO, gamma-emitting radionuclides, isotopic U, isotopic Pu, and Sr-90. 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 19-99-01.

Analytical results from the soil 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. 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

Analytical results for VOCs of environmental samples collected at this CAS that were detected above MDCs are presented in Table D.3-2. Methylene chloride was the only VOC detected at a concentration exceeding the MDC. The 2.5 micrograms per kilogram (µg/kg) concentration is less than the PAL of 21,000 µg/kg. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

Table D.3-2
Sample Results for VOCs Detected Above Minimum Detectable Concentrations at CAS 19-99-01, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (µg/kg)
			Methylene Chloride
Final Action Levels[a]			21,000
A01	553A001	0.0 - 0.5	2.5 (J)

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2006).

bgs = Below ground surface
ft = Feet
µg/kg = Micrograms per kilogram
J = Estimated value

D.3.2.2 Semivolatile Organic Compounds

Analytical results for SVOCs of environmental samples collected at this CAS detected no contaminants in concentrations greater than MDCs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

D.3.2.3 Total Petroleum Hydrocarbons

The analytical results for TPH-DRO for environmental samples collected at this CAS identified no samples that exceeded MDCs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

D.3.2.4 Gamma-Emitting Radionuclides

Gamma-emitting radionuclides analytical results for environmental samples collected at this CAS that were detected above MDCs are presented in Table D.3-3. No gamma-emitting radionuclides were detected at concentrations exceeding their respective PALs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

Table D.3-3
Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentrations at CAS 19-99-01, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)			
			Actinium-228	Lead-212	Lead-214	Thallium-208
Final Action Levels[a]			5	5	5	5
A01	553A001	0.0 - 0.5	3.375	3.548	2.083	2.998
	553A002	0.0 - 0.5	2.758	3.371	1.874	2.904
A02	553A003	0.0 - 0.5	3.555	3.238	2.267	2.608

[a]Based on preliminary action levels established in the CAU 553 SAFER Plan.

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

D.3.2.5 Plutonium, Strontium-90, and Uranium Isotopes

Isotopic Pu and isotopic U analytical results for environmental samples collected at this CAS that were detected above MDCs are presented in Table D.3-4. None of the Sr-90 concentrations exceeded the MDC. No isotopic Pu or isotopic U exceeded the PALs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

Table D.3-4
Sample Results for Plutonium and Uranium Isotopes Detected Above Minimum Detectable Concentrations at CAS 19-99-01, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)				
			Plutonium-238	Plutonium-239/240	Uranium-234	Uranium-235	Uranium-238
Final Action Levels[a]			13	12.7	143	17.6	105
A01	553A001	0.0 - 0.5	--	--	1.495	0.07	1.739
	553A002	0.0 - 0.5	--	0.031	1.734	0.064	1.708
A02	553A003	0.0 - 0.5	0.095	--	1.669	0.1	1.685

[a]Based on preliminary action levels established in the CAU 553 SAFER Plan.

bgs = Below ground surface
ft = Feet
pCi/g = Picocuries per gram
-- = Not detected above minimum detectable concentrations

D.3.3 Nature and Extent of Contamination

Based on the analytical results for soil samples collected within CAS 19-99-01, no COCs were identified.

D.3.4 Revised Conceptual Site Model

The CAU 553 SAFER Plan requirements were met at this CAS and revisions to the CSM were not necessary.

D.4.0 CAS 19-99-11, Mud Spill Investigation Results

Corrective Action Site 19-99-11 is located in Area 19 of the NTS (Figure 1-2) approximately 50 ft east of the fenced U-19q/U-19q PS#1D potential crater area west of Pahute Mesa Road. The item identified in the CAU 553 SAFER Plan for investigation is a series of three small mud spills referred to individually as the south, north, and west spills (Figure D.4-1). Additional detail is provided in the SAFER Plan.

D.4.1 SAFER Activities

Five characterization samples (including 1 FD) were collected during investigation activities at CAS 19-99-11. The sample location IDs, types, and analyses are listed in Table D.4-1 with the locations shown on Figure D.4-1. The specific CAI activities conducted to satisfy the CAU 553 SAFER Plan requirements at this CAS are described in the following sections.

Table D.4-1
Samples Collected at CAS 19-99-11, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
B01	553B001	0.0 - 0.5	Soil	Environmental	Set 1
	553B002	0.0 - 0.5	Soil	Field Duplicate of #553B001	Set 1
B02	553B003	0.0 - 0.5	Soil	Environmental, MS/MSD	Set 1
B03	553B004	0.0 - 0.5	Soil	Environmental	Set 1
B04	553B005	0.0 - 0.5	Soil	Environmental	Set 1
N/A	553B301	N/A	Water	Field Blank	Set 1

Set 1 = VOCs, SVOCs, TPH-DRO, Gamma Spectroscopy, Isotopic Uranium, Isotopic Plutonium, Strontium-90

bgs = Below ground surface
DRO = Diesel-range organics
ft = Feet
MS/MSD = Matrix spike/matrix spike duplicate
N/A = Not applicable
TPH = Total petroleum hydrocarbons
SVOC = Semivolatile organic compound
VOC = Volatile organic compound

D.4.1.1 Field Screening

Investigation samples were field screened for alpha and beta/gamma radiation. The FSRs were compared to FSLs to guide subsequent sampling decisions where appropriate. Neither the gross alpha radiation nor beta/gamma radiation FSLs were exceeded.

