RECORD OF TECHNICAL CHANGE

Technical Change No. 1 Page 1 of 3

Project/Job No. DP04 050 Date 3/10/04

Project/Job Name Corrective Action Investigation Plan for CAU 536: Area 3 Release Site

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

Laura Pastor (Name) Task Manager (Title)

Description of Change

1. **Section 3.3 Preliminary Action Levels**. Change the 5th bullet in the section to the following:

- "The PALs for radiological contaminants are based on the National Council on Radiation Protection and Measurement (NCRP) Report No. 129 recommended screening limits for construction, commercial, industrial land use scenario (NCRP 1999) scaled from 25 to 15 millirem (mrem) per year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). The PALs for the CAU 536 Corrective Action Investigation (CAI) are listed in Table 3-3."

- Replace Table 3-3 with the new Table 3-3 attached.

2. **Section A.1.4.2 Determine the Basis for the Preliminary Action Levels**. Change the 5th bullet to the following:

- "The PALs for radiological contaminants are based on the National Council on Radiation Protection and Measurement (NCRP) Report No. 129 recommended screening limits for construction, commercial, industrial land use scenario (NCRP 1999) scaled from 25 to 15 millirem (mrem) per year dose and the generic guidelines for residual concentration of radionuclides in DOE Order 5400.5 (DOE, 1993). The PALs for the CAU 536 CAI are listed in Table 3-3."

Eliminate Potassium-40 as a radionuclide COPC within the Gamma Spectrometry analysis.

3. **Sections 8.0 and A.1.9 References.** Add the following references:

- National Council on Radiation Protection and Measurements. 1999. *Recommended Screening Limits for Contaminated Surface Soil and Review of Factors Relevant to Site-Specific Studies*. NCRP Report No. 129. National Council on Radiation Protection and Measurements, Bethesda, MD.

- US Department of Energy (DOE). 1993. "Radiation Protection of the Public and the Environment". DOE Order 5400.5 Change 2. January 7, 1993.

Justification for change

Through ongoing discussions between DOE and NDEP it was determined that the PALs currently being used for the site investigations are not practical and should be replaced with dose-based action levels. In an agreement between NDEP and DOE (approved March 9, 2004) the PALs to be used for evaluating the potential radioactive contamination in soils will be based on an acceptable dose as specified by the NCRP Report No. 129 and DOE 5400.5 guidance rather than a comparison to background values. The use of the new radiological PALs has been accepted and approved for use in the planning and evaluation phase of the site investigations.

Potassium-40 (K-40) is a naturally occurring unstable isotope of potassium with a half-life of 1.3 x 10E+09 years. The abundance of K-40 is approximately 0.0118% of natural potassium. Because of the high abundance of potassium in the environment, K-40 is the predominant radionuclide in soil, foods, and human tissues. The average human male contains approximately 100,000 pCi of K-40. The human body strictly regulates the potassium content within the body and is not influenced by variations in environmental levels. Therefore, the internal dose from K-40 remains constant.

Potassium-40 is not considered to be a contaminant of potential concern due to its predominance in the environment. In addition, the only mechanism for K-40 to be a contaminant is through concentration.

There are no reported activities at the NTS that would have concentrated K-40 or released it as a contaminant.

The CAI will not be expanded to delineate the extent of K-40, nor will K-40 be evaluated in the Corrective Action Decision Document.

The project time will be (Increased)(Decreased)(**Unchanged**) by approximately 0 days.

Applicable Project-Specific Document(s): **Corrective Action Investigation Plan for Corrective Action Unit 536: Area 3 Release Site Nevada Test Site, Nevada, Revision 0, April 2003.**

CC:

Approved By: Kevin Cabble Date 3-15-04
Kevin Cabble, Acting Project Manager
Industrial Sites Project

Date 3/15/04
Janet Appenzeller-Wing, Acting Division Director
Environmental Restoration Division

NDEP Concurrence Yes__ No__ Date ________

NDEP Signature ________

Contract Change Order Required Yes__ No__

Contract Change Order No. ________

There are no reported activities at the NTS that would have concentrated K-40 or released it as a contaminant.

The CAI will not be expanded to delineate the extent of K-40, nor will K-40 be evaluated in the Corrective Action Decision Document.

The project time will be (Increased)(Decreased)[✓ (Unchanged)] by approximately 0 days.

Applicable Project-Specific Document(s): Corrective Action Investigation Plan for Corrective Action Unit 536: Area 3 Release Site Nevada Test Site, Nevada, Revision 0, April 2003.

CC:

Approved By: ____________________ Date 3-15-04
Kevin Cabble, Acting Project Manager
Industrial Sites Project

____________________ Date 3/15/04
Janet Appenzeller-Wing, Acting Division Director
Environmental Restoration Division

NDEP Concurrence [✓ Yes] No __ Date 3/19/04
NDEP Signature ____________________
Contract Change Order Required Yes__ No ____
Contract Change Order No. ____________________

Table 3-3
Preliminary Action Levels for Radionuclides in Samples Collected at CAU 536

Radionuclide	PAL (pCi/g)[a]
Americium-241	7.62E+00
Europium-155	8.11E+01
Uranium-234	8.59E+01
Uranium-235	1.05E+01
Uranium-238	6.32E+01
Plutonium-238	7.78E+00
Plutonium-239	7.62E+00
Plutonium-240	7.62E+00
Strontium-90	5.03E+02
Cesium-137	7.30E+00
Cobalt-60	1.61E+00

[a] pCi/g is Picocuries per gram

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Environmental
Restoration
Project

DOE/NV--900

National Nuclear Security Administration

Corrective Action Investigation Plan for Corrective Action Unit 536: Area 3 Release Site Nevada Test Site, Nevada

Controlled Copy No.: ___
Revision No.: 0

June 2003

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Environmental Restoration
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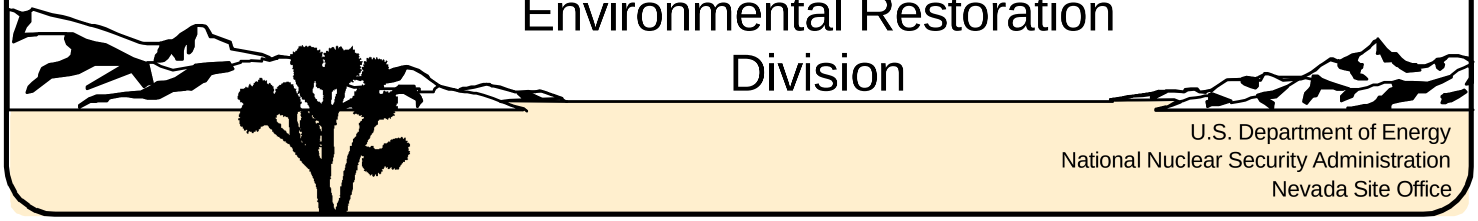


U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office

DOE/NV--900

CORRECTIVE ACTION INVESTIGATION PLAN FOR CORRECTIVE ACTION UNIT 536: AREA 3 RELEASE SITE NEVADA TEST SITE, NEVADA

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

Controlled Copy No.: ___

Revision No.: 0

June 2003

CORRECTIVE ACTION INVESTIGATION PLAN
FOR CORRECTIVE ACTION UNIT 536:
AREA 3 RELEASE SITE
NEVADA TEST SITE, NEVADA

Approved by: Signature Approved Date: 6/23/03

Janet Appenzeller-Wing, Project Manager
Industrial Sites Project

Approved by: Signature Approved Date: 6/23/03

Runore C. Wycoff, Division Director
Environmental Restoration Division

Table of Contents

Table of Contents *(Continued)*

Table of Contents *(Continued)*

List of Figures

Number ***Title*** ***Page***

List of Tables

List of Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
bgs	Below ground surface
BN	Bechtel Nevada
CADD	Corrective Action Decision Document
CAI	Corrective action investigation
CAIP	Corrective Action Investigation Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CFR	*Code of Federal Regulations*
CLP	Contract Laboratory Program
COC	Contaminant of concern
COPC	Contaminant of potential concern
CRDL	Contract-required detection limit
CRQL	Contract-required quantitation limit
CSM	Conceptual site model
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQI	Data quality indicator
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
FADL	Field activity daily log
FFACO	*Federal Facility Agreement and Consent Order*

List of Acronyms and Abbreviations *(Continued)*

FSL	Field-screening level
ft	Foot (feet)
HWAA	Hazardous waste accumulation area
IDW	Investigation-derived waste
in.	Inch(es)
IRIS	Integrated Risk Information System
ISMS	Integrated Safety Management System
LCS	Laboratory control sample
LLW	Low-level radioactive waste
mi	Mile
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MOSA	Methods of Soil Analysis
MRL	Minimum reporting limit
MS	Matrix spike
MSD	Matrix spike duplicate
NAC	*Nevada Administrative Code*
ND	Normalized difference
NDEP	Nevada Division of Environmental Protection
NEPA	*National Environmental Policy Act*
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NTS	Nevada Test Site
NTSWAC	*Nevada Test Site Waste Acceptance Criteria*

List of Acronyms and Abbreviations *(Continued)*

PAL	Preliminary action level
PCB	Polychlorinated biphenyl
pCi/g	Picocuries per gram
pCi/L	Picocuries per liter
PID	Photoionization Detector
PPE	Personal protective equipment
ppm	Parts per million
PRG	Preliminary remediation goal
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RCA	Radiologically controlled area
RCRA	*Resource Conservation and Recovery Act*
RMA	Radioactive materials area
ROTC	Record of Technical Change
RPD	Relative percent difference
RWMS	Radioactive Waste Management Site
SAA	Satellite accumulation area
SDWS	*Safe Drinking Water Standard*
SSHASP	Site-specific health and safety plan
SVOC	Semivolatile organic compound
TPH	Total petroleum hydrocarbon
TSCA	*Toxic Substances Control Act*
USACE	U.S. Army Corps of Engineers

List of Acronyms and Abbreviations *(Continued)*

VOC	Volatile organic compound
%R	Percent recovery
μg/L	Micrograms per liter

Executive Summary

This Corrective Action Investigation Plan contains information for conducting site investigation activities at Corrective Action Unit 536, Area 3 Release Site. This information includes facility descriptions, and environmental sample collection objectives and criteria. The results of the field investigation will support a defensible evaluation of viable corrective action alternatives that will be presented in the Corrective Action Decision Document.

Corrective Action Unit 536 is comprised of a single Corrective Action Site 03-44-02, Steam Jenny Discharge. The corrective action site is located in Area 3 of the Nevada Test Site, which is approximately 65 miles northwest of Las Vegas, Nevada.

Two conceptual site models (CSMs) were developed to address releases associated with the CAS. The first CSM represents the release mechanisms and migration pathways for contamination before the construction of the concrete pad. The second CSM addresses the release mechanisms and migration pathways for contamination after the construction of the concrete pad.

The data quality objective (DQO) process was used to identify and define the type, quantity, and quality of data needed to complete the investigation phase of the corrective action process. The DQOs address the primary problem that sufficient information was not available to determine the appropriate corrective action for the site. To be able to determine the corrective action alternative, two critical decisions were defined:

1. Does contamination from any of the releases exceed preliminary action levels?
2. Is the extent of contamination above action levels sufficiently delineated to determine the most effective corrective action?

For the purpose of determining distinct data needs, resolution of the first decision is addressed as Phase I and resolution of the second decision is addressed as Phase II. Phase I data will be generated and evaluated to determine if contaminants of potential concern are present at concentrations that exceed the preliminary action levels (PALs). Phase II data will be generated if at least one contaminant is detected at concentrations exceeding PALs to determine the extent of contamination.

Corrective action closure alternatives (i.e., no further action, closure in place, or clean closure) will be recommended based on an evaluation of all the DQO-required data.

Based on existing data and process knowledge, the contaminants of potential concern for Corrective Action Unit 536 include semivolatile organics, volatile organics, petroleum hydrocarbons, polychlorinated biphenyls, metals, and radionuclides.

The general technical approach for investigation of Corrective Action Unit 536 will consist of the following activities:

- Perform radiological surveys.
- Collect environmental soil samples and submit for laboratory analysis to determine if contaminants of concern are present or migrating. In general, field activities will consist of collecting soil samples at biased locations according to approved procedures.
- Collect required quality control samples.
- Collect additional environmental soil samples to define the lateral and vertical extent of contaminants of concern, if necessary.
- Collect data necessary to manage and dispose of investigation derived waste and for future waste management decisions.

This Corrective Action Investigation Plan (CAIP) has been developed in accordance with the *Federal Facility Agreement and Consent Order* (1996) that was agreed to by the State of Nevada, the U.S. Department of Energy, and the U.S. Department of Defense. Under the *Federal Facility Agreement and Consent Order* (1996), this CAIP will be submitted to the Nevada Division of Environmental Protection for approval. Fieldwork will be conducted following approval of this plan.

1.0 Introduction

This Corrective Action Investigation Plan (CAIP) contains project-specific information including facility descriptions, environmental sample collection objectives, and criteria for conducting site investigation activities at Corrective Action Unit (CAU) 536: Area 3 Release Site, Nevada Test Site (NTS), Nevada.

This CAIP has been developed in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) (1996) that was agreed to by the U.S. Department of Energy (DOE), the State of Nevada, and the U.S. Department of Defense (DoD).

The NTS is approximately 65 miles (mi) northwest of Las Vegas, Nevada (Figure 1-1). Corrective Action Unit 536 is comprised of the Corrective Action Site (CAS) shown on Figure 1-2 and listed below:

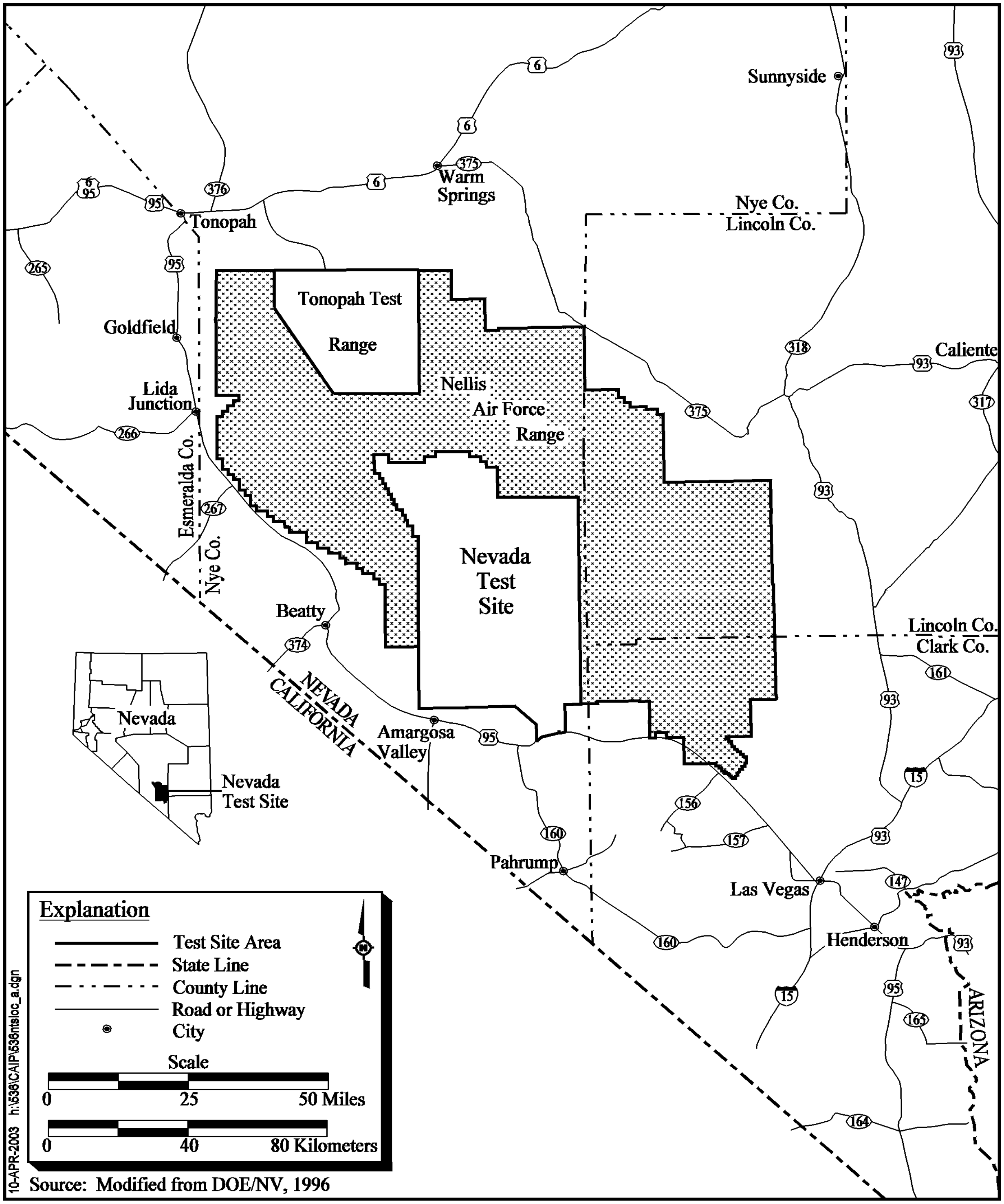
- 03-44-02, Steam Jenny Discharge

Corrective Action Unit 536 is being investigated because existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives for CAS 03-44-02. Therefore, additional information will be obtained by conducting a corrective action investigation (CAI) prior to evaluating corrective action alternatives and selecting the appropriate corrective action for this CAS. The CAI will include field inspections, radiological surveys, and media sampling, where appropriate. Data will also be obtained to support investigation-derived waste (IDW) disposal and potential future waste management decisions.

1.1 Purpose

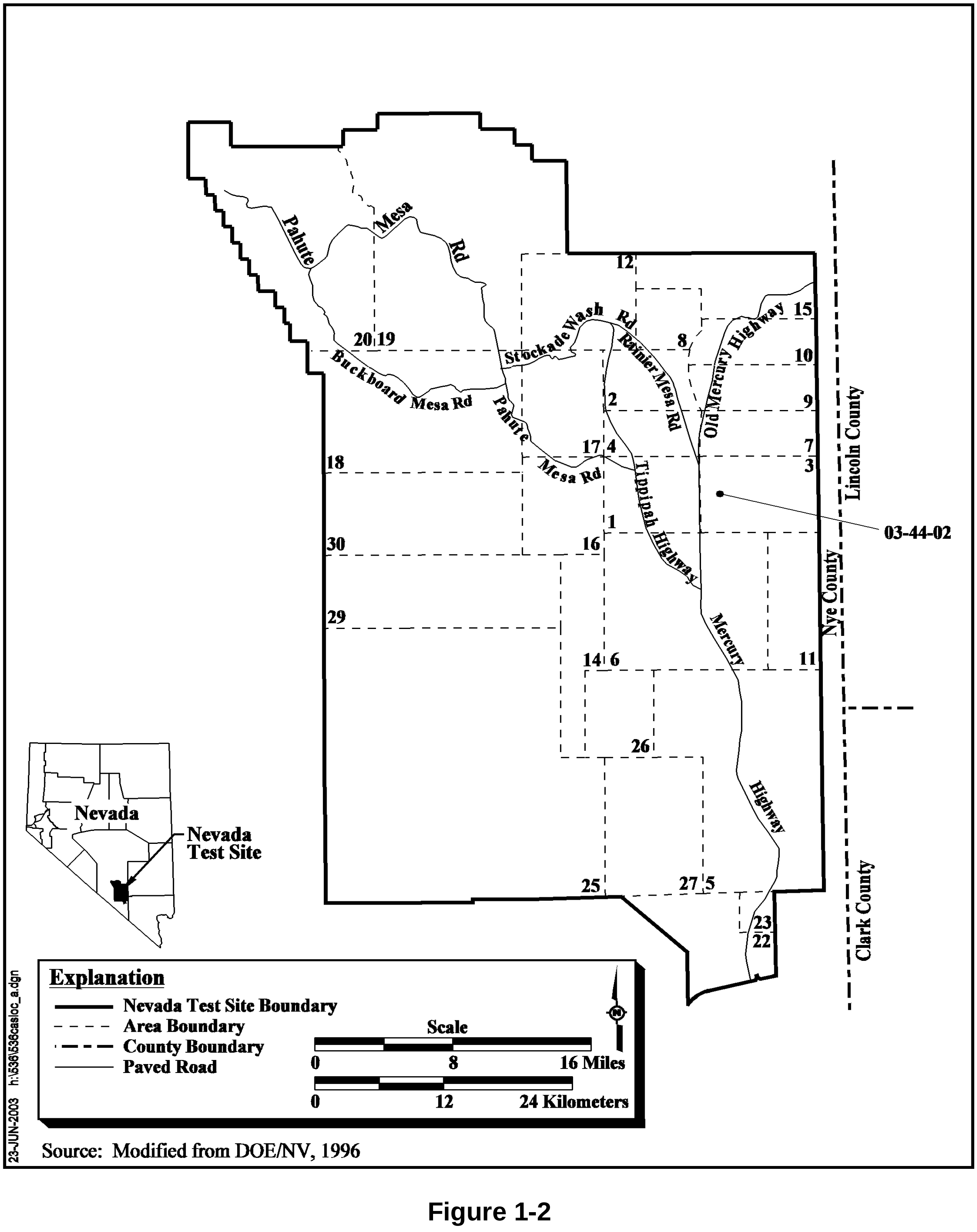
Corrective Action Site 03-44-02 is being investigated because hazardous and/or radioactive constituents may be present at concentrations that could potentially pose a threat to human health and/or the environment.

This CAI will be conducted following the data quality objectives (DQOs) developed by representatives of the Nevada Division of Environmental Protection (NDEP) and the DOE National Nuclear Security Administration Nevada Site Office (NNSA/NSO). The DQOs are used to identify



Source: Modified from DOE/NV, 1996

Figure 1-1
Nevada Test Site Location Map



Source: Modified from DOE/NV, 1996

Figure 1-2
CAS 03-44-02, Steam Jenny Discharge Location Map

and define the type, amount, and quality of data needed to develop and evaluate appropriate corrective actions for CAU 536, Area 3 Release Site.

The primary problem statement for the investigation is, “Existing information and data concerning the nature and extent of contamination potentially released from CAS 03-44-02 are insufficient to determine if there is an unacceptable risk to human health or the environment. If contamination is present at concentrations greater than the preliminary action levels (PALs), data are also insufficient to evaluate appropriate corrective actions.” To address this problem statement, the resolution of two decisions statements is required:

- Decision I is, “Define the nature of contamination” by identifying any contamination above PALs. Samples must be collected from areas most likely to contain contamination due to decontamination activities associated with the facility, and parameters must be selected that represent the types of potential contamination present. If PALs are not exceeded, the investigation is complete. If PALs are exceeded, then Decision II must be resolved.

- Decision II is, “Determine the extent of contamination identified above PALs.” This decision will be achieved by the collection of data that are adequate to define the extent of contaminants of concern (COCs).

Most of the data will be generated from the analysis of environmental samples collected during the CAI. The general purpose of the investigation is to:

- Identify the presence and nature of COCs.

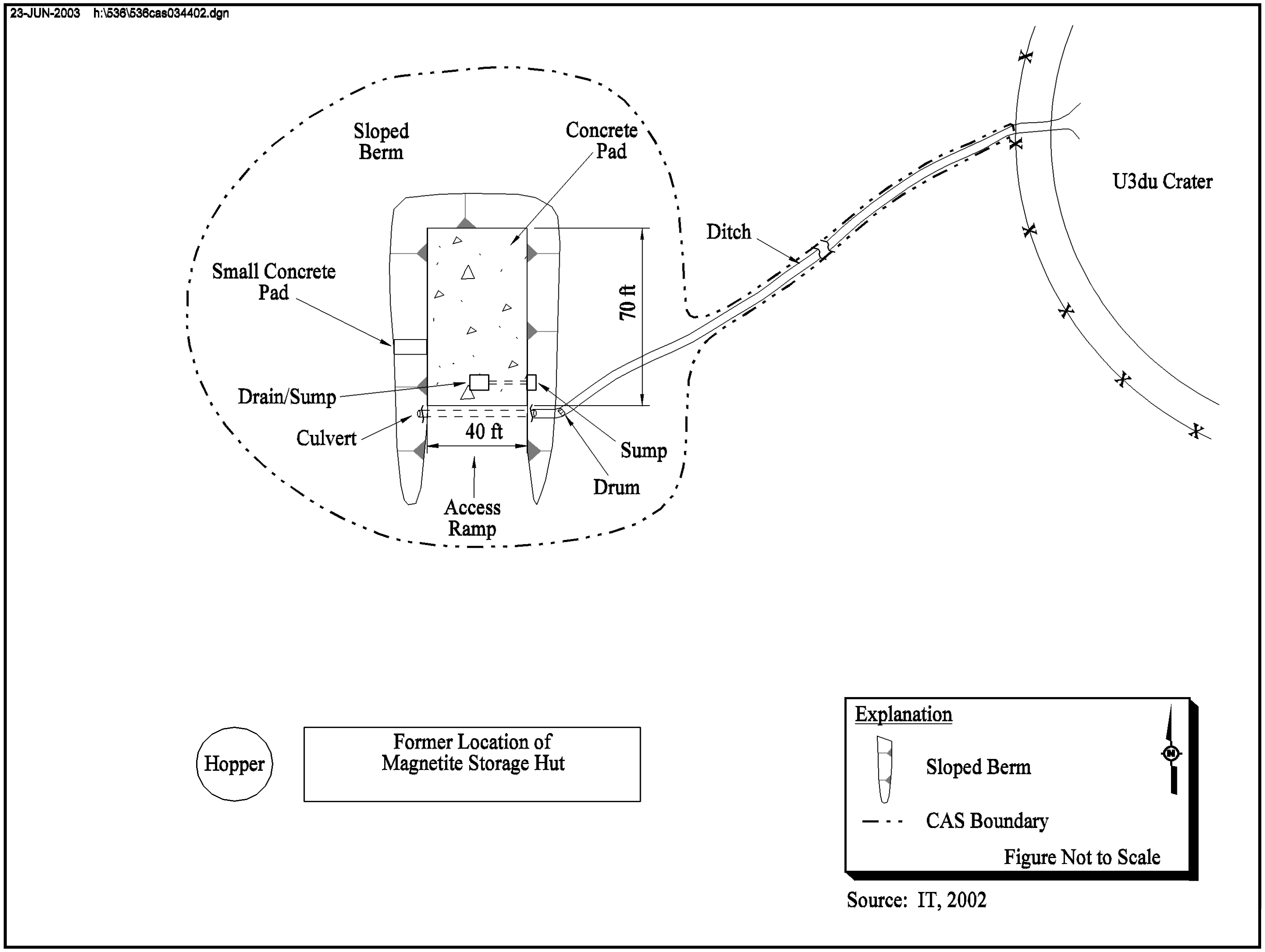
- Determine the vertical and lateral extent of identified COCs.

- Ensure that all NDEP, *Resource Conservation and Recovery Act* (RCRA), and DOE closure requirements have been met.

- In addition, data will be obtained to support IDW disposal and potential future waste management decisions.

1.1.1 CAS 03-44-02, Steam Jenny Discharge

Corrective Action Site 03-44-02 is a 70- by 40-foot (ft) concrete pad located in Area 3 Camp on the NTS near the eastern edge of Yucca Flat. The site is approximately 216 ft north of the former magnetite storage hut and yellow dispenser hopper. Figure 1-3 shows the CAS at it currently exists. This is the only CAS within CAU 536, Area 3 Release Site. There is a small drainage ditch



Source: IT, 2002

Figure 1-3
CAS 03-44-02, Steam Jenny Discharge Site Diagram

associated with the decontamination pad which leads from the southeastern corner of the pad to U3du crater, approximately 460 ft to the east (REECo, 1995). The site is reported to have been used to steam clean equipment in the Area 3 Camp (Haworth, 2001). It is possible that the equipment cleaned at the site may have been contaminated with radioactive material. According to the FFACO, CAU 536 is included in the functional category of Other Spill Sites. There are no other sites or CAUs near the concrete pad that would interfere with the identification of potential contamination. However, this CAS is located within the area potentially affected by the atmospheric testing conducted at NTS.

This site was first identified during a review of the *Environmental Survey Preliminary Report, Nevada Test Site, Mercury, Nevada* (DOE, 1988). The site was used for steam-cleaning operations, but is currently inactive and abandoned. There are no known uses of this area prior to the steam-cleaning operation, nor is there a confirmed record of dates of operation. A 1974 aerial photograph shows a disturbed area on the ground that is suspected of being the location of initial steam cleaning activities. There is no visible surface containment in the photograph and wastewater is suspected to have been allowed to flow directly onto the ground. Sometime after 1974, a small, flat concrete pad was constructed, but there were no means of controlling the discharge of wastewater and potential associated contaminants.

By mid-July 1989, the small concrete pad had been removed and replaced with the 70- by 40-ft concrete pad currently present at the site (REECo, 1995). This pad was better suited to controlling the waste generated during steam-cleaning operations. Reports indicate that there is a sump located in the southern third of the pad with the surface of the pad sloped to direct wastewater and sediments into the sump. Documentation also indicates that the decontamination liquids and sediments were collected in the sump, pumped out, transferred, and treated prior to discharge at a permitted facility **(**REECo, 1995**)**. A January 2003 site visit confirmed the presence of a sump in the southern third of the pad and another structure located on the eastern side of the pad that may also have been a sump. It is possible that these two structures are connected with an underground pipe. An overflow of a sump along the eastern side of the pad was reported to have occurred during the early life of the pad (REECo, 1995). This further supports the premise that there were two sumps associated with the pad. Currently, both structures are filled with concrete so there is no way to visually determine if a drain or piping exists. It is suspected that the liquids and solids from the steam-cleaning process were collected in the center feature and then flowed through an underground pipe to the structure along the eastern side of the pad where they were pumped from the collection system and transported to a permitted facility for disposal. The 1989 construction date of the pad also supports collection of the decontamination wastewater rather than an unpermitted release onto or into the ground (Radack, 1989). A geophysical survey conducted during the preliminary site assessment did not identify a drain or piping beyond the concrete pad; however, the reinforcing metal in the pad masked the features below the concrete (SAIC, 2001).

Although the sump in the center of the concrete pad is considered to have collected the majority of the water and sediments, there are no structures at the pad to prevent overspray and overflows of the sumps from leaving the pad and infiltrating into the surrounding soil. The overflow from the sump would also flow onto the surrounding soil or into the drainage ditch leading from the southern end of the pad to the U3du crater. During the preliminary site assessment, a soil sample was collected from the surface beneath a rusted and crushed drum which was found in the ditch next to the pad. The associated analytical results indicate the presence of various organic and inorganic constituents. It is unclear if the contamination originated from the contents of the drum or runoff form the decontamination pad. The sample did not provide information on the lateral or vertical extent of the detected contamination. In addition, during a site visit (IT, 2002) a large, orange-colored stain was identified near the center of the pad. This stain was not visible during the January 2003 site visit.

Environmental concerns at CAS 03-44-02 include the release of radionuclides, unspecified solvents, and petroleum hydrocarbons, metals, and polychlorinated biphenyls (PCBs) potentially originating from steam-cleaning activities associated with the maintenance activities conducted in Area 3 during the nuclear testing era.

1.1.2 DQO Summary

Corrective Action Unit 536 will be investigated based on DQOs developed by representatives of NDEP and the NNSA/NSO. The DQOs were used to identify and define the type, quantity, and quality of information and data needed to identify, evaluate, and recommend acceptable corrective actions. A phased approach has been selected to generate the data needed to satisfy the DQOs. Phase I data will be collected and evaluated to determine the presence of COCs. Contaminants of concern are defined as contaminants of potential concern (COPCs) that are present in the site media at concentrations above the PALs defined in Section 3.0. Phase II data will be collected and evaluated to define the extent of COCs that are identified during the Phase I sampling. Corrective action closure alternatives (i.e., no further action, closure in place, or clean closure) will be recommended for CAS 03-44-02 based on an evaluation of the DQO-required data.

1.2 Scope

To generate information needed to resolve the decision statements identified in the DQO process, the scope of the CAI for CAU 536 includes the following activities:

- Conduct land radiological surveys at CAS 03-44-02 to provide information on the potential presence of radionuclides and the protection of worker health and safety.
- Collect and submit Phase I environmental samples for laboratory analysis to determine the nature of contamination, and if COCs are present in the surrounding soil.
- If COCs are present, collect samples to define the horizontal and vertical extent of the contamination.
- Collect quality control (QC) samples for laboratory analyses to evaluate the performance of measurement systems and controls based on the requirements of the data quality indicators (DQIs).
- Ensure that all NDEP, RCRA, and DOE data needs are met for closure.
- Comply with regulatory requirements for waste disposal through the collection and analysis of IDW samples, and conduct inspections and surveys, as needed to support potential future waste management decisions.
- Collect soil samples for laboratory analysis of geotechnical parameters and/or bioassessment, as needed.

Radiological and beryllium contamination associated with atmospheric testing is expected in the area of CAS 03-44-02; however, these contaminants are not considered to be within the CAI scope for CAU 536 and are included in CAU 104; South Yucca Flat Atmospheric Sites. The investigation of radiological and beryllium contamination associated with the site will be limited to the concrete pad and surrounding soil as well as the soil within and directly adjacent to the drainage ditch leading from the concrete pad to crater U3du. Radiological contamination will not be delineated beyond the boundary of the CAS identified in Figure 1-3. Radiological contamination beyond this area will not be addressed in this investigation because contamination associated with atmospheric testing will be addressed by the Soils Project.

1.3 CAIP Contents

Section 1.0 presents the purpose and scope of this CAIP, while Section 2.0 provides background information about the CAU. The objectives, including the conceptual site models, are presented in Section 3.0. Field sampling activities are discussed in Section 4.0, and waste management for this project is discussed in Section 5.0. General field and laboratory quality assurance (QA) and QC requirements (including collection of QC samples) are presented in Section 6.0 and in the *Industrial Sites Quality Assurance Project Plan* (QAPP) (NNSA/NV, 2002a). The project schedule and records availability are discussed in Section 7.0. Section 8.0 provides a list of references. Appendix A.1 provides a DQO summary, while Appendix A.2 contains information on the project organization. The health and safety aspects of this project are documented in the *Environmental Architect-Engineer Services Contractor Health and Safety Plan*, and will be supplemented with a site-specific health and safety plan written prior to the start of field work. Public involvement activities are documented in the “Public Involvement Plan” contained in Appendix V of the FFACO (1996). The managerial aspects of this project are discussed in the *Project Management Plan* (DOE/NV, 1994) and will be supplemented with a site-specific field management plan that will be developed prior to field activities.

2.0 Facility Description

Corrective Action Unit 536 includes only one CAS (03-44-02), where decontamination procedures for the Area 3 Camp were reported to have been conducted.

2.1 Physical Setting

The following sections describe the general physical setting of the NTS and the geological and hydrological descriptions for CAS 03-44-02. General background information pertaining to topography, geology, hydrogeology, and climatology are provided for CAS 03-44-02 as described in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV, 1996). The location of the CAS on the NTS is shown in Figure 1-2.

2.1.1 Yucca Flat Hydrogeologic Area

Corrective Action Site 03-44-02 lies within the Yucca Flat Hydrographic Area of the NTS. Uplift and erosion of the surrounding mountains has resulted in the accumulation of more than 1,000 ft of alluvial deposits in some areas of Yucca Flat. Carbonate rocks primarily underlie the alluvium in parts of Yucca Flat and form much of the surrounding mountains in this area (Laczniak et al., 1996). The soil in Yucca Flat is typical desert alluvium composed of mostly fine soil and rock particles and includes loose rocks measuring up to 3 inches (in.) in diameter.

Groundwater occurs in Yucca Flat within alluvial and volcanic aquifers that overlie a carbonate aquifer. This carbonate aquifer underlies large areas of the NTS and is part of a regional groundwater flow system. Within the overlying alluvial and volcanic aquifers in Yucca Flat, lateral groundwater flow occurs from the margins to the center of the basin. Groundwater may flow downward from these aquifers into the carbonate aquifer (Winograd and Thordarson, 1975). The direction of groundwater flow in this region of the carbonate aquifer generally is from the northeast to southwest. The occurrence of local perched water units is unknown at this time.

Groundwater depth data were obtained for water wells located in the vicinity of CAS 03-44-02 in Yucca Flat (USGS, 2003). Well ER-3-2, located 1,347 ft northwest of the site, is monitored quarterly. The depth to groundwater has been measured consistently at 1,604 ± 2 ft below ground surface (bgs). This well is completed in valley fill. Water Well A, located 1,622 ft southwest of the site, is also monitored quarterly. It is completed in alluvium, and for the past nine years, the depth to groundwater has been 1,602 ± 2 ft bgs. The depth to groundwater in Well UE-16d, located 7.7 mi northwest of the site, was 752 ft bgs when last measured on May 23, 1977. This well is completed in carbonate rocks.

Average annual precipitation has been measured at stations in Yucca Flat ranges from 4.85 to 6.66 in. (ARL, 2003). No rain gauge station was identified locally for CAS 03-44-02 in Yucca Flat.

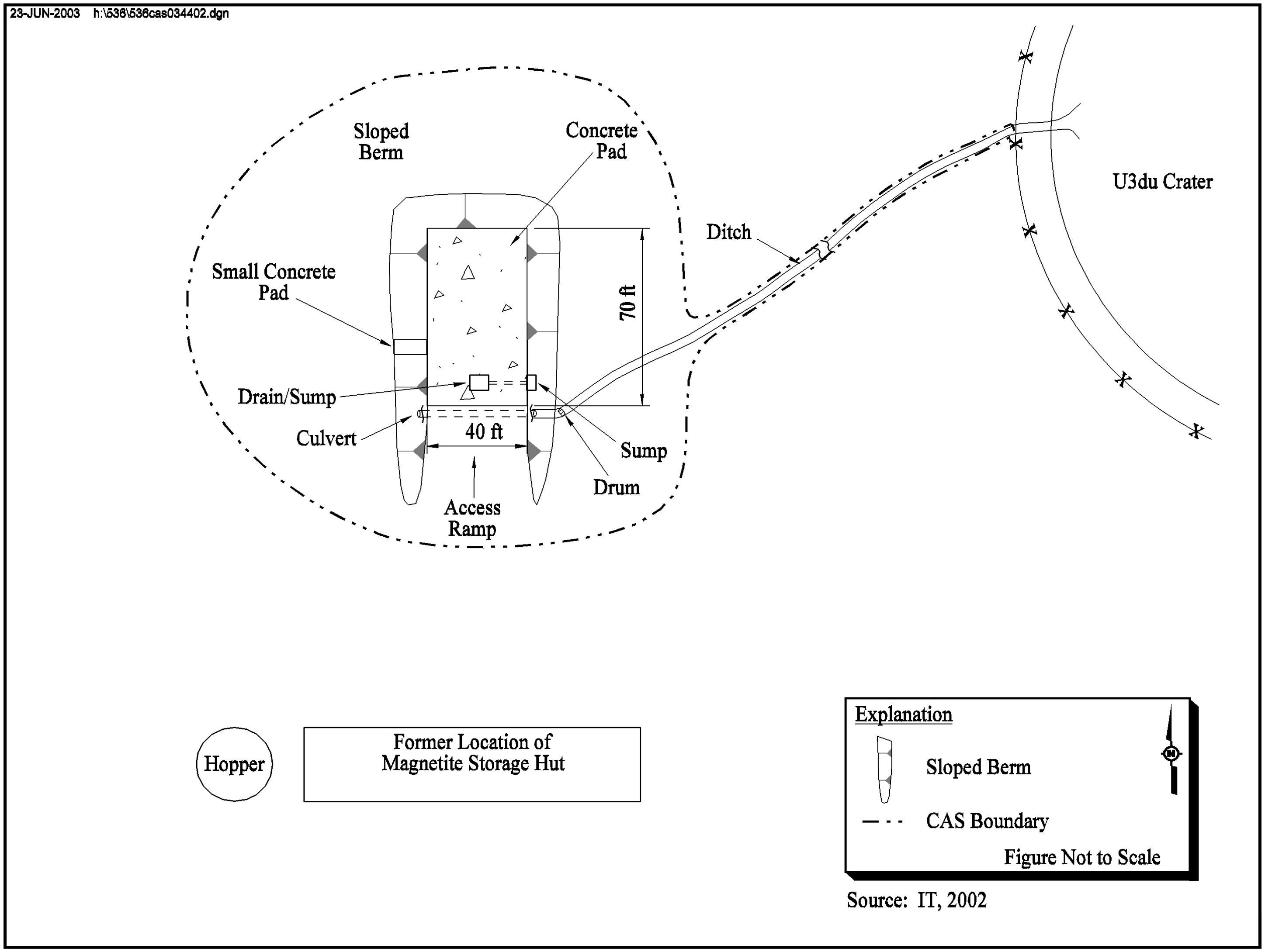
2.2 Operational History

The following subsections provide a description of the use and history of CAU 536 that may have resulted in a release of hazardous constituents to the environment. The summary discusses all significant, known activities. Figure 2-1 is a diagram of CAS 03-44-02 as it currently exists.

Corrective Action Site 03-44-02 was first identified during a review of the *Environmental Survey Preliminary Report, Nevada Test Site, Mercury, Nevada* (DOE, 1988) and currently identified as a 70- by 40-ft concrete decontamination pad located at the NTS on the eastern half of Yucca Flat in the Area 3 Camp. The site is reported to have been used to steam clean equipment contaminated during the maintenance activities conducted in the Area 3 Camp, but it is currently inactive and abandoned. Decontamination activities were also conducted in this area prior to the installation of this pad. There are no known uses of this area prior to the steam-cleaning operation, nor is there a confirmed record of dates of operation.

A 1974 aerial photograph shows a disturbed area that was suspected to be the location of initial steam-cleaning activities. Sometime after 1974, a small, flat concrete pad was constructed; however, no apparent means of controlling the discharge of wastewater and potential associated contaminants were included with the pad. The most referenced method for wastewater disposal was allowing surface runoff and infiltration at the location where the steam cleaning was conducted.

By mid-July 1989, the small concrete pad had been removed and replaced with the 70- by 40-ft concrete pad currently present at the site. This pad was better suited to control the waste generated during steam-cleaning operations. As reports indicate, the pad was equipped with a sump, and the



Source: IT, 2002

Figure 2-1
CAS 03-44-02, Steam Jenny Discharge Site Layout

surface of the pad sloped to direct water and waste into the sump. Documentation indicates that the decontamination liquids and sediments were collected in the sump, pumped out, transferred, and treated prior to discharge at a permitted facility. During a December 2002 site visit, a sump/drain was observed in the center of the lower third of the pad with another concrete feature along the eastern side of the concrete pad. This feature may be associated with the center sump and may be part of the liquid/solid collection system. Currently, the sump in the center of the pad and the one along the eastern side are filled with concrete so it is not possible to visually determine the configuration. It is suspected that the liquids and solids from the steam-cleaning process were collected in the center feature and then flowed through an underground pipe to the structure along the eastern side of the pad where they were pumped from the collection system and transported to a permitted facility for disposal. The 1989 construction date of the pad also supports collection of the decontamination wastewater rather than an unpermitted release onto or into the ground (Radack, 1989).

In addition, there is a small drainage ditch associated with the decontamination pad that diverts runoff from areas west of the pad to the U3du crater, which is approximately 640 ft to the east. As part of the drainage feature, a metal culvert underlies a soil access ramp that is located adjacent to the south side of the pad (Figure 2-1). This drainage ditch does not appear to have been part of the decontamination operations based on the current configuration of the site. There are no other sites or CAUs known to be near the concrete pad that would interfere with the identification of potential contamination.

It is suspected that wastewater was allowed to flow directly onto the ground and infiltrate into the surrounding soil prior to the construction of the current pad. Although the current concrete pad and sump are considered to have collected the majority of the decontamination liquids and sediments, no structures are present at the pad that would prevent overspray and overflows of the sump from leaving the pad. The overflow from the sump would flow onto the surrounding soil, or if enough water was present, into the drainage ditch located near the southern end of the pad.

2.3 Waste Inventory

No documented occurrences of waste disposal have been identified for this CAS. Because the site was used for steam cleaning, it is suspected that the soil may have been contaminated with materials that could be considered hazardous and/or radioactive. Historical information and site visits indicate that the concrete pad, soil, and other miscellaneous debris may be identified as hazardous and/or radioactive waste.

2.4 Release Information

The CAS-specific release information, migration routes, exposure pathways, and affected media are discussed in this section. However, there are no documented releases from CAS 03-44-02.

Prior to the construction of the concrete pad, contamination release would primarily have occurred at the location where the decontamination activities were conducted. Because the decontamination activities are suspected to have been moved around the general area, the releases are suspected to have impacted a larger area than would be expected after the construction of the pad. Surface migration may have occurred as a result of storm events when precipitation rates exceeded infiltration rates. Because there is very little relief across the site and the precipitation events are infrequent, surface migration prior to construction of the concrete pad is primarily expected to be controlled by the frequency of decontamination activities and the quantities of water used in the decontamination processes. The lateral extent of contamination will be primarily limited to locations where the activities were conducted and to a lesser extent where surface runoff occurred.

After the construction of the concrete pad, the release of contaminants is suspected to be limited to the soils immediately surrounding the pad, along the drainage ditch leading to the U3du crater, and beneath the sumps at the pad. Vertical infiltration driven by the water from the decontamination process and percolation of precipitation through the soil is the primary migration route. Runoff resulting from the overflow of the sumps could cause lateral migration of the decontamination liquid into the soil adjacent to the pad and through the drainage ditch toward the U3du crater prior to infiltrating. Infiltration may have transported contamination into the shallow subsurface below the ditch.

The concrete pad will reduce the vertical migration of contamination released to the soil prior to the construction of the pad. Similarly, the pad will reduce the migration of contamination that possibly leaked from the bottom of the sump/pipe by limiting the infiltration of precipitation that would be the primary mechanism to carry the shallow subsurface contaminants to deeper intervals in the soil. Currently the sumps are filled with concrete, eliminating additional infiltration from precipitation.

Additional information on migration is presented in Section 3.1.3 and Appendix A.1, Section A.1.2.3.1.

Potentially affected media for the CAS include surface and shallow subsurface soil and the concrete pad and sumps. Additional affected media information is given in Section A.1.2.3.1.

2.4.1 Exposure Pathways

Exposure routes to site workers include ingestion, inhalation, and/or dermal contact (absorption) from disturbance of contaminated soils, debris, and/or the concrete pad. Site workers may also be exposed to radiation by performing activities in proximity to radiologically contaminated materials.

Surface soils at CAU 536 may have been impacted by radiation associated with atmospheric nuclear testing. As discussed in Section 1.2, this contamination will be addressed by the Soils Project.

2.5 Investigative Background

Site investigation activities associated with CAU 536 prior to the preliminary site assessment have been identified and documented in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV, 1996). The following text discusses the investigation activities conducted at CAU 536 during the preliminary assessment.

An EM-61 surface geophysical survey was conducted at CAS 03-44-02 during the preliminary site assessment. Data were collected over the area immediately south and east of the concrete pad. Metal features at the site which are visible were identified by the survey, but no buried metallic debris were identified. This indicates that there are no buried metallic objects beyond the extent of the concrete pad. However, the metallic reinforcing material in the concrete pad may have masked the identification of drain pipes or other features underlying the pad (SAIC, 2001).

In addition to the geophysical survey, a soil sample was collected from the surface soil beneath a drum found in the ditch next to the pad. Gamma spectroscopic analysis indicated the presence of 1.65 ± 0.29 picocuries per gram (pCi/g) of americium-241 and 1.01 ± 0.13 pCi/g of cesium-137 in the soil. These values are within the range normally measured for Area 3 of the NTS and are considered to result from atmospheric testing. Diesel- and oil-range organics were also detected at 25 and

180 milligrams per kilogram (mg/kg), respectively. Barium, chromium, and lead were detected in the soil sample at total concentrations of 200, 12, and 10 mg/kg, respectively. Methylene chloride and di-n-butyl phthalate, detected at low concentrations, appear to represent laboratory artifacts. The soil sample was also analyzed for PCBs; the results were all below detection levels. It is unclear if the contamination originated from the contents of the drum or runoff from the decontamination pad. The sample did not provide information on the lateral or vertical extent of the detected contamination. In addition, during the initial preliminary site assessment visit an orange-colored stain was identified near the center of the pad. However, during the site visit conducted in December 2002, no visible stain was present on the pad.

2.5.1 National Environmental Policy Act

In accordance with the NNSA/NSO *National Environmental Policy Act* (NEPA) compliance program, a NEPA checklist will be completed prior to commencement of site investigation activities at CAU 536. This checklist compels NNSA/NSO project personnel to evaluate their proposed project activities against a list of potential impacts that include, but are not limited to: air quality, chemical use, waste generation, noise level, and land use. Completion of the checklist results in a determination of the appropriate level of documentation to be developed by the NNSA/NSO NEPA Compliance Officer.

3.0 Objectives

This section presents an overview of the DQOs for CAU 536 and formulation of the conceptual site models (CSMs). In addition, information is provided which addresses the COPCs and PALs for the investigation.

3.1 Conceptual Site Models

The CSMs describe the most probable scenario for current conditions at the site and define the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. Two CSMs have been developed for CAU 356 using assumptions formulated from historical background information, knowledge from studies of similar sites, and data from previous sampling efforts. Section A.1.2.3 provides additional information on the CSMs as presented for DQO formulation.

If evidence of potential contamination outside the scope of the CSMs is identified during investigation activities, the situation will be reviewed and a recommendation will be made as to how best to proceed. In such cases, NDEP will be notified and given the opportunity to comment on and/or concur with the recommendation.

The two CSMs for CAS 03-44-02, Steam Jenny Discharge, are presented in Figure 3-1 and Figure 3-2. Conceptual Site Model #1 represents the conditions at the site before the construction of the concrete pad. With no structures present to contain decontamination water, contamination had the potential to migrate downward from any location in the area where steam cleaning was conducted. This CSM represents the uncontrolled release of chemical constituents that potentially could adversely impact human health or the environment.

Conceptual Site Model #2 shows the concrete pad that was built to contain decontamination water and sediments, restrict potential releases to the area beneath the sumps, contain overspray, and prevent overflow of the sump to the surrounding soil. Overflow also could have been channeled through the drainage ditch toward U3du crater.