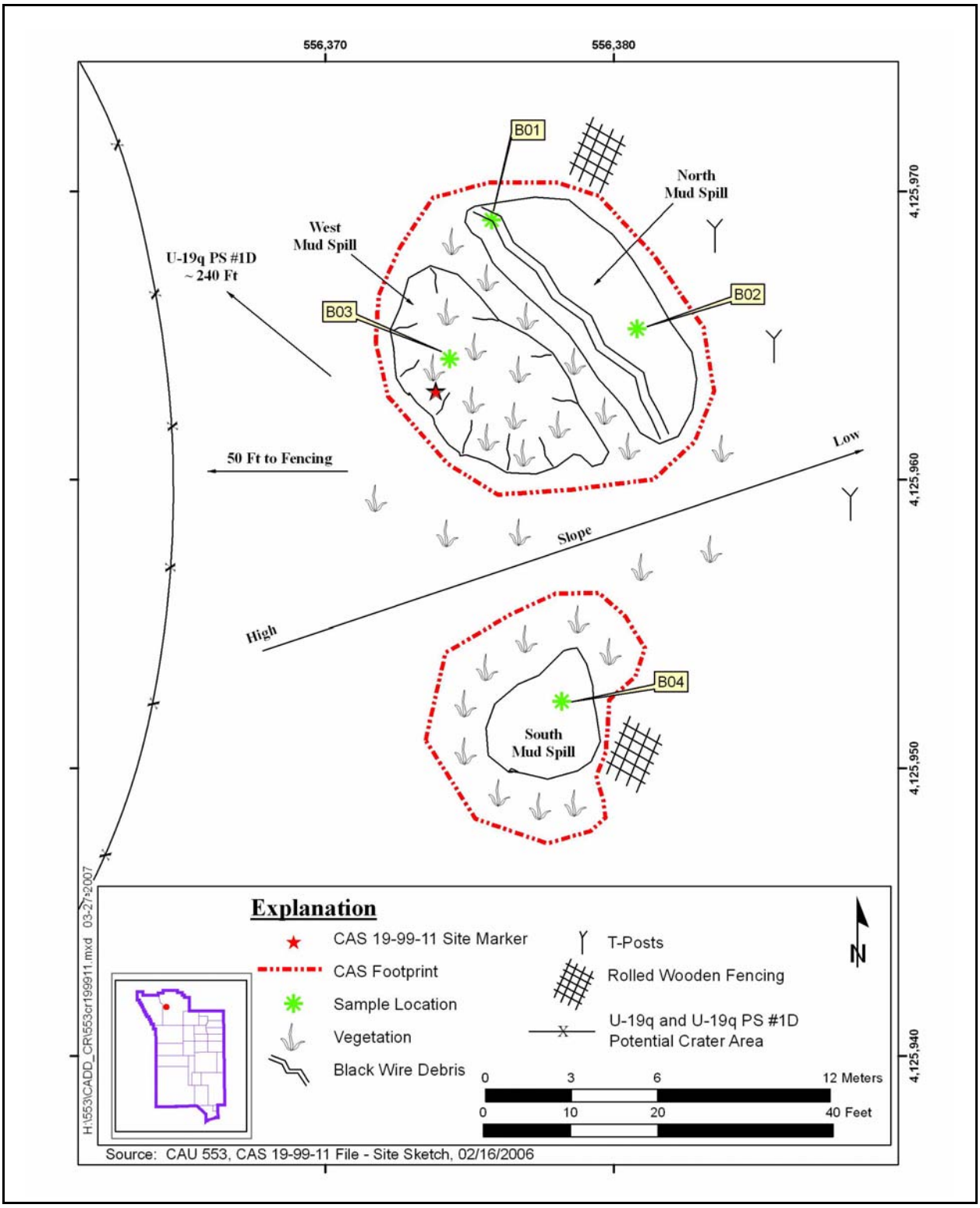

Figure D.4-1
Sample Locations at CAS 19-99-11, Mud Spill

D.4.1.2 Radiological Surveys

A radiological walkover survey was conducted on the area where the spilled mud is located at CAS 19-99-11. The survey identified no radiological count rates that exceeded the background levels in the surface soil (Figure D.4-1). No environmental samples were collected as a direct result of the walkover survey.

D.4.1.3 Visual Inspections

During the initial visual inspection the features identified in the north mud spill were an area of yellow discoloration and a low spot where the mud had pooled. The feature identified in the west mud spill was where the mud appeared to be the thickest and made up of multiple faint colors. The feature identified in the south mud spill was a low area where the mud had pooled. It is assumed that if contaminants were present within the CAS, the greatest likelihood would be at these locations; therefore, environmental samples were collected at these locations.

D.4.1.4 Sample Collection

Decision I environmental sampling activities included the collection of surface samples from sample location; B01, an area with yellow discoloring; B02, a low spot where the mud had pooled; B03, an area where the mud appeared to be thickest and made up of multiple colors; and B04, a low spot where the mud had pooled. The sample locations are shown on Figure D.4-1.

One environmental sample and one FD were collected from sample location B01. One environmental sample, a double volume for laboratory QC, was collected from sample location B02. One environmental sample was collected from each of sample locations B03 and B04.

D.4.1.5 Deviations

Investigation samples were collected as outlined in the CAU 553 SAFER Plan (NNSA/NSO, 2006a) and submitted for laboratory analysis. There were no deviations from the investigation as outlined.

D.4.2 Investigation Results

The following sections provide analytical results from the samples collected to complete investigation activities as outlined in the CAU 553 SAFER Plan. Investigation samples were

analyzed for the CAU 553 SAFER Plan-specified COPCs, which included VOCs, SVOCs, TPH-DRO, gamma-emitting radionuclides, isotopic U, isotopic Pu, and Sr-90. The analytical parameters and laboratory methods used to analyze the investigation samples are listed in Table D.2-2. Table D.4-1 lists the sample-specific analytical suite for CAS 19-99-11.

Analytical results from the soil 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.

D.4.2.1 Volatile Organic Compounds

Analytical results for VOCs for the environmental samples collected at this CAS that were detected above MDCs are presented in Table D.4-2. Methylene chloride was the only VOC detected in the samples. Although detected, the concentration of this VOC did not exceed the PALs identified in the SAFER Plan. As a result, the FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

Table D.4-2
Sample Results for VOCs Detected Above Minimum Detectable Concentrations at CAS 19-99-11, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (µg/kg)
			Methylene Chloride
Final Action Levels[a]			21,000
B02	553B003	0.0 - 0.5	2.6 (J)

[a]Based on U.S. Environmental Protection Agency, *Region 9 Preliminary Remediation Goals (PRGs)* (EPA, 2006).

bgs = Below ground surface
ft = Feet
µg/kg = Micrograms per kilogram
J = Estimated value

D.4.2.2 Semivolatile Organic Compounds

Analytical results for SVOCs of environmental samples collected at this CAS detected no contaminants in concentrations greater than MDCs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

D.4.2.3 Total Petroleum Hydrocarbons

The TPH-DRO analytical results for soil samples collected at this CAS that were detected above MDCs are presented in Table D.4-3. Total petroleum hydrocarbons-DRO was detected in two environmental samples (553B004 and 553B005) collected at this CAS, but neither exceeded the 100 milligrams per kilogram (mg/kg) PAL established in the CAU 553 SAFER Plan (NAC, 2006).

Table D.4-3
Sample Results for TPH-DRO Detected Above
Minimum Detectable Concentrations at CAS 19-99-11, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Diesel-Range Organics
Preliminary Action Levels[a]			100
B03	553B004	0.0 - 0.5	10 (J)
B04	553B005	0.0 - 0.5	10 (J)

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

bgs = Below ground surface
ft = Feet
mg/kg = Milligrams per kilogram
J = Estimated value

D.4.2.4 Gamma-Emitting Radionuclides

Gamma-emitting radionuclides analytical results for environmental samples collected at this CAS that were detected above MDCs are presented in Table D.4-4. The analytical results for actinium (Ac)-228 and lead (Pb)-212 exceeded the generic PALs of 5 picocuries per gram (pCi/g). The PALs were re-calculated for an industrial scenario using Residual Radioactive (RESRAD) computer code and established at 6.029 pCi/g for both Ac-228 and Pb-212. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

D.4.2.5 Plutonium, Strontium-90, and Uranium Isotopes

Isotopic U analytical results for environmental samples collected at this CAS that were detected above MDCs are presented in Table D.4-5. None of the isotopic Pu or Sr-90 concentrations exceeded the MDC. No isotopic U exceeded the PALs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

Table D.4-4
Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentrations at CAS 19-99-11, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)			
			Actinium-228	Lead-212	Lead-214	Thallium-208
Final Action Levels[a]			**6.029**	**6.029**	**5**	**5**
B01	553B001	0.0 - 0.5	--	0.413	0.799	--
B02	553B003	0.0 - 0.5	--	0.271	0.473	--
B03	553B004	0.0 - 0.5	3.85	3.924	2.192	3.42
B04	553B005	0.0 - 0.5	5.052	5.352	4.392	4.307