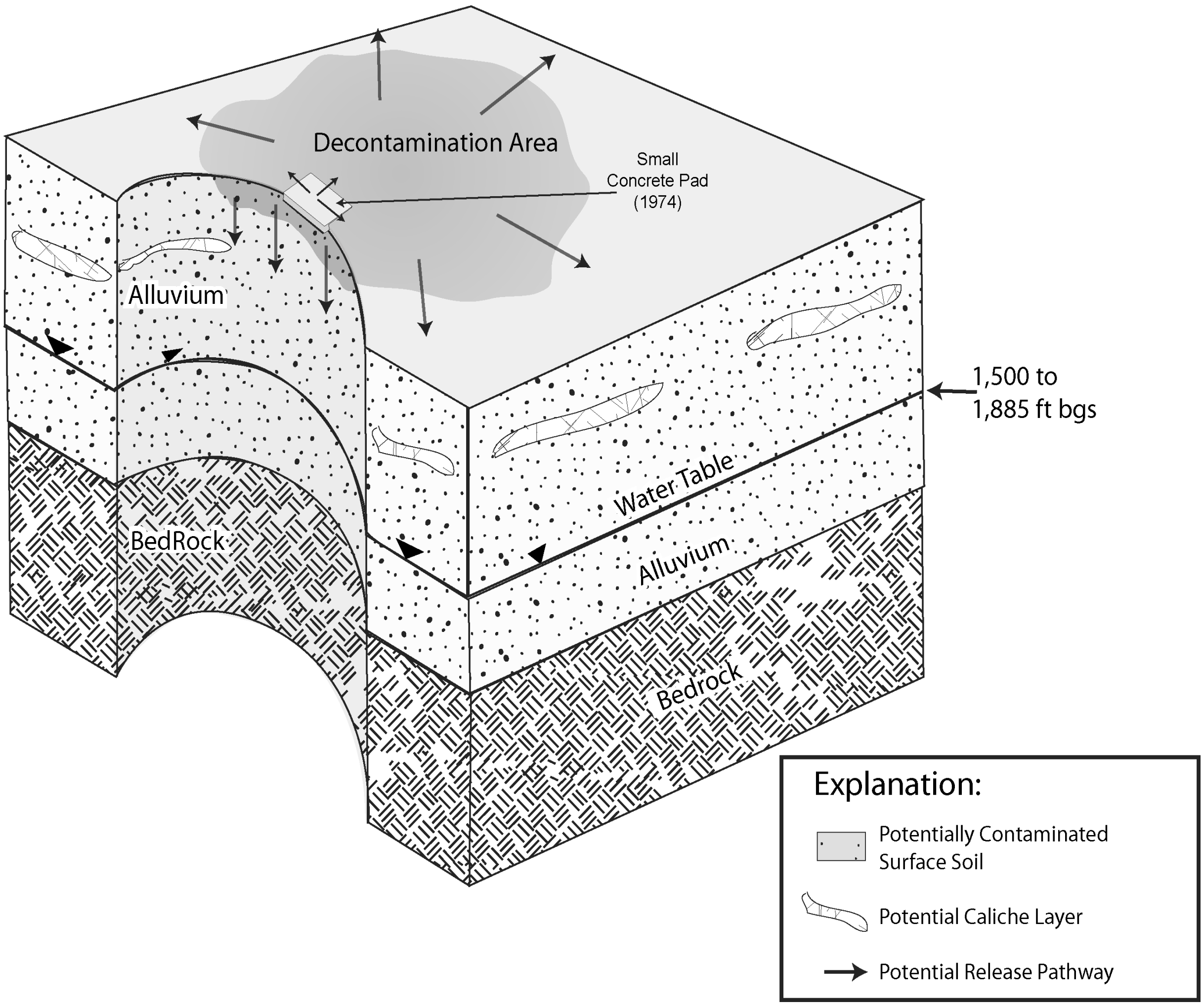


Figure 3-1
CAU 536, Area 3 Release Site - Conceptual Site Model #1, Before Pad Construction

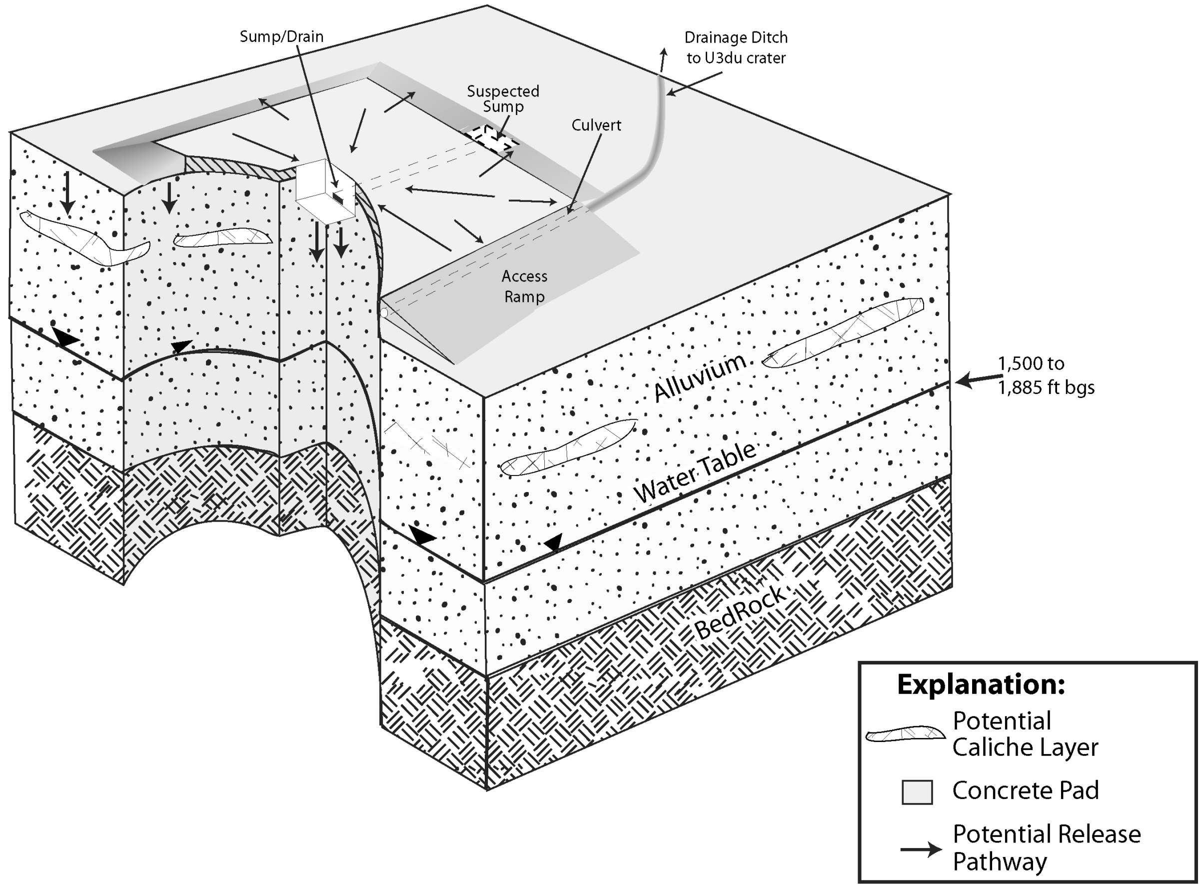


Figure 3-2
CAU 536, Area 3 Release Site - Conceptual Site Model #2, After Pad Construction

3.1.1 Future Land Use

Corrective Action Unit 536 is located within a reserved zone of NTS. The future land-use scenarios limit uses of the area around CAU 536 to various nonresidential uses (i.e., industrial) and include defense and nondefense research, development, and testing activities, as well as commercial-use capabilities. The area incudes land and facilities that provide widespread flexible support for diverse short-term testing and experimentation. The reserved zone is also used for short duration exercises and training, such as nuclear emergency response and Federal Radiological Monitoring and Assessment Center training and DoD land navigation exercises and training (DOE/NV, 1998).

3.1.2 Contaminant Sources and Release Mechanisms

The primary contaminant sources are identified in the two CSMs and include:

- Uncontrolled release of decontamination liquids and solids onto the ground surface before the construction of the decontamination pad.
- The release of decontamination liquids through over spray during decontamination activities, overflow of the sumps, and leaks from the bottom of the sumps.

The release mechanism was intentional or accidental release of steam-cleaning effluents. For CSM#1, the releases were to the ground surface wherever the decontamination activity took place. Prior to the construction of the current pad, it is suspected that wastewater from the decontamination activities was allowed to flow directly onto the ground and infiltrate into the surrounding soil. For CSM#2, the release was potentially beneath the concrete pad through cracks in the sump/drain, around the pad where overspray could have landed, or into the ditch leading to the U3du crater in the event that the pad or sumps overflowed. Although the current concrete pad and sump are considered to have collected the majority of the decontamination liquids and sediments, no structures are present at the pad that would prevent overspray and overflows of the sump from leaving the pad. The overflow from the sump would flow onto the surrounding soil, or if enough water is present, into the drainage ditch located near the southern end of the pad.

3.1.3 Migration Pathways and Transport Mechanisms

An important element of the CSM is the expected fate and transport of contaminants, which infer how contaminants migrate through media and where they can be expected in the environment. Fate and transport are influenced by physical and chemical characteristics of the contaminants and media. Contaminant characteristics include solubility, density, and adsorption potential. Media characteristics include permeability, porosity, water saturation, sorting, chemical composition, and total organic carbon content. In general, constituents with low solubility, high affinity for media, and high density can be expected to be found relatively close to release points. Contaminants with high solubility, low affinity for media, and low density can be expected to be found further from release points.

Migration pathways at the CAS are expected to be primarily vertical due to gravity. This is particularly true for CSM #1 where there were no controls to contain the decontamination wastes. For CSM #2 the primary migration pathway also would be vertical but the concrete pad and sumps would reduce the volume of effluent released. In addition, contaminants may have migrated laterally to some degree prior to infiltration depending on the volume of liquids used in the decontamination processes. The presence of relatively impermeable layers could modify transport pathways, both on the ground surface (e.g., concrete pad) and in the subsurface (e.g., caliche layers).

Contamination, if present, may be discontinuous at the site because it is not known exactly where equipment was steam cleaned prior to the construction of the concrete pad and these activities are suspected to have been moved around the immediate area.

Contaminants could be transported into the subsurface by infiltration of precipitation and water used in the decontamination process. The water serves as a driving force for downward migration of contaminants. However, potential evapotranspiration at the NTS is significantly greater than precipitation, thus limiting vertical migration of contaminants. Average annual precipitation has been measured at stations in Yucca Flat and ranges from 4.85 to 6.66 in. (ARL, 2003). The total annual potential evapotranspiration at the Area 3 Radiological Waste Management Site has been estimated at 62.6 in. (Shott et al., 1997). Thus, the potential annual evapotranspiration is approximately 10 times greater than the annual precipitation. These data indicate that evaporation is the dominant factor influencing the movement of water in the upper unsaturated zone. Therefore, recharge to groundwater from precipitation is not significant at the NTS and does not provide a significant mechanism for migration of contaminants to groundwater. However, if sufficient quantities of water were used in the decontamination activities, this may have caused some downward movement of contamination.

3.1.4 Exposure Points

Exposure points for CSM #1 are the locations where visitors and site workers will come in contact with potential contaminants in the soil or areas where contaminated debris may be present. For CSM #2, the exposure points also include the concrete pad, soil immediately surrounding the pad, and the ditch and adjacent soil that run toward U3du crater.

3.1.5 Exposure Routes

Exposure routes to site workers include ingestion, inhalation, and/or dermal contact (absorption) from disturbance of contaminated soils, debris, and/or the concrete pad. Site workers may also be exposed to radiation by performing activities in proximity to radiologically contaminated material.

3.1.6 Additional Information

Additional topographic information for CAU 536 will not be necessary because the data available is adequate to make determinations about the site.

General surface and subsurface soil descriptions will be observed and recorded during the CAI.

Climatic conditions for the CAU are well documented and have been addressed in the CSMs. No further information is required.

Groundwater data for the CAU are known and have been addressed in the CSM. The depth to groundwater data are presented in Section 2.1.1. No further information is required.

Because the site is located away from any significant drainages there is not a need to evaluate existing flood plain studies.

The only structures present at the site are the concrete pad, culvert, and drainage ditch. The drain/sumps have been filled with concrete, and the pad is no longer used. There are some suspected underground electrical utilities at the site that may have supplied power to the steam jenny. A utility survey will be conducted prior to intrusive sampling. The CAI will not compromise the structural integrity of the concrete pad or any active utilities identified.

3.2 Contaminants of Potential Concern

Suspected contaminants for CAU 536 were identified through a review of site history documentation, process knowledge information, personal interviews, past investigation efforts at similar sites, samples collected during the preliminary site investigation, and inferred activities associated with the CAS. Types of contaminants suspected to be present at CAS 03-44-02 include:

- Unspecified solvents
- Petroleum Hydrocarbons
- PCBs
- Metals
- Radionuclides

Since complete information regarding activities performed at CAS 03-44-02 as well as throughout the NTS is unavailable, some uncertainty as to the list of potential contaminants exists. Due to this uncertainty, constituents (in addition to the suspected contaminants) have been included in the Phase I analytical program to define the nature of contamination for the CAU 536 investigation. The Phase I analytical program for CAS 03-44-02 is listed in Table 3-1. These suspected contaminants are considered COPCs and defined as the analytes reported from the analytical methods listed in Table 3-2, for which the U.S. Environmental Protection Agency (EPA) Region IX has established *Preliminary Remediation Goals* (PRG) (EPA, 2002b) or for which toxicity data are listed in the EPA *Integrated Risk Information System* (IRIS) database (EPA, 2002a). Radiological COPCs are defined as the radionuclides reported from the analytical methods listed in Table 3-2.

Based on process knowledge information for steam cleaning/degreasing operations, certain analytes are suspected to be present at CAS 03-44-02. These suspected contaminants are referred to as critical analytes to define the nature of contamination (Decision I) and also are identified in Table 3-1. Critical analytes are defined as the chemicals and/or radionuclides that are suspected to be present at the site based on the information used to identify suspected contaminants. Because information such as documented use or process knowledge exists for critical analytes, these analytes are given greater importance in the decision-making process relative to other COPCs. For this reason, more stringent performance criteria are specified for critical analyte data quality indicators (Section 6.0).

Table 3-1
Phase I Analytical Program COPCs[a] and Critical Analytes for CAU 536
(Includes Site and Waste Characterization Analyses)

Chemical[b]		**Radiological**	
Suspected Contaminants	**Critical Analytes**	**Suspected Contaminants**	**Critical Analytes**
Total Petroleum Hydrocarbons	Diesel-Range Organics Gasoline-Range Organics	Gamma Spectrometry[c]	None
Semivolatile Organic Compounds	Dichlorobenzene Ethyl benzene Napthalene	Isotopic Uranium	None
Volatile Organic Compounds[d]	Tetrachloroethylene Toluene 1,1,1-Tetrachloroethene Trichloroethylene Xylene	Isotopic Plutonium	None
Polychlorinated Biphenyls	None	Strontium-90	None
Total *Resource Conservation and Recovery Act* Metals[e]	None	NA	NA
Beryllium	None	NA	NA

[a] The contaminants of potential concern are the analytes reported from the analytical methods listed in Table 3-2.
[b] If the volume of material is limited, prioritization of the analyses will be necessary.
[c] If americium-241 is detected above the minimum detectable activity, isotopic americium-241 may also be performed on sample.
[d] Acetone and methylene chloride are common degreasers, but are also common laboratory artifacts. Because they are common laboratory artifacts, they are not included as critical analytes.
[e] May also include toxicity characteristic leaching procedure metals if sample is collected for waste management purposes.

NA = Not applicable

Each COPC that is detected in a sample at concentrations exceeding the corresponding PAL becomes a COC for subsequent sampling to define the extent of contamination (Decision II). These follow-up samples will be collected and analyzed only for the COCs identified by Decision I sampling. However, if extent samples are collected prior to nature-of-contamination data becoming available, the extent samples will be analyzed for the full list parameters given for each CAS in Table 3-1.

As mentioned previously, the radionuclides resulting from the atmospheric nuclear testing are not intended to drive the nature and extent determination under this investigation. For CAU 536, source characterization is the focus of the sampling and analysis. Radiological analyses will be included in the analytical suite to determine if the decontamination processes released radioactive constituents to the environment and to support the disposal of IDW and potential waste management decisions.

Table 3-2
Chemicals of Potential Concern and Analytical Requirements for CAU 536
(Page 1 of 3)

Parameter	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD)[a]	Percent Recovery (%R)[b]
ORGANICS						
Total Volatile Organic Compounds (VOCs)	Aqueous	8260B[c]	Parameter-specific estimated quantitation limits[d]	Not Applicable (NA)	Lab-specific[e]	Lab-specific[e]
	Soil					
Toxicity Characteristic Leaching Procedure (TCLP) Volatile Organic Compounds (VOCs)						
Benzene	Aqueous	1311/8260B[c]	0.050 mg/L[d]	0.5 mg/L[f]	Lab-specific[e]	Lab-specific[e]
Carbon Tetrachloride			0.050 mg/L[d]	0.5 mg/L[f]		
Chlorobenzene			0.050 mg/L[d]	100 mg/L[f]		
Chloroform			0.050 mg/L[d]	6 mg/L[f]		
1,2-Dichloroethane			0.050 mg/L[d]	0.5 mg/L[f]		
1,1-Dichloroethene			0.050 mg/L[d]	0.7 mg/L[f]		
Methyl Ethyl Ketone			0.050 mg/L[d]	200 mg/L[f]		
Tetrachloroethene			0.050 mg/L[d]	0.7 mg/L[f]		
Trichloroethene			0.050 mg/L[d]	0.5 mg/L[f]		
Vinyl Chloride			0.050 mg/L[d]	0.2 mg/L[f]		
Total Semivolatile Organic Compounds (SVOCs)	Aqueous	8270C[c]	Parameter-specific estimated quantitation limits[d]	NA	Lab-specific[e]	Lab-specific[e]
	Soil					
TCLP SVOCs						
o-Cresol	Aqueous	1311/8270C[c]	0.10 mg/L[d]	200 mg/L[f]	Lab-specific[e]	Lab-specific[e]
m-Cresol			0.10 mg/L[d]	200 mg/L[f]		
p-Cresol			0.10 mg/L[d]	200 mg/L[f]		
Cresol (total)			0.30 mg/L[d]	200 mg/L[f]		
1,4-Dichlorobenzene			0.10 mg/L[d]	7.5 mg/L[f]		
2,4-Dinitrotoluene			0.10 mg/L[d]	0.13 mg/L[f]		
Hexachlorobenzene			0.10 mg/L[d]	0.13 mg/L[f]		
Hexachlorobutadiene			0.10 mg/L[d]	0.5 mg/L[f]		
Hexachloroethane			0.10 mg/L[d]	3 mg/L[f]		
Nitrobenzene			0.10 mg/L[d]	2 mg/L[f]		
Pentachlorophenol			0.50 mg/L[d]	100 mg/L[f]		
Pyridine			0.10 mg/L[d]	5 mg/L[f]		
2,4,5-Trichlorophenol			0.10 mg/L[d]	400 mg/L[f]		
2,4,6-Trichlorophenol			0.10 mg/L[d]	2 mg/L[f]		
Polychlorinated Biphenyls (PCBs)	Aqueous	8082[c]	Parameter-specific (CRQL)[g]	NA	Lab-specific[e]	Lab-specific[e]
	Soil					

Table 3-2
Chemicals of Potential Concern and Analytical Requirements for CAU 536
(Page 2 of 3)

Parameter	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD)[a]	Percent Recovery (%R)[b]
Total Petroleum Hydrocarbons (TPH) (C_6 - C_{38})	Aqueous GRO	8015B modified[c]	0.1 mg/L[h]	NA	Lab-specific[e]	Lab-specific[e]
	Soil GRO		0.5 mg/kg[h]			
	Aqueous DRO		0.5 mg/L[h]			
	Soil DRO		25 mg/kg[h]			
Explosives	Aqueous	8330[c]	14 mg/L[c]	NA	Lab-specific[e]	Lab-specific[e]
	Soil		2.2 mg/kg[c]			
INORGANICS						
Total *Resource Conservation and Recovery Act* (RCRA) Metals, Beryllium, and Zinc						
Arsenic	Aqueous	6010B[c]	10 µg/L[h, i]	NA	20[i]	Matrix Spike Recovery 75-125[i] Laboratory Control Sample Recovery 80 - 120[i]
	Soil	6010B[c]	1 mg/kg[h, i]		35[h]	
Barium	Aqueous	6010B[c]	200 µg/L[h, i]		20[i]	
	Soil	6010B[c]	20 mg/kg[h, i]		35[h]	
Beryllium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i]	
	Soil	6010B[c]	0.5 mg/kg[h, i]		35[h]	
Cadmium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i]	
	Soil	6010B[c]	0.5 mg/kg[h, i]		35[h]	
Chromium	Aqueous	6010B[c]	10 µg/L[h, i]		20[i]	
	Soil	6010B[c]	1 mg/kg[h, i]		35[h]	
Lead	Aqueous	6010B[c]	3 µg/L[h, i]		20[i]	
	Soil	6010B[c]	0.3 mg/kg[h, i]		35[h]	
Mercury	Aqueous	7470A[c]	0.2 µg/L[h, i]		20[i]	
	Soil	7471A[c]	0.1 mg/kg[h, i]		35[h]	
Selenium	Aqueous	6010B[c]	5 µg/L[h, i]		20[i]	
	Soil	6010B[c]	0.5 mg/kg[h, i]		35[h]	
Silver	Aqueous	6010B[c]	10 µg/L[h, i]		20[i]	
	Soil	6010B[c]	1 mg/kg[h, i]		35[h]	
Zinc	Aqueous	6010B[c]	20 µg/L[h, i]		20[i]	
	Soil	6010B[c]	2 mg/kg[h, i]		35[h]	
TCLP RCRA Metals						
Arsenic	Aqueous	1311/6010B[c] 1311/7470A[c]	0.10 mg/L[h, i]	5 mg/L[f]	20[i]	Matrix Spike Recovery 75-125[i] Laboratory Control Sample Recovery 80 - 120[i]
Barium			2 mg/L[h, i]	100 mg/L[f]		
Cadmium			0.05 mg/L[h, i]	1 mg/L[f]		
Chromium			0.10 mg/L[h, i]	5 mg/L[f]		
Lead			0.03 mg/L[h, i]	5 mg/L[f]		
Mercury			0.002 mg/L[h, i]	0.2 mg/L[f]		
Selenium			0.05 mg/L[h, i]	1 mg/L[f]		
Silver			0.10 mg/L[h, i]	5 mg/L[f]		

Table 3-2
Chemicals of Potential Concern and Analytical Requirements for CAU 536
(Page 3 of 3)

Parameter	Medium or Matrix	Analytical Method	Minimum Reporting Limit	RCRA Hazardous Waste Regulatory Limit	Laboratory Precision (RPD)[a]	Percent Recovery (%R)[b]
RADIOCHEMISTRY						
Gamma-Emitting Radionuclides	Aqueous	EPA 901.1[j]	The Minimum Reporting Limits and Minimum Detectable Activities for Radionuclides are given in Table 3-3 of this CAIP	NA	Relative Percent Difference (RPD[a]) 20% (Water)[h] 35% (Soil)[h] Normalized Difference (ND) -2<ND<2[k]	Laboratory Control Sample Recovery 80-120[i]
	Soil	HASL-300[l]				
Isotopic Uranium	Aqueous	HASL-300[l] ASTM D3972-02[m]		NA		Chemical Yield 30-105[n] Laboratory Control Sample Recovery 80-120[i]
	Soil	HASL-300[l] ASTM C1000-00[m]				
Isotopic Plutonium	Aqueous	ASTM D3865-02[m]		NA		
	Soil	HASL-300[l]				
Strontium - 90	Aqueous	ASTM D5811-00[m]		NA		
	Soil	HASL-300[l]				

[a] Relative percent difference (RPD) is used to calculate precision.
Precision is estimated from the relative percent difference of the concentrations measured for the matrix spike and matrix spike duplicate or of laboratory, or field duplicates of unspiked samples. It is calculated by: RPD = 100 x {(|C1-C2|)/[(C1+C2)/2]}, where
C1 = Concentration of the parameter in the first sample aliquot,
C2 = Concentration of the parameter in the second sample aliquot.

[b] %R is used to calculate accuracy.
Accuracy is assessed from the recovery of parameters spiked into a blank or sample matrix of interest, or from the recovery of surrogate compounds spiked into each sample. The recovery of each spiked parameter is calculated by: percent recovery (%R) = 100 x (Cs-Cu/Cn), where Cs = Concentration of the parameter in the spiked sample,
Cu = Concentration of the parameter in the unspiked sample, Cn = Concentration increase that should result from spiking the sample

[c] U.S. Environmental Protection Agency (EPA) *Test Methods for Evaluating Solid Wast*e, 3rd Edition, Parts 1-4, SW-846 CD ROM, Washington, DC (EPA,1996)

[d] Estimated Quantitation Limit as given in SW-846 (EPA, 1996)

[e] In-House Generated RPD and %R Performance Criteria
It is necessary for laboratories to develop in-house performance criteria and compare them to those in the methods. The laboratory begins by analyzing 15 to 20 samples of each matrix and calculating the mean %R for each parameter. The standard deviation (SD) of each %R is then calculated, and the warning and control limits for each parameter are established at ± 2 SD and ± 3 SD from the mean, respectively. If the warning limit is exceeded during the analysis of any sample delivery group (SDG), the laboratory institutes corrective action to bring the analytical system back into control. If the control limit is exceeded, the sample results for that SDG are considered unacceptable. These limits are reviewed after every quarter and are updated when necessary. The laboratory tracks trends in both performance and control limits by the use of control charts. The laboratory's compliance with these requirements is confirmed as part of an annual laboratory audit. Similar procedures are followed in order to generate acceptance criteria for precision measurements.

[f] Title 40 *Code of Federal Regulations* Part 261, "Identification and Listing of Hazardous Waste" (CFR, 2002a)

[g] EPA *Contract Laboratory Program Statement of Work for Organic Analysis* (EPA, 1988b; and 1994c)

[h] *Industrial Sites Quality Assurance Project Plan* (NNSA/NV, 2002a)

[i] EPA *Contract Laboratory Program Statement of Work for Inorganic Analysis* (EPA, 1988a; 1994b; and 1995)

[j] *Prescribed Procedures for Measurements of Radioactivity in Drinking Water*, EPA-600/4-80-032 (EPA, 1980)

[k] Normalized Difference is not RPD, it is another measure of precision used to evaluate duplicate analyses. The normalized difference is calculated as the difference between two results divided by the square root of the sum of the squares of their total propagated uncertainties. *Evaluation of Radiochemical Data Usability* (Paar and Porterfield, 1997)

[l] *Manual of Environmental Measurements Laboratory Procedures*, HASL-300 (DOE, 1997)

[m] American Society for Testing and Materials

[n] *General Radiochemistry and Routine Analytical Services Protocol (GRASP)* (EG&G Rocky Flats, 1991)

Definitions:
mg/L = Milligrams per liter
mg/kg = Milligrams per kilogram
µg/L = Micrograms per liter
CRQL = Contract-required quantitation limits

3.3 Preliminary Action Levels

Laboratory analytical results for COPCs in soil samples will be compared to the following PALs to evaluate the presence of COCs:

- EPA Region 9 Risk-Based PRGs for chemical constituents in industrial soils (EPA, 2002b).
- Background concentrations for RCRA metals will be used instead of PRGs when natural background exceeds the PRG, as is often the case with arsenic on the NTS. Background is considered the mean plus two times the standard deviation of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999).
- For detected chemical COPCs without established PRGs, a similar protocol to that used by EPA Region 9 will be used in establishing action levels for those COPCs listed in IRIS (EPA, 2002a).
- The total petroleum hydrocarbon (TPH) action limit of 100 mg/kg per the *Nevada Administrative Code* (NAC) 445A.2272 (NAC, 2002e).
- The PALs for radiological contaminants are isotope-specific and are defined as the maximum concentration for each isotope found in environmental samples taken from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1991). The US Ecology and Atlan-Tech reference is used because soil samples have not been collected from undisturbed background locations of the NTS and analyzed for their radionuclide concentrations. Therefore, data is needed on the concentration of radionuclides in soil at undisturbed background locations located in the vicinity of the NTS. Based upon the Ward Valley climatography, geology, and radionuclide concentration data, the use of *Environmental Monitoring Report for the Proposed Ward Valley California Low Level Radioactive Waste (LLRW) Facility* (US Ecology and Atlan-Tech, 1991) is appropriate for use in defining PAL concentrations based on background. The PALs are expressed in units of pCi/g for solid media or picocuries per liter (pCi/L) and are provided in Table 3-3.
- Solid media such as concrete 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 Radiological Control Manual* (DOE/NV, 2000).