[a]Based on preliminary action levels established in the CAU 553 SAFER Plan.

bgs = Below ground surface
ft = Feet
pCi/g = Picocuries per gram
SAFER = Streamlined Approach for Environmental Restoration
-- = Not detected above minimum detectable concentrations

Table D.4-5
Sample Results for Uranium Isotopes Detected Above Minimum Detectable Concentrations at CAS 19-99-11, Mud Spill
(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**
B01	553B001	0.0 - 0.5	0.63	--	0.752
	553B002	0.0 - 0.5	0.645	0.056	0.729
B02	553B003	0.0 - 0.5	0.961	--	0.83
B03	553B004	0.0 - 0.5	1.99	0.057	2.009

Table D.4-5
Sample Results for Uranium Isotopes Detected Above Minimum Detectable Concentrations at CAS 19-99-11, Mud Spill
(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**
B04	553B005	0.0 - 0.5	2.87	0.161	2.888

[a]Based on preliminary action levels established in the CAU 553 SAFER Plan.

bgs = Below ground surface
ft = Feet
pCi/g = Picocuries per gram
SAFER = Streamlined Approach for Environmental Restoration
-- = Not detected above minimum detectable concentrations

D.4.3 Nature and Extent of Contamination

Based on the analytical results for soil samples collected within CAS 19-99-11, no COCs were identified.

D.4.4 Revised Conceptual Site Model

The CAU 553 SAFER Plan requirements were met at this CAS and revisions to the CSM were not necessary.

D.5.0 CAS 20-09-09, Mud Spill Investigation Results

Corrective Action Site 20-09-09 is located in Area 20 of the NTS (Figure 1-2) in the Pahute Mesa Mud Plant at Rad-Safe Marker 20 P 114 and consists of two separate spills of dry, cracked, gray bentonite on the ground surface. Additional detail is provided in the CAU 553 SAFER Plan.

D.5.1 SAFER Activities

Four environmental samples (including 1 FD) were collected during investigation activities at CAS 20-09-09. The sample locations, IDs, types, and analyses are listed in Table D.5-1 and locations are shown on Figure D.5-1. The specific CAI activities conducted to satisfy the CAU 553 SAFER Plan requirements at this CAS are described in the following sections.

Table D.5-1
Samples Collected at CAS 20-09-09, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
C01	553C001	0.0 - 0.5	Soil	Environmental	Set 2
C02	553C002	0.0 - 0.5	Soil	Environmental	Set 2
	553C003	0.0 - 0.5	Soil	Field Duplicate of #553C002	Set 2
C03	553C004	0.0 - 0.5	Soil	Environmental, MS/MSD	Set 2
N/A	553C301	N/A	Water	Trip Blank	VOCs
N/A	553C302	N/A	Water	Field Blank	Set 1

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

bgs = Below ground surface
DRO = Diesel-range organics
ft = Feet
MS/MSD = Matrix spike/matrix spike duplicate
N/A = Not applicable
TPH = Total petroleum hydrocarbons
SVOC = Semivolatile organic compound
VOC = Volatile organic compound

D.5.1.1 Field Screening

Investigation samples were field screened for alpha and beta/gamma radiation. The FSRs were compared to FSLs to guide subsequent sampling decisions where appropriate. Neither gross alpha radiation nor beta/gamma radiation FSLs were exceeded.

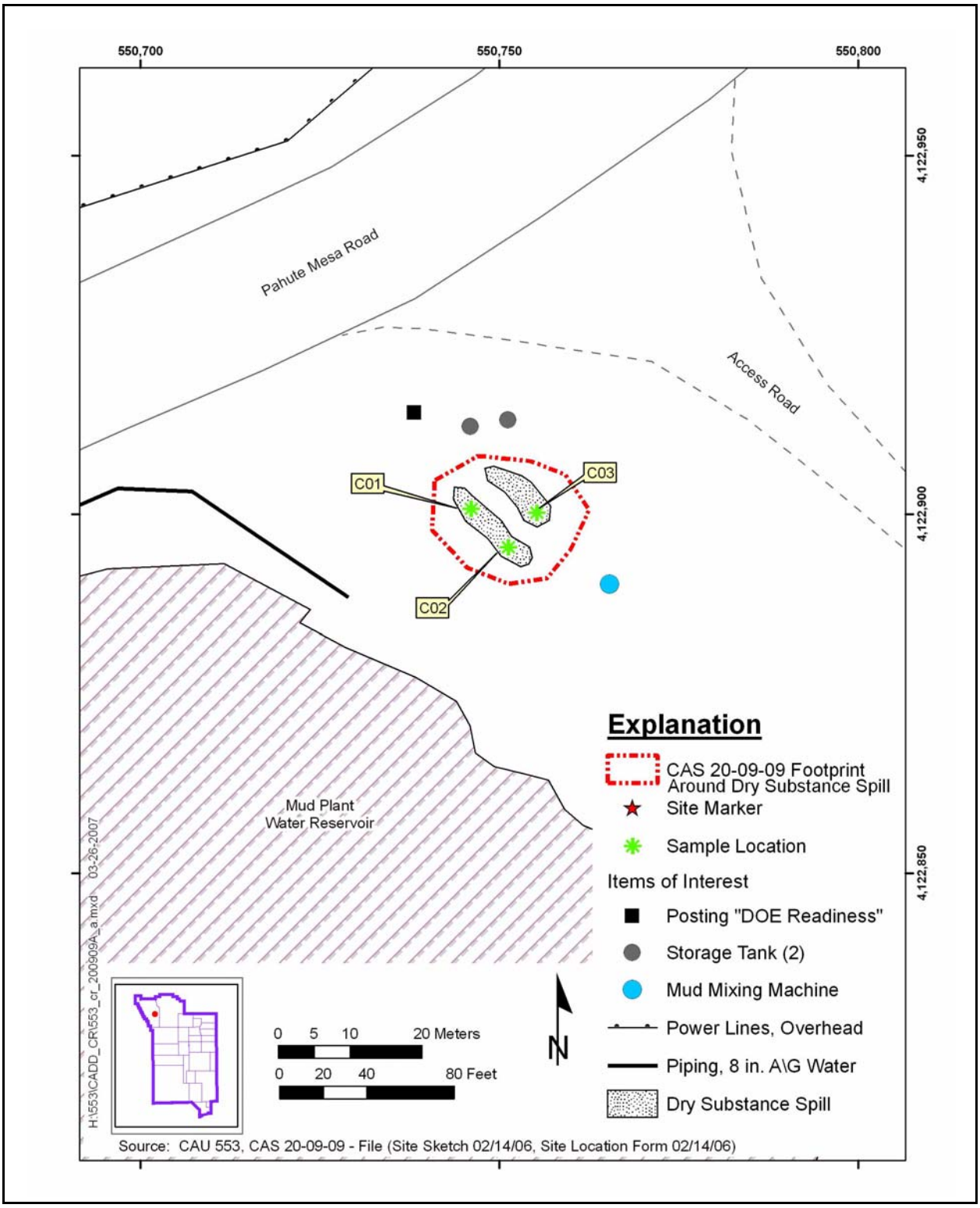

Figure D.5-1
Sample Locations at CAS 20-09-09, Mud Spill

D.5.1.2 Radiological Surveys

A radiological walkover survey was conducted on the area where the spilled mud is located at CAS 20-09-09. The survey identified no elevated radiological count rates in the surface soil (Figure D.5-1). No environmental samples were collected as a direct result of the walkover survey.

D.5.1.3 Visual Inspections

Features associated with the mud spill and identified within the CAS consisted of the location that appears to be where the spill is the thickest and near the edge of the spill where existing contaminants may have migrated. The final environmental feature identified was the soil below the spill where the bentonite had obviously been completely saturated. Some areas of the bentonite pile, even though it had been exposed to the elements for many years, was still a dry powder just below the surface. It is assumed that if contaminants were present within the CAS, the greatest likelihood would be at these locations; therefore, environmental samples were collected at these locations.

D.5.1.4 Sample Collection

Decision I environmental sampling activities included the collection of surface samples from location C01, where the pile of bentonite was the thickest and sample location C02, a location near the edge of the spill where any contaminants may have migrated. A final sample location, C03, was from soil below the pile where the bentonite had been completely saturated (Figure D.5-1).

One environmental sample was collected from each of the three locations identified in the CAU 553 SAFER Plan. In addition, an FD was collected at location C01, and a double volume for laboratory QC was collected from sample location C02.

D.5.1.5 Deviations

Investigation samples were collected as outlined in the CAU 553 SAFER Plan (NNSA/NSO, 2006a) and submitted for laboratory analysis. There were no deviations from the investigation as outlined in the SAFER Plan.

D.5.2 Investigation Results

The following sections provide analytical results from the samples collected to complete investigation activities as outlined in the CAU 553 SAFER Plan. Investigation samples were analyzed for the SAFER Plan-specified COPCs, which included VOCs, SVOCs, TPH-DRO, RCRA metals, gamma-emitting radionuclides, isotopic U, isotopic Pu, and Sr-90. The analytical parameters and laboratory methods used to analyze the investigation samples are listed in Table D.2-2. Table D.5-1 lists the sample-specific analytical suite for CAS 20-09-09.

Analytical results from the soil 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. The FALs were established as the corresponding PAL concentrations in cases where the contaminant concentrations were below their respective PALs. A discussion regarding the comparison of PALs and FALs is provided in Section D.2.4.

D.5.2.1 Volatile Organic Compounds

Analytical results for VOCs of environmental samples collected at this CAS that were detected above MDCs are presented in Table D.5-2. No VOCs were detected at concentrations exceeding their respective PALs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

D.5.2.2 Semivolatile Organic Compounds

Analytical results for SVOCs of environmental samples collected at this CAS detected no contaminants in concentrations greater than MDCs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

Table D.5-2
Sample Results for VOCs Detected Above Minimum Detectable Concentrations at CAS 20-09-09, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (µg/kg)	
			Acetone	Methylene Chloride
Final Action Levels[a]			**54,000,000**	**21.000**
C01	553C001	0.0 - 0.5	10 (J)	--
C02	553C002	0.0 - 0.5	--	2.1 (J)
C03	553C004	0.0 - 0.5	--	2 (J)

[a]Based on preliminary action levels established in the CAU 553 SAFER Plan.

bgs = Below ground surface
ft = Feet
µg/kg = Micrograms per kilogram
J = Estimated value
-- = Not detected above minimum detectable concentrations

D.5.2.3 RCRA Metals

The analytical results for *Resource Conservation and Recovery Act* (RCRA) metals for environmental samples collected that were detected above MDCs are presented in Table D.5-3. No metals were detected at concentrations exceeding PALs; therefore, the FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

Table D.5-3
Sample Results for Metals Detected Above Minimum Detectable Concentrations at CAS 20-09-09, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)			
			Arsenic	Barium	Chromium	Lead
Final Action Levels[a]			**23**	**67,000**	**450**	**800**
C01	553C001	0.0 - 0.5	2.73	159	0.41 (J)	27
C02	553C002	0.0 - 0.5	2.39	99.3	2.62	6.49
	553C003	0.0 - 0.5	1.93	84.7	2.13	4.85
C03	553C004	0.0 - 0.5	1.47	67.8	1.3	3.26

[a]Based on preliminary action levels established in the CAU 553 SAFER Plan.

bgs = Below ground surface
ft = Feet
mg/kg = Milligrams per kilogram
J = Estimated value

D.5.2.4 Total Petroleum Hydrocarbons

The TPH-DRO analytical results for soil samples collected at this CAS that were detected above MDCs are presented in Table D.5-4. No TPH-DRO was detected at concentrations exceeding the PAL. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

Table D.5-4
Sample Results for TPH-DRO Detected Above
Minimum Detectable Concentrations at CAS 20-09-09, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (mg/kg)
			Diesel-Range Organics
Preliminary Action Levels[a]			100
C02	553C002	0.0 - 0.5	13
	553C003	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 = Feet
mg/kg = Milligrams per kilogram

D.5.2.5 Gamma-Emitting Radionuclides

Gamma-emitting radionuclides analytical results for 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 respective PALs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

D.5.2.6 Plutonium, Strontium-90, and Uranium Isotopes

Isotopic U analytical results for environmental samples collected at this CAS that were detected above MDCs are presented in Table D.5-6. None of the isotopic Pu or Sr-90 concentrations exceeded the MDC. No isotopic U exceeded the PALs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

Table D.5-5
Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentrations at CAS 20-09-09, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)			
			Actinium-228	Lead-212	Lead-214	Thallium-208
Final Action Levels[a]			**5**	**5**	**5**	**5**
C01	553C001	0.0 - 0.5	3.827	4.371	3.581	3.228
C02	553C002	0.0 - 0.5	1.221	1.518	0.629	1.506
	553C003	0.0 - 0.5	1.195	1.421	0.761	1.06
C03	553C004	0.0 - 0.5	1.183	1.308	0.538	0.835

[a]Based on preliminary action levels established in the CAU 553 SAFER Plan.

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

Table D.5-6
Sample Results for Uranium Isotopes Detected Above Minimum Detectable Concentrations at CAS 20-09-09, Mud Spill

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**
C01	553C001	0.0 - 0.5	2.547	0.097	2.778
C02	553C002	0.0 - 0.5	0.678	0.047	0.76
	553C003	0.0 - 0.5	0.577	--	0.551
C03	553C004	0.0 - 0.5	0.547	0.046	0.556

[a]Based on preliminary action levels established in the CAU 553 SAFER Plan.

bgs = Below ground surface
ft = Feet
pCi/g = Picocuries per gram
-- = Not detected above minimum detectable concentrations

D.5.3 Nature and Extent of Contamination

Based on the analytical results for soil samples collected within CAS 20-09-09, no COCs were identified.

D.5.4 Revised Conceptual Site Model

The SAFER Plan requirements were met at this CAS and revisions to the CSM were not necessary.

D.6.0 CAS 20-99-03, Mud Spill Investigation Results

Corrective Action Site 20-99-03 is located in Area 20 of the NTS (Figure 1-2) south of the U-20aq crater area and consists of one continuous area of dried mud on the ground surface. Additional detail on site history and potential contaminants is provided in the CAU 553 SAFER Plan.

D.6.1 SAFER Activities

Five environmental samples (including 1 FD) were collected during investigation activities at CAS 20-99-03. The sample locations, IDs, 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 CAU 553 SAFER Plan requirements at this CAS are described in the following sections.