The comparison of laboratory results to PALs will be discussed in the Corrective Action Decision Document (CADD). Laboratory results above PALs indicate the presence of COCs that will require further evaluation. The evaluation of potential corrective actions and the justification for a preferred

Table 3-3
Minimum Detectable Concentrations and Preliminary Action Levels for Radionuclides in Samples Collected at CAU 536

Isotope	Soil and Sludge		Liquid	
	MDC[a] (pCi/g)	PAL[b] (pCi/g)	MDC[a] (pCi/L)	PAL[b] (pCi/L)
Americium-241 (by Gamma spectroscopy)	2.0[c]	2.0	50	50
Cesium-137	0.5[c]	7	10	10
Cobalt-60	0.5[c]	0.1	10[c]	10
Europium-152	4.0[c]	4.0	75[c]	75
Europium-154	2.5[c]	2.5	65[c]	65
Europium-155	1.0[c]	1.35	20[c]	20
Strontium-90	0.5	1.17	1.0	1.0
Uranium-234	0.05	3.47	0.1	8.92
Uranium-235	0.05	0.07	0.1	0.36
Uranium-238	0.05	3.47	0.1	9.39
Plutonium-238	0.05	0.05	0.1	0.16
Plutonium-239/240	0.05	0.106	0.1	9.0

[a] MDC is the minimum detectable concentration: detection limits required for the measurement of Shaw Environmental, Inc. samples.
[b] PAL is defined as the maximum concentration listed in the literature for a sample taken from an undisturbed background location (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1992; and DOE/NV, 1999). The PAL is equal to the MDC for isotopes not reported in soil samples from undisturbed background locations or if the PAL is less than the MDC.
[c] MDC for gamma-emitting radionuclides is relative to Cs-137.

pCi/L - Picocuries per liter
pCi/g - Picocuries per gram

action will be included in the CADD based on the results of this field investigation. Proposed cleanup levels will be presented in the CADD, if applicable.

3.4 DQO Process Discussion

The DQO process is a strategic planning approach based on the scientific method that is used to prepare for site characterization data collection. The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend the recommendation of viable corrective actions (e.g., no further action or close in place).

Details of the DQO process are presented in Appendix A.1 of this CAIP. During the DQO discussion for this CAU, the informational inputs and data needs to resolve the problem statement and decision statements were documented. Criteria for data collection activities were assigned. The analytical methods and reporting limits prescribed through the DQO process, as well as the DQIs for laboratory analysis (e.g., precision and accuracy requirements), are provided in more detail in Section 6.0 of this CAIP. Laboratory data will be assessed to confirm or refute the CSM and determine if the DQOs were met based on the DQIs of precision, accuracy, representativeness, completeness, and comparability. Other DQIs, such as sensitivity, also may be used.

The DQO strategy for CAU 536 was developed at a meeting on February 4, 2003. The DQOs were developed to identify data needs, clearly define the intended use of the environmental data, and to design a data collection program that will satisfy these purposes. During the DQO discussions for this CAU, the informational inputs or data needs to resolve problem statements and decision statements were documented.

The problem statement for the investigation is, "Existing information on the nature and extent of suspected contamination is insufficient to evaluate and recommend corrective action alternatives for CAU 536, CAS 03-44-02." To address this problem statement, resolution of two decisions statements is required:

- Decision I is, "Define the nature of contamination," by identifying any contamination above PALs. Data must be collected in areas most likely to contain contamination due to activities associated with the facility, and samples must be collected from areas most likely to be contaminated. If PALs are not exceeded, then the investigation is complete. If PALs are exceeded, then Decision II must be resolved.

- Decision II is, "Determine the extent of contamination identified above PALs." This decision will be achieved by the collection of data that are adequate to define the extent of COCs.

In addition, data will be obtained to support waste management decisions.

For the CAU 536 DQOs, two CSMs were developed using historical background information, knowledge from studies at similar sites, and data from previous sampling efforts. The CSMs (i.e., Before Pad Construction [CSM #1] and After Pad Construction [CSM #2]) are detailed in Appendix A.1 of this CAIP. As discussed in Section 1.2, soil contamination resulting from atmospheric nuclear testing is not included in the scope of CAU 536. This contamination will be addressed by the Soils Project. However, radiological contamination from steam-cleaning effluents identified within the CAS boundary will be addressed by this investigation.

Laboratory analysis of environmental soil samples will provide the means for quantitative measurement of the COPCs. Phase I chemical and radiological parameters of interest have been selected for CAS 03-44-02 and are listed in Table 3-2. The table includes the analytical methods for CAU 536, minimum reporting limits (MRLs), and precision and accuracy requirements for each method. The number and types of samples to be collected and the analytical methods are capable of generating data that meet the project needs determined through the DQO process. Specifically, the MRLs are set so that laboratory analyses will generate data with the necessary resolution for comparison to PALs.

4.0 Field Investigation

This section of the CAIP contains the approach for investigating CAU 536.

4.1 Technical Approach

The technical approach for the CAU 536 CAI consists of the following activities:

- Perform a radiological land-area survey.
- Perform a visual inspection of the site.
- Review previously conducted geophysical survey results to identify any subsurface metallic and nonmetallic debris.
- Collect and analyze samples from biased locations to determine if COCs are present.
- Collect and analyze samples from biased locations described in this section to define the lateral and vertical extent of contamination.
- Collect an adequate volume of material to accurately represent the location and media being sampled.
- Perform field screening for applicable COPCs.
- Collect required QC samples.
- Collect additional samples, as necessary, to estimate potential corrective action waste streams.
- Collect samples from native soils and analyze for geotechnical/hydrologic parameters, if necessary.
- Collect and analyze bioassessment samples if appropriate (e.g., if volatile organic compounds [VOCs] concentrations exceed field-screening levels [FSLs] in a pattern that suggests that a plume may be present).
- Perform radiological release surveys of construction materials and debris identified during the investigation.
- Stake or flag sample locations and record coordinates (i.e., Universal Transverse Mercator Zone 11, meters, North American Datum 1927 coordinate system).

4.2 Field Activities

This section provides a description of the field activities for CAU 536, CAS 03-44-02. Process knowledge indicates that if contamination is identified, it will be found within the spatial boundaries of the site as defined in the DQO process and CSMs. If while defining the nature of contamination, the investigation determines that COCs are present at the CAS, it will be further addressed by determining the lateral and vertical extent of contamination before evaluating corrective action alternatives. Only unbounded COCs will be considered during Phase II sampling

Modifications to the investigative strategy may be required should unexpected field conditions be encountered. Significant modifications will be justified in a Record of Technical Change (ROTC). An approved ROTC (i.e., concurrence from NNSA/NSO and NDEP) is required prior to proceeding with investigation activities significantly different from those described in the document. If contamination is more extensive than anticipated (e.g., the maximum investigation depth is limited by the capabilities of the equipment used to collect subsurface soil samples) the investigation will be rescoped. The investigation also will be rescoped if the CSMs have failed.

A radiological screening survey will be conducted throughout CAS 03-44-02 prior to intrusive sampling. The survey will include the concrete pad, ground surface surrounding the pad, the ramp at the southern end of the pad, and the drainage ditch.

Following the radiological survey, the surface of the concrete pad, areas surrounding the pad extending throughout the area identified as being disturbed in the 1974 aerial photograph, and the length of the drainage ditch extending from the southeastern corner of the pad to, but not into, U3du crater will be visually inspected and photodocumented. The visual inspection will focus on preferential pathways (e.g., small drainage systems) that may have transported or accumulated contamination associated with steam-cleaning operations prior to 1989 as well as more recent releases from the concrete pad.

Intrusive sampling will be conducted at CAS 03-44-02 to determine if COCs are present and, if present, to determine the extent. Initially, surface soil samples (< 0.5 ft bgs) will be collected from biased locations based on the results of the previously conducted geophysical surveys, radiological surveys, the visual inspection, existing analytical data, and other biasing factors listed in

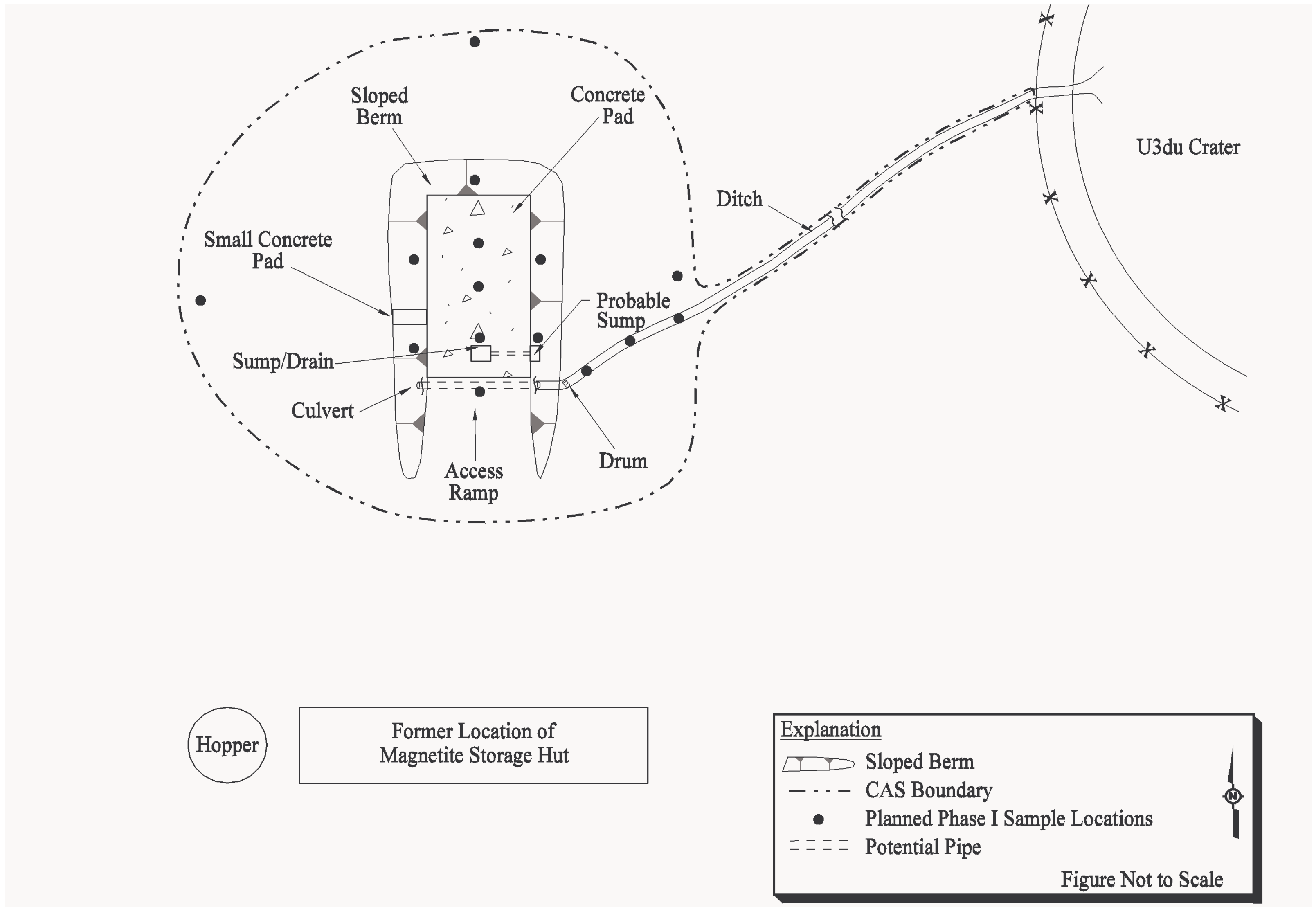
Table A.1-3, of Appendix A.1. If biasing factors indicate that contamination may be present at the surface, samples will be collected for laboratory analysis at the potentially contaminated locations as well as along each side of the pad. Soil samples will be selected from biased locations focusing on contamination that may have migrated from the suspected source areas, considering the potential for lateral surface migration prior to infiltration.

If no biasing factors (e.g., staining, elevated radiological readings) are present to indicate potential contamination, then surface soil samples will be collected from locations along the edge of the pad and outward at 25-ft intervals to a maximum of 50 ft from each side of the concrete pad. It is expected that the concrete pad was constructed over all or part of the former decontamination area.

A minimum of three surface soil samples will be collected from the bottom of the drainage ditch. Locations will be based on biasing factors (e.g., stains, radiological hot spots, areas of accumulated sediment). If biasing factors are not present, the samples will be spaced at 25-ft intervals along the ditch, with the first sample collected just downstream of the culvert beneath the ramp adjacent to the south side of the pad.

Subsurface soil samples will be collected from locations adjacent to the sump in the center of the concrete pad and adjacent to the sump on the east side of the pad. Figure 4-1 shows the planned location of the Phase I samples. Three locations are expected to be sampled below the concrete pad. Sample collection will begin with the first material immediately beneath the base of these features. If the depth to the base of the sump in the center of the pad cannot be determined, it will be assumed to be the same as the depth to the base of the sump on the east side of the pad. Additionally, subsurface soil samples will be collected from surface soil locations where biasing factors (e.g., field-screening results) indicate the potential for contaminant concentrations greater than PALs.

The frequency of subsurface soil samples will be based on biasing factors such as presence of debris, staining, odor, field-screening results, or professional judgment. For subsurface sampling locations, generally two consecutive soil samples with field-screening results below field-screening action levels are required to define the vertical extent of contamination. Generally, the uppermost “clean” sample from each location is submitted for laboratory analysis.



Source: IT, 2002

Figure 4-1
CAU 536, CAS 03-44-02, Steam Jenny Discharge - Planned Phase I Sample Locations

Surface soil samples will be collected by hand according to approved procedures. Sonic drilling, hollow-stem auger drilling, direct-push, handheld augers, or excavation may be used, as appropriate, to access subsurface sample intervals for laboratory analysis at select locations.

A visual inspection of the concrete pad will be conducted of the area where a stain was reported during the preliminary site assessment. If unconsolidated material is available, and if appropriate, this material will be collected for laboratory analysis. This will not include material containing bird and other animal droppings. Based on the results of the radiological survey of the concrete pad surface, swipes may be collected and analyzed on site for removable radiological contamination. Scabbling of the concrete may be performed to collect samples, if necessary.

Samples for waste characterization purposes may also be collected from the various media at CAS 03-44-02 (e.g., soil, concrete, or material in the drainage ditch).

4.3 Field-Screening Levels

Field screening, along with other biasing factors, may help guide the selection of the most appropriate sampling location for collection of laboratory samples. The following FSLs may be used for on-site field screening:

- Headspace VOC levels of 20 parts per million (ppm) or 2.5 times background, whichever is greater.
- The TPH level of 75 ppm measured using an appropriate field-screening method (e.g., field gas chromatograph or other acceptable field analytical method).
- The radiological (alpha and beta/gamma) FSL of the mean background activity plus two times the standard deviation of the mean background activity collected from undisturbed locations within the vicinity of the site (Adams, 1998).

Field-screening concentrations exceeding FSLs indicate potential contamination at that sample location. This information will be documented and the investigation will collect additional samples to delineate the extent of the contamination. Additionally, these data may be used to select discretionary samples for submission to the laboratory.

4.4 Additional Sampling to Define Extent of Contamination

If COCs are detected, step-out sampling may be necessary to properly define the extent of contamination (i.e., contaminant boundaries). Sample locations may be determined by the vertical and/or lateral extent of initial contamination, and will be based on process knowledge, site observations, field-screening data, and analytical results (if available) from nature samples. The target populations at step-out locations will be limited to COC concentrations above PALs for the samples that defined the nature of contamination. They will also be limited by previous extent samples that may continue to exceed PALs.

Step-out samples will be placed at a maximum of 15 ft from the previous sample location where COCs were detected. If biasing factors indicate that the COCs may extend beyond the initial step-out location, further step-out locations may be necessary. As field data are generated, these locations may be modified, but only if the modified locations meet the decision needs and criteria stipulated in the DQOs. At each step-out location, soil samples will be collected at the depth(s) where COCs were encountered and from two depth intervals below the lowest depth where COCs were observed. These samples will be screened, and if the results are not greater than FSLs, one of these samples (typically the uppermost) will be submitted to the laboratory for analysis. Laboratory analysis is the only acceptable verification that extent has been determined. In general, samples submitted for laboratory analysis will be those that define the lateral and vertical extent of COCs.

If the nature and/or extent of contamination is inconsistent with the CSM, or if contamination extends beyond the spatial boundaries identified in Appendix A.1, Section A.1.5.2, NDEP will be notified and the investigation strategy will be reevaluated. As long as contamination is consistent with the CSM and within spatial boundaries, sampling will continue to define extent.

4.5 Geotechnical/Hydrological Analysis and Bioassessment Tests

It may be necessary to measure the geotechnical/hydrological parameters of the CAS. Samples to be analyzed for these parameters will be collected within brass sleeves (or other containers, as appropriate) to maintain the natural physical characteristics of the soil. Table 4-1 lists general geotechnical and hydrological parameters of interest. The testing methods shown are minimum standards, and other equivalent or superior testing methods may be used. In some cases,

Table 4-1
General Geotechnical and Hydrological Analysis

Geotechnical Parameter	Methods
Initial moisture content	ASTM[a] D 2216-92
Dry bulk density	ASTM[a] D 2937-94
Calculated porosity	EM[b]-1110-2-1906 or MOSA[c] Chp. 18
Saturated hydraulic conductivity	ASTM[a] 2434-68(74) MOSA[c] Chp. 28
Unsaturated hydraulic conductivity	van Genuchten[d]
Particle-size distribution	ASTM[a] D 422-63(90)
Water-release (moisture retention) curve	MOSA[c] Chp. 26 ASTM[a] D 2325-68(94) MOSA[c] Chp. 24 Karanthanasis and Hajek[e]

[a] American Society for Testing and Materials (ASTM), 1996
[b] U.S. Army Corps of Engineers (USACE), 1970
[c] Methods of Soil Analysis (MOSA) (Soil Science Society of America, 1986)
[d] van Genuchten, 1980
[e] Karathanasis and Hajek, 1982

bioassessment will also be performed on the sample material. Bioassessment is a series of tests designed to evaluate the physical, chemical, and microbiological characteristics of a site. Bioassessment tests include determinants of nutrient availability, pH, microbial population density, and the ability of the microbial population to grow under enhanced conditions. This type of analysis is most appropriate for hydrocarbon contamination sites where bioremediation is a potential corrective action. Bioassessment samples may be collected if biasing factors suggests a fuel or solvent plume may be present.

4.6 Safety

A current version of the Environmental Architect-Engineer Services Contractor's HASP will accompany the field documents, and a site-specific health and safety plan (SSHASP) will be prepared and approved prior to the field effort. As required by the DOE Integrated Safety Management System (ISMS) **(**DOE/NV, 1997**)**, these documents outline the requirements for protecting the health and safety of the workers and the public, and the procedures for protecting the environment. The ISMS program requires that site personnel will reduce or eliminate the possibility of injury, illness, or accidents, and to protect the environment during all project activities. The following safety issues will be taken into consideration when evaluating the hazards and associated control procedures for field activities discussed in the SSHASP:

- Potential hazards to site personnel and the public include, but are not limited to: radionuclides, chemicals (e.g., heavy metals, VOCs, semivolatile organic compounds [SVOCs], and petroleum hydrocarbons), adverse and rapidly changing weather, remote location, and motor vehicle and heavy equipment operations.

- Proper training of all site personnel to recognize and mitigate the anticipated hazards.

- Work controls to reduce or eliminate the hazards including engineering controls, substitution of less hazardous materials, and use of appropriate personal protective equipment (PPE).

- Occupational exposure monitoring to prevent overexposures to hazards such as radionuclides, chemicals, and physical agents (e.g., heat, cold, and high wind).

- Radiological surveying for alpha/beta and gamma emitters to minimize and/or control personnel exposures; use of the “as-low-as-reasonably-achievable” principle when dealing with radiological hazards.

- Emergency and contingency planning to include medical care and evacuation, decontamination, spill control measures, and appropriate notification of project management. The same principles apply to emergency communications.

5.0 Waste Management

Management of IDW will be based on regulatory requirements, field observations, process knowledge, and the results of laboratory analysis of CAU 536 investigation samples.

Disposable sampling equipment, PPE, and rinsate are considered potentially contaminated waste only by virtue of contact with potentially contaminated media (e.g., soil) or potentially contaminated debris (e.g., construction materials). Therefore, sampling and analysis of IDW, separate from analysis of site investigation samples, may not be necessary for all IDW. However, if associated investigation samples are found to contain contaminant above regulatory levels, direct samples of IDW may be taken to support waste characterization.

Sanitary, hazardous, radioactive, and/or mixed waste, if generated, will be managed and disposed of in accordance with DOE Orders, U.S. Department of Transportation (DOT) regulations, state and federal waste regulations, and agreements and permits between DOE and the NDEP.

5.1 Waste Minimization

Investigation activities are planned to minimize IDW generation. This will be accomplished by incorporating the use of process knowledge, visual examination, and/or radiological survey and swipe results. When possible, disturbed media (e.g., soil removed during trenching) or debris will be returned to it original location. Contained media (e.g., soil managed as waste), as well as other IDW, will be segregated to the greatest extent possible to minimize generation of hazardous, radioactive, or mixed waste. Hazardous material used at the sites will be controlled in order to limit unnecessary generation of hazardous or mixed waste. Administrative controls, including decontamination procedures and waste characterization strategies, will minimize waste generated during investigations.

5.2 Potential Waste Streams

Process/historical knowledge was reviewed during the DQO process to identify suspect contaminants that may have been released at a particular site and to identify waste types that may be generated during the investigation process. The types of IDW that may be generated include low-level radioactive waste (LLW), mixed wastes (LLW and hazardous waste), radioactive waste, hydrocarbon waste, hazardous waste, and sanitary waste. Investigation-derived wastes typically generated during investigation activities may include one or more of the following:

- Media (e.g., soil)
- PPE and disposable sampling equipment (e.g., plastic, paper, sample containers, aluminum foil, spoons, bowls)
- Decontamination rinsate
- Field-screening waste (e.g., soil, spent solvent, rinsate, disposable sampling equipment, and PPE contaminated by field-screening activities)
- Construction or other nonhazardous debris

Each waste stream generated will be segregated, and further segregation may occur within each waste stream. Waste will be traceable to its source and associated environmental media samples.

5.3 Investigation-Derived Waste Management

The on-site management and ultimate disposition of IDW may be guided by several factors, including, but not limited to: the analytical results of samples either directly or indirectly associated with the waste, historical site knowledge, knowledge of the waste generation process, field observations, field-monitoring/screening results, and/or survey/swipe results. Table 4-2 of the *NV/YMP Radiological Control Manual* (DOE/NV, 2000) shall be used to determine if such materials may be declared nonradioactive. On-site IDW management requirements by waste type are detailed in the following sections. Applicable waste management regulations and requirements are listed in Table 5-1.

Waste generated during the investigation activities will include the following potential waste forms:

- PPE and disposable sampling equipment (e.g., plastic, paper, sample containers, aluminum foil, spoons, bowls)
- Decontamination rinsate
- Environmental media (e.g., soil)

Table 5-1
Waste Management Regulations and Requirements

Waste Type	Federal Regulation	Additional Requirements
Solid (nonhazardous)	NA	NRS 444.440 - 444.620[a] NAC 444.570 - 444.7499[b] NTS Landfill Permit SW13.097.04[c] NTS Landfill Permit SW13.097.03[d]
Liquid/Rinsate (nonhazardous)	NA	Water Pollution Control General Permit GNEV93001, Rev. 3iii[e]
Hazardous	RCRA[f]	NRS 459.400 - 459.600[g] NAC 444.850 - 444.8746[h] POC[i]
Low-Level Radioactive	NA	DOE Orders and NTSWAC[j]
Mixed	RCRA[f]	NTSWAC[j] POC[i]
Hydrocarbon	NA	NAC 445A.2272[k] NTS Landfill permit SW13.097.02[l]
Polychlorinated Biphenyls	TSCA[m]	NRS 459.400 - 459.600[g] NAC 444.940 - 444.9555[o]
Asbestos	RCRA[f] 29 CFR 1926.1101[q] TSCA[n]	NAC 444.965 - 444.976[p]

[a] *Nevada Revised Statutes* (NRS, 2001a)
[b] *Nevada Administrative Code* (NAC, 2002a)
[c] Area 23 Class II Solid Waste Disposal Site (NDEP, 1997)
[d] *Area 9 Class III Solid Waste Disposal Site*, Revision 4 *(*NDEP, 2002b)
[e] *Nevada Test Site Sewage Lagoons* (NDEP, 1999)
[f] *Resource Conservation and Recovery Act* (CFR, 2002a)
[g] *Nevada Revised Statutes* (2001b)
[h] *Nevada Administrative Code* (2002b)
[i] *Performance Objective for the Certification of Nonradioactive Hazardous Waste* (BN, 1995)
[j] *Nevada Test Site Waste Acceptance Criteria*, Revision 4 (NNSA/NV, 2002b)
[k] *Nevada Administrative Code* (2002e)
[l] *Area 6 Class III Solid Waste Disposal Site for Hydrocarbon*, Revision 4 (NDEP, 2002a)
[m] *Toxic Substance Control Act* (CFR, 2002b)
[n] *Toxic Substance Control Act* (CFR, 2002c)
[o] *Nevada Administrative Code* (2002c)
[p] *Nevada Administrative Code* (NAC, 2002d)
[q] Occupational Safety and Health Administration (CFR, 2002d)

NA = Not applicable
TSCA = *Toxic Substance Control Act*
NTSWAC = Nevada Test Site Waste Acceptance Criteria
POC = Performance Objective Criteria

- Surface debris in investigation area
- Field screening waste (e.g., soil, spent solvent, rinsate, disposable sampling equipment, and PPE contaminate by field-screening activities)

Each waste form generated will be reviewed and segregated at the point of generation.