Table D.6-1
Samples Collected at CAS 20-99-03, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Matrix	Purpose	Analyses
D01	553D001	0.0 - 0.5	Soil	Environmental	Set 1
	553D002	0.0 - 0.5	Soil	Field Duplicate of #553D001	Set 1
D02	553D003	0.0 - 0.5	Soil	Environmental	Set 1
D03	553D004	0.0 - 0.5	Soil	Environmental, MS/MSD	Set 1
D04	553D005	0.0 - 0.5	Soil	Environmental	Set 1
N/A	553D301	N/A	Water	Field Blank	Set 1

Set 1 = VOCs, SVOCs, TPH-DRO, Gamma Spectroscopy, Isotopic Uranium, Isotopic Plutonium, Strontium-90

bgs = Below ground surface
DRO = Diesel-range organics
ft = Feet
MS/MSD = Matrix spike/matrix spike duplicate
N/A = Not applicable
TPH = Total petroleum hydrocarbons
SVOC = Semivolatile organic compound
VOC = Volatile organic compound

D.6.1.1 Field Screening

Investigation samples were field screened for alpha and beta/gamma radiation. The FSRs were compared to FSLs to guide subsequent sampling decisions where appropriate. Neither gross alpha nor beta/gamma radiation FSLs were exceeded.

D.6.1.2 Radiological Surveys

A radiological walkover survey was conducted on the area where the spilled mud is located at CAS 20-99-03. The survey identified no elevated radiological count rates in the surface soil (Figure D.6-1). No environmental samples were collected as a direct result of the walkover survey.

D.6.1.3 Visual Inspections

Features associated with the mud spill identified within the CAS consisted of locations that contain less vegetation than the surrounding areas; an area where the soil was darker than the surrounding soil; a small depression where it appears the mud may have pooled; and a location near the edge of the spill where liquids with fewer solids would have flowed. It is assumed that if contaminants were present within the CAS, the greatest likelihood would be at these locations; therefore, environmental samples were collected at these locations.

D.6.1.4 Sample Collection

Decision I environmental sampling activities included the collection of surface samples from sample location D01, a location where the soil was darker in color than the surrounding soil; D02, a location where less vegetation was present; D03, a small depression where it appears mud may have pooled; and D04, a location near the lower edge of the mud spill where liquids appear to have flowed after depositing much of the associated solids upstream.

One environmental sample was collected from each of the four locations discussed above. In addition, one FD and a double sample volume for laboratory QC were collected from sample locations D01 and D03, respectively.

D.6.1.5 Deviations

Investigation samples were collected as outlined in the CAU 553 SAFER Plan (NNSA/NSO, 2006a) and submitted for laboratory analysis. There were no deviations from the investigation as outlined in the SAFER Plan.

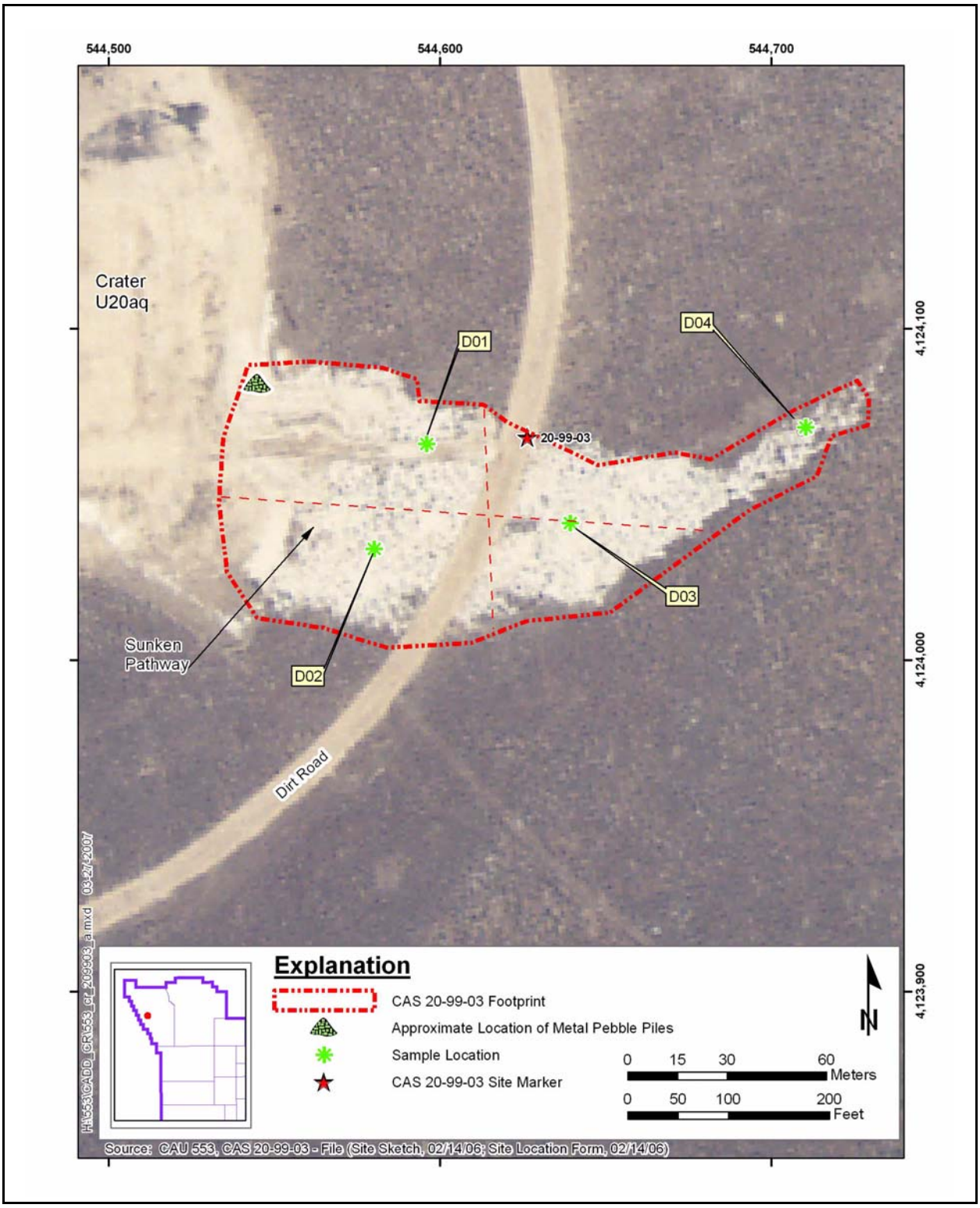

Figure D.6-1
Sample Locations at CAS 20-99-03, Mud Spill

D.6.2 Investigation Results

The following sections provide analytical results from the samples collected to complete investigation activities as outlined in the CAU 553 SAFER Plan. Investigation samples were analyzed for the SAFER Plan-specified COPCs, which included VOCs, SVOCs, TPH-DRO, gamma-emitting radionuclides, isotopic U, isotopic Pu, and Sr-90. 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 sample-specific analytical suite for CAS 20-99-03.

Analytical results from the soil 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. The FALs were established as the corresponding PAL concentrations in cases where the contaminant concentrations were below their respective PALs. A discussion regarding the comparison of PALs and FALs is provided in Section D.2.4.