5.3.1 Sanitary Waste

Office trash and lunch waste will be sent to the sanitary landfill via disposal in the dumpster.

Sanitary IDW generated at CAS 03-44-02 will be collected in plastic bags, sealed, labeled with the CAS number, and dated. The waste will then be placed in a rolloff box located in Mercury, or other approved rolloff box location. The number of bags of sanitary IDW placed in the rolloff box will be counted as they are placed in the rolloff box, noted in a log, and documented in the field activity daily log (FADL). These logs will provide necessary tracking information for ultimate disposal in the 10c Industrial Waste Landfill or other approved landfill.

5.3.1.1 Special Sanitary Waste

Hydrocarbon waste is defined as waste containing more than 100 mg/kg of TPH contamination (NAC, 2002e). Hydrocarbon waste will be managed on site in a drum or other appropriate container until fully characterized. Hydrocarbon waste may be disposed of at a designated hydrocarbon landfill (NDEP, 1997), an appropriate hydrocarbon waste management facility (e.g., recycling facility), or other methods in accordance with State of Nevada regulations.

Regulated asbestos-containing materials that may be encountered or generated during this investigation will be managed and disposed of in accordance with appropriate federal (CFR, 2002c) and State of Nevada regulations (NAC, 2002d).

Materials that are thought to potentially contain the hantavirus will be managed and disposed in accordance with appropriate health and safety procedures.

5.3.2 Hazardous Waste

Corrective Action Unit 536 will have waste accumulation areas established according to the needs of the project. Satellite accumulation areas (SAAs) and hazardous waste accumulation areas (HWAAs) will be managed consistent with the requirements of federal and state regulations (CFR, 2002a; NAC, 2002b). The HWAAs will be properly controlled for access and equipped with spill kits and appropriate spill containment. Suspected hazardous wastes will be placed in DOT-compliant containers. All containerized waste will be handled, inspected, and managed in accordance with Title 40 *Code of Federal Regulations* (CFR) 265, Subpart I (CFR, 2002a). These provision include managing the waste in containers compatible with the waste type, and segregating incompatible waste types so that in the event of a spill, leak, or release, incompatible waste shall not contact one another.

The HWAAs will be covered under a site-specific emergency response and contingency action plan until such time that the waste is determined to be nonhazardous or all containers of hazardous waste have been removed from the storage area. Hazardous wastes will be characterized in accordance with the requirements of Title 40 CFR 261. *Resource Conservation and Recovery Act* “listed” waste has not been identified at CAU 536. Any waste determined to be hazardous will be managed and transported in accordance with RCRA and DOT regulations to a permitted treatment, storage, and disposal facility (CFR, 2002a).

***Management of Personal Protective Equipment and Disposable Sampling Equipment* -** PPE and disposable sampling equipment will be visually inspected for stains, discoloration, and gross contamination as the waste is generated and evaluated for radiological contamination. Staining and/or discoloration will be assumed to be the result of contact with potentially contaminated media (e.g., soil, sludge, or liquid). Gross contamination is the visible contamination on an item (e.g., clumps of soil/sludge on a sampling scope or free liquid smeared on a glove). While gross contamination can often be removed through decontamination procedures, removal of gross contamination from small items, such as gloves or booties, is not typically conducted. Any IDW that meets this description will be segregated and managed as potentially “characteristic” hazardous waste. This segregated population of waste will either be (1) assigned the characterization of the soil/sludge that was sampled, (2) sampled directly, or (3) undergo further evaluation using the soil/sludge sample results to determine how much soil/sludge would need to be present in the waste to exceed regulatory levels. Waste that is determined to be hazardous will be entered into an approved waste management system, where it will be managed and dispositioned according to RCRA requirements or subject to agreements between NNSA/NSO and the State of Nevada. The PPE/equipment that is not visibly stained, discolored, or grossly contaminated will be managed as nonhazardous sanitary waste.

***Management of Decontamination Rinsate* -** The rinsates at this CAU will not be considered hazardous waste unless there is evidence that the rinsate would display a RCRA characteristic. Evidence may include such things as the presence of visible sheen, high or low pH, or association with equipment/materials used to respond to a release/spill of a hazardous waste/substance. Decontamination rinsate that is potentially hazardous (using associated sample results and/or process knowledge) will be managed as "characteristic" hazardous waste (CFR, 2002a). The regulatory status of the potentially hazardous rinsate will be determined through the application of associated sample results or through direct sampling. If determined to be hazardous, the rinsate will be entered into an approved waste management system, where it will be managed and dispositioned according to RCRA requirements or subject to agreements between NNSA/NSO and the State of Nevada. If the associated samples do not indicate the presence of hazardous constituents, the rinsate will be considered to be nonhazardous.

The disposal of nonhazardous rinsate will be consistent with guidance established in current NNA/NSO fluid management plans for the NTS as follows:

- Rinsate that is determined to be nonhazardous and contaminated to less than 5x *Safe Drinking Water Standards* (SDWS) is not restricted as to disposal. Nonhazardous rinsate which is contaminated at 5x to 10x will be disposed of in an established infiltration basin or solidified and disposed of as sanitary waste or low-level waste in accordance with the respective section of this document.
- Nonhazardous rinsate which is contaminated at levels greater than 10x SDWS will be disposed of in a lined basin or solidified and disposed of as sanitary waste or low-level waste in accordance with the respective section of this document.

***Management of Soil* -** This waste stream consists of soil produced during soil sampling, excavation, and/or drilling. This waste stream is considered to have the same COPCs as the material remaining in the ground. The preferred method for managing this waste stream is to place the material back into the borehole/excavation in the same approximate location from which it originated. If this cannot be accomplished, the material will either be managed on site by berming and covering next to the excavation, or by placement in a container(s). The disposal of soil may be deferred until implementation of corrective actions at the site.

***Management of Debris* -** This waste stream can vary depending on site conditions. Debris that requires removal for the investigation activities (e.g., soil sampling, excavation, and/or drilling) must be characterized for proper management and disposition. Historical site knowledge, knowledge of the waste generation process, field observation, field-monitoring/screening results, radiological survey/swipe results, and/or the analytical results of samples either directly or indirectly associated with the waste will be used to characterized the debris. Debris will be visually inspected for stains, discoloration, and gross contamination. Debris may be deemed reusable, recyclable, sanitary waste, hazardous waste, PCB waste, or low-level waste. Waste that is not sanitary may be entered into an approved waste management system, where it will be managed and dispositioned according to Federal, state requirements, and agreements between NNSA/NSO and the State of Nevada. The debris will wither be managed on site by berming and covering next to the excavation, or by placement in a container(s). The disposal of debris may be deferred until implementation of corrective actions at the site.

***Field Screening Wastes* -** The use of field test kits and/or instruments may result in the generation of small quantities of hazardous wastes. If hazardous waste is produced by field screening, it will be segregated from other IDW and managed in accordance with the hazardous waste regulations (CFR, 2002a). At radiological sites, this may increase the potential to generate mixed waste; however, the generation of mixed waste will be minimized as much as practicable. In the event a mixed waste is generated, the waste will be managed in accordance with the mixed waste section of this document.

5.3.3 Polychlorinated Biphenyls

The management of PCBs is governed by the *Toxic Substances Control Act* (TSCA) and its implementing regulations is 40 CFR 761 (CFR, 2002b). Polychlorinated biphenyls contamination may be found as a sole contaminant or in combination with any of the types of waste discussed in this document. For example, PCBs may be a co-contaminant in soil that contains a RCRA "characteristic" waste (PCB/hazardous waste), or in soil that contains radioactive wastes

(PCB/radioactive waste), or even in mixed waste (PCB/radioactive/hazardous waste). The IDW will initially be evaluated using analytical results for media samples from the investigation. If any type of PCB waste is generated, it will be managed according to 40 CFR 761 (CFR, 2002b) as well as State of Nevada requirements (NAC, 2002c), regulatory guidance, and agreements with NNSA/NSO.

5.3.4 Low-Level Waste

Radiological swipe surveys and/or direct-scan surveys may be conducted on reusable sampling equipment, PPE, and disposable sampling equipment waste streams exiting a radiologically controlled area. This allows for the immediate segregation of radioactive waste from waste that may be unrestricted regarding radiological release. Removable contamination limits, as defined in Table 4-2 of the current version of the *NV/YMP Radiological Control Manual* (DOE/NV, 2000), will be used to determine if such waste may be declared unrestricted regarding radiological release versus being declared radioactive waste. Direct sampling of the waste may be conducted to aid in determining if a particular waste unit (e.g., drum of soil) contains LLW, as necessary. Waste that is determined to be below the values of Table 4-2, by either direct radiological survey/swipe results or through process knowledge, will not be managed as potential radioactive waste but will be managed in accordance with the appropriate section of this document. Waste in excess of Table 4-2 values will be managed as potentially radioactive waste and be managed in accordance with this section and any other applicable section of this document.

Low-level radioactive waste, if generated, will be managed in accordance with the contractor-specific waste certification program, DOE Orders, and the requirements of the current version of the *Nevada Test Site Waste Acceptance Criteria* (NTSWAC) (NNSA/NV, 2002b). Potential radioactive waste drums containing soil, PPE, disposable sampling equipment, and/or rinsate will be staged at a designated radioactive materials area (RMA) within a radiologically controlled area (RCA) when full or at the end of an investigation phase. The waste drums will remain at the RMA pending certification and disposal under NTSWAC requirements (NNSA/NV, 2002b).

5.3.5 Mixed Waste

Mixed waste, if generated, shall be managed and dispositioned according to the requirements of RCRA (CFR, 2002a) or subject to agreements between NNSA/NSO and the State of Nevada, as well as DOE requirements for radioactive waste. The waste will be marked with the words “Hazardous Waste Pending Analysis and Radioactive Waste Pending Analysis.” Waste characterized as mixed will not be stored for a period of time that exceeds the requirements of RCRA unless subject to agreements between NNSA/NSO and the State of Nevada. The mixed waste shall be transported via an approved hazardous waste/radioactive waste transporter to the NTS transuranic waste storage pad for storage pending treatment or disposal. Mixed waste with hazardous waste constituents below land disposal restrictions may be disposed of at the NTS Area 5 Radioactive Waste Management Site (RWMS) if the waste meets the requirements of the NTSWAC (NNSA/NV, 2002b), the NTS’s NDEP Permit for a Hazardous Waste Management Facility, NEV HW0009 (NDEP, 2000b) and the (*RCRA Part B Permit Application for Waste Management Activities at the Nevada Test Site*) (DOE, 1999). Mixed waste not meeting Land Disposal Restrictions will require development of a treatment and disposal plan under the requirements of the *Mutual Consent Agreement* between DOE and the State of Nevada (NDEP, 1995).

6.0 Quality Assurance/Quality Control

The primary objective of the characterization activities described in this CAIP is to collect accurate and defensible data to support the selection and implementation of a closure alternative for CAS 03-44-02 in CAU 536. Section 6.1 and Section 6.2 discuss the collection of required QC samples in the field and QA requirements for laboratory/analytical data to achieve closure, respectively. Section 6.3 provides QA/QC requirements for radiological survey data. Data collected during the corrective action investigation will be evaluated against DQI-specific performance criteria to verify that the DQOs established during the DQO process (Appendix A.1) have been satisfied.

Unless otherwise stated in this CAIP or required by the results of the DQO process (Appendix A.1), this investigation will adhere to the Industrial Sites QAPP (NNSA/NV, 2002a).

6.1 Quality Control Field Sampling Activities

Field QC samples will be collected in accordance with established procedures. Field QC samples are collected and analyzed to aid in determining the validity of sample results. The number of required QC samples depends on the types and number of environmental samples collected. The minimum frequency of collecting and analyzing QC samples for this investigation, as determined in the DQO process, include:

- Trip blanks (one per sample cooler containing VOC environmental samples)
- Equipment blanks (one per sampling event for each type of decontamination procedure)
- Source blanks (one 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 collected)
- Field blanks (1 per 20 environmental samples)
- Matrix spike (MS)/matrix spike duplicate (MSD) (1 per 20 environmental samples or 1 per CAS per matrix, if less than 20 collected, not required for all radionuclide measurements)

Additional QC samples may be submitted based on site conditions at the discretion of the Site Supervisor. Field QC samples shall be analyzed using the same analytical procedures implemented for associated environmental samples. Additional details regarding field QC samples are available in the Industrial Sites QAPP (NNSA/NV, 2002a).

6.2 Laboratory/Analytical Quality Assurance

Criteria for the investigation, as stated in the DQOs (Appendix A.1) and except where noted, require laboratory analytical quality data to be used for making critical decisions. Rigorous QA/QC will be implemented for all laboratory samples including documentation, data verification and validation of analytical results, and an assessment of DQIs as they relate to laboratory analysis.

6.2.1 Data Validation

Data verification and validation will be performed in accordance with the Industrial Sites QAPP (NNSA/NV, 2002a), except where otherwise stipulated in this CAIP. All nonradiological laboratory data from samples collected and analyzed will be evaluated for data quality according to *EPA Functional Guidelin*es (EPA, 1994a and 1999). Radiological laboratory data from samples that are collected and analyzed will be evaluated for data quality according to company-specific procedures. The data will be reviewed to ensure that all critical samples were appropriately collected, analyzed, and the results passed data validation criteria. Validated data, including estimated data (i.e., J-qualified), will be assessed to determine if they meet the DQO requirements of the investigation and the performance criteria for the DQIs. The results of this assessment will be documented in the CADD. If the DQOs were not met, corrective actions will be evaluated, selected, and implemented (e.g., refine CSM or resample to fill data gaps).

6.2.2 Data Quality Indicators

Data quality indicators are qualitative and quantitative descriptors used in interpreting the degree of acceptability or utility of data. The principal DQIs are precision, accuracy, representativeness, comparability, and completeness. A sixth DQI, sensitivity, has also been included for the CAU 536 investigation. Data quality indicators are used to evaluate the entire measurement system and laboratory measurement processes (i.e., analytical method performance) as well as to evaluate individual analytical results (i.e., parameter performance). The performance criteria for each indicator has been selected based on the intended use of the data, current field and analytical procedures, and instrumentation. Laboratory quality control samples used to measure precision and accuracy of analytical procedures shall be analyzed using the same analytical procedures implemented for environmental samples. Additional details regarding DQIs and laboratory QC samples are available in the Industrial Sites QAPP (NNSA/NV, 2002a).

Precision and accuracy are quantitative measures used to assess overall analytical method and field sampling performance as well as to assess the need to “flag” (qualify) individual parameter results when corresponding QC sample results are not within established control limits. Therefore, performance metrics have been established for both analytical methods and individual analytical results. Data qualified as estimated for reasons of precision or accuracy may be considered to meet the parameter performance criteria based on assessment of the data.

Representativeness and comparability are qualitative measures, and completeness is a combination of both quantitative and qualitative measures. Representativeness, comparability, and completeness are used to assess the measurement system performance. The DQI parameters are individually discussed in Section 6.2.3 through Section 6.2.8.

Table 6-1 provides the established analytical method/measurement system performance criteria for each of the DQIs and the potential impacts to the decision if the criteria are not met. The Industrial Sites QAPP (NNSA/NV, 2002a) documents the actions required to correct conditions that adversely affect data quality both in the field and the laboratory. All DQI performance criteria deficiencies will be evaluated for data usability and impacts to the DQO decisions. These evaluations will be discussed and documented in the data assessment section of the CADD. The following subsections discuss each of the DQIs that will be used to assess the quality of laboratory data.

6.2.3 Precision

Precision is used to assess the variability of a population of measurements with the variability of the analysis process. It is used to evaluate the performance of analytical methods as well as to evaluate the usability of individual analytical results. Precision is a measure of agreement among a replicate set of measurements of the same property under similar conditions. This agreement is expressed as the relative percent difference (RPD) between duplicate measurements. The method used to calculate RPD is presented in the Industrial Sites QAPP (NNSA/NV, 2002a).

Table 6-1
Laboratory and Analytical Performance Criteria for CAU 536 Data Quality Indicators

Data Quality Indicator	Performance Criteria	Potential Impact on Decision if Performance Criteria Not Met
Precision	Variations between duplicates (laboratory and field) and original sample should not exceed analytical method-specific criteria discussed in Section 6.2.3.	Data that do not meet the performance criteria will be evaluated for purposes of completeness. Decisions may not be valid if analytical method performance criteria for precision are not met.
Accuracy	Laboratory control sample results and matrix spike results should be within specified acceptance windows.	Data that do not meet the performance criteria will be evaluated for purposes of completeness. Decisions may not be valid if analytical method performance criteria for accuracy are not met.
Sensitivity	Detection limits of laboratory instruments must be less than or equal to respective PALs.	Cannot determine if COCs are present or migrating at levels of concern; therefore, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives.
Comparability	Equivalent samples analyzed using same analytical methods, the same units of measurement and detection limits must be used for like analyses.	Inability to combine data with data obtained from other sources and/or inability to compare data to regulatory action levels.
Representativeness	Correct analytical method performed for appropriate COPC; valid data reflects appropriate target population.	Cannot identify COC or estimate concentration of COC; therefore, cannot make decision(s) on target population.
Nature Completeness	80% of the CAS-specific noncritical analytes identified in the CAIP have valid results. 90% of critical analytes are valid.	Cannot make decision on whether COCs are present.
Extent Completeness	90% of critical analytes used to define extent of COCs are valid.	Extent of contamination cannot be determined.
Clean Closure Completeness	90% of critical analytes are valid.	Cannot determine if COCs remain in soil.

Determinations of precision will be made for field duplicate samples and laboratory duplicate samples. Field duplicate samples will be collected simultaneously with samples from the same source under similar conditions in separate containers. The duplicate sample is treated independently of the original sample in order to assess field impacts and laboratory performance on precision through a comparison of results. Laboratory precision is evaluated as part of the required laboratory internal QC program to assess performance of analytical procedures. The laboratory sample duplicates are an aliquot, or subset, of a field sample generated in the laboratory. They are not a separate sample but a split, or portion, of an existing sample. Typically, laboratory duplicate QC samples include MSD and laboratory control sample (LCS) duplicate samples for organic, inorganic, and radiological analyses.

6.2.3.1 Precision for Chemical Analysis

The RPD criteria to be used for assessment of precision are the parameter-specific criteria listed in Table 3-2. When laboratory-specific control limits are indicated, they are based on the evaluation at the laboratory on a quarterly basis by monitoring the historical data and performance for each method. No review criteria for field duplicate RPD comparability have been established; therefore, the laboratory sample duplicate criteria will be applied to the review of field duplicates.

The parameter performance criteria for precision will be compared to RPD results of duplicate samples. This will be accomplished as part of the data validation process. Precision values for organic and inorganic analyses that are within the established control criteria indicate that analytical results for associated samples are valid. The RPD values that are outside the criteria for organic analysis do not necessarily result in the qualification of analytical data. It is only one factor in making an overall judgment about the quality of the reported analytical results. For the purpose of data validation of inorganic analyses, precision is measured in two ways. The RPD is calculated when the sample and its duplicate results are greater than 5 times the contract-required detection limit (CRDL). The absolute difference is calculated and applied to the CRDL when the results are less than 5 times the CRDL. Inorganic laboratory sample duplicate RPD values outside the established control criteria result in the qualification of associated analytical results as estimated; however, qualified data does not necessarily indicate that the data are not useful for the purpose intended. This qualification is an indication that data precision should be considered for the overall assessment of the data quality and potential impact on data applicability in meeting site characterization objectives.

The criteria to evaluate analytical method performance for precision (Table 6-1) will be assessed based on the analytical method-specific (e.g., VOCs) precision measurements. The analytical method-specific precision measurement is calculated by taking the number of analyses meeting the RPD criteria, dividing that by the total number of analyses with detectable concentrations, and multiplying by 100. Each analytical method-specific precision measurement will be assessed for potential impacts on meeting site characterization objectives, and results of the assessment will be documented in the CADD.

6.2.3.2 Precision for Radiochemical Analysis

The parameter performance criteria for precision will be compared to the RPD or normalized difference (ND) results of duplicate samples. The criteria for assessment of the radiochemical precision are parameter-specific criteria (see Table 3-2). This assessment will be accomplished as part of the data validation process. Precision values that are within the established control criteria indicate that analytical results for associated samples are valid. Out of control RPD or ND values do not necessarily indicate that the data are not useful for the purpose intended; however, it is an indication that data precision should be considered for the overall assessment of the data quality and the potential impact on data applicability in meeting site characterization objectives.

If the RPD or ND criteria are exceeded, samples will be qualified. Field duplicates will be evaluated, but field samples will not be qualified based on their results. The MSD results outside the control limits may not result in qualification of the data. An assessment of the entire analytical process, including the sample matrix, is conducted to determine if qualification is warranted.

The evaluation of precision based on duplicate RPD requires that both the sample and its duplicate have concentrations of the target radionuclide exceeding five times their MDC. This excludes many measurements because the samples contain nondetectable or low levels of the target radionuclide. However, the ND method may be used for evaluating duplicate data where the results are less than five times their MDCs. This is based on the measurement uncertainty associated with low-level results. The ND test is calculated using the following formula:

Normalized Difference = $S - D / \sqrt{(TPU_S)^2 + (TPU_D)^2}$

Where:

S = Sample Result
D = Duplicate result
TPU = Total Propagated Uncertainty
TPUs = 2 sigma TPU of the sample
TPUd = 2 sigma TPU of the duplicate

The control limit for the normalized difference is -1.96 to 1.96, which represents a confidence level of 95 percent.

The criteria to evaluate analytical method performance for precision (Table 6-1) will be based on the analytical method-specific (e.g., gamma spectrometry) precision measurements. Analytical method-specific precision measurement is calculated by taking the number of analyses meeting the RPD or ND criteria, dividing that by the total number of analyses, and multiplying by 100. Each analytical method-specific precision measurement will be assessed for potential impacts on meeting site characterization objectives, and results of the assessment will be documented in the CADD.

6.2.4 Accuracy

Accuracy is a measure of the closeness of an individual measurement or the average of a number of measurements to the true value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that result from sampling and analytical operations. It is used to assess the performance of laboratory measurement processes as well as to evaluate individual groups of analyses (i.e., sample delivery groups).

Accuracy is determined by analyzing a reference material of known parameter concentration or by reanalyzing a sample to which a material of known concentration or amount of parameter has been added (spiked). The measure of accuracy is expressed as the percent recovery (%R) (NNSA/NV, 2002a). This is calculated by dividing the measured sample concentration by the true concentration and multiplying the quotient by 100.

6.2.4.1 Accuracy for Chemical Analyses

The %R criteria to be used for assessment of accuracy are the parameter-specific criteria listed in Table 3-2. Accuracy for chemical analyses will be evaluated based on results from three types of spiked samples: MS, LCS, and surrogates. Matrix spike samples are prepared by adding a known concentration of a target parameter to a specified amount of matrix sample for which an independent estimate of the target parameter concentration is available. Laboratory control samples are prepared by adding a known concentration of a target parameter to a “clean” sample matrix (does not contain the target parameter). Surrogate samples are prepared by adding known concentrations of specific organic compounds to each sample analyzed for organic analyses (including QC samples).

For organic analyses, laboratory control limits are used for evaluation of %R. They are reevaluated quarterly at the laboratory by monitoring the historical data and performance for each method. The acceptable control limits for inorganic analyses are established in the EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 1994a).

The %R parameter performance criteria for accuracy will be compared to %R results of spiked samples. This will be accomplished as part of the data validation process. Accuracy values for organic and inorganic analysis that are within the established control criteria indicate that analytical results for associated samples are valid. The %R values that are outside the criteria do not necessarily result in the qualification of analytical data. It is only one factor in making an overall judgment about the quality of the reported analytical results. Factors beyond the laboratory's control, such as sample matrix effects, can cause the measured values to be outside of the established criteria. Therefore, the entire sampling and analytical process must be evaluated when determining the quality of the analytical data provided.

The criteria to evaluate analytical method performance for accuracy (Table 6-1) will be based on the analytical method-specific (e.g., VOCs) accuracy measurements. The analytical method-specific accuracy measurement is calculated by taking the number of analyses meeting the %R criteria, dividing that by the total number of analyses, and multiplying by 100. Each analytical method-specific accuracy measurement will be assessed for potential impacts on meeting site characterization objectives, and results of the assessment will be documented in the CADD.

6.2.4.2 Accuracy for Radiochemical Analysis

Accuracy for radiochemical analyses will be evaluated based on results from LCS and MS samples. The LCS is prepared by adding a known concentration of the radionuclide being measured to a sample that does not contain radioactivity (i.e., distilled water). This sample is analyzed with the field samples using the same sample preparation, reagents, and analytical methods employed for the samples. One LCS is prepared with each batch of samples for analysis by a specific measurement.

The MS samples are prepared by adding a known concentration of a target parameter to a specified field sample with a measured concentration. The MS samples are analyzed to determine if the measurement accuracy is affected by the sample matrix. The MS samples are analyzed with sample batches when requested.

The %R criteria to be used for assessment of accuracy will be the control limits for radiochemical analyses listed in Table 3-2. These criteria will be used to assess qualification of data associated with each spiked sample. This will be accomplished as part of the data validation process. Accuracy values that are within the established control criteria indicate that analytical results for associated samples are valid.

The criteria to evaluate analytical method performance for accuracy (Table 6-1) will be assessed based on the analytical method-specific (e.g., gamma spectrometry) accuracy measurements. The analytical method-specific accuracy measurement is calculated by taking the number of analyses meeting the %R criteria, dividing that by the total number of analyses, and multiplying by 100. Each analytical method-specific accuracy performance will be assessed for potential impacts on meeting site characterization objectives, and results of the assessment will be documented in the CADD.