D.6.2.1 Volatile Organic Compounds

Analytical results for VOCs of environmental samples collected at this CAS detected no contaminants in concentrations greater than MDCs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

D.6.2.2 Semivolatile Organic Compounds

Analytical results for SVOCs of environmental samples collected at this CAS detected no contaminants in concentrations greater than MDCs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

D.6.2.3 Total Petroleum Hydrocarbons

The TPH-DRO analytical results for soil samples collected at this CAS detected no concentrations above MDCs. The FALs were established as the PAL concentrations as determined in the SAFER Plan.

D.6.2.4 Gamma-Emitting Radionuclides

Gamma-emitting radionuclides analytical results for environmental samples collected at this CAS that were detected above MDCs are presented in Table D.6-2. No gamma-emitting radionuclides were detected at concentrations exceeding their respective PALs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

Table D.6-2
Sample Results for Gamma-Emitting Radionuclides Detected Above Minimum Detectable Concentrations at CAS 20-99-03, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)				
			Actinium-228	Lead-212	Lead-214	Thallium-208	Thorium-234
Final Action Levels[a]			**5**	**5**	**5**	**5**	**105**
D01	553D001	0.0 - 0.5	2.367	2.125	1.822	1.833	--
	553D002	0.0 - 0.5	1.935	2.12	1.599	1.685	--
D02	553D003	0.0 - 0.5	3.513	3.137	2.221	2.613	--
D03	553D004	0.0 - 0.5	2.874	3.355	2.153	2.487	--
D04	553D005	0.0 - 0.5	2.81	2.968	2.388	2.662	6.724

[a]Based on preliminary action levels established in the CAU 553 SAFER Plan.

bgs = Below ground surface
ft = Feet
pCi/g = Picocuries per gram
-- = Not detected above minimum detectable concentrations

D.6.2.5 Plutonium, Strontium-90, and Uranium Isotopes

Isotopic Pu and isotopic U analytical results for environmental samples collected at this CAS that were detected above MDCs are presented in Table D.6-3. None of the Sr-90 concentrations exceeded the MDC. No isotopic Pu or isotopic U exceeded the PALs. The FALs were established as the PAL concentrations as determined in the CAU 553 SAFER Plan.

Table D.6-3
Sample Results for Plutonium and Uranium Isotopes Detected Above Minimum Detectable Concentrations at CAS 20-99-03, Mud Spill

Sample Location	Sample Number	Depth (ft bgs)	Contaminants of Potential Concern (pCi/g)				
			Plutonium-238	Plutonium-239	Uranium-234	Uranium-235	Uranium-238
Final Action Levels[a]			**13**	**12.7**	**143**	**17.6**	**105**
D01	553D001	0.0 - 0.5	--	--	0.771	--	0.746
	553D002	0.0 - 0.5	--	--	0.777	0.053	0.756
D02	553D003	0.0 - 0.5	0.088	--	1.701	0.118	1.52
D03	553D004	0.0 - 0.5	--	--	1.621	0.102	1.518
D04	553D005	0.0 - 0.5	0.057	0.076	1.607	0.072	1.574

[a]Based on preliminary action levels established in the CAU 553 SAFER Plan.

bgs = Below ground surface
ft = Feet
pCi/g = Picocuries per gram
-- = Not detected above minimum detectable concentrations

D.6.3 Nature and Extent of Contamination

Based on the analytical results for soil samples collected within CAS 20-99-03, no COCs were identified.

D.6.4 Revised Conceptual Site Model

The CAU 553 SAFER Plan requirements were met at this CAS and revisions to the CSM were not necessary.

D.7.0 Waste Management

Section D.7.1 addresses IDW management, and Section D.7.2 addresses the management of various remediation waste streams.

D.7.1 Investigation-Derived Waste

During the field investigation activities of CAU 553, IDW was generated. The waste streams generated include disposable PPE and disposable sampling equipment. To the greatest extent possible, IDW was segregated 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, but the execution of planned potential decontamination activities was not necessary.

No hazardous waste accumulation areas or satellite accumulation areas were necessary or installed during this investigation.

D.7.1.1 Waste Streams

During the investigation, the following IDW was generated:

- Disposable PPE and sampling equipment

D.7.1.2 Waste Generated

One bag of waste containing PPE and sampling equipment was generated during the investigation. Office waste and lunch trash was disposed of in designated sanitary waste bins allocated for disposal at the NTS Area 23 Municipal and Industrial Solid Waste Landfill (NDEP, 1997a). Sanitary industrial waste was inspected and disposed of in designated sanitary industrial waste bins located at Building 23-153 and allocated for disposal at the NTS Area 9 U10c Industrial Waste Landfill (NDEP, 1997b).

D.7.2 Non-IDW Waste Characterization

Waste characterization samples of the bentonite at CAS 20-09-09 were collected in anticipation of collecting, containerizing, and disposing of the small piles of bentonite located at the CAS. The material was analyzed for VOCs, SVOCs, TPH-DRO, RCRA metals, gamma spectroscopy, isotopic U, isotopic Pu, and Sr-90. No contaminants were found to exist in concentrations greater than the landfill requirements. Therefore, this material is considered industrial waste and has been moved to Building 23-153 waiting disposal in the NTS Area 9 U10c Industrial Waste Landfill (NDEP, 1997b).

D.8.0 Quality Assurance

This section contains a summary of QA/QC measures implemented during the sampling and analysis activities conducted in support of the CAU 553 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 contained in the Industrial Sites QAPP (NNSA/NV, 2002).

D.8.1 Data Validation

Data validation was performed in accordance with the Industrial Sites QAPP and approved protocols and procedures. All laboratory data from samples collected and analyzed for CAU 553 were evaluated for data quality in a tiered process described in Sections D.8.1.1 through D.8.1.3. Data were reviewed to ensure that samples were appropriately processed and analyzed, and the results were evaluated using validation criteria. Documentation of the data qualifications resulting from these reviews is retained in project files as a hard copy and electronic media.

One hundred percent 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.8.1.1 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 stated in cover letter or case narrative.
- Completeness of certificates of analysis.

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

D.8.1.2 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 MSD percent recovery (%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.
- Re-calculation 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, 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.8.1.3 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 TechLaw, Inc., of Lakewood, 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:

- QC sample results (e.g., calibration source concentration, percent recovery, 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.8.2 Field Quality Control Samples

Field QC samples consisted of 2 trip blanks, 4 field blanks, 1 source blanks, 4 QC (MS/MSDs), and 4 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 laboratory duplicates.

Review of the field blank analytical data resulted in no samples being qualified due to possible field blank contamination. Field blanks were analyzed for the applicable parameters listed in Table D.2-2 and trip blanks were analyzed for VOCs only.

During the CAI, 4 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.8.2.1 Laboratory Quality Control Samples

Analysis of method QC blanks were performed on each sample delivery group (SDG) for inorganics. Analysis for surrogate spikes and preparation blanks (PBs) were performed on each SDG for organics only. Initial and continuing calibration and LCSs were performed for each SDG. The results of these analyses were used to qualify associated environmental sample results. Documentation of data qualifications resulting from the application of these guidelines is retained in project files as both hard copy and electronic media.