6.2.5 Representativeness

Representativeness is a qualitative evaluation of measurement system performance. It is the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition (EPA, 1987). Representativeness is assured by a carefully developed sampling strategy, collecting the specified number of samples from proper sampling locations, and analyzing them by the approved analytical methods. An evaluation of this qualitative criterion will be presented in the CADD.

6.2.6 Completeness

Completeness is a quantitative and qualitative evaluation of measurement system performance. The criterion for meeting completeness is defined as generating sufficient data of the appropriate quality to satisfy the data needs identified in the DQOs. The quantitative measurement to be used to evaluate completeness is presented in Table 6-1 and is based on the percentage of measurements made that are judged to be valid. Percent completeness is determined by dividing the total number of valid analyses by the total number of analyses required to meet DQO data needs and multiplying by 100. Problems that may affect completeness include total number of samples sent to the laboratory but not analyzed due to problems with samples (e.g., broken bottles, insufficient quantity, insufficient preservation), samples that were collected and sent but never received by the laboratory, and rejected data. If these criteria are not achieved, the dataset will be assessed for potential impacts on meeting site characterization objectives.

The qualitative criterion for evaluation of measurement system performance is that sufficient data of the appropriate quality have been generated to satisfy the data needs identified in the DQOs. An evaluation of this qualitative criterion will be presented in the CADD.

6.2.7 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another (EPA, 1987). To ensure comparability, all samples will be subjected to the same sampling, handling, preparation, analysis, reporting, and validation criteria. Approved standard methods and procedures will also be used to analyze and report the data (e.g., Contract Laboratory Program [CLP] and/or CLP-like data packages). An evaluation of this qualitative criterion will be presented in the CADD.

6.2.8 Sensitivity

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest (EPA, 2001). The evaluation criteria for this parameter will be that measurement sensitivity (detection limits) will be less than or equal to the corresponding PALs. If this criterion is not achieved, the affected data will be assessed for usability and potential impacts on meeting site characterization objectives.

6.3 Radiological Survey Quality Assurance

Radiological surveys will be performed and data collected in accordance with approved standard operating procedures.

7.0 Duration and Records Availability

7.1 Duration

After the submittal of the CAIP to NDEP (FFACO milestone date of June 30, 2003), the following is a tentative schedule of activities (in calendar days):

- Day 0: Preparation for field work will begin.
- Day 120: The field work will commence. Samples will be shipped to meet laboratory holding times.
- Day 200: The field investigation will be completed.
- Day 260: The quality-assured laboratory analytical data will be available for NDEP review.
- The FFACO milestone date for the CADD has been established at December 31, 2004.

7.2 Records Availability

Historic information and documents referenced in this plan are retained in the NNSA/NSO project files in Las Vegas, Nevada, and can be obtained through written request to the NNSA/NSO Project Manager. This document is available in the DOE public reading rooms located in Las Vegas and Carson City, Nevada, or by contacting the DOE Project Manager. The NDEP maintains the official Administrative Record for all activities conducted under the auspices of the FFACO.

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Appendix A.1

Data Quality Objectives

A.1 Seven-Step DQO Process for CAU 536 Investigation

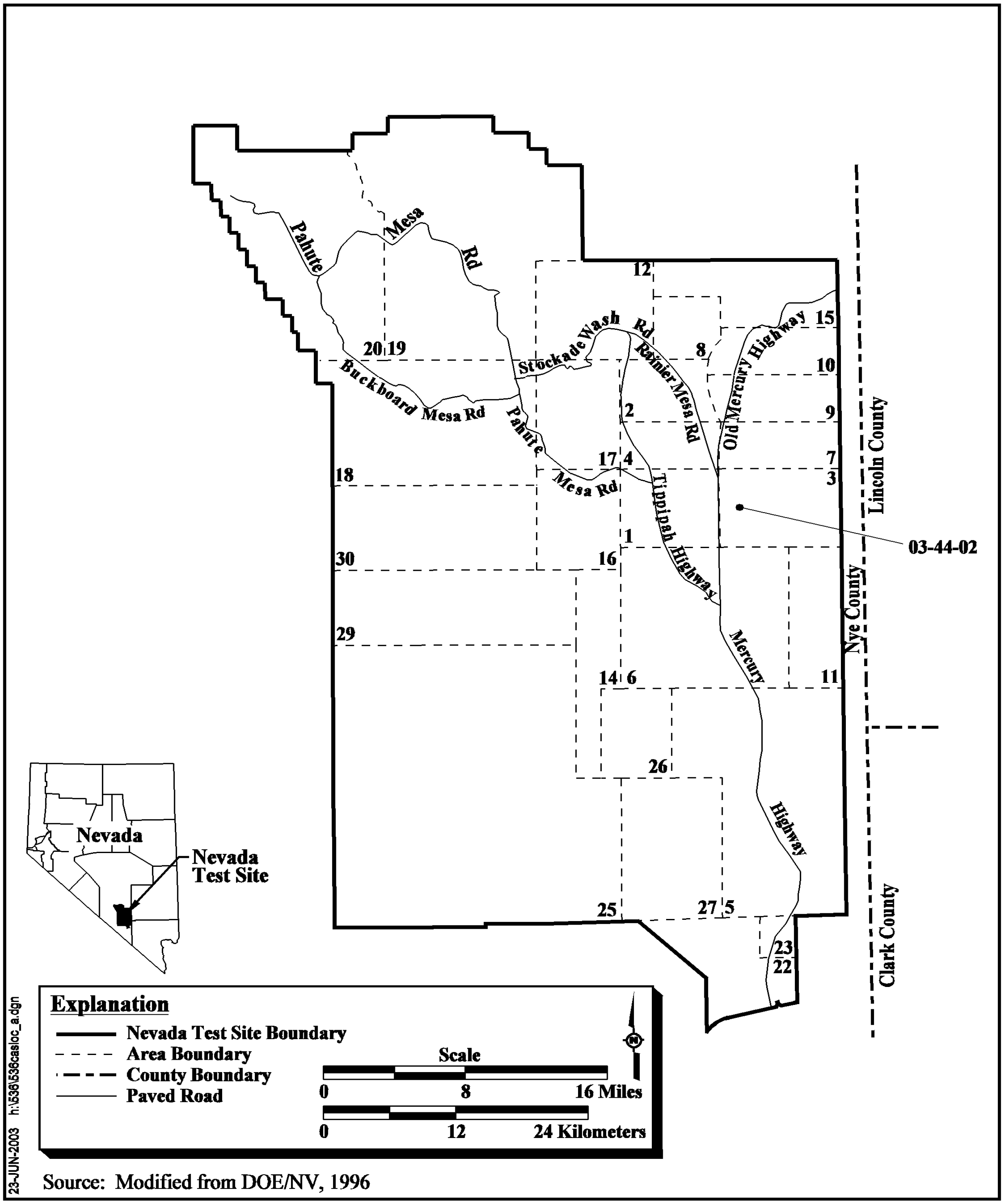
The DQO process described in this appendix is a seven-step strategic planning approach based on the scientific method used to plan data collection activities at CAU 536, Area 3 Release Site. The DQOs are designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically evaluate the recommended corrective actions (i.e., no further action, closure in place, or clean closure). Existing information about the nature and extent of contamination at the CAS in CAU 536 is insufficient to evaluate and select preferred corrective actions; therefore, a CAI will be conducted.

The CAU 536 investigation will be based on the DQOs presented in this appendix as developed by representatives of the NDEP and the NNSA/NSO. The seven steps of the DQO process for CAU 536 and presented in Sections A.1.2 through A.1.8 were developed based on the CAS-specific information presented in Section A.1.1 and in accordance with *EPA Guidance for Quality Assurance Project Plans* (EPA, 2002a). This document identifies and references the associated EPA quality system document for DQOs entitled *Data Quality Objectives Process for Hazardous Waste Site Investigations* (EPA, 2000), upon which the DQO process is based.

A.1.1 CAS-Specific Information

Corrective Action Unit 536 consists of one CAS (03-44-02, Steam Jenny Discharge), and is located in Area 3 of the NTS as shown in Figure A.1-1. The following section presents a summary of the history of the CAS.

Physical Setting and Operational History **-** Corrective Action Site 03-44-02 was first identified during a review of the *Environmental Survey Preliminary Report, Nevada Test Site, Mercury, Nevada* (DOE, 1988). Currently CAS 03-44-02 is identified as a 70- by 40-ft concrete decontamination pad located at the NTS on the eastern half of Yucca Flat in the Area 3 Camp. The site is approximately 216 ft north of the magnetite storage hut and hopper and approximately 640 ft west of the U3du crater. The site is reported to have been used to steam clean equipment contaminated during the maintenance activities conducted in the Area 3 Camp, but it is currently inactive and abandoned. Decontamination activities also were conducted in this area prior to the installation of this pad. There



Source: Modified from DOE/NV, 1996

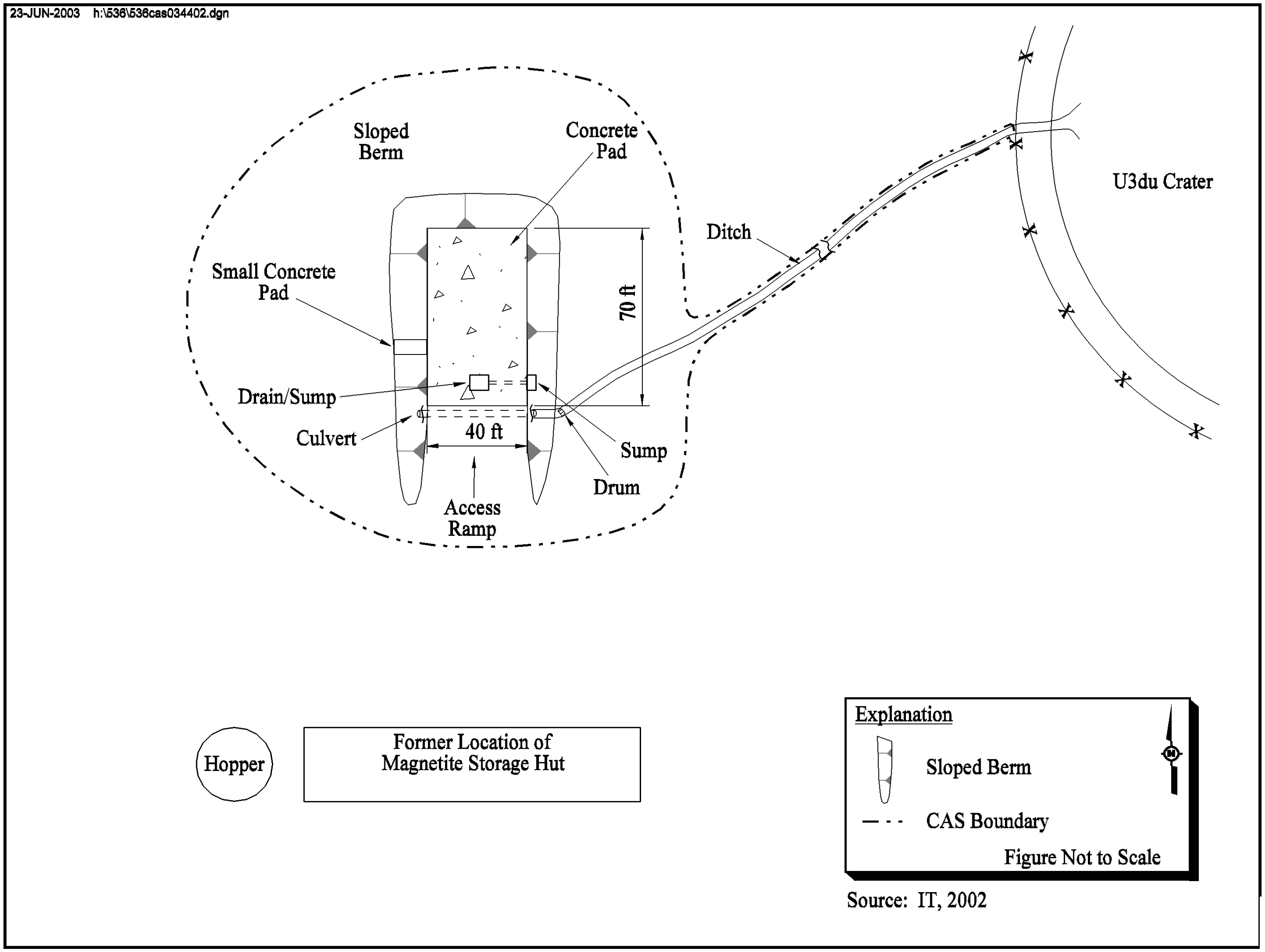
Figure A.1-1
CAU 536, CAS 03-44-02 Location

are no known uses of this area prior to the steam-cleaning operation, nor is there a confirmed record of dates of operation.

A 1974 aerial photograph shows a disturbed area that is suspected to be the location of initial steam-cleaning activities. Sometime after 1974, a small, flat concrete pad was constructed, but reportedly no means of controlling the discharge of wastewater and potential associated contaminants were included with the pad. The most referenced method for wastewater disposal was allowing surface runoff and infiltration at the location where the steam cleaning was conducted.

By mid-July 1989, the small concrete pad had been removed and replaced with the 70- by 40-ft concrete pad currently present at the site (REECo, 1995). This pad was better suited to controlling the waste generated during steam-cleaning operations. Reports indicate that there is a sump located in the southern third of the pad with the surface of the pad sloped to direct wastewater and sediments into the sump. Documentation also indicates that the decontamination liquids and sediments were collected in the sump, pumped out, transferred, and treated prior to discharge at a permitted facility (REECo, 1995). A January 2003 site visit confirmed the presence of a sump in the southern third of the pad and another structure located on the eastern side of the pad that may also have been a sump. It is possible that these two structures are connected with an underground pipe. An overflow of a sump along the eastern side of the pad was reported to have occurred during the early life of the pad (REECo, 1995). This further supports the premise that there were two sumps associated with the pad. Currently, both structures are filled with concrete so there is no way to visually determine if a drain or piping exists. It is suspected that the liquids and solids from the steam-cleaning process were collected in the center feature and then flowed through an underground pipe to the structure along the eastern side of the pad where they were pumped from the collection system and transported to a permitted facility for disposal. The 1989 construction date of the pad also supports collection of the decontamination wastewater rather than an unpermitted release onto or into the ground (Radack, 1989). A geophysical survey conducted during the preliminary site assessment did not identify a drain or piping beyond the concrete pad; however, the reinforcing metal in the pad masked the features below the concrete (SAIC, 2001).

Also associated with the decontamination pad is a small drainage ditch that diverts runoff from areas west of the pad to the U3du crater approximately 640 ft to the east. As part of the drainage feature, a



Source: IT, 2002

Figure A.1-2
CAU 536, CAS 03-44-02 Site Diagram

metal culvert underlies a soil access ramp that is located adjacent to the south side of the pad (Figure A.1-2). This drainage ditch does not appear to have been part of the decontamination operations based on the current configuration of the site. There are no other sites or CAUs known to be near the concrete pad that would interfere with the identification of potential contamination.

***Sources of Potential Contamination* -** It is suspected that wastewater was allowed to flow directly onto the ground and infiltrate into the surrounding soil prior to the construction of the current pad. Although the current concrete pad and sump are considered to have collected the majority of the decontamination liquids and sediments, no structures are present at the pad that would prevent overspray and overflows of the sump from leaving the pad. The overflow from the sump would flow onto the surrounding soil, or if enough water was present, into the drainage ditch located near the southern end of the pad.

***Previous Investigation Results* -** A geophysical survey conducted at CAS 03-44-02 during the preliminary assessment of the site did not identify a drain or piping; however, the reinforcing metal in the pad masked the features below the concrete. In addition to the geophysical survey, a soil sample was collected from the surface soil beneath a drum found in the ditch next to the pad. Gamma spectroscopic analysis indicated the presence of 1.65 ± 0.29 pCi/g of americium-241, 1.01 ± 0.13 pCi/g of cesium-137, and 31.1 ± 3.6 of potassium-40 in the soil. Diesel- and oil-range petroleum hydrocarbons were also detected at 25 and 180 mg/kg, respectively. Barium, chromium, and lead were detected in the soil sample at total concentrations of 200, 12, and 10 mg/kg, respectively. Methylene chloride and di-n-butyl phthalate, detected at relatively low concentrations, appear to represent laboratory artifacts. The soil sample was also analyzed for PCBs; the results were all below detection. It is unclear if the contamination originated from the contents of the drum or runoff from the decontamination pad. The sample did not provide information on the lateral or vertical extent of the detected contamination. In addition, during the initial preliminary assessment site visit an orange-colored stain was identified near the center of the pad. However, there was no visible stain present on the pad during the site visit conducted in December 2002.

***Potential Contamination* -** Contaminants suspected of being present at CAS 03-44-02 include unspecified solvents, petroleum hydrocarbons, metals, radionuclides, and PCBs potentially originating from steam-cleaning activities associated with the maintenance activities conducted in Area 3 Camp during the nuclear testing era.

The investigation of radiological contamination will be limited to the area within the CAS boundary. Radiological contamination associated with atmospheric testing will be addressed by the Soils Project. However, it is possible the equipment cleaned at the site may have been contaminated with radioactive material, and any radiological contamination encountered during the investigation will be included in the CAU 536 investigation. Additional background information is presented in the Section 1.1.1 of the CAIP.

A.1.2 Step 1 – State the Problem

This initial step of the DQO process identifies the planning team members and decision-makers, describes the problem that has initiated the CAU 536 CAI, and develops the CSMs.

A.1.2.1 Planning Team Members

The DQO planning team consists of representatives from NDEP, NNSA/NSO; Shaw Environmental, Inc. (Shaw), and Bechtel Nevada (BN). The primary decision-makers for this CAI are representatives from NDEP and NNSA/NSO. Table A.1-1 lists representatives from each organization in attendance at the DQO meeting on February 4, 2003.

A.1.2.2 Describe the Problem

Corrective Action Unit 536 is being investigated because CAS 03-44-02 is an inactive and abandoned concrete decontamination pad, surrounded by soil, and includes a drainage ditch that has not been properly closed and may not comply with the requirements for future use. In addition, wastes generated during the use of the pad may be present without appropriate controls (i.e., use restrictions).

As a result of the activities performed at the decontamination pad, hazardous and or radioactive constituents may be present at this CAS at concentrations that could potentially pose a threat to human health and the environment. The problem statement for CAU 536 is, “Existing information on the nature and extent of potential contamination is insufficient to evaluate and recommend corrective action alternatives for CAS 03-44-02.”

Table A.1-1
DQO Meeting Participants

Participant	Affiliation
Sabine Curtis	NNSA/NSO
Greg Raab	NDEP
Allison Urbon	BN
Orin L. Haworth	BN
David Schrock	Shaw
Amber Steed	SAIC
Jeanne Wightman	Shaw
Joe Hutchinson	SAIC
Lynn Kidman	Shaw
John M. Fowler	Shaw
TerryLynn C. Foley	Shaw
Robert Sobocinski	Shaw
Al Wickline	SAIC

BN – Bechtel Nevada
Shaw - Shaw Environmental, Inc.
NDEP – Nevada Division of Environmental Protection
NNSA/NSO – DOE, National Nuclear Security Administration Nevada Site Office

A.1.2.3 Develop Conceptual Site Models

Conceptual site models describe the most probable scenario for current conditions at a CAS and define the assumptions that are the basis for identifying appropriate sampling strategies and data collection methods. They are the basis for assessing how contaminants could reach receptors in the present and future by addressing contaminant nature and extent, transport mechanisms and pathways, potential receptors, and potential exposures to those receptors. Accurate CSMs are important because they serve as the starting point for all subsequent inputs and decisions throughout the DQO process. Different CSMs for a single CAS or CAU are not dependent on the types of contaminants suspected, geographic location, or being part of an engineered system; rather, they are dependent on the release mechanism and potential migration pathways and potential receptors that may influence the sampling strategies.

As a result of the pad construction and containment of wastewater, the potential release mechanisms and potential location of contamination are included in two CSMs for CAS 03-44-02. The CSMs have been developed using information from the physical setting, potential contaminant sources, knowledge from similar sites, release information, historical background information, and physical and chemical properties of the potentially affected media and COPCs. The two CSMs represent the location of contamination/release, affected media, transport mechanisms, and the potential migration pathways for the period of activity before and after the installation of the concrete pad in 1989. The CSMs are termed Before Pad Construction (CSM #1) and After Pad Construction (CSM #2). The two CSMs are discussed in the following sections and depicted in Figure A.1-3 and Figure A.1-4.

An important element of a CSM is the expected fate and transport of contaminants, which dictate how contaminants move through site media and where they can be expected in the environment. The expected fate and transport is based on distinguishing physical and chemical characteristics of the suspected contaminants and media. Contaminant characteristics include solubility, density, and affinity for nonmobile particles (adsorption). Media characteristics include permeability, porosity, hydraulic conductivity, chemical composition, and adsorption coefficients. In general, contaminants with low solubility and high density can be expected to be found relatively close to release points. Contaminants with high solubility and low density can be expected to be found further from release points or in areas where settling may occur.

Contaminants migrating to regional aquifers are not considered a likely scenario at CAU 536 based on the low annual average precipitation rates, high potential evapotranspiration, and low mobility of expected COPCs (e.g., SVOCs, PCBs, petroleum hydrocarbons, radionuclides, and metals).

Contamination directly caused by atmospheric nuclear tests (i.e., fallout) is outside the scope of CAU 536 (Section A.1.1) but is included in CAU 104, South Yucca Flat Atmospheric Tests. However, within the spatial boundaries of CAS 03-44-02, this contamination will be investigated to the extent necessary to determine the nature and extent and to evaluate corrective action alternatives.

Currently, the potential for exposure to contamination at CAS 03-44-02 is limited to other industrial and construction workers as well as military personnel conducting training in the area (DOE/NV, 1998). These human receptors may be exposed to COPCs through oral ingestion, inhalation, and dermal contact (absorption) from soil and/or debris (e.g., equipment, concrete) due to

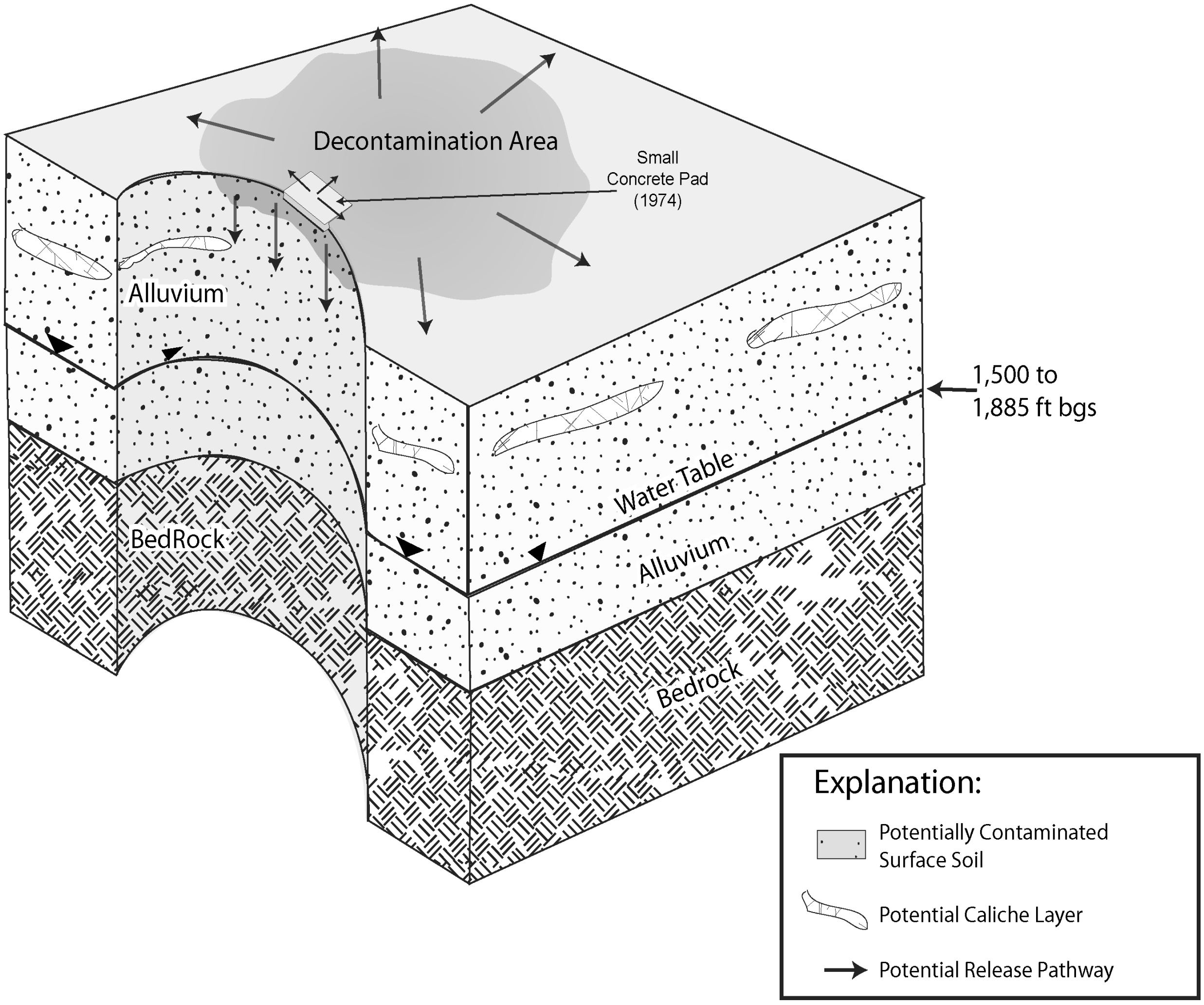


Figure A.1-3
CAU 536, Area 3 Release Site - Conceptual Site Model #1,
Before Pad Construction

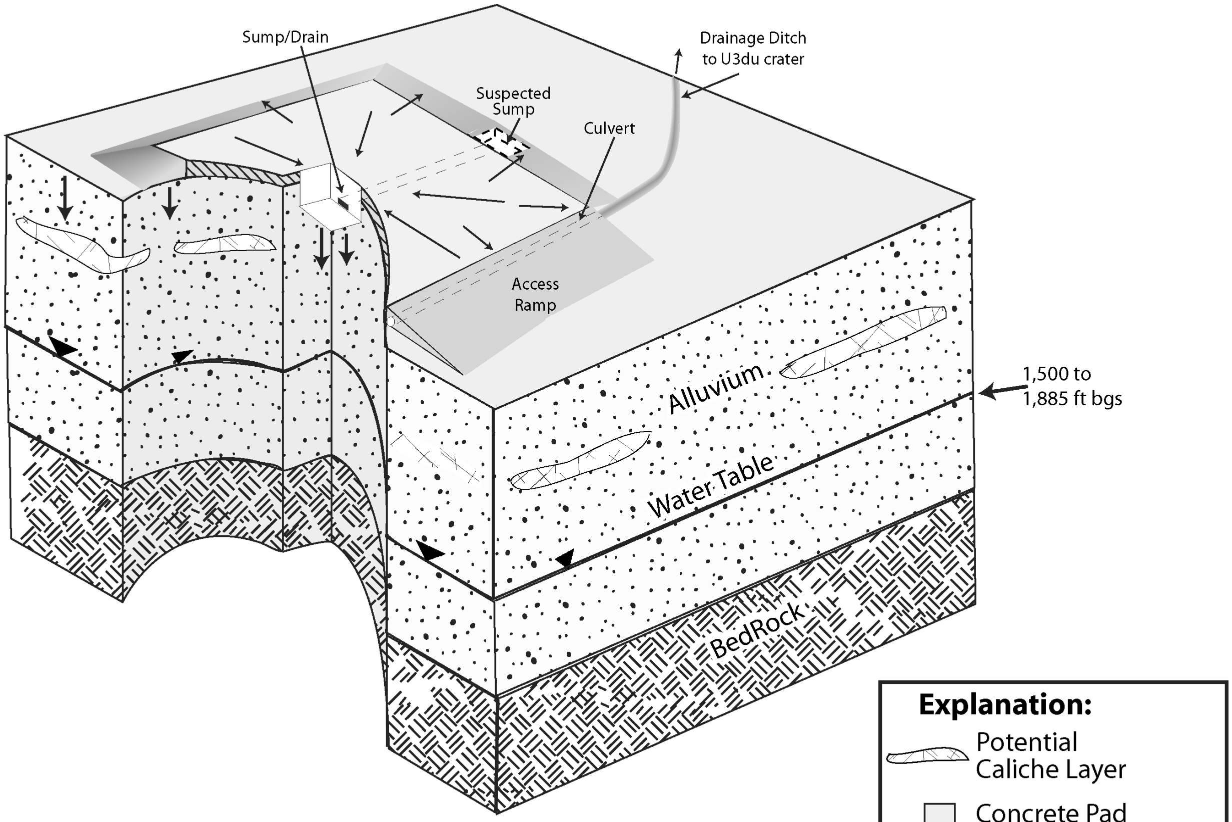


Figure A.1-4
CAU 536, Area 3 Release Site - Conceptual Site Model #2,
After Pad Construction

inadvertent disturbance of these materials or irradiation by radioactive material(s). The future land-use scenario limits use of the CAU to various nonresidential activities (i.e., industrial uses) and include defense and nondefense research, development, and testing activities, and commercial-use capabilities. The future land-use scenario for CAU 536 is presented in Table A.1-2.