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

D.8.3 Field Nonconformances

There were no field nonconformances identified during SAFER activities.

D.8.4 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. No nonconformances were issued by the laboratories.

D.9.0 Summary

Organic, inorganic and radionuclide constituents detected in environmental samples during the CAI were evaluated against FALs to determine the nature and extent of COCs for CAU 553. Assessment of the data generated from investigation activities indicates the FALs were not exceeded in any of the samples collected and no COCs were identified at any of the four CAS. Therefore, no further action is required.

Based on the observations made, the surveys conducted, and the analytical results of the environmental samples collected at these CASs, no contamination is present.

D.10.0 References

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Appendix E

Waste Disposition Documentation

This section does not apply to CAU 553.

Appendix F

Modifications to the Post-Closure Plan

This section does not apply to CAU 553.

Appendix G

Use Restrictions

This section does not apply to CAU 553.

Appendix H

Risk Evaluation

H.1.0 Introduction

The RBCA process used to establish FALs is described in the *Industrial Sites Project Establishment of Final Action Levels* (NNSA/NSO, 2006a). This process conforms with NAC Section 445A.227 (NAC, 2006a) that lists the requirements for sites with soil contamination. For the evaluation of corrective actions, NAC Section 445A.22705 (NAC, 2006b) requires the use of ASTM Method E 1739-95 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" (ASTM, 1995).

The presence of a COC would require a corrective action. A corrective action may also be necessary if there is a potential for wastes that are 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:

- Contaminants, if present, are at their greatest concentration in the spilled mud.
- If contamination is present in the spilled mud, the resulting concentration of contaminants in the surrounding soils may be equal to the concentration of contaminants in the spilled mud.
- If the spilled mud contains no contaminants in concentrations greater than FALs, then the soil surrounding the spilled mud can contain no contaminants in concentrations greater than FALs from the spilled mud.

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

H.1.1 A. Scenario

Corrective Action Unit 553, Areas 19, 20 Mud Pits and Cellars, consists of the following four inactive CASs within Areas 19 and 20 of the NTS:

- 19-99-01, Mud Spill
- 19-99-11, Mud Spill
- 20-09-09, Mud Spill
- 20-99-03, Mud Spill

All four CASs consist of mud spills that occurred during drilling activities conducted at the NTS in support of the underground nuclear weapons testing.

H.1.2 B. Site Assessment

The CAU 553 SAFER Plan at all CASs involved visual inspections through walkover surveys and application of process knowledge and previous site investigation results from similar CASs in CAUs 530-535 and CAU 177. Applying process knowledge, the assumptions and results from previous mud pit investigation, is expected to result in no required activity at these CASs (NNSA/NSO, 2006c).

The maximum concentration of contaminants identified at each CAS, and their corresponding PALs are presented in Tables H.1-1 through H.1-4.

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.

Table H.1-1
Maximum Concentration of Contaminants from Samples Collected at CAS 19-99-01, Mud Spill

Constituent	Max Result	Sample Number	Depth (ft bgs)	Location	FAL	Units
Actinium-228	3.555	553A003	0 - 0.5	A02	5	pCi/g
Lead-212	3.548	553A001	0 - 0.5	A01	5	pCi/g
Lead-214	2.267	553A003	0 - 0.5	A02	5	pCi/g
Methylene Chloride	0.0025 (J)	553A001	0 - 0.5	A01	21	mg/kg
Plutonium-238	0.095	553A003	0 - 0.5	A02	13	pCi/g
Plutonium-239/240	0.031	553A002	0 - 0.5	A01	12.7	pCi/g
Thallium-208	2.990	553A001	0 - 0.5	A01	5	pCi/g
Uranium-234	1.734	553A002	0 - 0.5	A01	143	pCi/g
Uranium-235	0.1	553A003	0 - 0.5	A02	17.6	pCi/g
Uranium-238	1.739	553A001	0 - 0.5	A01	105	pCi/g

bgs = Below ground surface
FAL = Final action level
ft = Feet
pCi/g = picocuries per gram
J = Estimated value

Table H.1-2
Maximum Concentration of Contaminants from Samples Collected at CAS 19-99-11, Mud Spill
(Page 1 of 2)

Constituent	Max Result	Sample Number	Depth (ft bgs)	Location	FAL	Units
Actinium-228	5.052	553B005	0 - 0.5	B04	6.029	pCi/g
TPH-DRO	10 (J)	553B005	0 - 0.5	B04	100	mg/kg
TPH-DRO	10 (J)	553B004	0 - 0.5	B03	100	mg/kg
Lead-212	5.352	553B005	0 - 0.5	B04	6.029	pCi/g
Lead 214	4.392	553B005	0 - 0.5	B04	5	pCi/g
Methylene Chloride	0.0026 (J)	553B003	0 - 0.5	B02	21	mg/kg
Thallium-208	4.307	553B005	0 - 0.5	B05	5	pCi/g
Uranium-234	2.87	553B005	0 - 0.5	B04	143	pCi/g
Uranium-235	0.161	553B005	0 - 0.5	B04	17.6	pCi/g

Table H.1-2
Maximum Concentration of Contaminants from Samples Collected at CAS 19-99-11, Mud Spill
(Page 2 of 2)

Constituent	Max Result	Sample Number	Depth (ft bgs)	Location	FAL	Units
Uranium-238	2.888	553B005	0 - 0.5	B05	105	pCi/g

bgs = Below ground surface
DRO = Diesel-range organics
FAL = Final action level
ft = Feet
mg/kg = Milligrams per kilogram
pCi/g = Picocuries per gram
TPH = Total petroleum hydrocarbons
J = Estimated value

Table H.1-3
Maximum Concentration of Contaminants from Samples Collected at CAS 20-09-09, Mud Spill

Constituent	Max Result	Sample Number	Depth (ft bgs)	Location	FAL	Units
Acetone	0.01 (J)	553C001	0 - 0.5	C01	54,000	mg/kg
Actinium-228	3.827	553C001	0 - 0.5	C01	5	pCi/g
Arsenic	2.73	553C001	0 - 0.5	C01	23	mg/kg
Barium	159	553C001	0 - 0.5	C01	67,000	mg/kg
Chromium	2.62	553C002	0 - 0.5	C02	450	mg/kg
TPH-DRO	14	553C003	0 - 0.5	C02	100	mg/kg
Lead	27	553C001	0 - 0.5	C01	800	mg/kg
Lead-212	4.371	553C001	0 - 0.5	C01	5	pCi/g
Lead-214	3.581	553C001	0 - 0.5	C01	5	pCi/g
Methylene Chloride	0.0021 (J)	553C002	0 - 0.5	C02	21	mg/kg
Thallium-208	3.228	553C001	0 - 0.5	C01	5	pCi/g
Uranium-234	2.547	553C001	0 - 0.5	C01	143	pCi/g
Uranium-235	0.097	553C001	0 - 0.5	C01	17.6	pCi/g
Uranium-238	2.778	553C001	0 - 0.5	C01	105	pCi/g

bgs = Below ground surface
DRO = Diesel-range organics
FAL = Final action level
ft = Feet
mg/kg = Milligrams per kilogram
pCi/g = Picocuries per gram
TPH = Total petroleum hydrocarbons
J = Estimated value

Table H.1-4
Maximum Concentration of Contaminants from Samples Collected at CAS 20-99-03, Mud Spill

Constituent	Max Result	Sample Number	Depth (ft bgs)	Location	FAL	Units
Actinium-228	3.513	553D003	0 - 0.5	D02	5	pCi/g
Lead-212	3.355	553D004	0 - 0.5	D03	5	pCi/g
Lead-214	2.388	553D005	0 - 0.5	D04	5	pCi/g
Plutonium-238	0.088	553D003	0 - 0.5	D02	13	pCi/g
Plutonium-239/240	0.076	553D005	0 - 0.5	D04	12.7	pCi/g
Thallium-208	2.662	553D005	0 - 0.5	D04	5	pCi/g
Thorium-234	6.724	553D005	0 - 0.5	D04	105	pCi/g
Uranium-234	1.701	553D003	0 - 0.5	D02	143	pCi/g
Uranium-235	0.118	553D003	0 - 0.5	D02	17.6	pCi/g
Uranium-238	1.574	553D005	0 - 0.5	D04	105	pCi/g

bgs = Below ground surface
FAL = Final action level
ft = Feet
pCi/g = Picocuries per gram

Based on the CAU 553 SAFER Plan, the CASs pose no immediate threat to human health, safety, and the environment; therefore, no interim response actions are necessary (NNSA/NSO, 2006c). Based on this information, all four CASs are determined to be Classification 4 sites as defined by ASTM Method E 1739-95 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 RBSLs have been defined as the PALs established during the DQO process. The PALs are a tabulation of chemical-specific (but not site-specific) screening levels based on the type of media (soil) and potential exposure scenarios (industrial). These are very conservative risk estimates, are preliminary in nature, and used as action levels for site screening purposes. The analytical results for Ac-228 and Pb-212 at CAS 19-99-11 exceeded the generic PALs of 5 pCi/g. The PALs were re-calculated for an industrial scenario using RESRAD and established at 6.029 pCi/g for both Ac-228 and Pb-212. 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 final action level is practical. The PALs are defined as:

- Region 9 Risk-Based PRGs (EPA, 2006).
- Background concentrations for RCRA metals will be evaluated when natural background exceeds the PAL, as is often the case with arsenic. Background is considered the mean plus two times the standard deviation indicative of the mean redundant based on data published in Mineral and Energy Resource Assessment of the Nellis Air Force Range (NBMG, 1998; Moore, 1999).
- TPH concentrations above the action level of 100 mg/kg per NAC 445A.2272 (NAC, 2006c).
- For COPCs without established PRGs, a protocol similar to EPA Region 9 will be used to establish an action level; otherwise, an established PRG from another EPA region may be chosen.
- The PALs for material, equipment, and structures with residual surface contamination are the allowable total residual surface contamination values for unrestricted release of material and equipment listed in the DOE Order 5400.5 (DOE, 1993), which is also Table 4-2 of the NV/YMP RadCon Manual (NNSA/NSO, 2006c).
- The PALs for radioactive contaminants 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 dose constraint (Appenzeller-Wing, 2004) and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993).

The PALs were developed based on an industrial scenario. Because the CAU 553 CASs 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 CAU 553 SAFER Plan.

H.1.5 E. Exposure Pathway Evaluation

The DQOs stated that site workers would only be exposed to COCs through oral ingestion, inhalation, or dermal contact (absorption) due to exposure to potentially contaminated media (i.e., soil) at the CASs. The results of the CAU 553 SAFER Plan showed that no COCs were identified at any CAU 553 CASs are localized near the release point and have not migrated more than 15 ft vertically or laterally. 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 to be a significant exposure pathway (NNSA/NSO, 2006c).

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

All analytical results from CAU 553 samples were less than corresponding Tier 1 action levels (i.e., PALs).

H.1.7 G. Evaluation of Tier 1 Results

For all contaminants at all CASs, the FALs were established as the Tier 1 RBSLs. It was determined that no further action is required 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

A Tier 2 evaluation was not necessary.

H.2.0 Recommendations

As all of the site contaminant concentrations in soils from the analysis of CAU 553 samples were less than the corresponding FALs at all locations, it was determined that contamination at these locations poses no risk to human health, safety, or the environment and, therefore, do not warrant corrective actions. However, this does not preclude the consideration of these sites for additional protective measures that may be implemented as best management practices (i.e., removal of spilled mud in roadway at CAS 20-09-09).

H.3.0 References

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U.S. Environmental Protection Agency. 2006 (as revised). *Region 9 Preliminary Remediation Goals (PRGs).* As accessed at www.epa.gov/region09/waste/sfund/prg/htm on 4 March.

Appendix I

Global Positioning System Data Points

I.1.0 Global Positioning System Data Points

Sample location coordinates for the CAI sampling were determined using a Trimble 5800 GPS Unit with centimeter-level accuracy. These coordinates identify the CAU 553 sampling locations (easting and northing positions) and ground surface elevations at CAU 553.

Sample locations are shown in Appendix D, while the corresponding coordinates for CAU 553 locations are listed in Table I.1-1.

Table I.1-1
Sample Location Coordinates for CAU 553

Easting	Northing	Height	Location
CAS 19-99-01			
557215.8	4125263.7	2037.4	A01
557218.0	4125260.7	2037.5	A02
CAS 19-99-11			
556375.8	4125969.1	2046.4	B01
556380.8	4125965.3	2046.4	B02
556374.3	4125964.2	2049.8	B03
556378.2	4125952.3	2048.3	B04
CAS 20-09-09			
550762.5	4122901.3	1964.1	C01
550763.9	4122900.1	1967.3	C02
550766.0	4122901.1	1970.6	C03
CAS 20-99-03			
544595.9	4124065.2	1867.1	D01
544580.0	4124033.6	1868.2	D02
544639.2	4124041.3	1866.5	D03
544684.5	4124054.7	1865.7	D04

Appendix J

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 553: Areas 19, 20 Mud Pits and Cellars, Nevada Test Site, Nevada	**2. Document Date:** 07/09/2007
3. Revision Number: 0	**4. Originator/Organization:** Stoller-Navarro
5. Responsible NNSA/NV ERP Project Manager: Kevin Cabble	**6. Date Comments Due:** 08/02/2007
7. Review Criteria: Full	
8. Reviewer/Organization/Phone No: Don Elle, NDEP, 486-2850	**9. Reviewer's Signature:**

10. Comment Number/Location	11. Type*	12. Comment	13. Comment Response	14. Accept
1.) Section 4.1.1.1.1, Page 20 of 26 1st Paragraph, 1st Sentence	Mandatory	The word 'dateable' should be replaced with 'detectable'.	The word 'dateable' has been changed to 'detectable'.	
2.) Section 4.1.5.1, Page 22 of 26, 1st Bullet Point	Mandatory	The term 'FAFL' should be replaced with 'FAL'.	FAFL has been changed to FAL.	
3.) Appendix D, Sample Results Tables, General Comment	Mandatory	Please review the sample results, and verify that the number of significant figures reported is appropriate for comparison with the Final Action Levels for each CAS.	The data has been reviewed and the number of significant figures is appropriate for the comarison with the FALs. In addition, SNJV is in the process of reviewing all the reporting limits and trying to adjust the reporting to match the significan figures typically listed for each PAL or FAL.	

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