Table A.1-2
Future Land-Use Scenario for CAU 536, CAS 03-44-02

Land Use Zone	Zone Description
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 nondefense research, development, and testing activities (DOE/NV, 1998).

A.1.2.3.1 CSM #1 - Before Pad Construction

The Before Pad Construction CSM applies to CAS 03-44-02 for activities before the construction of the current pad in 1989. Figure A.1-3 shows a generalized representation of CSM #1. During the early decontamination activities at CAS 03-44-02, no known facilities were present to control or contain the wastewater or solids generated during the steam cleaning of equipment. Sometime between the suspected initiation of decontamination activities in 1974 and 1989, a small flat concrete pad was installed. This pad may have been constructed to support the steam cleaner or other equipment. Even when the small concrete pad was in use, there were no known controls to prevent the decontamination wastes from moving off the pad onto the surrounding soil. The lack of a permanent location for conducting the decontamination efforts would also suggest that the actual location of cleaning activities may have been moved around the site. This would increase the area of surface contamination and infiltration. In addition, the aerial photographs that were taken before 1989 did not show the drainage ditch leading from the current decontamination pad to the U3du crater.

The following discussion of the CSM #1 parameters provide additional details to supplement this model.

Affected Media - The potentially affected media are the surface and shallow subsurface soil at the location where the steam cleaning process was conducted. Because there was not a dedicated structure where the decontamination process was conducted (i.e., pad), the area potentially affected is expected to extend over a larger area than would have actually been needed for any one decontamination activity.

Location of Contamination/Release Points - Releases to the environment under CSM #1 would first occur directly onto the surface soil at the sites of the steam cleaning activity or at the edges of the small concrete pad. Under this CSM, the surface soil adjacent to the small pad or where large equipment decontamination took place is the most likely location of the contamination and points of release to the environment. Contamination may also be found in subsurface soils as a result of infiltration. The depth of contamination migration would be affected by the quantity of water used in a decontamination activity and precipitation pushing the contamination downward. Solid wastes would have remained at the release point with only minor lateral migration as a result of being initially suspended or dissolved in liquids. The construction of the small flat concrete pad would have done little to prevent the infiltration of wastewater into the soil. The permeability of the soil within this area of NTS combined with the low relief across the site would limit horizontal migration. In addition, the lack of the drainage ditch would eliminate or greatly reduce the potential of surface water flow to the U3du crater.

Transport Mechanisms - The primary transport mechanisms under CSM #1 are vertical infiltration driven by the water from the decontamination process and subsequent percolation of precipitation through the soil. These liquids would serve as a driving force for downward migration. Vertical migration will be influenced by the physical properties of the soil such as permeability, porosity, and conductivity. Migration of certain inorganic constituents (e.g., metals, radionuclides) may also be controlled by geochemical processes such as adsorption, ion exchange, and precipitation of solids from solution. The migration of organic constituents (e.g., petroleum hydrocarbons, PCBs, SVOCs, and VOCs) may be controlled by their affinity for sorption on organic material present in soil.

Because of the flat topography in the area, horizontal migration beyond the area of initial impact is expected to be limited, and liquids would have primarily infiltrated vertically into the soil at or near the point of release. Surface migration may have occurred as a result of storm events when precipitation rates exceeded infiltration rates (stormwater runoff). However, these events are infrequent. The primary lateral migration pathways would be dispersion through the shallow soil and limited migration in the down slope direction. The land surface slopes very slightly to the southeast.

If an airborne release occurred during the steam-cleaning process, the VOCs would have dissipated and moved with the prevailing wind for deposition on the surrounding land surface. Because of the limited quantity of liquids used during the steam-cleaning process and the associated heat of the process, it is expected that negligible quantities of airborne VOC constituents impacted the surrounding area. Because of these factors, volatilization is not considered a viable transport mechanism and will not be evaluated.

Preferential Pathways - The only preferential pathway for CSM #1 is the possible presence of small gullies that may have served to channelize runoff from decontamination activities. This could have allowed decontamination wastewater containing contaminants to preferentially run off in certain areas and caused increased infiltration in these areas. This mechanism is thought to have had only a minor impact on the transport and distribution of contamination at CAS 03-44-02. The presence of relatively impermeable layers (e.g., concrete or caliche) may influence both lateral and vertical migration pathways.

Lateral and Vertical Extent of Contamination - Contamination is expected to be contiguous with release points, and concentrations are expected to decrease with distance both laterally and vertically from release points. Surface migration may have occurred as a result of storm events when precipitation rates exceeded infiltration rates (stormwater runoff). However, these events are infrequent and surface migration under CSM #1 is expected to be controlled by the frequency of decontamination activities and the quantities of water used in the decontamination processes. The lateral extent of contamination will be primarily limited to locations where the activities were conducted and the areas where surface runoff occurred. Surface migration is a biasing factor to be considered in the selection of sampling points.

The extent of vertical contaminant migration at CAS 03-44-02 is unknown because the volume of waste generated during a given decontamination event and frequency of the events are unknown. Also, low precipitation and high evapotranspiration rates at the NTS will limit the potential for continued vertical migration of contaminants subsequent to release.

Exposure Scenario **-** The CSM #1 shows that the exposure pathway to the industrial, construction or military workers would be through inadvertent ingestion, inhalation, or dermal contact (absorption) with soil and/or debris during excavation or other activities that would disturb the soils potentially contaminated during past decontamination activities. The future land use is shown in Table A.1-2. An additional exposure pathway for workers is through external exposure to beta/gamma radiation if radiological contamination is present.

Groundwater contamination is not considered likely under CSM #1 due to the minimal precipitation, high evapotranspiration, limited vertical migration, and significant depth to groundwater. For example, static water levels beneath the eastern two-thirds of the Yucca Flat range from 1,500 to 1,885 ft bgs (DRI, 1988). Within Area 3, the approximate depth to groundwater is 1,610 ft bgs (Wueller, 1994).

In summary, CSM #1 predicts that the concentration of the contaminants would be highest in the immediate vicinity of a release during the decontamination activities and would decrease with distance (both horizontally and vertically). The area subjected to contamination is unknown and the quantities of release and potentially affected area are suspected to be larger because the decontamination activities may have been moved around the site. If additional elements are identified during the CAI that are inconsistent with the CSMs as presented, the DQOs will be reviewed and any significant deviation from the planned approach will be presented to the decision-makers for approval.

A.1.2.3.2 CSM #2 - After Pad Construction

The CSM #2 includes the 70- by 40-ft concrete pad that was constructed in 1989, the sump/drain located in the southern third of the pad along with the concrete structure adjacent to the eastern edge of the pad, the soil immediately surrounding the pad, the access ramp, and the soil within and adjacent to the drainage ditch running from the southern end of the pad toward U3du crater. This CSM predicts that contamination as a result of the steam-cleaning process may exist at the site and how the presence of the concrete pad, sump, and drainage ditch affected the potential release and migration of contaminants. There are no structures present at the pad to prevent overspray or runoff from the pad from impacting the adjacent soil and the drainage ditch leading to U3du crater. This CSM differs from CSM #1 because the decontamination pad would prevent significant vertical migration into the soil below and adjacent to the point of release. Also, CSM #2 assumes that most decontamination wastewater was contained rather than indiscriminately discharged to the ground. Figure A.1-4 shows CSM #2.

The following discussion of the CSM #2 parameters provides additional detail to further explain this model.

Affected Media **-** The potentially affected media under CSM #2 are the surface and shallow subsurface soil adjacent to the concrete pad, soil within and adjacent to the drainage ditch, and the subsurface soil immediately below the sump/drain. The potentially affected media will most likely be within a short distance from the pad or drainage ditch. For waste management purposes, the concrete pad and sumps may also be considered a potentially affected medium.

Location of Contamination/Release Points **-** Contaminants may have been released to the surface soil through overspray and runoff onto the soil adjacent to the concrete pad during the steam-cleaning operations. Contaminants may have also been released into the soil adjacent to the concrete pad or soil within and adjacent to the drainage ditch if the sump overflowed or if an accident occurred when the sumps were cleaned out. It is assumed that the sumps were open and functional during the active life of the decontamination pad. Subsurface releases would have occurred through cracks in the sumps or leaks in the pipe connecting the sumps, if present (Figure A.1-4). Therefore, contamination would be expected in the shallow subsurface soils beneath the sumps or pipe. The geophysical survey conducted during the preliminary site assessment did not identify any subsurface piping that extends beyond the edge of the concrete pad; however, the reinforcing steel in the pad masked the identification of any piping underneath the concrete. After the sumps were filled with concrete, contaminants on the pad may have been transported to the surrounding soil and the drainage ditch in runoff from precipitation events.

Limited disturbance of the contamination introduced to the surface soil prior to 1989 is expected to have occurred during the construction of the existing pad. The current concrete pad is constructed on the surface, and there is visible evidence that gravel has been used to level the current pad. There is also a gentle slope away from the pad on three sides. Therefore, it is expected that residual contamination from decontamination procedures conducted prior to pad construction would not have been removed.

Transport Mechanisms - The discussion of transport mechanisms presented for CSM #1 (Section A.1.2.3.1) also applies to CSM #2. The primary transport mechanisms under CSM #2 are vertical infiltration driven by the water from the decontamination process and percolation of precipitation through the soil. These liquids would serve as a driving force for downward migration. Runoff resulting from the overflow of the sumps could cause lateral migration of the decontamination liquid into the soil adjacent to the pad and through the drainage ditch toward the U3du crater prior to infiltrating. Currently the pad sumps are filled with concrete, eliminating additional infiltration from precipitation.

Because the concrete pad is sloped toward the sump in the center, contaminated wastewater would only have entered the ditch during times when the sump overflowed; therefore, it is not suspected that there was a continuous release to the ditch. A culvert, located beneath the access ramp adjacent to the southern end of the pad, allows surface runoff from upslope areas to flow into the ditch, preventing erosion of the ramp. As a result, surface runoff from surrounding areas may have moved contaminants in the ditch further downstream toward the U3du crater. Surface migration is a biasing factor to be considered in the selection of sampling points. Also, infiltration may have transported contamination into the shallow subsurface below the ditch.

The concrete pad will reduce the vertical migration of contamination released to the soil prior to the construction of the pad. The pad will similarly reduce the migration of contamination that possibly leaked from the bottom of the sump/pipe by limiting the infiltration of precipitation that would be the primary mechanism to carry the shallow subsurface contaminants to deeper intervals in the soil.

Preferential Pathways - The preferential lateral pathway for contaminant migration under CSM #2 is runoff within the drainage ditch that extends from the pad ramp to the U3du crater. Preferential vertical pathways are focused infiltration along the bottom of the drainage ditch, and infiltration below the base of the pad sumps and the pipe connecting the two sumps, if present. The presence of relatively impermeable layers (e.g., concrete or caliche) may influence both lateral and vertical migration.

Lateral and Vertical Extent of Contamination - The CSM #2 suggests that the concentration of contaminants would be localized in the surface and shallow subsurface along the edges of the pad, on the ramp, and in the drainage ditch near the pad. In addition, contaminants may be in the subsurface at the base of the sumps and beneath the pipe, if present. Contamination is expected to be contiguous with release points, and concentrations are expected to decrease with distance both laterally and vertically from release points. Identical to CSM #1, groundwater contamination is not considered a likely scenario under the CSM #2.

Exposure Scenario - The CSM shows that the exposure pathway to the industrial or construction workers would be through inadvertent ingestion, inhalation, or dermal contact (absorption) with soil adjacent to the concrete pad or soil within and adjacent to the drainage ditch during excavation or other activities that would disturb the soil. Another possible exposure pathway is through dermal contact with residual contaminants on the concrete pad. An additional exposure pathway for workers is through external exposure to beta/gamma radiation if radiological contamination is present.

In summary, the lateral and vertical extent of contamination is assumed to be limited based on the limited quantity of liquid generated during the steam-cleaning activities, the slope of the pad and sump system for collection of liquids, and the low precipitation and high evapotranspiration rates at the NTS. The CSM #2 indicates that downward contaminant transport is expected to be the primary pathway; however, below the concrete pad, the pad itself would limit this mechanism. If additional elements are identified during the CAI that are inconsistent with the CSMs as presented, the DQOs will be reviewed and any significant deviation from the planned approach will be presented to the primary decision-makers for approval.

A.1.3 Step 2 – Identify the Decision

Step 2 of the DQO process identifies the decisions that require new environmental data to resolve the potential contamination problem. This step develops decision statements and defines alternative actions. Also presented in this section is the decision logic for the entire process.

A.1.3.1 Develop Decision Statements

The primary problem statement is, “An insufficient amount of information is available concerning the nature and extent of contamination potentially released at CAS 03-44-02 to determine if there is an unacceptable risk to human health and the environment.” Because existing information at this CAS is insufficient to resolve the problem statement, the following two decision statements have been established as criteria for determining the adequacy of the data collected during the CAI.

The Decision I statement is, "Is a contaminant present within the CAS at a concentration that could pose an unacceptable risk to human health and the environment?" Any contaminant detected at a concentration exceeding the corresponding PAL as defined in Section A.1.4.2 will be considered a COC. The presence of a contaminant within the CAS is defined as the analytical detection of a COC. Samples used to resolve Decision I are identified as Phase I samples.

The Decision II statement is, "If a COC is present, is sufficient information available to evaluate appropriate corrective action alternatives?" Sufficient information is defined as the data needs identified in this DQO process to define the lateral and vertical extent of all COCs within the CAS. Samples used to resolve Decision II are identified as Phase II samples.

A.1.3.2 Alternative Actions to the Decision

For each decision identified in the previous section there is an alternate decision.

The alternate for Decision I is: If a COC is not present, further assessment of the CAS is not required. If a COC is present, resolve Decision II.

The alternate for Decision II is: If the extent of a COC is defined in both the lateral and vertical direction, further assessment of the CAS is not required. If the extent of a COC is not defined, re-evaluate site conditions and collect additional samples.

A.1.4 Step 3 – Identify the Inputs to the Decisions

This step identifies the information needed, determines sources for information, determines the basis for establishing action levels, and identifies sampling and analysis methods that can meet the data requirements. To determine if a COC is present, each sample result is compared to a PAL (defined in Section A.1.4.2). If any sample result is greater than the PAL, then the CAS is advanced to Decision II (define the lateral and vertical extent) for that parameter. This approach does not use a statistical mean/average for comparison to the PALs, but rather a point-by-point comparison to identify COCs.

A.1.4.1 Information Needs and Information Sources

In order to determine if a COC is present at CAS 03-44-02, sample data must be collected and analyzed following these two criteria: (1) samples must be collected in areas most likely to be contaminated, and (2) the analytical suite selected must be sufficient to detect any contamination present in the samples. Biasing factors to support Criterion #1 include:

- Documented process knowledge on source and location of release
- Field observations
- Historical sample results
- Radiological survey results
- Geophysical survey results
- Experience and data from investigations of similar sites
- Professional judgment

To determine the extent of a COC for Decision II, Phase II samples will be collected from locations to bound the lateral and vertical extent. The data required to satisfy the information needs for Decision II for each COC is a sample concentration that is below the corresponding PAL. Step-out locations identified for Decision II sampling will be selected based on the CSM, biasing factors, and existing data. For Phase II sampling, analytical suites will only include those parameters that exceed PALs (i.e., COCs) in prior samples. Biasing factors to support information needs may include the factors previously listed and Phase I analytical results.

Table A.1-3 lists the information needs, the source of information for each need, and the proposed methods to collect the data needed to resolve Decisions I and II. The last column addresses the QA/QC data type and associated metric. The data type is determined by the intended use of the resulting data in decision making.

Data types are discussed in the following text. All data to be collected are classified into one of three measurement quality categories: quantitative, semiquantitative, and qualitative. The categories for measurement quality are defined below.

Quantitative Data

Quantitative data measure the quantity or amount of a characteristic or component within the population of interest. These data require the highest level of QA/QC in collection and measurement

Table A.1-3
Information Needs to Resolve Decisions I and II
(Page 1 of 3)

Information Need	Information Source	Collection Method	Biasing Factors to Consider	Data Type/Metric
Decision I (Phase I): Determine if a COC is present. Criteria I: Samples must be collected in areas most likely to contain a COC.				
Source and location of release points	Process knowledge, preliminary site assessment, historical documentation, and previous investigations of similar sites	Information documented in CSM and public reports – no additional data needed	None	Qualitative - CSM has not been shown to be inaccurate
	Field observations	Conduct site visits and document field observations	Visible evidence of contamination, topographic lows, gullies	Qualitative - CSM has not been shown to be inaccurate
	Aerial photographs	Review and interpret aerial photographs	Disturbed areas	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
	Radiological surveys	Review and interpret radiological surveys	Areas of elevated radiation (“hot spots”)	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
	Field screening	Review and interpret field-screening results	Bias sample locations/intervals based on elevated field-screening results (FSRs)	Semiquantitative - Sampling based on biasing criteria stipulated in DQO Step 3
Nature of contamination	Biased samples	Collect samples from locations/depths based on biasing factors	Send samples with highest survey/screening results to laboratory	Semiquantitative - Sampling based on survey and screening results
	Biased samples	Collect samples from additional locations near CAS features	Worst-case locations such as edge of pad, base of sump, bottom of drainage ditch	Semiquantitative - Sampling based on CAS features

Table A.1-3
Information Needs to Resolve Decisions I and II
(Page 2 of 3)

Information Need	Information Source	Collection Method	Biasing Factors to Consider	Data Type/Metric
Decision I (Phase I): Determine if a COC is present. Criteria 2: Analyses must be sufficient to detect any COCs in samples.				
Identification of all potential contaminants	Process knowledge and previous investigations of similar sites; use analytical suite in Table A.1-4.	Information documented in CSM and public reports – no additional data needed; comprehensive analytical suite developed to account for uncertainty	None	Qualitative - CSM has not been shown to be inaccurate
Analytical results	Data packages from biased samples	Appropriate sampling techniques and approved analytical methods will be used; minimum reporting limits (MRLs) and minimum detectable activities (MDAs) are sufficient to provide quantitative results for comparison to PALs	None	Quantitative - Validated analytical results will be compared to PALs
Decision II (Phase II): Determine the extent of a COC. Criteria: Sample collection and analysis methods must be sufficient to bound extent of COC.				
Identification of applicable COCs	Data packages of prior samples	Review analytical results and compare to PALs to select COCs	None	Quantitative - Only COCs identified will be analyzed in future sampling events
Extent of Contamination	Field observations	Document field observations	Visible evidence of contamination	Qualitative - CSM has not been shown to be inaccurate
	Field screening	Conduct field screening using appropriate methods	Bias sample locations/intervals based on FSRs	Semiquantitative - FSRs will be compared to field-screening levels
	Step-out samples	Generate locations based on previous sampling results and biasing factors	Locations selected based on the initial sampling results for both horizontal and vertical sampling	Semiquantitative - Sampling based on previous results and biasing factors
	Data packages of analytical results	Appropriate sampling techniques and approved analytical methods will be used to bound COCs; MRLs and MDAs are sufficient to provide quantitative results for comparison to PALs	None	Quantitative - Validated analytical results will be compared to PALS to determine COC extent

Table A.1-3
Information Needs to Resolve Decisions I and II
(Page 3 of 3)

Information Need	Information Source	Collection Method	Biasing Factors to Consider	Data Type/Metric
Decision: Determine if sufficient information exists to characterize waste. Criteria: Analyses must be sufficient to allow disposal options to be accurately identified and estimated.				
Radiological data for comparison to unrestricted release criteria	Radiological surveys and swipe measurement	Perform radiological surveys and swipe measurements using appropriate methods	Bias locations based on areas of visible or likely surface spills/leaks or areas of accumulation	Semiquantitative - Locations based on biasing criteria stipulated in DQO Step 7
Analytical results	Data packages of analytical results; use analytical suite in Table A.1-4; require TCLP if results are >20X TCLP limits	Appropriate sampling techniques and approved analytical methods will be used; MRLs and MDAs are sufficient to provide quantitative results for comparison to disposal requirements	Sufficient material must be available for analysis	Quantitative - Validated analytical results will be compared to disposal criteria

systems because the intended use of the data is to resolve primary decisions (i.e., Decision I or Decision II) and/or verifying that closure standards have been met. Laboratory analytical data are generally considered quantitative.

Semiquantitative Data

Semiquantitative data indirectly measure the quantity or amount of a characteristic or component. Inferences are drawn about the quantity or amount of a characteristic or component because a correlation has been shown to exist between the indirect measurement and the results from a quantitative measurement. The QA/QC requirements on semiquantitative collection and measurement systems are high but not as rigorous as the requirements for a quantitative measurement system. Semiquantitative data contribute to decision making but are not used alone to resolve primary decisions. Field-screening data are generally considered semiquantitative. The data are often used to guide investigations toward quantitative data collection.

Qualitative Data

Qualitative data identify or describe the characteristics or components of the population of interest. The QA/QC requirements are the least rigorous for data collection methods and measurement systems. The intended use of the data is for information purposes, to refine conceptual models, and guide investigations rather than resolve primary decisions. This measurement of quality is typically assigned to historical information and data where QA/QC may be highly variable or not known. Professional judgment is often used to generate qualitative data.

Metrics provide a tool to determine if the collected data support decision making as intended. Metrics tend to be numerical for quantitative and semiquantitative data, and descriptive for qualitative data.

A.1.4.2 Determine the Basis for the Preliminary Action Levels

Industrial Site workers, construction/remediation workers, and military personnel may be exposed to contaminants through oral ingestion, inhalation, external (radiological), or dermal contact (absorption) of soil. Laboratory analytical results for soil will be compared to the following PALs to evaluate if COCs are present:

- EPA Region 9 Risk-Based PRGs for chemical constituents in industrial soils (EPA, 2002c)
- Background concentrations for RCRA metals will be used instead of PRGs when natural background exceeds the PRG, as is often the case with arsenic on the NTS. Background is considered the mean plus two times the standard deviation of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (NBMG, 1998; Moore, 1999).
- For detected chemical COPCs without established PRGs, a similar protocol to that used by EPA Region 9 will be used in establishing action levels for those COPCs listed in IRIS (EPA, 2002b).
- The TPH action limit of 100 mg/kg per the NAC 445A.2272 (NAC, 2002)
- The PALs for radiological contaminants are isotope-specific and are defined as the maximum concentration for each isotope found in environmental samples taken from undisturbed background locations in the vicinity of the NTS (McArthur and Miller, 1989; US Ecology and Atlan-Tech, 1991). The US Ecology and Atlan-Tech reference is used because soil samples have not been collected from undisturbed background locations of the NTS and analyzed for their radionuclide concentrations. Therefore, data is needed on the concentration of radionuclides in soil at undisturbed background locations located in the vicinity of the NTS.

> Based upon the Ward Valley climatography, geology, and radionuclide concentration data, the use of *Environmental Monitoring Report for the Proposed Ward Valley California Low Level Radioactive Waste (LLRW) Facility* (US Ecology and Atlan-Tech, 1991) is appropriate for use in defining PAL concentrations based on background. The PALs are expressed in units of pCi/g for solid media or picocuries per liter (pCi/L) and are provided in Table 3-3.

At locations such as CAS 03-44-02 in the Yucca Flat area, surface soil radionuclide concentrations greater than PALs may not be a concern if the concentrations are associated with fallout from atmospheric nuclear testing. As discussed in Section A.1.1, potential contamination of soil within this CAS that is related to atmospheric testing will be addressed by the Soils Project.

Solid media such as concrete and/or structures may only pose a potential radiological exposure risk to site workers. Surface radiological surveys of the solid media will be compared to the unrestricted-release criteria, as defined in the *NV/YMP Radiological Control Manual* (DOE/NV, 2000), to determine if radiological COPCs are present at levels that may pose an unacceptable risk to human health and/or the environment.

A.1.4.3 Potential Sampling Techniques and Appropriate Analytical Methods

As discussed in Section A.1.4.1, the collection, measurement, and analytical methods will be selected so results will be generated for all of the suspected contaminants (critical analytes, Section A.1.4.3.3) as well as all other possible contaminants at CAS 03-44-02. This effort will include field screening, soil sampling, and laboratory analysis to determine the presence of COPCs and extent of identified COCs.

At CAS 03-44-02, both site characterization and waste characterization efforts are proposed. Site characterization sampling and analysis are the focus of the DQO process. However, waste characterization sampling and analysis has been included to support the decision-making process for waste management, and to ensure an efficient field program. Specific analyses required for the disposal of IDW are identified in Section 5.0 of the CAIP.

A.1.4.3.1 Field Screening

Field-screening activities may be conducted for the following analytes and/or parameters:

- Alpha and Beta/Gamma Radiation - a handheld radiological survey instrument or method may be used based on the possibility that radiologically contaminated equipment may have been decontaminated at CAS 03-44-02. On-site gamma spectrometry may also be used to screen samples.

- VOCs - a Photoionization Detector (PID), or an equivalent instrument or method, may be used to conduct headspace analysis because VOCs are a common concern at the NTS and have not been ruled out based upon process knowledge at CAU 536.

- TPH - a gas chromatograph, or equivalent equipment or method, may be used at CAS 03-44-02 because TPH is a common concern at the NTS and has not been ruled out based upon process knowledge.

Based on the results of previous CAU investigations and common NTS practices, the aforementioned field-screening techniques may be applied during the Phase I and II sampling at CAS 03-44-02. These field-screening techniques will provide semiquantitative data that can be used to guide soil sampling activities.

A.1.4.3.2 Sampling and Measurement Methods

Surface soil samples will be collected by hand. Augering, direct-push, excavation, drilling, or other appropriate sampling methods will be used to collect subsurface soil samples. Sample collection and handling activities will be conducted in accordance with approved procedures. Radiological surveys and swipe collection and measurement will also follow standard procedures.

A.1.4.3.3 Analytical Program

The analytical program for CAU 536 is presented in Table A.1-4. The analytical program was developed based on the suspected-contaminant information presented in Section A.1.1. Because complete information regarding activities performed at this site, as well as throughout the NTS, is not well documented, some uncertainty exists regarding the complete list of suspected contaminants at CAU 536. Due to this uncertainty, additional constituents have been included in the analytical program for the investigation.

Based on process knowledge information for steam-cleaning/degreasing operations, certain analytes are suspected to be present at CAS 03-44-02. These analytes, referred to as critical analytes, are given greater importance in the decision-making process relative to other COPCs. For this reason,

Table A.1-4
Analytical Program for CAU 536
(Includes Site and Waste Characterization Analyses)

Analyses[a]	**CAS 03-44-02**
Organics	
Total Petroleum Hydrocarbons (Diesel-, and Gasoline-Range Organics)	X
Polychlorinated Biphenyls	X
Semivolatile Organic Compounds	X
Volatile Organic Compounds	X
Metals	
Resource Conservation and Recovery Act Metals[b]	X
Beryllium	X
Radionuclides	
Gamma Spectrometry[c]	X
Isotopic Uranium	X
Isotopic Plutonium	X
Strontium-90	X

[a] If the volume of material is limited, prioritization of the analyses will be necessary.
[b] May also include Toxicity Characteristic Leaching Procedure metals if sample is collected for waste management purposes.
[c] If americium-241 is detected above the minimum detectable activity, isotopic americium-241 analysis may also be performed on sample.

more stringent performance criteria are specified for critical analyte data quality indicators (Section 6.0 of the CAIP). Table A.1-5 identifies the critical analytes to define the nature of contamination (Decision I).

For sampling performed to define the extent of contamination (Decision II) at CAS 03-44-02, samples will be collected and analyzed only for those COCs identified in samples collected to resolve Decision I. However, if extent samples are collected prior to nature-of-contamination data becoming available, the extent samples will be analyzed for the full list parameters given for the CAS in Table A.1-4. For samples collected to define the extent of contamination, critical analytes are the

Table A.1-5
Critical Analytes for Nature of Contamination (Decision I) Sampling

Chemical	Radiological
Common Solvents and Degreasers[a]: - dichlorobenzene - ethyl benzene - napthalene - tetrachloroethylene - toluene - 1,1,1-trichloroethane - trichloroethylene - xylene TPH (DRO and GRO)	None

[a] Acetone and methylene chloride are common degreasers, but are also common laboratory artifacts. Because they are common laboratory artifacts, they are not included as critical analytes.

DRO = Diesel-range organics
GRO = Gasoline-range organics
TPH = Total petroleum hydrocarbons

COCs identified during the Decision I activities. These critical analytes may be different than those listed for CAS 03-44-02 in Table A.1-5.

Section 3.0 and Section 6.0 of the CAIP provide the analytical methods and laboratory requirements (e.g., detection limits, precision, and accuracy) to be followed during this CAI. Sample volumes are laboratory- and method-specific and will be determined in accordance with laboratory requirements.

Analytical requirements (e.g., methods, detection limits, precision, and accuracy) are specified in the Industrial Sites QAPP (NNSA/NV, 2002), unless superseded by the CAIP. These requirements will ensure that laboratory analyses are sufficient to detect contamination in samples at concentrations exceeding the MRL. Specific analyses required for the disposal of IDW are identified in Section 5.0 of the CAIP.

A.1.5 Step 4 - Define the Study Boundaries

The purpose of this step is to define the target population of interest, specify the spatial and temporal features of that population that are pertinent for decision making, determine practical constraints on data collection, and define the scale of decision making relevant to target populations for Decision I and Decision II.

A.1.5.1 Define the Target Population

Decision I target populations represent locations within the CAS that contain COCs, if present. Decision II target populations are areas within the CAS where COC concentrations are less than PALs and are contiguous to areas of COC contamination. The target populations are dependent upon the CSMs developed for CAS 03-44-02. These target populations represent locations within the CAS that, when sampled, will provide sufficient data to resolve the primary problem statement (Section A.1.3.1).

A.1.5.2 Identify the Spatial and Temporal Boundaries

The geographic (spatial) boundaries are defined as the vertical or horizontal boundaries beyond which the CSM and/or the scope of the investigation will require reevaluation. Intrusive activities are not intended to extend into the boundaries of neighboring areas of environmental concern (e.g., other CASs). The spatial boundaries for CAS 03-44-02 are listed in Table A.1-6. The horizontal boundaries at CAS 03-44-02 reflect the uncertainty in the locations where the decontamination processes were conducted prior to the installation of the concrete decontamination pad in 1989. As discussed in Section A.1.1, even though contamination related to atmospheric nuclear testing may have been "superimposed" on CAS 03-44-02, it will not be investigated during the CAU 536 effort. It will be addressed by the Soils Project.

Table A.1-6
Spatial Boundaries Investigation

Feature	**Spatial Boundary**	
	Horizontal	**Vertical**
Decontamination Pad	A maximum of 100-ft buffer around the decontamination pad	A maximum of 20 ft bgs
Drainage Ditch	A maximum of 10-ft buffer on either side of drainage ditch; downstream to the edge of the U3du crater	A maximum of 20 ft bgs

Temporal boundaries are time constraints due to time-related phenomena such as weather conditions, seasons, or activity patterns. Significant temporal constraints due to weather conditions are not expected; however, snow events may affect site activities during winter months. Moist weather may place constraints on sampling and field screening of contaminated soils because of the attenuating effect of moisture in samples. There are no time constraints on collecting samples as environmental conditions at the site will not significantly change in the near future, and conditions would have stabilized over the years since the sites were last used.

A.1.5.3 Identify Practical Constraints

Nevada Test Site activities may affect the ability to characterize the CAS, although the site is inactive and abandoned. The primary practical constraints to be encountered at CAS 03-44-02 would be the presence of underground utilities and the need to core through the concrete pad to gain access to soil sampling locations. Utility constraints are subject to change as additional information is collected prior to the commencement of investigation activities, and will be appropriately documented. The CAS will be surveyed for utilities prior to field activities in accordance with the SSHASP. Standing water on the pad (as observed during recent site visit) may temporarily affect the performance of certain investigation activities.

A.1.5.4 Define the Scale of Decision Making

For CAS 03-44-02, the scale of decision making for Decision I is defined as the CAS. The scale of decision making for Decision II is defined as the extent of COC contamination originating from the CAS. Additionally, the scale of decision making for an unrestricted release determination for the concrete pad is individual areas of contamination if only hot spots are present. Otherwise, the scale of decision making is the entire object/structure (e.g., concrete pad) radiologically surveyed.

A.1.6 Step 5 – Develop a Decision Rule

This step integrates outputs from the previous steps, with the inputs developed in this step into a decision rule (*"If..., then...")* statement. This rule describes the conditions under which possible alternative actions would be chosen.

A.1.6.1 Specify the Population Parameter

The population parameter for Phase I data collected from biased sample locations is the maximum observed concentration of each COC within the target population.

The population parameter for Phase II data will be the observed concentration of each unbounded COC in any sample.

A.1.6.2 Choose an Action Level

Action levels are defined as the PALs, which are defined in Section A.1.4.2. As appropriate, action levels may also be the unrestricted release criteria given in the *NV/YMP Radiological Control Manual* (DOE/NV, 2000).

A.1.6.3 Decision Rule

If the concentration of any COPC in a target population exceeds the PAL for that COPC in a Phase I sample, then that COPC is identified as a COC, and the extent of contamination (Phase II) sampling will be conducted. If the Site Supervisor determines that an indicator of contamination (e.g., staining) is present, then Phase II sampling may be conducted before the results of Phase I sampling are available. If all COPC concentrations are less than the corresponding PALs, then the decision will be no further action.

If the observed population parameter of any COC in a Phase II sample exceeds the PALs, then additional samples will be collected to complete the Phase II evaluation. If all observed COC population parameters are less than PALs, then the decision will be that the extent of contamination has been defined in the lateral and vertical directions.

If contamination is inconsistent with the CSM or extends beyond the identified spatial boundaries, then work will be suspended and the investigation strategy will be reevaluated. If contamination is consistent with the CSM and is within spatial boundaries, then the decision will be to continue sampling until the extent is defined.

A.1.7 Step 6 – Specify the Tolerable Limits on Decision Errors

The sampling approach for the investigation relies on biased sampling locations; therefore, statistical analysis is not appropriate. Only validated analytical results (quantitative data) will be used to determine if COCs are present (Phase I) or the extent of a COC (Phase II), unless otherwise stated. The baseline condition (i.e., null hypothesis) and alternative condition for Phase 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 Phase II are:

- 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 an alpha (false negative) or beta (false positive) error associated with their determination (discussed in the following subsections). Since quantitative data are compared to action levels on a point-by-point basis, statistical evaluations of the data such as averages or confidence intervals are not appropriate.

A.1.7.1 False Negative (Rejection) Decision Error

The false negative (rejection of the null or alpha) decision error would mean one of the following:

- Deciding that a COC is not present when it is (Decision I)

- Deciding that the extent of a COC has been defined when it has not (Decision II)

In both cases, this would result in an increased risk to human health and the environment.

For Decision I, a false negative decision error (where the consequences are more severe) is controlled by meeting the following criteria:

- Having a high degree of confidence that the sample locations selected will identify COCs if present anywhere within the CAS.

- Having a high degree of confidence that analyses selected will be sufficient to detect any COCs present in the sampled media, and that the detection limits are adequate to ensure an accurate quantification of the COCs.

For Decision II, the false negative decision error is reduced by:

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

- Having a high degree of confidence that analyses conducted will be sufficient to detect any COCs present in the samples.
- Having a high degree of confidence that the dataset is of sufficient quality and completeness.

To satisfy the first criterion for both decisions, Phase I samples will be collected in areas most likely to be contaminated by any COCs, and Phase II samples will be collected in areas that represent the lateral and vertical extent of contamination. The following characteristics are considered during both phases to accomplish the first criterion:

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

These characteristics were considered during the development of the CSMs. The biasing factors listed in Table A.1-3 and Section A.1.8.1 will be used to further ensure that these criteria are met.

To satisfy the second criterion for Decision I, all samples used to define the nature of contamination will be analyzed for the chemical and radiological parameters listed in Section A.1.4.3.3 using analytical methods that are capable of producing quantitative data at concentrations below or equal to PALs (unless stated otherwise in the CAIP). The PALs, which are derived from the EPA Region IX PRGs, are the basis of the DQOs. To satisfy the second criterion for Decision II, Phase II samples will be analyzed for those chemical and radiological parameters that identified unbounded COCs.

To satisfy the third criterion for Decision II, the entire dataset as well as individual sample results will be assessed against the DQIs of precision, accuracy, comparability, completeness, and representativeness defined in the Industrial Sites QAPP (NNSA/NV, 2002). The goal for the DQI of completeness is that 90 percent of the critical COPC results are valid for every sample. Critical COPCs are defined as those contaminants that are known or expected to be present within a CAS (Section A.1.4.3.3). In addition, sensitivity has been included as a DQI for laboratory analyses. Site-specific DQIs are discussed in more detail in Section 6.0 of the CAIP. Strict adherence to established procedures and QA/QC protocols also protects against false negatives.

A.1.7.2 False Positive Decision Error

The false positive (acceptance of the null or beta) decision error would mean one of the following:

- Deciding that a COC is present when it is not (Decision I)
- Accepting that the extent of a COC has not been defined when it really has (Decision II)

These errors result in increased costs for unnecessary characterization or corrective actions.

The false positive decision error is controlled by protecting against false positive analytical results. False positive results are typically attributed to laboratory and/or sampling/handling errors. Quality assurance samples such as field blanks, trip blanks, laboratory control samples, and method blanks minimize the risk of a false positive analytical result. Other measures include proper decontamination of sampling equipment and using certified clean sample containers to avoid cross-contamination.

A.1.7.3 Quality Assurance/Quality Control

Radiological survey instruments and field-screening equipment, if used, will be calibrated and checked in accordance with the manufacturer’s instructions or approved.

Quality control samples will be collected as required by the Industrial Sites QAPP (DOE/NV, 2002) and in accordance with established procedures. The required QA field samples include:

- Trip blanks (1 per sample cooler containing VOC environmental samples)
- Equipment blanks (1 per sampling event for each type of decontamination procedure)
- Source blanks (1 per source lot per sampling event)
- Field duplicates (minimum of 1 per matrix per 20 environmental samples, or 1 per CAS if less than 20 collected)
- Field blanks (minimum of 1 per 20 environmental samples, or 1 per CAS if less than 20 collected)
- Matrix spike/matrix spike duplicate (minimum of 1 per matrix per 20 environmental samples, or 1 per CAS if less than 20 collected; not required for all radionuclide measurements)

Additional QC samples may be submitted based on site conditions.

A.1.8 Step 7 – Optimize the Design for Obtaining Data

This section presents a resource-effective sampling and analysis design for generating data that are required to meet the project DQOs developed in the previous six steps. Because the types of suspected contaminants are similar and the two decontamination features are expected to be located within the same area, with the primary differences between the two CSMs being the potentially affected area and the release pathways, the investigation of CSM #1 and CSM #2 will be combined. The effort is planned to resolve the decision statements for CAU 536.

A.1.8.1 General Investigation Strategy

Following visual inspection and a radiological survey, intrusive soil sampling for field screening and laboratory analysis will be conducted at CAU 536. The selection of sample locations for CAU 536 will be biased by the following:

- Visual indicators (e.g., staining, drainage areas, topography, areas of preferential flow)
- Radiological survey results
- Geophysical survey results
- Existing site-specific data
- Physical and chemical characteristics of contaminants
- Known or suspected sources and locations of release
- Geologic and/or hydrologic conditions
- Process knowledge and experience at similar sites

The Site Supervisor has the discretion to modify the biased locations, but only if the modified locations meet the decision needs and criteria stipulated in Section A.1.4.

Phase II (step-out) sampling locations at CAS 03-44-02 will be selected based on the outer boundary sample locations where COCs were detected, the CSM, and other biasing factors. If biasing factors indicate COCs extend beyond planned Phase II sample locations, planned locations may be modified or additional Phase II samples may be collected from incremental step-out locations. If field data generated during the course of collecting Phase I samples strongly indicate that contaminants are above PALs, Phase II data may be collected without the support of Phase I analytical results (e.g., the presence of VOCs is indicated by PID analysis, extensive staining).

Contaminants determined not to be present in Phase I samples will be eliminated from Phase II analytical suites. In general, samples submitted for off-site analysis would be those that define the expected lateral and vertical extent of COCs.

A.1.8.2 Detailed Investigation Strategy

A radiological screening survey will be conducted throughout CAS 03-44-02 prior to intrusive sampling. The survey will include the concrete pad, ground surface surrounding the pad, the ramp at the southern end of the pad, and the drainage ditch.

Following the radiological survey, the surface of the concrete pad, areas surrounding the pad extending throughout the area identified as being disturbed in the 1974 aerial photograph, and the length of the drainage ditch extending from the southeastern corner of the pad to, but not into, the U3du crater will be visually inspected and photodocumented. The visual inspection will focus on preferential pathways (e.g., small drainage systems) that may have transported or accumulated contamination associated with steam-cleaning operations prior to 1989 as well as more recent releases from the concrete pad.

Intrusive sampling will be conducted at CAS 03-44-02 to determine if COCs are present and, if present, to determine the extent. Initially, surface soil samples (<0.5 ft bgs) will be collected from biased locations based on the results of the previously conducted geophysical surveys, radiological surveys, the visual inspection, existing analytical data, and other biasing factors listed in Table A.1-3. If biasing factors indicate that contamination may be present at the surface, samples will be collected for laboratory analysis at the potentially contaminated locations as well as along each side of the pad. Soil samples will be selected from biased locations focusing on contamination that may have migrated from the suspected source areas, considering the potential for lateral surface migration prior to infiltration.

If no biasing factors (e.g., staining, elevated radiological readings) are present to indicate potential contamination, then surface soil samples will be collected from locations along the edge of the pad and outward at 25-ft intervals to a maximum of 50 ft from each side of the concrete pad. It is expected that the concrete pad was constructed over all or part of the former decontamination area.

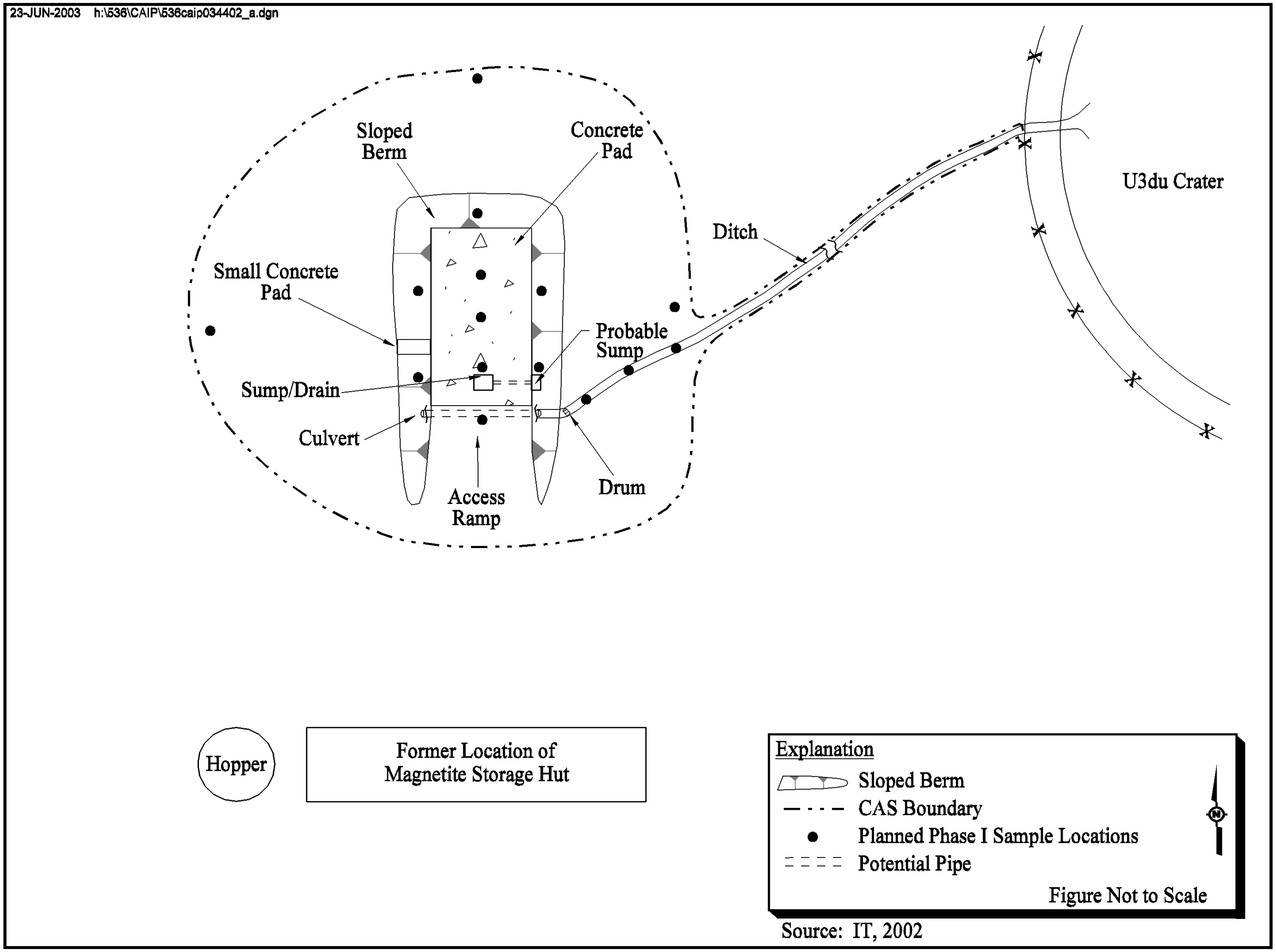
A minimum of three surface soil samples will be collected from the bottom of the drainage ditch. Locations will be based on biasing factors (e.g., stains, radiological hot spots, areas of accumulated sediment). If biasing factors are not present, the samples will be located 25 ft apart in the ditch, with the first sample collected just downstream of the culvert beneath the ramp adjacent to the south side of the pad.

Subsurface soil samples will be collected from locations adjacent to the sump in the center of the concrete pad and adjacent to the sump on the east side of the pad (Figure A.1-5). Three locations are expected to be sampled below the concrete pad. Sample collection will begin with the first material immediately beneath the base of these features. If the depth to the base of the sump in the center of the pad cannot be determined, it will be assumed to be the same as the depth to the base of the sump on the east side of the pad. Additionally, subsurface soil samples will be collected from surface soil locations where biasing factors (e.g., field-screening results) indicate the potential for contaminant concentrations greater than PALs.

The frequency of subsurface soil samples will be based on biasing factors such as presence of debris, staining, odor, field-screening results, or professional judgment. For subsurface sampling locations, generally two consecutive soil samples with field-screening results below field-screening action levels are required to define the vertical extent of contamination. Generally, the uppermost “clean” sample from each location is submitted for laboratory analysis.

Surface soil samples will be collected by hand according to approved procedures. Sonic drilling, hollow-stem auger drilling, direct-push, handheld augers, or excavation may be used, as appropriate, to access subsurface sample intervals for laboratory analysis at select locations.

A visual inspection of the concrete pad will be conducted of the area where a stain was reported during the preliminary site assessment. If unconsolidated material is available and, if appropriate, this material will be collected for laboratory analysis. This will not include material containing bird and other animal droppings. Based on the results of the radiological survey of the concrete pad surface, swipes may be collected and analyzed on site for removable radiological contamination. Scabbling of the concrete may be performed to collect samples, if necessary.



Source: IT, 2002

Figure A.1-5
CAU 536, CAS 03-44-02 - Planned Phase I Sample Locations

Samples for waste characterization purposes may also be collected from the various media at CAS 03-44-02 (e.g., soil, concrete, or material in the drainage ditch).

A.1.9 References

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Appendix A.2

Project Organization

A.2 Project Organization

The NNSA/NSO Project Manager is Janet Appenzeller-Wing, and her telephone number is (702) 295-0461.

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

Appendix A.3

NDEP Comment Responses

NEVADA ENVIRONMENTAL RESTORATION PROJECT
DOCUMENT REVIEW SHEET

1. Document Title/Number: Draft Corrective Action Investigation Plan for Corrective Action 536: Area 3 Release Site, Nevada Test Site, Nevada	2. Document Date: April 2003
3. Revision Number: 0	4. Originator/Organization: Shaw Environmental, Inc.
5. Responsible NNSA/NSO ERP Project Mgr.: Janet Appenzeller-Wing	6. Date Comments Due: May 12, 2003
7. Review Criteria: Full	
8. Reviewer/Organization/Phone No.: Greg Raab, NDEP, 486-2867	9. Reviewer’s Signature:

10. Comment Number/ Location	11. Type*	12. Comment	13. Comment Response	14. Accept
1) Page A-33 Section A.1.7.1 False Negative Decision Error (continued) 3rd Paragraph 1st Sentence		"...quantitative data at concentrations below or equal to PALs..." The authors have substituted PALs for the DQOs without the decision errors. Include a statement that the PALs are the basis of the DQOs and that the PALs are rooted in the EPA Regional IX PRGs.	The following sentence has been added, “The PALs, which are derived from the EPA Region IX PRGs, are the basis of the DQOs.”	Yes

[a] Comment Types: M = Mandatory, S = Suggested.

Return Document Review Sheets to NNSA/NSO Environmental Restoration Division, Attn: QAC, M/S 505.

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